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Developing an in-depth understanding of acute pain assessment and management in the prehospital setting in the Western Cape, South Africa, the factors influencing practice and what improvement measures could advance prehospital acute pain management.

by

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1. Lourens A, McCaul M, Parker R and Hodkinson P. Acute Pain in the African Prehospital Setting: A Scoping Review. Pain Research and Management [Internet]. Vol 2019. Article ID 2304507. 13 pages. Available from: <https://doi.org/10.1155/2019/2304507>
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“Make the most of yourself ... for that is all there is of you.” Ralph Waldo Emerson

Abstract

Introduction: Acute pain is a common reason for seeking emergency care in the prehospital and emergency centre settings where pain prevalence ranges widely. Pain is a significant global health problem which often goes unnoticed and is undermanaged. To this end, a project consisting of a series of research studies aimed to develop an understanding of acute prehospital pain assessment and management in South Africa was conducted to identify how best to improve this field.

Methods: The project consisted of four distinct objectives to be investigated as separate but interconnected studies. The first objective was answered through a secondary research methodology (scoping review) to identify and map the body of evidence on acute prehospital pain assessment and management in Africa. The remaining three objectives were answered using primary research methods in studies conducted in the Western Cape, South Africa. Two observational studies, (i) a cross-sectional online survey and (ii) a retrospective review, respectively, aimed to describe (i) the knowledge, attitudes and practices regarding prehospital acute pain assessment and management among emergency care providers and (ii) current prehospital acute pain assessment and management practices in high acuity trauma patients. The final study employed qualitative research methods using focus groups and content analysis to explore and describe emergency care providers' perspectives of acute pain assessment and management as well as perceived barriers and facilitators to pain management.

Main results: In the scoping review, six publications on acute pain research in the African prehospital setting were identified, indicative of the paucity and immaturity of this research area. In the cross-sectional online survey, suboptimal levels of knowledge and attitudes regarding pain (58.01%) were found among emergency care providers, with gaps in all aspects of pain knowledge and attitudes of distrust in self-reported pain identified. The retrospective review recorded pain scores were documented in only 18.1% of the high acuity trauma patients reviewed, while moderate-to-severe pain (78.6%) was prevalent among those who had a pain score documented. Less than 3% of all trauma patients, and less than 8% of those with moderate-to-severe pain received analgesic medication, thus, suggesting less than ideal prehospital pain assessment and management practices. In the final qualitative study, six focus groups and one interview were conducted among 25 emergency care providers. Through content analysis five themes, namely: assessing pain is difficult in this setting; many factors affect clinical reasoning some unique to this (hostile) setting; basic and intermediate life support practitioners' reality of prehospital pain care;

the emergency centre does not understand what we do, how we work, what it is like; and how can we do better; emerged from the data.

Conclusion: Africa has a scarcity of prehospital pain research with current evidence mainly from South Africa while knowledge of prehospital pain assessment and management in the Western Cape, South Africa proved to be a significant gap. This gap appears to be underpinned by limited educational focus, lack of pain prioritisation in emergency medical services (EMS) organisations, lack of clear evidence-based prehospital pain clinical practice guidelines, and emergency care providers' indifference towards prehospital pain care. A joint approach from EMS organisations and educational institutions, coupled with clinical practice guideline development, as well as interdisciplinary collaboration between prehospital emergency care and emergency medicine, are required. Further research must focus on developing the body of African prehospital pain knowledge to inform clinical practice and advance quality prehospital pain care.

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List of Abbreviations

ALS	Advanced Life Support
AEA	Ambulance Emergency Assistant
BAA	Basic Ambulance Assistant
BLS	Basic Life Support
BP	Blood Pressure
CCA	Critical Care Assistant
CHEOPS	Children’s Hospital of Eastern Ontario Pain Scale
CI	Confidence Interval
CPGs	Clinical Practice Guidelines
CPOT	Critical-care Pain Observation Tool
CQI	Continuous Quality Improvement
DBP	Diastolic Blood Pressure
EC	Emergency Centre ¹
ECP	Emergency Care Practitioner
ECT	Emergency Care Technician
ED	Emergency Department ¹
EM	Emergency Medicine
EMS	Emergency Medical Services
ePCR	Electronic Patient Care Report
FLACC	Face, Legs, Activity, Cry, Consolability
FPS	Faces Pain Scale
FPS-R	Faces Pain Scale-Revised
GCS	Glasgow Coma Score
GSW	Gunshot Wound
HCP	Healthcare Provider
HPCSA	Health Professions Council of South Africa

¹ The terms Emergency Centre (EC) and Emergency Department (ED) are used interchangeably throughout the thesis. In South Africa, the part of a hospital dealing with emergencies is the EC, while the more international term is ED, thus the term ED was used in the international publications.

HR	Heart Rate
HREC	Human Research Ethics Committee
HRS	High-resource Settings
IASP	International Association for the Study of Pain
ICU	Intensive Care Unit
IM	Intramuscular
IN	Intranasal
IO	Intraosseous
IQR	Interquartile Range
IV	Intravenous
KAP	Knowledge, Attitudes and Practices
KASRP	Knowledge and Attitudes survey regarding Pain
LOC	Level of Consciousness
LRS	Low-resource Settings
MCQs	Multiple-choice Questions
NECET	National Emergency Care Education and Training
NHRS	National Health Research Systems
N ₂ O	Nitrous Oxide
NRS	Numerical Rating Scale
NSAIDs	Nonsteroidal Anti-inflammatory Drugs
NVPS	Nonverbal Pain Scale
OR	Odds Ratio
PBEC	Professional Board of Emergency Care
PCR	Patient Care Report
PEC	Prehospital Emergency Care
PNKAS	Pediatric Nurses' Knowledge and Attitudes survey regarding Pain
POPI	Protection of Personal Information
QR	Quick response
RCT	Randomised Control Trial
RR	Respiratory Rate
RTIs	Road Traffic Injuries
SA	South Africa

SATS	South Africa Triage Scale
SBP	Systolic Blood Pressure
SpO ₂	Oxygen Saturation
SPSS	Statistical Package for the Social Sciences
UCT	University of Cape Town
USA	United States of America
USB	Universal Serial Bus
VAS	Visual Analog Scale
VNRS	Verbal Numerical Rating Scale
VRS	Verbal Rating Scale
WC	Western Cape
WCEMS	Western Cape Emergency Medical Services
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

1.1 Background

Pain is a significant global health problem (1,2). It affects any population and occurs secondary to various causes, yet it often goes unnoticed and is invariably undermanaged (2,3). The International Association for the Study of Pain (IASP) defines pain as *“an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage”* (4). Cohen et al. (5) proposed redefining pain in 2018 as *“Pain is a mutually recognisable somatic experience that reflects a person’s apprehension of threat to their bodily or existential integrity”*. Regardless of the complexities of defining pain, it is an unpleasant experience which impacts emotions and thoughts, not always protective in purpose and the cause not always observable (3).

Pain can be classified in several ways, for instance, as acute or chronic pain. Acute pain is described as recent in onset and usually with a recognisable causal link to traumatic injuries such as fractures or burns, acute disease processes like appendicitis (inflammatory), or childbirth (3,6). Chronic pain continues beyond the healing phase of an injury or disease and frequently lacks an identifiable cause (3,6). If unalleviated, acute pain may lead to the later development of chronic pain (7) due to a prolonged stress response and possible irreversible nerve damage (8). Evidence suggests that the severity of acute pain is associated with the risk for the development of chronic pain (9). Pain can also be categorised according to the mechanism, namely nociceptive, neuropathic and nociplastic pain (3). Nociceptive pain originates from actual or potential non-neural tissue damage, has a protective purpose and is due, in part, to the stimulation of pain receptors (nociceptors) (3,4,8). It can be visceral (involving organs) or somatic (involving muscles, joints, bones and/or skin) in nature (4,8). In contrast, neuropathic pain originates from a lesion or disease in the somatosensory system (part of the sensory nervous system involved in pain perception, touch, pressure, position, movement, temperature, etc.) (3,4,8). Nociplastic pain is defined as *“pain that arises from altered nociception despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors or evidence for disease or lesion of the somatosensory system causing the pain”* (10). Neither, neuropathic (nerve injury) nor nociplastic pain (sensitisation of the nervous system) is protective in function.

The nociceptive pathway (Figure 1.1) consists of four complex processes, starting with *transduction* which is the stimulation of nociceptors by a potentially noxious (harmful) trigger (thermal, mechanical, or chemical stimuli) generating an action potential. The action potential is transmitted (*transmission*) by nociceptive fibres (first-order nerves) to the spinal cord (second-

order nerves) and the higher brain centres (thalamus, cortex, limbic system, brainstem) where the perception of pain is generated (*pain perception*). The perception of pain include affective (fear, anxiety, etc.), cognitive (meaning) and sensory (severity, location, and quality) components which coincide with behavioural (movement, facial expressions, etc.) and physiological (stress response) responses to pain (8). The final process, *modulation*, is whereby the nociceptive impulse is either enhanced or inhibited (8,11). Pharmacological and non-pharmacological pain management may influence any of these processes (8).

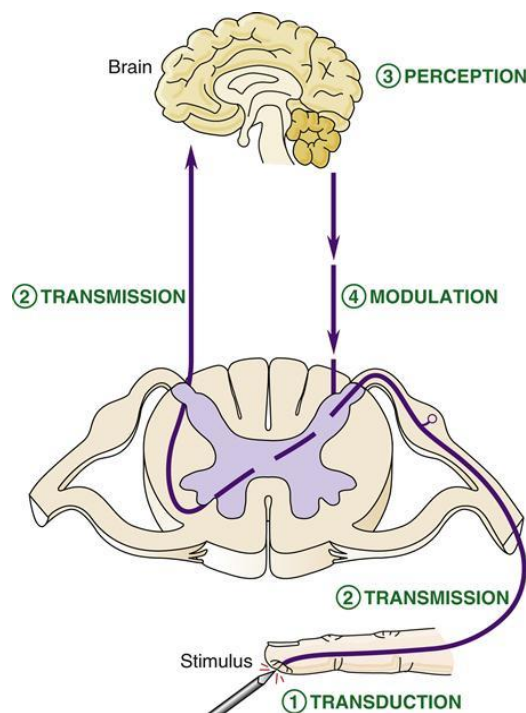


Figure 1.1: Nociceptive pathway
 (Source: <https://basicmedicalkey.com/pain-3/>)

Nociceptive stimuli activate the stress and inflammatory responses which may result in hyperglycaemia, protein catabolism, hyperalgesia and fever (11). In addition, the sympathetic nervous system is also triggered with nociceptive stimuli, leading to an increased heart rate (HR), respiratory rate (RR), blood pressure (BP), oxygen demand, cardiac workload and decrease gastric emptying and intestinal mobility and hypercoagulation (physiological responses) (7,11–13). Unalleviated pain prolongs the stress response and suppresses the immune system leading to poor wound healing, greater risk of infection and longer recovery times (7). Further, issues like anxiety, hypoxia, hypo/hyperthermia, acidosis, and protracted immobilisation, among others, may exacerbate the stress response (13). Pain is a multifaceted experience, influenced by various individual aspects, including, beliefs, culture, support system, previous painful events, social factors (family, work) and coping mechanisms (11,14). Pain decreases physical function and in the long-term may result in depression and anxiety, difficulty with concentration and attention,

impaired sleep and decrease in quality of life (9,11). Pain management, therefore, is an ethical and human rights concern (7,15), and effective control thereof is an essential component of quality emergency care (7).

Acute pain is a common reason for seeking emergency care both in the prehospital and emergency centre (EC) settings. Pain prevalence in the emergency (EC (16–21) and prehospital (22–31)) environment are reported to range widely (20-90%) while pain recognition, assessment and management are broadly identified as being of poor quality and often inadequate in most healthcare contexts (16,22,24,25,27). Prehospital emergency care (PEC) refers to the assessment, stabilisation and transportation of ill or injured patients to hospital via road or air ambulance (32) while an EC is an area in a hospital where ill and injured patients receive emergency care (33). Patients can arrive by ambulance or public transportation.

To quantify and conceptualise pain and establish a foundation for pain management decision-making, the assessment and regular re-assessment of pain are crucial. Various validated pain assessment tools for adult and paediatric patients exist. Yet pain assessment can be extremely challenging, influenced by patient factors like culture, gender, age, language, context, previous experiences etc. (15). One-dimensional pain scales are typically used to measure the intensity of acute pain and due to time and logistical constraints recommended for prehospital use while multi-dimensional and neuropathic pain scales are employed to assess chronic pain (34,35). The inability to communicate pain, due to a decreased level of consciousness (LOC) or cognitive impairment, does not negate a patient from experiencing nociception or requiring pain relief (7). The beliefs, attitudes and personal opinions of healthcare providers (HCPs) may influence pain assessment and management, often negatively (24,36). Research indicates that HCPs largely underestimate pain (15,24,37,38) with evidence predominantly from the nursing domain suggesting this underestimation increases with experience (35,38).

Prehospital analgesia incorporates both pharmacological and non-pharmacological approaches, best used in conjunction. Pharmacological pain management includes various analgesic agents suitable for prehospital use (opioids, nitrous oxide (N₂O), methoxyflurane, ketamine, etc.) administered through several routes namely oral, inhaled, intravenous (IV), intraosseous (IO), intramuscular (IM) and/or intranasal (IN) (14). Non-pharmacological pain interventions in the prehospital setting may include effective communication with patients and interventions like splinting fractures, applying burn dressings, allowing the patient to assume a position of comfort, distraction, etc.

In the EC, pain management is frequently delayed therefore prioritizing prehospital analgesia before handover may result in a significant reduction in time to administration (39,40), easing suffering and anxiety, and decreasing or minimising the harmful effects of acute pain. Effective pain control helps facilitate further diagnostic and treatment processes, both in the prehospital and in-hospital settings. Prehospital analgesia is also associated with an increased likelihood of faster subsequent EC analgesia (39,41).

Seeing as pain is the subject of ongoing scientific and clinical research to refine and expand its understanding, the available literature was pragmatically interpreted and presented to develop a framework for the proposed research.

1.2 Research context

1.2.1 Prehospital education and training in South Africa

Emergency medical services (EMS) systems around the world are diverse and emergency care providers practice with different protocols/guidelines, medications, scopes of practice and standard operating procedures. Additionally, training and education of prehospital practitioners differ significantly between countries. Historically, South African prehospital education and training occurred in a short course format, qualifying practitioners with a Basic Ambulance Assistant (BAA), Ambulance Emergency Assistant (AEA) and Critical Care Assistant (CCA) paramedic qualification. With the addition of each qualification, practitioners gained skills and practice according to a broader scope with licencing to use more medication. In more recent times, tertiary level qualifications [National Diploma in Emergency Medical Care (NDEMC), Emergency Care Technician (ECT) and Bachelor of Technology or Bachelor degree in Emergency Medical Care (Emergency Care Practitioner (ECP))] became available, with additional scopes of practice as well as allowing access to further education (Table 1.1) (42,43). The 2017 National Emergency Care Education and Training (NECET) policy aimed to align prehospital education in South Africa (SA) with the national education and training needs of the Department of Health as well as with existing education legislation, in effect to facilitate “professionalisation”. Accordingly, current emergency care education and training are being replaced with a three-tiered undergraduate framework (Table 1.2) (42–44).

1.2.2 Pain assessment and management in the South African prehospital setting

South African prehospital protocols have only recently recommended specific pain assessment tools and made recommendations for pain assessment. In 2018, the Professional Board of Emergency Care (PBEC) of the Health Professions Council of South Africa (HPCSA) published the South African EMS Clinical Practice Guidelines (CPGs) (45) which included recommendations for

the assessment and management of pain. The CPG made specific recommendations for pain assessment: “an age-appropriate pain assessment tool should be used as part of general patient care”, and “pain should be reassessed every 5 minutes after the administration of analgesia”. “All trauma patients should be deemed candidates for analgesia and the pain relief expectations of women in labour should be met” (45).

Table 1.1: Current South African emergency care education and training (43)

HPCSA Registration Category	Level of Emergency Care	Course Name	Course Type and Duration
Basic Ambulance Assistant (BAA register)	Basic Life Support (BLS)	Basic Ambulance Assistant (BAA)	4-6 week short course
Ambulance Emergency Assistant (ANA register)	Intermediate Life Support (ILS)	Ambulance Emergency Assistant (AEA)	3-month short course
Paramedic (ANT ^a register)	Advanced Life Support (ALS)	Critical Care Assistant (CCA)	9-month short course
		National Diploma: EMC ^b (NDEMC)	3-year qualification
Diploma Emergency Care		2-year qualification	
Bachelor of Tech ^c EMC ^b		1-year postgraduate qualification (After NDEMC)	
Bachelor Degree EMC ^b		4-year qualification	
Emergency Care Technician (ECT register)			
Emergency Care Practitioner (ECP register)			

Footnote: ^a Ambulans Nood Tegnikus, ^b Emergency Medical Care, ^c Bachelors of Technologiae

In terms of pain management, in the past, BAA and AEA qualified practitioners, only had the inhaled analgesic agent, Entonox® (50% N₂O + 50% O₂) on their scope of practice while ECTs and paramedics (ANT register) had the addition of IV morphine and ECPs ketamine (IV & IN). The 2018 CPGs, with approval from the South African Health Products Regulatory Authority, will add the inhaled analgesic agent, penthroxyflurane (or methoxyflurane), to the scope of all qualifications, ketamine to the scope of the ANT registered practitioners and fentanyl (IV and IN) and paracetamol (oral and IV) as well as oral nonsteroidal anti-inflammatory drugs (NSAIDs) to the scope of ANT and ECP registered practitioners. The addition of these medications, all extensively used in the prehospital setting worldwide, may alleviate some of the gaps in the current prehospital analgesic formulary. Unfortunately, for no clear reasons, Entonox® is frequently unavailable thus limiting the pain management capacity of predominantly lower qualified practitioners, the majority of the workforce (43).

Table 1.2: Emergency Care Qualifications (Undergraduate) framework (42,43)

Qualification	NQF ^a level	Duration	Designation
Higher Certificate in Emergency Care	5	1-year	ECA ^b
Diploma in Emergency Care	6	2-years	ECT ^c
Bachelor in Emergency Medical Care (BEMC)	8	4-years	ECP ^d

Footnote: ^a National Qualifications Framework, ^b Emergency Care Assistant, ^c Emergency Care Technician, ^d Emergency Care Practitioner

1.3 Research Rationale

Although there is a wealth of knowledge on the topic of prehospital pain care in high-resource settings (HRS) (7-16,27-33) truly little is known about acute pain assessment and management in the prehospital setting in low-resource settings (LRS), particularly in the African context. This research will allow for the development of an understanding of acute pain assessment and management knowledge and practices in the prehospital setting, in the Western Cape (WC), SA. Current research evidence will be encapsulated and gaps within the existing literature, in the African prehospital setting, identified. Additionally, the research will aim to identify obstacles and facilitators of acute pain assessment and management in the prehospital setting, in the WC, SA. The outcomes will be aligned to make recommendations for further research and improving prehospital pain care in the WC and to other similar settings.

1.4 Research questions, aim and objectives

1.4.1 Research questions

- What are the current body of evidence related to acute pain assessment and management in the African prehospital setting?
- What are the knowledge, attitudes and practices regarding acute pain assessment and management among emergency care providers in the WC, SA?
- What is the prevalence of acute pain in the prehospital setting in the WC, SA and how is it assessed and managed by emergency care providers?
- What are emergency care providers' perspectives (viewpoints and experiences) of pain assessment and management in the prehospital setting, in the WC, SA and what are the perceived barriers and facilitators?

1.4.2 Research aim

The overall aim of the research project is to develop an in-depth understanding of acute pain assessment and management in the prehospital setting in the WC, SA and to make recommendations for improvement initiatives.

1.4.3 Objectives

- To identify and map the body of evidence related to acute pain assessment and management in the prehospital setting (*Scoping Review*).

- To describe the knowledge, attitudes, and practices of emergency care providers in relation to acute pain assessment and management in the prehospital setting, in the WC, SA (*Knowledge, Attitudes and Practices (KAP) survey*).
- To review and describe current prehospital acute pain assessment and management practices among emergency care providers in the WC, SA (*Retrospective Review*).
- To explore and describe emergency care providers' perspectives of acute pain assessment and management and perceived barriers and facilitators of pain assessment and management in the prehospital setting, in the WC, SA (*Qualitative study*).

The four distinct objectives, to be investigated as separate but interconnected studies, propose to create an understanding of prehospital pain care in the South African prehospital setting in terms of the significance of the problem, depth of knowledge and attitudes among practitioners, scarcity of research and the challenges that practitioners face daily.

1.5 Ethical clearance and permission to conduct research

The study received ethical approval from the University of Cape Town (UCT), Faculty of Health Sciences, Human Research Ethics Committee (HREC) (Ref: 220/2017) ([Appendix 1](#): Approval letter and annual renewals).

Additionally, the project received permission to conduct research from the:

- Western Cape Government, Department of Health (WC_2017RP54_569) ([Appendix 2](#): Approval letters from Strategy and Health Support and Western Cape Emergency Medical Services (WCEMS));
- Research Operations Committee of a private ambulance service in SA requiring anonymity (UNIV-2018-0039) ([Appendix 3](#));
- ER 24 Research Committee (08/2018) ([Appendix 4](#)).

The relevant research outputs will be disseminated to the institutions involved in the investigation. In addition, research results will be submitted for poster presentation at national and international conferences.

1.6 Reporting structure

Each of the four objectives were investigated as individual but interconnected studies and are presented in chapters three to six. Each chapter includes declarations from the author and co-authors, a peer-reviewed journal article followed by a discussion of additional methods, results

and limitations around the individual studies not included in the published article. Where applicable, supplementary, and relevant material, are added as appendices. The final chapter of the thesis, Chapter 7, aims to link together the findings of all four articles and draw together conclusions and recommendations for implementation and further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Objectives of the Literature Review

The focus of this literature review is to identify relevant evidence on the research topic, acute prehospital pain assessment and management, permitting an introduction into existing literature from both an African and global perspective, providing a wide-ranging knowledge base and contextualising the current project in relation to existing literature. The literature review aims to summarise and critically analyse pain research under the themes; acute pain epidemiology (prehospital and hospitalised patients), pain assessment, barriers and enablers of prehospital acute pain care, disparities in prehospital pain care, prehospital (non-pharmacological and pharmacological) pain management, the impact of pain education and continuous quality improvement (CQI) programmes, knowledge and attitudes regarding pain as well as the patient's perspective of prehospital pain care. It is expected that results from this research project may be comparable to global scientific knowledge in certain areas like prehospital pain prevalence and less so in others, for instance, barriers and enablers to prehospital pain care. However, it will be valuable in terms of understanding and improving the quality of prehospital pain care for SA communities.

2.2 Literature review search strategy

PubMed, ScienceDirect and Google Scholar were searched for articles relevant to the research topic using numerous search strategies by means of free text search terms (Table 2.1) and variations thereof in February 2019. Search strategies were developed through using keywords, terms and phrases identified from the research questions and refined during the search process. Searches were updated from December 2019 through to 29 February 2020 and included no limitations/filters. The researcher was responsible for making decisions regarding the inclusion of publications. Most included articles were sourced from, but not limited to professional journals. In addition, articles identified through further reading, collaboration and the compilation of the research thesis and articles, deemed relevant to acute prehospital pain assessment and management were included in the literature review.

2.3 Epidemiology of acute pain

This section of the literature review describes and explores the epidemiological characteristics of acute pain including prevalence, aetiology, pain assessment practices, pain severity, pharmacological and non-pharmacological pain management practices as well as the efficacy of

pain management in hospitalised including EC, and prehospital patients. Moreover, acute pain in LRS will be deliberated.

Table 2.1: Search terms per literature review topics

Topics	Search terms
Acute pain prevalence	<ul style="list-style-type: none"> - acute pain AND prevalence AND (emergency department OR emergency room) - acute Pain AND prevalence AND (prehospital OR ambulance OR out of hospital) - acute pain AND prevalence AND (prehospital OR out of hospital OR paramedic OR ambulance OR emergency medical services)
Pain assessment	<ul style="list-style-type: none"> - acute pain AND emergency AND (pain assessment OR pain intensity OR pain score OR pain scale OR pain rating)
Barriers / enablers / attitudes	<ul style="list-style-type: none"> - barriers AND enablers AND prehospital AND analgesia - attitudes OR perspective OR perceptions AND prehospital AND acute pain
Disparities	<ul style="list-style-type: none"> - gender OR sex AND prehospital AND acute pain - age AND prehospital AND acute pain
Patient perception	<ul style="list-style-type: none"> - patient perception OR patient satisfaction AND prehospital AND acute pain
Pharmacological pain management	<ul style="list-style-type: none"> - acute pain AND prehospital OR ambulance OR out of hospital AND inhaled analgesia - acute pain AND prehospital OR ambulance OR out of hospital AND nitrous oxide - acute pain AND prehospital OR ambulance OR out of hospital AND methoxyflurane OR pentrox - acute pain AND prehospital OR ambulance OR out of hospital AND fentanyl OR morphine - acute pain AND prehospital OR ambulance OR out of hospital AND ketamine - acute pain AND prehospital OR ambulance OR out of hospital AND paracetamol
Non-pharmacological pain management	<ul style="list-style-type: none"> - acute pain AND prehospital OR ambulance OR out of hospital AND non-pharmacological

2.3.1 Epidemiology of acute pain in EC and/or hospitalised patients

For this topic, studies from North America (16,20,49) and Europe (17,18,21) were identified which included both adults and paediatrics. For the studies conducted in North America, Cordell et al. 2002 (20) reported in a chart review that of all 1689 EC visits (over 7-days), 61.2% of patients had a complaint of pain recorded and a further 4.7% underwent a painful procedure. Taylor et al. 2008 (49) found in a cross-sectional study that of the hospitalised (surgical and medical) children ($n=241$) interviewed, 77% had pain on admission, 23% had moderate-to-severe pain at the time of the interview and 64% had moderate-to-severe pain sometime in the preceding 24 hours. Of the children who experienced pain on admission, 42% received pain relief, 25% regular analgesia and 33% sporadic analgesia. About 23% of children were likely to have had chronic pain. The pain management index calculated for children in the preceding 24 hours suggested pain was undermanaged in 47.3% of children. Todd et al. 2007 (16), on the other hand, assessed 842 EC

patients (≥ 8 years) with moderate-to-severe pain (numerical rating scale (NRS) >3) as chief complaint in a cohort study. For 34% of patients, the pain severity remained unchanged, for 7% pain severity increased during their stay and only 50% of patients experienced a clinically meaningful 2-point or more reduction in pain severity. Of the 84% of patients with moderate-to-severe pain expressing a desire for pain relief only 70% received analgesia.

Trauma ($\pm 32\%$) was the most common pain aetiology reported by Todd et al. 2007 (16) and Cordell et al. 2002 (20), with back/neck pain, abdominal pain, headache, infections, non-cardiac chest pain and unknown, being additional causes reported by Todd et al. 2007 (16). In hospitalised children, Taylor et al. 2008 (49) found that surgical patients were more likely to have pain assessed and managed than medical patients. The authors further suggested that possible causes for poor pain management included: poor pain assessment documentation, a lack of pain assessment knowledge, and the duration and efficiency of medication. On the part of HCPs, lack of knowledge and understanding of patients and family members in terms of pain relief expectations, attitudes and beliefs about opioids and cultural barriers were further suggested as possible causes for poor pain management (49).

Relevant European studies included publications from the Netherlands (17) and Italy (18,21). These studies all reported a high prevalence of pain with moderate to severe pain and poor pain management common. Berben et al. 2008 (17) conducted a prospective descriptive study on 450 stable trauma [≥ 16 years, glasgow coma score (GCS) ≥ 13] patients admitted to Dutch ECs. On admission, 91% of trauma cases reported pain and 86% still had pain on discharge. The mean pain score (NRS) on admission was 5.9 and 5 at discharge. Most (91%) patients reported extremities as the pain location. An observational study by Mura et al. 2017 (18) assessed adult patients (≥ 18 years) visiting an Italian EC. Of the 732 patients with pain at triage, 61.4% reported severe pain (NRS 7-10), 30.5% moderate pain (NRS 4-6) and 8.20% mild pain (NRS 1-3). The aetiology of pain was secondary to trauma in 40.4%, urological diseases in 13.5%, abdominal pain in 13.4% and musculoskeletal (non-traumatic) pain in 7.1% of patients. These four causes were also associated with higher pain scores. Damico et al. 2018 (21) found in a multicentre cross-sectional study, a 38% pain prevalence among patients admitted to the intensive care unit (ICU), nursing home, orthopaedic, medical and surgical units in Italian hospitals. This prevalence among hospitalised patients was deemed high. Severe pain was recorded in 21.3% of patients with women at higher risk for severe pain ($RR=1.73$). Compared to other causes of pain, trauma was the foremost aetiology.

Two of these studies (17,18) reported poor pharmacological pain management. Berben et al. 2008 (17) found that only 19% ($n=83$) of patients received opioids, paracetamol, NSAIDs or benzodiazepines to manage pain while the efficacy of pain relief was poor. Non-pharmacological pain management (bandage, splints etc.) was performed in 63% of patients however during this treatment, two-thirds of patients experienced an increase in pain (17). Of the 684 patients assessed by Mura et al. 2017 (18), 32.5% received non-opioid analgesics or an opioid (4%) with 22% receiving a second dose of analgesia. The reduction in pain score after pharmacological management was 3.97 for males and 4.39 for females. Damico et al. (21) reported that 83.2% ($n=223$) of patients with pain received treatment primarily with paracetamol. Pain management was received within 30 minutes of determining the presence of pain and 31.6% (18/57) of wards had pain management protocols.

Gregory and McGowan's 2016 systematic review (19) incorporated 14 English language publications conducted in HRS from 1990 to 2013. They reported a pain prevalence among hospitalised patients between 37.7% and 84% with severe pain in between 7% and 36%. Further, pain was found to be more prevalent in the surgical wards (48-78%) compared to the medical wards (30.0-55.6%). The variations in the study results may be attributed to the fact that since there is no validated pain prevalence survey tool, included studies used different instruments. Further, the survey response rate could have been affected by the method of survey completion (face-to-face versus self-completed) and the clinical condition of the patients participating in the survey. Most studies excluded patients with cognitive impairment.

Many studies in this section concluded that pain, including moderate-to-severe pain in hospitalised patients, was prevalent (17–20,49), poorly recognised and assessed, as well as undermanaged (16–18,49). Trauma was the most frequent aetiology of pain (16,18,20,21) while surgical patients were more likely to have pain assessed, suffer severe pain and receive pain management (19,49). It must be noted that the pain prevalence ranged widely across studies. One would expect the prevalence of pain in an EC setting to be higher than that of patients admitted to hospital and therefore under treatment and continuous observation. Further, the prevalence reported in studies including only trauma versus all patients is also likely to be higher as trauma is reported to be the most frequent pain aetiology. Variation in pain prevalence may be affected by institutional culture, pain prioritisation and treatment guidelines. Staff attitude, workload, lack of knowledge, fallacies about pain, underassessment, challenges with assessing pain, the belief that patients overstate pain, patients refusing to report pain or to receive medication, communication barriers between HCPs, and the lack of pain management knowledge

are all possible reasons for the poor pain management described by the three European papers (17,18,21). It was further recommended that pain education should not be the only intervention utilised in an attempt to improve pain practice (21). The study designs were almost exclusively observational, constituting lower-level evidence, yet aptly conducted.

2.3.2 Epidemiology of acute pain in prehospital patients

A range of studies reporting epidemiological characteristics of acute pain in the prehospital setting were identified from the United States of America (USA) (23,40,41,50), Europe (22,25–30,51) and Australia (31,52). A chart review by Mclean et al. 2002 (23) reported that in 1999, 14% of all patients in the USA arrived at EC by ambulance. The study used the National Hospital Ambulatory Medical Care Survey data sourced from the National Centre of Health Statistics public use database for the period 1999 to 2000. Most (90%) patients were ≥ 18 years. Of these, 14% had mild pain and 20% moderate-to-severe pain (at hospital) however $< 50\%$ had pain information collected in the prehospital setting. For patients with moderate-to-severe pain arriving by ambulance, trauma (27%) was the most common aetiology followed by musculoskeletal (non-trauma) pain and chest pain. Of the patients who received narcotic analgesics, 21% had pain information recorded while 13% had none documented.

Infinger and Studnek 2014 (50) reported in a retrospective review that 43.33% (487/1124) of adult patients, transported by an EMS system in North Carolina, USA, who sustained an injury secondary to a fall had an initial pain score recorded with only 8.18% ($n=92$) receiving pain medication. For these fall victims, the most common injury location was extremities ($n=57$, 61.96%) (50). Abbuhl and Reed 2009 (40) reviewed data of adult patients with isolated extremity trauma transported by ambulance to a trauma centre in New York. Of the 706 patients, 104 (14.7%) patients met the inclusion criteria [≥ 18 years, painful isolated extremity injury, receive analgesia by EMS or at EC] of which 12.5% ($n=13$) received analgesia prehospitally and the remaining 87.5% ($n=91$) at hospital. For the group receiving prehospital analgesia, the mean time to administration was 23.5 minutes while for the in-hospital group the mean time was 113.6 minutes. These findings are supported by the 2006 literature review by Hennes and Kim (41) which found adult and paediatric studies reporting a shorter mean time to analgesia if administered in the prehospital setting compared to the EC, thus suggesting prehospital analgesia ensures earlier pain relief while EC administration is associated with delays.

Studies from Europe: Italy (29), France (22,26), the Netherlands (30), Ireland (25), Denmark (28,51) and Switzerland (27) were incorporated. The Italian study (questionnaire) found that two-thirds ($\pm 66.6\%$) of the 383 cases reported acute pain with 41.75% reporting moderate-to-

unbearable pain. Of the ambulance services involved, 11.5% had no opioids while 10.6% were without any analgesic agents. Trauma (36.8%) was the aetiology most commonly associated with pain (29). The two French studies, were both prospective cohort studies, one among adults (≥ 16 years) and the other paediatrics (≤ 15 years) (22,26). In France, EMS includes mobile units staffed by emergency physicians and mobile intensive care units staffed by a physician, ICU anaesthetist and trained ambulance practitioner. The overall acute self-reported pain prevalence among 2279 adult patients was 42%, with 64% of these having intense to severe pain and 40% severe pain. Multivariate analysis indicated that the factors most associated with acute pain were trauma (*OR* 2.9) and patients aged >75 years (Odds ratio (*OR*) 2.2). Factors associated with more severe pain were trauma-related (*OR* 2.2) and cardiac-related (*OR* 1.6) pain. Of the acute pain patients transported, 73% received analgesia while 51% experienced pain relief. Forty-four percent received paracetamol and 29% morphine which was mainly administered for trauma. Pain relief was less common in trauma cases and obstetric emergencies (22). For the paediatric cohort ($n=258$), 37% of patients presented with acute pain of which 67% had intense to severe pain. Children with the capacity to communicate, self-reported pain while preverbal children were assessed by the crew. Children with head injuries, coma, epilepsy etc. could not be evaluated for pain. Trauma was the most common cause of pain (34%) followed by neurological disorders, respiratory disorders, and others. Of the 96 children experiencing pain, 92% received analgesia at least once. Paracetamol (45%), morphine (39%), N_2O (50%) (39%) and nalbuphine (18%) were administered while some children (41%) received 2 or more drugs. Both studies were limited by missing data and the inability to generalise findings to rural areas (26).

In a Dutch study, Berben et al. 2011 (30) retrospectively reviewed ($n=1407$) adult patients (≥ 16 years) with recent (<1 hour) trauma managed by EMS. Patients unable to report pain verbally, attempted suicide or nearly drowned were excluded. Pain was present in 70% of trauma cases with 2% reporting no pain and pain information missing for 28%. NRS score was recorded in 31% of patients of which 75% reported a score ≥ 4 . Five patients refused pharmacological pain management and 42% ($n=410$) of trauma patients with pain received analgesia. Fentanyl (82%), N_2O (50%) (9%) and ketamine (9%) were administered. Cleaning and dressing wounds and splinting or immobilizing were the most frequent non-pharmacological management provided (30). Murphy et al. 2016 (25) included 6371 Irish paediatric (<16 years) patients transported by ambulance in their study, of which 41.4% had pain documented. The aetiology of pain was trauma in 78%, non-traumatic in 20% and not documented in 2% of cases. Pain assessment was documented in 32% of cases, with 11.4% assigned a score of 0 despite complaining of pain and 71% complaining of moderate-to-severe pain. At EC triage, 54% complained of pain (median

score 4) of which 60% reported moderate-to-severe pain. Only 26% of patients received analgesia, 73% receiving one agent and 27% receiving two or more agents.

Hebsgaard et al. 2016 (51) and Friesgaard et al. 2018 (28) reviewed the clinical data of patients transported by Danish ambulances. Hebsgaard et al. (51) included 985 trauma cases, 55.3% experienced mild and 17.1% severe pain, while pain assessment was not recorded in 30 cases. Opioids or ketamine were administered to 18.2% of trauma patients with 7.5% experiencing mild pain and 82.1% severe pain. Further, analgesia administration, intubation, severe trauma, a greater amount of analgesia and the need for more >1 analgesic agent were associated with severe pain (51). Friesgaard et al. (28), on the other hand, included all 41 241 acute cases transported by ambulance of which 27.7% suffered moderate-to-severe pain (10.3% severe pain) while 40.1% had mild to no pain and 32.2% had no pain information recorded. Of all patient encounters, 7.9% received IV fentanyl with 88.1% of these suffering moderate-to-severe pain. Of the patients with moderate-to-severe pain, 30.1% had a traumatic aetiology. Of these patients, 59.6% had moderate pain with 10% receiving fentanyl, and 40.4% had severe pain with 28.9% receiving fentanyl (28).

A Swiss study by Albrecht et al. 2013 (27) reviewed patient care reports (PCRs) of trauma (non-intubated, ≥ 16 years, GCS >13 and NRS >3) patients transported by helicopter and treated by physicians. Of the 1202 patients included, 67% experienced moderate-to-severe pain. Of all patients, 84% received analgesia while 61% ($n=620$) achieved pain relief. Fentanyl (82%) and ketamine (5%) was administered to those receiving analgesia. For the study population, the mean NRS was 6.9 (*SD* 1.9) and an average pain reduction of 3.5 reported. Polytrauma was present in 50% of cases and extremities were the most affected body area.

Both Australian studies were observational in nature (31,52). Jennings et al. 2011 (31) found a pain prevalence of 34.5% (108 853/315 273). Trauma was the aetiology in 41% of patients, medical in 39% and cardiac in 17%. Forty-one percent of patients achieved a clinically significant (≥ 3) reduction in pain while in EMS care. Prehospital analgesia was administered to 51% of patients with pain of which 20.3% received an opioid. Pharmacological agents available were morphine, fentanyl, glyceryl trinitrate and methoxyflurane. Simpson et al. 2013 (52), investigated prehospital pain management in older patients ($n=333$) with a suspected fracture due to a fall. Morphine (63%) was the most common analgesia administered (alone or in combination) followed by methoxyflurane (39%) and fentanyl (17%). Oral analgesia was uncommon. Of the patients ($n=173$) with an initial and final pain score recorded, 62% had a clinically significant pain reduction and 84% of those with moderate-to-severe pain received analgesia.

Similar to the hospital findings, acute pain and moderate-to-severe pain is prevalent (22,23,27–30,51,52) and mostly associated with trauma (22,23,25,26,28,29,31). Although prehospital analgesia appears to decrease the time to administration compared to EC analgesia (40,41), pain management in the prehospital setting, in terms of the proportion of patients with pain assessed and analgesia administered, appears to be poorer (22,23,25,27–30,51) than in the hospital setting. Pain management (<30%) was particularly poor in the USA, Irish and Danish studies (25,28,40,50,51). The Dutch study (30) (paramedics) fared better with 42% of patients receiving pain management while in the French and Swiss (22,26,27) studies with physician facilitated analgesia, more than 70% of patients received pain management. Limited studies reported the efficacy of pain relief in terms of clinically significant pain reductions. The pharmacological agents most used were morphine, fentanyl and methoxyflurane.

All studies in this section were observational. Common limitations of studies were the exclusion of patients with decreased LOC and those vulnerable to pain due to difficulties with pain assessment. Murphy et al. (25) proposed that barriers to pain management may include occasional exposure to paediatrics, lack of education and training as well as CPG restrictions in terms of pain assessment tools appropriate for preverbal children and limited medication options for distressed paediatrics. In addition, Albrecht et al. 2013 (27) stated that continuous, quick feedback to practitioners may be a good education tool and reduce variation in pain management.

2.3.3 Acute pain and pain epidemiology in low-resource settings

Access to morphine and other controlled medication for pain relief in LRS remains a significant healthcare issue. It is thought that 83% of the global population and 800 000 trauma victims annually have little to no access to acute pain management, and these victims are mostly in LRS (53,54). In most African countries with the exception of South Africa (10.93 mg), the 2010 consumption of morphine was less than 1mg per capita (55). Acute pain from trauma, surgical conditions and childbirth are prevalent in these countries and are frequently under or untreated (54,56) creating a low patient expectation for pain relief (57). This is reinforced by HCPs attitudes and lack of knowledge, practitioners not offering analgesia, not prioritising pain relief and cultural factors (53–55,57). Although the barriers to pain management in HRS versus LRS may be similar, these obstacles are compounded by resource constraints like the lack of opioid analgesics, insufficient staff, lack of pain education, healthcare funds and opiophobia (concerns about addiction and adverse effects) as well as poor government policies and priorities and poorly developed healthcare systems in LRS (53–56,58,59). Quality pain research and research capacity

building in African countries has been encouraged to enhance the contribution to the field of study from this region (60).

Limited studies relevant to acute pain assessment and management in the emergency setting in Africa and SA could be identified. In-hospital studies echoed the findings of publications from HRS indicating moderate-to-severe pain to be prevalent (61,62), pain being less than optimally managed (61–63) and commonly related to trauma (61–63). Both, Dilunga et al. 2018 (61) (conducted in Tanzania) and Awolola et al. 2015 (62) (conducted in SA) reported that a high proportion (>90%) of patients had some form of pain assessment in the EC. The study by Thiadens et al. 2011 (63), which reviewed children (<13years) admitted to the Red Cross Children's Hospital trauma unit in Cape Town, SA, further questioned the appropriateness of the pain assessment tools for the setting and the low NRS allocated by foreign researchers suggesting that different pain expression by Western compared to African children may be a possible explanation.

A Central African study found that EC nurses had no official pain education, were incapable of properly performing a pain assessment, reported hesitance to administer morphine and some were influenced by cultural factors. Also, in this setting, patients with severe pain waited longer than those with less pain for analgesia (64). Thiadens et al. 2011 (63), further reported that some nurses believed receiving analgesia shows weakness while others were hesitant to administer opioids due to addiction concerns. Several African studies have found unfavourable attitudes and suboptimal knowledge about pain among nurses and other HCPs (65–70).

The SA prehospital pain studies by Matthew et al. 2017 (71), Vincent-Lambert and De Kock 2015 (72) and Mulder 2012 (73) were reviewed. Matthew et al. 2017 (71) found that for 49% of patients receiving analgesia by ALS paramedics in Cape Town, SA the pain aetiology was trauma. Most of the 530 patients (70%) received IV morphine while only 21% had a pain score (NRS) recorded and 6% had a second pain score recorded. Vincent-Lambert and De Kock 2015 (72) found that paramedics were unduly cautious of adverse events due to morphine administration. The authors stated that the failure to administer appropriate dosages may result in delayed pain relief and that new protocols are needed to provide clearer recommendations for prehospital analgesia. Mulder 2012 (73) stated that to initiate prehospital analgesia practitioners require a comprehensive image instead of a single factor. Internal factors like practitioner perceptions and external factors like mechanism of injury as well as the required intervention influence pain management decision-making.

Though the evidence from HRS seem adequate to conclude that prehospital pain assessment and management practices are insufficient, the data for LRS are extremely limited to make precise

inferences. Even so, it may be safe to assume the pain assessment and management practices in LRS are likely worse than in HRS. In this light, resources in HRS may be better utilised in quality improvement initiatives while in LRS a dual approach with further research and quality improvement initiatives will likely be advisable and informative.

2.4 Acute pain assessment in the prehospital setting

This section will review the literature comparing different pain assessment tools used in the prehospital or EC settings as well the literature making recommendations related to prehospital pain assessment. One-dimensional pain scales are commonly used in the prehospital setting. As mentioned these pain scales only measure pain intensity while multi-dimensional scales, in addition to pain intensity, also measure the nature, location and emotional impact of pain (74). Multi-dimensional pain scales are time-consuming and complex thus regarded as not generally appropriate for prehospital use. For alert adults and older paediatrics, self-report (one-dimensional) scales like the NRS (Figure 2.1), VRS (Table 2.2) or Visual Analog Scale (VAS) (Figure 2.1) are useful (35,75–77). For younger children, infants and neonates, tools incorporating behavioural variables as in observational scales or scales incorporating both behavioural and physiological variables, are beneficial (35,78). Scales with behavioural variables may also be utilised in patients with altered mental status or cognitive impairment (14,74).

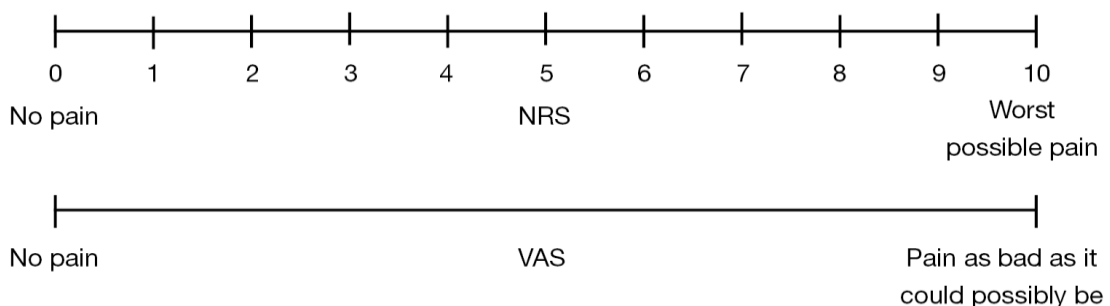


Figure 2.1: Numerical Rating Scale (NRS) and Visual Analog Scale (VAS)

(Reproduced from <https://rebelem.com/rebel-cast-episode-49-pediatric-pain-management-pearls-with-sebrina-perkins/visual-analog-scale/>)

Two systematic reviews (75,76) evaluated studies comparing one-dimensional pain tools. Hjermstad et al. 2011 (75) examined [54] studies comparing pain scales in adult postoperative, EC, ICU, cancer, rheumatoid arthritis, and elderly patients while Karcioglu et al. 2018 (76) included 19 randomised control trials (RCTs) comparing pain scales in adults (postoperative, EC, prehospital, nursing home and labour wards) to evaluate compliance, usability and superiority in clinical use. In Hjermstad et al. (75), 11 studies considered the NRS to be superior mainly due to compliance and easy use, yet, some studies indicated that it is more applicable to certain

subgroups of patients. Due to the ease of use and appropriateness for various age groups, seven studies endorsed the VRS, though the recommendations were dependent on pain aetiology. The VAS was endorsed by four studies, with the VRS and VAS found equally dependable in clinical use. Although the studies found these pain scales effective to assess pain intensity, the more imperative factor may instead be to select the correct scale for the situation (standardisation, interpretation, administration, etc.). Karcioğlu et al. (76) found all three pain scales (NRS, VRS, VAS) to be valid, reliable and suitable for clinical use with good correlation between scales. The VAS has shown some practical difficulties in vulnerable populations (elderly or cognitive impaired) for whom the VRS appears to be more appropriate. Even though pain scales assess pain intensity, clinical judgement and interpretation are still required.

Table 2.2: Verbal Rating Scale (VRS)

Pain score	Choose the word best-describing pain
0	No pain (None)
1	Mild pain
2	Moderate pain
3	Severe pain

Bahreini et al. 2015 (79) found a strong correlation ($p < 0.001$) between the Verbal Numerical Rating Scale (VNRS), VAS and Colour Analog Scale for the assessment of acute traumatic and non-traumatic pain in adults in the emergency setting and suggest that these scales can be used interchangeably. Göransson et al. 2015 (80) compared the VAS and NRS for assessing pain in adults visiting a Swedish EC. Here, a strong correlation was also found, yet patients found the NRS easier to use compared to the VAS. Hence, it was suggested that the NRS might be superior to the VAS. Likewise, Bijur et al. (81) found a strong correlation between VAS and NRS in adult EC patients, in addition, it was suggested that the scales can be used interchangeably.

An observational study by Ismail et al. 2015 (82) conducted in Malaysia among adult patients with pain transported by ambulance found that since it was quicker to perform and, required no additional tools or motor skills, paramedics (54%) and patients (53%) preferred the VNRS. The interrater reliability (kappa) for pain measurement using the VNRS and VAS on-scene and on arrival at hospital was substantial (0.61-0.80) (83), leading to the conclusion that the scales perform equally. In contrast to Bahreini et al. (79), the authors stated that the VNRS and VAS should not be used interchangeably. Luger et al. 2003 (37) compared the pain rating of emergency care providers at three time points during the prehospital encounter and found physicians, ambulance technicians and ambulance drivers, all underestimating pain and severe pain.

The literature review by Jennings et al. 2009 (35) suggested that for a pain assessment tool to be suitable and applicable to the prehospital setting, it must be quick to assess, not require equipment to record, be reproducible and have good interpersonal and intrapersonal reliability. At the time, the VNRS was found to be most applicable in adults, and the Faces Pain Scale (FPS) or Oucher scale suited for paediatrics older than 5 years or 3 years, respectively. An EMS clinical note review also suggested that the VRS and NRS were reasonable for pain assessment in patients ≥ 13 years (77) while another review article stated that the NRS, VRS, VAS, and Faces Pain Scale-Revised (FPS-R) (Figure 2.2) are the most commonly used scales in the clinical and research environment (78).



Figure 2.2: Faces Pain Scale-Revised (FPS-R)
(Reproduced from: <https://www.iasp-pain.org/Education/Content.aspx?ItemNumber=1519>)

Further evidence supports the use of behavioural and physiological variables to assess pain in infants. The FLACC (Face, Legs, Activity, Cry and Consolability) Scale (Table 2.3) or Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) (Table 2.4) are observational scales commonly used in young children (78). Shavit et al. 2008 (84), however, suggest that observational scales should not be used in paediatrics >3 years as these underrate children's pain perception.

Table 2.3: FLACC (Face, Legs, Activity, Cry and Consolability) Scale

Variables	0	1	2
Face	No expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant frown, clenched jaw quivering chin
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No crying (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or being talked to, distractible	Difficult to console or comfort

The systematic review by Lord 2009 (85) reviewed literature related to pain assessment tools validated for the use in cognitively impaired patients to make a recommendation for prehospital use. The author concluded that although the use of certain pain assessment tools is

recommended, agreement on the most suitable tool is lacking. As a result, further research to assess the Abbey pain scale for validity and reliability in the measurement of pain intensity in vulnerable prehospital patient populations was recommended. Further, a literature review (abstract) by Rooney 2018 (86) likewise recommends the Abbey pain scale but also recommends the Pain Assessment in Advanced Dementia (PAINAD) scale for patients who are unable to self-report. Additional scales recommended for non-verbal critical care patients include the Critical-Care Pain Observation Tool (CPOT) incorporating behavioural attributes and the Nonverbal Pain Scale (NVPS) which include behavioural and physiological attributes (87,88), amongst others.

Table 2.4: Children's Hospital of Eastern Ontario Pain Scale (CHEOPS)

Variables	0	1	2
Cry	No	Crying, Moaning	Scream
Facial	Smile	Neutral	Grimace
Verbal	Positive statement	Negative Statement	Suffering in pain
Torso	Neutral	Variable, upright	Stretched
Legs	Neutral	Continuous move kicking	Stretched

The evidence-based guideline for prehospital trauma analgesia by Gausche-Hill et al. 2014 (89) provides the following recommendations regarding pain assessment. Pain assessment should form part of general patient care with all trauma cases considered candidates for pain management. An age-appropriate pain scale should be used to assess pain. For patients >12 years, the use of self-reporting pain scales like NRS is recommended whereas, for patients between 4-12 years self-reporting pain scales like Wong-Baker Faces, FPS and FPS-R are recommended, and observational pain scales like FLACC or CHEOPS for patients <4 years are recommended.

Furthermore, the guideline recommends that for patients who receive analgesia, pain assessment must be repeated every five minutes and severe adverse events like hypoxia, hypotension, and anaphylaxis are indications to stop further medication administration. The authors identified areas in need of additional research to improve prehospital trauma pain care and suggested among others, the development of prehospital-friendly pain assessment tools suitable in diverse patient populations being needed. The lack of high-quality RCTs and systematic reviews was a limitation. These recommendations coincide with the prehospital pain management position statement by Alonso-Serra et al. 2003 (90).

Although various acute pain assessment tools exist, none is perfect (91), thus determining the tool most appropriate for the prehospital setting is challenging and emergency care providers find the lack of objective pain measurement frustrating (14). The reviewed studies deemed the NRS, VNRS, VAS, VRS, FPS and FPS-R pain scales to be effective and reliable for measuring pain

severity in adults in the prehospital setting whereas the FLACC and CHEOPS pain scales were considered appropriate for paediatrics (age-dependent). The most important aspect of prehospital pain assessment is that it must occur as part of general patient care and be reassessed regularly using an age-appropriate, standardised pain scale (14,89). As mentioned, research in terms of the validity and reliability of a pain assessment tool for prehospital use in patients with altered mental status or cognitive impairment is lacking, and further work is needed.

2.5 Prehospital pain management

2.5.1 Pharmacological pain management

Across the world, various agents are used for prehospital pain relief. The available evidence on the most common agents, with a specific focus on safety and efficacy, are reviewed.

2.5.1.1 Inhaled analgesia

As mentioned, Entonox® (50% N₂O + 50% O₂) is the inhaled analgesic currently included in the scope of practice for all levels of emergency care qualifications in SA. For prehospital use, Entonox® is carried in a lightweight (<3kg) cylinder (blue and white) with a demand valve for self-administration (92) which may be perceived as bulky (93) but can be used for multiple patients. However, the medication is not readily available. Further, the new SA EMS Clinical Practice Guideline (45) includes, in addition to Entonox® the inhaled analgesic agent, Penthoxyflurane (Penthrox) or methoxyflurane, a volatile fluorinated hydrocarbon administered (3ml) via a single-use inhaler (“Green Whistle”) with an activated charcoal chamber to absorb the exhaled gas (94). The Clinical Practice Guidelines are still in the implementation phase and most practitioners need or are currently undergoing training as part of the implementation process.

2.5.1.1.1 Nitrous Oxide (N₂O) and Methoxyflurane

A 2002 literature review (95) evaluating medication options for prehospital analgesia, reported limited studies and a scarcity of high-quality evidence. N₂O was described as the earliest method of prehospital analgesia introduced in the 1970s-1980s and found it to be safe and effective for the setting. Similarly, O’Sullivan and Bengner (96), reviewing emergency medicine (EM) literature in 2003, found clinical evidence to suggest N₂O in various concentrations is effective for pain relief during fracture and dislocation reduction, abdominal pain and musculoskeletal injuries in adults as well as providing moderate to good pain relief in paediatrics. Further, N₂O was found to have similar effectiveness to IM morphine (10-15 mg). It was suggested to be safe for prehospital use and advantageous during labour with limited effects on the baby. Similarly, the systematic review (14 studies) by Sheyklo et al. 2017 (97), which evaluated Entonox® for pain management in

labour, found the medication to be effective during vaginal delivery with mothers expressing a high level of satisfaction. The RCT by Ducassé et al. 2013 (98) found that compared to placebo, N₂O (50%) was clinically effective in relieving moderate prehospital traumatic pain with no severe complications and a low rate of adverse events. The 2005 systematic review including 12 RCTs by Faddy and Garlick (99) found that none of the side effects (nausea, vomiting, dizziness, headache & drowsiness) in the pool risk difference analysis were associated with the administration of N₂O (50%) while some studies suggested a shorter recovery time for patients receiving N₂O compared to conventional analgesia. N₂O 50% was found to be safe and effective for use by trained laypersons.

The systematic review by Porter et al. 2017 (100) synthesised the results of two placebo control RCTs (98,101) using indirect network analysis to compare efficacy, safety and tolerability of methoxyflurane and N₂O (50%) in trauma patients in the emergency setting. Compared to placebo both agents reduced pain, however, the indirect analysis found no significant differences between the two agents for pain relief at 5, 10 or 15 minutes after administration. Coffey et al. 2104 (101), however, reported that methoxyflurane versus placebo showed mild and transient adverse effects.

Studies (101–103) of various levels of quality (RCT, observational and literature review) conclude that methoxyflurane is effective in reducing pain and is an easily administered inhaled analgesia with minimal adverse effects (dizziness, nausea, euphoria, headaches, hallucinations and paraesthesia of the lips) in prehospital patients (trauma and medical). Methoxyflurane is of particular benefit in patients able to self-administer and requiring ongoing pain relief with no IV access or to allow for pain management as a bridge to other medication (94,102). Studies have also found methoxyflurane safe and effective in paediatric patients (94,104–106). Most studies included in the systematic review by Hartshorn and Middleton 2018 (104) indicated a clinically significant reduction in pain at first assessment after administration. In addition, methoxyflurane appears to cause limited serious adverse effects and both caregivers and HCP express satisfaction with it as an analgesic. Babl et al. 2006 (105) found that drowsiness was the most common reported minor adverse effect followed by hallucinations/disinhibition, vomiting, confusion, dizziness, cough and headache.

The METEORA trial (107) is an ongoing RCT investigating methoxyflurane's safety, efficacy and practicality of use in trauma patients with moderate-to-severe pain during rescue by a helicopter EMS in Italy. The outcomes of the trial will further strengthen the body of knowledge on the safety and efficacy of methoxyflurane in the prehospital setting by adding high-quality evidence.

2.5.1.1.2 *Inhaled analgesics in comparison to other analgesics*

Three studies (108–110) compared IV morphine, IN fentanyl and methoxyflurane administered to adult or paediatric patients with acute pain in the prehospital setting in Australia. Middleton et al. (108) deemed all three agents to be effective in adult patients, although IV morphine appeared to be more effective than IN fentanyl, while IN fentanyl, carried the benefit of not requiring IV access for administration. IV morphine and IN fentanyl were both superior to methoxyflurane. Bendall et al. 2011 (109) found that in comparison to IV morphine (87.5%) and inhaled methoxyflurane (78.9%), IN fentanyl achieved the highest percentage (89.5%) of effective pain reduction in paediatrics (5-15 years), however, there was no significant difference in pain reduction between the agents. The transportation time was shorter for patients who received methoxyflurane compared to other analgesic agents while the scene time for patients who received morphine, or a combination of analgesic agents was longer than for patients who received IN fentanyl or methoxyflurane. Methoxyflurane was effective in 80% of paediatric patients. These findings are supported by the retrospective review comparing methoxyflurane to IN fentanyl for relieving visceral pain in the prehospital setting in Australia (111). Both agents were effective to reduce pain at 5 minutes. However, patients with cardiac pain, females, patients ≥ 75 age and those with IN fentanyl administered had a greater pain reduction upon arrival at hospital. Further, inhaled methoxyflurane was found to be superior to IM tramadol in patients with musculoskeletal trauma presenting to a Singaporean EMS system. More adverse effects were associated with methoxyflurane, although patients and paramedics were more satisfied with it compared to IM tramadol (112).

The MEDITA (113,114) trial was an RCT conducted in Italy investigating the safety and efficacy of methoxyflurane compared to standard analgesia [severe pain received IV morphine, moderate pain IV paracetamol or IV ketoprofen], in alert adult patients with moderate-to-severe acute traumatic pain in the emergency (prehospital and EC) setting. The study concluded that methoxyflurane is an easy, quick, and effective non-narcotic analgesic to relieve moderate-and-severe pain. Most clinicians (90%) rated methoxyflurane as excellent, very good or good compared to the standard analgesia group (64%). In the methoxyflurane group, 17% of patients experience non-serious adverse effects compared to 3% in the standard analgesia group. Voza et al. 2020 (115) conducted a subgroup analysis of the MEDITA trial data, between low-dose methoxyflurane and IV morphine for severe trauma patients. The reduction in pain with methoxyflurane was superior to IV morphine over the first 10 minutes. Non-serious adverse effects were found in 20.4% of methoxyflurane and 4.8% of morphine patients.

Current evidence deems N₂O (50%) and methoxyflurane to be safe and effective inhaled analgesic agents for pain management in adult and paediatric patients in the emergency setting. The portability and ease of administration of methoxyflurane makes it ideal for the prehospital setting, for use during major incidents or hard-to-reach locations, however, cost is a concern. The added benefit of N₂O (50%) is that it allows for multiple uses. Adverse effects are generally minor in nature, however, studies comparing methoxyflurane to opioids suggest that the rate of adverse effects, although non-serious, appear to be higher with methoxyflurane. Further, other analgesic agents like IV morphine and IN fentanyl may be more effective in the reduction of pain compared to methoxyflurane, however, it must be noted that methoxyflurane may be a more appropriate medication in terms of safety profile and ease of administration for non-ALS practitioners. Initial studies related to inhaled analgesics used in the prehospital setting appear to be mostly of lower quality while more recent studies are of higher quality, however, high-quality studies evaluating the effectiveness and safety of nitrous oxide still seem to be limited.

2.5.1.2 Opioids

Gausche-Hill et al. 2014 (89) recommend the use of opioids, IV/IN fentanyl (1 µg/kg) or IV morphine (0.1 mg/kg) for prehospital trauma patients with moderate-to-severe pain using redosing with half dosage if pain persists. Hypoxia, allergies to morphine or fentanyl, hypotension, hypoventilation, decreased LOC (GCS<15) and issues preventing medication administration are described as relative contraindications to analgesia administration. Areas in need of additional research to improve prehospital trauma pain care included, among others, prehospital use of oral opioids and other analgesic agents in prehospital traumatic pain as well as the management of pain in the cognitively impaired.

2.5.1.2.1 Morphine and Fentanyl

Various opioids are used as prehospital analgesics, however, in more recent times, morphine and fentanyl, are preferred. A double-blinded RCT by Bounes et al. 2008 (116) examined two doses of IV morphine; 0.05 mg/kg followed by 0.025 mg/kg every 5 minutes (group A) or 0.1 mg/kg followed by 0.05 mg/kg every 5 minutes (group B), for severe prehospital pain. Ten minutes after the administration of morphine, 17% of group A and 40% of group B patients reported an NRS score of ≤3 (OR 3.4, 95% confidence interval (CI) 1.3-8.8, $p<0.1$) although at 30 minutes the difference in pain reduction between groups was not significant ($p=0.25$). Pain relief was reported as excellent by 85% of patients in group A and 97% in group B. Group A reported less adverse effects (12% vs 19%) with the most common adverse effect being nausea and vomiting.

Several studies, predominantly observational, examined the efficacy and safety of IN and IV fentanyl for paediatrics and adults in the prehospital setting (117–122). Friesgaard et al. 2016 (121) reviewed PCRs of adults who received IV fentanyl (total of 2 µg/kg, not exceeding 1 µg/kg at 5 minute intervals) and found a significant overall pain reduction ($p=0.001$). Nausea/vomiting (3.7%), decreased GCS (1.3%), hypoxia [oxygen saturation (SpO_2) <90%] (0.9%) and hypotension (<70mmHg) (3%) were observed. Fentanyl was deemed effective in reducing pain in most patients, and due to the availability of continuous patient monitoring after fentanyl administration, there was no serious safety concern. Kanowitz et al. 2006 (119) reviewed PCRs of adult and paediatric patients who received IV fentanyl (1-2 µg/kg, repeat doses of 1 µg/kg as needed). A significant ($p<0.000$) difference was found between the mean pain score before and after fentanyl administration. Although all vital signs remained within normal ranges, a significant decrease was found in HR, systolic blood pressure (SBP), diastolic blood pressure (DBP) and RR after fentanyl administration. Karlsen et al. 2014 (120) inspected the safety and effectiveness of IN fentanyl (50 or 100 µg repeated once or twice after 10 and 25 minutes) in patients >8 years. Four percent experienced adverse effects including hypotension, nausea and vomiting, decreased LOC, vertigo, rash and worsening abdominal pain, nevertheless, none were serious. Of all patients, 79% had a pain reduction of NRS ≥ 2 with a median pain reduction of 3. Both studies deemed prehospital fentanyl (IN & IV) safe and effective.

Samuel et al. 2015 (117) concluded that although their systematic review identified a small number of studies with variable methodological quality, fentanyl at a dose of 1 to 3µg/kg showed acceptable analgesic efficacy in prehospital paediatric trauma patients. Murphy et al. 2017 (118) examined (cross-sectional study) the safety and efficiency of IN fentanyl in children (1-16 years) with severe acute pain due to trauma in the prehospital setting. No adverse effects were observed with IN fentanyl (1.5 µg/kg) was deemed safe and effective as prehospital analgesia in children. Krauss et al. 2011 (122) on the other hand, focused on whether an association exists between fentanyl administration (as analgesia) and the occurrence of hypotension (<90 mmHg) and hypoxemia ($SpO_2<90\%$) in patients ≥ 5 years. The risk for hypotension and hypoxia after fentanyl administration was deemed low. The foremost factor associated with hypotension after fentanyl administration was a borderline low SBP before. No significant difference was noted between mean SpO_2 before and after fentanyl.

2.5.1.2.2 Comparing the effectiveness and safety of fentanyl and morphine

Several studies compared the effectiveness and safety of fentanyl and morphine for prehospital analgesia (123–126). All these studies deemed fentanyl (IN or IV) and morphine to be equally

effective in adult patients with a low occurrence of adverse effects and no difference in the occurrence of adverse effects between the two agents (123–126). Further, one study reported that 76% of patients in the fentanyl and 62% in the morphine group, described analgesia as excellent or good (123). Adverse effects experienced included nausea, vomiting, dysphoria, pruritis and dizziness. In addition, one study reported serious adverse effects (altered mental status, hypotension and respiratory depression) more commonly occurred in the fentanyl than the morphine group, however, the difference was not significant (124).

The Cochrane systematic review by Murphy et al. 2012 (127) evaluated the safety and efficacy of IN fentanyl compared to alternative (other agents, placebo or non-pharmacological interventions) analgesic interventions for acute pain in children (<18 years) in the prehospital setting. No difference was found between pain relief of IN fentanyl and high concentration fentanyl or IV morphine, nevertheless, one study indicated, a greater reduction in pain (10 minutes) after IN fentanyl compared to IM morphine. IN fentanyl was also better tolerated by patients than IM morphine. None of the studies showed adverse effects due to IN fentanyl. The systematic review endorses further high-quality research.

2.5.1.3 Ketamine

The double-blinded RCT by Andolfatto et al. 2019 (128) compared IN ketamine (≤ 50 kg received 30 mg, 50-100 kg received 50 mg & >100 kg received 75 mg) to IN placebo for a clinically significant reduction (VNRS ≥ 2) of moderate-to-severe pain in adult prehospital patients. Patients with nontraumatic chest pain, altered mental status, pregnant, with nasal occlusion and SBP <90 mmHg were excluded. IN ketamine in addition to N₂O (50%) resulted in a significantly greater proportion of patients experiencing a clinically relevant pain reduction. Ketamine was associated with minor adverse effects while both providers and patients were satisfied with the pain relief. IN ketamine by paramedics was deemed both safe and effective.

All studies included in the systematic review by Jennings et al. 2011 (129) reported ketamine used in combination with another agent (most commonly morphine) in the prehospital setting. Due to the small number of included studies, the results were not pooled but communicated descriptively. One study reported a significant reduction in pain on ED arrival in patients who received morphine followed by ketamine compared to morphine alone while a second study reported no significant difference in pain reduction (<30 mm VAS) at 30 minutes between patients receiving morphine and ketamine compared to only morphine. The rate of nausea and vomiting appears to be similar between patients receiving morphine and ketamine versus only morphine, however, some studies indicated the patients receiving ketamine were more prone to

hallucinate, diplopia, dizziness, and dysphoria - albeit weak and short-lived. Additionally, one study reported on hospital admission an increased mean SBP in the group receiving ketamine. The open-labelled RCT by Jennings et al. 2012 (130) evaluated morphine and ketamine versus only morphine for the reduction of moderate-to-severe (NRS >5) traumatic pain in alert adults (≥ 18 years) prehospitally. The morphine group initially received 5mg followed by 1-5mg every 5 minutes while the ketamine group, received morphine (5mg) followed by ketamine 10-20 mg and 10 mg aliquots every 3 minutes. Morphine and ketamine were more efficacious than morphine alone to reduce pain in adult trauma victims in this study. In addition, the rate of pain reduction was more rapid in the ketamine group. Adverse effects were uncommon, nevertheless more research was recommended.

Bronsky et al. 2018 (131) evaluated IV fentanyl (2 $\mu\text{g}/\text{kg}$ over 1-2 minutes followed by a further dose every 10 minutes if needed) versus IV ketamine (0.3 mg/kg every 20 minutes if needed with a maximum of 3 doses) in adult prehospital patients (≥ 18 years) with severe pain. A higher pain reduction was found in the ketamine group compared to the IV fentanyl group ($p < 0.001$). Four patients experience adverse effects, all from the fentanyl group. The clustered RCT conducted among rural prehospital trauma victims (older than 30 months) in Vietnam by Tran et al. 2014 (132) found that morphine and ketamine had similar analgesic effects. Vomiting was lower in the ketamine group (5% vs 19%), while agitation and hallucinations were higher in the ketamine group (11% vs 1.5%). Neither ketamine nor morphine had a significant effect on the respiratory rate, while the mean BP was higher in the ketamine group but not significantly. Though limited studies which compare opioids (morphine and fentanyl) to ketamine (only) for prehospital analgesia could be identified, some RCTs conducted in the EC setting suggest found that ketamine may be more effective compared to morphine (133–135) whereas other studies found neither morphine nor ketamine to be superior (136).

2.5.1.4 Paracetamol

Although limited studies examining the effectiveness and safety of IV paracetamol in the prehospital setting could be identified, some RCTs conducted in the EC found IV paracetamol to be better than (137) or equal to (138) the pain relief provided by IV morphine for limb trauma. The literature review by Grimson 2016 (139) reported that if administered alone IV paracetamol had less adverse effects compared to morphine and was as efficacious as morphine in reducing pain. The author recommended that if the practitioners can choose, IV paracetamol should be preferred over morphine. Luiz et al. (140) (article in German, only abstract in English) analysed, for quality management purposes, all administrations ($n=416$) of IV paracetamol (1g) to patients

with an NRS >5 due to isolated limb trauma by paramedics after they had participated in a 2-hour educational programme. The median NRS score decreased from 8 (interquartile range (IQR 6-8) to 4 (IQR 3-7) after administration with 50.5% of patients reporting an NRS score of >5 after treatment. The study found IV paracetamol to be both safe and effective for patients with limb trauma in the prehospital setting. Additionally, the RCT by Barnaby et al. (141) found IV paracetamol and IV hydromorphone to both provide clinically significant pain reduction in adult patients in the EC, still, IV hydromorphone was superior in terms of pain relief but had a higher frequency of nausea and vomiting.

2.5.1.5 Comparing analgesic agents

The systematic review of prehospital and EC studies, by Häske et al. 2017 (142) compared the effects of several analgesic agents, alone and in combination, in severely injured but spontaneously breathing trauma cases. Ketamine, morphine, and fentanyl were all found to be safe and effective IV analgesic agents while ketamine and fentanyl were also found to be safe and effective via the IN route. Most studies comparing fentanyl (IV/IN) and morphine (IV) found no clear advantage of one agent over the other, yet the analgesic effect of fentanyl is generally achieved faster than morphine. Ketamine alone or ketamine in combination was found to be more effective as well as faster in onset of action compared to morphine alone. The onset of ketamine's analgesic effect was faster than or equivalent to fentanyl. The expected duration of effect for morphine is four hours, 20-40 minutes for fentanyl and 10-15 minutes for ketamine. The main adverse effects for ketamine, morphine and fentanyl were nausea and vomiting, while hypotension was observed in a small proportion of patients who received fentanyl and morphine. All three agents were also associated with decreased SpO₂ while agitation may arise after ketamine administration. Studies comparing N₂O (50%) with ketamine and fentanyl found the effects to be comparable. One RCT found the effect of morphine and paracetamol to be equivalent, however, the onset of action of paracetamol was slower, while a prehospital observational study found paracetamol mostly ineffective in reducing severe pain.

Another systematic review evaluated opioid analgesics versus non-opioid analgesics for moderate-to-severe acute pain in the prehospital setting (143). Since prehospital evidence was either absent or deficient, conclusions related to initial analgesia were based on indirect EC evidence, signifying a need for prehospital research. Opioids, as initial analgesia, were found to be no different to ketamine, paracetamol and NSAIDs (all primarily administered by IV), in reducing acute pain. It is further suggested that if pain relief is inadequate after morphine, administering ketamine instead of an additional morphine dose may provide faster and better

pain relief, however, the potential harm is unclear. Opioids may cause less adverse effects than ketamine but more in comparison to paracetamol and NSAIDs.

2.5.1.6 Prehospital pain guidelines

The 2019 systematic review by Yousefifard et al. (144) gathered and encapsulated 12 prehospital management guidelines for adult and paediatric patients with mild, moderate and severe pain. For mild pain in adults, guidelines recommended oral paracetamol (1g or 15 mg/kg), IV/IO/IM ketorolac and propose the administration of N₂O (50%) as an alternative. Mainly morphine and fentanyl (1-2 ug/kg) were endorsed for moderate pain while some guidelines suggested paracetamol (oral or IV), ketamine as the second line after morphine, and in hypovolemic patients' ketamine (0.25 mg/kg) with midazolam (1 mg). Additional medications endorsed for moderate pain by some guidelines were ketorolac and NSAIDs (not for trauma). Likewise, morphine and fentanyl were endorsed for severe pain while other guidelines suggest fentanyl with paracetamol, and for hypovolemic patients and those with an insecure airway, ketamine with midazolam (1 mg) and paracetamol IV (1g). Alternative options were IV paracetamol, N₂O, methoxyflurane, ketorolac, NSAIDs, diamorphine, codeine, and tramadol.

For paediatric mild pain, oral paracetamol (10-20 mg/kg) or ibuprofen (4-10 mg/kg) were recommended and for moderate pain, fentanyl (IV/IO/IN) as well as IV morphine, IN ketamine (0.5 mg/kg) and paracetamol (15 mg/kg). Other guidelines endorsed ketorolac, N₂O, methoxyflurane and oral ibuprofen. The first line medication recommended for severe pain in paediatrics was fentanyl (1-2 ug/kg IV/IO/IN) and morphine (0.05-0.1 mg/kg). Ketamine (IV/IO/IN) is endorsed by various guidelines while alternative options include paracetamol, ketorolac, methoxyflurane, N₂O and hydromorphone.

Various analgesic agents have been considered and studied for prehospital use, nevertheless, EMS systems need to evaluate each agent in light of efficacy, adverse effect profile, route of administration, mechanism of action, storage, local needs, practitioners' level of qualification and competencies to determine which is most appropriate (41,90). Of these more pertinent factors to consider are the selection and range of medication available to different levels of EMS qualifications to enable quality prehospital pain management, routes of administration to ease management in difficult situations and consideration of logistical and cost issues and medication availability. Morphine, fentanyl, ketamine, and paracetamol, all appear to be safe and effective for prehospital pain management while ketamine and fentanyl carry the additional benefits of IN administration and shorter onset of action.

2.5.2 *Non-pharmacological pain management*

McManus and Sallee (14) labelled three broad groups of prehospital non-pharmacological pain management, namely cognitive or psychological, physical and behavioural methods. Although, the effectiveness of these methods has not been scientifically proven they have shown benefit in clinical practice. Physical methods like positioning, dressing, splinting and immobilization are commonly used in this setting while cognitive methods like distraction can also be effective if the patient is cooperative (14,145). Touch may also be helpful to communicate empathy while massage may help with muscle relaxation and increasing blood circulation (145,146).

The literature review by Pak et al. 2015 (147) stated that although the evidence to support alternative therapies like acupuncture and/or acupressure, transcutaneous electrical nerve stimulation or active warming is limited and further research is required, the existing literature suggests these therapies can play an important role and ultimately may result in more sparing use of pharmacological agents, decreasing adverse effects and cost.

Three double-blinded, sham-controlled RCTs tested acupressure to reduce pain in the prehospital setting. Kober et al. 2002 (148) tested whether acupressure in minor trauma will reduce pain and anxiety and increase patient satisfaction; Barker et al. 2006 (149) tested auricular acupressure to decrease anxiety and pain in elderly (80-95 years) patients with hip fractures; while Lang et al. 2007 (150) tested two-point acupressure for relieving pain and anxiety in adult patients with distal radial fractures. Acupressure was found to be an easy-to-learn skill which may be an effective method of pain relief as it reduced pain, anxiety and improved satisfaction (148–150). Although evidence suggests these pain relief methods are effective, the practical application in the dynamic, fluent, and labour-intensive African prehospital setting is questionable.

The proposed scoping review by Mato et al. 2019 (151) aiming to map the non-pharmacological pain interventions for the reduction of acute pain in adult trauma patients in the emergency setting (prehospital, EC and trauma centre) will prove valuable to encapsulate current evidence on the topic.

2.6 Barriers and enablers of prehospital acute pain management

Several studies, predominantly qualitative, investigated barriers and enablers of prehospital pain management, all of which were conducted in high-resource settings. Additionally, a number of these studies focus specifically on the paediatric patient population. Barriers to prehospital pain management can be broadly abridged into four categories namely: practitioner-related; patient-related; system/organisation-related; and protocol/guideline-related barriers. In addition to

barriers related to practitioners' attitudes, perceptions, behaviours, personal biases and culture, fixation on the diagnosis and treatment of the primary injuries, the barrier most highlighted is knowledge deficit. The suggestion is that knowledge deficit may be attributed to limited attention to pain assessment and management during initial training and the lack of ongoing education (36,41,48,152–158). Protocol/guideline-related issues include the lack of validated pain assessment tools, lack of alternative routes of drug administration, guideline restrictions or inadequacies, practitioners requiring permission to administer analgesic agents and medical control being reluctant to give permission (24,39,48,152,153,155). System/organisation-related hindrances include negative feedback from EC staff or paramedic supervisors, organisational culture, lack of availability of higher qualified practitioners, lack of monitoring adherence to protocols and lack of communication (24,39,41,152–155,158,159).

Several barriers related to paediatric pain management, namely, challenges with pain assessment and establishing IV access, the view that pain is unimportant, concerns with medication adverse effects, fear of masking clinical signs, lack of education related to paediatric analgesia, lack of exposure to paediatrics in the clinical setting during undergraduate studies, inexperience, parental influence, uncooperative children, transport distance (short transport times) and criticism from EC staff or unwanted attention from authority figures has been acknowledged (48,153,157–160). Some of these barriers are also applicable to adults. In addition, patient perceptions and expectations, language/communication barriers, culture and the expression of pain, as well as difficulties understanding pain assessment tools and patients refusing analgesia are further patient barriers identified (24,39,161,41,48,152,154–158).

Further, Walsh et al. 2012 (154) reported that paramedics were more willing to treat based on physiological changes and the patient's appearance than self-reported pain severity. Participants expressed concerns that patients overstate pain or seek drugs. Instead of alleviating pain paramedics focused on 'taking off the edge'. It was further, articulated that resolving anxiety and normalising vital signs were the desired endpoints of pain management. Moreover, Iqbal et al. 2013 (24) found that a professional approach may reassure patients while promoting analgesia and assist with facilitating treatment and transportation. In addition to pain scales, paramedics took a wide range of variables into account in their decision making, however, overall, they believed patients overrate pain. Medication selection was based on the cause of pain instead of the severity of pain, with barriers to pain management including patient refusals, concerns for complications, false beliefs, and previous clinical experience. Limited medication options

frustrated some practitioners whereas situations like hypotension, paediatrics and potential drug abuse were deemed difficult to manage.

Enablers identified to improve pain management included the certainty that managing pain was important, medical control being supportive of pain management, offline medical control, the availability of guidance in cases with severe pain, and leadership support within EMS organizations (155,158). Further, the Brownslow tape was useful in determining the paediatric dose of morphine and fentanyl (158).

2.7 Disparities in prehospital acute assessment and pain management

Various disparities or inequalities in prehospital pain assessment and management have been identified and discussed by studies predominantly conducted in the USA.

2.7.1 Age

Several studies suggest that adults are more likely than children to have pain assessed and managed. Hewes et al. 2018 (162) found that paediatrics between 11-14 years had the highest proportion (32.9%) and infants and toddlers (0-3 years) the lowest proportion (14.6%) of pain documented (USA). Less than 16% of patients received pain medication with infants and toddlers being least likely to receive. Hennes et al. 2005 (48) reported that in comparison to children and adolescents, adults with extremity injuries were 4.3 times more likely, while adults with burns were 1.5 times more likely to received prehospital analgesia. Ramgopal et al. 2008 (163) showed that paediatric trauma patients were less likely compared than adults to have a pain score recorded (*OR* 0.80). The Australian study by Bendall et al. 2012 (110) reported that opioids were less commonly administered to children compared to adults while children more commonly received fentanyl compared to morphine as paramedics preferred IN opioids over IV in children.

The retrospective review of adults (≥ 18 years) who sustained injuries after a fall by Infinger and Studnek (50) found an increase in age was associated with a decreased odds of receiving pain medication ($p=0.03$), and younger patients were more likely to receive analgesia. Platts-Mill et al. 2013 (164) analysed data from all adults (≥ 18 years) transported by ambulance in North Carolina state and found that those between 18 and 64 years were more like to report severe pain compared to patients ≥ 65 years. Older (≥ 65 years) men were less likely to receive any analgesia while older (≥ 65 years) women with mild to moderate pain were less likely to receive any analgesia. Older women with severe pain were more likely to receive analgesia. Siriwardena et al. 2019 (165) found no association between patient age and the administration of analgesia in all adults (≥ 18 years) transported to hospital by two British ambulance services. The Platts-Mill

paper illustrates that not only does age influence the likelihood of pain being assessed and treated, but gender is also an influence (164).

2.7.2 *Patient gender and clinician gender or level of qualification*

Several USA (164,166) and Australian (110,167,168) studies found that females were less likely than males to receive IV opioids. One study suggested that regardless of age or pain severity, women were less likely to receive opioids (*OR* 0.71) or any analgesia (*OR* 0.75) (164). Three studies also reported that paramedic gender and qualification did not influence analgesia administration (165,167,169). On the other hand, the observational study by Kiavialaitis et al. 2019 (170) conducted in Switzerland found that female paramedics (*OR* 1.2, $p < 0.001$) provided better analgesia compared to their male counterparts. Further, the judgement of Swiss physicians in relation to prehospital pain management may be influenced by personal factors like empathy or external factors like being unsure about the diagnosis (27). Lower fentanyl doses were administered by female compared to male physicians and the patients of female physicians experienced less pain reduction ($p < 0.001$). The odds of oligoanalgesia was increased if the patient were treated by a female physician, less experienced physicians (irrespective of gender), were male, had unrelieved pain (no analgesia) and more severe injuries. Castrèn et al. 2015 (171) showed male compared to female paramedics had more stoic viewpoints ($p < 0.05$) toward the need for analgesia whereas younger participants expressed a more positive attitude towards pain assessment.

2.7.3 *Ethnic/racial disparity*

Several studies suggest racial and ethnic disparities in prehospital pain assessment and management (50,162,172–174). Kennel et al. 2019 (172) evaluated the equity of traumatic pain management practices among adults (>17 years) managed by the Oregon EMS. Both Hispanic (21%) and Asian (31%) patients were less likely than White patients to have a pain assessment recorded, while Black (32%), Hispanic (21%), Asian (24%) and other races/ethnicities (41%) were less likely than White patients to receive analgesia. Lord et al. 2019 (173) showed that Caucasian patients had higher odds of receiving analgesia than non-Caucasian patients when treated by paramedic students in the USA. After adjusting for gender, age category and injury cause, African-Americans had the lowest odds of receiving any analgesia. Hewes et al. (162) found that Hawaiian/Pacific Islanders were most likely, and American Indian/Native Alaskans least likely to have pain documented while Hispanics were more likely to have pain documented versus non-Hispanic ethnicities. Black patients were less likely to receive analgesia than other racial groups. However, poor documentation of ethnicity and the lack of recording pain scores limited the study.

Young et al. 2013 (174) (USA) found that Caucasian trauma patients were more likely than patients of other ethnicities to receive morphine. Likewise, Infinger and Studnek 2014 (50) (USA) reported that compared to whites with an injury secondary to a fall, the odds for black patients to receive analgesia was lower ($p < 0.001$). Racial disparities in EMS are unlikely to be limited to pain care, therefore, future work is needed to fully understand the influence of racial inequalities on prehospital care (172).

2.7.4 Other

Two USA studies determined that trauma patients who spend longer in prehospital care and patients with higher pain scores were more likely to receive morphine (166,174) whereas Siriwardena et al. 2019 (165) found that IV morphine was more likely to be administered if the ambulance crew had at least a paramedic ($OR\ 2.82, p < 0.001$), or patients had moderate-to-severe pain. Likewise, Friesgaard et al. 2018 (28) found that patients with severe-or-moderate pain were more likely to receive IV fentanyl compared to those with no/mild pain or no pain information. Murphy et al. 2016 (25) showed that paediatrics with severe pain were more likely to receive analgesia compared to those with mild or moderate pain. The study also reported that pain assessment was less likely in younger patients, on calls between 00:00 and 06:00 and with short transportation to EC. In Friesgaard et al. 2017 (175) factors like older age, short time in EMS care, low urgency, treatment by a general practitioner before transportation, the year the fracture occurred (2011), male, institutional housing and medial fracture were risks for no-analgesia in the prehospital setting. Further, an association was found between having at least one comorbidity and not receiving IV fentanyl. Infinger and Studnek (50) reported that patients with a pain score recorded were 4.4 ($p < 0.001$) times more likely to receive analgesia.

The studies showing patient and practitioner gender, age, time spent in EMS care, pain severity and race/ethnicity inequalities in prehospital pain care were all conducted in high-resource settings. No studies examining these disparities in the African prehospital setting could be identified, thus indicating a knowledge gap. Prehospital care inequalities are unlikely to be restricted to pain therefore further investigation is needed to describe and mitigate for these.

2.8 Impact of pain education and quality improvement programmes

Hennes and Kim 2006 (41) identified three studies describing the positive influence protocol changes and education may have on prehospital pain management. The literature shows an improvement in pain assessment and the frequency of analgesia administration immediately after educational initiatives. Further, the implementation of pain protocols and removing the

need to obtain medical control authorisation likewise improved the provision of analgesia in the prehospital setting. These sentiments are also expressed in the literature review by McManus and Sallee (14). The review recommends multi-disciplinary pain protocol development and CQI programmes which include education and training, the establishment of pain management endpoints, chart reviews and the measurement of pain management outcomes. Scott et al. (176) implemented a CQI programme to improve prehospital trauma care in Rwanda. They found an improvement in the percentage of extremity fractures splinted ($p=0.019$) as well as in the administration of pain control ($p<0.001$) after the implementation of the CQI programme. The study concluded that the CQI programme led to an immediate improvement as well as an improvement over time of, amongst others, prehospital pain care.

The quality improvement study by French et al. 2006 (177) found that after a 3-hour pain management educational initiative the knowledge of the rudimentary principles of pain management among paramedics improved from 57.5% to 74.9%. However, no significant improvement in the administration of pain medication was observed, but the utilisation of non-pharmacological pain management methods improved by 32%. The documentation of pain assessment and re-assessment also improved. The follow-up study published in 2013 (178) noted an improvement in basic knowledge of pain management principles before the initiative between 2007 and 2001 while limited improvement was observed after the initiative in 2007. Significantly more participants believed paramedics have a restricted role in pain management in 2001 (57%) versus 2007 (5%). In addition, less cultural biases were noticed in 2007. The study concluded that paramedics will benefit from initial and continuous pain management education (178).

A two-part pain assessment and management for prehospital paediatric emergencies educational intervention by Hennes et al. 2007 (179) showed improvement in prehospital practitioners knowledge ($p<0.001$) of paediatric pain management with the proportion of paediatrics with a pain score documented and the proportion of paediatrics receiving analgesia increasing after part 1 and part 2 of the educational intervention. Prehospital practitioners' knowledge retention after 9 months was excellent.

Through a 3-round online modified Delphi study, Howard et al. (180) identified among other quality indicators for South African prehospital emergency care, three process quality indicators for pain management, namely *"Patients with the level of pain measured via defined pain score"*, *"Patients with a defined pain score threshold who were administered analgesia"* and *"Patients with the level of pain measured via defined pain score following analgesia administration."* These quality indicators provide an opportunity to identify areas for pain care improvement in SA.

Ricard-Hibon et al. 199 (181) evaluated the effects of a quality control program on acute pain management in prehospital critical care medicine in a French EMS (BLS and physician-based ALS) system. Pain management was assessed before and after a 2-week training program and implementation of a pain protocol encouraging the use of opioids (like IV morphine) and the use of combination analgesics (morphine plus N₂O or morphine plus propacetamol). The study found improved acute pain management, use of VRS and VAS to assess pain and that morphine was safe and effective for the relief of pain in the prehospital setting.

Castrèn et al. 2015 (171) reported that among Swedish and Finnish prehospital practitioners, participants who received regular pain education were less hesitant about the administration of pain medication. Decosterd et al. (182) in 2007 conducted a cohort study before and after the implementation of educational interventions and pain management guidelines for adults in a Swedish EC and found an increase in pain assessment documentation, analgesia administration, pain reassessment and pain reduction which was linked to patient satisfaction. All these studies demonstrate that educational interventions and guidelines have the potential to improve prehospital pain management.

2.9 Knowledge and attitudes regarding pain

No evidence quantifying prehospital practitioners' knowledge and attitudes regarding pain could be identified in the literature. Only knowledge and attitudes of pain surveys conducted among nurses and other HCPs, in Africa and around the world could be found. Most of these studies utilised the Knowledge and Attitudes Survey Regarding Pain (KASRP) or Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain (PNKAS) questionnaires to measure knowledge and attitudes regarding pain. Nevertheless, other surveys, for example, the nurse's attitude survey, pain management principles assessment test (knowledge), paediatric pain knowledge and attitude questionnaire, etc. were also reported on.

2.9.1 Knowledge and attitudes regarding pain scores

In global literature regarding knowledge and attitudes of pain, the scores for studies conducted in the Middle East (41.7-48.5%) (183–187), Mexico (40.1-43.6%) (188,189), Italy (50.2%) (190), Taiwan (45.4%) (191), Hong Kong (47.7%) (192), Turkey (38.2%) (193) and Mongolia (36.4%) (194) were all suboptimal. In contrast literature from HRS like the USA (72-76%) (195–197), Canada (79%) (198), Australia (72.5%) (199) and Norway (72%) (200) reported significantly higher scores for KAP among HCPs. In addition, the literature review by Ung et al. (201) concluded that pain management knowledge among nursing and medical students were consistently poor. African

studies conducted in various clinical settings found the scores in Ethiopia to range between 41.4% and 67.4% (65–68) with Wurjine et al. (67) reporting unfavourable attitudes in 52.1% of respondents. A Ugandan study reported an average score of 71% (69) and a Zimbabwean study 64.5% pain knowledge while 56% of respondents presented positive attitudes towards pain (70). Evidence has shown a direct link between pain knowledge and attitudes and pain management practices. A Jordanian study found nurses' pain management practices to be influenced by both pain knowledge and attitudes. Sixty-nine percent of variance in pain management practices was explained by knowledge and attitudes, while attitudes ($b=0.578$, $p<0.001$) provided a higher positive contribution for predicting pain management practice than knowledge ($b=0.328$, $p<0.001$). This suggests that nurses with higher knowledge and favourable attitudes will provide more effective pain management (202). Further, a weak positive correlation between pain knowledge and attitudes ($r=0.33$, $p=0.038$) (196) has been reported, while another study found a strong positive correlation between patient satisfaction and good pain knowledge and favourable attitudes towards pain. These results suggest that nurses with high pain knowledge and positive attitudes may encourage patient satisfaction (195).

2.9.2 Factors influencing knowledge and attitudes regarding pain

Most literature (65,69,184,193,195) found no difference between male and female HCPs knowledge and attitudes scores. Likewise, some studies found age to influence pain knowledge and attitude scores (70,193,198) whereas others, found no difference between age (65,197,200) and no correlation between age and the score (184,186,187). For the studies which identified age as a factor, Manwere et al. (70) found respondents ≥ 40 years achieved higher scores compared to those younger while both, Ekim et al. (193) (20-25 years) and Lewthwaite et al. (198) (20-45 years versus ≥ 50 years) found younger respondents achieved higher scores. Additionally, Wurjine et al. (67) found the age group, 30-40 years to be more knowledgeable about post-operative pain and 20-30 years to have better post-operative pain management practices compared to other age groups.

Two studies found respondents who attended prior pain education achieved higher knowledge and attitude scores (184,195) while a third study, found those who did not attend prior pain education scored higher than those who did (66). Eid et al. (186) found no difference between the two groups. Number of years of experience does not seem to influence scores with respondents with more years' experience achieving higher scores in some studies (192,195), no differences in other studies (67,69), and those with fewer years' experience scoring higher in other studies (193,198,200). Further, Al Qadire et al. (184) found no correlation between total

knowledge and attitude scores and years' experience, whereas Alotaibi et al. (183) reports a weak negative correlation ($r=-0.129$, $p=0.009$) (203) and Samarkandi et al. (187) a weak positive correlation between mean score and years' experience ($r_s=0.162$, $p=0.022$) (203).

Qualification level is a factor commonly found to influence knowledge and attitudes regarding pain, with respondents with higher qualifications achieving higher scores (67,69,183–185,193,198,200). In contrast, two studies did not find a difference (66,197). An Italian study observed a difference between the region of employment and scores achieved, respondents from central Italy obtain statistically significant higher knowledge and attitude scores compared to those from southern and northern Italy ($p<0.001$) (190). A study conducted among nurses working in Saudi Arabia found a significant difference between nurses' nationality and KASRP scores, with Nigerian nurses achieving higher scores compared to other nationalities (Filipino, Indian, Pakistani, Saudi Arabian, etc.) (186).

2.10 Patient perspective of or satisfaction with prehospital acute pain care

Studnek et al. 2013 (204) conducted a secondary analysis of patient satisfaction data collected for quality improvement reasons by the Mecklenburg EMS agency in North Carolina. The overall quality of care was scored excellent by 65.9% of patients and pain management judged excellent by 59.2%. Patients who scored EMS excellent for controlling pain were 14.1 times more likely to score the overall quality of care as excellent. Patients were 2.7 times more likely to score the quality of EMS care as excellent if, EMS were scored excellent for both helping control pain and explaining the medication being administered. General emphasis placed on patient satisfaction and overall rating of the quality of care by the EMS system in question may have resulted in an inflation of findings compared to other EMS systems.

As part of the qualitative study by Iqbal et al. 2013 (24), 17 patients interviewed in two focus groups reported that they expected immediate pain relief before transportation. Conflicting views between patients and practitioners may hinder the provision of adequate pain care and patients may sometimes be confused by pain scores and prefer easy verbal pain scales. Better communication and the discussion of pain management options between patient and practitioners will benefit pain management. McEachin et al. 2004 (205) describe EMS pain management from the patients' perspectives. Telephonic or in-person interviews were performed with patients who were treated by EMS for extremity trauma. Of the 110 patients interviewed 81.8% ($n=90$) reported experiencing moderate-to-severe pain upon evaluation with 23.4% receiving IV analgesia and 49.1% perceiving treatment to be beneficial for pain relief. Of the 84 patients which did not receive pharmacological pain management, 76.2% experienced

moderate-to-severe pain and 63.1% were unaware of EMS pain management abilities. Of the patients who were aware of EMS pain management capabilities, 86.7% ($n=26$) did not request pain management. Of all the patients, 7.1% ($n=6$) perceived that pain was assessed by EMS and 35.5% ($n=39$) perceived their pain to have been managed adequately. The study concluded that a lack of awareness of EMS capabilities on the part of patients, and patients not requesting pain management contribute to poor pain management.

From the literature, it is evident that patients may perceive the overall quality of EMS care as outstanding if their pain is managed well, medication(s) administered, and the possible adverse effects are explained. This suggests communication may be a key component of prehospital pain management. The lack of awareness of EMS capabilities and patients not requesting analgesia contributing to poor prehospital pain care further highlights the necessity for good communication regarding pain and pain management and offering analgesia.

2.11 Chapter conclusion and gaps identified

The current body of evidence suggests that acute pain is prevalent and commonly associated with trauma, poorly recognised, and assessed, and undermanaged in the emergency setting. People living in poorer countries are worst affected by injuries and violence (206) thus it is probably fitting to assume that trauma will be a common aetiology for acute pain in Africa, and reasonable to anticipate that pain is prevalent. As the number of publications regarding pain epidemiology in Africa were limited, additional investigation is needed to build an understanding of the burden and determinants of acute pain in this context. Studies reviewed often excluded vulnerable patients like the cognitively impaired or patients with an altered mental status, the polytraumatised, and children due to difficulty with or an inability to assess pain, leaving it an area with a scarcity of scientific knowledge, particularly in the prehospital setting.

Various acute pain assessment tools have been deemed effective and reliable for measuring pain severity in adults and paediatrics (age-dependent) in the prehospital setting. The most important aspect is that pain assessment must occur as part of general patient care and be regularly reassessed using an age-appropriate, standardised pain scale. The evidence does not suggest a clear and significant benefit of one medication over another (Entonox®, penthroxyflurane, morphine, fentanyl, paracetamol, and ketamine) with these medications all found to be safe and effective for prehospital use.

Barriers and enablers of prehospital pain care seem to be an area with a fair amount of scientific knowledge, however, none of the studies originated from Africa. Since cultural, social, moral,

religious, political and aesthetic (traditional beliefs) values on the African continent differ widely from other cultures and even among different African societies (207), one can deduce that barriers and enablers of prehospital pain care may have some similarity and some differences to those identified in high-resource settings, thus an area for additional investigation. Likewise, studies reviewed reporting inequalities in prehospital pain assessment and management practices originated only from high-resource settings, suggesting a need to investigate the presents of similar disparities in the African prehospital context.

Thus far, research on knowledge and attitudes regarding pain were conducted exclusively among nurses and other HCPs, excluding emergency care providers. Therefore, prehospital pain education is another area in need of additional investigation. The included studies demonstrated the positive influence pain education may have on the knowledge of the principles of pain, provision of non-pharmacological pain relief methods and improvement of the quality of pain care documentation. In general, pain management in low-resource settings is a healthcare problem (lack of education and limited resources) (53–55) and pain education programmes have in recent times brought about significant improvements in clinical practice (208). It must, however, be considered that education alone will not solve the problem. Organisational culture must promote effective pain management practices, provide leadership and support, encourage a culture of continuous learning and promote interdisciplinary teamwork (198). CQI programmes have also proved effective in improving both prehospital pharmacological and non-pharmacological pain management (176). A further area with a scarcity of research, specifically in low-resource settings is the patients' perspective or satisfaction with the quality of prehospital pain care. This, however, may be attributed to the immaturity of prehospital pain research in these settings.

The literature review included publications with a variety of research designs including higher-level evidence like RCTs and systematic reviews as well as lower-level evidence such as qualitative studies, but most notably, descriptive observational studies. Descriptive observational studies (cross-sectional and retrospective review) designs are deemed low-level evidence with various limitations like incomplete or missing data in retrospective reviews (209,210) or participants changing behaviour when observed (Hawthorne effect) during cross-sectional studies and inherent biases like information, recall and selection bias (211,212). These designs are commonly used for studying the distribution, aetiology and determinates of disease (211,213) to develop a basic understanding of the health care problem, as they are quick, easy, inexpensive and less time-consuming (209). Prospective studies may carry some benefit over retrospective studies as

the design allows for more accurate data recording, for example, non-pharmacological pain management and reporting of treatment efficacy.

Finally, considering the paucity of prehospital pain research on the African continent identified during the literature review it was fitting that the first objective of this research project was to conduct a scoping review to identify all available evidence related to acute pain assessment and management in the prehospital setting and to distinguish research gaps in the hope to develop a clear picture of what is known and what is not. The other objectives of this research project were focused on starting to fill the identified gaps in African prehospital literature.

CHAPTER 3: ACUTE PAIN IN THE AFRICAN PREHOSPITAL SETTING: A SCOPING REVIEW

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3.1 Declaration from author and co-authors

3.1.1 Declaration from author

The following co-authors¹ contributed to the publication: Mr Michael McCaul (MM), Associate Professor Romy Parker (RP), and Associate Professor Peter Hodkinson (PH). In the case of Chapter 3, contribution by authors to the work was as follow:

Andrit Lourens (AL) conceived the idea and designed the scoping review with input from MM. AL developed the search string with the assistance of UCT librarian, Namhla Madini and revised by Anel Schonees from the Centre for Evidence-Based Health Care at Stellenbosch University. AL conducted database searches for published, unpublished and on-going research and uploaded results to the web-based software platform, Covidence (214) for eligibility assessment (title/abstract and full-text screening). Screening and data extraction were conducted by AL and MM and disagreements were resolved by RP. AL drafted the article for publication with all other authors (MM, RP, and PH) contributing through critical revision of intellectual content and quality. All authors approved the final published version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Extent of contribution:

- Andrit Lourens: 70%
- Michael McCaul: 16%
- A/Prof Romy Parker: 7%
- A/Prof Peter Hodkinson: 7%

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17 July 2020

Andrit Lourens

Date:

3.1.2 Declaration by co-authors

The undersigned hereby certifies that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise.
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication.
4. There is no other author of the publication according to these criteria.
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
6. The original data are stored at the following location and will be held for at least five years from date indicated below.

Location of stored data: Search results and screening are stored in the authors covidence account at www.covidence.org (214) and search results and other study-related material (eligibility and data extraction forms) stored on the author's password-protected (AL) laptop and external universal serial bus (USB).

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17 July 2020

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Associate Professor Peter Hodgkinson

Date

3.2 Synopsis

3.2.1 *Rationale for conducting the study*

Since the literature review demonstrated the paucity of publications on acute pain assessment and management in the African prehospital setting, the purpose of the scoping review was to systematically identify all available evidence on the research topic of this setting. This allowed for a description of the extent of that evidence, encapsulate findings and distinguish research gaps (215–218). The scoping review supported and strengthened the overall research project by providing insight into what is known about the topic, clearly identifying and unfolding the scientific knowledge gaps and allowing for the researcher to make recommendations for further research to fill these gaps. The findings of the scoping review further reinforced and underpinned the necessity of the remaining three objectives of the research project although only as a starting point for addressing gaps in the body of knowledge.

3.2.2 *Aim and objectives*

Aim:

The scoping review aimed to provide insight into the current body of evidence related to acute pain assessment and management in the African prehospital setting and allow for making recommendations.

Objectives:

- To identify and map the range and nature of evidence in relation to acute pain assessment and management in the African prehospital setting.
- To identify research gaps in the existing literature related to acute pain assessment in the African prehospital setting.
- To summarise research findings related to acute pain assessment and management in the African prehospital setting.
- To inform future research related to acute pain assessment and management in the African prehospital setting.

The aim and objectives of the scoping review link closely with the overall aim of the thesis. Through the synthesis of current prehospital pain care evidence in Africa, the researcher became attentive to the scarcity of research on this topic and developed a deeper understanding of what is known and what research and interventions are needed to fully comprehend aspects of acute pain assessment and management in the African prehospital setting.

3.2.3 Main results

- After an extensive database search, only six publications related to acute pain assessment and management in the African prehospital setting could be identified. The publications included four peer-reviewed journal articles, a thesis dissertation, and evidence-based CPGs, all published in English and between 2012 and 2018. Five of the six publications were conducted in SA and the remainder in Rwanda, a country in Central East Africa.
- None of the studies reported on the prevalence of acute pain in the African prehospital setting. The causes commonly associated with acute pain in the prehospital setting were identified as soft tissue injuries including burns, fracture/dislocations, stabbing, gunshot wounds (GSW), chest pain and non-traumatic pain including back pain. One study reported the aetiology of acute pain in the prehospital setting based on a review of PCRs and the second reported aetiology based on the information obtained during an online survey of ALS practitioners.
- Pain assessment using a pain scale in the included studies was poor. For the studies which presented patients data, one reported that no pain assessment was conducted prior to the patients' admission to a burns unit whereas the second included that an initial pain score was recorded in 34% and a second in only 6% of PCRs reviewed. The quantitative data, however, indicated that ALS practitioners elicit a more comprehensive clinical picture to support their pain management decision-making and rely less on formal pain measurement as they perceived it to be a poor indicator. The South African evidence-based CPGs provide clear and concise recommendations in terms of pain assessment requirements.
- Limited results related to the non-pharmacological management of acute pain were obtained. Nevertheless, the findings indicate that CQI initiatives may prove beneficial to improve aspects like splinting of fractures. Some of the included studies concluded that pharmacological management of acute pain was insufficient and not conforming to current best practice.
- The findings of the scoping review allowed for making some recommendations for clinical practice and several comprehensive recommendations for research focus.

“Below is the content of the published article followed by the references of the paper. The context and meaning of the published paper are described in detail in the rest of the chapter”

3.3 Article published in Pain Research and Management

Acute pain in the African prehospital setting: A scoping review

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Abstract:

Background: Acute pain is a common reason for seeking prehospital emergency care. Regrettably, acute pain is often underestimated and poorly managed in this setting. The scoping review was conducted to gain insight into existing research on the topic and to make recommendations for future work.

Objectives: To identify all available evidence related to acute pain assessment and management in the African prehospital setting, describe the extent of the evidence, encapsulate findings, and identify research gaps.

Methods: The scoping review considered primary and secondary research related to acute pain assessment and management of both medical and traumatic origin in all age groups in the African prehospital setting. The search strategy aimed to identify published, unpublished, and on-going research which met the inclusion criteria. Potentially eligible studies were identified by a comprehensive search of electronic databases, trial registers, dissertation/thesis databases, grey literature databases, and conference proceedings. Screening and data extraction were conducted independently and in duplicate.

Results: The comprehensive search identified 3823 potential studies, duplicate titles were removed, and 3358 titles/abstracts screened. Full-text of 66 potentially eligible titles were screened, 60 were excluded and six publications met the inclusion criteria. Despite recommendations for pain assessment during general patient care, most studies reported no/limited pain assessment. In general pain management was concluded to be insufficient and not conforming to best practice.

Conclusions: Only six studies addressing prehospital acute pain care in Africa could be identified, possibly indicative of a knowledge gap. Future research is indicated to enable a better understanding of the epidemiology of acute pain, barriers, and enablers of acute pain care and to develop evidence-based clinical practice guidelines (CPGs) catering for all EMS systems in Africa. Additionally, educational initiatives should be implemented to improve the quality of acute pain care and to monitor quality through continuous quality improvement (CQI) programs.

1. Introduction

Acute pain (on its own, or along with other complaints) is a common reason for seeking emergency care (EC), in the prehospital and hospital emergency department (ED) setting. The prevalence of ED visits secondary to acute pain is between 38% and 91% (1–6) with prevalence in the prehospital setting, reported to range between 34% and 75% (7–14). Acute pain is fundamentally a protective mechanism and fosters survival.

Being a stressor, acute pain activates various body systems with the potential to result in numerous physiological and psychological adverse effects. If unalleviated, acute pain is associated with worse patient outcomes (15–18) thus making pain assessment and management in the acute setting an essential aspect of quality care (18). In addition, when considering the ethical and human rights concerns related to acute pain (17,18), all healthcare providers (HCPs) should view it as a priority with the aim to alleviate suffering and minimising the coinciding adverse effects. Despite the high prevalence of pain in the acute setting and the associated negative effects, research highlights the poor and often insufficient assessment and management of acute pain (1,8,10,15,19,20). Three main barriers have been identified as contributing to poor prehospital acute pain management, namely: provider perceptions and beliefs, patient-related barriers, and system barriers (21).

Adequate pain management in the prehospital setting is both realistic and achievable, but improvement will require an understanding of the aforesaid pain management barriers and limitations in Emergency Medical Services (EMS) systems, development of pain management policies/strategies (21) and investment in pain management education (18,21). French et al. (22) demonstrated that after a 3-hour educational intervention, paramedics exhibited an increased understanding of the principles of pain and pain management with practitioners subsequently more likely to document the outcomes of interventions and the delivery of non-pharmacological pain management. A follow-up study six years later showed those practitioners' knowledge and perception of pain, and pain management remained improved (23).

Knowledge and perceptions about pain should include the understanding that pain is influenced by various factors like culture, gender, age, language, context, previous experiences, level of consciousness, and cognition (17). Pain assessment and management are prejudiced by HCPs beliefs, attitudes, and opinions of pain with studies reporting that HCPs generally underestimate pain (15,18,24–27) with the underestimation increasing with practitioner experience (27). Prehospital education and levels of qualifications differ significantly from country to country, with Emergency Care Providers (ECPs), worldwide practising according to different protocols or guidelines, scope of practice and standard operating procedures. Levels of qualifications may vary from basic life support (BLS) practitioners with a limited scope of practice and skill set aimed at assuring basic vital functions through to advanced life support (ALS) practitioners with a broader scope of practice including more invasive skills and medications. In Africa, access to EC in the prehospital setting is very limited, nevertheless, this is a rapidly developing area as health care systems evolve and countries aspire to establish/develop EMS systems (28).

Although globally, pain and pain management are well-researched topics, given the diversity of EMS systems in Africa and the role of culture, gender, attitudes, and beliefs about pain, acute pain assessment, and management in the African prehospital setting is a pertinent area deserving in-depth exploration (28-30). Furthermore, given that the literature reports that acute pain in the African in-hospital setting is highly prevalent and poorly managed, it is likely that acute pain in the prehospital setting is also a challenge in Africa (24,31,32). In low-resource settings, like most African countries, various factors have been identified which may hinder effective pain management. These include insufficient education and training of HCP's, lack of resources and opioid analgesics and malalignment of government priorities and policies (33).

The methodology behind scoping reviews allows for evaluating a broad research question with the intent to summarize research findings and to articulate what is known about a specific topic (34–38). This review will provide insight into existing prehospital acute pain assessment and management practice and research in Africa to clinicians and policymakers and allow for making recommendations to the profession as a whole and specifically to researchers through 1) identifying and mapping the range and nature of evidence; 2) identifying research gaps in the existing literature; 3) summarizing research findings; and 4) informing future research, related to acute pain assessment and management in the prehospital setting in Africa.

2. Methods

Inclusion and exclusion criteria were considered in terms of types of participants, concept, context, and sources.

2.1 Inclusion/Exclusion Criteria

2.1.1 Type of participants

The scoping review considered research in any age group, with patients managed by ECPs, physicians and/or nurses in the prehospital setting, in Africa. Studies relating to neonates were excluded as it is beyond the scope of the review.

2.1.2 Concept

The concept of interest was the assessment and management of acute pain of both traumatic and medical aetiology in the African prehospital setting.

2.1.3 Context

The context of the scoping review was the prehospital setting and only considered research conducted on the African continent. Prehospital refers specifically to care provided before or during transportation of the patient to hospital by EMS consequently, studies conducted in the aero-medical (helicopter and fixed-wing) setting and ground ambulance services were eligible. Studies related to inter-facility transfers of critically ill and injured patients were excluded as pain assessment and management may be influenced by prior treatment and therefore should probably not be compared to pain care in the primary setting.

2.1.4 Type of sources

The research designs considered for inclusion were primary research designs [experimental designs (randomised controlled trials & non-randomised controlled trials), observational designs (cohort studies, case-control studies, cross-sectional studies & surveys) & qualitative designs] and secondary research designs [systematic reviews & meta-analysis & evidence-based CPGs] whereas case reports, case series and literature reviews were excluded.

2.2 Search Strategy

The search strategy aimed to identify published, unpublished, and on-going research. Potentially eligible studies were identified by comprehensively searching the following electronic databases up to December 2018: MEDLINE, Science Direct, Scopus, Google Scholar, EBSCOhost (Academic Search Premier, Africa Wide Information, CINHAL & Health Source: Nursing/Academic Edition), The Cochrane Central Register for Controlled Trials (CENTRAL), Web of Science (All databases), African Journals Online (AJOL) and Sabinet African Journals (African Journal Archive) ([Appendix 5](#)). The International Guidelines Library and National Institute for Health and Care Excellence

(NICE) were searched for CPGs. Searches were limited by year of publication (from 1 January 2000) but not by language.

The ClinicalTrials.gov register and World Health Organization (WHO) International Clinical Trials Registry Platform were searched to identify relevant protocols, ongoing studies, and unpublished studies up to 29 November 2018. The ProQuest Dissertations and Thesis Database and Sabinet WorldCat Dissertations were searched for potentially relevant dissertations and theses (search up to December 2018). The Grey Literature database was searched for potentially relevant grey literature and the ERIC ProQuest database was searched for potentially relevant conference abstracts or proceedings. A further effort was made in August 2018 to find grey literature by contacting emergency medicine (EM) leaders and EM societies in the African region as well as searching the following databases: Open Thesis, Network Digital Library Theses and Dissertations, Agency for Healthcare Research and Quality, WHO: Global Index Medicus, OpenUCT, Scopus (Conference Proceedings) and Database of African Theses and Dissertation including Research (DATAD-R). The reference lists of included studies/thesis were reviewed for eligible publications. The corresponding authors of included studies were contacted to identify additional relevant studies (published, unpublished or on-going).

2.3 Selecting eligible studies

Search results were imported to the Covidence online software (39). A two-stage process was utilised to identify eligible studies. In stage one, two reviewers (AL & MM) independently, and in duplicate reviewed the search results for potentially eligible studies (titles/abstracts) using the pre-specified inclusion/exclusion criteria. After concluding screening, the full-text reports of potentially relevance titles/abstracts were retrieved for final eligibility ([Appendix 6](#)) assessment (stage two) by the two reviewers, independent and, in duplicate. Disagreements were resolved through discussion and where necessary mediated by a third party (RP).

2.4 Data extraction

Data of the included studies were captured independently, and in duplicate, by two reviewers (AL & MM) on a data extraction form ([Appendix 7](#)). The following information was recorded: author/s, year of publication, publication type (journal article, dissertation, conference proceedings, etc), study aim/s, study design, study location (city & country), study setting, data collection method [interviews, questionnaires, patient care report (PCR) reviews, etc.], sampling strategy and sample size, type of participants [(adult or paediatric), (trauma or medical)], medication information (class of medication, medication administered, dose administered, repeated dosages

and/or rescue analgesia), type of pain assessment, route of administration [inhaled, oral, intranasal (IN), intramuscular (IM), intravenous (IV)], non-pharmacological management and main results. Disagreements were resolved through discussion.

3. Results

3.1 Search results

The comprehensive search identified 3823 potential studies. Duplicate titles (465) were removed, after which 3358 titles/abstracts were screened. Sixty-six titles/abstracts were potentially eligible with 3292 records excluded. The full-text articles of the 66 potentially eligible titles were retrieved, and eligibility criteria applied. Sixty articles/publications were excluded and six included (see Figure 3.1) in the scoping review.

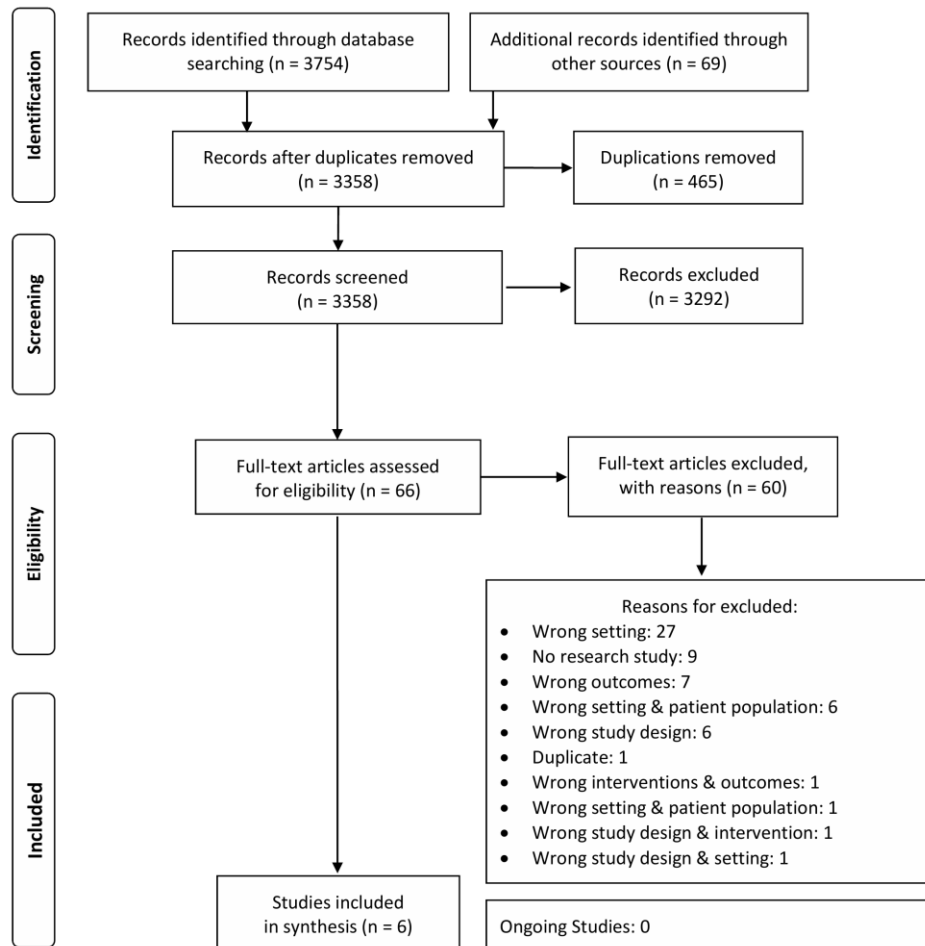


Figure 3.1: Flow diagram of the study selection

3.2 Characteristics of Included Studies

Of the six included titles, four were peer-reviewed journal articles and one a thesis dissertation. The sixth, was grey literature published by the Professional Board for Emergency Care (PBEC),

Health Professions Council of South Africa (HPCSA), and obtained through the authors' knowledge of the field of EC. One study utilised a mixed methods approach, three were observational descriptive research, one an interrupted time series analysis and the remaining were evidence-based CPGs. All six studies were written in English and published between 2012 and 2018. Five originated from South Africa (SA) and one from Rwanda (Table 3.1).

Table 3.1: Included source characteristics

Characteristics	Number (n = 6)	Percentage (%)
Publication Year:		
2012	1	16.7%
2015	2	33.3%
2017	2	33.3%
2018	1	16.7%
Publication Type:		
Journal Article (Peer Reviewed)	4	66.6%
Thesis dissertation	1	16.7%
Grey Literature	1	16.7%
Countries of Origin:		
South Africa	5	83.3%
Rwanda	1	16.7%
Research Methods: (Primary and Secondary Research)		
Mixed Methods (Primary Research):		
Sequential exploratory	1	16.7%
Quasi-Experimental (Primary Research):		
Interrupted time series analysis	1	16.7%
Descriptive Observational Studies (Primary Research):		
Cross-sectional study	1	16.7%
Survey	2	33.3%
Secondary Research:		
Evidence-based Clinical Practice Guideline	1	16.7%
Area of Intervention (clinical, educational, policy, etc.):		
Clinical	6	100%
Language of Publication:		
English	6	100%

3.3 Key results/finding of included studies

The key features of the six included papers are synthesised in Table 3.2.

3.3.1 Acute Pain Prevalence

None of the included papers reported acute pain prevalence in the African prehospital setting. Nevertheless, in Phase 1 (quantitative phase) of the mixed methods study by Mulder (40), respondents to the survey indicated that 2% encountered >1 patient requiring analgesia per month, 28% encountered between 1 - 5 patients, 19% between 10 - 15, 6% between 15 - 20 and 9% more than 20 patients per month.

Table 3.2: Overview of included studies

Author(s), year of publication	Study design	Study aim(s)	Study setting	Data Collection Period	Study sample	Results		
						Pain assessment (Initial & reassess)	Non-pharmacological management	Pharmacological management
Mulder 2012 [40]	Mixed-methods: Sequential Exploratory	To determine the factors contributing to the clinical decision-making process made by South African paramedics in their management of patients with acute traumatic pain	South Africa	Phase 1: Quantitative (Descriptive cross-sectional study)				
				7 Jun - 30 Sep 2010	N = 57 participants (ALS ^s), 22% Response rate	Initial: Analgesia initiated based on a comprehensive clinical picture Reassess: Both decreased pain score & physiological indicator of change	Positioning & splinting	Morphine, Ketamine, Voltaren, NSAIDs ^s , Tramadol, Benzodiazepines
				Phase 2: Qualitative (In-depth interviews)				
				2010	N = 5 participants (ALS ^s)	Initial: Main determinant in decision-making around initiating analgesia was the patient's expression (verbal) of pain Re-assess: Participants rely on the patient's expression of pain relief rather than a numerical score in the decision-making process	Not reported	Morphine or Ketamine (preferred when in scope) or alternatively a combination of Morphine & Ketamine
Matthews et al. 2017 [41]	Descriptive retrospective survey	To describe prehospital pharmacological analgesia practices in the City of Cape Town	Cape Town, South Africa	Aug 2013 - Jul 2014	530 PCR ^s (ALS ^s employees of WCEMS)	Initial: NRS ^s assessed in 21% (n=111) of PCR ^s Reassess: 2 nd NRS ^s assessed in 6% (n=34) of PCR ^s	Not reported	Nitrates administered in 37% (n=197), Morphine in 75% (n=278), Ketamine in 1.7% (n=9) of cases
Vincent-Lambert and De Kock 2015 [42]	Prospective descriptive study (internet-based survey)	To describe the use of morphine sulphate & compare paramedic practices to existing guidelines & literature	South Africa	One month in 2015	N = 60 participants (ALS ^s), 38% Response rate	Initial: Not reported Reassess: Stop pain management partly based on decreased pain score	Not reported	Morphine
Cox et al. 2015 [43]	Descriptive cross-sectional study	To assess the community management of paediatric burns prior to admission to a burns centre against the current provincial policy guidelines & to identify areas for improvement	Cape Town, South Africa	Aug - Oct 2012 & Jun - Aug 2013	N = 353 Paediatric burn patients (aged 1 month to 14 years)	Initial: Not performed Reassess: Not performed	Cooling with water, ice or cooling agents like Burnshield [®] Burnshield [®] applied by EMS ^s in 6.2% (n=22) children	Paracetamol, NSAID ^s , Tilidine, Morphine, Ketamine

<p>HPCSA 2018 [44]</p>	<p>Adaptive CPG[§] Design</p>	<p>To review & update existing protocols for ECPs[§] & create an evidence-based CPG[§] which: provides an evidence base for emergency care practice contextualised to the South African setting, is patient-centred, realistic and enhance continuity of care throughout the emergency system, is aligned to best practice & provide guidance to current practitioners and those envisioned by the draft NECET[§] policy</p>	<p>South Africa</p>	<p>Searching: Oct 2015 - Jan 2016</p>	<p>276 CPGs[§] included</p>	<p>Initial: Assess pain as part of general patient care</p> <p>Reassess: Use age-appropriate pain assessment scale, reassess every 5 minutes</p> <p>Obverse for evidence of serious adverse effects</p>	<p>Burns: Cool & cover burns</p> <p>Fracture: Effectively immobilise fracture</p> <p>No further recommendation specifically related to non-pharmacological pain management</p>	<p>Labour: Inhaled nitrous oxide or opioids (IV[§] or IM[§])</p> <p>Chest Pain (dependent on the cause): Sublingual or IV[§] Nitrates and/or Opioids (IV[§] or IM[§])</p> <p>Burns: Paracetamol or NSAIDs[§], consider opioids for intermittent or procedural pain</p> <p>Trauma: Narcotic analgesics (Morphine IV[§] or Fentanyl IV[§]/IN[§]) for moderate to severe pain</p> <p>Procedural sedation & analgesia: Ketamine: IV[§], if sedation inadequate incremental IV[§] doses</p> <p>Post-resuscitation care: Pain & discomfort should be controlled with analgesics & sedatives</p>
<p>Scott et al. 2017 [45] *</p>	<p>Quasi-Experimental: Interrupted Time Series Analysis</p>	<p>To compared five quality process measures recorded before & after the implementation of the CQI[§] programme & aimed to determine the immediate impact of the CQI[§] programme as well as the impact over time</p>	<p>Kigali, Rwanda</p>	<p>Pre-CQI[§]: Jan 2013 – Feb 2014 Post CQI[§]: April 2014 – May 2015</p>	<p>N = 1028 Trauma patients >15 years</p>	<p>Initial: Not reported</p> <p>Reassess: Not reported</p>	<p>Splinting of long bone fractures: Pre-CQI[§]: 87.5% (n=335) Post-CQI[§]: 92,6% (n=393) p-value: 0.019</p>	<p>Acetaminophen, ibuprofen, diclofenac, morphine, tramadol, fentanyl, pethidine & ketamine.</p> <p>Pain management for long bone fractures: Pre-CQI[§]: 85.1% (n=335) Post-CQI[§]: 93,6% (n=393) p-value: < 0.001</p>
<p>Footnote: *No formal prehospital care certified programme was available, thus ambulances in Rwanda are manned by one driver, one anaesthesia technician & one nurse, § Abbreviations - ALS: Advanced Life Support, CPGs: Clinical Practice Guidelines, CQI: Continuous Quality Improvement, ECPs: Emergency Care Providers, EMS: Emergency Medical Services, IM: Intramuscular, IN: Intranasal, IV: Intravenous, NECET: National Emergency Care Education and Training, NRS: Numerical Rating Scale, NSAIDs: Non-Steroidal Anti-Inflammatory Drugs, PCRs: Patient Care Reports, WCEMS: Western Cape Emergency Medical Services</p>								

3.3.2 Aetiology of Acute Pain

In the review of PCRs ($n=530$), Matthews et al. (41) found the following causes for initiating analgesia: soft tissue injuries including burns ($n=74$, 14%, 95%CI 11-17), fracture, amputations or dislocations ($n=132$, 25%, 95%CI 21-29%), stabbing or gunshot wounds ($n=52$, 10%, 95%CI 7-13), chest pain ($n=226$, 42%, 95%CI 38-47) and non-traumatic pain including back pain ($n=42$, 8%, 95%CI 6-11). In four cases diagnostic notes were not recorded. Participants ($n=60$) in the study by Vincent-Lambert and De Kock (42) identified fractures (100%), dislocations (96.7%), burns (95%), chest pain (90%) and severe soft tissue injuries (81.7%) as conditions commonly associated with noteworthy pain and the need for analgesia.

3.3.3 Pain assessment (Initial and re-assessment)

Generally, pain assessment practice in the included studies was poor. Matthews et al (41) reported that the numeric rating scale (NRS) were recorded in 111 (21%, 95%CI 18-25) cases whereas a second NRS assessment was recorded in only 34 (6%, 95%CI 4-9) cases. In the descriptive cross-sectional study by Cox et al. (43), none of the 353 paediatric burns victims had their pain management assessed using a pain scale prior to admission to the burns unit.

In phase 1 of the study by Mulder (40) respondents indicated that to initiate analgesia, a comprehensive picture is required, and decisions are not based on a single isolated factor. Additionally, respondents (81%) reported that both a decrease in pain score and physiological changes are indications to stop pain management. In the second phase (quantitative) the patient's expression of pain was identified as the main determinant in the decision to initiate analgesia. Despite the questionnaire indicating that practitioners incorporated pain scores during pain management most of the interviewees ($n=5$) expressed that a pain score is not a good indicator for initiating analgesia. The patient's expression of comfort was deemed a good indicator for stopping analgesia, whereas the practitioner's opinion of the patient's pain in terms of the patient appearing comfortable and the patient requesting practitioners to stop pain management were identified as factors contributing cessation of analgesia. Vincent-Lambert and De Kock (42) stated that participants used verbalised pain relief, decreased pain score and decreased heart rate as perceived end-points of analgesia (effective pain relief).

The evidence-based CPGs for the South African prehospital setting by the Health Professions Council of South Africa (HPCSA) (44) recommends the following in terms of pain assessment. The description partly reproduces the wording as captured in the HPCSA CPGs (44).

- Use age-appropriate pain scales as part of general patient care,

- All trauma patients should be considered candidates for pain relief,
- In labour, meet the mother's pain relief expectations,
- All patients which received analgesia must be reassessed every 5 minutes (using age-appropriate pain scale),
- Observe patients for evidence of severe adverse effects like sedation, hypotension, hypoxia, and anaphylaxis,
- Presence of severe adverse effects demonstrates the need to stop further administration,
- EC courses should teach nationally standardised age-appropriate pain scales.

3.3.4 Factors influencing decision-making

Respondents to the study by Vincent-Lambert and De Kock (42) indicated that the following factors were considered during the decision making of whether to administer morphine for analgesia: level of pain being experienced, patient's desire for pain relief, practitioners' fears of adverse effects and transportation (mode, time and conditions). During decision-making, interviewees in the second phase of the study by Mulder (40) reported mechanism of injury, the need to move the patient, factors causing emotional influences like socio-economic status, insurance status, age, gender and the practitioner perceiving the injury to be painful based on personal experience or looking at the injury, as contributing factors. Physiological indicators, influenced by external stimuli particularly in the prehospital setting, were deemed a poor reference for decision making unless the patient was intoxicated or altered.

3.3.5 Non-Pharmacological management of acute pain

Limited results related to the non-pharmacological management of acute pain were obtained from the included papers. For paediatric burns victims, a Burnshield® dressing was applied by EMS in 22 (6.2%) children and 251 (71.1%) children at CHCs (43). HPCSA (46) CPGs recommends cooling and covering burns and the immobilisation of fractures. Scott et al. (45) found that after the implementation of the CQI program, there were a significant improvement in the percentage of extremity fractures splinted [pre-CQI: 87.5% ($n=335$) vs post-CQI: 92,6% ($n=393$); $p=0.019$].

3.3.6 Pharmacological management of acute pain

The main pharmacological pain management recommendation of evidence-based CPGs by the HPCSA (44) is shown in Table 3.3. The description in Table 3.3 partly reproduces the wording as captured in the HPCSA CPGs (44).

For paediatric burns victims, parents and medical staff used paracetamol most frequently, whereas IV morphine in combination with oral paracetamol was administered if transported to

burns units by ambulance (40). As evidence from PCRs, Matthews et al. (41) reported the following analgesia practices by ALS practitioners. Morphine with a median dose of 4 mg (IQR 3-6) was administered in 371 (70%, 95%CI 66-74) cases and a total of ≥5 mg morphine administered in 278 (75%, 95%CI 70-79) cases. One dose of morphine was administered in 268 (72.2%, 95%CI 67-77), two doses in 86 (23%, 95%CI 19-28) and three doses in 18 (5%, 95%CI 3-8) cases. Co-administration of morphine with nitrates occurred in 47 (24%, 95%CI 18-30) cases and morphine with ketamine in three (33%, 95%CI 7-70) cases. Sublingual nitrates were administered in 197 (37%, 95%CI 33-41) cases and ketamine in nine (1.7%, 95%CI 1-3) cases (41).

Table 3.3: Summary of pharmacological management of pain as per HPSCA CPGs (44)

Indication	Description
Labour	<ul style="list-style-type: none"> Inhaled nitrous oxide is the recommended method for pain relief Practitioners to explain medications result in moderate pain relief and ensure that the patient understands possible adverse effects If, IV or IM opioids considered, inform the patient of limited effect
Trauma (moderate to severe pain)	<ul style="list-style-type: none"> Morphine (IV) or Fentanyl (IV or IN) is recommended Morphine: IV 0.1 mg/kg or IV/IN Fentanyl: 1.0 µg/kg (Adult IN dose) Paediatric IN dose for Fentanyl 1.5 µg/kg If pain remains noteworthy, consider re-dosing with half the initial dose
Burns	<ul style="list-style-type: none"> Appropriately management pain Administer paracetamol or NSAIDs to management pain Opioids can be considered for intermittent pain or pain associated with procedures
Chest Pain (management dependent on cause)	<ul style="list-style-type: none"> Chest pain at first contact - Sublingual or IV nitrates while titrating to blood pressure and/or Opioids titrated and used with caution to limit potential interaction with antiplatelet therapy
Procedural sedation and analgesia	<ul style="list-style-type: none"> Ketamine IV, IN or IM is recommended, followed by additional incremental IV doses of ketamine if sedation inadequate Loading dose over 30-60 secs: Adults IV 1 mg/kg and Paediatrics IV 1.5-2 mg/kg If sedation inadequate or repeated dose necessary, administer additional incremental doses of 0.5-1 mg/kg IV Alternative to IV administration: IM 4-5 mg/kg or IN (No dose stipulated)
Post-resuscitation care	<ul style="list-style-type: none"> Opioids (morphine or fentanyl) and sedative can be administered to control pain and discomfort
Footnote: IM: Intramuscular, IN: Intranasal, NSAIDs: Non-Steroidal Anti-Inflammatory Drugs, IV: Intravenous	

Fifty-one participants (85%) in the internet-based survey by Vincent-Lambert and De Kock (42) indicated a preference for a high-dose morphine regimen (0.1 mg/kg followed by 0.05 mg/kg after 5 minutes) whereas nine participants selected a low-dose morphine regimen (0.05 mg/kg followed by 0.025 mg/kg after 5 minutes) in hemodynamically stable patients with severe pain. The most common reasons for low-dose regimen were concerns for nausea/vomiting, hypotension, respiratory depression, blunting diagnostic procedures at the ED, dose enough to

dull pain to a tolerable level and the belief that patients sometimes lie about the extent of their pain. The rationale for selecting high-dose regimens was based on the following opinions of participants: adverse effects depend more on the rate of medications administration than the dose; aim of relieving pain instead of merely blunting pain; pain may be harmful to patient outcomes; and if a definite pain response is present, patients will not experience adverse effects. Scott et al. [45] found that after the implementation of the CQI program, there was a significant improvement in the administration of pain control [pre-CQI: 85.1% ($n=335$) vs post-CQI: 93,6% ($n=393$); $p<0.001$] in trauma patients.

Morphine was specified as the method of analgesia in 68% of respondents in Phase 1 of Mulder's (40) study. For practitioners with ketamine and morphine in their scope of practice, ketamine was preferred in terms of onset of action and efficacy in trauma by interviewees (Phase 2). Some practitioners deemed a combination of ketamine and morphine more effective. In the absence of immediate life-threatening conditions, interviewees indicated that pain management takes the highest priority and that without pain management further management may not be possible.

3.3.7 Study conclusions

Cox et al. (43) determined that health staff were unfamiliar with provincial burns guidelines and analgesic drug dosages; hence, the study identified pain management as one of the six major shortfalls in the implementation of provincial burns guidelines (Western Cape, SA). Matthews et al. (41) concluded that, in the study setting (SA), prehospital pain management is likely haphazard, ineffective, and not conforming to current best practice. Furthermore, morphine is administered at low dosages and there was limited evidence of pain assessment using a pain scale. Multimodal pain management in the prehospital setting is restricted probably due to the limited availability of alternative medications. Finally, the study urged for continuous pain care education and the development of prehospital pain management CPGs. Much like Matthews et al. (41), Vincent-Lambert and De Kock (42) recommend the development of pain management protocols for the SA prehospital setting and found that pain assessment using a pain score is lacking. Nevertheless, SA ALS practitioners seem to consider various vital factors during pain management decision-making. Further, the authors were concerned with the practice of administering the morphine loading dose in a measured approach likely resulting in a delayed onset or failure of pain relief. The study by Scott et al. (45) demonstrated that the CQI programme significantly improved both the pharmacological and non-pharmacological management of pain and concluded that the CQI programme led to an immediate improvement in prehospital care delivered as well as an improvement over time. Mulder (40) concluded that the approach to pain management of SA ALS practitioners indicates a dynamic thought process. Internal factors such as previous

experience, personal perceptions and opinions and external inputs like the patients' perception, pain score, physiological indicators, the mechanism of the injury and the required interventions are factors influencing clinical decision-making in terms of acute traumatic pain management.

4. Discussion

From the results of the scoping review, it is evident that high-quality research into prehospital acute pain assessment and management in Africa is significantly lacking. Despite extensive searches, only six papers addressing the topic could be identified. Furthermore, although Cox et al. (43) met the eligibility criteria for inclusion in the scoping review, the study provided very limited information and insight into the assessment and management of acute pain associated with burn injuries in the prehospital setting. In comparison with the volume and range of prehospital pain research conducted in high-income regions like North America, Australasia, Europe and the United Kingdom (UK), the shortfall in this field in Africa is irrefutable (7-15,18-23,25,26).

4.1 EMS Systems and Research in Africa

Both the WHO (46) and the World Bank (47) declared a decade ago that EMS is a fundamental part of the national health systems of low-income and middle-income countries, and that Governments and Ministries of Health of these countries should pay attention to and promote the development of EMS systems as well as prioritise investment. Due to the knowledge gap related to EMS systems in low and middle-income countries, research should aim to determine the necessity for EMS systems, develop a better understanding of the conditions/diseases which may be addressed by or benefit from well-established EMS systems (for example time-sensitive conditions like acute coronary syndrome and severe trauma) and examine possible solutions to region-specific problems (46,48). Furthermore, because EC is a neglected research area, development of and defining research priorities are problematic (49) but necessary to focus and direct prehospital research.

Access to EMS in most low and middle-income countries including the African continent is very limited (49-52). According to Mould-Millman et al. (28), 61.1% of African countries have no evidence of EMS systems. Less than 9% of Africans have access to an EMS system, with injury (commonly associated with acute pain) being the leading reason for EMS transportation. Forty-eight percent of systems utilised laypersons trained in first aid (tier-one) as responders and 96% medically-trained (tier-two) responders of which 84% were BLS practitioners. In terms of appropriate pain management, what is of concern is that first aid trained and BLS practitioners will predominantly manage pain with non-pharmacological methods only and to a lesser degree

with pharmacological methods, which will be limited to medications such as inhaled nitrous oxide (Namibia and South Africa) (45,53), other inhaled analgesics, like penthroxyflurane (SA) (45) or oral analgesics like paracetamol (Ghana) (54).

Despite literature describing the necessity for and importance of research for the development of EMS systems in Africa (47,49), research in Africa and particularly in the prehospital setting remains challenging in terms of research funding, research frameworks and governance, research capacity and clear research priorities. Worldwide, the majority of research is conducted in high-income countries with the Global Forum on Health Research [55] stating that the 10-90 gap, whereby <10% of health research funding is allocated to research in developing countries where more than 90% of preventable health issues occur, persists. As described above, some of these preventable health issues and the incurring burden may benefit from or be addressed by quality EMS systems (47,48). The assessment of national health research systems (NHRS) in the WHO Africa region in 2015 found that when compared to the 2003 and 2009 NHRS assessments, some countries in the African region had made advancements in developing certain functions of their NHRS. However, other countries in the region remained without NHRS (56). To establish prehospital research principles for Africa, Mould-Millman et al. (48) recommend including, among others, the development of methods to accurately gather data related to emergency conditions (commonly associated with pain) in Africa, to measure the efficacy of basic prehospital EC (pain care is an essential part of EC), to develop region-specific prehospital research priorities and align these priorities with the global research agenda. To address the lack of research capacity, the focus should be placed on education and training to conduct quality and meaningful research (48).

Considering the limited number and methodological quality of the included research, this scoping review exposes the paucity of high-quality prehospital acute pain research in Africa. Except for the evidence-based CPG, no high-level evidence in the form of RCTs or systematic reviews and meta-analysis examining pain interventions in African prehospital setting could be identified. Furthermore, it is noteworthy that none of the guidelines adapted, adopted or contextualised for the purposed of the CPGs (44) originated from Africa. Additionally, the studies contained no or very limited epidemiological data, making describing acute pain and developing an understanding of the extent of the acute pain burden in the African prehospital setting problematic. It is desirable to develop a broader understanding of how ECPs knowledge, opinions, and behaviours influence pain care in the form of qualitative research as well as how CQI projects may improve acute pain care in the African prehospital setting.

4.2 Acute Pain Prevalence in the Prehospital setting

As mentioned, none of the studies included in the scoping review investigated or reported the prevalence or any other noteworthy epidemiological characteristics of acute pain in the African prehospital setting. As previously stated, international studies indicate that acute pain in the prehospital setting is prevalent and often undertreated (7-11,13,15). If one merely considers the high trauma rate in the African region, it is reasonable to anticipate that acute pain in the African prehospital setting will be prevalent. Because pain management is a human right, for all citizens of the world (57,58) and its presence brings about unnecessary suffering, it must be emphasised, scrutinised and addressed.

In comparison to communicable diseases (like malaria, TB, HIV/AIDS), primary health care (child immunization) and basic resources like running water, pain management would seem to be a low priority in the health systems of low and middle-income countries; with a paucity of comprehensive data on pain and pain management (58-60).

4.3 Acute Pain Assessment in the Prehospital setting

Continuous assessment of the severity of acute pain forms an integral part of acute pain management as it provides the basis for decision-making (15,61); nevertheless, barriers are numerous. The subjective nature of pain, cultural, religious, and personal beliefs of patients, language barriers, lack of education and knowledge (practitioners and patients), attitudes and practices on the part of HCP's, all make pain assessment a challenge (15,61-63). Three of the studies (40-42) included in the review discussed and raised concerns related to acute pain assessment as practitioners did not conform with best practice which requires the use of an age-appropriate pain scale with regular reassessment (17,44,64,65). For a pain assessment tool to be applicable and suitable for prehospital use, it must be quick, not require equipment to record, be reproducible and have good interpersonal and intrapersonal reliability (25). Self-reported pain is the most reliable indicator of pain severity and, if patients are unable to report on pain, pain behavioural tools may be used to estimate pain severity (17,64). Although this scoping review identified a limited number of studies, the data show that practitioner behaviour in terms of assessing pain severity may be an area of concern needing further investigation and explanation.

Research which focuses on developing an understanding of the various challenges faced when assessing pain in the African prehospital setting is indicated. In addition, research should aim to determine pain assessment enablers and the development of pain assessment policies/strategies to guide practice and to ensure appropriate education for ECPs to facilitate effective pain assessment in the prehospital setting. Furthermore, to monitor the quality of prehospital acute

pain care, EMS systems can incorporate acute pain assessment and management as clinical quality indicators and implement CQI programs to improve the quality of and accountability for prehospital pain care. The study by Scott et al. 2017 (45) is indicative of the value CQI programs may have on the delivery of quality prehospital EC and acute pain care.

4.4 Prehospital Acute Pain Management

Mulder (40), Matthews et al. (41) and Vincent-Lambert and De Kock (42) reported on the use of morphine and, depending on the level of qualification, the use of ketamine in the prehospital setting. As a result of levels of ECP qualifications restricting the pharmacological scope of practice as well as logistical and cost issues related to inhaled nitrous oxide, many patients treated and transported by EMS in SA may not receive prehospital pain management. Pain management practice in the Rwandan EMS system appears to be unique as prehospital care in the studies' cohort was provided by nurses and anaesthesia technicians with a broad array of pain medications (acetaminophen, ibuprofen, diclofenac, morphine, tramadol, fentanyl, pethidine, and ketamine) at their disposal (45). In the rest of Africa, access to pain management in the prehospital setting would likely be more limited, due to scope of practice confines and other EMS system related limitations. In SA, some of the limitations in the provision of pain management in the prehospital setting would likely be addressed by the recently revised evidence-based CPGs (44). Similar pain management frameworks relevant to the African prehospital setting, whether novel or based on international practice, are needed. Research should focus on in-depth investigation and evaluation to develop appropriate policies/strategies for pain management and practitioner education in terms of pain management. Undoubtedly, the development of the CPGs (44) for the South African prehospital setting demonstrates growth in the profession and will prove valuable for quality patient care. Nonetheless, considering the limited resources and the lack of ECPs trained to a level higher than BLS in the rest of Africa it must be questioned whether the CPGs is adaptable to other EMS systems in Africa.

Included studies provided limited evidence on non-pharmacological pain management making it a further aspect requiring additional investigation in the African prehospital setting. The literature review by Pak et al. (66) determined that evidence indicate the potential for non-pharmacological pain management choices to play a vital role and likely decrease the use of medications.

4.5 Study Limitations

An attempt was made to ensure that all unpublished literature on the topic of the scoping review was accessed by searching grey literature and contacting leaders in EM in Africa. Nevertheless, relevant unpublished articles or thesis dissertations may still have been missed. Despite the extended search a very limited number of studies could be identified and as a result, the

implications for practice are limited but there are significant implications for research as the review clarifies research gaps and assists in directing focus.

The majority (83%) of the studies included in the scoping review were conducted in the South African prehospital setting, this can most likely be attributed to the immaturity or lack of EMS systems in most African countries (20) as well as be an indication of the limited research capacity in Africa. As a result, the findings of the scoping review are probably a true representation of the paucity of prehospital pain research in Africa. In comparison to other African countries, SA probably possesses the most developed EMS system, employing ECPs with university level qualifications thus more likely to perform research.

A further drawback to the findings of the scoping review is that none of the included studies represented data on the patients perspective of the quality of pain management (satisfaction), but then this may, as well, be attributed to the scarcity and immaturity of research in the African prehospital setting.

Scoping review methodology does not generally require the critical appraisal of the quality of the included studies (34,37,38), consequently, the quality of included studies in the scoping review was not assessed. This issue remains a critique and controversy (35) in the methodology of scoping reviews and therefore deemed a limitation (36) of this scoping review.

5. Conclusion

5.1 Implications for research

Acute pain research in the African prehospital setting is significantly lacking and large knowledge gaps exist. In order to fill the research gaps in the African prehospital setting and develop the profession, it is paramount that research capacity amongst members of the EC profession is built through education and training and that governments invest in the development of EMS systems and quality prehospital care.

In terms of acute pain it is recommended that research should focus on the following pertinent areas: gathering and publishing epidemiological data related to acute pain in the African prehospital setting, understanding provider's practice as well as barriers to and enablers of pain assessment and management in the African prehospital setting, identifying limitations within EMS systems and limitations in scope of practice, and developing evidence-based CPGs for pain assessment and management catering for all EMS systems in Africa.

5.2 Implications for practice

Due to the limited number of studies included in the scoping review deducing implications for practice is problematic. Educational initiatives to improve the knowledge and understanding of

pain assessment and management principles may prove beneficial to the quality of acute pain care. Additionally, ensuring that the scope of practice for every level of qualification for ECPs includes medication(s) appropriate to alleviate pain yet fitting for the level of qualification, suffering secondary to acute pain will be reduced and patient outcomes improved. Introducing pain assessment and management as EMS quality indicators will allow services to start evaluating pain care and allow for the development of CQI initiatives to advance patient care and outcomes.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

1. Todd KH, Ducharme J, Choiniere M, Crandall CS, Fosnocht DE, Homel P, et al. Pain in the Emergency Department: Results of the Pain and Emergency Medicine Initiative (PEMI) Multicenter Study. *J Pain* [Internet]. 2007;8(6):460–6. Available from: [http://www.researchgate.net/publication/6498205_Pain_in_the_emergency_department_results_of_the_pain_and_emergency_medicine_initiative_\(PEMI\)_multicenter_study/links/09e4150b202ea66e0c000000.pdf](http://www.researchgate.net/publication/6498205_Pain_in_the_emergency_department_results_of_the_pain_and_emergency_medicine_initiative_(PEMI)_multicenter_study/links/09e4150b202ea66e0c000000.pdf).
2. Berben SAA, Meijs THJM, van Dongen RTM, van Vugt AB, Vloet LCM, Mintjes-de Groot JJ, et al. Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. *Injury* [Internet]. 2008;39(5):578–85. Available from: https://ac-els-cdn-com.ezproxy.uct.ac.za/S0020138307001659/1-s2.0-S0020138307001659-main.pdf?_tid=ddb3ff0-3153-406b-9165-05fb36b84a09&acdnat=1545808895_3670b09766590aa76cad2aa8d98362ab
3. Mura P, Serra E, Marinangeli F, Patti S, Musu M, Piras I, et al. Prospective study on prevalence, intensity, type, and therapy of acute pain in a second-level urban emergency department. *J Pain Res* [Internet]. 2017;10:2781–8. Available from: <https://www.dovepress.com/prospective-study-on-prevalence-intensity-type-and-therapy-of-acute-pa-peer-reviewed-article-JPR#>
4. Gregory J, McGowan L. An examination of the prevalence of acute pain for hospitalised adult patients: A systematic review. *J Clin Nurs* [Internet]. 2016;25(5–6):583–98. Available from: <https://onlinelibrary-wiley-com.ezproxy.uct.ac.za/doi/epdf/10.1111/jocn.13094>
5. Cordell WH, Keene KK, Giles BK, Jones JB, Jones JH, Brizendine EJ. The high prevalence of pain in emergency medical care. *Am J Emerg Med* [Internet]. 2002;20(3):165–9. Available from: https://ac-els-cdn-com.ezproxy.uct.ac.za/S0735675702868164/1-s2.0-S0735675702868164-main.pdf?_tid=5c9599ec-1b10-48b5-a0a8-

47d9b83aeacb&acdnat=1545468191_fbf7725b27d2e4232e2ab10cabadad44

6. Damico, V, Murano, L, Cazzaniga, F, Dal Molin A. Pain prevalence, severity, assessment and management in hospitalized adult patients: a result of a multicenter cross sectional study. *Ann Ist Super Sanità* [Internet]. 2018;54(3):194–200. Available from: http://old.iss.it/binary/publ/cont/ANN_18_03_05.pdf
7. McLean S, Maio R, Domeier R. The epidemiology of pain in the prehospital setting. *Prehospital Emerg Care* [Internet]. 2002;6(4):402–405 4p. Available from: <http://ezproxy.library.dal.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=c8h&AN=106805705&site=ehost-live>
8. Murphy A, McCoy S, O’Reilly K, Fogarty E, Dietz J, Crispino G, Wakai A, O’Sullivan R. A Prevalence and Management Study of Acute Pain in Children Attending Emergency Departments by Ambulance. *Prehospital Emerg Care*. 2016;20(1):52–8.
9. Galinski M, Picco N, Hennequin B, Raphael V, Ayachi A, Beruben A, et al. Out-of-hospital emergency medicine in pediatric patients: Prevalence and management of pain. *Am J Emerg Med* [Internet]. 2011;29(9):1062–6. Available from: <http://dx.doi.org/10.1016/j.ajem.2010.06.031>
10. Galinski M, Ruscev M, Gonzalez G, Kavas J, Ameer L, Biens D, et al. Prevalence and management of acute pain in prehospital emergency medicine. *Prehospital Emerg Care*. 2010;14(3):334–9.
11. Jennings PA, Cameron P, Bernard S. Epidemiology of prehospital pain: An opportunity for improvement. *Emerg Med J* [Internet]. 2011;28(6):530–1. Available from: <https://emj-bmj-com.ezproxy.uct.ac.za/content/emered/31/10/840.full.pdf>
12. Marinangeli F, Narducci C, Ursini M, Paladini A, Pasqualucci A, Gatti A, et al. Acute pain and availability of analgesia in the prehospital emergency setting in Italy: A problem to be solved. *Pain Pract* [Internet]. 2009;9(4):282–8. Available from: <http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L354932098%5Cnhttp://dx.doi.org/10.1111/j.1533-2500.2009.00277.x%5Cnhttp://sfx.library.uu.nl/utrecht?sid=EMBASE&issn=15307085&id=doi:10.1111/j.1533-2500.2009.00277.x&atitle=Acute+pai>
13. Friesgaard KD, Riddervold IS, Kirkegaard H, Christensen EF, Nikolajsen L. Acute pain in the prehospital setting: A register-based study of 41.241 patients. *Scand J Trauma Resusc Emerg Med* [Internet]. 2018;26(1):1–10. Available from: <https://sjtrem.biomedcentral.com/articles/10.1186/s13049-018-0521-2>.
14. Berben SAA, Schoonhoven L, Meijjs THJM, Van Vugt AB, Van Grunsven PM. Prevalence and

- relief of pain in trauma patients in emergency medical services. *Clin J Pain* [Internet]. 2011;27(7):587–92. Available from: <https://ovidsp-tx-ovid-com.ezproxy.uct.ac.za/sp-3.32.0a/ovidweb.cgi?WebLinkFrameset=1&S=OACEFPHBJDDDEONENCDKGDIBFEMIAA00&returnUrl=ovidweb.cgi%3F%26TOC%3DS.sh.22.23.27.31%257c4%257c50%26FORMATT%3Dtoc%26FIELDS%3Dtoc%26S%3DOACEFPHBJDDDEONENCDKGDIBFEMIAA00&di>
15. Iqbal M, Spaight PA, Siriwardena AN. Patients' and emergency clinicians' perceptions of improving pre-hospital pain management: a qualitative study. *Emerg Med J* [Internet]. 2013;30(3). Available from: <https://emj-bmj-com.ezproxy.uct.ac.za/content/30/3/e18.full.pdf>
 16. Chapman CR, Tuckett RP, Song CW. Pain and Stress in a Systems Perspective: Reciprocal Neural, Endocrine, and Immune Interactions. *J Pain* [Internet]. 2008;9(2):122–45. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2278005/pdf/nihms-40524.pdf>
 17. Wells N, Pasero C, McCaffery M. Chapter 17. Improving the Quality of Care Through Pain Assessment and Management. *Patient Safety and Quality: An Evidence-Based Handbook Nurses Vol 1* [Internet]. 2004;469–86. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK2658/>
 18. Lord B. Pain Management: Can education make a difference? *Australas J Paramed*. 2003;1(3):1–2.
 19. Albrecht E, Taffe P, Yersin B, Schoettker P, Decosterd I, Hugli O. Undertreatment of acute pain (oligoanalgesia) and medical practice variation in prehospital analgesia of adult trauma patients: A 10 yr retrospective study. *Br J Anaesth* [Internet]. 2013;110(1):96–106. Available from: <http://dx.doi.org/10.1093/bja/aes355>
 20. McManus JG, Sallee DR. Pain management in the prehospital environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://www.jsomonline.org/Publications/20081111McManus.pdf>.
 21. Hennes H, Kim MK. Prehospital pain management: Current status and future direction. *Clin Pediatr Emerg Med* [Internet]. 2006;7(1):25–30. Available from: https://ac-els-cdn-com.ezproxy.uct.ac.za/S1522840106000097/1-s2.0-S1522840106000097-main.pdf?_tid=31668de0-d9e1-4e4d-8cec-da9e3053ea3e&acdnat=1536829812_57ccabee511f175a4ffb6c89143d2578.
 22. French SC, Salama NP, Baqai S, Raslavicus S, Chan SB, Ramaker J. Effects of Educational Interventions on Prehospital Pain Management. *Prehospital Emerg Care* [Internet]. 2006;10(1):71076. Available from: doi: 10.1080/10903120500366086.

23. French S, Chan S, Ramaker J. Education on Prehospital Pain Management: A Follow-Up Study. *West J Emerg Med* [Internet]. 2013;14(2):96–102. Available from: <http://www.escholarship.org/uc/item/9qp925q9>
24. Seers T, Derry S, Seers K, Moore RA. Professionals underestimate patients' pain. *Pain* [Internet]. 2018;159(5):1. Available from: <http://insights.ovid.com/crossref?an=00006396-900000000-99055>
25. Jennings PA, Cameron P, Bernard S. Measuring acute pain in the prehospital setting. *Emerg Med J* [Internet]. 2009;26(8):552–5. Available from: https://www.researchgate.net/profile/Paul_Jennings7/publications.
26. Luger TJ, Lederer W, Gassner M, Löckinger A, Ulmer H, Lorenz IH. Acute pain is underassessed in out-of-hospital emergencies. *Acad Emerg Med* [Internet]. 2003;10(6):627–32. Available from: <https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1553-2712.2003.tb00046.x>
27. Solomon P. Congruence between health professionals' and patients' pain ratings: A review of the literature. *Scand J Caring Sci* [Internet]. 2001;15(2):174–80. Available from: <https://onlinelibrary-wiley-com.ezproxy.uct.ac.za/doi/epdf/10.1046/j.1471-6712.2001.00027.x>
28. Mould-Millman NK, Dixon JM, Sefa N, Yancey A, Hollong BG, Hagahmed M, et al. The state of Emergency Medical Services (EMS) systems in Africa. *Prehosp Disaster Med* [Internet]. 2017;32(3):273–83. Available from: https://www-cambridge-org.ezproxy.uct.ac.za/core/services/aop-cambridge-core/content/view/90C79371E0A0C62DE1CB1B729E8F93DB/S1049023X17000061a.pdf/state_of_emergency_medical_services_ems_systems_in_africa.pdf
29. Peacock S, Patel S. Cultural Influences on Pain. *Rev Pain* [Internet]. 2008;1(2):6–9. Available from: <http://journals.sagepub.com/doi/10.1177/204946370800100203>
30. Nortjé N, Albertyn R. The cultural language of pain: A South African study. *South African Fam Pract* [Internet]. 2015;57(1):24–7. Available from: <http://dx.doi.org/10.1080/20786190.2014.977034>
31. Huang KTL, Owino C, Gramelspacher GP, Monahan PO, Tabbey R, Hagembe M, et al. Prevalence and Correlates of Pain and Pain Treatment in a Western Kenya Referral Hospital. *J Palliat Med* [Internet]. 2013;16(10):1260–7. Available from: <http://online.liebertpub.com/doi/abs/10.1089/jpm.2013.0080>
33. Mate JW. Prevalence, severity and initial management of pain among children admitted in Kenyatta national hospital general paediatric wards [Internet]. University of Nairobi;

2014. Available from: http://erepository.uonbi.ac.ke/bitstream/handle/11295/77865/Mate_Prevalence_severity_and_initial_management_of_pain_among_children_admitted_in_Kenyatta_national_hospital_general_paediatric_wards.pdf?sequence=3
33. Ogboli-Nwasor E, Hogans B. Fact Sheet 8: Pain Education in Low-Resource Countries. In: International Association of the Study of Pain [Internet]. Available from: http://s3.amazonaws.com/rdcms-iasp/files/production/public/globalyear/8_Pain_Education_in_Low_Resource_Countries_English_FINAL.pdf.
 34. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. *Int J Soc Res Methodol Theory Pract* [Internet]. 2005;8(1):19–32. Available from: https://pdfs.semanticscholar.org/fff5/133d387e6c1b32292c955a997d376f05dccb.pdf?_ga=2.110295877.1137967985.1545808984-590204880.1544022904
 35. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 edition/supplement [Internet]. Adelaide: Joanna Briggs Institute; 2015. Available from: http://joannabriggs.org/assets/docs/sumari/Reviewers-Manual_Methodology-for-JBI-Scoping-Reviews_2015_v2.pdf
 36. Peterson J, Pearce PF, Ferguson LA, Langford CA. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* [Internet]. 2017;29(1):12–6. Available from: <https://onlinelibrary-wiley-com.ezproxy.uct.ac.za/doi/epdf/10.1002/2327-6924.12380>
 37. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Res Synth Methods* [Internet]. 2014;5(4):371–85. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4491356/pdf/jrsm0005-0371.pdf>.
 38. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* [Internet]. 2015;13(3):141–6. Available from: <https://ovidsp-tx-ovid-com.ezproxy.uct.ac.za/sp-3.32.0a/ovidweb.cgi?WebLinkFrameset=1&S=DJNJFPBPNPDDCOGONCDKDFGCFOKMAA00&returnUrl=ovidweb.cgi%3F%26TOC%3Djb.search.31%257c1%257c50%26FORMAT%3Dtoc%26FIELDS%3DTOC%26S%3DDJNJFPBPNPDDCOGONCDKDFGCFOKMAA00&direct>
 39. Covidence systematic review software [Internet]. Melbourne, Australia: Veritas Health Innovation. Available from: www.covidence.org.
 40. Mulder RK. Clinical Decision Making by South African Paramedics in the Management of

- Acute Traumatic Pain [Internet]. Durban University of Technology; 2012. Available from: http://openscholar.dut.ac.za/bitstream/10321/854/1/Mulder_2012.pdf
41. Matthews R, McCaul M, Smith W. A description of pharmacological analgesia administration by public sector advanced life support paramedics in the City of Cape Town. *African J Emerg Med* [Internet]. 2017;7(1):24–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.002>
 42. Vincent-Lambert C, De Kock JM. Use of morphine sulphate by South African paramedics for prehospital pain management. *Pain Res Manag* [Internet]. 2015;20(3):141–4. Available from: https://www.researchgate.net/publication/277082041_Use_of_Morphine_Sulphate_by_South_African_Paramedics_for_Prehospital_Pain_Management
 43. Cox SG, Martinez R, Glick A, Numanoglu A, Rode H. A review of community management of paediatric burns. *Burns* [Internet]. 2015;41(8):1805–10. Available from: <http://dx.doi.org/10.1016/j.burns.2015.05.024>
 44. Health Professions Council of South Africa. South African Emergency Medical Services Clinical Practice Guidelines [Internet]. Pretoria; 2018. Available from: http://www.hpcs.co.za/Uploads/editor/UserFiles/downloads/emergency_care/CLINICAL_PRACTICE_GUIDELINES_PROTOCOLS_2018.pdf
 45. Scott JW, Nyinawankusi JDA, Enumah S, Maine R, Uwitonze E, Hu Y, et al. Improving prehospital trauma care in Rwanda through continuous quality improvement: an interrupted time series analysis. *Injury* [Internet]. 2017;48(7):1376–81. Available from: <http://dx.doi.org/10.1016/j.injury.2017.03.050>
 46. Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C. Policy and Practice Components of emergency medical systems. *Bull World Health Organ* [Internet]. 2005;83(8):626–31. Available from: <https://www.who.int/bulletin/volumes/83/8/626.pdf>
 47. Kobusingye OC, Hyder AA, Bishai D, Joshipura M, Hicks ER, Mock C. Emergency Medical Services. In: *Disease control priorities in developing countries* [Internet]. 2nd Ed. Washington, DC: World Bank and Oxford University Press; 2006. Available from: <https://openknowledge.worldbank.org/handle/10986/7242>
 48. Mould-Millman NK, Sasser SM, Wallis LA. Prehospital research in sub-Saharan Africa: Establishing research tenets. *Acad Emerg Med* [Internet]. 2013;20(12):1304–9. Available from: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/acem.12269>
 49. Tolefac, PN, Nana, TN, Chichom, AM, Tchente, CN, Siegning, LK, Efie, DT, Yeika, EV, Luma, HN, Minkande, JZ, Ngowe M. Challenges in Emergency Medical Services in a Resource-

- Limited Setting in Sub-Sahara Africa; Perspectives from Cameroon: a Review Article. *Int Ann Med* [Internet]. 2017;1(10). Available from: <https://iamresearcher.online/ojs/index.php/iam/article/view/308>
50. Kironji AG, Hodkinson P, De Ramirez SS, Anest T, Wallis L, Razzak J, et al. Identifying barriers for out of hospital emergency care in low and low-middle income countries: A systematic review. *BMC Health Serv Res* [Internet]. 2018;18(1):1–20. Available from: <https://bmchealthservres.biomedcentral.com/track/pdf/10.1186/s12913-018-3091-0>
 51. Nielsen, K, Mock, C, Joshipura, M, Rubiano, AM, Zakariah, A, Rivara F. Assessment of the Status of Prehospital Care in 13 Low- and Middle-Income Countries. *Prehosp Emerg Care* [Internet]. 2013;16(3):381–9. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3360803/pdf/nihms356966.pdf>
 52. Stein C, Mould-Millman NK, De Vries S, Wallis L. Access to out-of-hospital emergency care in Africa: Consensus conference recommendations. *African J Emerg Med* [Internet]. 2016;6(3):158–61. Available from: <http://dx.doi.org/10.1016/j.afjem.2016.08.008>
 53. Haufiku B. Regulations Relating to Scope of Practice for the Profession of Emergency Care: Allied Health Professions Act, 2004 [Internet]. Windhoek, Namibia, Namibia: Government Gazette of the Republic of Namibia; Aug 29, 2018 p. 1–7. Available from: https://laws.parliament.na/cms_documents/6690-d6cbbbf574.pdf
 54. Mould-Millman N, Oteng R, Zakariah A, Osei-Ampofo M, Oduro G, Barsan W, et al. Assessment of emergency medical services in the Ashanti region of Ghana. *Ghana Med J* [Internet]. 2015;49(3):125. Available from: <http://www.ajol.info/index.php/gmj/article/view/126291>
 55. The 10/90 Report on Health Research 2001-2002. [Internet]. Global Forum for Health Research & World Health Organization. Geneva: Global Forum for Health Research; 2002. Available from: http://announcementsfiles.cohred.org/gfhr_pub/assoc/s14792e/s14792e.pdf
 56. Kirigia JM, Ota MO, Motari M, Bataringaya JE, Mouhouelo P. National health research systems in the WHO African region: Current status and the way forward. *Heal Res Policy Syst* [Internet]. 2015;13(1):1–14. Available from: <http://dx.doi.org/10.1186/s12961-015-0054-3>
 57. Lohman, D, Schleifer, R, Amon J. Access to pain treatment as a human right. *BMC Med* [Internet]. 2009;8(8):1–9. Available from: <https://bmcmecine.biomedcentral.com/track/pdf/10.1186/1741-7015-8-8>
 58. Brennan F, Carr DB, Cousins M. Pain management: A fundamental human right. *Anesth*

- Analg [Internet]. 2007;105(1):205–21. Available from: <http://anesthesiology.pubs.asahq.org/pdfaccess.ashx?url=/data/journals/jasa/931064/000539-200707000-00037.pdf>.
59. Size, M, Soyannwo, OA, Justins D. Pain management in developing countries. *Anaesthesia* [Internet]. 2007;62(Suppl 1):38–43. Available from: <http://www.jpalliativecare.com/text.asp?2016/22/4/373/191742>
60. Vijayan R. Managing Acute Pain in the Developing World Why Focus on Acute Pain? *Pain - Clin Updat* [Internet]. 2011;19(3):1–7. Available from: https://s3.amazonaws.com/rdcms-iasp/files/production/public/Content/ContentFolders/Publications2/PainClinicalUpdates/Archives/PCU_19-3_web_revised_1390260400113_4.pdf
61. Carr E. Barriers to effective pain management. *J Perioper Pract* [Internet]. 2007;17(5). Available from: <https://pdfs.semanticscholar.org/d389/6d3982d17b50d3086169030a9cb9371c316d.pdf>
62. Glowacki D. Pain Management and Improvements in Patient’s Outcomes and Satisfaction. *Crit Care Nurse* [Internet]. 2015;35(November):33–43. Available from: <http://ccn.aacnjournals.org/content/35/3/33.full.pdf+html>.
63. Bond M. Pain education issues in developing countries and responses to them by the International Association for the Study of Pain. *Pain Res Manag* [Internet]. 2011;16(6):404–6. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3298046/pdf/prm16404.pdf>
64. Gausche-Hill M, Brown KM, Oliver ZJ, Sasson C, Dayan PS, Eschmann NM, et al. An evidence-based guideline for prehospital analgesia in trauma. *Prehospital Emerg Care* [Internet]. 2014;18(SUPPL.1):25–34. Available from: <https://www.tandfonline.com/doi/pdf/10.3109/10903127.2013.844873?needAccess=true>
65. McLean SA, Domeier RM, DeVore HK, Hill EM, Maio RF, Frederiksen S. The feasibility of pain assessment in the prehospital setting. *Prehospital Emerg Care*. 2004;8(2):155–6.
66. Pak S, Micalos PS, Maria SJ, Lord B. Nonpharmacological Interventions for Pain Management in Paramedicine and the Emergency Setting: A Review of the Literature. *Evid Based Complement Alternat Med* [Internet]. 2015;1-8. Available from: <https://www.hindawi.com/journals/ecam/2015/873039/>

3.4 Discussion

The findings of the scoping review brought to the fore how little is known about pain epidemiology, assessment and management practices, knowledge and attitudes regarding pain, barriers and enablers as well as practitioners' and patients' perceptions of acute pain and acute pain care in the prehospital setting in Africa. It allowed the researcher to confirm acute pain research in the African prehospital setting as an area where new scientific knowledge must be added. Although acute pain research in the African prehospital setting is unquestionably not the only research area with a scarcity of scientific knowledge for the setting and region, the exploration of this research topic will assist in decreasing unnecessary suffering, improving the quality of prehospital care and add to the progress and development of this field of medicine. Further, the finding highlights the immaturity of EMS systems in the African region as well as showing the limitations in terms of research capacity to drive the development of prehospital medicine in the region (220). EMS systems are described as a fundamental part of health care systems in Africa, however, the potential benefit of well-established EMS systems are not clearly understood (221).

Outside of the published article, no additional methods, results, or study limitations related to the scoping review can be reported. All methods utilised, results and study limitations found were detailed in the publication. This publication provided valuable insight for what is to follow in the research project and reinforced the basis for the overall research project, that in order to ensure quality prehospital acute pain care, a better understanding of the different components which influence pain care in this setting is needed and will allow for making recommendations (222).

3.5 Chapter conclusion

In conclusion, the findings of the scoping review support the notion presented after the literature review, that research pertaining to acute pain care in the African prehospital setting is scarce. The scoping review allowed the researcher to develop a clear understanding of what is known about the research topic compared to what is yet to be explored. With the backdrop of the knowledge gained from the scoping review (222), the remaining three objectives form a foundation for addressing some of the knowledge gaps identified by the scoping review, with more research expected to follow.

CHAPTER 4: ACUTE PAIN ASSESSMENT AND MANAGEMENT IN THE PREHOSPITAL SETTING, IN THE WESTERN CAPE, SOUTH AFRICA: A KNOWLEDGE, ATTITUDES AND PRACTICES SURVEY

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4.1 Declaration from author and co-authors

4.1.1 Declaration from author

The following co-authors contributed to the paper: Associate Professor Romy Parker (RP), and Associate Professor Peter Hodkinson (PH). In the case of Chapter 4, contribution by authors to the work was as follow:

AL conceived the idea and designed the study including the knowledge, attitudes and practices survey with input from RP and PH. AL analysed the data using Statistical Package for the Social Sciences (SPSS) version 25 (223) and drafted the article for publication with all other authors contributing through critical revision of intellectual content and quality. All authors approved the final published version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Extent of contribution:

- Andrit Lourens: 70%
- A/Prof Romy Parker: 15%
- A/Prof Peter Hodkinson: 15%

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17 July 2020

Andrit Lourens

Date:

4.1.2 Declaration by co-authors

The undersigned hereby certifies that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise.
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication.
4. There is no other author of the publication according to these criteria.
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
6. The original data are stored at the following location and will be held for at least five years from date indicated below.

Location of stored data: Survey data were collected online at www.surveymonkey.com (224) on the UCT Division of EM SurveyMonkey account and subsequently downloaded in Microsoft Excel® 2016 (225) format, shared with the research student (AL) and subsequently archived. The Excel® spreadsheets, SPSS version 25 data analysis (223), and any other study-related material are stored on the author's password-protected (AL) laptop and external USB.

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4.2 Synopsis

4.2.1 *Rationale for conducting the study*

The knowledge, attitudes, and practices (KAP) survey model focusses on measuring what is known about a health problem, as well as establishing a baseline of beliefs and behaviours towards that health problem in a specific population. In addition, the model may be utilised to measure change after health interventions. Data generated from KAP surveys are informative and insightful and contribute to a better understanding of the health problem under investigation (226,227). The knowledge aspect of the survey measures what the study population knows about the health problem and may help to identify gaps in training and education. Attitudes refer to the study population's beliefs or position on the health problem whereas practices refer to the study population's observable actions and behaviours as individuals (226,227).

No published KAP surveys regarding pain assessment and management in the prehospital setting could be identified. The motivation for the survey was thus to be the first study to identify and describe knowledge and attitudes regarding pain assessment and management among emergency care providers in the prehospital setting, in the WC, SA, to identify gaps in knowledge and attitudes regarding pain assessment and management and to describe practice or behaviours. In addition, the study would identify barriers and enablers to pain assessment and management in the prehospital setting in the WC, SA to form the basis for further investigation and elaboration.

4.2.2 *Aim and objectives*

Aim:

The aim was to describe the knowledge, attitudes, and practices of emergency care providers in relation to acute pain assessment and management in the prehospital setting, in the WC, SA.

Objectives:

- To assess and identify gaps in knowledge and understanding of acute pain assessment and management among emergency care providers in the prehospital setting, in the WC, SA.
- To develop a baseline comprehension of emergency care providers' attitudes towards acute pain assessment and management in the prehospital setting, in the WC, SA.
- To describe current acute pain practices and behaviours amongst emergency care providers' in the prehospital setting, in the WC, SA.

- To identify barriers and enabling factors to acute pain assessment and management by emergency care providers in the prehospital setting, in the WC, SA.

4.2.3 Main results

Participation:

- Two hundred and one individuals completed the informed consent with 180 agreeing to participate. Of the 180 responses, 80 were excluded secondary to being incomplete. Responses were included if respondents completed, at least to the end of the “True/False/Don’t Know” section (2) or onwards.
- A hundred respondents completed to the end of section 2, 91 (91%) up to the end of section 3, 87 (87%) to the end of section 4, 73 (73%) to the end of section 5 and 65 (65%) completed section 6 with an overall dropout rate of 35% ($n=35$).

Demographic Information:

- The mean age of respondents was 34.74 (SD 8.13) years while the mean years’ experience was 10.02 (SD 6.47) years.
- Sixty-nine respondents (69%) were male and 31 (31%) female. Most respondents were employed in the public/government sector ($n=93$, 93%) and functioned as operational emergency care providers ($n=85$, 85%). Fifty-four (54%) respondents had attended training on the research topic in the last two years. Most respondents were from the Eden district ($n=41$, 41%) and the City of Cape Town ($n=29$, 29%).

Questionnaire results:

- The mean overall percentage correct for knowledge and attitudes regarding pain measured in sections 2, 3 and 4 was 58.01% ($n=87$, SD 15.66, 95%CI 54.67-61.35).
- Respondents with higher qualifications, more years’ experience and those who did not attend medical education on pain, achieved higher scores.
- Patients’ alcohol or drug use ($n=49$, 67.1%), patients’ language ($n=45$, 61.6%) and workload and lack of time ($n=44$, 58.9%) were the most frequently selected barriers ($n=73$).
- The most commonly selected enablers ($n=73$) were the availability of higher qualified emergency care providers ($n=54$, 74.0%), insight and awareness that pain management is important ($n=43$, 58.9%), availability of resources (medications, disposables, monitoring equipment) ($n=38$, 52.1%) and cooperative patients ($n=38$, 52.1%).
- On the case vignettes, only 23 (35.4%) respondents assigned pain score as self-reported to the patient without behavioural indications of severe pain (Andrew) whereas 42 (64.6%)

assigned a pain score as self-reported to the patient with behavioural indications of severe pain (Robert). Andrew's median pain score was 5 (*IQR* 3-8) and Robert's 8 (*IQR* 6-8).

- From the pain management practice questions, it appears that some non-pharmacological approaches (calm, reassess, tender loving care, position, make comfortable) to pain management are employed regularly. Pharmacological pain management practices appear to be less rigorous, with clear differences between the management of the two case studies presented. Further, from the summaries, it appears that patients with severe pain may regularly not receive appropriate pain management during the prehospital phase of their health care.

"Below is the content of the published article followed by the references and supplementary tables and figures of the paper. The context and meaning of the published paper are described in detail in the rest of the chapter"

4.3 Article published in BMC Emergency Medicine

Acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: A Knowledge, Attitudes and Practices Survey

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Abstract

Background: Acute pain is frequently encountered in the prehospital setting, and therefore, a fundamental aspect of quality emergency care. Research has shown a positive association between healthcare providers' knowledge of, and attitudes towards pain and pain management practices. This study aimed to describe the knowledge, attitudes, and practices of emergency care providers regarding acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa. The specific objectives were to, identify gaps in pain knowledge; assess attitudes regarding pain assessment and management; describe pain assessment and management behaviours and practices; and identify barriers to and enablers of pain care.

Methods: A web-based descriptive cross-sectional survey was conducted among emergency care providers of all qualifications, using a face-validated Knowledge, Attitudes and Practices of Pain survey.

Results: Responses of 100 participants were included in the analysis. The survey response rate could not be calculated. The mean age of respondents was 34.74 (*SD* 8.13) years and the mean years' experience 10.02 (*SD* 6.47). Most respondents were male (69%), employed in the public/government sector (93%) as operational practitioners (85%) with 54% of respondents having attended medical education on pain care in the last two years. The mean percentage for knowledge and attitudes regarding pain among emergency care providers was 58.01% (*SD* 15.66) with gaps identified in various aspects of pain and pain care. Practitioners with higher qualifications, more years' experience and those who did not attend medical education on pain, achieved higher scores. Alcohol and drug use by patients were the most selected barrier to pain care while the availability of higher qualified practitioners was the most selected enabler. When asked to record pain scores, practitioners were less inclined to assign scores which were self-reported by the patients in the case scenarios. The participant dropout rate was 35%.

Conclusion: Our results suggest that there is suboptimal knowledge and attitudes regarding pain among emergency care providers in the Western Cape, South Africa. Gaps in pain knowledge, attitudes and practices were identified. Some barriers and enablers of pain care in the South African prehospital setting were identified but further research is indicated.

Keywords

Prehospital; Acute pain assessment and management; Analgesia; Knowledge, Attitudes and Practices

Background

Acute pain prevalence in the prehospital arena is thought to be high with the assessment and management thereof widely shown to be insufficient at large (1–4). The South African prehospital setting appears to be no different with two recent studies showing limited evidence of pain assessment, and pain management likely being ineffective (5,6). Very little is known about acute pain in the African prehospital setting (7). In low- and middle-income countries, inadequate pain management is often attributed to a lack of resources and knowledge, poor pain assessment and/or pain being a low priority (8,9). Benefits of alleviating acute pain are numerous. Suffering, recovery time, infection risk and the risk for chronic pain are reduced while diagnostic and treatment processes are enabled, and patient satisfaction and patient outcomes are improved (10–13). Evidence also suggests that prehospital analgesia reduces the time to administration and likely increases appropriate subsequent emergency department analgesia (13,14). Pain management is a fundamental aspect of quality prehospital care, and despite apparently straightforward approaches, in theory, it is extremely challenging to achieve, even in well-developed systems (15–17).

Various barriers to prehospital pain management like lack of knowledge, pain assessment challenges, language barriers, organisational culture, pain underestimation and practitioners beliefs and attitudes have been highlighted (13,18–21). Children are less likely to have pain assessed and managed (22–25) and females regardless of age and pain severity less likely to receive opioids (25–28) while patients in severe pain and those spending more time with Emergency Medical Services (EMS) more likely to receive opioids (28,29). Some prehospital practitioners express an attitude that pain is not life-threatening, therefore, a minor priority (18,19). Male prehospital practitioners express more enduring (stoic) viewpoints regarding the need for analgesia while older practitioners have more negative attitudes about assessing pain medication requirements (30). Moreover, prehospital providers from various high-income countries (HIC) still report that pain assessment and management during undergraduate studies receive limited focus (18,20,21) and that continuous pain education is lacking (22).

Knowledge, attitudes, and practices (KAP) surveys can be conducted to measure what is known about a health problem, develop a baseline understanding of beliefs and behaviours, and even to quantify change after health interventions (31,32). This study aimed to describe the KAP of emergency care providers regarding acute pain assessment and management in the prehospital setting, in the Western Cape (WC), South Africa (SA). The specific objectives were to, identify gaps in pain knowledge; assess attitudes regarding pain assessment and management; describe pain assessment and management behaviours and practices; and identify barriers to and enablers of pain care.

Methods

Study design

A web-based (33) descriptive cross-sectional KAP in Pain survey was conducted among prehospital emergency care providers of all qualifications, registered with the Health Professionals Council of South Africa (HPCSA) and currently practising in the WC, SA.

Study setting

Respondents to this study were emergency care providers from the WC province, one of nine provinces in SA with a population of more than 6.3 million people, which accounts for 11.3% of the SA population. The WC is sub-divided into six districts, one large metropolitan area with a well-developed healthcare network including several tertiary and many district-sized hospitals (the City of Cape Town), and five (rural or peri-urban areas) districts (Cape Winelands; Overberg; West Coast; Eden (or Garden Route) and Central Karoo districts) characterised by largely small district or regional hospitals separated by long distances (34). Most of the communities in the WC are served by the public (government-operated) EMS system while various private ambulance services deliver a service to the minority of the population who can afford medical insurance.

Emergency care education in SA is broadly categorised into basic (BLS), intermediate (ILS) or advanced life support (ALS) level qualifications which evolved from a three-tiered short course framework to more professional tertiary (undergraduate) level qualifications in recent years (35,36). At the time of the study, non-ALS practitioners' scope of practice limited their analgesic options to inhaled nitrous oxide (Entonox®), which is regularly not available on most ambulances in the WC. For these practitioners (the majority of the workforce (35)), to deliver pain relief or to provide stronger analgesia, a request for assistance from a higher (ALS) qualified practitioner, who is able to administer intravenous analgesia (morphine or ketamine), needs to be made and the availability of these practitioners is often limited.

Sampling and sample size

A non-probability, convenience sampling strategy was utilised, with the aim to obtain a representative sample of each level of qualification within the target population. Based on the number of emergency care providers (9091) registered under the different HPCSA (iRegister) (37) emergency care registers in the WC, a sample size of 192 was calculated using an online sample size calculator (38) with a 7% margin of error in survey responses, a 95% confidence interval (CI) and a 50% response distribution. The actual sample size obtained was 100 respondents. With this sample, the margin of error in survey responses was 9.75% with a 95% CI and a 50% response distribution.

Data collection

The development of the questionnaire was based primarily on two existing surveys - the Knowledge and Attitudes Survey Regarding Pain (KASRP) used to assess nurses and other healthcare providers (HCPs) (revised 2014) (39) and the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain (40) as well as including questions adapted from the article by Pocock (41) and questions specific to the SA prehospital setting. Dependent on the level of qualification, emergency care providers practice within a set scope with certain medication limitations, therefore, questions related to pharmacological pain management were restricted. Three experts (including an expert in pain management) made comments and suggestions on the structure and length of the questionnaire, appropriateness of the questions, accuracy of answers and response options after which the survey was piloted among emergency care providers. Remarks received during the pilot study were mostly related to the length of the questionnaire. The questionnaire was, therefore, refined to include the questions/statements most appropriate and relevant to the setting. The questionnaire consisted predominantly of closed-ended questions with limited open-ended questions in six sections including demographic questions; "true/false/don't know" statements [18]; likert scale statements [8]; multiple-choice questions (MCQs) [5]; barriers and enablers (selection from the list provided); and two case studies (measuring pain assessment and management practices (free text questions)) (Additional File 1: [Appendix 8](#)).

A recruitment flyer ([Appendix 9](#)) containing an embedded link and quick response (QR) code to the online survey was sent to senior management of the different EMS systems for distribution to staff members. Data collection started on the 11th of October 2018 and was extended due to poor participation until the 31st of March 2019. The management structure of the services involved was requested to remind staff of the survey in December 2018 and January 2019. All completed questionnaires were anonymised by the web-based survey service (33).

Data Analysis

Data were analysed using SPSS Statistics, Version 25 (42). The primary outcome of the study was knowledge and attitudes regarding pain scores and percentages with secondary outcomes being factors influencing scores, gaps in pain knowledge, attitudes and practices, the proportion of selected barriers and enablers of pain assessment and management in the prehospital setting and the description of pain management practices. The overall score was calculated by adding the scores obtained for the true/false/don't know statements, likert scale statements and MCQs. For the true/false/don't know statements, 1 score was assigned for a correct response and 0 for incorrect or don't know responses. The three-point Likert scales were collapsed into dichotomous variables (correct and incorrect). A correct response to a statement was assigned a score of 1 while 0 was assigned to an incorrect or neutral response. Descriptive statistics were used to express the results and tables used to present demographic information (frequencies, percentages, means, standard deviation and ranges), survey responses (frequencies and percentages), overall scores (means, standard deviation, ranges and 95%CI) and selected barriers and enablers of pain assessment and management (frequencies and percentages). Shapiro-Wilk tests were conducted to assess normality in the data. To determine whether scores correlated with demographic information Spearman's correlation coefficient were conducted. To identify whether demographic information may influence overall scores, the non-parametric tests, Mann-Whitney U test and Kruskal-Wallis H test were conducted. For the case scenarios, self-reported pain scores for each case were reported through descriptive statistics (frequencies, percentages and medians) while free-text responses to the open-ended question related to the management of the two cases were summarised in a table. The developers of the KASRP survey (39) recommended that distinguishing between knowledge and attitude items during data analysis be avoided.

Results

Participation

Figure 4.1 presents a flow diagram of survey participation and the number of responses included in the data analysis. A relatively new South African law, the Protection of Personal Information (POPI) Act 4 of 2013 (43), protects South Africans' right to privacy and restricts access to personal information. Consequently, the organisations which approved the research distributed the questionnaire internally. The number of individuals to which the questionnaire was disseminated was unknown, making accurately calculating the survey response rate unanticipatedly difficult.

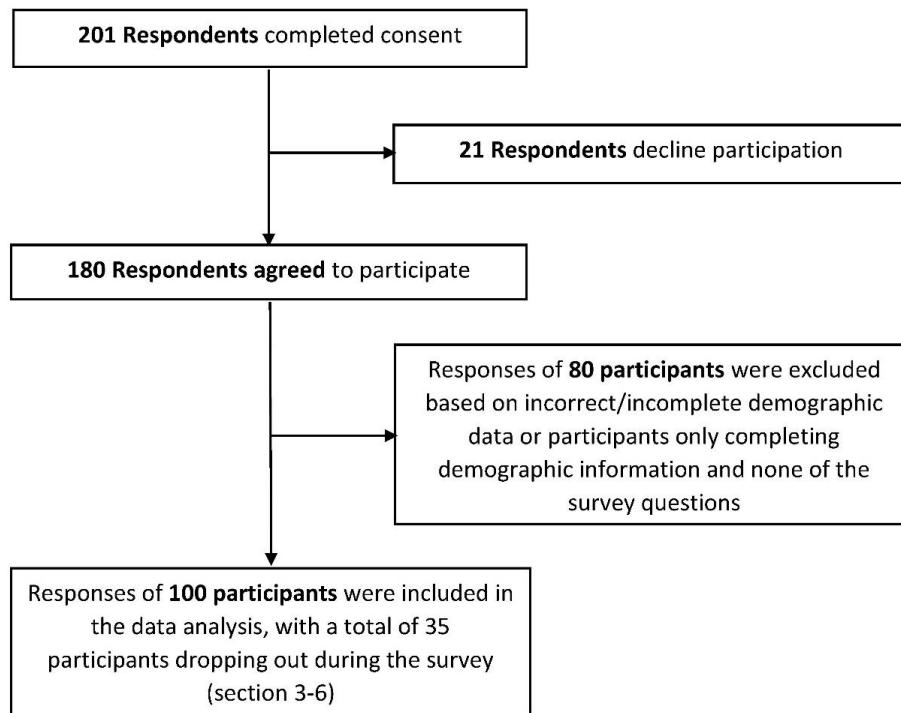


Figure 4.1: Flow diagram of survey participation

Demographic information (Section 1)

The mean age of respondents was 34.74 (*SD* 8.13) years and ranged between 21 and 57 years, while years of experience ranged between 1 and 29 with a mean of 10.02 (*SD* 6.47) years (see Table 4.1).

Table 4.1: Demographic characteristics of respondents ($n=100$)

Characteristics	
Gender	<i>n</i> (%)
Male	69 (69%)
Female	31 (31%)
Level of qualification	<i>n</i> (%)
Basic Life Support (BLS) ^a	20 (20%)
Intermediate Life Support (ILS) ^b	48 (48%)
Advanced Life Support (ALS) ^c	32 (32%)
Region of employment	<i>n</i> (%)
Cape Town Metropolitan	29 (29%)
Cape Winelands District	8 (8%)
Central Karoo District	8 (8%)
Eden District	41 (41%)
Overberg District	8 (8%)
West Coast District	6 (6%)
Years' experience (range)	<i>n</i> (%)
0 - 10 Years	60 (60%)
11 - 20 Years	32 (32%)
21 - 30 Years	8 (8%)
Current role within EMS	<i>n</i> (%)
Operational Emergency Care Provider	85 (85%)
Other ^d	15 (15%)

Continuing medical education on acute pain assessment and management received in the last 2 years	<i>n (%)</i>
Yes	54 (54%)
No	46 (46%)
Sector of employment	<i>n (%)</i>
Public/Government Sector	93 (93%)
Private Sector	7 (7%)
Age groups	<i>n (%)</i>
21 - 30 Years	38 (38%)
31 - 40 Years	40 (40%)
41 - 50 Years	19 (19%)
51 - 60 Years	3 (3%)
Footnote: ^a Include the Basic Ambulance Assistant (BAA) qualification, ^b Include the Ambulance Emergency Assistant (AEA) qualification, ^c Include the following qualifications: Emergency Care Technician (ECT), Critical Care Assistant (CCA) paramedic, National Diploma in Emergency Medical Care (NDEMC) paramedic, Emergency Care Practitioner (ECP), ^d Include the following roles: Supervisor/Manager, Higher education, Rescue, CQI/Patient safety, Emergency Medical Care Student and Emergency Medical Services Volunteer	

Knowledge and attitudes regarding pain management in the SA prehospital setting (Sections 2, 3 and 4)

For the “true/false/don’t know” section [2] of the questionnaire, scores ($n=100$) ranged between 3 (17%) and 18 (100%) with a mean score of 10.14 out of 18 or 56.38% (SD 17.02, $95\%CI$ 53.00 - 59.76). Frequencies and percentages of correct responses for the true/false/don’t know statements are reported in Table 4.2. Eighty-three percent of respondents correctly indicated that self-reported pain using the numeric rating scale is the quickest way to assess pain, while 41% wrongly believed that giving patients sterile water by injection (placebo) is a useful test to determine if the patient’s pain is real. Only 25% of respondents were aware that the patient's culture and/or spiritual beliefs influenced the experience and expression of pain while only 31% and 29% were respectively aware that vital signs and patient behaviour are poor/unreliable indicators of pain severity.

Table 4.2: Frequencies and percentages of correct responses for “true/false/don’t know” section ($n=100$)

True/false/don’t know statements	<i>n (%)</i>
Pain can be defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (True)* .	90 (90%)
Non-pharmacological methods, such as splinting, are effective methods to assist pain relief (True) .	86 (86%)
In the event that a patient’s pain is not managed, their overall clinical condition may deteriorate (progressively worse) (True) .	84 (84%)
Self-reports of pain according to the numeric rating scale (pain assessment tool) are the quickest way to assess pain (True) .	83 (83%)
Entonox® (Nitrous Oxide) is a potent analgesic with a very rapid onset of action and is quickly eliminated from the body (True) .	82 (82%)
Children younger than 11 years cannot reliably report pain, therefore, clinicians should rely solely on the parent’s assessment of the child's pain intensity (False) .	75 (75%)
Similar or comparable stimuli, in different people, will produce the same intensity or severity of pain (False) .	65 (65%)
If you do not consider the condition to be painful the patient should not receive analgesia (pain relief) (False) .	61 (61%)

In the pre-hospital environment, patients should not receive analgesia for chronic medical conditions (False).	61 (61%)
Giving patients' sterile water by injection (placebo) is a useful test to determine if their pain is real (False).	59 (59%)
Unconscious patients do not experience pain (False) ^a .	53 (53%)
Due to an underdeveloped nervous system, children younger than 2 years, have decreased sensitivity to pain and limited memory of painful experiences (False).	39 (39%)
Adult and paediatric patients who can be distracted from their pain are usually not experiencing severe pain (False).	39 (39%)
Vital signs are always reliable (good) indicators of the intensity or severity of a patient's pain (False).	31 (31%)
Young infants, less than 6 months of age, cannot tolerate opioids/narcotics (like morphine) for pain relief (False).	30 (30%)
Patient behaviour is a more reliable (good) indicator of pain than a patient's self-report (False).	29 (29%)
The experience and expression of pain are influenced by a patient's culture and/or spiritual beliefs (True).	25 (25%)
If the source of a patient's pain is unknown, opioids/narcotics (like morphine) should not be used during the pain evaluation period, as this could mask the ability to correctly diagnose the cause of pain (False).	23 (23%)
Footnote: *Correct responses for each statement indicated in bold , ^a There is a debate in the literature that pain is a construct of the conscious brain and all other processes contributing to pain should be referred to as nociception. Based on such an understanding, pain cannot be felt by an unconscious person. However, the curricula of EM practitioners in South Africa refer to pain pathways and pain processes at both the unconscious and conscious levels of the nervous system without discriminating between pain and nociception. Hence, in this context, this statement is regarded as false.	

Ninety-one (91%) of the 100 respondents completed the 3-point Likert-scale section [3]. Correct responses ranged between 0 (0%) and 7 (100%) out of 7 with an average percentage of 64.68% (*SD* 22.87, *95%CI* 59.92 - 69.44). The correct responses for the Likert statements are depicted and ranked in Table 4.3. Only 33% of respondents disagreed that their experience dealing with patients in pain allows them to score patients' pain more accurately than the patient themselves and 62.6% disagreed that parents or guardians of children should not be present during painful procedures.

Table 4.3: Frequencies and percentages of correct responses for Likert-scale section (*n*=91)

Likert-scale statements	<i>n</i> (%)
Using a pain assessment tool is a necessary instrument in pain assessment and pain management decision making (Agree) [*] .	76 (83.5%)
Patients should not be included in the pain management decision-making process (Disagree).	75 (82.4%)
The main reason for administering analgesia (pain relief) is to enable the patient to get to the ambulance (Disagree).	73 (80.2%)
It is better to be stoic (endure pain or hardship without showing their feelings or complaining) about pain than totally open about it (Disagree).	60 (65.9%)
Parents or guardians of children should not be present during painful procedures (Disagree).	57 (62.6%)
Expectations of my peers or the company/EMS service I work for, strongly influence my pain management practice (Disagree).	41 (45.1%)
I believe that my prior experience dealing with patients in pain allows me to score patients' pain more accurately than the patient themselves (Disagree).	30 (33.0%)
[*] Correct responses for each statement indicated in bold	

Statement 35 of section 3 required respondents to share their own opinion on whether they believe the current HPCSA protocols provide sufficient and appropriate pain management options for the SA prehospital setting. Of the 91 respondents, 46.2% ($n=42$) disagreed while 14.3% ($n=13$) neither agreed nor disagreed and 39.6% ($n=36$) agreed with the statement.

The mean score for the MCQs (see Table 4.4) section [4] was 2.59 out of 5 or 51.72% (SD 21.03, 95% CI 47.24 - 56.21) and ranged between 0 (0%) and 5 (100%). For 79.3% of respondents, the patient was the most accurate judge of pain intensity while 65.5% of respondents selected the correct wording of the numeric rating scale. For the 87 (87%) respondents who completed all three sections [2,3,4], the mean score was 17.40 out of 30 or 58.01% (SD 15.66, 95% CI 54.67 - 61.35) with scores ranging between 6 (20.0%) and 29 (96.67%).

Table 4.4: Frequencies and percentages of correct responses for multiple-choice questions (MCQs) section ($n=87$)

Multiple-choice questions	n (%)
The most accurate judge of the intensity of the patient's pain is: The patient* .	69 (79.3%)
The correct wording when using the Numeric Rating Scale is: Can you give your pain a score between 0 & 10 with 0 being no pain and 10 the worst imaginable pain.	57 (65.5%)
Effective management of acute pain is a fundamental component of: Quality patient care.	55 (63.2%)
Pain is believed to play a major part in the activation of the 'stress' response to injury, leading to all the below, EXCEPT: Decreased coagulability.	24 (27.6%)
With regards to pain, all the following descriptors are applicable EXCEPT: Always associated with actual tissue damage.	20 (23.0%)

*Correct responses for each statement indicated in bold

Factors influencing knowledge and attitudes regarding pain in the SA prehospital setting

A significant difference was found in the scores obtained by respondents with different levels of qualification ($H=30.79$, $p<0.001$) as well as in the scores of respondents with different number of years of experience ($H=9.051$, $p=0.011$) (Additional File 2: [Table S4.1](#)). ALS qualified practitioners obtained higher scores compared to both BLS and ILS qualified practitioners, and ILS practitioners obtained higher scores compared to BLS practitioners. The median percentage for ALS practitioners were 76.67% ($IQR=56.67-80.00$), 56.67% ($IQR=47.50-66.67$) for ILS practitioners and 46.67% ($IQR=40.00-50.00$) for BLS practitioners. Respondents with 0-10 years' experience obtained lower scores compared to respondents with 11-20 years' experience. The median percentage for respondents with 0-10 years' experience was 51.67% ($IQR=43.33-64.17$) and 60.00% ($IQR=53.33-73.33$) for those with 11-20 years' experience. A weak (0.10-0.39) positive relationship ($r_s=0.323$, $p=0.002$, two-tailed) was found between overall scores and years' experience and a moderate (0.40-0.69) positive relationship ($r_s=0.597$, $p<0.001$, two-tailed) between overall scores and level of qualification (44).

Respondents who had not attended any specific training on pain management in the preceding two years obtained a statistically significant ($U=664.0$, $p=0.017$) higher score compared to those who did. The median percentage for respondents who had not attended any specific training on pain management was 60.00% ($IQR=50.00-75.00$) and 53.33% ($IQR=45.83-63.33$) for those who did. There was no difference in scores analysed by gender ($U=718.5$, $p=0.327$) and age group ($H=2.800$, $p=0.424$).

Barriers to and enablers of pain assessment and management (section 5) (n=73)

The three most selected (from list provided) barriers to pain assessment and management were: alcohol and drug use by patients ($n=49$, 67.1%); language ($n=45$, 61.6%); and workload or lack of time ($n=44$, 58.9%). The three most selected enablers were: the availability of higher qualified emergency care providers ($n=54$, 74%); the understanding that pain management is important ($n=43$, 58.9%); and the availability of resources such as medication, disposables, and monitoring equipment and a cooperative patient with 52.1% ($n=38$), each. The complete list of barriers and enablers, as well as the additional barriers and enablers cited by respondents, are available in Additional File 2, [Table S4.2](#).

Case Studies (section 6) (n=65)

Two case scenarios (see Table 4.5) were used to determine pain assessment (pain scale 0-10) and management practices. Of the 65 respondents who completed this section, only 35.4% ($n=23$) assigned a pain score of 8 as self-reported by the patient (patient 1) presenting with no behavioural indicators of severe pain whereas, for the patient (patient 2) with behavioural indicators of severe pain, 64.6% ($n=42$) of respondents assigned a pain score of 8 as self-reported (see Additional File 2: [Figure S4.1](#) and [S4.2](#)). The median pain score for patient 1 was 5 (IQR 3-8) and 8 (IQR 6-8) for patient 2.

The pain management indicated by respondents for both patients is summarised per level of qualification in Additional File 2: [Table S4.3](#). Although both patients self-reported a pain score of 8/10 (severe pain), the pain management strategies provided suggest that respondents will manage a patient with behavioural indicators of severe pain more aggressively with pharmacological agents than a patient without behavioural signs of severe pain. Positive points to highlight were the consideration of requesting pain medication from the referring facility (BLS & ILS) before transportation, providing pain relief before moving the patient and the consideration given to non-pharmacological pain management (make patient comfortable, reposition and continuous reassessment). Points of concern were the administration of placebo to test whether the patient is reporting pain honestly and the fact that overall, the descriptions

provided suggested that the patients (specifically patient 1), would have been transported with little to no pain relief.

Table 4.5: Case scenarios ($n=65$)

<p>Patient 1: Andrew</p> <p>Andrew is 25 years old and this is his first day following abdominal surgery. As you enter his room, he smiles and continues talking and joking with his visitor. You are required to transport him to a hospital closer to home. Your assessment reveals the following information: BP = 120/80 mmHg; Heart Rate = 80 bpm; Respiratory Rate = 18 bpm. When questioned about his pain, on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort) he rates his pain as 8.</p> <p>Questions:</p> <ul style="list-style-type: none">- On the patient care report form, you are required to indicate his pain score. Select the number on the below scale (0-10) that represents your assessment of Andrew's pain.- Indicate how you will manage Andrew's pain.
<p>Patient 2: Robert</p> <p>Robert is 25 years old and this is his first day following abdominal surgery. As you enter his room, he is lying quietly in bed and grimaces as he turns in bed. You are required to transport him to a hospital closer to home. Your assessment reveals the following information: BP = 120/80mmHg; Heart Rate = 80 bpm; Respiratory rate = 18 bpm. When questioned about his pain, on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort) he rates his pain as 8.</p> <p>Questions:</p> <ul style="list-style-type: none">- On the patient care report form, you are required to indicate his pain score. Select the number on the below scale (0-10) that represents your assessment of Robert's pain.- Indicate how you will manage Robert's pain.

Discussion

To our knowledge, this is the first study investigating prehospital acute pain knowledge, attitudes, and practices in an African prehospital setting, therefore, the findings will be valuable in terms of making recommendations for pain education and further research.

Knowledge and attitudes regarding pain

Our findings show that there are significant gaps in knowledge and attitudes regarding pain in this cohort of prehospital providers. Research investigating acute pain KAP in Africa and around the world are more commonly conducted in hospitals among nurses and other HCPs. Given the vast differences between nursing curricula and that of prehospital practitioners in South Africa, variances between the in-hospital and out-of-hospital setting and the fact that the questionnaire used was only face validated, makes direct comparison difficult and limited.

The low scores obtained by the respondents in the present study are similar to those reported in studies conducted among nurses and other HCPs from various countries including the African region (45–57). Studies from North America (58–60), Norway (61) and Australia (62) found substantially higher (72% to 79%) knowledge and attitudes scores among nurses. Still, these

studies recommend targeted pain education to overcome specific areas of knowledge and attitudes deficits along with regular in-service pain education (58,60,62). Research among nurses has shown that knowledge and attitudes regarding pain predict pain management practices, with attitudes contributing more to variances in pain management practices than knowledge (63). Additionally, adequate pain knowledge and favourable attitudes among nurses also correlate positively with patient satisfaction (58). Although pain education is paramount to altering attitudes and improving pain knowledge, the opinion of some is that education alone may not suffice (59). In addition to pain education, organisational culture must promote effective pain management practices, provide leadership and support, encourage a culture of continuous learning, and promote interdisciplinary teamwork (59). Further, the implementation of a continuous quality improvement programme (16,64) and pain protocols or guidelines as well as removing the need to obtain medical control authorisation (13) have likewise improved the provision of prehospital analgesia.

Factors influencing knowledge and attitudes regarding pain

Our findings show that the level of qualification is a key factor influencing provider knowledge and attitudes regarding pain. This relationship has been confirmed by many international studies (47,48,54,57,59,61,65,66). However, the effect of years of experience on scores is uncertain with many differing findings across studies (53,54,58,59,61,65,66). As would be thought, prior pain education usually results in higher knowledge and attitudes regarding pain scores (48,58) yet our findings echoed that of an Ethiopian study by Germossa et al. (46) which showed higher scores amongst those not having attended further pain education.

Gaps in pain knowledge, attitudes, and pain management practices

After contrasting participant responses, gaps in knowledge and attitudes regarding pain were identified. Comprehension of the rudimentary principles of pain, pain physiology, pain assessment, indicators of pain severity and pain management was questionable.

Some respondents believed it to be appropriate to administer sterile water to test whether the pain is real, while some believed that pain relief should not be provided if (in their opinion) the condition is not painful. Mistakenly, vital signs were perceived to be a reliable indicator of pain severity (67) while some respondents believed that their prior experience dealing with patients in pain, allows them to score pain more accurately than patients themselves.

Although most respondents indicated that non-pharmacological approaches to pain management assist pain relief, answers to other statements related to non-pharmacological

approaches like distraction and emotional support from parents were less positive. Most were correct with regards to pharmacological pain management, however, more than 70% held the belief that infants aged less than 6 months cannot tolerate opioids (poor performance on this item must be considered in terms of the scope of many practitioners limiting their familiarity with infants and opioids).

Despite strong evidence that culture, ethnicity and spirituality plays a significant role in both pain expression and pain behaviour, making behaviour a poor indicator of pain severity (68), comprehension on the part of survey respondents were poor. These misconceptions were further evident in the case scenarios. Respondents considered behavioural indicators of pain more important than self-reported pain. All of which suggests a lack of trust in patients to accurately self-report pain. Further, pain management practices described by respondents for the case studies suggest that the patients will not receive ideal pain relief during the prehospital phase. The practice of administering sterile water (placebo) to test whether the pain is real, is questionable and likely a violation of the ethical principles (69).

As mentioned, knowledge deficit and practitioners' perceptions, beliefs and attitudes are barriers to pain assessment and management frequently highlighted in the literature (13,18,21,22,70). The inadequacies of pain knowledge in emergency care providers have been attributed to limited focus during initial training, as well as the lack of continuous pain education (13,18,21,22,70). The extent of pain education during the initial training of emergency care providers in SA is hard to gauge and varies between training institutions and level of qualification. Nevertheless, all levels of emergency care providers are qualified to provide analgesia in some form. It is imperative that initial emergency care education in South Africa incorporates the topic of pain with pain capabilities specified to include competency in pain assessment, non-pharmacological and scope-specific pharmacological pain management.

Educational interventions

The study by Germossa et al. (46) additionally showed a significant increase in the mean percentage (41.4% to 63%) for the KASRP scores obtained by nurses after an educational intervention, suggesting that educational initiatives are effective in improving knowledge and attitudes regarding pain. Surprisingly, similar to our findings, the authors reported that in both the pre- and post-intervention testing, nurses with no previous in-service training in pain obtained significantly higher KASRP scores compared to those who received prior pain education (46). This finding could not be explained due to a lack of further information about the in-service training; however, the authors suggested that nurses can change prior knowledge and attitudes

regarding pain by attending pain educational programmes and that further tailored continuous education is needed. The positive effects of educational initiatives on pain care were also reported in the prehospital research by French et al (71) in 2006. The authors found that although paramedics attended an average of 2.2 hours of pain education prior to the educational intervention on prehospital pain care, a significant improvement was found in all features of pain assessment and management after the educational intervention (71).

Respondents in this study who reported receiving training on pain assessment and management as part of continuing medical education also performed more poorly than others. Like, Gernossa et al. (46) reported, this finding could not be explained due to a lack of further information. Continuing medical education may occur in an array of formal and informal formats. Various factors could have affected the acquisition and retention of the knowledge respondents received during educational initiatives, such as the extent, content, depth, and form of education which were not the focus of the current study. Literature also suggests that knowledge gained from pain education will likely decline over time (72).

The current findings suggest that pain education should focus on all aspects relating to pain in order to improve knowledge and attitudes among emergency care providers in SA and that pain education must be continuous. Further research investigating instructional methodologies and strategies to improve pain knowledge acquisition, reinforcement and retention may be beneficial.

Barriers and enablers

As elsewhere in the world, language barriers, and alcohol/drug use were identified as key barriers to prehospital pain management (73,74). Workload and lack of time with patients appear to be barriers specific to the South African prehospital setting. Public EMS, in particular, have a significant workload burden (75), frequently dealing with more than one patient at a time which may influence the delivery of pain care. Availability of higher qualified emergency care practitioners as the foremost enabler of pain management is also likely specific to the SA prehospital setting and due to the structure of the EMS workforce in SA, pain management limitations in the scopes of practice of different levels of qualifications and resource (medication) limitations. The unavailability of the inhaled analgesic medication, Entonox®, in the SA prehospital setting significantly limits the provision of pain management. It is essential that prehospital providers have access to the resources required to facilitate pain management. Although more than half of the respondents identified that pain management is important, the influence of EMS and emergency department culture and leadership support on pain prioritisation and the provision of pain care in the prehospital setting must not be underestimated or overlooked

(19,20). Studies investigating barriers and enablers of prehospital pain assessment and management have all occurred in HIC (18–21,70). The South African prehospital setting is unique in terms of the various levels of qualification and coinciding limitations in scopes of practice, skillset and experience of ALS practitioners, organisational culture, the threat of violence against EMS staff, workload outweighing resource (ambulance) availability, resource limitations, vast distances to health care in rural areas, lack of universal health coverage and disparities in health care, high trauma burden etc. all which may influence prehospital care. Consequently, research to further investigate and describe the barriers to, and enablers of, pain assessment and management in this environment are essential (76).

Study limitations

Being the first survey of its kind in the African prehospital setting, this study is an important point of departure for acute pain research. Observational studies have limitations, and in this study, participation was poor despite additional recruitment and extended data collection, which may have left the study underpowered to determine significant relationships between demographic groups. Tracking questionnaire distribution and calculating a response rate was unanticipatedly problematic. In the future, survey response rates will have to be carefully assessed, in light of the POPI act and may also be mitigated through technology assisting better tracking of the number of surveys disseminated by third parties, in an anonymous way.

Non-response bias may have been introduced if the respondents that declined to participate were systematically different from those that agreed or if some eligible participants were not reached (77). The survey suffered a 35% dropout rate by the end which may have been secondary to the length of the survey, technical difficulties, work requirements or a lack of interest. The high dropout rate may have introduced further bias in the results due to the under-representation of certain categories of respondents. Respondents who failed to complete the survey were predominantly male (77.1%), had ≤ 10 years' experience (68.6%) and were ILS (45.7%) qualified. The generalisability of these findings is not clear, but we believe that despite the small number of respondents, and limited diversity of respondents in terms of the level of qualification, the role within EMS and the region of origin within the province (which may weigh rural practitioners disproportionately), the findings nevertheless create a foundation towards the understanding of the assessment and management of acute pain in the prehospital setting in SA.

Reporting bias may have originated from participants responding in what they perceive to be a professionally desirable manner, instead of exclusively based on personal beliefs, but we believe this bias was reduced by anonymity of the survey, the wide range of questions in different formats

and the case study scenarios. The study findings are further limited by the lack of a validated prehospital knowledge and attitudes survey regarding pain. However, to maximise validity the questionnaire was based on existing validated questionnaires, received expert input and was piloted. Finally, although emergency care providers are required to be fluent in English, it may not be the home language (78) of a significant proportion of respondents leading to the possible misinterpretation of statements or questions answered in the survey.

Conclusion

Our results suggest suboptimal knowledge and attitudes regarding pain among most emergency care providers in the WC, SA. Further, we identified gaps in pain knowledge, attitudes and practices which can be addressed through sufficient attention during undergraduate education as well as tailored, evidence-based pain educational initiatives and ongoing pain education for qualified practitioners. Future work should focus on describing the impact of educational initiatives on pain care as well as exploring the decline in pain knowledge and attitudes over time and what aspects may influence this decline. Although practitioners indicated some issues which they perceive to be barriers and enablers of prehospital pain assessment and management, additional research is indicated to develop a deeper understanding. EMS systems must promote quality pain care and monitor the effectiveness and efficiency of the pain management practice in the prehospital setting, ensuring feedback to operational staff.

Abbreviations

AEA: Ambulance Emergency Assistant; BAA: Basic Ambulance Assistant; CCA: Critical Care Assistant; CI: Confidence Interval; ECP: Emergency Care Practitioner; ECT: Emergency Care Technician; EMS: Emergency Medical Services; HCP: Healthcare Provider; HPCSA: Health Professionals Council of South Africa; KAP: Knowledge, Attitudes and Practices; KASRP: Knowledge and Attitudes Survey Regarding Pain; MCQs: Multiple-choice Questions; SA: South Africa; WC: Western Cape.

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Authors' contributions

AL conceived the study design, conducted the data analysis, and drafted the report. PH and RP assisted with the final report. All authors have read and approved the manuscript.

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Availability of data and material

The datasets used and/or analysed during the study are not publicly available but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Approval was obtained from the Human Research Ethics Committee at the University of Cape Town (Reference: 220/2017) and three ambulance services. Informed consent was obtained through a tick box and participation was voluntary.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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References

1. Galinski M, Ruscev M, Gonzalez G, Kavas J, Ameer L, Biens D, et al. Prevalence and management of acute pain in prehospital emergency medicine. *Prehosp Emerg Care* [Internet]. 2010;14(3):334–9. Available from: <https://doi.org/10.3109/10903121003760218>
2. Jennings PA, Cameron P, Bernard S. Epidemiology of prehospital pain: An opportunity for improvement. *Emerg Med J* [Internet]. 2011;28(6):530–1. Available from: <http://dx.doi.org/10.1136/emj.2010.098954>

3. Murphy A, McCoy S, O'Reilly K, Fogarty E, Dietz J, Crispino G, et al. A Prevalence and Management Study of Acute Pain in Children Attending Emergency Departments by Ambulance. *Prehospital Emerg Care* [Internet]. 2016;20(1):52–8. Available from: <https://doi.org/10.3109/10903127.2015.1037478>
4. Friesgaard KD, Riddervold IS, Kirkegaard H, Christensen EF, Nikolajsen L. Acute pain in the prehospital setting: A register-based study of 41.241 patients. *Scand J Trauma Resusc Emerg Med* [Internet]. 2018;26(1):1–10. Available from: <https://doi.org/10.1186/s13049-018-0521-2>
5. Matthews R, McCaul M, Smith W. A description of pharmacological analgesia administration by public sector advanced life support paramedics in the City of Cape Town. *African J Emerg Med* [Internet]. 2017;7(1):24–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.002>
6. Vincent-Lambert, C, de Kock J. Use of morphine sulphate by South African paramedics for prehospital pain management. *Pain Res Manag* [Internet]. 2015;20(3):141–4. Available from: <http://dx.doi.org/10.1155/2015/507470>
7. Lourens A, McCaul M, Parker R, Hodgkinson P. Acute Pain in the African Prehospital Setting: A Scoping Review. *Pain Res Manag* [Internet]. 2019;1–13. Available from: <https://doi.org/10.1155/2019/2304507>
8. Ogboli-Nwasor E, Hogans BB. Fact Sheet 8: Pain Education in Low-Resource Countries [Internet]. International Association of the Study of Pain. 2018. p. 1–7. Available from: <https://www.iasp-pain.org/GlobalYear/PainEducation>
9. Size, M, Soyannwo, OA, Justins D. Pain management in developing countries. *Anaesthesia* [Internet]. 2007;62(Suppl 1):38–43. Available from: <https://doi.org/10.1111/j.1365-2044.2007.05296.x>
10. Wells N, Pasero C, McCaffery M. Improving the Quality of Care Through Pain Assessment and Management. In: Hughes RG, editor. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses, Vol 1* [Internet]. Rockville, MD: Agency for Healthcare Research and Quality; 2008. p. 474–502. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK2658/>
11. Glowacki D. Pain Management and Improvements in Patient's Outcomes and Satisfaction. *Crit Care Nurse* [Internet]. 2015;35(3):33–43. Available from: <http://dx.doi.org/10.4037/ccn2015440>
12. Sinatra R. Causes and Consequences of Inadequate Management of Acute Pain. *Pain Med*

- [Internet]. 2010;11:1859–71. Available from: <https://doi.org/10.1111/j.1526-4637.2010.00983.x>
13. Hennes H, Kim MK. Prehospital pain management: Current status and future direction. *Clin Pediatr Emerg Med* [Internet]. 2006;7(1):25–30. Available from: <http://dx.doi.org/10.1016/j.cpem.2006.01.008>
 14. Thomas SH, Shewakramani S. Prehospital Trauma Analgesia. *J Emerg Med* [Internet]. 2008;35(1):47–57. Available from: <https://doi.org/10.1016/j.jemermed.2007.05.041>
 15. Hanson S, Hanson A, Aldington D. Pain priorities in pre-hospital care. *Anaesth Intensive Care Med* [Internet]. 2017;18(8):380–2. Available from: <http://dx.doi.org/10.1016/j.mpaic.2017.05.001>
 16. McManus JG, Sallee DR. Pain management in the prehospital environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://doi.org/10.1016/j.emc.2004.12.009>
 17. Studnek JR, Fernandez AR, Vandeventer S, Davis S, Garvey L. The Association between Patients' Perception of Their Overall Quality of Care and Their Perception of Pain Management in the Prehospital Setting. *Prehospital Emerg Care* [Internet]. 2013;17(3):386–91. Available from: <https://doi.org/10.3109/10903127.2013.764948>
 18. Berben SAA, Meijs THJM, Van Grunsven PM, Schoonhoven L, Van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury* [Internet]. 2012;43(9):1397–402. Available from: <http://dx.doi.org/10.1016/j.injury.2011.01.029>
 19. Williams DM, Rindal KE, Cushman JT SM. Barriers to and enablers for prehospital analgesia for pediatric patients. *Prehospital Emerg Care* [Internet]. 2012;16(4):519–26. Available from: <https://doi.org/10.3109/10903127.2012.695436>
 20. Whitley DE, Li T, Jones CMC, Cushman JT, Williams DM, Shah MN. An assessment of newly identified barriers to and enablers for prehospital pediatric pain management. *Pediatr Emerg Care* [Internet]. 2017;33(6):381–7. Available from: <http://http://dx.doi.org/10.1097/pec.0000000000000514>
 21. Murphy A, Barrett M, Cronin J, McCoy S, Larkin P, Brenner M, et al. A qualitative study of the barriers to prehospital management of acute pain in children. *Emerg Med J* [Internet]. 2014;31(6):493–8. Available from: <http://dx.doi.org/10.1136/emered-2012-202166>

22. Hennes H, Kim MK, Pirrallo RG. Prehospital pain management: A comparison of providers' perceptions and practices. *Prehospital Emerg Care* [Internet]. 2005;9(1):32–9. Available from: <https://doi.org/10.1080/10903120590891705>
23. Hewes HA, Dai M, Mann NC, Baca T, Taillac P. Prehospital Pain Management: Disparity By Age and Race. *Prehosp Emerg Care* [Internet]. 2018;22(2):189–97. Available from: <https://doi.org/10.1080/10903127.2017.1367444>
24. Ramgopal S, Elmer J, Escajeda J, Martin-Gill C. Differences in Prehospital Patient Assessments for Pediatric Versus Adult Patients. *J Pediatr* [Internet]. 2018;199:200-205.e6. Available from: <https://doi.org/10.1016/j.jpeds.2018.03.069>
25. Bendall JC, Simpson PM, Middleton PM. Prehospital analgesia in New South Wales, Australia. *Prehosp Disaster Med* [Internet]. 2012;26(6):422–6. Available from: <https://doi.org/10.1017/S1049023X12000180>
26. Platts-Mills, TF, Hunold KM, Weaver, MA, Dickey, RM, Fernandez, AR, Fillingim, RB, Cairns, CB, McLean S. Pain Treatment for Older Adults During Prehospital Emergency Care: Variations by Patient Gender and Pain Severity. *J Pain* [Internet]. 2014;14(9):966–74. Available from: <https://doi.org/10.1016/j.jpain.2013.03.014>
27. Lord B, Bendall JC, Reinten T. The Influence of Paramedic and Patient Gender on the Administration of Analgesics in the Out-of-Hospital Setting. *Prehospital Emerg Care* [Internet]. 2014;18(2):195–200. Available from: <https://doi.org/10.3109/10903127.2013.856502>
28. Michael GE, Sporer KA, Youngblood GM. Women are less likely than men to receive prehospital analgesia for isolated extremity injuries. *Am J Emerg Med* [Internet]. 2007;25(8):901–6. Available from: <https://doi.org/10.1016/j.ajem.2007.02.001%0A>
29. Young MF, Hern HG, Alter HJ, Barger J, Vahidnia F. Racial differences in receiving morphine among prehospital patients with blunt trauma. *J Emerg Med* [Internet]. 2013;45(1):46–52. Available from: <http://dx.doi.org/10.1016/j.jemermed.2012.07.088>
30. Castrèn M, Lindström V, Hagman Branzell J, Niemi-Murola L. Prehospital personnel's attitudes to pain management. *Scand J Pain* [Internet]. 2015;8(1):17–22. Available from: <http://dx.doi.org/10.1016/j.sjpain.2015.02.003>
31. World Health Organisation and Stop TB Partnership. Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys

- [Internet]. Geneva: World Health Organisation; 2008. 1–68 p. Available from: papers2://publication/uuid/F52C6E32-6B86-4DCC-A96C-4ED36F8491A8
32. Gumucio, S, Luhmann, N, Guillaume, F, Zompi, S, Ronsse, A, Courcaud, A, Bouchon, M, Trehin, C, Schapman, S, Cheminat, O, Ranchal, H, Simon, S, Monde M. The KAP Survey Model [Internet]. Médecins Du Monde. 2011. Available from: https://www.researchgate.net/publication/51761253_Measuring_Quality_in_Emergency_Medical_Services_A_Review_of_Clinical_Performance_Indicators
 33. SurveyMonkey Inc. [Internet]. San Mateo, California, USA; Available from: www.surveymonkey.com
 34. Western Cape Government. Overview of the Western Cape [Internet]. 2019 [cited 2019 Jun 7]. Available from: https://www.westerncape.gov.za/your_gov/70#overview
 35. National Department of Health. National Emergency Care Education and Training Policy [Internet]. 2017 p. 1–16. Available from: <http://www.health.gov.za/index.php/2014-08-15-12-53-24/category/327-2017po?download=2126:national-emergency-care-education-and-training-policy>
 36. Sobuwa S, Christopher LD. Emergency care education in South Africa: past, present and future. *Australas J Paramed* [Internet]. 2019;16:1–6. Available from: <https://doi.org/10.33151/ajp.16.647>
 37. HPCSA. iRegister [Internet]. 2017. Available from: <http://isystems.hpcsa.co.za/iregister/>
 38. Raosoft.com. Sample Size Calculator [Internet]. Raosoft, Inc; 2016. Available from: <http://www.raosoft.com/samplesize.html>
 39. Ferrell BR, McCaffery M. Knowledge and Attitudes Survey Regarding Pain [Internet]. Vol. 10, *Journal of Palliative Medicine*. Available from: [https://prc.coh.org/Knowledge_&AttitudeSurvey7-14\(1\).pdf](https://prc.coh.org/Knowledge_&AttitudeSurvey7-14(1).pdf)
 40. Manworren R. Development and Testing of the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain. *Pediatr Nurs* [Internet]. 2001;27(2):151–8. Available from: <http://link.galegroup.com/apps/doc/A73827307/AONE?u=unict&sid=AONE&xid=7d19588e>
 41. Pocock H. Adaptation of a tool measuring attitudes towards pain in paramedics. *Int Emerg Nurs* [Internet]. 2013;21(3):210–5. Available from: <http://dx.doi.org/10.1016/j.ienj.2012.07.003>
 42. IBM. SPSS Statistics for Windows [Internet]. Armonk, NY: IBM Corp; 2017. Available from:

<https://www.ibm.com/za-en/analytics/spss-statistics-software>

43. Republic of South Africa. Protection of Personal Information, Act 4 of 2013. Gov Gaz [Internet]. 2013;(912):1–75. Available from: http://www.gov.za/sites/www.gov.za/files/37067_26-11_Act4of2013ProtectionOfPersonalInfor_correct.pdf
44. Schober P, Boer C, Schwarte LA. Correlation Coefficients: Appropriate Use and Interpretation. *Anesth Analg* [Internet]. 2018;126(5):1763–8. Available from: <https://doi.org/10.1213/ANE.0000000000002864%0A>
45. Eyob T, Mulatu A, Abrha H. Knowledge And Attitude Towards Pain Management Among Medical And Paramedical Students Of An Ethiopian University. *J Pain Reli* [Internet]. 2014;03(01):1–5. Available from: <http://www.dx.doi.org/10.4172/2167-0846.1000127>
46. Germossa GN, Sjetne IS, Hellesø R. The Impact of an In-service Educational Program on Nurses' Knowledge and Attitudes Regarding Pain Management in an Ethiopian University Hospital. *Front Public Heal* [Internet]. 2018;6(229):1–7. Available from: <https://doi.org/10.3389/fpubh.2018.00229>
47. Al-Quliti KW, Alamri MS. Knowledge, attitudes, and practices of health care providers in Almadinah Almunawwarah, Saudi Arabia. *Neurosciences* [Internet]. 2015;20(2):131–6. Available from: <https://doi.org/10.17712/nsj.2015.2.20140546>
48. Al Qadire, M, Al Khalailah M. Jordanian Nurses Knowledge and Attitude Regarding Pain Management. *Pain Manag Nurs* [Internet]. 2014;15(1):220–8. Available from: <http://dx.doi.org/10.1016/j.pmn.2012.08.006>
49. Amponsah AK, Oduro E, Bam V, Kyei-Dompim J, Aphoto CK, Axelin A. Nursing students and nurses' knowledge and attitudes regarding children's pain: A comparative cross-sectional study. *PLoS One* [Internet]. 2019;14(10):1–12. Available from: <https://doi.org/10.1371/journal.pone.0223730>
50. Woldehaimanot T, Saketa Y, Zeleke A, Gesesew H, Woldeyohanes T. Pain knowledge and attitude: a survey among nurses in 23 health institutions in Western Ethiopia. *Gaziantep Med J* [Internet]. 2014;20(3):254. Available from: <https://doi.org/10.5455/gmj-30-157196>
51. Zanolin ME, Visentin M, Trentin L, Saiani L, Brugnolli A, Grassi M. A Questionnaire to Evaluate the Knowledge and Attitudes of Health Care Providers on Pain. *J Pain Symptom Manage* [Internet]. 2007;33(6):727–36. Available from:

<https://doi.org/10.1016/j.jpainsymman.2006.09.032%0A>

52. Lin P, Chiang H, Chiang T, Chen C. Pain management: evaluating the effectiveness of an educational programme for surgical nursing staff. *J Clin Nurs* [Internet]. 2008;17(315):2032–41. Available from: <https://doi.org/10.1111/j.1365-2702.2007.02190.x>
53. Lui LYY, Winnie SKW, Fong DYT. Knowledge and attitudes regarding pain management among nurses in Hong Kong medical units. *J Clin Nurs* [Internet]. 2008;17(25):2014–21. Available from: <https://doi.org/10.1111/j.1365-2702.2007.02183.x>
54. Ekim A, Ocakçı A. Knowledge and Attitudes Regarding Pain Management of Pediatric Nurses in Turkey. *Pain Manag Nurs* [Internet]. 2013;14(4):e262–7. Available from: <http://dx.doi.org/10.1016/j.pmn.2012.02.004>
55. Samarkandi O. Knowledge and attitudes of nurses toward pain management. *Saudi J Anesth* [Internet]. 2018;12(2):220–6. Available from: http://doi.org/10.4103/sja.SJA_587_17
56. Eid, T, Manias, E, Bucknall, T, Almazrooa A. Nurses' Knowledge and Attitudes Regarding Pain in Saudi Arabia. *Pain Manag Nurs* [Internet]. 2014;15(4):e25–36. Available from: <http://dx.doi.org/10.1016/j.pmn.2014.05.014>
57. Alotaibi, K, Higgins, I, Chan S. Nurses' Knowledge and Attitude toward Pediatric Pain Management : A Cross-Sectional Study. *Pain Manag Nurs* [Internet]. 2018;1–12. Available from: <https://doi.org/10.1016/j.pmn.2018.09.001>
58. Brant JM, Mohr C, Coombs NC, Finn S, Wilmarth E. Nurses' Knowledge and Attitudes about Pain: Personal and Professional Characteristics and Patient Reported Pain Satisfaction. *Pain Manag Nurs* [Internet]. 2017;18(4):214–23. Available from: <http://dx.doi.org/10.1016/j.pmn.2017.04.003>
59. Lewthwaite BJB, Jabusch KM, Cmsn C, Jabusch, KM, Wheeler, BJ, Schnell-Hoehn, KN, Mills, J, Estrella-Holder, E, Fedorowicz A. Nurses' Knowledge and Attitudes Regarding Pain Management in Hospitalized Adults HOW TO OBTAIN CONTACT hours BY. *J Contin Educ Nurs* [Internet]. 2011;42(6):251–7. Available from: <http://doi.org/10.3928/00220124-20110103-03>
60. Mocerri, JT, Drevdahl D. Nurses' Knowledge and Attitudes Toward Pain in the Emergency Department. *J Emerg Nurs* [Internet]. 2014;40(1):6–12. Available from: <http://dx.doi.org/10.1016/j.jen.2012.04.014>
61. Smeland, AH, Twycross, A, Lundeberg, S, Rustøen T. Nurses' Knowledge, Attitudes and

- Clinical Practice in Pediatric Postoperative Pain Management. *Pain Manag Nurs* [Internet]. 2018;19(6):585–98. Available from: <https://doi.org/10.1016/j.pmn.2018.04.006>
62. Peirce D, Corkish, V, Lane, M, Wilson S. Nurses' Knowledge and Attitudes Regarding Pediatric Pain Management in Western Australia. *Pain Manag Nurs* [Internet]. 2018;19(6):707–17. Available from: <https://doi.org/10.1016/j.pmn.2018.03.002>
 63. Alzghoul BI, Azimah N, Abdullah C. Pain Management Practices by Nurses: An Application of the Knowledge, Attitude and Practices (KAP) Model. *Glob J Health Sci* [Internet]. 2016;8(6):154–60. Available from: <http://dx.doi.org/10.5539/gjhs.v8n6p154>
 64. Scott JW, Nyinawankusi JDA, Enumah S, Maine R, Uwitonze E, Hu Y, et al. Improving prehospital trauma care in Rwanda through continuous quality improvement: an interrupted time series analysis. *Injury* [Internet]. 2017;48(7):1376–81. Available from: <http://dx.doi.org/10.1016/j.injury.2017.03.050>
 65. Wurjine TH, Nigussie BG. Knowledge, attitudes and practices of nurses regarding to post-operative pain management at hospitals of Arsi zone, Southeast Ethiopia, 2018. *Women's Heal* [Internet]. 2019;7(4):130–5. Available from: <https://doi.org/10.15406/mojwh.2018.07.00183>
 66. Kizza IB, Muliira JK, Kohi TW, Nabirye RC. Nurses' knowledge of the principles of acute pain assessment in critically ill adult patients who are able to self-report. *Int J Africa Nurs Sci* [Internet]. 2016;4:20–7. Available from: <http://dx.doi.org/10.1016/j.ijans.2016.02.001>
 67. Lord B, Woollard M. The reliability of vital signs in estimating pain severity among adult patients treated by paramedics. *Emerg Med J* [Internet]. 2011;28:147–50. Available from: <https://doi.org/10.1136/emj.2009.079384>
 68. Peacock S, Patel S. Cultural Influences on Pain. *Rev Pain* [Internet]. 2008;1(2):6–9. Available from: <http://journals.sagepub.com/doi/10.1177/204946370800100203>
 69. Sullivan M. Ethical Principles in Pain Management. *Pain Med* [Internet]. 2000;1(3):274–9. Available from: <https://doi.org/10.1046/j.1526-4637.2000.00031.x>
 70. Walsh B, Cone D, Meyer E, Larkin G. Paramedic attitudes regarding prehospital analgesia. *Prehospital Emerg Care* [Internet]. 2012;17(1):78–87. Available from: <https://doi.org/10.3109/10903127.2012.717167>
 71. French SC, Salama NP, Baqai S, Raslavicus S, Chan SB, Ramaker J. Effects of Educational Interventions on Prehospital Pain Management. *Prehospital Emerg Care* [Internet].

- 2006;10(1):71–6. Available from: <https://doi.org/10.1080/10903120500366086>
72. Howell, D, Butler, L, Vincent, L, Watt-Watson, J, Stearns N. Influencing Nurses' Knowledge, Attitudes, and Practice in Cancer Pain Management. *Cancer Nurs* [Internet]. 2000;23(1):55–63. Available from: <https://doi.org/10.1097/00002820-200002000-00009>
73. Parker M, Rodgers A. Management of pain in pre-hospital settings. *Emerg Nurse* [Internet]. 2015;23(3):16–21. Available from: <https://doi.org/10.7748/en.23.3.16.e1445>
74. Iqbal M, Spaight PA, Siriwardena AN. Patients' and emergency clinicians' perceptions of improving pre-hospital pain management: a qualitative study. *Emerg Med J* [Internet]. 2013;30(3):1–6. Available from: <http://dx.doi.org/10.1136/emered-2012-201111>
75. Department of Health. Western Cape Government, Department of Health: Annual Report 2016/2017 [Internet]. 2017. Available from: <http://www.westerncape.gov.za>
76. Norman R, Matzopoulos R, Groenewald P, Bradshaw D. The high burden of injuries in South Africa. *Bull World Health Organ* [Internet]. 2007;85(9):695–702. Available from: <https://doi.org/10.2471/BLT.06.037184>
77. Merkle D. Nonresponse Bias. In: Lavrakas P, editor. *Encyclopedia of Survey Research Methods* [Internet]. Thousand Oaks: SAGE Publications, Inc; 2011. p. 532–3. Available from: <http://methods.sagepub.com.ezproxy.uct.ac.za/base/download/ReferenceEntry/encyclopedia-of-survey-research-methods/n340.xml>
78. Government of South African. Western Cape [Internet]. South Africa's provinces. 2019 [cited 2019 Jun 7]. Available from: <https://www.gov.za/about-sa/south-africas-provinces#wc>

Supplementary material of the published article

Table S4.1: Comparing overall score between demographic groups ($n=87$)

	Test Score	Mean Rank	<i>p-value</i>
Gender*			
Male (n=59)	718.5	45.82	0.327
Female (n=28)		40.16	
Highest Qualification**			
BLS (n=19)	30.79	20.79	< 0.001
ILS (n=44)		43.31	
ALS (n=24)		63.65	
Years' Experience**			
0-10 Years (n=50)	9.051	37.34	0.011
11-20 Years (n=30)		51.18	
21-30 Years (n=7)		60.79	
Continuous Medical Education on acute pain assessment and management received in the last 2 years*			
Yes (n=46)	664.0	37.93	0.017
No (n=41)		50.80	
Age Groups**			
20-30 Years (n=30)	2.800	38.00	0.424
31-40 Years (n=37)		46.07	
41-50 Years (n=18)		49.25	
51-60 Years (n=2)		48.50	
*Mann-Whitney U test (p value < 0.05, two tailed), **Kruskal-Wallis H test (p value < 0.05, two tailed)			

Table S4.2: Barriers to and enablers of pain assessment and management (n=73)

Barriers to pain assessment and management	n (%)
Patient alcohol or drug use	49 (67.1%)
Language	45 (61.6%)
Workload and lack of time	44 (58.9%)
Uncooperative patient	42 (57.5%)
Lack of resources (medications, disposables, nasal atomizers, etc.) to manage pain	37 (50.7%)
Patient spiritual, cultural or religious believes	34 (46.6%)
Inability to determine adequate history/allergies	33 (45.2%)
Paediatric patients	32 (43.8%)
Culture in the emergency service or work environment	25 (34.2%)
Practitioners reluctance to administer medication to manage pain	25 (34.2%)
Parental influence or involvement	24 (32.9%)
Lack of available clinical practice guidelines to guide decision making	22 (30.1%)
Difficulty to assess pain	22 (30.1%)
Patient reluctance to report pain	22 (30.1%)
Service-related standard operating procedures or policy	21 (28.8%)
Patient reluctance to receive analgesic agents	20 (27.4%)
Concerns about adverse effects secondary to analgesic agents	20 (27.4%)
Insufficient availability of clinical education	19 (26.0%)
Unfamiliarity with protocols, medications, or indications for pain management	18 (24.7%)
Concerns about causing more pain	15 (20.5%)
Difficulty to calculate medication dosages	12 (16.4%)
Other: see additional items added below	4 (5.5%)
Insufficient number of Advanced Life Support practitioners,	
Protocol deficiency,	
Availability of ketamine (better analgesic medication for prehospital use than morphine),	
Lack of expertise,	
Entonox® not available on all ambulances	
Enablers of pain assessment and management	n (%)
Availability of higher qualified emergency care providers	54 (74.0%)
Pain management is important	43 (58.9%)
Resources (medications, disposables, monitoring equipment) always available	38 (52.1%)
Cooperative patients	38 (52.1%)
Regular clinical education	36 (49.3%)
Available clinical practice guidelines which guide decision making	32 (43.8%)
Regular pain assessment facilitates good pain management	28 (38.4%)
Service or company prioritise pain management	27 (37.0%)
Supportive management and leadership structure with work environment or emergency service	26 (35.6%)
Service-related standard operating procedures or policy	22 (30.1%)
Regular clinical audits	21 (28.8%)
Other: see additional items added below	3 (4.1%)
Regular updates,	
Providing all qualifications in emergency care with more efficient analgesic medications,	
Knowing the quality of pain ("stabbing versus burning pain")	

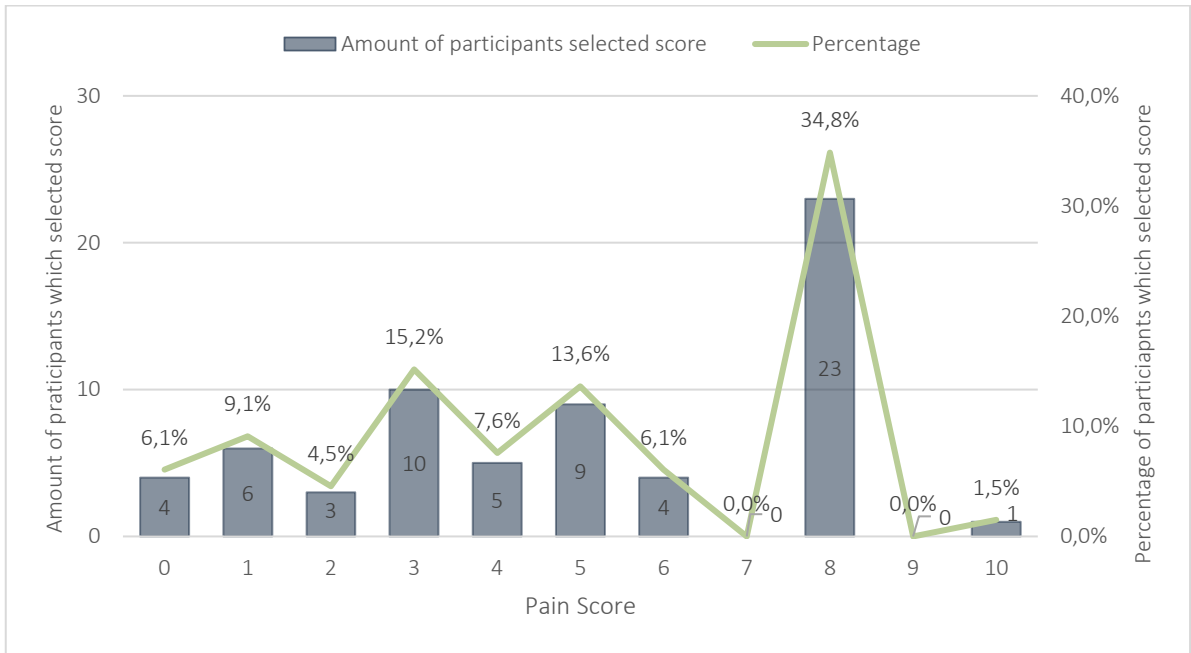


Figure S4.1: Pain score scenario – patient 1 (Andrew) (n=65)

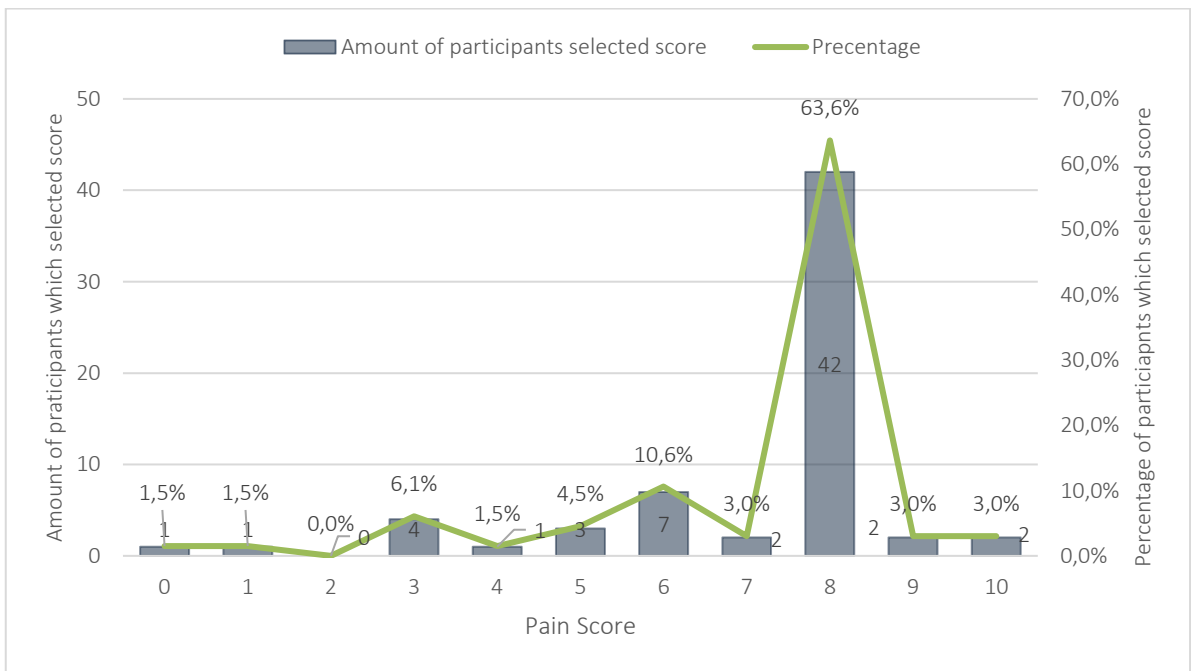


Figure S4.2: Pain score scenario – patient 2 (Robert) (n=65)

Table S4.3: Pain management for case scenarios (n=65)

Qualification	Patient 1 (Andrew's)	Patient 2 (Robert's)
BLS (n=12)	<ul style="list-style-type: none"> - Re-assess patient & conduct ongoing assessment - Observe facial expressions - Position & make patient comfortable, ask nurse to administer pain medication before transportation - Administer 40% oxygen - Administer Entonox® according to protocol 	<ul style="list-style-type: none"> - Re-assess patient & conduct ongoing assessment - "Calm patient" - Position & make patient comfortable, ask nurse to administer pain medication before transportation - Administer 40% oxygen - Administer Entonox® according to protocol
ILS (n=32)	<ul style="list-style-type: none"> - Calm & re-assess the patient - Position & make comfortable, monitor vital signs & transport - Consider the administration of oxygen 40% - Administer Entonox® according to protocol - No pain medication on scope of practice, therefore, will start oxygen & IV therapy in case advanced life support (ALS) backup is needed to administer pain medication, make patient comfortable - Request for the administration of pain medication from nursing staff - Consult ALS practitioner 	<ul style="list-style-type: none"> - Calm & re-assess the patient - Position & make comfortable, monitor vital signs & transport - Consider the administration of oxygen 40% - Administer Entonox® according to protocol - No pain medication on scope of practice, therefore, will start oxygen & IV therapy in case ALS backup is needed to administer pain medication, make patient comfortable - Consult ALS practitioner or request backup for pain medication - Request for the administration of pain medication from nursing staff
ALS (n=21)	Emergency Care Technician (n=4)	
	<ul style="list-style-type: none"> - Provide "Tender Loving Care (TLC)" - Make patient comfortable & titrate pain medication - Assess vital signs, obtain history (allergies) & administer pain medication if needed - Conduct visual assessment (overall behaviour & facial expressions) as patient may be enduring pain or exaggerating pain. Administer placebo & reassess pain score, if the same transport. 	<ul style="list-style-type: none"> - Provide "TLC" & pain medication - Since patient in the hospital, consultant doctor regarding analgesia before departure & during transfer - Assess vital signs, obtain history (allergies) establish intravenous (IV) therapy, administer pain medication & monitor - Administer placebo & re-assess pain, in the event the pain score remains the same, consult with the medical officer
	Paramedic (Critical care Assistant and National Diploma in Emergency Medical Care paramedic) (n=9)	
	<ul style="list-style-type: none"> - "Calm & reassure" - "No intervention" - Manage conservatively, position, if ineffective administer pain medication - If the patient request, administer analgesia prior to loading the patient for transportation - Position & make comfortable, monitor to see whether pain medication needed - Administer morphine (3 mg) IV & monitor 	<ul style="list-style-type: none"> - "TLC" - "No intervention" - Position, if pain did not take any pain medication, administer analgesia - Administer analgesia prior to loading the patient for transportation - Administer morphine (titrate 1 mg to the desired effect, 5mg) IV & monitor
	Emergency Care Practitioner (n=8)	
<ul style="list-style-type: none"> - Comfort patient - Reposition, if no pain relief administer analgesia - Inquire whether the patient requires pain medication, administer 1g of paracetamol before considering opioids, would consider adverse effects of opioids in this patient before administration - Ask the hospital for oral analgesia - Administer pentrox - Administer morphine - Consider patient factors, moving patient will increase pain, inquire about whether pain medication was administered & when, inquire whether patient what pain medication & document replay, administer IV morphine but IV paracetamol would be preferred. 	<ul style="list-style-type: none"> - Comfort patient - Inquire whether something relieves the pain, if not administer analgesia - Inquire whether the patient requires pain medication, administer 1g of paracetamol IV before considering opioids, would consider adverse effects of opioids in this patient before administration - Administer morphine IV or ketamine IV - Consider patient factors & determine whether the patient is overstating pain since pain management is a vital part of patient care administer morphine & transport patient in a position of comfort. 	

4.4 Discussion

4.4.1 *Supplementary methods*

As previously described, the KAP survey model is often used to measure the three facets captured in the term namely; degree of knowledge, viewpoints or attitudes and observable actions or practices, about a health problem among a given study population with the goal to gain insight, identify misunderstanding or misconceptions and make recommendations for interventions (226,227). In relation to pain, KAP surveys are commonly utilised among nurses, physicians, and other HCPs, including students, those managing adults, paediatrics, and neonates in various clinical settings, for example, in the EC, ICU, and post-operative settings, etc. This research methodology provides a good opportunity to develop an understanding of the depth of knowledge and comprehension among emergency care providers in the WC, SA in terms of the rudimentary principles of acute pain, pain assessment and management as well as to determine their attitudes towards prehospital pain care and what actions they will employ to manage it.

The KASRP was developed in 1987 by Ferrell and McCaffery (228) and revised over the years. The survey is used to assess nurses and other HCPs and can also be used to assess HCPs before and after pain educational interventions as a measure of evaluation. In 2001, the KASRP was adapted by Manworren (229) to develop the PNKAS for the assessment of pain knowledge and attitudes among paediatric nurses. The KASRP and PNKAS were used as the basis for the development of the questionnaire used in this study ([Appendix 8](#)) but consideration was given to the fact that emergency care providers, dependent on their level of qualification, practice within a set scope with certain limitations, therefore, restricted questions on pharmacological pain management were adopted. In addition, various published articles on the topic were reviewed, with one particular article by Pocock (230) which adapted the KASRP to measure attitudes about pain in paramedics, proving beneficial. As indicated in the article the questionnaire was face validated.

In order to distribute the survey developed on the SurveyMonkey (www.surveymonkey.com) (224) platform via email to the calculated sample, a request to conduct research was submitted to the HPCSA. The request was specifically to obtain contact details of emergency care providers for email distribution of the survey. Unfortunately, the HPCSA initially denied the request and upon re-submission did not reply to the request to conduct research. In light of the Protection of Personal Information (POPI) Act 4 of 2013 (231), the EMS organisations which approved the research were also unable to share the personal information of employees to facilitate questionnaire distribution. As a result, an alternative method of distributing the survey needed to be established. A research poster ([Appendix 9](#)) with basic information on the survey as well as

an embedded link to the survey with a quick response (QR) code was developed and distributed by the management structures of the three EMS systems involved. When potential participants followed the link to the online survey an information page opened, providing the aim, rationale, and length of the survey after which practitioners could either agree or disagree (tick box informed consent) to participate voluntarily.

In addition to the statistical analysis reported in the article, further analyses were conducted. Supplementary descriptive statistical analysis was performed and are presented below. The non-parametric tests, Mann-Whitney U test, and Kruskal-Wallis H test were conducted to compare the mean ranks of pain scores (Andrew’s and Robert’s) between independent demographic information. The non-parametric test, Mann Whitney U test was conducted to determine whether Andrew’s pain score was statistically significantly different to Robert’s pain score. Further, simple, and multiple regression analyses were conducted to predict the overall scores based on demographic information.

4.4.2 Supplementary results

4.4.2.1 Participation and demographic information

Even though the survey was open for more than 5 months and various requests were made to the management structures of participating EMS systems to remind and encourage their staff to participate, the planned sample size could not be achieved. The aim was to achieve a representative sample of qualifications practising in the WC. Of all the emergency care providers registered with the HPCSA in the WC, a total of 1.1% (100/9091) participated in the survey. However, the accuracy of the number of practitioners registered with the HPCSA versus those truly practising in the WC is questionable. The BLS group appear to be significantly underrepresented in the study population (Table 4.6). According to the NECET policy (43) published in 2017, 40.5% ($n=619$) of practitioners employed by the public ambulance service in the WC are BLS practitioners and 43.6% ($n=665$) ILS and the remaining 15.9% ($n=242$) ALS practitioners. These data support the suggestion that the BLS group were underrepresented.

Table 4.6: Comparison of registered practitioners in WC versus survey participation

Level of Qualification	Registered in the WC <i>n</i> (%)	Participated in survey <i>n</i> (%)
BLS ^a	5890 (64.8%)	20 (20%)
ILS ^b	2337 (25.7%)	48 (48%)
ALS ^c	863 (9.6%)	32 (32%)
Total	9091 (100%)	100 (100%)
Footnote: ^a Basic Life Support including Basic Ambulance Assistant (BAA), ^b Intermediate Life Support including Ambulance Emergency Assistant (AEA), ^c Advanced Life Support including Emergency Care Technician (ECT), Critical Care Assistant (CCA) Paramedic, National Diploma in Emergency Medical Care (NDEMC), Emergency Care Practitioner (ECP).		

In addition to the demographic information reported in the article, it is noteworthy that while the survey was distributed to two private ambulance services only 7 (7%) questionnaires were completed by those employed in this sector. As a result, the private EMS sector was underrepresented in the results. Figure 4.2 illustrates the respondents' main employment function/responsibility within their EMS system at the time of the study.

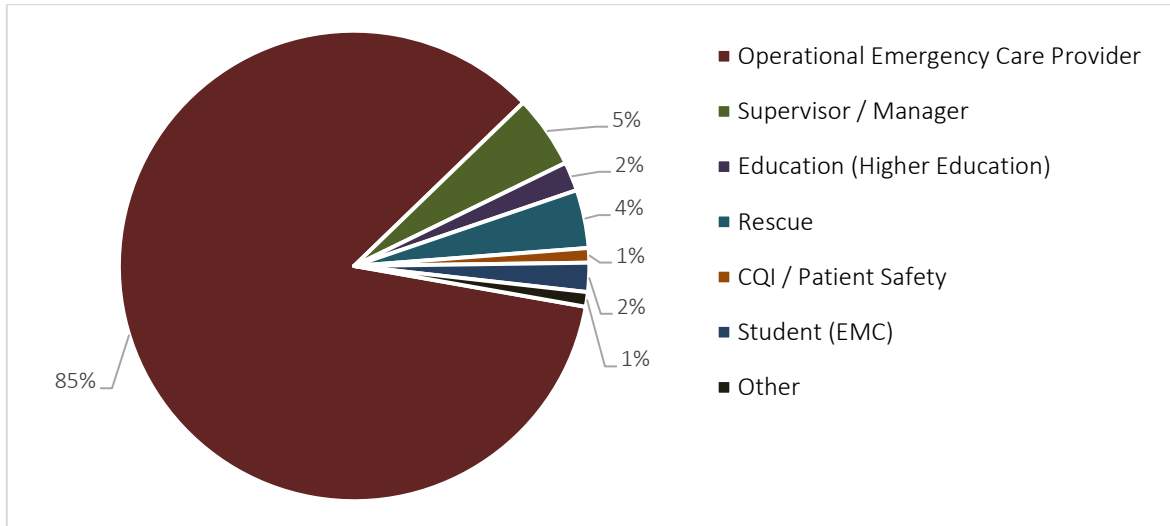


Figure 4.2: Current employment within EMS

Most (78%) respondents were between 21-40 years of age while 60% had ≤ 10 years' experience with 32% having between 11-20 years' experience in the profession (Figure 4.3).

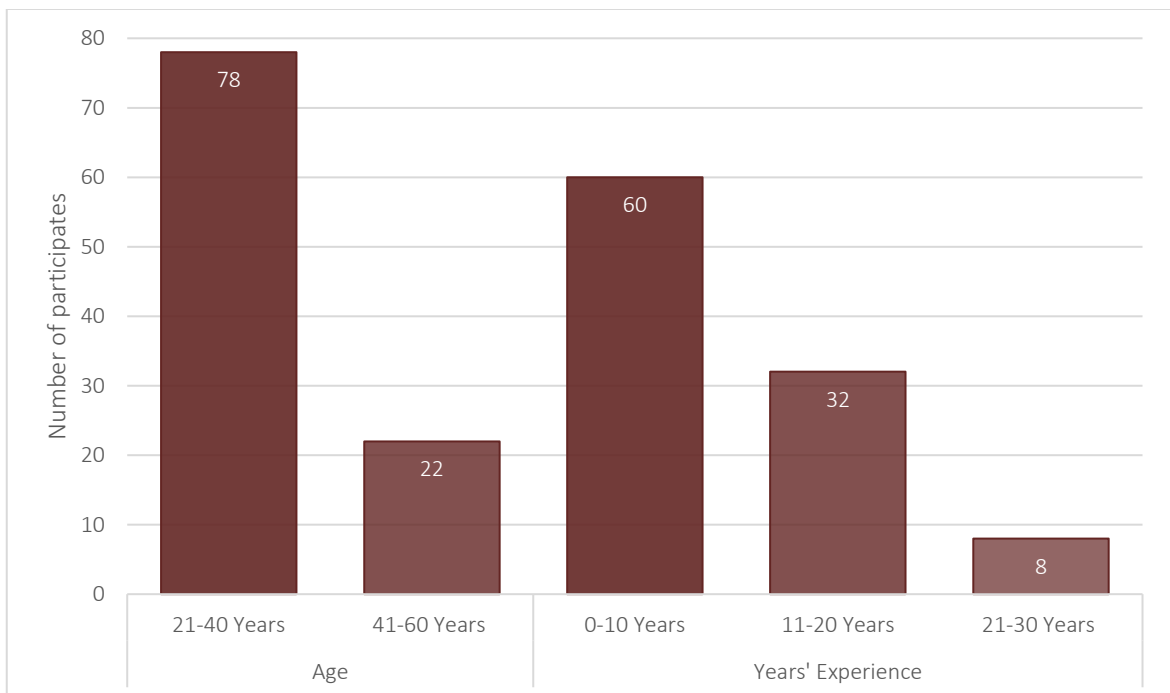


Figure 4.3: Respondents years of experience and age groups ($n=100$)

4.4.2.2 Factors influencing knowledge and attitudes regarding pain

As discussed in the article, differences in the KAP scores between the level of qualification, years' experience and training on the research topic were statistically significant ([Table S4.1](#)). Table 4.7 illustrates the differences in the median percentages and IQR of each of the demographic groups.

Table 4.7: Median percentage and IQR between demographic groups

Demographics	Percentage Median (IQR)
Level of Qualification	
BLS (n=19)	46.67 (40.00-50.00)
ILS (n=44)	56.67 (47.50-66.67)
ALS (n=24) ^a	76.67 (56.67-80.00)
Years of Experience	
0-10 Years (n=50)	51.67 (43.33-64.17)
11-20 Years (n=30)	60.00 (53.33-73.33)
21-30 Years (n=7)	76.67 (56.67-80.00)
Continuous Medical Education on acute pain assessment & management received in the last 2 years	
Yes (n=46)	53.33 (45.83-63.33)
No (n=41)	60.00 (50.00-75.00)
Footnote: ^a Advanced Life Support includes Emergency Care Technician (ECT), Critical Care Assistant (CCA) Paramedic, National Diploma in Emergency Medical Care (NDEMC), Emergency Care Practitioner (ECP).	

For male respondents, the median KAP percentage was 56.67% ($IQR=46.67-73.34$, $n=59$) and 53.33% ($IQR=46.67-70.00$, $n=28$) for female respondents though this difference was not statistically significant (Figure 4.4).

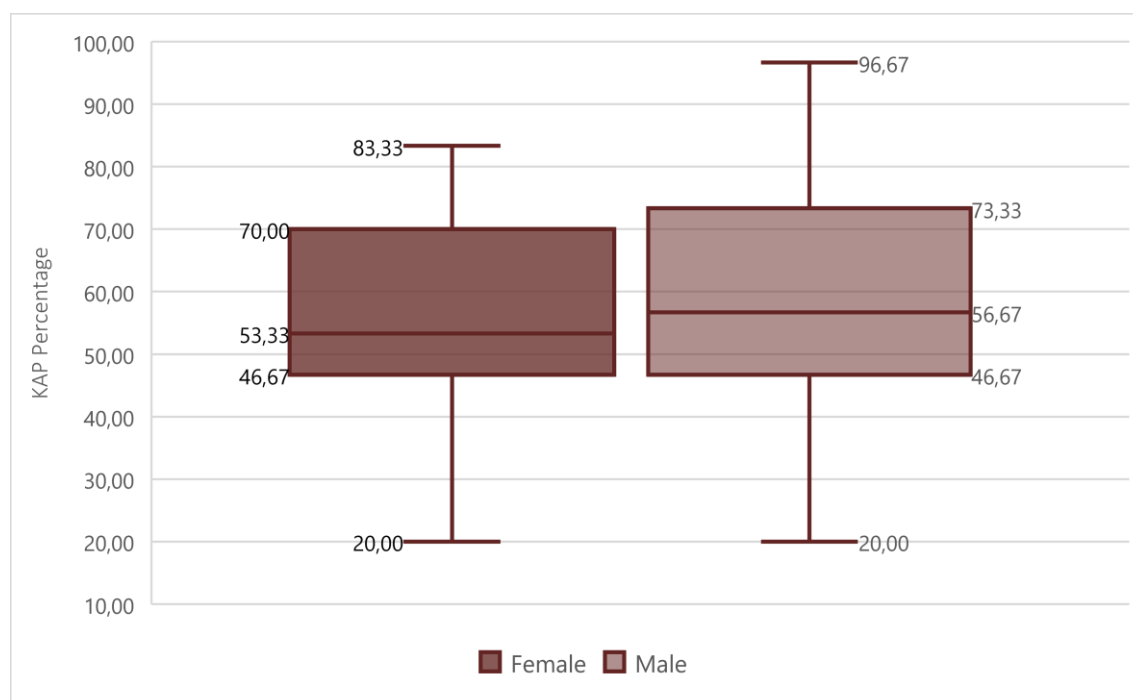


Figure 4.4: Box and whiskers plots of KAP percentage by sex

4.4.2.3 Factors influencing pain scores assigned

The Mann Whitney U test revealed a statistically significant difference between the median pain scores assigned to Andrew and Robert ($U=1204.0$, $p<0.001$). Robert (behavioural indications of severe pain) was more likely to be assigned a pain of 8/10 compared to Andrew (no behavioural indications of severe pain) who were more likely to be assigned a pain score lower than 8/10 despite both patients reporting their pain as 8/10. Figure 4.5 illustrates box and whisker charts for the median pain score and IQR assigned for Andrew (patient 1) and Robert (patient 2).

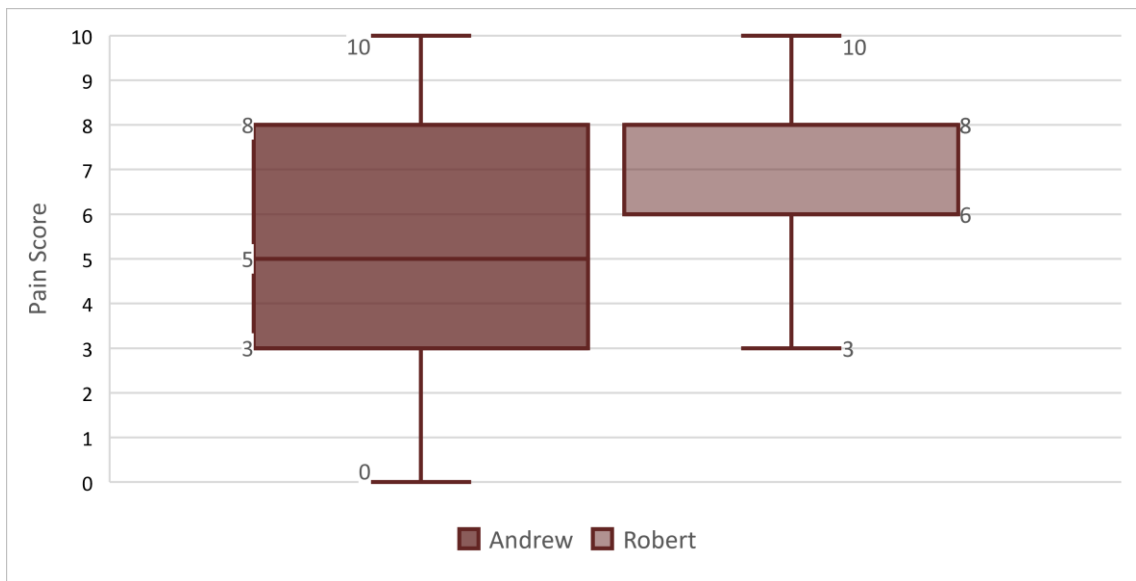


Figure 4.5: Box and whisker plots of pain scores for patient 1 and 2

The median pain score for Robert was consistent between demographic groups as is illustrated in Table 4.8, while the median pain score for Andrew varied. Nevertheless, no statistically significant difference between the demographic groups for Andrew's and Robert's pain score was found (Table 4.9).

4.4.2.4 Regression analysis

Simple linear regression models to investigate the relationships between demographic variables and overall score were carried out. Level of qualification accounted for 36% ($F(1,85)=47.91$, $p<0.001$) of variation in overall scores while years' experience accounted for 8.4% ($F(1,85)=7.747$, $p=0.007$) and pain education in the last two years for 6.2% ($F(1,85)=9.148$, $p=0.02$) of variation in overall score. It was found that these three demographic variables namely level of qualification ($\beta_1=4.003$, $p<0.001$), years' experience ($\beta_1=2.106$, $p=0.007$) and pain education in the last two years ($\beta_1=2.33$, $p=0.02$) significantly predicted the overall score.

Table 4.8: Andrew's and Robert's pain scores between demographic groups

Demographics	Andrews' Pain Score Median (IQR)	Roberts' Pain Score Median (IQR)
Sex		
Male (n=42)	5 (3-8)	8 (7-8)
Female (n=23)	5 (3-8)	8 (6-8)
Age Groups		
20-30 Years (n=24)	6 (3.5-8)	8 (6-8)
31-40 Years (n=26)	5 (3-8)	8 (8-8)
41-50 Years (n=13)	3 (1-8)	8 (4-8)
51-60 Years (n=2)	2 (1-)	7.5 (7-)
Level of Qualification		
BLS (n=12)	5 (2.5-6)	8 (3.25-8.75)
ILS (n=32)	5 (2.25-8)	8 (6.25-8)
ALS (n=21) ^a	5 (3-8)	8 (7-8)
Years of Experience		
0-10 Years (n=36)	5 (3-8)	8 (6-8)
11-20 Years (n=22)	5 (1.75-8)	8 (7.5-8)
21-30 Years (n=7)	3 (1-4)	8 (6-8)
Continuous Medical Education on acute pain assessment & management received in the last 2 years		
Yes (n=33)	5 (3-8)	8 (5.5-8)
No (n=32)	4.5 (3-8)	8 (8-8)
Footnote: ^a Advanced Life Support including Emergency Care Technician (ECT), Critical Care Assistant (CCA) Paramedic, National Diploma in Emergency Medical Care (NDEMC), Emergency Care Practitioner (ECP).		

A multiple regression model was conducted to predict the overall score from the level of qualification, years' experience and pain education received in the last two years. These variables significantly predicted 38.3% of the variation in overall scores ($F(3,83)=17.178$, $p<0.001$). Only level of qualification ($\beta_1=3.671$, $p<0.001$) added significantly to the prediction of the overall score while years' experience ($\beta_1=0.434$, $p=0.528$) and pain education in the last two years ($\beta_1=1.329$, $p=0.109$) did not.

4.4.2.5 Barriers and enablers

The most frequently identified barriers and enablers selected by respondents were outlined and discussed in the article and the table depicting the complete list of each. Further, the additional barriers and enablers cited by respondents, are available in the supplementary material of the article ([Table S4.2](#)).

4.4.2.6 Pain management practices for case studies

A summary of the responses to the two open-ended questions in relation to the management of the severe pain experienced by the two case study patients, Andrew and Robert is available in the supplemental material ([Table S4.3](#)) of the article and discussed in the text.

4.4.3 Supplementary limitations

As discussed in the article there are various limitations associated with the survey. The sample size was small and as a result, the study population lacked diversity in terms of qualification level, function within EMS, sector of employment and region of practice within the WC. This may have led to a lack of power to determine an effect where one may exist. In general, the findings of small studies need to be interpreted with care, as results may be unreliable and imprecise (232). We were unable to calculate the response rate due to constraints related to the POPI act 4 of 2013 (231), however, since the sample size achieved was small the response rate (233) was likely to be on the low side, increasing the likelihood of non-response bias and limiting the generalizability of study findings (234,235). The data from small studies should best be used as the foundation for larger work on the topic.

Table 4.9: Comparing pain scores (patient 1 and 2) between demographic groups

Demographics	Andrew's Pain Score			Robert's Pain Score		
	Test Score	Mean Rank	P-value	Test Score	Mean Rank	P-value
Sex*						
Male	444.5	33.92	0.587	463.00	33.48	0.748
Female		31.33			32.13	
Level of education**						
BLS ^a		30.54	0.759	0.342	34.25	0.843
ILS ^b	0.554	32.45			31.81	
ALS ^c		35.24			34.10	
Years of Experience**						
0-10 Years		35.43	0.143	0.732	34.08	0.693
11-10 Years	3.893	33.02			32.68	
21-30 Years		20.43			28.43	
Continuous Medical Education on acute pain assessment & management received in the last 2 years*						
Yes	482.5	34.38	0.540	467.5	31.17	0.352
No		31.58			34.89	
Age Groups**						
20-30 Years		38.08	0.076	4.002	31.48	0.261
31-40 Years	6.888	33.98			37.54	
41-50 Years		24.73			27.27	
51-60 Years		13.00			29.50	

Footnote: *Mann-Whitney U test (p-value < 0.05, two-tailed), **Kruskal-Wallis H test (p-value < 0.05, two-tailed), ^a Basic Life Support including Basic Ambulance Assistant (BAA), ^b Intermediate Life Support including Ambulance Emergency Assistant (AEA), ^c Advanced Life Support including Emergency Care Technician (ECT), Critical Care Assistant (CCA) Paramedic, National Diploma in Emergency Medical Care (NDEMC), Emergency Care Practitioner (ECP).

The questionnaire consisted of 45 items and since some sections of the survey were not completed by all respondents the quality of the survey data may have been affected by respondent fatigue (236) possibly causing measurement error. Further possible reasons for respondents not completing all sections may have been due to the loss of connectivity or since some respondents may only have had access to a computer during work hours, work

responsibility may have resulted in respondents skipping sections or terminating the questionnaire prematurely.

In the WC, Afrikaans (46.6%) and isiXhosa (31.1%) are the most common home languages, while English is the home language of <20% of the population (237,238). Although emergency care providers are required to be proficient in English it is likely not the home language of a significant number of participants and therefore study statements and questions may have been misinterpreted due to a language barrier (234). Further, the study may have been affected by social desirability bias (234). All the above research biases may have resulted in systematic error in the study findings.

4.4.4 Supplementary discussion

4.4.4.1 Factors influencing knowledge and attitudes regarding pain

As reported in the article, level of qualification, years' experience and medical education on pain assessment and management received in the last two years were factors which significantly influenced knowledge and attitudes regarding pain scores. Level of qualification is a factor commonly found in literature to influence knowledge and attitudes regarding pain scores, those with higher qualifications (67,69,183,185,193,198,200) commonly achieve higher scores. Level of qualification was also the only variable in the multiple regression model which significantly predicted overall knowledge and attitudes regarding pain scores in the current study. In light of the variances in prehospital education and training (short course versus tertiary education) this finding is not surprising, nevertheless, since all level of qualifications in SA can provide analgesia, all emergency care providers should at least have a rudimentary understanding of the physiology of pain, pain assessment and management.

4.4.4.2 Gaps in knowledge and attitude and the effect on practice

Questionnaire responses obtained allowed for the identification of knowledge and attitude gaps among all aspects covered. Since the lack of pain knowledge and practitioners' attitudes are recognised barriers to prehospital pain assessment and management (39,41,153,158,159), the gaps identified may prove crucial to guiding pain education and improvement initiatives as well as to inform future research to better comprehend the deficiencies.

4.4.4.2.1 Pain physiology and basic knowledge

Most respondents appear to know the IASP definition of pain, however, this is contradicted by the lack of awareness that pain is not always associated with actual tissue damage. Many respondents were aware that if the pain is unmanaged, the patient's overall clinical condition

may deteriorate while effective acute pain management was recognised as a fundamental component of quality patient care. However, only about 40% of respondents were aware that children <2 years are sensitive to pain and will recall painful experiences. Some respondents believed that patients with chronic medical conditions should not receive prehospital analgesia while many believed that opioids could mask the ability to accurately diagnose the pain source, if unknown. Further, respondents appear to have limited knowledge of the effects of the activation of the 'stress' response secondary to pain.

The above signifies a lack of knowledge of rudimentary principles of pain physiology and the adverse effects of acute pain in addition to suggesting suboptimal attitude in some instances. All emergency care providers are authorised to administer some form of analgesia. It is to be expected that higher qualified practitioners will have a better understanding of the principles of pain, however, at least a basic understanding is required.

4.4.4.2.2 Pain assessment and indicators of pain severity

In contrast to the high proportion of respondents agreeing that using a pain assessment tool is necessary for pain management decision-making, being aware that self-reported pain using the NRS is the quickest way to assess pain and believing children <11 years can reliably report pain, less than two-thirds knew the correct wording for the NRS. Further, despite most respondents believing the patient is the most accurate judge of their own pain intensity, about 40% believed that if they do not consider the condition to be painful the patient should not receive analgesia and giving sterile water by injection (placebo) to determine if pain is real is appropriate. About two-thirds of respondents were aware that similar stimuli, in different people, will not produce the same pain severity whereas less than a third correctly concluded that vital signs are an unreliable indicator of pain severity. Further, many respondents agreed that their prior experience dealing with patients in pain, allows them to score pain more accurately than the patients themselves.

Previous studies have reported no meaningful correlation between changes in vital signs and pain scores among prehospital patients (239). Vital signs are, therefore, deemed to be unreliable for assessing pain severity and should be used cautiously (240). Although emergency care providers indicate that pain assessment using a pain scale is essential, they do not trust patients to report pain truthfully nor are knowledgeable on the correct wording to be able to administer an NRS. Further, the administration of placebo to test whether the pain is real is unethical and constitutes a violation of the principles of beneficence and nonmaleficence. Placebo analgesia administered outside ethically approved clinical trials are poor quality care, deceptive and undermines the trust

relationship between the HCP and the patient and not in the patient's best interest, thus every effort must be made to cease this practice (241,242).

4.4.4.2.3 Non-pharmacological approaches to pain management

The high rate of correct responses related to physical non-pharmacological approaches and the pain management practices expressed by respondents in the case studies suggest some comprehension of the benefit of non-pharmacological pain interventions. On the other hand, responses to other related statements suggest suboptimal attitudes and lack of knowledge. Distraction and emotional support are psychological approaches intended to make the pain more bearable (243). However, respondents believed that if patients could be distracted, that this was an indication that they were not experiencing severe pain while some believed that parents/guardians of children should not be present during painful procedures. The latter also raises some ethical concerns (244). For a large proportion of emergency care providers (BLS & ILS) in the WC, non-pharmacological pain management will, in addition to requesting the assistance of higher qualified practitioners, be the only method of providing analgesia since Entonox® are regularly not available.

4.4.4.2.4 Pharmacological management

As indicated, due to scope of practice limitations, a restricted number of questions on pharmacological pain management were included in the survey. Most respondents showed good knowledge of Entonox® pharmacology, the pharmacological treatment available to all levels. On the other hand, about 70% believed that younger infants cannot tolerate opioids. This, however, may be explained by the fact that 75% of respondents may not administer opioids and thus are not expected to be knowledgeable about these medications. Further, Mulder 2012 (73) described that being able to move the patient to facilitate transportation plays a role in pain management decision-making in the South African prehospital setting, yet, most respondents in the current study indicated that preparing the patient for transportation is not the primary reason for analgesia administration.

4.4.4.2.5 Other

Poor responses (75% incorrect) to statements related to the influence of culture and/or spiritual beliefs on pain experience and expression and the belief that behaviour to pain is a reliable indicator of pain (71% incorrect) suggest a distrust in patients ability to accurately self-report pain as well as misconceptions about the (verbal and non-verbal) communication of pain. These fallacies are further displayed by the practice of not assigning or believing the patients' self-

reported pain scores in the case studies. The patient with behavioural indications of severe pain was more likely to be assigned a pain score as self-reported compared to the patient without behavioural indications (65.25% vs 36.5%). Even so, more than one-third of the respondents still did not assign a pain score as self-reported by the patient with behaviour suggestive of the reported pain. Further, the pain management practices of participants differed between the two patients suggesting that respondents believed that the patient without behavioural indications of severe pain may be overstating his pain and thus did not require analgesia.

For HCPs, an understanding of the factors influencing pain behaviour and expression are important to effectively assess and manage pain (245,246). Both, the patient, and the HCP brings beliefs and values about pain to the patient encounter and these may have profound effects on pain care (245–247). Cultural, social and psychological factors along with the patient's perception of the pain influence the way pain is expressed as well as the patient's behaviour (245,246). Social and cultural groups may have their own language, verbal and/or non-verbal, for expressing pain and suffering, with pain behaviour largely believed to be dependent on culture. Some cultural groups may display emotion during pain whereas others value being stoic (245). South Africa, the setting for this study, is a culturally diverse country with different ethnic groups, beliefs and social norms and as a result, HCPs must be aware and sensitive to the cultural expression and communication of pain (248).

As stipulated, HCPs bring cultural and spiritual beliefs to the healthcare encounter which influence pain assessment and management, (245–247). This was also evident in the present study. One-third of respondents believed that individuals should be stoic about pain. Although there was no significant association between sex and answers to this statement, female respondents (48.3% versus 27.4%) in this study had a more stoic opinion about pain expression. In contrast, a study in 2015 found male prehospital practitioners to have a more stoic viewpoint toward the need for analgesia compared to females ($p < 0.05$) (171).

Some responses also suggested an organisational culture not conducive to optimal pain assessment and management. Published literature states that leadership support in EMS organisations is a pain management enabler (159) while the culture in the organisation may be a potential hindrance (155). It has also been suggested that organisational feedback and a shared organisational consensus perspective on pain management may be facilitators to good pain management practice (152).

Most respondents did not believe patients should be included in the pain management decision-making process. Shared decision-making concerning pain management ensures that patients are

well informed, and that pain management is in-line with personal values and beliefs as well as optimising pain relief. In recent times, shared decision-making in EM has received much attention and is the preferred method of healthcare decision-making except in clinical situations where not practical (249). It is believed that shared decision-making in EM will, in addition to promoting patient-centred healthcare, have the potential to improve quality care and patient safety (250).

4.4.4.3 Barriers and enablers

The barriers and enablers of pain care in the SA prehospital setting will be further investigated and discussed in Chapter 6 using qualitative research methods.

4.4.4.4 Implications for practice and research

Several studies (66,189,191,194,251) have shown an improvement in pain knowledge and attitudes after pain education initiatives, nevertheless, the improvement appears to decline over time (191,252) suggesting the need for continuous education. Further, it has been suggested that education alone is not sufficient to change pain management practice (198). Although some improvement in pain management has been observed (253), progress has been slow and in addition to pain education, change in organisational culture with practitioners taking ownership of pain management and being appropriately empowered to manage pain with the necessary leadership support are measures suggested to further assist in the improvement of pain management.

In summary, to improve knowledge and attitudes regarding pain, continuous pain education, appropriate CPGs with recommendations for the management of mild, moderate and severe pain, availability of approved analgesic medication, developing, implementing and monitoring of pain quality indicators as suggested by Howard et al. (180) and an EMS organisational culture promoting pain care are a necessity.

4.5 Chapter conclusion

Although this study is an integral part of the overall research project, it also creates an opportunity for further research investigating the impact of pain education on pain knowledge, attitudes and practices among emergency care providers in the SA prehospital setting as well as to refine and validate, the knowledge, attitudes and practices questionnaire specific for the environment. In addition to measuring knowledge and attitudes regarding pain, such a questionnaire can also be used to evaluate pain educational initiatives and the retention of knowledge over time.

To strengthen data quality and descriptive survey results in future endeavours, more emphasis could be placed on keeping the questionnaire focused and concise to minimise participant fatigue and dropout rate as well as to limit the variation in response scales to ease data analysis. Further, alternative methods to improve survey distribution and participation such as blogs, social media, incorporating snowball sampling and regular reminders may enhance the survey response rate and reduce possible biases.

This chapter of the thesis links closely with the preceding chapter, Chapter 3 and coinciding article (222), likewise Chapters 5 and 6 to follow. Chapter 3 found that limited research on the topic of acute pain assessment and management in the African prehospital setting has been published. This study suggested that emergency care providers' knowledge and attitudes in relation to acute pain are suboptimal while pain assessment and management practices also appear to be less than ideal (254). In Chapter 5, the main aim will be to determine the prevalence of acute pain in trauma patients and describe current pain assessment and management practices. Thereafter, the intention will be to further develop the understanding of practitioners' perspectives, barriers and enablers of acute pain assessment and management in the SA prehospital setting started in Chapter 4 through qualitative research methods in Chapter 6.

CHAPTER 5: PREHOSPITAL ACUTE TRAUMATIC PAIN ASSESSMENT AND MANAGEMENT PRACTICES IN THE WESTERN CAPE, SOUTH AFRICA: A RETROSPECTIVE REVIEW

Publication Reference:

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5.1 Declaration from author and co-authors

5.1.1 Declaration from author

The following co-authors contributed to the paper: Associate Professor, Romy Parker (RP), and Associate Professor, Peter Hodkinson (PH). In the case of Chapter 5, contribution by authors to the work was as follow:

AL conceived the idea and designed the study with input from RP and PH. AL analysed the data using SPSS version 25 (223) and drafted the article for publication with all other authors contributing through critical revision of intellectual content and quality. All authors approved the final published version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Extent of contribution:

- Andrit Lourens: 70%
- A/Prof Romy Parker: 15%
- A/Prof Peter Hodkinson: 15%

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17 July 2020

Andrit Lourens

Date:

5.1.2 Declaration by co-authors

The undersigned hereby certifies that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise.
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication.
4. There is no other author of the publication according to these criteria.
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
6. The original data are stored at the following location and will be held for at least five years from date indicated below

Location of stored data: The data were downloaded from the WCEMS electronic patient care report (ePCR) system in Microsoft Excel® 2016 (225) spreadsheets. The Microsoft Excel® spreadsheets, SPSS (version 25) data analysis (223), and any other study-related material are stored on the author's password-protected (AL) laptop and external USB.

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17 July 2020

Associate Professor Romy Parker

Date

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17 July 2020

Associate Professor Peter Hodkinson

Date

5.2 Synopsis

5.2.1 *Rationale for conducting the study*

The rationale for the study is based on the knowledge that traumatic injuries in SA are prevalent (255), trauma in the emergency setting is a common aetiology of pain (16–18,20–23,29,63,152) and that acute pain has negative physiological and psychological effects potentially causing worse patient outcomes and suffering (7). In addition, gathering prehospital epidemiological data on emergency conditions like acute pain is required to progress prehospital research (256), the profession, as well as demonstrate the necessity for prehospital emergency care (PEC). Due to the lack of published evidence on the topic and potential biases like the Hawthorne effect introduced by prospective descriptive observational studies, a retrospective study design was preferred at the time. Further, retrospective studies are ethically safe and present no risk to the patient while the sample for the current study could be randomly selected to assist with generalisability. Acute pain assessment and management are thought to be essential clinical quality indicators in PEC (180,257). If prehospital practitioners do not actively assess and re-assess acute pain as well as adequately manage pain and conduct research to investigate the issues regarding pain care in the prehospital setting, acute pain will continue to remain a quality concern. The current study, therefore, is the starting point for developing an understanding of epidemiological characteristics as well as to describe current prehospital acute traumatic pain assessment and management practices in SA.

5.2.2 *Aim and objectives*

Aim:

The study aimed to identify the prevalence of acute traumatic pain and describe prehospital acute traumatic pain assessment and management practices amongst emergency care providers, in the WC, SA.

Objectives:

- To determine the prevalence of acute traumatic pain in adult and paediatric patients with a final South African Triage Scale (SATS) priority colour of yellow, orange, or red in the prehospital setting, in the WC, SA.
- To determine the percentage of adult and paediatric trauma patients with a final SATS priority colour of yellow, orange, or red who had an acute pain assessment conducted in the prehospital setting, in the WC, SA.

- To determine whether an appropriate pain assessment tool in terms of age and mental status was used to assess prehospital adult and paediatric acute traumatic pain, in the WC, SA.
- To describe prehospital adult and paediatric acute traumatic pharmacological and non-pharmacological pain management practices in the WC, SA.
- To compare prehospital acute adult traumatic pain and acute paediatric traumatic pain assessment and management by emergency care providers in the WC, SA.
- To compare the level of emergency care provider qualification to whether acute traumatic pain assessment occurred and whether pain management was provided as per provider HPCSA protocol.

5.2.3 Main results

- A total of 24575 trauma patients met the inclusion criteria of which a sample of 2401 patients was selected through stratified random sampling.

Patient characteristics:

- Of all 2401 patients reviewed, 68.7% ($n=1650$) were male and 31.3% ($n=751$) female patients.
- Two hundred and seventy-two (11.3%) patients were ≤ 14 years of age (paediatrics) while the remaining 2129 (88.7%) patients were >14 years (adolescents and adults).

Pain assessment and pain severity:

- Of the 2401 patients reviewed, 435 (18.1%) had a pain score recorded of which 52 ($n=272$, 19.1%) patients were ≤ 14 years and 383 ($n=2129$, 18%) were >14 years.
- The median pain score was 6 (*IQR* 4-8) and 72 (16.6%) of the patients with a pain score documented, had at least one repeated pain score recorded.
- Of the patients with a pain score recorded 423 (97.2%) experienced pain (mild to severe) while most ($n=342$, 78.6%) experienced moderate-to-severe (score 4-10) pain.
- A further 194 (8.1%) patients had the presence of pain and/or tenderness reported in the working diagnosis, but no pain score recorded.
- A total of 617 ($n=2401$, 25.7%) patients had pain in some form recorded (pain score or the presence of pain and/or tenderness recorded in the working diagnosis).
- No statistically significant association were found between pain score (yes/no) and age groups (≤ 14 versus >14 years) ($\chi^2(1, n=2401)=0.207, p=0.649$), as well as between pain score (yes/no) and gender ($\chi^2(1, n=2401)=2.186, p=0.139$).

Non-pharmacological pain management:

- A range of physical non-pharmacological pain management approaches were recorded in the ePCR including haemorrhage control ($n=680$, 28.3%), application of splints ($n=106$, 4.4%) and burn dressings 57 (2.4%).

Pharmacological pain management:

- Sixty-eight ($n=2401$, 2.8%) patients received medication with analgesic properties of which 27 (58.7%) had a pain score recorded.
- As initial analgesia, IV morphine was administered to 66 ($n=68$, 97.0%) patients while one received IV ketamine and one IM diclofenac.
- Of the 342 patients with moderate-to-severe pain recorded, only 7.6% ($n=26$) received analgesic medication.
- Fifty-two (78.8%) of the 66 patients who received morphine were male, while 4 (6.1%) were ≤ 14 years. The patients who received ketamine and diclofenac were both >14 years and male.
- A statistically significant association was found between pain score (yes/no) and the administration of medications with analgesic properties ($\chi^2(1, n=2401)=21.986, p<0.001$). The strength of association was weak ($\phi=-0.096$). Patients with a pain score recorded were more likely to receive medication with analgesic properties.
- A statistically significant association was found between pain severity (mild, moderate, and severe) and whether medication with analgesic properties was administered ($\chi^2(2, n=423)=14.892, p=0.001$). Patients with severe pain were more likely to receive medication with analgesic properties, nonetheless, the strength of association was weak ($\phi_c=0.188$).
- A statistically significant association was found between the documented highest qualification (BLS, ILS and all ALS levels) and the administration of analgesic medication ($\chi^2(2, n=2401)=140.843, p<0.001$). Patients, where the highest qualification was documented as an ALS (ECT, ALS and ECP) level, were more likely to receive analgesic medication. The strength of the association was weak ($\phi_c=0.242$).
- No statistically significant association was found between age groups (≤ 14 versus >14 years) and whether medication with analgesic properties was administered ($\chi^2(1, n=2401)=2.066, p=0.151$), nor between gender and whether medication with analgesic properties was administered ($\chi^2(1, n=2401)=3.721, p=0.054$).

"Below is the published article followed by references and supplementary table of the paper. The context and meaning of the published paper are described in detail in the rest of the chapter"

5.3 Article published in International Journal of Emergency Medicine

Prehospital acute traumatic pain assessment and management practices in the Western Cape, South Africa: a retrospective review

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Abstract

Background: Trauma is a common aetiology of acute pain in the emergency setting and traumatic injuries have been recognised as a global public health crisis leading to numerous deaths and disabilities. This study aimed to identify the prevalence of acute pain among high acuity trauma patients presenting to a public sector emergency medical service and to describe prehospital acute traumatic pain assessment and management practices amongst emergency care providers in the Western Cape Province, South Africa.

Methods: A retrospective review of electronic patient care reports of trauma patients treated by the South African Western Cape Emergency Medical Service between January 1 and December 31, 2017. Stratified random sampling was utilised to select 2401 trauma patients out of 24575 that met the inclusion criteria.

Results: Of the 2401 patients reviewed, 435 (18.1%) had a pain score recorded, of which 423 (97.2%) were experiencing pain. An additional 8.1% ($n=194$) of patients had pain or tenderness mentioned in the working diagnosis but no pain score noted. Eighty-one (18.6%) patients experienced mild pain, 175 (40.2%) moderate pain and 167 (38.2%) severe pain. No association was found between a pain score being recorded and age group (≤ 14 versus >14 years) ($p=0.649$) or gender ($p=0.139$). Only 7.6% of patients with moderate-to-severe pain and 2.8% of all trauma patients received any form of analgesic medication. No association was found between the administration of analgesia and age group (≤ 14 versus >14 years) ($p=0.151$) or gender ($p=0.054$). Patients were more likely to receive analgesia if they had a pain score recorded ($p<0.001$), were managed by advanced life support practitioners ($p<0.001$) or had severe pain ($p=0.001$).

Conclusion: Acute trauma pain assessment and management practices in this prehospital cohort are less well established than reported elsewhere. Whether this reflects emergency care training, institutional culture, scopes of practice or analgesic resources, requires further research.

Emergency medical services need to monitor and promote a culture of quality pain care, enhance pain education, and ensure that all levels of emergency care providers have access to analgesic medication approved for prehospital use. Clear and rational guidelines would enable better pain management by all cadres of providers, for all levels of pain.

Keywords

Prehospital, Acute pain assessment and management, Analgesia, Trauma

Background

Traumatic injuries are a global public health crisis with more than 4.8 million deaths annually, and many more left disabled (1,2). In South Africa, the high burden of trauma is evidenced by death rates secondary to interpersonal violence/homicide and road traffic accidents, far higher than the global rate (3). Many studies identify traumatic injuries as the foremost aetiology of acute pain in the prehospital (4–8) and emergency department (ED) settings (9,10), and patients with acute trauma regularly experience moderate-to-severe pain (5,9,11,12) which is likely to be more widespread in severely injured or high acuity trauma patients.

In addition to relieving suffering and enabling diagnostic and treatment processes in the acute setting, pain control carries further benefits which include reducing the psychological (e.g. anxiety) and physiological effects of acute pain, infection risk, the risk for developing chronic pain as well as improving patient satisfaction, recovery time and outcomes (13–15). Failing to adequately manage acute pain may contribute to continued impaired physical function and the subsequent development of psychological disorders (such as depression) and reduced quality of life (13,14,16). Although a fundamental aspect of prehospital emergency care (17), the poor quality of acute pain assessment and management, for any aetiology, in the prehospital arena remains a concern worldwide (5–7,18,19).

In the African prehospital setting, little is known about acute pain, with no studies reporting on the epidemiological characteristics of acute traumatic pain, and limited studies describing pain management practices (20,21). The paucity of data has been identified as one of many obstacles limiting the advancement of the field of prehospital emergency care in the African region (22). The aim of this study was to identify the prevalence of acute pain among high acuity trauma patients and to describe prehospital acute traumatic pain assessment and management practices among emergency care providers in the Western Cape, South Africa.

Methods

A retrospective review of electronic patient care reports (ePCRs) of high acuity trauma patients treated by the Western Cape Emergency Medical Services (WCEMS) was conducted between January 1 and December 31, 2017. The WCEMS is a government-operated emergency medical service (EMS) which serves the communities of the Western Cape, one of the nine South African provinces, with an area of 190 370 km² and a population exceeding 6.3 million. WCEMS operates around 250 ambulances throughout the province, staffed at either basic life support (BLS), intermediate life support (ILS) or advanced life support (ALS) emergency care levels.

Prehospital emergency care education in South Africa has occurred through short course (three-tiered) training, but increasingly through higher education and training (23,24). Most ambulances are staffed by ILS and BLS practitioners (24), who can request assistance from a higher qualified practitioner (if available). The extent of pain education is hard to gauge and likely varies between training institutions across South Africa.

BLS and ILS practitioners are restricted to the use of self-administered inhaled nitrous oxide (Entonox®) for the relief of pain arising from myocardial infarction, musculoskeletal trauma, burns, active labour and any other condition requiring pain relief where no contraindication is present. ALS practitioners, according to their specific qualifications, may administer intravenous (IV) morphine (some requiring permission from university degree ALS practitioners or a doctor), and IV or intranasal (IN) ketamine may be administered by ALS practitioners with a university degree.

In 2016, WCEMS rolled out an ePCR system which replaced paper-based patient care reports with real-time digital capturing of patient care records of all prehospital patient encounters (25). The system incorporates a pain assessment tool (See Figure 5.1) similar to the Wong-Baker Faces scale, rating pain between 0 (no pain) and 10 (worst pain imaginable) with six smiley emoticons [personal communication R Booley, 07/2019]. The system also allows for recording pain characteristics (onset, quality, provoking/palliating factors and radiation) and updated pain scores.



Figure 5.1: Pain assessment tool using Smiley Emoticons (26)

Inclusion criteria were adult and paediatric patients with acute trauma (primary emergencies) and a South Africa Triage Scale (SATS) final priority colour of yellow, orange or red which denote urgent, very urgent, or emergency patients respectively (27), managed in the prehospital setting by emergency care providers in the Western Cape, South Africa, in 2017. Based on the National Department of Health 2012 age definitions for South Africa, paediatric were defined as patients ≤ 14 years. Medical patients, interfacility transfers and patients with a green (non-urgent) or blue (deceased) final priority colour were excluded. The SATS is a triage tool used to measure patient acuity in the South African context, and although developed and validated in the hospital setting, is also widely used prehospitally to guide optimal disposition (patient destination) decisions (28,29).

A total of 24575 trauma patients met the inclusion criteria. Stratified random sampling was utilised to select a representative sample of the study population. A sample of 2401 was calculated using an online sample size calculator (30) with an estimated acute traumatic pain prevalence of 50%, 2% precision, 95% confidence interval (CI) and an infinite population. Acute traumatic injury prevalence is thought to vary during the year, resultantly, the sample was stratified per month (Figure 5.2) to adjust for possible seasonal variation. Two-thirds (66%) of data were selected during spring (30%) and summer (36%) including the December/January festive season which likely has a higher trauma prevalence compared to autumn (21%) and winter (13%).

Data were extracted from the WCEMS ePCR system and analysed using SPSS statistics software (IBM. 2017. SPSS Statistics: Version 25. Armonk, NY: IBM Corps). Shapiro-Wilk tests were conducted to assess for normality. Descriptive statistics (frequency, percentages, median (*M*) and interquartile range (*IQR*)) were calculated for patient characteristics, incident types, injuries sustained, pain score, pain severity and nonpharmacological and pharmacological pain management and presented in graphs and tables. The Pearson chi-square test of independence (inferential statistics) was used to determine relationships between the categorical variables, pain score recorded (yes/no) and age group (≤ 14 and > 14 years), gender, final triage colour (yellow, orange and red) and analgesic medication administered (yes/no) as well as between analgesic medication administered (yes/no) and age group (≤ 14 and > 14 years), gender, crew highest qualification (BLS, ILS and all ALS levels) and pain severity (mild, moderate, or severe). If relationships between categorical variables were identified, the strength of association was assessed with Phi (ϕ) and Cramer's V (ϕ_c) correlation coefficient.

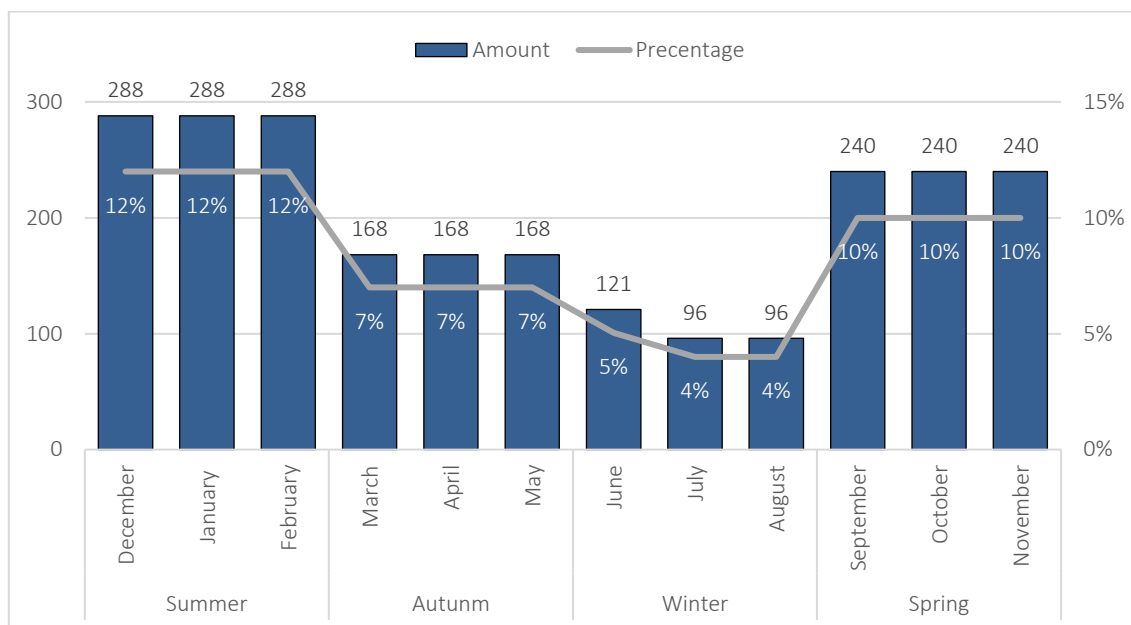


Figure 5.2: Number of patients randomly sampled per month

Results

Patient characteristics

Of the 2401 records reviewed, 272 (11.3%) patients were ≤ 14 years of age ($M=7$, $IQR=3-11$) while the remaining 2129 (88.7%) were > 14 years ($M=31$, $IQR=24-41$) of which 80.5% ($n=1713$) were between 15-44 years of age. High acuity patients (SATS red or orange) accounted for 35.0% ($n=839$) of all cases (Table 5.1).

Table 5.1: Patient characteristics

Characteristics	n (%)
Gender	
Male	1650 (68.7%)
Female	751 (31.3%)
Crew highest qualification	
Basic Life Support (BLS)	415 (17.3%)
Intermediate Life Support (ILS)	1321 (55.0%)
Advanced Life Support (ALS) ^a	655 (27.7%)
South African Triage Scale (SATS) - priority colour	
Red	200 (8.3%)
Orange	639 (26.6%)
Yellow	1562 (65.1%)
Total	2401 (100%)
Footnote: ^a Advanced Life Support include the following qualifications: Emergency Care Technician (ECT) ($n=299$, 12.5%), Paramedic (Critical Care Assistant (CCA) and National Diploma in Emergency Medical Care (NDEMC)) ($n=324$, 13.5%) and Emergency Care Practitioner (ECP) ($n=42$, 1.7%)	

Incident types and injury sustained

Assault, transport-related incidents, and accidental injuries were the three most common type of incidents (See Additional File 1: [Table S5.1](#)). The specific injuries sustained were noted in the

working diagnosis of 1278 (53.2%) patients with 139 (10.9%) of these sustaining more than one injury (Table 5.2).

Table 5.2: Specific injuries sustained by patients as documented ($n=1278$)

Specifics of sustained injuries	≤14 Years <i>n</i> (%)	>14 Years <i>n</i> (%)	Total <i>n</i> (%)
More than 1 injury sustained	10 (0.8%)	129 (10.1%)	139 (10.9%)
Fractures / dislocations / deformities	34 (2.7%)	155 (12.1%)	189 (14.8%)
Burns	21 (1.6%)	38 (3%)	59 (4.6%)
Gunshot wound (GSW)	1 (0.1%)	34 (2.6%)	35 (2.7%)
Polytrauma	0 (0%)	12 (0.9%)	12 (0.9%)
Head injury	18 (1.4%)	102 (8%)	120 (9.4%)
Pneumo-,haemothorax or cardiac tamponade	0 (0%)	25 (2%)	25 (2%)
Sprains / strains / muscle Injuries	1 (0.1%)	11 (0.8%)	12 (0.9%)
Rape	0 (0%)	2 (0.2%)	2 (0.2%)
Neck and/or back pain/tenderness/injury	4 (0.3%)	86 (6.7%)	90 (7%)
Drowning	2 (0.15%)	2 (0.15%)	4 (0.3%)
Open and/or closed wounds	73 (5.7%)	783 (61.3%)	856 (67%)

Footnote: Since about 11% of patients sustained more than one injury, the total injuries sustained will account to more than 1278.

Almost 15% ($n=189$) of patients reportedly sustained fractures/dislocations/deformities (with 9 (4.8%) sustaining more than one fracture). The most common injury site was lower extremities ($n=78$, 41.3%) followed by upper extremities ($n=63$, 33.3%) while 5 (2.6%) of these patients injured both upper and lower limbs, and 15 (8%) patients were thought to have a pelvis/hip fracture.

Of the 59 (4.6%) patients who had burns documented, 25 (42.4%) had a percentage of burn area recorded (range: 1-80%). The remaining patients either had no description of the burn or had the burn described in terms of location, type of burn and/or burn severity.

Pain Score and Pain Severity

A total of 435 (18.1%) patients had a pain score recorded. The median pain score was 6 (*IQR* 4-8). Seventy-two (16.6%) of the patients with a pain score, had at least one repeated pain score recorded. Figure 5.3 illustrates the proportion of records in which a pain score was recorded by gender and age group (adult and paediatric).

No association was found between a pain score being recorded and age group (≤ 14 years versus > 14 years) ($p=0.649$), gender ($p=0.139$) or final triage colour ($p=0.076$). The majority (78.6%) of those with a pain score, reported moderate-to-severe pain (Figure 5.4). A further 194 (8.1%) patients had the presence of pain and/or tenderness reported in the working diagnosis, but no pain score recorded. In total, pain was recorded in 617 ($n=2401$, 25.7%) patients. Of note, the records of numerous other patients indicated injuries likely to be painful for which the presence of pain was not recorded.

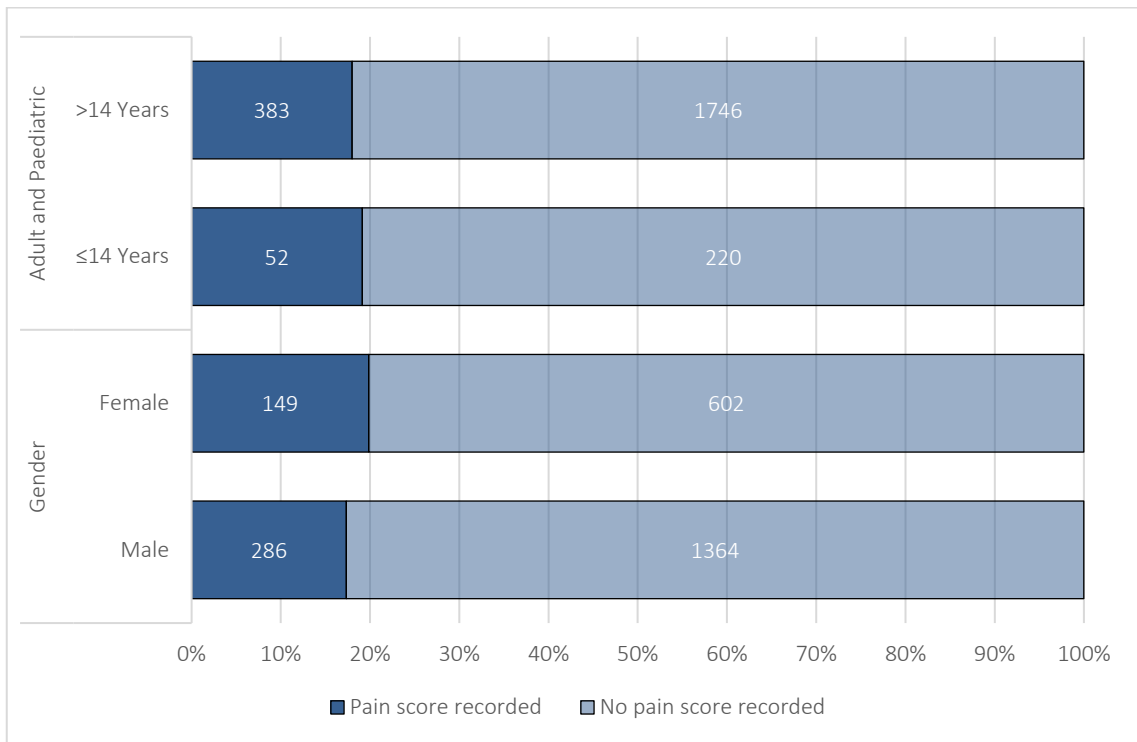


Figure 5.3: Comparison of pain assessment between gender and age group

Non-pharmacological pain management

A range of physical non-pharmacological management approaches were recorded in the ePCR including haemorrhage control ($n=680$, 28.3%), application of splints ($n=106$, 4.4%) and burn dressings 57 (2.4%).

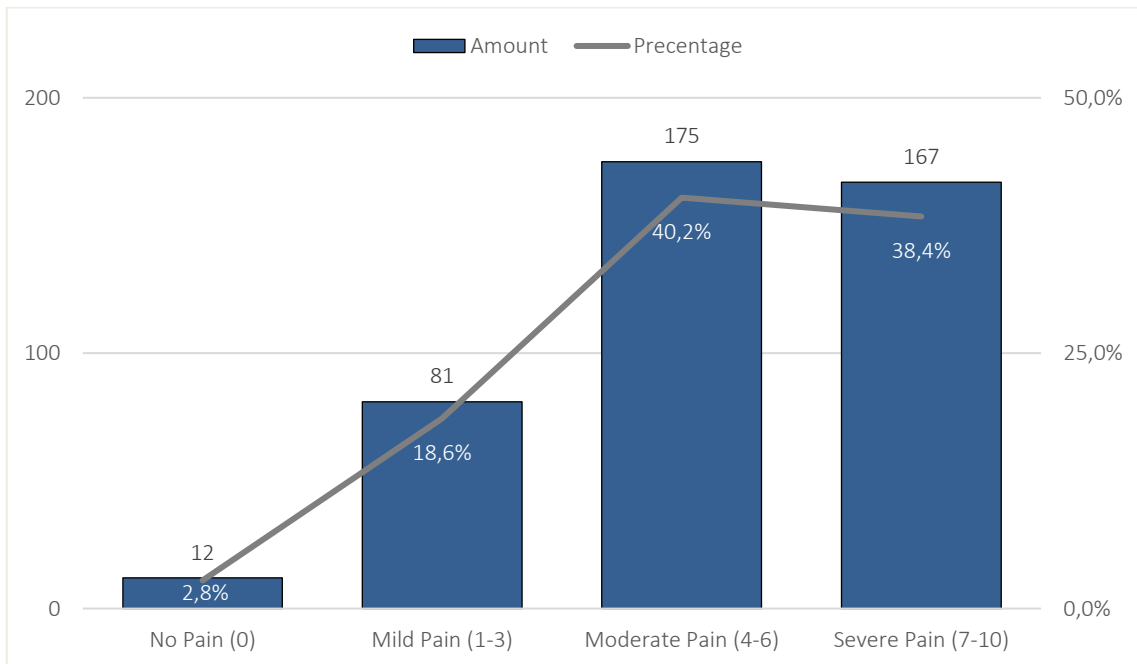


Figure 5.4: Pain severity of patients with pain score recorded

Pharmacological pain management

Only 68 ($n=2401$, 2.8%) patients received medication with analgesic properties of which 27 (39.7%) had a pain score recorded. IV morphine was administered to 66 ($n=68$, 97.0%) patients while one received IV ketamine and one intramuscular (IM) diclofenac, firstly or only. Of all the patients ($n=66$) who received IV morphine, 10 (15.2%) received an additional morphine dose (all adults) and 6 (9.1%) received ketamine [IV or IM] (one paediatric) in addition to the initial morphine. None of the patients received inhaled nitrous oxide.

Of the 342 patients with moderate-to-severe pain recorded, only 7.6% ($n=26$) received analgesic medication. Fifty-two (78.8%) of the 66 patients who received morphine were male, while 4 (6.1%) were ≤ 14 years. The patients who received ketamine and diclofenac were both > 14 years and male. No association was found between the administration of analgesic medications and gender ($p=0.054$) or age group (≤ 14 years versus > 14 years) ($p=0.151$).

For six (8.8%) of the patients who received analgesic medication, the highest qualification of the crew was documented as BLS ($n = 1$, 1.5%) or ILS ($n = 5$, 7.3%) while for the remaining 62 (91.2%) patients it was documented as an ALS level qualification (Emergency Care Technician (ECT): $n = 22$, 32.3%, ALS: $n = 32$, 47.1% and Emergency Care Practitioner (ECP): $n = 8$, 11.8%). An association was found between the documented highest qualification (BLS, ILS and all ALS levels) and the administration of analgesic medication ($p < 0.001$). Patients, where the highest qualification was documented as an ALS (ECT, ALS and ECP) level, were more likely to receive analgesia medication. The strength of the association was weak ($\phi_c = 0.242$).

Additionally, an association was found between a pain score being recorded and the administration of analgesic medication ($p < 0.001$). Patients with a pain score were more likely to receive analgesic medication however the strength of association was weak ($\phi = -0.096$). An association was also found between pain severity (mild, moderate, or severe pain) and the administration of analgesic medication ($p=0.001$). Patients with severe pain were more likely to receive analgesic medication however the strength of association was weak ($\phi_c = 0.188$).

Discussion

To our knowledge, this study is the first to describe the epidemiological characteristics of acute traumatic pain in the African prehospital setting and only the second to describe prehospital pain management practices in the Western Cape Province of South Africa (21).

Traumatic pain and pain assessment

Our findings indicate that many patients sustained injuries likely to be painful while only a quarter of patients had pain recorded in some form. Less than a fifth of patients had pain measured with a pain assessment tool with the prevalence of moderate-to-severe pain found to be high (> 75%). International studies, likewise, report the prevalence of pain among trauma patients to be high (> 70%) (8,31) with a high likelihood of moderate-to-severe pain (5,9,11,12). This study found pain assessment practices to be poorer than those reported by most international studies (7,8,18,19). The results, however, are similar (18.1% versus 21%) to pain assessment practices previously found among ALS practitioners in Cape Town, South Africa with better rates of pain reassessment found in the current study (16.6% versus 6%) (21).

The lack of pain assessment has been identified as a hindrance to adequate pain management (14,32). The present study supports these findings as patients with a pain score recorded were more likely to receive medication with analgesic properties. Numerous factors contributing to poor pain assessment documentation have been identified. Being younger, being attended to between 00:00 and 06:00, and shorter transport distances were associated with a reduced likelihood of documented pain assessment in children (18). Adults, in contrast, appear more likely to have pain assessment recorded (33,34) although this finding is not supported by the current study. Finally, uncooperative patients and communication difficulties have been identified as barriers to pain assessment (18,35) while the lack of validated age-appropriate pain assessment tools for preverbal children have been identified as a barrier to the management of pain (18).

The use of age-appropriate pain scales as part of general patient care, and regarding all trauma patients with acute pain as candidates for analgesia with regular pain reassessment, is evidence-based recommendations made in a clinical practice guideline (CPG) published in the United States of America (36) and recently adopted for South African EMS CPGs (37). Employing observational pain scales is recommended for paediatrics <4 years (36) and would be more appropriate than the current smiley emoticons found in the ePCR, while the Abbey Pain Scale is a suggested option for the cognitively impaired patient in the prehospital setting (38).

While clear prehospital pain assessment guidelines are helpful, the most frequent reason proposed for the insufficient documentation of pain assessment is a lack of pain knowledge (14,39,40). Several studies have shown that educational activities improve the documentation of pain severity, characteristics, and pain reassessment (41,42). In addition to educational activities, EMS systems need to encourage the systematic assessment of pain and the proper clinical documentation thereof.

Non-pharmacological pain management practices

Non-pharmacological pain management interventions are more commonly associated with the non-emergency setting. However, cognitive, and psychological interventions like reassurance, distraction, and physical interventions like positioning, splinting fractures, burn dressings etc. can all be utilised in the prehospital setting (43). Psychological interventions sometimes occur inadvertently and are unlikely to be documented in clinical notes. Pain educational initiatives increase awareness and utilisation of non-pharmacological pain interventions in the prehospital setting (41,42).

Most prehospital studies examine acute pain retrospectively (7,8,31), and do not report much, if at all, on non-pharmacological pain management thus limiting comparison. The lack of documentation of non-pharmacological pain management also made an evaluation of these treatments in the current study challenging.

Pharmacological pain management practices

Morphine, ketamine, and diclofenac (not in the scope of South African prehospital practitioners)² were the only medications with analgesic properties administered during this study. Despite the high prevalence of moderate-to-severe pain, less than 8% of those patients, and less than 3% of all the trauma patients received any analgesia. These results are substantially worse than those reported by studies conducted in high-income countries (HIC) although these also reported prehospital pain relief (any aetiologies) to be poor (8 to 42%) (8,18,19).

This study revealed that inhaled nitrous oxide was not used. Similar observations were identified by Matthews et al (21) in the same setting. In the WC, for most emergency care providers ($\pm 84\%$ are operational BLS/ILS) (24) inhaled nitrous oxide is the only prehospital analgesic option. Pain management decision-making for these practitioners is thus limited to requesting the assistance of a higher qualified practitioner (frequent unavailability), non-pharmacological pain management, and transportation to a medical facility for further management. The lack of availability of this treatment is a major barrier to effective pain management. Practitioners must have access to analgesic medications as pain care is both a measure of quality emergency care and a human right (44).

² IM Diclofenac was likely administered by a doctor on scene prior to transportation to hospital by ambulance.

Our findings do not suggest disparity between adult and paediatric pain management. This is not consistent with other studies which suggest that adults are more likely to receive opioid analgesics (32,34,45). Further, studies report that women, regardless of age or pain severity are less likely to receive analgesia (45–48) a finding which was not supported in this study. Our findings suggest, like other evidence, that patients with more severe pain recorded are more likely to receive analgesia (46,49).

A finding which is difficult to explain was that six patients received medication with analgesic properties from crews not licensed to administer those medications. We attribute this to either documentation errors, or in some high workload situations, emergency care providers may be transporting patients after an analgesic medication had been administered by a higher qualified practitioner on scene.

Barriers to pain assessment and management in the prehospital setting

Findings of the study are concerning; however, consideration must be given to the possible reasons for the apparent poor pain assessment and management practices among emergency care providers in the Western Cape, South Africa.

Studies conducted in HIC have identified several constraints to prehospital pain assessment and management (32,35,40,50–52). A barrier commonly highlighted is knowledge deficit, which may be attributed to limited attention to pain assessment and management during initial training and a lack of ongoing education (32,40,51,52). The lack of alternative routes of drug administration, guideline restrictions or inadequacies, the need to obtain permission, and the reluctance of medical control to approve prehospital analgesia administration are, also, previously identified constraints (15,32,35,40,52). Further barriers include negative feedback from ED staff or supervisors, organisational culture, scarcity of higher qualified practitioner, lack of monitoring guideline adherence and communication (35,40,50,52).

The prehospital setting is a challenging and dangerous work environment with emergency care providers in South Africa increasingly confronted by the threat of violence. In addition to the concerns for personal safety, high workload and demands on emergency care providers, analgesic agents are only available to a small proportion of prehospital practitioners in South Africa. Research to describe barriers and enablers to prehospital pain assessment and management in the South African setting may identify further issues. Epidemiological studies, further investigating inequalities in pain assessment and management, as well as the prevalence,

assessment, and management of pain in medical and obstetric cases, will add to the knowledge base.

Study limitations

Like most other observational studies, retrospective reviews have various potential sources of bias including selection and information bias, uncertainty about generalizability and issues with missing data (53). Probability sampling strategy was used to minimise sampling bias and select a representative sample of the population to allow generalisability of findings (54). The random selection of the sample from a broader trauma population of the Western Cape; the high burden of trauma; and the profile of EMS in the rest of South Africa, mean that the study findings are likely generalisable to prehospital trauma patients in the rest of South Africa. The results may be less generalisable outside South Africa where the burden of trauma may be different, and the profile of EMS systems differ (55). International studies suggest medical and gynaecological or obstetric conditions to be less common aetiologies of prehospital acute pain (4,7), and this is another area for further research in low and middle-income settings. Inaccuracies and poor quality of ePCR clinical notes were the foremost limitations to the study findings; however, this may not be a reflection of clinical practice, as an inherent restriction of the retrospective review methodology is the assumption that if it was not documented, it was not done.

Conclusion

Pain assessment and management was shown to be significantly lacking. Much can be done to improve prehospital pain care in the South African prehospital setting. For instance, including better pain education during undergraduate studies, ongoing pain education, an EMS culture prioritising pain relief, monitoring the quality of pain care, optimising resources (most importantly ensuring inhaled analgesia availability), scope of practice revision to consider other analgesic agents suitable for the setting and specifically for BLS and ILS practitioners, specific guideline recommendations for mild, moderate and severe pain and promoting pain assessment, reassessment and redosing to optimise pain care as well as the proper documentation thereof. This study provides clear directions for future research which could further improve pain assessment and management.

Abbreviations

ALS: Advanced Life Support; BLS: Basic Life Support; CPGs: Clinical Practice Guideline; ePCRs: Electronic patient care reports; ED: Emergency Department; EMS: Emergency Medical Service; HIC: High-income countries; ILS: Intermediate Life Support; IQR: Interquartile Range; IV:

Intravenous IM: Intramuscular; IN: Intranasal; M: Median; SATS: South African Triage Scale; WCEMS: Western Cape Emergency Medical Service.

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Authors' contributions

AL conceived the study design, conducted the data analysis, and drafted the report. PH and RP assisted with the final report. All authors have read and approved the manuscript.

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Availability of data and material

The datasets used and/or analysed during the study are not publicly available but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The Human Research Ethics Committee of the University of Cape Town (HREC 220/2017) and the WC Provincial Health Research Committee (WC_2017RP54_569) approved the study. No personally identifiable data for patients and practitioners were extracted.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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References

1. Haagsma JA, Graetz N, Bolliger I, Naghavi M, Higashi H, Mullany EC, et al. The global burden of injury: Incidence, mortality, disability-adjusted life years and time trends from the global burden of disease study 2013. *Inj Prev* [Internet]. 2016;22(1):3–18. Available from: <http://dx.doi.org/10.1136/injuryprev-2015-041616>

2. World Health Organization. Injuries and Violence. The Facts 2014 [Internet]. World Health Organization. Geneva: WHO Press; 2014. Available from: <https://apps.who.int/iris/handle/10665/149798>
3. Norman R, Matzopoulos R, Groenewald P, Bradshaw D. The high burden of injuries in South Africa. *Bull World Health Organ* [Internet]. 2007;85(9):695–702. Available from: <https://doi.org/10.2471/BLT.06.037184>
4. Marinangeli F, Narducci C, Ursini M, Paladini A, Pasqualucci A, Gatti A, et al. Acute pain and availability of analgesia in the prehospital emergency setting in Italy: A problem to be solved. *Pain Pract* [Internet]. 2009;9(4):282–8. Available from: <https://doi.org/10.1111/j.1533-2500.2009.00277.x>
5. Galinski M, Ruscev M, Gonzalez G, Kavas J, Ameer L, Biens D, et al. Prevalence and management of acute pain in prehospital emergency medicine. *Prehosp Emerg Care* [Internet]. 2010;14(3):334–9. Available from: <https://doi.org/10.3109/10903121003760218>
6. Galinski M, Picco N, Hennequin B, Raphael V, Ayachi A, Beruben A, et al. Out-of-hospital emergency medicine in pediatric patients: Prevalence and management of pain. *Am J Emerg Med* [Internet]. 2011;29(9):1062–6. Available from: <http://dx.doi.org/10.1016/j.ajem.2010.06.031>
7. Jennings PA, Cameron P, Bernard S. Epidemiology of prehospital pain: An opportunity for improvement. *Emerg Med J* [Internet]. 2011;28(6):530–1. Available from: <http://dx.doi.org/10.1136/emj.2010.098954>
8. Berben SAA, Schoonhoven L, Meijs THJM, Van Vugt AB, Van Grunsven PM. Prevalence and relief of pain in trauma patients in emergency medical services. *Clin J Pain* [Internet]. 2011;27(7):587–92. Available from: <https://doi.org/10.1097/AJP.0b013e3182169036>
9. Mura P, Serra E, Marinangeli F, Patti S, Musu M, Piras I, et al. Prospective study on prevalence, intensity, type, and therapy of acute pain in a second-level urban emergency department. *J Pain Res* [Internet]. 2017;10:2781–8. Available from: <https://doi.org/10.2147/JPR.S137992>
10. Damico V, Murano L, Cazzaniga F, Dal Molin A. Pain prevalence, severity, assessment and management in hospitalized adult patients: a result of a multicenter cross-sectional study. *Ann Ist Super Sanità* [Internet]. 2018;54(3):194–200. Available from: https://doi.org/10.4415/ANN_18_03_05

11. Ahmadi A, Bazargan-hejazi S, Zadi ZH, Eusasobhon P, Keturman P, Karbasfrushan A, et al. Pain management in trauma: A review study. *Inj Violence* [Internet]. 2016;8(2):89–98. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4967367/pdf/jivr-08-89.pdf>
12. Keene DD, Rea WE, Aldington D. Acute pain management in trauma. *Trauma* [Internet]. 2011;13(3):167–79. Available from: <https://doi.org/10.1177/1460408611400813>
13. Sinatra R. Causes and Consequences of Inadequate Management of Acute Pain. *Pain Med* [Internet]. 2010;11:1859–71. Available from: <https://doi.org/10.1111/j.1526-4637.2010.00983.x>
14. Wells N, Pasero C, McCaffery M. Improving the Quality of Care Through Pain Assessment and Management. In: Hughes RG, editor. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses, Vol 1* [Internet]. Rockville, MD: Agency for Healthcare Research and Quality; 2008. p. 474–502. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK2658/>
15. Thomas SH, Shewakramani S. Prehospital Trauma Analgesia. *J Emerg Med* [Internet]. 2008;35(1):47–57. Available from: <https://doi.org/10.1016/j.jemermed.2007.05.041>
16. Braun EE, Khan TW, Campbell SM. Acute Pain Management in Trauma. In: Papadakos PJ, Gestring ML, editors. *Encyclopedia of Trauma Care* [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2015. p. 48–52. Available from: https://doi.org/10.1007/978-3-642-29613-0_495
17. Studnek JR, Fernandez AR, Vandeventer S, Davis S, Garvey L. The Association between Patients' Perception of Their Overall Quality of Care and Their Perception of Pain Management in the Prehospital Setting. *Prehosp Emerg Care* [Internet]. 2013;17(3):386–91. Available from: <https://doi.org/10.3109/10903127.2013.764948>
18. Murphy A, McCoy S, O'Reilly K, Fogarty E, Dietz J, Crispino G, et al. A Prevalence and Management Study of Acute Pain in Children Attending Emergency Departments by Ambulance. *Prehosp Emerg Care* [Internet]. 2016;20(1):52–8. Available from: <https://doi.org/10.3109/10903127.2015.1037478>
19. Friesgaard KD, Riddervold IS, Kirkegaard H, Christensen EF, Nikolajsen L. Acute pain in the prehospital setting: A register-based study of 41.241 patients. *Scand J Trauma Resusc Emerg Med* [Internet]. 2018;26(1):1–10. Available from: <https://doi.org/10.1186/s13049-018-0521-2>

20. Lourens A, McCaul M, Parker R, Hodgkinson P. Acute Pain in the African Prehospital Setting: A Scoping Review. *Pain Res Manag* [Internet]. 2019;1–13. Available from: <https://doi.org/10.1155/2019/2304507>
21. Matthews R, McCaul M, Smith W. A description of pharmacological analgesia administration by public sector advanced life support paramedics in the City of Cape Town. *Afr J Emerg Med* [Internet]. 2017;7(1):24–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.002>
22. Mould-Millman NK, Sasser SM, Wallis LA. Prehospital research in sub-Saharan Africa: Establishing research tenets. *Acad Emerg Med* [Internet]. 2013;20(12):1304–9. Available from: <https://doi.org/10.1111/acem.12269>
23. Sobuwa S, Christopher LD. Emergency care education in South Africa: past, present and future. *Australas J Paramed* [Internet]. 2019;16:1–6. Available from: <https://doi.org/10.33151/ajp.16.647>
24. National Department of Health. National Emergency Care Education and Training Policy [Internet]. 2017 p. 1–16. Available from: <http://www.health.gov.za/index.php/2014-08-15-12-53-24/category/327-2017po?download=2126:national-emergency-care-education-and-training-policy>
25. Valentia Technologies. Western Cape EMS commences rollout of CareMonX PTS CAD and CareMonX Electronic Patient Care Reporting (ePCR) [Internet]. News Archive. 2016 [cited 2019 Aug 23]. Available from: <https://www.valentiatech.com/Valentia-Technologies-dublin-march-2016.html>
26. Department of Health, Western Cape Government. Electronic Patient Care Report, Pain Evaluation. Western Cape Emergency Medical Service; 2016.
27. Paediatric Triage Working Group (PTWG) and South Africa Triage Group (SATG). The South African Triage Scale Training (SATS) Manual [Internet]. Western Cape Government. 2012. 1–34 p. Available from: <https://emssa.org.za/sats/>
28. Gottschalk SB, Wood D, De Vries S, Wallis LA, Bruijns S. The cape triage score: a new triage system South Africa. Proposal from the cape triage group. *Emerg Med J* [Internet]. 2006;23(2):149–53. Available from: <https://doi.org/10.1136/emj.2005.028332>
29. Twomey M, Wallis L, Thompson M, Myers JE. The South African Triage Scale (adult version) provides valid acuity ratings when used by doctors and enrolled nursing assistants. *Afr J*

- Emerg Med [Internet]. 2012;2(1):3–12. Available from: <https://doi.org/10.1016/j.afjem.2011.08.014>
30. Glaziou P. Computes sample size and power [Internet]. 2005. Available from: <http://sampsizе.sourceforge.net/iface/#prev>
 31. Hebgards, S, Mannering, A, Zwislер S. Assessment of acute pain in trauma - A retrospective prehospital evaluation. J Opioid Manag [Internet]. 2016;12(5):347–53. Available from: <https://doi.org/10.5055/jom.2016.0351>
 32. Hennes H, Kim MK, Pirrallo RG. Prehospital pain management: A comparison of providers' perceptions and practices. Prehosp Emerg Care [Internet]. 2005;9(1):32–9. Available from: <https://doi.org/10.1080/10903120590891705>
 33. Ramgopal S, Elmer J, Escajeda J, Martin-Gill C. Differences in Prehospital Patient Assessments for Pediatric Versus Adult Patients. J Pediatr [Internet]. 2018;199:200–205.e6. Available from: <https://doi.org/10.1016/j.jpeds.2018.03.069>
 34. Hewes HA, Dai M, Mann NC, Baca T, Taillac P. Prehospital Pain Management: Disparity By Age and Race. Prehosp Emerg Care [Internet]. 2018;22(2):189–97. Available from: <https://doi.org/10.1080/10903127.2017.1367444>
 35. Iqbal M, Spaight PA, Siriwardena AN. Patients' and emergency clinicians' perceptions of improving pre-hospital pain management: a qualitative study. Emerg Med J [Internet]. 2013;30(3):1–6. Available from: <http://dx.doi.org/10.1136/emered-2012-201111>
 36. Gausche-Hill M, Brown KM, Oliver ZJ, Sasson C, Dayan PS, Eschmann NM, et al. An evidence-based guideline for prehospital analgesia in trauma. Prehosp Emerg Care [Internet]. 2014;18(SUPPL.1):25–34. Available from: <https://doi.org/10.3109/10903127.2013.844873>
 37. Health Professions Council of South Africa. South African Emergency Medical Services Clinical Practice Guidelines [Internet]. Pretoria; 2018. Available from: http://www.hpcsа.co.za/Uploads/editor/UserFiles/downloads/emergency_care/CLINICAL_PRACTICE_GUIDELINES_PROTOCOLS_2018.pdf.
 38. Lord B. Paramedic assessment of pain in the cognitively impaired patient. BMC Emerg Med [Internet]. 2009;9(20):1–9. Available from: <https://doi.org/10.1186/1471-227X-9-2>
 39. Hennes H, Kim MK. Prehospital pain management: Current status and future direction. Clin Pediatr Emerg Med [Internet]. 2006;7(1):25–30. Available from:

<http://dx.doi.org/10.1016/j.cpem.2006.01.008>

40. Berben SAA, Meijs THJM, Van Grunsven PM, Schoonhoven L, Van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury* [Internet]. 2012;43(9):1397–402. Available from: <http://dx.doi.org/10.1016/j.injury.2011.01.029>
41. French SC, Salama NP, Baqai S, Raslavicus S, Chan SB, Ramaker J. Effects of Educational Interventions on Prehospital Pain Management. *Prehosp Emerg Care* [Internet]. 2006;10(1):71–6. Available from: <https://doi.org/10.1080/10903120500366086>
42. French S, Chan S, Ramaker J. Education on Prehospital Pain Management: A Follow-Up Study. *West J Emerg Med* [Internet]. 2013;14(2):96–102. Available from: <http://www.escholarship.org/uc/item/9qp925q9>
43. McManus JG, Sallee DR. Pain management in the prehospital environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://doi.org/10.1016/j.emc.2004.12.009>
44. Brennan F, Carr DB, Cousins M. Pain management: A fundamental human right. *Anesth Analg* [Internet]. 2007;105(1):205–21. Available from: <https://doi.org/10.1213/01.ane.0000268145.52345.55>
45. Bendall JC, Simpson PM, Middleton PM. Prehospital analgesia in New South Wales, Australia. *Prehosp Disaster Med* [Internet]. 2012;26(6):422–6. Available from: <https://doi.org/10.1017/S1049023X12000180>
46. Michael GE, Sporer KA, Youngblood GM. Women are less likely than men to receive prehospital analgesia for isolated extremity injuries. *Am J Emerg Med* [Internet]. 2007;25(8):901–6. Available from: <https://doi.org/10.1016/j.ajem.2007.02.001%0A>
47. Lord B, Bendall JC, Reinten T. The Influence of Paramedic and Patient Gender on the Administration of Analgesics in the Out-of-Hospital Setting. *Prehosp Emerg Care* [Internet]. 2014;18(2):195–200. Available from: <https://doi.org/10.3109/10903127.2013.856502>
48. Platts-Mills TF, Hunold KM, Weaver MA, Dickey RM, Fernandez AR, Fillingim RB, Cairns CB, McLean S. Pain Treatment for Older Adults During Prehospital Emergency Care: Variations by Patient Gender and Pain Severity. *J Pain* [Internet]. 2014;14(9):966–74. Available from: <https://doi.org/10.1016/j.jpain.2013.03.014>

49. Young MF, Hern HG, Alter HJ, Barger J, Vahidnia F. Racial differences in receiving morphine among prehospital patients with blunt trauma. *J Emerg Med* [Internet]. 2013;45(1):46–52. Available from: <http://dx.doi.org/10.1016/j.jemermed.2012.07.088>
50. Whitley DE, Li T, Jones CMC, Cushman JT, Williams DM, Shah MN. An assessment of newly identified barriers to and enablers for prehospital pediatric pain management. *Pediatr Emerg Care* [Internet]. 2017;33(6):381–7. Available from: <http://dx.doi.org/10.1097/pec.0000000000000514>
51. Walsh B, Cone D, Meyer E, Larkin G. Paramedic attitudes regarding prehospital analgesia. *Prehosp Emerg Care* [Internet]. 2012;17(1):78–87. Available from: [https://www-tandfonline-com.ezproxy.uct.ac.za/doi/pdf/10.3109/10903127.2012.717167?needAccess=true](https://www.tandfonline-com.ezproxy.uct.ac.za/doi/pdf/10.3109/10903127.2012.717167?needAccess=true)
52. Murphy A, Barrett M, Cronin J, McCoy S, Larkin P, Brenner M, et al. A qualitative study of the barriers to prehospital management of acute pain in children. *Emerg Med J* [Internet]. 2014;31(6):493–8. Available from: <http://dx.doi.org/10.1136/emermed-2012-202166>
53. Hammer GP, Du Prel J, Blettner M. Avoiding Bias in Observational Studies. *Dtsch Arzteblatt Int* [Internet]. 2009;106(41):664–8. Available from: <https://doi.org/10.3238/arztebl.2009.0664>
54. Vassar M, Holzmann M. The retrospective chart review: important methodological considerations. *J Educ Eval Health Prof* [Internet]. 2013;10:12. Available from: <https://doi.org/10.3352/jeehp.2013.10.12>
55. Mould-Millman NK, Dixon JM, Sefa N, Yancey A, Hollong BG, Hagahmed M, et al. The state of Emergency Medical Services (EMS) systems in Africa. *Prehosp Disaster Med* [Internet]. 2017;32(3):273–83. Available from: <https://doi.org/10.1017/S1049023X17000061>

Supplementary material of the published article

Table S5.1: Types of emergency incidents

Incident Type	n (%)
Assault ^a	1211 (50.4%)
Transport-related incident ^b	492 (20.5%)
Accidental injury ^c	380 (15.8%)
Burns ^d	90 (3.8%)
Self-harm	90 (3.8%)
Gunshot wound (GSW)	68 (2.8%)
Environmental	63 (2.6%)
Drowning	4 (0.2%)
Electrocution	3 (0.1%)
Total	2401 (100%)
Footnote: ^a Includes physical assault, assault with a weapon and sexual assault, ^b Includes light motor vehicle, bus/taxi, truck/heavy vehicle, motorcyclist, cyclist, pedestrian, train, and railway incidents, ^c Includes domestic, sport and industrial accidental injuries, ^d Includes burns and corrosives, residential and informal structure fires.	

5.4 Discussion

5.4.1 *Supplementary methods*

To conduct the retrospective review, an application to perform research was submitted to the National Health Research Database. After approval was received from the WC Health Research Committee (WC_2017RP54_569) ([Appendix 2](#)) a request for data was made to the WCEMS.

Since the ePCR database includes over 400 variables, the definitions for the variables included in the ePCR was requested to create a list of variables relevant to the research aim and objectives. With the assistance of a WCEMS senior information officer (Mr Selwyn September), a final list of 77 likely relevant variables was compiled. None of these data variables contained personal identifiable information of patients or emergency care providers employed by WCEMS.

The data points were extracted into Microsoft Excel® 2016 (225) spreadsheets for each month of the year for 2017. To randomly select the calculated sample size, stratified per month, all duplicate entries, non-trauma emergency cases, interfacility transfers and cases with a final SATS colour priority of green (minor injuries) or blue (deceased) were excluded. A total of 24575 emergency trauma cases met the inclusion criteria. After the data were cleaned, the sample per month was randomly selected and the final dataset of 2401 patients compiled. The dataset was imported to SPSS Version 25 (223) for analysis.

In addition to the results in the article further descriptive statistics were calculated and presented in graphs and tables. For inferential statistics, non-parametric test, Pearson chi-square test of independence (χ^2) were used to determine relationships between categorical variables and Phi (ϕ) and Cramer's V (ϕ_c) correlation coefficient to determine the strength of association. Wilcoxon Signed Ranks tests (non-parametric) were used to determine the change between initial and final vital signs. Spearman's correlation coefficient (r_s) was conducted to determine whether a relationship exists between pain score and initial vital signs (RR, SpO₂, HR, SBP & DBP). Further, binary logistic regression analyses were conducted to determine the effect of demographic information on pain score recorded and medication with analgesic properties administered.

5.4.2 *Supplementary results*

5.4.2.1 *Case characteristics*

Most of the patients reviewed were aged between 15-44 years ($n=1713$, 71.3%) while the most prominent age subgroup was 25-34 years ($n=761$, 31.7%) and the least common, the age subgroup <1 year (0.4%) (Figure 5.5). The median age for males was 29 (IQR 22-38) years and 30 (IQR 21-42) years for females.

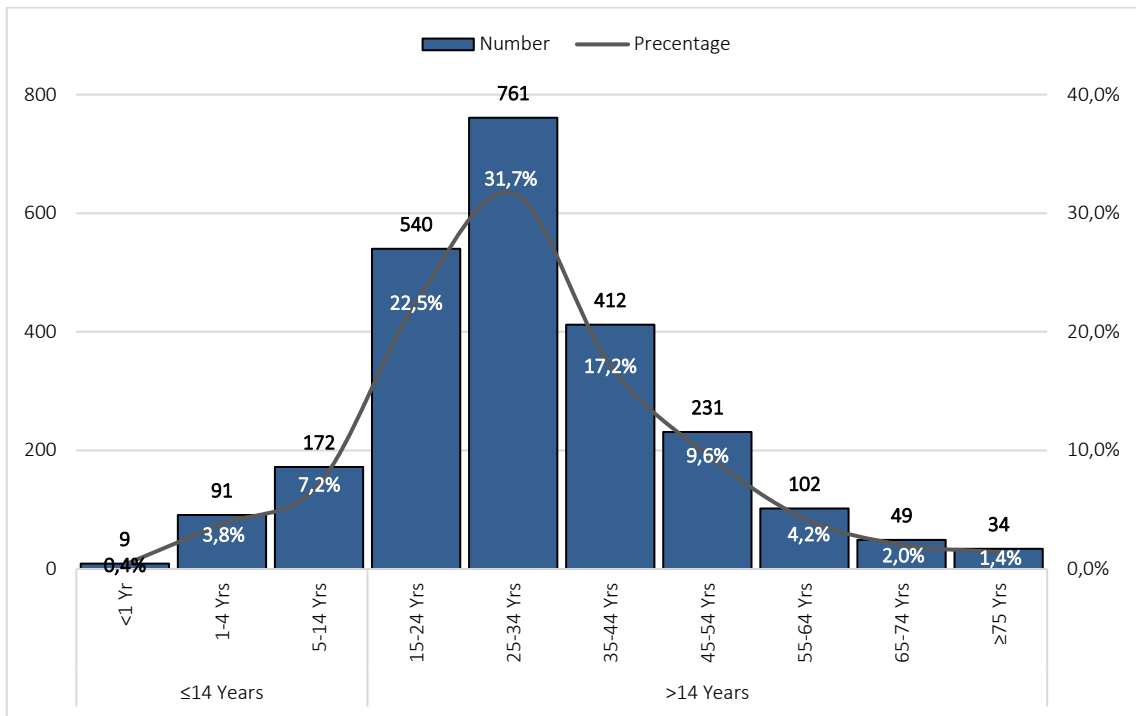


Figure 5.5: Age subgroups

Most incidents ($n=1589$, 66.2%) occurred in the City of Cape Town and Cape Winelands District with 45.3% ($n=1088$) and 20.9% ($n=501$) respectively (Figure 5.6).

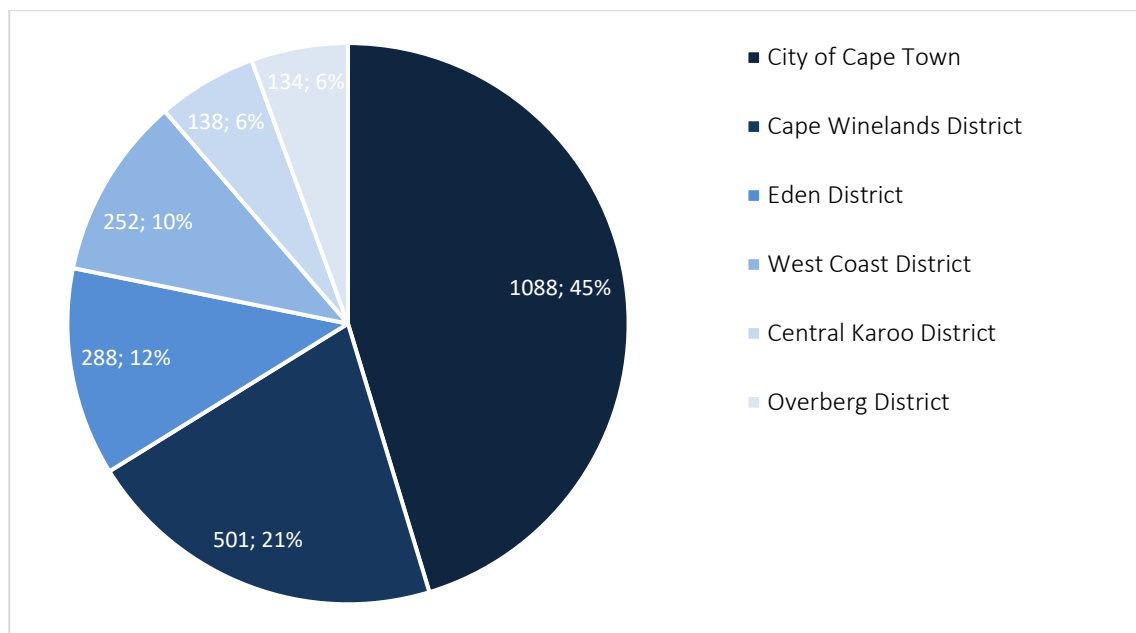


Figure 5.6: Cases reviewed per district

The final triage colour for most patients was yellow ($n=1562$, 65.1%) (Figure 5.7). Red patients were more likely to be male ($n=158$, 9.6%) than female ($n=42$, 5.6%) whereas yellow patients were more likely to be female (68.4% versus 63.5%) ($\chi^2(2, n=2401) = 11.929, p=0.003, \phi_c=0.07$). Twenty-six percent of female and 26.9% of male patients were triaged orange.

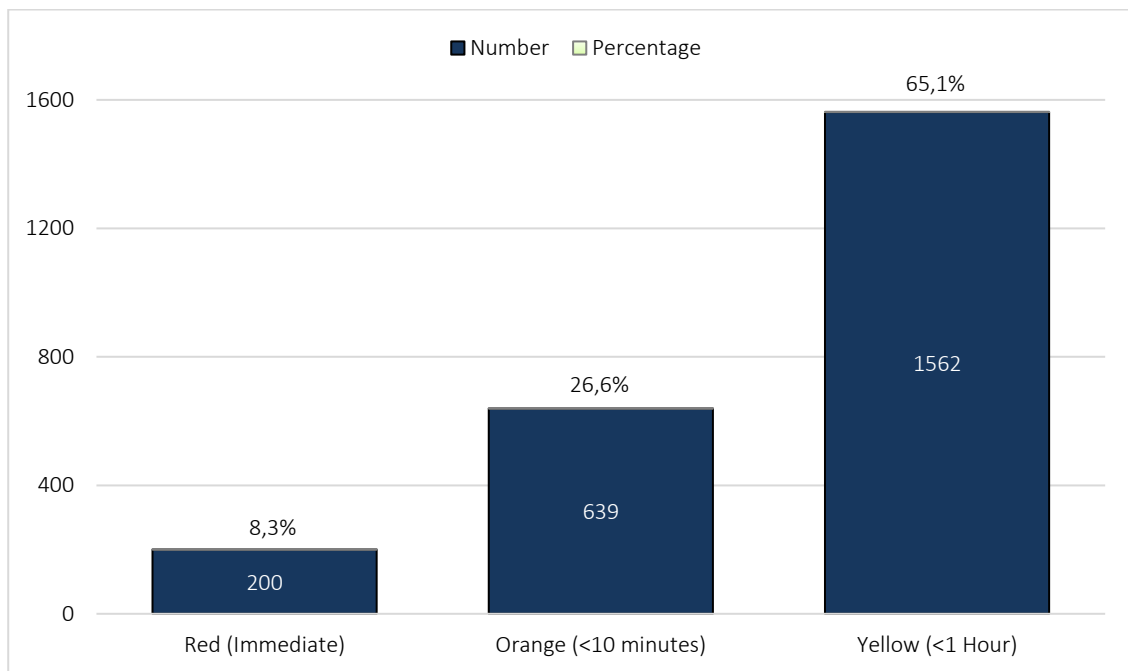


Figure 5.7: South African Triage Scale (SATS) priority colour

No association ($p=0.071$) was found between final triage and age (≤ 14 and >14 years) however 4.8% ($n=13$) of patients ≤ 14 years and 8.8% ($n=187$) of patients >14 years were red. A weak ($\phi_c=0.083$) but significant association was found between final triage colour and the highest level of qualification (BLS, ILS and all ALS) ($\chi^2(4, n=2401) = 19.825, p < 0.001$). For all three triage colours, red (51.5%), orange (52.1%) and yellow (56.7%), patients were more likely treated by an ILS practitioner as the highest qualification.

Of all trauma cases, 5 (0.2%) patients refused treatment and 49 (2%) refused transportation while the remaining 2347 (97.8%) patients were treated and transported to hospital. Practitioner qualification level was upgraded for pain management in 5 (0.2%) trauma cases.

5.4.2.2 Incident type

As reported, assault, transport-related and accidental injuries were the three most common incident types followed by burns (3.8%), self-harm (3.8%) and GSW (2.8%). Overall, at least 53.3% ($n=1279$) of trauma cases (assault & GSW) appeared to be due to interpersonal violence while 20.5% ($n=492$) were due to transport-related incidents. Table 5.3 illustrates the types and subtypes of all trauma incidents reviewed.

Of the male trauma cases ($n=1650$), 58.7% ($n=970$) were related to interpersonal violence (assault and GSW) and 41.1% ($n=309$) of female cases ($n=751$). Of all assault cases ($n=1211$), 75.4% ($n=913$) were male and 24.6% ($n=298$) female while for all GSW ($n=68$), 83.8% ($n=57$) were male and 16.2% ($n=11$) female.

Table 5.3: Types and subtypes of traumatic incidents

Incident Type	Sub-type	n (%)	Total
1. Assault	Physical	231 (9.6%)	1211 (50.4%)
	Weapon (other)	978 (40.7%)	
	Sexual	2 (0.1%)	
2. Transport Related Incident	Light motor vehicle	216 (9%)	492 (20.5%)
	Bus / Taxi	18 (0.7%)	
	Truck / Heavy Vehicle	10 (0.4%)	
	Motorcyclist	24 (1%)	
	Cyclist	9 (0.4%)	
	Pedestrian	202 (8.4%)	
Train and Railway incident	13 (0.55%)		
3. Accidental Injury	Domestic	283 (11.8%)	380 (15.8%)
	Sport	44 (1.8%)	
	Industrial	52 (2.2%)	
4. Burns	Burns and Corrosives	83 (3.4%)	90 (3.8%)
	Residential Fire	2 (0.1%)	
	Informal Structure Fire	5 (0.2%)	
5. Self-Harm			90 (3.8%)
6. Gun Shot Wound (GSW)			68 (2.8%)
7. Environmental (bites and stings, heat-exposure)			63 (2.6%)
8. Electrocution			3 (0.1%)
9. Drowning			4 (0.2%)
Total			2401 (100%)

Three hundred and thirty-seven (20.4%) males and 155 (20.6%) females were injured in transport-related incidents. For females, accidental injuries ($n=178$, 23.7%) were the second most common traumatic incident after interpersonal violence while for males it was transport-related incidents (Table 5.4).

Table 5.4: Types of traumatic incidents versus gender

Incident Type	Male, n (%)	Female, n (%)	Total
Assault	913 (55.3%)	298 (39.7%)	1211
Transport Related Incident	337 (20.4%)	155 (20.6%)	492
Accidental Injury	202 (12.2%)	178 (23.7%)	380
Gun Shot Wound (GSW)	57 (3.5%)	11 (1.5%)	68
Burns	52 (3.2%)	38 (5.1%)	90
Self-Harm	48 (2.9%)	42 (5.6%)	90
Environmental (bites and stings, heat exposure)	36 (2.2%)	27 (3.6%)	63
Electrocution	2 (0.1%)	1 (0.1%)	3
Drowning	3 (0.2%)	1 (0.1%)	4
Total	1650	751	2401

For patients ≤ 14 years ($n=272$), the three most common incidents were accidental injuries ($n=101$, 37.1%), transport-related incidents ($n=50$, 18.4%) and burns ($n=39$, 14.3%) while for patients >14 years, it was assault ($n=1178$, 55.4%), transport-related ($n=443$, 20.8%) and accidental injuries ($n=279$, 13.1%) (Table: 5.5).

Table 5.5: Types of traumatic incidents versus age (≤ 14 years and >14 years)

Incident Type	≤ 14 Years, n (%)	>14 Years, n (%)	Total
Assault	33 (12.1%)	1178 (55.3%)	1211
Transport Related Incident	50 (18.4%)	442 (20.8%)	492
Accidental Injury	101 (37.1%)	279 (13.1%)	380
Gun Shot Wound (GSW)	2 (0.7%)	66 (3.1%)	68
Burns	39 (14.3%)	51 (2.4%)	90
Self-Harm	22 (8.1%)	68 (3.2%)	90
Environmental (bites and stings, heat exposure)	21 (7.7%)	42 (2.0%)	63
Electrocution	2(0.7%)	1 (0.1%)	3
Drowning	2 (0.7%)	2 (0.1%)	4
Total	272	2129	2401

Assault was the most common incident in all six districts (ranging between 43% and 63%) (Figure 5.8), followed by accidental injuries in the Cape Winelands (22.2%), Overberg (20.9%) and West Coast (15.5%) districts and transport-related incidents for the City of Cape Town (30.9%) and Eden district (11.1%). For the Central Karoo, accidental injuries and transport-related incidents were joint second at 13.8% each.

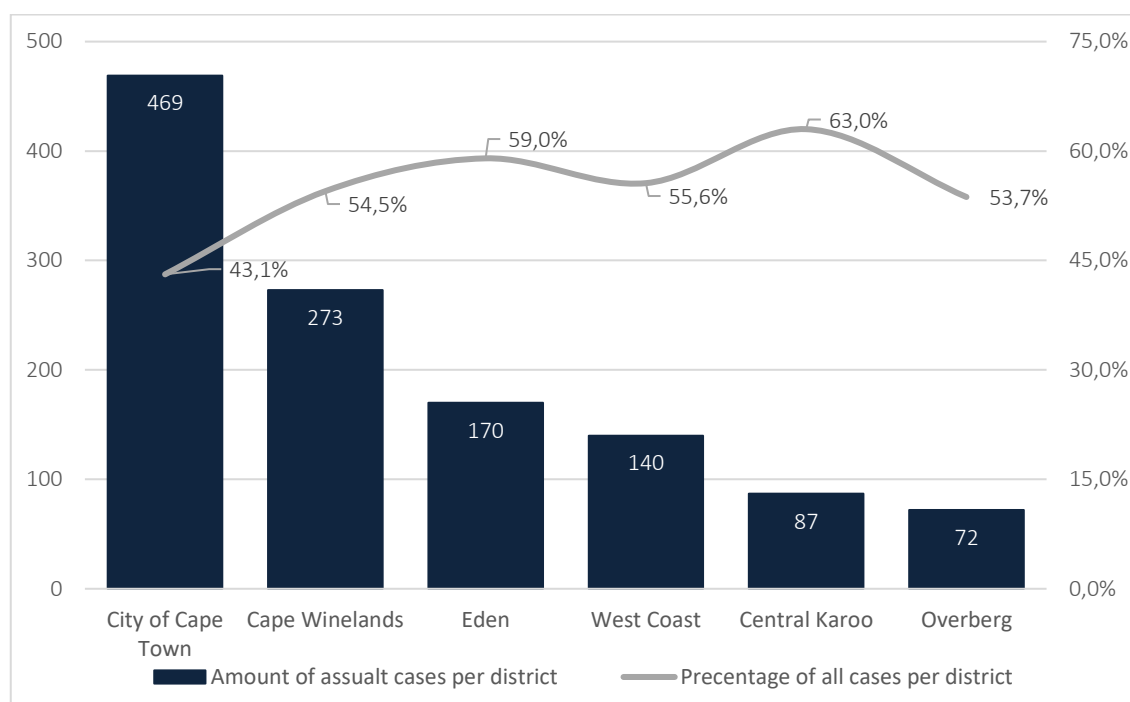


Figure 5.8: Assault cases per district

5.4.2.3 Injuries sustained

For 863 (35.9%) patients, open and/or closed wounds were reported as part of the working diagnosis while 47 (2%) had more than one open and/or closed wounds reported. The most frequently reported wound sustained was laceration/incision ($n=547$, 63.4%) (Table 5.6).

Table 5.6: Open and/or closed wounds sustained

Open and/or closed wounds	n (%)
Laceration / incision	547 (63.4%)
Abrasions	30 (3.5%)
Avulsion	14 (1.6%)
Puncture	46 (5.3%)
Bites	31 (3.6%)
Contusion / bruises / swelling	103 (12%)
Haematoma	36 (4.2%)
Evisceration	4 (0.5%)
Unknown injury	104 (12.1%)

5.4.2.4 Vital signs

The AVPU (alert, voice, pain, unconscious) scale mode for both patients >14 years ($n=2110$) and ≤ 14 years ($n=267$) was alert. Table 5.7 and 5.8 presents the median and IQR for initial and final vitals for patients >14 years and ≤ 14 years. For adults, a significant difference was found between initial and final RR, SpO₂ and HR and for paediatrics between initial and final RR, although these differences are likely clinically insignificant.

Table 5.7: Median and IQR for initial and final vital signs of patients >14 years ($n=2129$)

Vital Signs	Initial		Final		p-value
	Median (IQR)	n	Median (IQR)	n	
Respiratory Rate*	18 (16-20)	2113	18 (16-20)	840	<0.001
SpO ₂ *	98% (97-99)	1101	99% (97-100)	474	<0.001
Heart Rate*	93 (81-105)	2119	91 (80-104)	837	<0.001
Systolic BP*	127 (113-140)	2108	128 (116-140)	837	0.609
Diastolic BP*	79 (70-88)	2108	79 (70-88)	835	0.881
HGT	5.8 (5.2-6.5)	879	5.75 (5.2-6.7)	118	
Temperature	36.2 (35.9-36.6)	2703	36.2 (35.9-36.6)	606	
GCS	15 (15-15)	978	15 (15-15)	768	

*Wilcoxon Sign-Rank test

Table 5.8: Median and IQR for initial and final vital signs of patients ≤ 14 years ($n=272$)

Vital Signs	Initial		Final		p-value
	Median (IQR)	n	Median (IQR)	n	
Respiratory Rate*	22 (18-28)	265	22 (19-25)	107	0.001
SpO ₂ *	99% (98-100)	147	99% (97-100)	58	0.442
Heart Rate*	108 (93.5-124)	269	101 (89-119)	105	0.939
Systolic BP*	116 (104-122)	87	114.5 (109-120.75)	40	0.680
Diastolic BP*	70 (62-88)	87	70 (63.5-80)	40	0.518
HGT	5.6 (4.95-6.5)	69	5.35 (5.05-5.95)	12	
Temperature	36.2 (36.0-36.8)	262	36.2 (36-36.9)	83	
GCS	15 (11.75-15)	132	15 (15-15)	89	

*Wilcoxon Sign-Rank test

For paediatrics (≤ 14 years) a significant weak (0.10-0.39) (203) positive correlation was found between pain score and initial RR ($r_s=0.398$, $p=0.003$) as well as a moderate (0.40-0.69) (203) positive correlation between initial HR ($r_s=0.458$, $p=0.001$). In adults (>14 years), a weak (0.10-

0.39) (203) positive correlation was found between pain score and initial RR ($r_s=0.141$, $p=0.006$). No significant difference was found between initial and final vital signs (RR, SpO₂, HR, SBP & DBP) of adults and paediatrics which received pain medication.

5.4.2.5 Pain assessment and pain severity

Of the 435 patients with a pain score recorded, 12 (2.8%) had no pain, 81 (18.6%) mild pain, 175 (40.2%) moderate pain and 167 (38.4%) severe pain. Of these, 72 ($n=435$, 16.6%) patients had a pain score repeated at least once while only 9 (12.5%) had a clinically significant pain reduction of two or more points, four (5.5%) of which received IV morphine. Twelve (2.8%) of the patients with a pain score recorded had an AVPU scale of react to voice or react to pain recorded.

For the 52 patients aged ≤ 14 years with a pain score recorded, 88.5% ($n=46$) suffered moderate-to-severe (4-10) pain while 77.3% ($n=296$) of patients >14 years ($n=383$) suffered moderate-to-severe pain. All patients ≤ 14 years ($n=52$) with a pain score recorded experienced (mild to severe) pain whereas 96.8% ($n=371$) of patients >14 years with a pain score recorded experienced (mild to severe) pain (Figure 5.9).

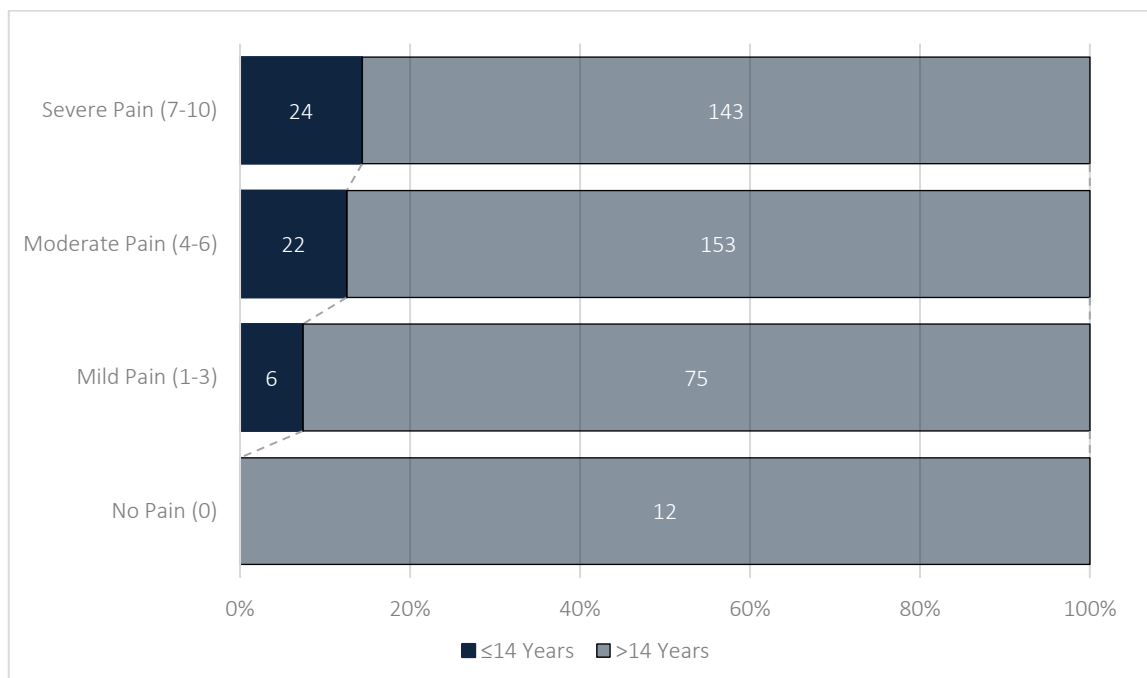


Figure 5.9: Pain severity of patients ≤ 14 years and >14 years

5.4.2.6 Association between pain score (yes/no) and categorical variables

No significant association was found between pain score and the patients' final triage colour ($p=0.076$) while a significant association was found between pain score and incident location ($p<0.001$) and between pain score and crew highest qualification ($p=0.020$) (Table 5.9).

A higher proportion of patients with incidents occurring in the Overberg district (38.8%) (Table 5.9) compared to the other districts [Cape Winelands (17.8%), Central Karoo (18.8%), Eden (20.1%), West Coast (11.5%) and the City of Cape Town (16.6%)] had a pain score recorded, however, the strength of association was weak ($\phi_c=0.142$). Trauma patients managed by crews with BLS (22.2%) as highest qualification were more likely to have a pain score recorded compared to trauma patients managed by ILS (16.4%) or ALS (19.1%) practitioners (Table 5.9). The strength of association was weak ($\phi_c=0.057$).

Table 5.9: Association between pain score (yes/no) and other categorical variables

Final Triage Colour	Pain score (Yes) n (%)	Pain score (No) n (%)	Total n (%)
Yellow	270 (17.3%)	1292 (82.7%)	1562 (100%)
Orange	134 (21.0%)	505 (79.0%)	639 (100%)
Red	31 (15.5%)	169 (84.5%)	200 (100%)
Total	435 (18.1%)	1966 (81.9%)	2401 (100%)
	Value	Df	p-value
Pearson Chi-Square	5.158	2	0.076
Incident Location	Pain score (Yes) n (%)	Pain score (No) n (%)	Total n (%)
City of Cape Town	181 (16.6%)	907 (83.4%)	1088 (100%)
Cape Winelands District	89 (17.8%)	412 (82.2%)	501 (100%)
Central Karoo District	26 (18.8%)	112 (81.2%)	138 (100%)
Eden District	58 (20.1%)	230 (79.9%)	288 (100%)
Overberg District	52 (38.8%)	82 (61.2%)	134 (100%)
West Coast District	29 (11.5%)	223 (88.5%)	252 (100%)
Total	435 (18.1%)	1966 (81.9%)	2401 (100%)
	Value	Df	p-value
Pearson Chi-Square	48.576	5	P<0.001
Crew Highest Qualification	Pain score (Yes) n (%)	Pain score (No) n (%)	Total n (%)
Basic Life Support (BLS)	92 (22.2%)	323 (77.8%)	415 (100%)
Intermediate Life Support (ILS)	216 (16.4%)	1105 (83.6%)	1321 (100%)
Advanced Life Support (ALS)	127 (19.1%)	538 (80.9%)	665 (100%)
Total	435 (18.1%)	1966 (81.9%)	2401 (100%)
	Value	Df	p-value
Pearson Chi-Square	7.800	2	0.020

5.4.2.7 Pharmacological pain management

As indicated in the article, 68 ($n=2401$, 2.8%) patients received analgesic medication. Sixty-six (97.0%) received IV morphine, one (1.5%) received IM diclofenac (75 mg) and one (1.5%) IV ketamine (150 mg) as first analgesic agent. Of the 66 patients who received IV morphine, 10 (15.2%) patients received an additional morphine dose (all adults) and 6 (9.1%) received ketamine (IV or IM) (one paediatric) after IV morphine. The overall median first IV morphine dose was 5.0 mg (IQR 4-5) and the median total dose of 5.0 mg (IQR 4-7). Paediatrics (≤ 14 years) which received

analgesia were aged 10 to 14 years while most adults (>14 years) who received IV morphine were between 15 and 44 years ($n=51$, 77.3%).

Twenty-seven ($n=435$, 6.2%) patients with a pain score recorded received analgesic medication (Table 5.10). Two of the six patients with moderate pain who received morphine received ketamine IV later, three of the 20 patients with severe pain who received morphine received ketamine (IV/IM) later while five of the 10 patients who received additional morphine dosages had severe pain.

Table 5.10: Pain severity versus medication with analgesic properties administered

Pain Severity	Analgesic Medication (Yes)		Analgesic Medication (No)	
	Amount	%	Amount	%
No Pain (0)	0	0.0%	12	100.0%
Mild Pain (1-3)	1	1.2%	80	98.8%
Moderate Pain (4-6)	6	3.4%	169	96.6%
Severe Pain (7-10)	20	12.0%	147	88.0%
Total	27	6.2%	408	93.8%

5.2.4.8 Association between medication administered and categorical variables

A significant association was found between analgesic medication administered and patients' final priority triage colour. High acuity trauma patients [red (9%) or orange (5.3%)] were more likely to receive analgesic medication compared to the 1% of yellow patients (Table 5.11). The strength of association was weak ($\phi_c=0.159$).

Table 5.11: Association between analgesic medication administered and final triage

Final Triage Colour	Medication (Yes)	Medication (No)	Total
	<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>
Yellow	16 (1.0%)	1546 (99.0%)	1562 (100%)
Orange	34 (5.3%)	605 (94.7%)	639 (100%)
Red	18 (9.0%)	182 (91.0%)	200 (100%)
Total	68 (2.8%)	2333 (97.2%)	2401 (100%)
	Value	Df	p-value
Pearson Chi-Square	60.579	2	<0.001

5.2.4.9 Regression analysis

5.2.4.9.1 Effect of independent variables on pain score recorded

A binary logistic regression analysis was conducted to establish the effects of patient sex, location of the incident, age (≤ 14 and > 14 years), final triage priority colour and crew highest qualification on the likelihood of having a pain score (yes/no) recorded. The logistic regression model was found to be statistically significant [$\chi^2(11, n=2401)=60.965, p<0.000$] with 25% (Cox & Snell R^2) to 41% (Nagelkerke R^2) of variance in pain score (yes/no) explained by the model. The Hosmer and

Lemeshow test were $\chi^2(8)=3.337$, $p=0.911$ and the percentage accuracy in classification was 81.9%.

The independent variables significantly predicting recording a pain score were the location of incident and crew highest qualification. Trauma cases in the Overberg district were more likely ($OR\ 3.377$, $95\%CI\ 2.292-4.977$, $p<0.001$) compared to cases in the City of Cape Town to have a pain score recorded while trauma cases in the West Coast ($OR\ 0.636$, $95\%CI\ 0.416-0.972$, $p=0.036$) was less likely compared to cases in the City of Cape Town ($p<0.001$) to have a pain score recorded. Cases in the remaining districts [Cape Winelands ($p=0.520$), Central Karoo ($p=0.367$) and Eden ($p=0.139$)] were not significantly different in comparison to the City of Cape Town in terms of recording pain scores. Patients managed by an ILS practitioner were less likely ($OR\ 0.636$, $95\%CI\ 0.481-0.841$, $p=0.001$) than those managed by a BLS practitioner ($p=0.004$) to have a pain score recorded while patients managed by ALS practitioners ($OR\ 0.816$, $95\%CI\ 0.596-1.116$, $p=0.204$) was not significantly less likely than those managed by a BLS to have a pain score recorded.

5.2.4.9.2 *Effect of independent variables on medication with analgesic properties received*

A binary logistic regression analysis was conducted to establish the effects of patient sex, age (≤ 14 and >14 years), final triage priority colour, pain score (yes/no) and crew highest qualification on the likelihood of receiving medication with analgesic properties (yes/no). The logistic regression model was found to be statistically significant [$\chi^2(7, n=2401)=187.142$, $p<0.000$] with 7.5% (Cox & Snell R^2) to 33.0% (Nagelkerke R^2) of variance in medication with analgesic properties administered (yes/no) explained by the model. The Hosmer and Lemeshow test were $\chi^2(7)=4.786$, $p=0.686$ and the percentage accuracy in classification was 97.2%.

The independent variables, pain score (yes/no), final triage priority colour and crew highest qualification were statistically significant in the model. Patients with a pain score recorded were 3.1 ($95\%CI\ 1.796-5.371$, $p<0.001$) times more likely than those with no pain score recorded to receive analgesia. Red patients were 7.2 ($95\%CI\ 3.470-14.988$, $p<0.001$) times more likely and orange patients 4.6 ($95\%CI\ 2.472-8.606$, $p<0.001$) times more likely compared to yellow patients to received medication with analgesic properties. Patients managed by an ALS practitioner as highest qualification were 38.98 ($95\%CI\ 5.347-284.17$, $p<0.001$) times more likely to receive analgesia compared to those managed by a BLS as the highest qualification. Patients managed by an ILS ($p=0.652$) qualified practitioner was not more likely than those managed by BLS as the highest qualification, to receive analgesia.

5.2.4.10 Compliance to HPCSA protocols

Assessing compliance of the emergency care provider with current HPCSA protocols in terms of the administration of pharmacological pain management (Table 5.12) in the study was problematic. None of the patients in the dataset received inhaled Entonox[®], although according to the indications (*relief of pain from myocardial infarction, musculoskeletal trauma, burns, active labour, any other condition requiring pain relief where no contra-indication is present*) for the administration of inhaled Entonox[®] as stipulated in the HPCSA protocols (at the time of the study) many patients could have received and benefited from the inhaled analgesic agent.

Table 5.12: Analgesic medication per scope of practice before 31 December 2018 (258)

Level of Qualification	Analgesic Medication (Before 31 December 2018)
Basic (BLS) and Intermediate Life Support (ILS)	Entonox [®] (Self-Administered)
Emergency Care Technician (ECT)	Entonox [®] or Morphine IV* (ECP or medical officer permission)
Advanced Life Support (ALS) ^a	Entonox [®] or Morphine IV*
Emergency Care Practitioner (ECP)	Entonox [®] , Morphine IV* or Ketamine IV*/IN*
Footnote: Abbreviations ^a IV – Intravenous, IN – Intranasal, ^a Include both, Critical Care Assistant (CCA) and National Diploma in Emergency Medical Care (NDEMS) paramedics	

For most (apart from one patient), the dose of morphine for adults (*dilute to a concentration of 1mg/ml and titrate to effect at 1mg/30 seconds slowly IVI, titrate to effect*) appears to be broadly administered according to the basic principles set out in the HPCSA protocol at the time. Further, seeing as the ketamine analgesia dose and the IV morphine dose for paediatrics are weight-based, it was not possible to determine the appropriateness of dosages since patient weight was not uniformly recorded.

5.4.3 Supplementary limitations

Although research is one of a range of reasons for collecting clinical data, it is by no means the foremost purpose and probably carries a relatively low priority. One of the more pertinent reasons for clinical documentation is to ensure continuity of care and as a result, the reliability and validity of clinical record data is a common issue when conducting research. Examples of challenges to the reliability and validity of the data included missing data in the records, the omission of pertinent observations, and inaccurate and inconsistent data recording, to name a few. In addition to concerns related to reliability and validity of clinical records, data analysis is limited to the content which is recorded in the specific type of clinical record (259). While some of the limitations were divulged in the article various restrictions were encountered secondary to the quality of the data received. The patient demographics and data related to the incident location and incident types were complete, but the patient clinical data were less accurate, inconsistent, and incomplete. Some improvement over time was noted in the dataset, possibly

as staff members became more familiar with the new system throughout the year. A significant number of patients did not have any pain score recorded while the working diagnosis or injuries sustained were also not recorded for many cases. In hindsight, it may have been more advantageous to have selected a later (2018) study period, as by then, the WCEMS may have resolved most or at least some of the clinical documentation issues and staff members may have been more familiar with the system.

Additional issues which could have attributed to data inaccuracies and inconsistencies are the variance in the level of qualification of the practitioner who completed the clinical records, as well as English language proficiency as most of the clinical records, are captured in English (238). As previously alluded to, English is the first language of less than 20% of the population of the WC yet writing clinical notes in English (as required by the Department of Health) requires a good level of English language writing proficiency. The crew's highest qualification was BLS and ILS in most (72.3%) cases included in the review. With these being short course qualifications with strict limitations in terms of course content and time-period, the description and detail provided in clinical documentation by these practitioners may be limited.

5.4.4 Supplementary discussion

In addition to the discussion provided in the article, further topics for deliberation were added.

5.4.4.1 Case characteristics and incident types

In the global context, SA is a country well-known for its high rate of traumatic injuries secondary to violence and road traffic accidents. The findings of this study suggest a similar injury-related profile for the WC as identified in previously published SA data (255,260–262). More than 70% of the trauma patients were aged 15 - 44 years, more than 65% male while interpersonal violence and transport-related incidents accounted for more than 70% of the incidents.

The national disease burden study for SA found homicide (7.5%) and road traffic injuries (RTIs) (4.1%) to be the second and fourth leading causes of mortality in 2000. For males' homicide were the second and RTIs the fourth leading cause of mortality while for females' homicide was seventh and RTIs eighth. Intentional and unintentional injuries were also a significant contributor to disability-adjusted life years in SA (260). The 2007 Bulletin of the WHO reported that the SA injury profile was dominated by interpersonal violence, seven times the global rate. In 2000, homicide/interpersonal violence accounted for 46% of all injury-related deaths and RTIs 26.7%. For both, males and females, the leading causes of injury-related deaths were homicide/interpersonal violence and RTIs, however, for males' these accounted for a higher proportion of death compared to females. In comparison to the global homicide/interpersonal

violence mortality rate for males aged 15-29 years (19.8 per 100 000) and 30-44 years (19.1 per 100 000), the SA rate was significantly higher at 184 per 100 000 and 180.1 per 100 000, respectively. Although the female homicide/interpersonal violence death rate for all age groups was lower than males, it was still higher than the global death rate (255).

5.4.4.2 Vital signs

Similar to the current study, Lord and Woollard 2011 (239) found a significant positive but weak correlation between RR and initial pain score ($r=0.058$, $p=0.001$) among patients >14 years in the Australian prehospital setting while no correlation was found between pain score and HR or BP. However, unlike the current study both medical and trauma patients were included in the analysis. The study findings support the inference made by Lord and Woollard 2011 (239) that vital signs cannot be utilised to validate pain intensity in adults. Marco et al. 2006 (263) similarly found no clinically significant relationship between pain scores and HR or BP, but also RR in all EC patients (USA) older than 17 years.

Likewise, Bendall et al. 2011 (264) conducted a retrospective review of Australian prehospital patients 16 years and older with an initial pain score and who received analgesia, found a weak positive correlation between initial pain score and RR ($r_s=0.15$, $p<0.001$). Patients 16 years and older with an initial RR of ≥ 25 breaths per minute had higher odds of having more severe pain than those with a RR <25 while patients aged between 16 - 64 years with an initial HR ≥ 100 beats per minute likewise had a higher odds of more severe pain.

5.4.4.3 Appropriateness of the pain assessment tool

As mentioned in the article, the current smiley emoticons found in the WCEMS ePCR are not appropriate for the assessment of pain in paediatrics <4 years (89) or patients with a decreased LOC and the cognitively impaired in the prehospital setting (85). As indicated in the results some patients with a pain score recorded had a decreased LOC (react to voice or react to pain) raising questions about the accuracy of self-reported pain scores. In these instances, observational pain scales may be more suitable. The South African EMS CPGs recommendations propose using the FLACC scale or CHEOPS for paediatrics <4 years (45) which are adapted from Gausche-Hill et al. (89). Unfortunately, no recommendations are made for patients with decreased LOC or cognitive impairment, however, the Abbey pain scale has been suggested elsewhere (85,86).

5.4.4.4 Factors influencing acute pain assessment and management

In the present study, cases which occurred in the Overberg district were more likely to have a pain score recorded. This finding was of interest. A likely explanation might be that this district

placed more focus on pain assessment, pain education and/or monitoring the quality of clinical documentation and/or pain care compared to other districts. A further finding which is challenging to explain was that ALS and ILS (although not significantly) was less inclined to record pain scores compared to BLS practitioners. We did not collect data which would allow us to hypothesize on these findings, however, these results may have been secondary to poor data quality, random error or due to weaknesses in the study design.

Most acute pain epidemiological studies set in the prehospital arena only elaborate on factors which may influence the administration of analgesic medication and not pain assessment. Nevertheless, contrary to the current study findings, others studies have found that adults were more likely to have a pain score assessed compared to paediatrics in this setting (48,110,162,163) and that adults were more likely to receive analgesia (48,162). In clinical practice, paediatrics are likely to have their pain under managed secondary to it being un- or under-recognised (85,265). The results are equivocal, however, as some research reports that males are more likely than females (regardless of age and pain severity) to receive opioids (103,164,166,167) while another study reported females were more likely to receive pain medication (174).

Like reported in the article and supported by the binary logistic regression model, trauma patients with a pain score recorded and those managed by an ALS practitioner were more likely to receive analgesic medication. However, it remains difficult to infer whether not recording a pain score is necessarily suggestive of a practitioner's intention not to provide analgesia or vice versa. Since Entonox[®], the only medication allowed for BLS and ILS practitioners was not administered to any patients nor commonly available on ambulance it was not surprising that those managed by ALS practitioners were more inclined to receive pain medication. Similar to the present study, studies report that patients with a pain score (50) and those thought to be in severe pain are more likely to receive opioids (166,174). Acute trauma patients regularly experience moderate-to-severe pain which is likely to be more widespread among high acuity trauma patients (266,267). This may explain the findings of the current study where high acuity patients (red and orange triaged) were more likely to receive analgesia.

Unfortunately, the dataset did not allow for the comparison of the administration of medication administered between female and male prehospital practitioners, practitioner age groups nor the length of time the patients spent in EMS care. Published prehospital literature, however, have reported that compared to female practitioners, male practitioners express more enduring (stoic) viewpoints regarding the need for analgesia while older practitioners express more negative attitudes about assessing pain medication requirements (171). Conversely, a prehospital study

found that oligoanalgesia and unrelieved pain were more common when patients were treated by female physicians compared to male physicians (27). In addition, patients spending more time in EMS care, are more likely to receive opioids (25,28,166,174,268). Research conducted predominately in the USA has identified, that White patients compared to other races/ethnicities are more likely to have pain assessment recorded as well as more likely to receive pain management in the prehospital setting (162,172,174).

Importantly, it has been found that prehospital analgesia compared to EC analgesia are related to earlier patient treatment (269,270). The 2015 study by Patrick et al. (271) evaluating the implementation of policy to improve the time to analgesia in the EC of an USA hospital found that after the policy implementation the time to EC analgesia increased from 64 to 80 minutes while the proportion of patients who received analgesia within 30 minutes of arrival decreased from 17% to 7%. Additionally, research has found that some prehospital practitioners express an attitude that pain is not life-threatening thus a minor priority during trauma care (152).

5.4.4.5 Compliance to protocols

As stated, the lack of administration of inhaled Entonox[®] is most likely due to it not being regularly available on ambulances although it is within the scope of practice for all levels of emergency care provider qualifications registered under the PBEC of the HPCSA. The unavailability of Entonox[®] significantly limits analgesia in the SA prehospital setting and was also reported by Matthews et al. in 2017 (71). The EMS regulations published under the National Health Act 61 of 2003 in 2017 stipulates that medicines, as approved by the HPCSA scope of practice, must be carried by on-duty registered practitioners (272), nonetheless, the reasons for or factors related to the unavailability of Entonox[®] is elusive. Table 5.13 illustrates the additional analgesic medication per level of qualification which will be available to emergency care providers after undergoing CPG continuous professional development activities related to these medications and approval by the South African Health Products Regulatory Authority.

As mentioned in the literature review, the addition of these medications may alleviate some of the current protocol/guideline-related barriers to pain management. The addition of Penthroxyflurane may benefit the lower qualified practitioners who currently do not have access to an analgesic agent, however, the cost of Penthroxyflurane may create a similar situation as currently exist with Entonox[®]. Although the new CPGs published in 2018 may contribute towards improving prehospital pain assessment and management, the guidelines referring to pain management do, lack specific treatment strategies for the management of mild, moderate, and severe pain in adult and paediatric patient populations and do not consider aetiology.

Table 5.13: Analgesic medication per new scope of practice (CPGs for SA EMS (45))

Qualification	Additional Analgesic Medication added
Basic (BLS) & Intermediate Life Support (ILS)	Penthydroxylurane
Emergency Care Technician (ECT)	Penthydroxylurane
Advanced Life Support (ALS) ^a	Penthydroxylurane, Fentanyl (IV/IN) ^b , Ketamine (IV/IN/IM) ^b , Paracetamol (oral/IV) ^b , NSAIDs ^c (non-IV) ^b
Emergency Care Practitioner (ECP)	Penthydroxylurane, Fentanyl (IV/IN) ^b , Paracetamol (oral/IV) ^b , NSAIDs ^c (non-IV) ^b
Footnote: ^a Include both, Critical Care Assistant (CCA) and National Diploma in Emergency Medical Care (NDEMC) paramedics, ^b IV – Intravenous, IN – Intranasal, IM – Intramuscular, ^c Non-Steroidal Anti-Inflammatory Drugs	

5.5 Chapter conclusion

Though the current study forms a foundation for describing the epidemiological characteristics of acute pain and its management in the African prehospital arena, further work is necessary. Efforts should focus on, firstly improving prehospital pain assessment practices through clear guidelines and age-appropriate pain assessment tools for the alert patients as well as guidance and pain assessment tools for the child, cognitively impaired or altered mental status patient. Pain assessment tools in the prehospital setting should be quick and easy to apply and reproducible. Secondly, emergency care providers must have access to pain medication as allocated in their qualification specific scopes of practice and receive regular pain education to facilitate better pain management practice. To continuously monitor the effectiveness of pain management, pain assessment must occur regularly (every 5 mins). Further, the assessment and management of pain in the prehospital environment should be actively monitored with real-time feedback provided to operational practitioners while EMS organisational culture must promote quality pain care.

In future research endeavours of a retrospective descriptive nature, consideration would be given to conducting a pilot study comprising of approximately 10% of the sample of the intended target population selected randomly. The pilot test will be conducted to aid in assessing the study feasibility as well as evaluate the study methodology and procedures. In addition, the pilot test will assess the practicalities of data collection emphasising missing data in records, and judge inclusion/exclusion criteria and data reliability (273).

With Chapter 3 identifying the scarcity of prehospital pain research in the African context and Chapter 4 raising concerns about emergency care providers knowledge and attitudes regarding pain, Chapter 5, in light of the apparently high prevalence of acute traumatic pain, identified pain assessment and non-pharmacological and pharmacological management practices among emergency care providers to be less than ideal (274). The project will conclude with the qualitative study to delve into emergency care providers views and experiences of acute pain as well as barriers and enablers of acute prehospital pain in SA.

CHAPTER 6: EMERGENCY CARE PROVIDERS' PERSPECTIVES OF ACUTE PAIN ASSESSMENT AND MANAGEMENT IN THE PREHOSPITAL SETTING, IN THE WESTERN CAPE, SOUTH AFRICA: A QUALITATIVE STUDY

Publication Reference:

Lourens A, Parker R, Hodkinson P. Emergency care providers' perspectives of acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: A qualitative study. PLoS ONE (under peer review).

6.1 Declaration from author and co-authors

6.1.1 Declaration from author

The following co-authors contributed to the paper: Associate Professor Romy Parker (RP) and Associate Professor Peter Hodkinson (PH). In the case of Chapter 6, contribution by authors to the work was as follow:

AL conceived the idea and designed the study with input from RP and PH. In addition, Prof Petra Brysiewicz (Professor of Nursing, University of KwaZulu Natal) provided input and support in terms of qualitative research methods. AL conducted the focus groups and transcribed the discussions. Initial focus groups were conducted with the assistance of an experienced focus group facilitator, Dr Amber Abrams. AL analysed the data and drafted the article for publication with all other authors contributing through critical revision of intellectual content and quality. RP and PH, contributed to the data analysis with regular meetings and checking all codes, categories, and themes. All authors approved the final published version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Extent of contribution:

- Andrit Lourens: 70%,
- A/Prof Romy Parker: 15%,
- A/Prof Peter Hodkinson: 15%

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17 July 2020

Andrit Lourens

Date

6.1.2 Declaration from co-authors

The undersigned hereby certifies that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise.
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication.
4. There is no other author of the publication according to these criteria.
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
6. The original data are stored at the following location and will be held for at least five years from date indicated below

Location of stored data: All audio-recordings, transcripts and any other study-related material are stored on the author's password-protected (AL) laptop and external USB.

Signature Removed

17 July 2020

Associate Professor Romy Parker

Date

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17 July 2020

Associate Professor Peter Hodkinson

Date

6.2 Synopsis

6.2.1 *Rationale for conducting the study*

The rationale for the study was to explore emergency care providers' experiences and opinions around acute pain assessment and management, and to develop an in-depth understanding of factors which may negatively or positively influence pain assessment and management practices in the prehospital setting, in the WC, SA. The qualitative study design allows for the thorough description of individuals' perceptions, opinions, and beliefs, thus providing the human perspective of the research topic.

6.2.2 *Aim and objectives*

Aim:

The qualitative study aimed to gain, from the viewpoint and experience of emergency care providers, a deeper understanding of acute pain assessment and management in the prehospital setting, in the WC, SA and to obtain insights into perceived barriers to, and facilitators of acute pain assessment and management in this setting.

Objectives:

- To explore and describe emergency care providers' viewpoints and experiences of prehospital acute pain assessment and management in the WC, SA.
- To explore and describe barriers to acute pain assessment and management perceived by emergency care providers in the prehospital setting, in the WC, SA.
- To explore and describe facilitators of acute pain assessment and management perceived by emergency care providers in the prehospital setting, in the WC, SA.

6.2.3 *Main results*

Demographics of focus group participants:

- A total of 25 emergency care providers participated in six focus groups and one interview (only 1 participant arrived for the focus group).
- Most participants were male and worked in both private and public ambulance services with various educational levels and years' experience (Range: 2 to 25 years). Participant age ranged between 22 and 48 years of age.
- At the time of the study, participants were practicing in regions across the WC, SA, and three had also previously practised in other regions of the WC.

- Eight participants previously practiced in other provinces (Gauteng, Free State, KwaZulu-Natal, North West, Eastern Cape, and Northern Cape) in SA, while two had also worked outside of South Africa (Namibia and the Middle East).

Five themes emerged from the qualitative content analysis and were discussed in the article:

- Theme 1: Assessing pain is difficult in this setting.
- Theme 2: Many factors affect clinical reasoning, some unique to this (hostile) setting.
- Theme 3: BLS and ILS practitioners' reality of prehospital pain care.
- Theme 4: The ED does not understand ... what we do, how we work, what it is like!
- Theme 5: How can we do better?

“Below is the content of the published article followed by the references of the paper. The context and meaning of the published paper are described in detail in the rest of the chapter”

6.3 Article (currently under peer review by PLoS ONE)

Emergency care providers' perspectives of acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: a qualitative study.

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Abstract

Introduction: A growing body of evidence suggests that knowledge and attitudes towards pain, and pain assessment and management practices are poor, and perhaps even more so in the prehospital setting. The daily challenges that emergency care providers face in dealing with prehospital pain remain unclear. This study aimed to gain a deeper understanding from the perspective of emergency care providers in the Western Cape, South Africa, of acute prehospital pain assessment and management, and the perceived barriers and facilitators.

Methods: An exploratory and contextual study design employing qualitative research methodology through a series of focus group discussions, using a constructivist paradigm and qualitative content analysis was conducted.

Findings: A diverse group of 25 emergency care providers participated in six focus groups and one interview. The key themes emerging related to the difficulties of assessing pain in this setting, factors affecting clinical reasoning in this (hostile) setting, the realities of prehospital pain care for non-advanced life support practitioners, along with emergency departments' lack of understanding and appreciation of the prehospital environment, and participants' suggestions to improve pain practice.

Conclusion: Several barriers and enablers, some novel, to pain assessment and management in the South African prehospital setting were identified. To overcome the challenges that underpin inadequate prehospital pain practices, a combined approach from emergency medical services and educational institutions, coupled with clinical practice guideline development must be implemented. Interdisciplinary collaboration between prehospital emergency care and emergency medicine is vital to ensure continuity of emergency pain care. Further qualitative research to understand the perspective of emergency department staff, and patients, as well as

research on prehospital pain assessment strategies in the South African prehospital setting, are vital.

Introduction

Although acute traumatic moderate-to-severe pain is a common presentation for prehospital providers in the Western Cape, South Africa (SA) (1), pain knowledge and attitudes, and practice among emergency care providers are less than ideal (2,3). Due to the paucity of prehospital research in Africa, a great deal remains unknown about acute pain in this setting including, the daily challenges emergency care providers face that contribute to and underwrite the insufficiency of prehospital pain care practices (4).

International studies have identified several barriers to prehospital pain care (5–12) with practitioner knowledge deficit the most recognised (5,8–11). Further hindrances include patient perceptions and expectations, language, culture, lack of validated pain assessment tools, and guideline restrictions (5,11–13). Barriers more specific to paediatric prehospital pain management include challenges with pain assessment, establishing intravenous (IV) access, pain viewed as unimportant, medication adverse effects and parental influence, to name a few (6,7,10,11). Moreover, evidence from well-resourced settings suggests several inequalities, based on gender, ethnicity, pain severity and age, in prehospital pain care (11,14–20). For example, males and patients with severe pain are more likely to receive analgesia (18,19) while adults are more likely to have pain assessed and managed (11,14,15,20).

Systemic factors which have been found to facilitate prehospital pain management include eliminating the need for medical control authorisation, better understanding that pain management is important, the availability of guidance for patients with severe pain, leadership support within emergency medical services (EMS), the patient's viewpoint on adequate pain relief, a single guideline for pre- and in-hospital pain management and pain research (5,7,13,21).

While many of these barriers and enablers are likely pertinent to the South African prehospital setting, current evidence originates mostly from well-resourced settings and the focus is on advanced life support (ALS) practitioners. The study aim was to gain, from the viewpoint and experience of emergency care providers, a deeper understanding of acute prehospital pain assessment and management, in the Western Cape, SA and to obtain insight into perceived barriers and facilitators.

Methods

Using a constructivist paradigm with no preconceived frame of reference, this exploratory and contextual study employed qualitative research methodology using focus group discussions.

Study context

The study was conducted among emergency care providers employed by EMS in the Western Cape, SA. The Western Cape consists of a large metropolitan area (Cape Town), and five districts (22). A large public sector ambulance service (provided largely at no cost to patients) operates at a provincial level, with other services provided by licensed private ambulance organisations (fee-based and consequently restricted to wealthy & formally employed with medical insurance) (23,24).

Prehospital emergency care providers in SA are registered with the Health Professions Council of South Africa (HPCSA) are broadly categorised into basic (BLS), intermediate life support (ILS) or ALS level qualifications (recently developed from a three-tiered short course framework to formal professional qualifications) (25,26).

Pharmacological pain relief from non-ALS practitioners, who comprise most of the frontline workforce (26), is restricted to self-administered inhaled nitrous oxide (Entonox®), which is not commonly available. ALS practitioners may administer IV morphine (some requiring permission) and some (with a professional degree) ketamine (IV & intranasal (IN)) in addition to morphine. To deliver pain relief or to provide stronger analgesia, non-ALS practitioners must request assistance from ALS qualified practitioners. SA prehospital protocols have recently been revised and propose the inclusion (dependent on qualification) of analgesic agents such as penthroxyflurane, fentanyl (IV & IN), paracetamol (IV & oral), ketamine (IV, IN & intramuscular (IM)) and non-steroidal anti-inflammatory drugs into the EMS armamentarium. These proposals are pending approval by the South African Health Products Regulatory Authority coupled with continuous professional development activities (27).

Study population and recruitment

The study population consisted of emergency care providers of all qualifications registered with the HPCSA and working in the Western Cape. Convenience and snowball sampling were utilised through key individuals within each participating district identified to assist with recruitment. Practitioners from both sexes, working in the public or private domain, with, where possible, at least three years' operational experience and of all levels of qualification were invited to participate. Focus groups consisted of small groups [3-7] and were divided based on participants'

qualifications (ALS or BLS/ILS qualified). Data collection occurred between December 2019 and March 2020 and continued until no new information emerged (28). Focus groups were conducted in the City of Cape Town, Cape Winelands, and Eden districts. Eligible practitioners were contacted via e-mail ([Appendix 10](#)) or by a district contact person, to volunteer to participate of their own accord.

Data collection and analysis

Focus group discussions were conducted in English, by AL, who fulfilled the role of moderator, initially with the assistance of an experienced facilitator. Throughout discussions, the moderator observed and actively listened, respected participants and their opinions about the research topic (29). A focus group guide ([Appendix 11](#)) was developed with the input of all authors to focus on the research aim and objectives. Questions were open-ended, encouraging participants to share experiences and engage in dialogue. With participant consent, discussions were audio-recorded for transcription and analysis. All study data were securely stored.

Focus group transcriptions were analysed by means of qualitative (inductive) content analysis (30,31) using NVivo 12 software (32). Preliminary data analysis was used to assist with determining saturation (33). Discreet meaning units were identified and condensed, and then coded, leading to the formation of categories and themes as described by Erlingsson and Brysiewicz (30).

Reflexivity

The authors aimed to adhere to the principle of reflexivity throughout the research endeavour (33,34). The primary author (AL) is a female ALS practitioner with a good deal of prehospital experience and knowledge in the Western Cape EMS system and thus approached the research from an insider perspective. AL, who has conducted several studies on prehospital pain care in the study setting, deliberately aimed not to influence the conversation with her opinions and viewpoints. While drawing on her prehospital clinical experience, AL collaborated with the co-authors, PH (Emergency Medicine) and RP (expertise in pain), both experts in their respective fields with qualitative research experience, to analyse the data and write the report.

Trustworthiness

The authors sought to ensure trustworthiness by utilising measures to establish credibility, dependability, confirmability, and transferability (33,35). These included keeping an audit trail, conducting in-depth interviews, regular reflection on beliefs and assumptions, describing the

study context and participants, data source, site, and investigator triangulation and thick data description using quotations (33,36,37).

Ethics Approval

Approval was granted by the University of Cape Town, Faculty of Health Sciences, Human Research Ethics Committee (220/2017). Participants provided written informed consent ([Appendix 12](#)) and were reminded that participation was voluntary and that they were free to withdraw at any time. Before commencing focus group discussions, participants were informed of the ground rules ([Appendix 11](#)), study aim and were encouraged to be honest and frank and to respect each other's privacy and anonymity.

Findings

Twenty-five emergency care providers with a combined 282 years (ranging from 2 to 25 years) of experience participated in six focus groups and one interview (only one participant attended) (Table 6.1). Interviews lasted between 48 and 115 minutes. Participants were all currently practising in the Western Cape, with eight having previously practised in other provinces, and two had also worked outside of SA.

Table 6.1: Characteristics of focus group participants

Participant characteristics	
Age (Years), mean (SD)	34.92 (7.9)
Years' Experience, mean (SD)	11.28 (6.2)
Sex	n (%)
Female	6 (24%)
Male	19 (76%)
Levels of Qualification	n (%)
Basic Life Support (BLS) Practitioners	3 (12%)
Intermediate Life Support (ILS) Practitioners	12 (48%)
Advanced Life Support (ALS) Practitioners ^a	10 (40%)
Sector of Employment	n (%)
Public Service	13 (52%)
Private Service	12 (48%)
Western Cape district currently employed	n (%)
Cape Town Metropole	3 (12%)
Cape Winelands	11 (44%)
Eden	8 (32%)
Overberg	2 (8%)
Central Karoo	1 (4%)
Recently attended continued professional development activities on pain	n (%)
Yes	5 (20%)
No	20 (80%)
Footnote: ^a Emergency Care Technician (n=2, 8%), National Diploma in Emergency Medical Care (new 2-year NQF level 6 qualification) (n=1, 4%), Critical Care Assistant paramedic (n=4, 16%), Emergency Care Practitioner (n=3, 12%)	

The following five main themes emerged from the data and will be discussed (*supported by quotations*).

1. Assessing pain is difficult in this setting.

2. Many factors affect clinical reasoning, some unique to this (hostile) setting.
3. BLS and ILS practitioners' reality of prehospital pain care.
4. The Emergency Department (ED) does not understand ... what we do, how we work, what it is like!
5. How can we do better?

Assessing pain is difficult in this setting

In general, pain assessment was described as challenging, *"I think this is one of the grey areas ... the assessment of pain"* (ALS, private) and the subjective nature of pain was emphasised, *"It's difficult, you get a lot of different people ... from all sort of different social backgrounds ... I think each case is unique and different"* (ALS, public).

Pain assessment appears to be mainly performed using clinical parameters, physical (e.g. visible injuries, etc.) and behavioural attributes (e.g. facial expression, body language, etc.) as well as observing patient responses during physical examination, to assess pain, rather than pain scales alone, since pain scales were not perceived to be optimal to assess pain, especially the numerical rating scale (NRS). *"We need to be asking the pain scale ... but is it accurate? It depends on the patient ... what that patient might perceive as a 10, might be my 2"* (ALS, public). In contrast, the faces pain scale was viewed as a better option, though some felt children do not comprehend the question. Some participants rely on a gestalt picture to determine the presence of pain.

"We use that (pain scales) a lot ... I do not think it's that effective" (ILS, Private).

"You need to use it (pain scale) as an adjunct" (ALS, private).

"There is a place for the pain assessment score out of 10, but then you almost have to trust a patient, and also consider the mechanism and the vitals" (ALS, public).

"I just go on my intuition, my gut feeling ... I can see ... If they tell me ... You can pick up" (ALS, public).

Perceived inaccuracy of pain scales to measure pain appears to be linked to a perception of patients being dishonest or overstating pain. The apparent misuse of ambulance resources as a mode of transport (socio-economic factors), overstating pain to receive faster care and possible drug-seeking behaviour, *"I think there are the people that ... just also like drugs a lot ... just want to be given medication or morphine ... they will ask you"* (ALS, public), produce distrust in self-reported pain. Other factors like perceived low levels of literacy and education, language (patient's ability to understand and practitioner's ability to explain), intoxication, mental status and lack of previous pain experiences hinder the patient's understanding of pain scales (NRS).

Some participants acknowledged personal difficulties with rating and describing pain, and believed that patients are not intentionally deceitful but rather find pain challenging to communicate, *“Here I get upset with my patient if they cannot describe their pain, but they are so confused and in pain. They say whatever because they cannot describe it ... I cannot describe my own pain”* (ILS, private).

Patient age, culture and religion, and emotions (e.g. anger, fear etc.) were also believed to hinder pain assessment. Although pain assessment in children was described as more difficult by most, they were not perceived as dishonest when reporting pain, *“They (children) are not going to lie”* (ALS, public) while crying is perceived as a good pain indicator, *“Their (children) threshold is high, so when they cry, it means that there’s something”* (ALS, public) although some may be reticent.

Experience was perceived to be a greater enabler to assessing pain rather than formal teaching, *“I don’t think there is a lot that they teach you on pain assessment ... they would mention the faces ... when you go out there and get your own experience ... you must now figure out ...”* (ALS, public). Barriers and enablers of prehospital pain care identified by participants are summarised in Table 6.2.

Many factors affect clinical reasoning, some unique to this (hostile) setting

Many factors such as assessment, the patient, the practitioner, the organisation, the environment, family, friends and bystanders, the receiving facility, treatment options and pain education and knowledge were thought to impact prehospital pain management decision-making.

In this setting, several features contribute to the hostility of the work environment within which emergency care providers function daily, yet practitioners are required to make sound clinical decisions, provide quality care and relieve suffering, *“If you are irritated, it is not your day, you’ve been attacked ... people expect you to help their people, but their people are attacking you ... so that plays on your mind, so that can have an effect on quality care”* (ALS, public).

Environmental factors

Environmental challenges affect pain care decision-making including time and distance to hospital as well as the mobile (moving vehicle, road surface, moving patient into vehicles) nature of the prehospital setting. The most challenging aspect of the environment is the dangers that emergency care providers face daily in terms of personal safety and crime which many relate directly to pain care.

“The environment is playing a big role ... personally, I am not going to play on a scene, putting up an IV and give morphine ... I’m gonna get out of that area” (ALS, public).

“I do not carry 10 amps of morphine in my bag, at once, in case the bag gets stolen, or the ambulance or something ... I am responsible for those schedules” (ALS, public).

“If the wrong community members find out, with what medications you are walking around, you become more of a target than you already are” (ALS, public).

Table 6.2: Barriers and enablers of prehospital pain assessment and management

Prehospital pain assessment	
Barriers	Enablers
Culture and religion Illiteracy and uneducated Inability to report pain e.g. unconscious patient Intoxication and mental state Lack of pain assessment education Lack of previous pain experience Language Patient age e.g. paediatrics patient Pain scales, especially the numerical rating scale (NRS) Patient emotions e.g. anger, fear etc.	Experience Faces pain scale for adults and paediatrics
Prehospital pain management	
Barriers	Enablers
Cultural beliefs and religion Intoxication Refusal Substance abuse or drug-seeking behaviour Adequate justification for administering morphine or ketamine ALS attitudes Practitioner desensitisation EMS politic and interpersonal relationships Discretion and selectivity in pain medication administration Practitioner mood and state of mind Workload and number of patients in the ambulance Lack of human resources ALS scarcity and availability Entonox® availability Equipment availability e.g. splints, nasal atomisers, etc. Financial constraints Medication availability Environmental dangers (e.g. personal safety, crime and driving) Non-static environment Time and distance to hospital Family members, friends, and bystanders Lack of criteria for initiating analgesia Medication restrictions Permission to administer morphine Hospital staff criticism or disapproval Doctor or nursing staff on-duty Fear of masking of symptoms Lack of pain knowledge and education	Consultation Empathy and a desire to relieve suffering Experience and exposure Medication options including oral medication Pain education Patient will likely wait at hospital in pain Personal experience with acute pain Professionalism and communication Re-introducing Entonox® Separate patient in an ambulance Advise patient to use available analgesic agents e.g. over the counter or chronic medication

Practitioner factors

Empathy and a desire to relieve suffering, previous experience, and exposure, finding ways to overcome barriers, professionalism and communication, and personal experience with acute pain

all appear to facilitate pain management. Conversely, becoming desensitised, ALS practitioner attitudes, internal EMS politics and interpersonal relationships, practitioner selectivity and discretion, and practitioner mood and state of mind are factors that may hinder pain management.

"I also think it is about the exposure and experience because the more you are exposed to something, the more you will know what to do" (ALS, private).

"You have all the stuff that you're dealing with all the time, you get very desensitised" (ALS, public).

"On the farm areas ... you call the paramedic for pain ... they are going to first (scold) you" (ALS, public).

"This looks like you (patient) are pretending ... Now, maybe you (practitioner) are tired ... you are overworked ... worked a double shift. I am like, can you (patient) please calm down? ... Those are the things that work on your nerves" (ALS, private).

Receiving facility

ALS practitioners described that their decision-making was compounded by receiving hospital personnel, and their disapproval or criticism of pain medication administration, suggestions that pain medication masks symptoms and delays diagnosis and care and whether the patient will wait at the hospital in pain.

"Which doctor is on duty ... is he gonna be okay with me giving this pain meds" (ALS, private).

"What also is becoming another deciding factor in pain medication, is the hospital ... like if this patient ... got a broken arm ... they are gonna go sit in triage for a few hours waiting for that arm to be fixed, then it might be feasible to actually put that drip up, give some pain medication" (ALS, public).

Assessment factors

ALS practitioners consider several factors obtained during the assessment process (as described in theme 1), including the patient's wishes and whether the pain justifies the administration of morphine or ketamine, to inform decision-making. Patient stabilisation is usually prioritised before pain medication administration with some acknowledging that in the heat of the moment, analgesia may fall by the wayside.

Similarly, non-ALS practitioners, reliant on ALS for pharmacological pain relief, also often consider a variety of assessment factors during decision-making (as described in theme 1) including

whether the delay (until arrival at the hospital) may result in exacerbation of the clinical condition, *“Is the patient going to need it now or can you make it to the hospital?”* (BLS, private).

Organisational factors

We found that organisational pain culture, workload, as well as operational, human resource and financial constraints, influenced pain management decision-making. In the public sector, the pain culture among practitioners appears to be that pain is not life-threatening and is a lesser priority. The workload and number of patients in an ambulance appears to negatively influence pain management in the public sector while in the private sector, call volumes are lower and generally, one patient is managed at a time. In the private sector, there is a financial incentive to manage pain pharmacologically (this may be the main incentive to request an ALS at additional cost) to the extent that practitioners may feel forced to do so while non-billable patients, in contrast, may not receive analgesia.

“I’ve now experienced ... working with the government ... that it’s like ... it’s fine ... it’s only pain, whereas in private ... you know the pain situation ... in the public sector ... it’s not as willingly that the people would just be given pain management” (ILS, private).

“Private sector ... probably way more inclined to provide analgesia, for any moan or groan ... which is also influenced by the financial side of the business of the private ambulance service ... they (management) try and almost force you to ... administer pain meds” (ALS, private).

“Pain management and assessment become like null ‘n void sometimes working in the government service ... because you loading so many patients ... now you get that fourth patient, that’s really in pain ... now putting up a drip, drawing up morphine ... going straight to hospital might just be easier for everybody.” (ALS, Public).

Resource and financial constraints hindering pain management, mostly raised by public sector participants included availability of ALS practitioners, medication, and equipment (e.g. splints & nasal atomisers etc.), financial constraints (cost of new medication) and limited human resources. *“We are understaffed, and the call rate and the population are growing ... we are not growing as a service”* (ALS, public). The cost of newer inhaled agents and ALS scarcity and availability were also a concern for the private sector. Entonox® is not available in either service which was deemed a significant barrier by most and believed to be a result of prior practitioner abuse and/or financial constraints, *“If we can have that (Entonox®) ... I think that would be wonderful, even for like ILS. Paramedics (ALS) are a very scarce resource... we are so short of paramedics ... I know they have been abusing it in the past, but there should be strict protocol”* (ALS, Public).

Family, friends, and bystanders

Family members of the patient, friends, and bystanders often complicate decision making, *“Pressure from family to stop playing on scene ... why you wanna attach an ECG still ... why do you need vitals, they tend to pressure you to load, to load quickly and go ... they become hysterical ... they tend to upset the patient indirectly ... because they become agitated”* (ALS, private). Some practitioners describe loading the patient into the ambulance, and once isolated enquire about the pain management needs.

Patient factors

Cultural beliefs and religion, intoxication, refusal, and perceived drug-seeking behaviour may hinder pain management. In contrast, some patient characteristics like age (paediatrics & geriatrics), sex (female) and how the patient deals with the pain was suggested to increase the likelihood of pain medication administration.

“They’re intoxicated, so you couldn’t even be giving them morphine for pain anyway” (ALS, public).

“To me, it is like an ethical dilemma ... you are willing to help but at the same time, this thing (cultural beliefs) is stopping you to help this person” (BLS, private).

“You get those guys ... you can prick them ... they do not even twitch their eyes ... then already you know, okay, it is fine ... I can carry on to hospital with this patient if I immobilise the limb” (ILS, Private).

Treatment factors

ALS practitioners are concerned with possible medication adverse effects but aim to stabilise the patient beforehand and/or administer medication in a method that minimises adverse effects like nausea/vomiting and hypotension. Additionally, they acknowledge that patients respond differently to medication. For most, medication options are currently restricted to morphine and for some ketamine, while many were excited about the prospect of having additional options, but had also heard that cost is likely to hinder availability for some (e.g. penthroxyflurane, fentanyl, paracetamol IV), *“Fentanyl is a synthetic opioid that they recently added to the new scope ... our newly qualified NDips did receive fentanyl last year ... I think it’s a great new additive because it’s more haemodynamically stable, it works a lot faster but now I’ve also heard because it’s too expensive, we’re not gonna be issued with fentanyl anymore ... that’s very sad”* (ALS, public). Most participants believed consultation (with higher qualified or more experienced practitioners) is

beneficial, however, the prerequisite for some cadres of ALS to ask permission to administer morphine was a contentious matter.

BLS and ILS practitioners' reality of prehospital pain care

The unavailability of pain medication for non-ALS practitioners causes frustration and, for some, even a feeling of helplessness. *"It's definitely frustrating not being able ... well you know you can give something, but you don't have it"* (ILS, public), *"We are ILS, we have nothing to give that patient"* (ILS, public). Patients expect to receive pain medication and will ask, so the unavailability creates a negative image to the public, *"They might even report you for not giving pain meds, because ... the public ... they don't understand qualifications and our protocols"* (ILS & BLS, private).

Except for requesting ALS assistance (rarely available) for analgesia, non-ALS practitioners rely on physical and/or psychological non-pharmacological interventions, although these are not deemed universally efficacious by all. Where possible, practitioners will advise the patient to take prescribed pain medication and in children, they may advise the parents to administer over the counter bought analgesic agents like paracetamol.

"Most fractures, if you finish like splinting or stabilising the fracture, then you can transport the patient like that, depends on your road surface" (ILS, private).

"If you can give them something else to think of ... it does work, but it is not effective" (ILS, private), *"What we basically do is distraction, we distract them from what's busy happening"* (ILS, private), *"We do that because we don't have drugs"* (ILS, private).

Many felt that the scope of practice of ILS practitioners should be expanded to include stronger analgesic agents, *"We need it in the prehospital environment but it's not available to enough practitioners"* (ILS, Private), *"I think that (penthoxyflurane) will probably work well for BLS ... I think morphine or something else ... that is stronger ... that would work for ILS"* (ILS, private). Finally, non-ALS practitioners expressed a desire to do more for patients, *"If I could, I would have given them more, but it's not in my scope"* (ILS, private) and an interest in improving their level of qualification to do so.

The ED does not understand ... what we do, how we work, what it is like!

The data suggest a dissociation between prehospital and ED pain care, with hospital staff apparently lacking an understanding of the prehospital environment and scopes of practice.

"I feel honestly ... and when it comes to pain management ... the hospital staff think still ... they have got this mindset that you do not know nothing and if there is anything ... if there are issues you will not be able to handle it ... they still see you as a taxi driver" (ALS, private).

"We've got different scopes, the hospital doesn't understand" (ILS, private).

"Neither do they understand prehospital scenes" (ALS, private), "or the moving environment" (ALS, private), "sometimes, you are in a confined space (ALS, private).

Some hospital staff disapprove or criticise prehospital pain management.

"I think the hospitals' perception of our pain management is that we're too aggressive" (ALS, private).

"Mostly in the government sector ... if you bring a patient in that the paramedic gave morphine then they like flip themselves ... because they say it's not necessary" ... "They are not on the scene, so how can they tell us it's not necessary" (ILS, private).

"Some of them would rather want us to bring the patient in like that so that they can assess the pain, and they can give pain medication" (ALS, private).

There is also a perceived lack of continuity of pain care between the prehospital and ED setting.

"If they do not listen to your handover when you say you've given pain medication ... they will just start with their regimen ... start from the bottom up" (ALS, public).

How can we do better?

Some practitioners questioned the justification and clarity around the choice and use of the currently available pain medications (morphine & ketamine).

"How do you justify, is there a number, is there a minimum level of pain ... or minimum clinical picture ... where do you draw the line basically?" (ALS, private).

"I also think that there are times where patient's pain score is low enough for drugs that are not so invasive, like say oral medication" (ILS, private).

"You don't always need something as drastic as morphine" (ALS, public).

Participants largely thought that pain management could improve but were vague on exactly how and the prioritization of this.

"I would say we are doing okay but there is a lot of room for improvement" (ALS, private).

"There's a lot of other problems", "It's good to do pain management, don't get me wrong ... nobody deserves to be in pain, but shouldn't we be pushing some other situations and other stories" (ALS, public).

Some ideas included the development of a simpler or alternative pain assessment method, re-introduction of Entonox® with a monitoring system, access to new analgesic agents, prioritising pain during patient care and within organisations, pain education, one medication with different routes of administration for all levels of qualification, and educating the public on the effective utilisation of EMS.

Discussion

This was the first study to describe and explore perceived barriers and enablers to pain care in the African prehospital setting (4). Although many of the findings are common to other prehospital pain research and other healthcare contexts, some aspects were novel to this setting and provide useful insights to explore.

Pain assessment

Many of the pain assessment barriers described have been identified in other healthcare settings, including distrust in self-reported pain, patients' malingering or exaggerating pain, difficulty with self-reported pain scales (linked to drug-seeking behaviour, intoxication, language, culture and religion), patient belief that they will receive faster care, and assessment challenges related to patient age (paediatrics & geriatrics) (7–9,11–13,38–42).

Prehospital practitioners have been widely found to rely on vital signs, visual cues and behaviour (influenced by culture (43)) rather than pain scales to approximate pain (5,7–9,12,13,44) (though unreliable by itself (45–47)). Mulder (48) in a mixed-methods study among SA ALS practitioners found that pain scores are not perceived to be a good indicator for initiating pain management but rather that decisions are based on a comprehensive picture instead of a single factor. However, recording a pain score is associated with a higher likelihood for administering analgesia in various healthcare contexts including the prehospital setting (1,11,12,16,40,49,50). Emergency care providers are known to underestimate pain and evidence from the nursing domain suggests that more experienced practitioners are more inclined to underestimate pain and less likely to believe self-reported pain (40,51,52).

Incomprehension of self-reported pain scales (NRS) due to patients' low levels of literacy and education, appears to not have been previously described as a barrier to pain assessment. Literacy and numeracy in adults in SA remains a concern (53) and evidence suggests that since mathematical reasoning develops with education, picturing pain as a numerical function may be challenging for persons with limited schooling (54).

Participants only mentioned self-reported scales (NRS & Faces), which are not appropriate for all patient populations (10,11) and did not appear proficient in pain scale instructions which may be linked to participants learning pain assessment mainly through experience rather than formal teaching. The lack of education on pain assessment in the prehospital setting has been suggested to contribute to less than optimal pain management (13).

Gaining practical experience was articulated as a pain assessment facilitator, however, it must also be noted that experience can lead to practitioners developing a belief that they are more equipped than patients' themselves to approximate pain (3,13).

Pain management

Like pain assessment, many of the factors identified in the current study have been reported elsewhere in prehospital research (5–13), and in other healthcare settings (38,41,42,50) as barriers to pain management (refer to Table 2 for summary of all barriers and enablers to pain management identified). The barrier most acknowledged in both prehospital (5,7–11,13,21,39) and other healthcare contexts (41,42,50) is knowledge deficit, commonly attributed to limited focus during initial training and ongoing education which is reaffirmed by the current study.

Notably, we found factors related to the environment, family members, friends, and bystanders, the receiving ED as well as practitioner and organisational factors influencing pain management decision-making to be unique to our study. The prehospital work environment in SA and in several other countries (55-59) has become increasingly hostile, with South African emergency care providers more and more at risk of crime and violence (60,61). Evidence suggests workplace violence may result in practitioners modifying their approach to patient care and impacting the quality of care provided (62,63). This was echoed by our participants, with pain management being a low priority compared to crew safety with practitioners being selective and using discretion in terms of which patients receive analgesia. Additionally, evidence proposes that a combination of work-related stresses may cause practitioner desensitisation and reduce empathy toward patients (62).

Workload has been described as a SA prehospital pain management barrier (3), but the number of patients in an ambulance and staffing constraints is undescribed in the prehospital pain management context while being well established in hospital ED practice (5,38,41,64). The cost of prehospital care in SA for medically insured patients varies dependent on practitioner level of qualification. Our participants (as in another SA prehospital study (65)) reported that private sector calls are routinely upgraded to ALS rates through performing unnecessary medical

interventions such as administering morphine and pressuring EMS practitioners to meet call targets, while patients with no medical insurance are either treated to limit the potential loss of revenue if unable to pay or overlooked in preference for private patients.

Non-ALS practitioners are the frontline EMS workforce across SA (26), and making appropriate analgesic agents available to them, as well as agents for less severe pain may significantly improve the quality of prehospital pain management. Poor pain management practices may be further compounded by factors such as medication unattainability (logistics) and financial constraints, mainly in public sector EMS, limiting the availability of equipment for pain management and possibly the proposed new analgesic agents.

ED staff criticism of prehospital analgesia administration seemed to be underpinned by a lack of understanding of the prehospital environment, and prehospital provider's scopes of practice on the part of some ED staff, but could also be rooted in outdated notions of analgesia masking diagnosis or that prehospital analgesia is unnecessary and can wait until hospital arrival. Since continuity in pain care is lacking, and opinions and perspectives differ, it is apparent that there is no shared consensus regarding pain management between SA EMS systems and EDs. Pain management is ultimately a human right, thus waiting until arrival at the hospital when there is an earlier option to reduce pain is unethical (66,67).

We found that many SA prehospital practitioners demonstrate empathy, and desire to relieve suffering and use resourcefulness to overcome the adversity that the environment presents. We need to work to provide more patient-centred pain care and a system that facilitates and promotes such acts and behaviour until they become the norm. Evidence suggests that educational initiatives, removing the need to obtain medical control authorisation, development of a multi-disciplinary pain protocol, continuous quality improvement (CQI) interventions, case reviews, establishing pain management endpoints and measuring pain management outcomes may improve prehospital pain care (13,68–72).

Strengths and limitations

We believe that the diverse group of practitioners with a wealth of experience from different perspectives provided good insights to the issues, even though the sample size was small and not particularly representative of levels of qualification and geographical areas. A real concern is that we struggled to recruit participants to talk about pain assessment and management, which likely reflects the overwhelming de-prioritisation of the subject, but we are cognisant of the workload and hours EMS providers work, perhaps making the low response understandable. There will

inevitably be a bias in those that elected to participate in such research being those with an interest in the subject, and we can likely assume a more negative and dismissive attitude from the majority of prehospital practitioners. Participants shared their opinions freely and some verbalised their belief that the environment was safe to do so without fear of reprisal.

Some participants were reluctant to partake in the conversation while others, at times, overwhelmed the discussion. This was mitigated by deliberately involving all participants and ensuring that everyone had an opportunity to voice their opinions. Some participants had differences of opinion leading to heated but respectful conversations, while the moderator ensured that the conversation remained focused. Although emergency care providers are required to be proficient in English, the language of communication of the focus groups may have been a further limitation given that it is unlikely to be the home language of most.

Conclusion and recommendations

Several novel barriers and enablers of prehospital pain care in SA were identified. To optimise, EMS organisations and educational institutions coupled with clinical practice guideline development must aim to overcome the challenges that underpin the less than ideal prehospital pain practices. These include adopting standardised age-appropriate pain assessment tools, ensuring the availability of resources required for both non-pharmacological and pharmacological pain management, CQI initiatives to change organisational pain culture as well as promoting and prioritising pain education (initial and ongoing), diversifying analgesic agents across scopes of practice, clear pain management criteria, recommendations and endpoints for mild, moderate and severe pain and rethinking the requirement for permission to administer morphine (for some ALS practitioners).

Interdisciplinary collaboration is urgently required to ensure that emergency medicine systems within SA are harmonious and benefit all, irrespective of whether healthcare is received in or out-of-hospital. We recommend further qualitative research that seeks to describe and explore prehospital pain care from the perspective of ED staff and patients as well as to assess patients' satisfaction with pain care. In addition, research investigating prehospital pain assessment strategies as well as the validity and reliability of pain assessment instruments for adults, paediatrics and those unable to communicate pain in the SA prehospital setting are indicated.

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References

1. Lourens A, Parker R, Hodkinson P. Prehospital acute traumatic pain assessment and management practices in the Western Cape, South Africa: a retrospective review. *Int J Emerg Med* [Internet]. 2020;13(21):1–10. Available from: <https://doi.org/10.1186/s12245-020-00278-w>
2. Matthews R, McCaul M, Smith W. A description of pharmacological analgesia administration by public sector advanced life support paramedics in the City of Cape Town. *Afr J Emerg Med* [Internet]. 2017;7(1):24–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.002>
3. Lourens A, Hodkinson P, Parker R. Acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: A Knowledge, Attitudes and Practices Survey. *BMC Emerg Med* [Internet]. 2020;20(31):1–12. Available from: <https://doi.org/10.21203/rs.2.12353/v1>
4. Lourens A, McCaul M, Parker R, Hodkinson P. Acute Pain in the African Prehospital Setting: A Scoping Review. *Pain Res Manag* [Internet]. 2019;1–13. Available from: <https://doi.org/10.1155/2019/2304507>
5. Berben SAA, Meijs THJM, Van Grunsven PM, Schoonhoven L, Van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury* [Internet]. 2012;43(9):1397–402. Available from: <http://dx.doi.org/10.1016/j.injury.2011.01.029>
6. Whitley DE, Li T, Jones CMC, Cushman JT, Williams DM, Shah MN. An assessment of newly identified barriers to and enablers for prehospital pediatric pain management. *Pediatr Emerg Care* [Internet]. 2017;33(6):381–7. Available from: <http://http://dx.doi.org/10.1097/pec.0000000000000514>
7. Williams DM, Rindal KE, Cushman JT SM. Barriers to and enablers for prehospital analgesia for pediatric patients. *Prehosp Emerg Care* [Internet]. 2012;16(4):519–26. Available from: <https://doi.org/10.3109/10903127.2012.695436>
8. Walsh B, Cone D, Meyer E, Larkin G. Paramedic attitudes regarding prehospital analgesia.

- Prehosp Emerg Care [Internet]. 2012;17(1):78–87. Available from: <https://doi.org/10.3109/10903127.2012.717167>
9. Jones GE, Machen I. Pre-hospital pain management: The paramedics' perspective. *Accid Emerg Nurs* [Internet]. 2003;11(3):166–72. Available from: [https://doi.org/10.1016/S0965-2302\(02\)00219-9](https://doi.org/10.1016/S0965-2302(02)00219-9)
 10. Murphy A, Barrett M, Cronin J, McCoy S, Larkin P, Brenner M, et al. A qualitative study of the barriers to prehospital management of acute pain in children. *Emerg Med J* [Internet]. 2014;31(6):493–8. Available from: <http://dx.doi.org/10.1136/emermed-2012-202166>
 11. Hennes H, Kim MK, Pirrallo RG. Prehospital pain management: A comparison of providers' perceptions and practices. *Prehosp Emerg Care* [Internet]. 2005;9(1):32–9. Available from: <https://doi.org/10.1080/10903120590891705>
 12. Iqbal M, Spaight PA, Siriwardena AN. Patients' and emergency clinicians' perceptions of improving pre-hospital pain management: a qualitative study. *Emerg Med J* [Internet]. 2013;30(3):1–6. Available from: <http://dx.doi.org/10.1136/emermed-2012-201111>
 13. Hennes H, Kim MK. Prehospital pain management: Current status and future direction. *Clin Pediatr Emerg Med* [Internet]. 2006;7(1):25–30. Available from: <http://dx.doi.org/10.1016/j.cpem.2006.01.008>
 14. Ramgopal S, Elmer J, Escajeda J, Martin-Gill C. Differences in Prehospital Patient Assessments for Pediatric Versus Adult Patients. *J Pediatr* [Internet]. 2018;199:200–205.e6. Available from: <https://doi.org/10.1016/j.jpeds.2018.03.069>
 15. Hewes HA, Dai M, Mann NC, Baca T, Taillac P. Prehospital Pain Management: Disparity By Age and Race. *Prehosp Emerg Care* [Internet]. 2018;22(2):189–97. Available from: <https://doi.org/10.1080/10903127.2017.1367444>
 16. Infinger AE, Studnek JR. An assessment of pain management among patients presenting to emergency medical services after suffering a fall. *Prehosp Disaster Med*. 2014;29(4):344–9. Available from: <https://doi.org/10.1017/S1049023X14000594>
 17. Lord B, Bendall JC, Reinten T. The Influence of Paramedic and Patient Gender on the Administration of Analgesics in the Out-of-Hospital Setting. *Prehosp Emerg Care* [Internet]. 2014;18(2):195–200. Available from: <https://doi.org/10.3109/10903127.2013.856502>
 18. Michael GE, Sporer KA, Youngblood GM. Women are less likely than men to receive

- prehospital analgesia for isolated extremity injuries. *Am J Emerg Med* [Internet]. 2007;25(8):901–6. Available from: <https://doi.org/10.1016/j.ajem.2007.02.001>
19. Young MF, Hern HG, Alter HJ, Barger J, Vahidnia F. Racial differences in receiving morphine among prehospital patients with blunt trauma. *J Emerg Med* [Internet]. 2013;45(1):46–52. Available from: <http://dx.doi.org/10.1016/j.jemermed.2012.07.088>
 20. Bendall JC, Simpson PM, Middleton PM. Prehospital analgesia in New South Wales, Australia. *Prehosp Disaster Med* [Internet]. 2012;26(6):422–6. Available from: <https://doi.org/10.1017/S1049023X12000180>
 21. Mellion SA, Adalgais K. Prehospital Pediatric Pain Management: Continued Barriers to Care. *Clin Pediatr Emerg Med* [Internet]. 2017;18(4):261–7. Available from: <https://doi.org/10.1016/j.cpem.2017.09.007>
 22. Western Cape Government. Overview of the Western Cape [Internet]. 2019 [cited 2019 Jun 7]. Available from: https://www.westerncape.gov.za/your_gov/70#overview
 23. Tesser M. EMS in South Africa – The National Department of Health presents its ambulance service structure. *Emergency Live* [Internet]. Available from: <https://www.emergency-live.com/ambulance/ems-in-south-africa-the-national-department-of-health-presents-its-ambulance-service-structure/>
 24. Stevenson S. *The National Health Act Guide* [Internet]. 3rd ed. Cape Town: Siber Ink, South Africa; 2019. Available from: <http://section27.org.za/wp-content/uploads/2019/07/Stevenson-National-Health-Act-Guide-2019-1.pdf>
 25. Sobuwa S, Christopher LD. Emergency care education in South Africa: past, present and future. *Australas J Paramed* [Internet]. 2019;16:1–6. Available from: <https://doi.org/10.33151/ajp.16.647>
 26. National Department of Health. National Emergency Care Education and Training Policy [Internet]. 2017 p. 1–16. Available from: <http://www.health.gov.za/index.php/2014-08-15-12-53-24/category/327-2017po?download=2126:national-emergency-care-education-and-training-policy>
 27. Health Professions Council of South Africa. South African Emergency Medical Services Clinical Practice Guidelines [Internet]. Pretoria; 2018. Available from: http://www.hpcsa.co.za/Uploads/editor/UserFiles/downloads/emergency_care/CLINICAL_PRACTICE_GUIDELINES_PROTOCOLS_2018.pdf.

28. Hennink MM, Kaiser BN, Marconi VC. Code Saturation Versus Meaning Saturation: How Many Interviews Are Enough ? *Qual Health Res* [Internet]. 2016;27(4):591–608. Available from: <https://doi.org/10.1177/1049732316665344>
29. Dilshad RM, Latif MI. Focus Group Interview as a Tool for Qualitative Research: An Analysis. *Pakistan J Soc Sci* [Internet]. 2013;33(1):191–8. Available from: <https://www.bzu.edu.pk/PJSS/Vol33No12013/PJSS-Vol33-No1-16.pdf>
30. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. *Afr J Emerg Med* [Internet]. 2017;7(3):93–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.08.001>
31. Bengtsson M. How to plan and perform a qualitative study using content analysis. *NursingPlus Open* [Internet]. 2016;2:8–14. Available from: <http://dx.doi.org/10.1016/j.npls.2016.01.001>
32. QSR International Pty Ltd. NVivo qualitative data analysis software [Internet]. 2018. Available from: <https://www.qsrinternational.com/nvivo/support-overview/downloads>
33. Elo S, Kääriäinen M, Kanste O, Pölkki T, Utriainen K, Kyngäs H. Qualitative Content Analysis: A Focus on Trustworthiness. *SAGE Open* [Internet]. 2014;4(1):1–10. Available from: <https://doi.org/10.1177/2158244014522633>
34. Dodgson JE. Reflexivity in Qualitative Research. *J Hum Lact* [Internet]. 2019;35(2):220–2. Available from: <https://doi.org/10.1177/0890334419830990>
35. Erlingsson C, Brysiewicz P. Orientation among multiple truths: An introduction to qualitative research. *African J Emerg Med* [Internet]. 2013;3(2):92–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2012.04.005>
36. Shenton AK. Strategies for ensuring trustworthiness in qualitative research projects. *Educ Inf* [Internet]. 2004;22(2):63–75. Available from: <https://doi.org/10.3233/EFI-2004-22201>
37. Korstjens I, Moser A. Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *Eur J Gen Pract* [Internet]. 2018;24(1):120–4. Available from: <https://doi.org/10.1080/13814788.2017.1375092>
38. Pretorius A, Searle J, Marshall B. Barriers and Enablers to Emergency Department Nurses' Management of Patients' Pain. *Pain Manag Nurs* [Internet]. 2015;16(3):372–9. Available from: <http://dx.doi.org/10.1016/j.pmn.2014.08.015>
39. Rahman A, Curtis S, Debruyne B, Sookram S, Thomson D, Lutz S, et al. Emergency Medical

- Services Provider Comfort with Prehospital Analgesia Administration to Children. *Prehosp Disaster Med* [Internet]. 2015;30(1):66–71. Available from: <https://doi.org/10.1017/S1049023X14001277>
40. Schiavenato M, Craig KD. Pain assessment as a social transaction: Beyond the “gold standard.” *Clin J Pain* [Internet]. 2010;26(8):667–76. Available from: <https://doi.org/10.1097/AJP.0b013e3181e72507>
 41. Sampson FC, O’Cathain A, Goodacre S. How can pain management in the emergency department be improved? Findings from multiple case study analysis of pain management in three UK emergency departments. *Emerg Med J* [Internet]. 2020;37:85–94. Available from: <http://dx.doi.org/10.1136/emered-2019-208994>
 42. Fitzgerald S, Tripp H, Halksworth-Smith G. Assessment and management of acute pain in older people: Barriers and facilitators to nursing practice. *Aust J Adv Nurs* [Internet]. 2017;35(1):48–57. Available from: <https://www.ajan.com.au/archive/Vol35/Issue1/6Fitzgerald.pdf>
 43. Peacock S, Patel S. Cultural Influences on Pain. *Rev Pain* [Internet]. 2008;1(2):6–9. Available from: <http://journals.sagepub.com/doi/10.1177/204946370800100203>
 44. Parker M, Rodgers A. Management of pain in pre-hospital settings. *Emerg Nurse* [Internet]. 2015;23(3):16–21. Available from: <https://doi.org/10.7748/en.23.3.16.e1445>
 45. Lord B, Woollard M. The reliability of vital signs in estimating pain severity among adult patients treated by paramedics. *Emerg Med J* [Internet]. 2011;28:147–50. Available from: <https://doi.org/10.1136/emj.2009.079384>
 46. Marco CA, Plewa MC, Buderer N, Hymel G, Cooper J. Self-reported Pain Scores in the Emergency Department: Lack of Association with Vital Signs. *Acad Emerg Med* [Internet]. 2006;13(9):974–9. Available from: <https://doi.org/10.1197/j.aem.2006.04.015>
 47. Bendall JC, Simpson PM, Middleton PM. Prehospital vital signs can predict pain severity: Analysis using ordinal logistic regression. *Eur J Emerg Med* [Internet]. 2011;18(6):334–9. Available from: <https://doi.org/10.1097/MEJ.0b013e328344fdf2>
 48. Mulder RK. Clinical Decision Making By South African Paramedics in the Management of Acute Traumatic Pain [Internet]. Durban University of Technology; 2012. Available from: http://openscholar.dut.ac.za/bitstream/10321/854/1/Mulder_2012.pdf
 49. Luger TJ, Lederer W, Gassner M, Löckinger A, Ulmer H, Lorenz IH, et al. Acute pain is

- underassessed in out-of-hospital emergencies. *Acad Emerg Med* [Internet]. 2003;10(6):627–32. Available from: <https://doi.org/10.1111/j.1553-2712.2003.tb00046.x>
50. Twycross A. Nurses' views about the barriers and facilitators to effective management of pediatric pain. *Pain Manag Nurs* [Internet]. 2013;14(4):e164–72. Available from: <http://dx.doi.org/10.1016/j.pmn.2011.10.007>
 51. Jennings PA, Cameron P, Bernard S. Measuring acute pain in the prehospital setting. *Emerg Med J* [Internet]. 2009;26(8):552–5. Available from: <https://doi.org/10.1136/emj.2008.062539>
 52. Solomon P. Congruence between health professionals' and patients' pain ratings: A review of the literature. *Scand J Caring Sci* [Internet]. 2001;15(2):174–80. Available from: <https://onlinelibrary-wiley-com.ezproxy.uct.ac.za/doi/epdf/10.1046/j.1471-6712.2001.00027.x>
 53. Aitchison J. Proxies and perplexities: What is the current state of adult (il)lteracy in South Africa? *J Educ* [Internet]. 2016;(66). Available from: <http://joe.ukzn.ac.za>
 54. Clark P, Lavielle P, Martínez H. Learning from pain scales: Patient perspective. *J Rheumatol* [Internet]. 2003;30(7):1584–8. Available from: <http://www.jrheum.org/content/30/7/1584>
 55. Boyle M, Koritsas S, Coles J, Stanley J. A pilot study of workplace violence towards paramedics. *Emerg Med J*. 2007;24(11):760–3.
 56. Boyle M, McKenna L. Paramedic student exposure to workplace violence during clinical placements – A cross-sectional study. *Nurse Educ Pract* [Internet]. 2017;22:93–7. Available from: <http://dx.doi.org/10.1016/j.nepr.2017.01.001>
 57. Petzäll K, Tällberg J, Lundin T, Suserud B-O. Threats and violence in the Swedish pre-hospital emergency care. *Int Emerg Nurs* [Internet]. 2011;19(1):5–11. Available from: <https://doi.org/10.1016/j.ienj.2010.01.004>
 58. Rahmani A, Hassankhani H, Mills J, Dadashzadeh A. Exposure of Iranian emergency medical technicians to workplace violence: A cross-sectional analysis. *Emerg Med Australas*. 2012;24(1):105–10. Available from: <https://doi.org/10.1111/j.1742-6723.2011.01494.x>
 59. Maguire BJ, O'Meara P, O'Neill BJ, Brightwell R. Violence against emergency medical services personnel: A systematic review of the literature. *Am J Ind Med* [Internet].

- 2018;61(2):167–80. Available from: <https://doi.org/10.1002/ajim.22797>
60. Etheridge J. The hell paramedics go through to keep you alive. News 24 [Internet]. 2016; Available from: <https://www.news24.com/SouthAfrica/News/the-hell-paramedics-go-through-to-keep-you-alive-20160914?isapp=true>
 61. Ramphele L. Paramedics fear for their lives as attacks on EMS crews continue [Internet]. Cape Talk; 2019. Available from: <http://www.capetalk.co.za/articles/342299/paramedics-fear-for-their-lives-as-attacks-on-ems-crews-continue>
 62. Murray RM, Davis AL, Shepler LJ, Moore-Merrell L, Troup WJ, Allen JA, et al. A Systematic Review of Workplace Violence Against Emergency Medical Services Responders. *New Solut.* 2020;29(4):487–503. Available from: <https://doi.org/10.1177/1048291119893388>
 63. Taylor JA, Barnes B, Davis AL, Wright J, Widman S, Levasseur M. Expecting the unexpected: A mixed methods study of violence to EMS responders in an urban fire department. *Am J Ind Med.* 2016;59(2):150–63. Available from: <https://doi.org/10.1002/ajim.22550>
 64. Bennetts S, Campbell-Brophy E, Huckson S, Doherty S. Pain management in Australian emergency departments: Current practice, enablers, barriers and future directions. *Emerg Med Australas.* 2012;24(2):136–43. Available from: <https://doi.org/10.1111/j.1742-6723.2011.01499.x>
 65. Vincent-Lambert C, Jackson RK. Paramedics’ experiences of financial medicine practices in the pre-hospital environment. A pilot study. *Heal SA Gesondheid* [Internet]. 2016;21:103–9. Available from: <http://dx.doi.org/10.1016/j.hsag.2015.12.003>
 66. Lohman, D, Schleifer, R, Amon J. Access to pain treatment as a human right. *BMC Med* [Internet]. 2009;8(8):1–9. Available from: <https://doi.org/10.1186/1741-7015-8-8>
 67. Brennan F, Carr DB, Cousins M. Pain management: A fundamental human right. *Anesth Analg* [Internet]. 2007;105(1):205–21. Available from: <https://doi.org/10.1213/01.ane.0000268145.52345.55>
 68. Hennes H, Pirrallo R, Simpson D, Rehm J, Kim M. PAMPPER; A Pediatric Pain Management Educational Program for EMS Providers. *Prehosp Emerg Care.* 2007;11(1):94–136.
 69. French SC, Salama NP, Baqai S, Raslavicus S, Chan SB, Ramaker J. Effects of Educational Interventions on Prehospital Pain Management. *Prehosp Emerg Care* [Internet]. 2006;10(1):71–6. Available from: <https://doi.org/10.1080/10903120500366086>
 70. French S, Chan S, Ramaker J. Education on Prehospital Pain Management: A Follow-Up

- Study. *West J Emerg Med* [Internet]. 2013;14(2):96–102. Available from: <https://doi.org/10.5811/westjem.2012.7.6678>
71. McManus JG, Sallee DR. Pain management in the prehospital environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://doi.org/10.1016/j.emc.2004.12.009>
72. Scott JW, Nyinawankusi JDA, Enumah S, Maine R, Uwitonze E, Hu Y, et al. Improving prehospital trauma care in Rwanda through continuous quality improvement: an interrupted time series analysis. *Injury* [Internet]. 2017;48(7):1376–81. Available from: <http://dx.doi.org/10.1016/j.injury.2017.03.050>

6.4 Discussion

6.4.1 *Supplementary methods*

No additional methods related to the qualitative study beyond those reported in the article are described. As per the agreement with the Emergency Medicine Divisional Research Committee, the research student completed a qualitative research methods course ([Appendix 13](#)) before commencing with the study. Participants were primarily recruited via email ([Appendix 10](#)) and provided informed consent ([Appendix 12](#)) before the focus group discussions. To gather demographic data, participants completed an information sheet ([Appendix 14](#)).

As stipulated, qualitative content analysis as described by Erlingsson and Brysiewicz 2017 (275) using the Nvivo 12 software (276) was conducted. The focus group discussions took place in a neutral environment, in English and refreshments were provided. Participants were afforded the time to share their viewpoints and opinions in detail. The researcher continuously reflected on the appropriateness of questions, critically assessing actions as the moderator and the researcher's position as an insider was described in the article. Preliminary data analysis was initiated early to assist with determining saturation. The trustworthiness of the data analysis was estimated through regular meetings and face validity with the supervisors with further measures taken to ensure rigour in the research process (277,278).

6.4.2 *Supplementary results*

Five themes emerged from the qualitative content analysis and were described and discussed in the article. This section provides additional details and description for themes 1 to 4.

6.4.2.1 *Assessing pain is difficult in this setting*

As mentioned, the two main difficulties emergency care providers experience with pain assessment is the subjective nature of pain and the perceived inaccuracy and ineffectiveness of pain assessment tools (particularly NRS) *“What is pain ... and where is peoples' pain? ... Where does that pain start? ... Like what is their pain threshold? ... Where is pain?”* (ALS, public), *“What is the assessment? ... Like I said, what is ... you know like, funny face, or what is a 10, what is 5, what is a 6?”* (ALS, public). Despite this, some participants recognise acute pain to be a red flag, indicating that something is wrong, *“Let's face it, pain is just a symptom of a problem that's elsewhere, so you've now dealt with that symptom that's supposed to be like a red flag, there's a problem there, somewhere ... ”* (ALS, public).

Participants highlighted that the patients' emotional state of mind may influence the pain experience, *“I think it is a state of being, the whole human condition ... because ... pain is also a*

state of mind ... I mean you can have two people sitting next to each other, they can have exactly the same situation, but because the one is in a very negative state of mind, everything is gonna be more severely painful, and I am falling apart ... where that one is still coping, but that is exactly the same issue, but that's why I'm trying to say it is a state of mind as well ... pain" (ALS, public) while another stated, "Pain is only in the mind" (ILS, private).

The false reporting of pain or overstating pain to be transported to hospital faster and/or receive immediate care were also perceived to be due to impatience and particularly common during holiday and festive season periods (being booked off from work).

"I would say on that especially in the public hospital ... a lot of people ... that want to go to hospital, but they just hate waiting. So, lot of the time they will tell you if you're asking them about the pain, even if you explained to them, they will say it's 10 because they have that in mind ... first, especially Africans in the township, they have that in mind that if you go with an ambulance to hospital, they are gonna help you faster than the one that went with the private car ... secondly, if I tell the paramedic there that my pain is so huge, that it's on 10, then they're gonna help me faster than the other ones that are here in the ambulance. So, I will say a lot of the people who are saying it is 10 ... it is not 10 ... it is due to their impatience" (ILS, public).

For private cases, the documentation of a pain score may be deemed a requirement for medical aid payment thus a likely facilitator for assessing pain for records, one may argue that this is not necessarily associated with the appropriate and adequate assessment thereof, *"With your medical aids, they normally require that we have a pain score in there ... and if there is no pain score in there, they will send that prf (patient report form) back" (ILS, Private).*

As reported, paediatrics presents an additional pain assessment challenge. Paediatric patients' ability to understand and communicate the presence and severity of their pain using pain assessment tools were questioned, *"We had a booklet with the faces, you show that to a child ... they don't understand" (ALS, public), "Like for an adult if my approach is sir do you have pain ... Yes! ... Okay, give me the score? ... Okay, it is about 8 ... Now, if I go to that child, then the child doesn't even know ... what I'm talking about, needless to say, giving me a proper score ... so the child says it is like 2 for instance ... whatever the case may be ... I can't use it, it is not accurate ... in order for me to decide whether I should ... give him some analgesia" (ALS, private).*

Participants reported varying pain thresholds among the paediatric patient population. Some indicated that paediatric patients have a high perceived pain threshold and others do not, *"I think it's more difficult to assess kiddies pain levels because in my experience sometimes kiddies can*

experience more pain than adults, their (pain threshold) is higher than adults so it is difficult for me to assess kiddies” (ALS, public).

The emotional state of paediatric patients is used to determine the presence of pain, although it may also hinder the pain assessment process by affecting verbal communication. As stated, crying is often perceived as an indicator of pain, *“But I also feel like it is easier, to work out a kid’s pain score because the crying is right there, enough to tell” (ALS, public),* although this may not be true for all paediatrics while pre-verbal paediatrics present an added obstacle.

“On the pain assessment, especially with kids, it’s very difficult to be ... how to be sure that this kid is in pain or not ... because sometimes kids like to cry, even for nothing ... and then especially the one that cannot talk, can’t say, I have pain here or here and then once you try to feel, to touch the arm, she will cry, then when you touch this arm as well, she will cry ... so you now don’t know whether ... where is the pain ...?” (ILS, public).

As mentioned, providers reported limited education and training on pain assessment. Many providers can only recall being taught of faces or the OPQRST (onset, provocation or palliation, quality, radiation, severity and time) mnemonic, commonly used to assess cardiac chest pain, *“Did we get training on pain assessment? (ILS, private), “Cardiac chest pain, yes” (ILS, public), “Just OPQRST stuff, that’s all” (ILS, public)* and rely on their past experiences with patients in pain to gauge the patient’s severity of pain, *“We learn pain assessment practically, where we work on the road with someone experienced ... you then combine the knowledge and experience gained” (ALS, public).*

6.4.2.2 Many factors affect clinical reasoning, some unique to the (hostile) setting

As reported in the article, several factors influence prehospital pain management decision-making, some of which will be further described here.

Participants shared some of their beliefs and experiences in terms of pain management about different types of patients such as paediatric and geriatric patients as well as patients with different injuries or conditions like burns, labour, medical, trauma and unconscious patients.

“When it comes to pain management than because we tend to be a little bit scared man when it comes to drugs and kids ... when it comes to pain management for them, most of the time ... I just took them to hospital without giving them anything, because they are fine, they are not complaining of pain... should we give them?” (ALS, private).

“So, I will never think twice to give pain medication ... you know ... when there is pain ... but what I’ve also experienced is ... where I have children where they’ve had burns, and that is very painful,

and so the first thing I would do, you put on your burnshields, you cover them up, if they are calm, then ... and you close to the hospital, I don't want to ... you have to put up a drip, and you need to maybe give something for the pain, but if they stopped and they're not hysterical, I've already traumatised them just putting all the stuff on them. If they calm, then ... it's a judgement that you make, you decide" (ALS, public).

"I have never seen ... in my career ... a paramedic ... giving pain medication for a child between the age of 1 and 3" (ILS, private).

"Pain management ... definitely" (ILS, private), "No, it is terrible, especially depending on the degree of burns" (ILS, private).

"Old people ... you should give smaller dosages ... because I mean 2mg can be too much for an older lady that is very ... that's having chest pain and stuff" (ALS, public).

"I think I have alluded to the fact that your unconscious patient is an issue, I think it will make one less likely to give pain management in that scenario when your patient is unconscious" (ALS, private).

"That's terrible (laughing) ... I do not think you can really, give much for patients that are ... labour is labour ... there is nothing that you can maybe do for them" (ILS, private). "Wanted to play with that" (ILS, private), "It's not a normal pain, it is, something completely out of this world" (ILS, private).

"Trauma wise, I would say ... okay, 80% of the time, you gonna need pain meds ... cause it's like open wound and ... broken bones and whatever ... with the medical it's very difficult to administer pain meds ... say, for abdominal pain, or chest pain or ... cause ... you get people that fake" (ILS, private), "It is (trauma) more localised than what medical ... medical is very uncertain" (ILS, private).

Several participants described previous personal acute pain experiences and acknowledged that their approach to patients in pain subsequently changed. Concerningly, some participants reported administering placebo to patients. Participants appear to validate this practice by the fact that it proves to be effective in relieving pain, therefore of benefit to the patient or if they perceive a patient is exhibiting drug-seeking behaviour. An ILS participant shared an experience where he was on a scene of a child injured in a motor vehicle accident (cyclist) to whom he administered placebo because the parents were asking him to give something for pain and the child was crying and he had nothing else to give.

“Placebo, actually, also has an effect ... so I’ve had a few incidents where I’ve given “morphine” ... So that also works, that should be in there somewhere ... because at the end of the day ... if you really go into how people control pain within their own bodies, it’s amazing” (ALS, public).

“Sometimes ... when you get that eager guy ... give me, give me ... do you have that nice stuff ... then you know, the bells will go off ... this guy no ... then you give them a placebo, but I am not fond of that placebo thingie ... like you put up a drip and say okay look here, I gave you some stuff ... I am not fond of that, because I don’t want to lie to my patient ... a lot of practitioners do that, I do not see the need for doing that but when you get that eager guy, you know he is on something.” (ILS, private).

Not all participants appeared to be well-informed about the new analgesic medications to be added to the scope of practice of emergency care providers. Those that were more familiar with the additional medication believed they will be beneficial although there were concerns regarding the cost of new medication and whether they will be made available. An additional advantage of some of the new medications is administration via alternative routes, some less invasive and quicker such as IN. Morphine, the analgesic agent available to most was perceived to be less than ideal and have several limitations.

“You start to realise like is morphine actually an optimal drug to be using with all the side effects that it is got” (ALS, public).

“But now the new CPGs, like fentanyl and ketamine, much better than morphine ... and you can ... give ketamine to stabilise the patient and if the BP is normal or then you can give morphine to transport the patient” (ALS, public).

“Or this new “green whistle” thing that is in the new CPG ... that stuff is so expensive, I don’t know if we gonna get it ... if the patient says ... my pain is 8 ... I think... you can also start by giving those things instead of going to the (morphine)” (ALS, public).

“We only have for moderate to severe pain, but we don’t have maybe something else ... that is less aggressive than morphine” (ALS, public).

“I have requested perfolgan (IV paracetamol) from the pharmacy at hospital ... and the answer I got was it is reserved for specialists only, even though ... it has been found to be safe” (ALS, public).

“Fentanyl ... that is more haemodynamically stable and works a lot faster ... which is safer... for the patient at the end of the day, you can make the work ... easier also ... and to decrease our mission time also, we do not have to wait 25 minutes before the morphine work” (ALS, public).

“To come back to the kiddies, fentanyl you can give intranasally ... you do not traumatise the patient more to put up an IV, you can give it intranasally” (ALS, public).

“So, you will get there ... you will give it immediately after you have done your assessment and those things ... and you do not actually have to hassle your patient with putting up lines” (ALS, private).

A participant indicated that adequate pain management for intubated and sedated interfacility transfer patients are often neglected, and a discrepancy in terms of the appropriate standard of care exists.

“Most of ... the paramedic interfacility transfers are intubated and sedated patients ... it is more difficult to assess the pain ... we also know that being intubated and having an ETT (endotracheal tube) in your throat is a painful stimulus ... and it is neglected a lot of the time ... and the vitals can also be confounded by whatever the disease process is ... so there it is a bit more difficult to assess ... a lot of the time, especially between hospitals, then this hospital or this particular doctor has this opinion about what the patient should get ... a lot of times, they (the patient) are only on midazolam ... but we know midazolam has no analgesic properties ... he can still have pain, at that moment, being intubated ... but when we enquire, then the doctor will say no, he doesn't need that, or they don't want him that side (receiving hospital) that deeply sedated ...” (ALS, public).

We asked participants to comment on the pain education received during their initial training as well as ongoing pain education. In general, most participants indicated that pain management education during their initial training was limited although some felt the topic was well covered. Participants also believed in the necessity of gaining practical pain management experience in addition to the theoretical content.

“No, just we touch on it and that is it ... but not in-depth” (ILS, public).

“It was substandard in my opinion” (ALS, private), “Yes, I agree” (ALS, private).

“Well initial training, we were given the protocol book ... there you go, and you had to learn it ... you had to learn by yourself ... self-study ... you had to know that book off by heart, it was your bible ... you had to know everything ... schedules ... pharmacological action ... the dosages” (ALS, public).

“If we have the training and then also the practical experience ... but that is also something difficult ... to gauge, because you don't know always what you are going to get, or what you're

getting on the shift ... (ALS, public), You learn a lot more practical, than what you have learnt academically” (ALS, public).

Some participants stated that they gain knowledge and education every day through clinical practice, while others believed that ongoing pain education is neglected. Some received pain education as part of a recent CPG update.

“Every day is ongoing education (ALS, public), “Yes, every day is ongoing education” (ALS, public), “Learning people, learning what areas are going to call for what problems ... what cultures have more heart attacks, diabetes ... learning what peoples’ says pain scores are ... gonna be for certain people ... understand when that person’s going on to get a bed ... understand the climate that we are working in ... that is education there” (ALS, public).

“We have recently done it, with the CPG” (ILS, private).

“Even subsequently, I feel that there is a lot of neglect in the prehospital industry ... with regards to pain detection ... and objective pain analysis, there is a big gap, in, the prehospital field in the sense of detecting pain” (ALS, private).

Participants had some comprehension of the effects of pain and the clinical benefits of managing pain albeit not wide-ranging, while pain management was also reported to carry situational and practical benefits such as enabling further diagnostic, treatment, and transport processes.

“It is easier to ... yes ... then you can ... then the patient is calmer ... you can manoeuvre the patient because sometimes we are in houses ... that is small and small rooms ... if that pain is not managed then no, you wouldn’t be able to” (ILS, private).

“Imagine, breaking your leg or something and they pick you up, splint you, it’s gonna be painful ... you are not gonna like them ... so for the benefit of the patient” (BLS, private).

“And getting your patient somewhere there is pain, yes, pain management would really help, because it makes it easier to transport, extricate ...” (ILS, private).

“If you do not manage the pain it is going to influence the patient psychologically and emotionally” (ALS, public).

“What is pain? ... It’s a discomfort, it’s an unease, it can push up the blood pressure, it can release the stress hormones ... so you can alleviate that” (ALS, public).

6.4.2.3 BLS and ILS practitioners’ reality of prehospital pain care

Non-ALS practitioners believed that they do nothing to relieve pain as the analgesic agent Entonox[®] is not available to them, thus forcing them to request ALS assistance, *“BLS and ILS, I do not think you are doing anything ... well, because there is nothing we can give the patient for any*

(pain)" (ILS, public), "If we had the Entonox® which we don't have it now, it could be an asset to other cases that we will meet on the road as ILS if ever we are dealing with any kind of patient who is in pain ... so we know okay we will have to call the backup (ALS)" (ILS, public).

Since ALS practitioners are scarce or frequently unavailable, non-ALS practitioners strongly emphasised the necessity for analgesic agents to be made available to them and highlighted some situations such as transporting patients over long distances in rural areas, entrapped patients and wilderness search and rescue incidents when this is essential.

"We need pain meds, because ALS and stuff, they are not available, and if you contact the other service for ALS ... not available, or they don't want to help, or something ... something like that, so if we do get something for pain, that would be awesome", (BLS, private).

"Times when you need that medication ... when we in the rural areas ... when you drive so many hours ... fluid management, that does nothing ... but if you have that pain medication" (ILS, private).

"Does not have to be for long, it just could be something, just enough for us to ... get the patient comfortable or load the patient, or, get the difficult part over" (BLS, private).

6.4.2.4 The ED does not understand ... what we do, how we work, what it is like!

Participants perceived that ED staff do not understand the challenges emergency care providers face in terms of pain care and that ED staff may deem themselves more equipped to assess and manage pain. However, particularly with government hospitals, participants questioned the quality of pain care patients receive.

"If you triage the patient yellow or orange, in reality, the patient does not go to major, you will go in, then they will tell you ... no man the patient can be triaged in front ... you take the patient in front ... you leave them there and there they sit ... sometimes ... I don't know all the times ... they would get maybe, I mean they would beg literally beg, give me something for pain, they would give" (ILS, public).

"Because I remember one time ... we were with a patient from xxx for xxx (hospital), shoulder dislocation, that patient was never given pain medication, but he has a shoulder dislocation and now I'm thinking that how was his pain ... when I had it I was in pain ... he comes to hospital, he waited ... lucky for me it was empty that hospital, on that day ... he waited, when I come back 12:00 at night ...that guy was still waiting" (ILS, public).

One participant expressed a belief that the perceived disassociation between EMS practitioners and ED staff was caused by the inconsistency in the care provided by emergency care providers,

"I understand that point of view but certain times it feels as if we are the enemy when it comes to helping them ... be that extended arm and the biggest issue, that I have picked up is because there is no consistency as far as patient management is concerned out there" (ALS, private).

6.4.3 Supplementary limitations

Besides the limitations covered in the article, as is widely acknowledged in research methodology, the qualitative nature of the study limits its generalizability. However, the goal of this study was to gain a contextual understanding of the process of pain assessment and participants' decision-making regarding pain management rather than generalizability to the larger population of prehospital practitioners in the WC. The study still included a diverse group of emergency care providers with numerous years of experience adding to the richness and depth of the information shared.

Further limitations included that the first author is a novice in facilitating focus group discussions and qualitative content analysis. However, the initial focus groups were conducted with the assistance of an experienced facilitator while both supervisors have previous qualitative research experience. A single coder was used; however, this was addressed through reflection and the supervisors checking all codes, categories, and themes.

6.4.4 Supplementary discussion

As mentioned before, pain assessment is challenging for a variety of reasons, mostly due to its subjective, multidimensional and complex nature (279). Even so, acute pain is often assessed using unidimensional pain scales which only measure pain intensity (78). Self-reported pain has the potential for bias and error, due to several patient and clinician factors (280). This qualitative study reconfirms the complexities of pain assessment, in this instance in the prehospital setting, a dynamic environment. Evidence suggests that practitioners base pain assessment more on previous experience with patients, and expert opinion rather than on the patients' pain score (36,41). In the current study, experiences gained through clinical practice were described by participants as a facilitator of pain assessment, as pain assessment education appeared to be limited.

Pain assessment in the paediatric population presented some additional challenges to participants. These were linked to the perceived inability of paediatrics to understand the pain assessment scale and pre-verbal or younger paediatrics inability to self-report pain. Participants only mentioned the self-reported pain scales, NRS and Faces of Pain Scale, during the discussion. To self-report pain intensity, patients need to use higher cognitive function and abstract

reasoning to, for instance, link pain to a number (85). Therefore, self-reported pain measures are not recommended for all paediatric patient populations, particularly, not younger, uncooperative and preverbal paediatrics (48,85,153,281) neither for unconscious or cognitive impaired patients (85). Participants acknowledged that since unconscious patients do not report pain, combined with the emergence of the patient's condition, pain management commonly falls by the wayside. On the other hand, research also suggests that acute pain may negatively affect cognitive function (282). Considering the restricted pain assessment education reported by participants, the efficacy of applying pain scales must be questioned and is amplified since no age-appropriate pain scales were mentioned.

Prehospital pain education has in the past showed benefits to improving the documentation of pain intensity, the characteristics of pain as well as the reassessment of pain (177–179), although pain education alone is unlikely to suffice. Adopting validated, standardised, age-appropriate pain assessment tools for younger and preverbal paediatrics and validated standardise pain assessment scales for other non-verbal patients such as the cognitively impaired and critically ill or injured patient, as well as uncooperative patients is essential. Further research is needed to determine the most appropriate pain assessment tools for different patient populations in the South African prehospital setting. Multidimensional non-validated mnemonics for the assessment of pain such as SOCRATES (site, onset, character, radiation, associations, time course, exacerbating/relieving factors and severity) (78) allow for conducting a more comprehensive initial assessment, however, these do not assess the physical and emotional impact of pain and are likely more applicable in medical cases.

In the knowledge, attitudes, and practices survey (Chapter 4) regarding pain, emergency care providers selected barriers and enablers from lists and added additional factors not listed to pain assessment and management in the prehospital setting in the WC, SA (Table S4.2). Several of the barriers reported in the survey such as workload, language, alcohol and drug use, lack of resources including Entonox®, patient culture and EMS culture, among others were also reported in the qualitative study while the enablers were less closely related to those reported in the survey. Several of the barriers related to pain management decision-making described in the article have not been reported elsewhere.

Like the current study, ALS practitioners in the study by Mulder 2012 (73) reported that visible injuries, as well as previous personal experiences with acute pain, may play a role in pain management. The administration of placebo as pain management outside of ethically approved clinical trials is believed to be intended to discredit and question the patients' reported pain and

amounts to professional deceit, undermining the trust relationship between the patient and the HCP (241). However, in the current study, it appears some participants administered placebo with good intentions, believing that it would benefit the patient secondary to the placebo effect or because they had no alternative. The positive effect some patients may experience after the administration of placebo is defined as a placebo effect and are believed to be influenced by several factors including patient expectations (241,283,284). Both a legal and ethical argument can be made against the administration of placebo analgesia in clinical practice and various calls have been made for this practice to be ceased (241). Legally a patient has a right to pain management while ethically placebo administration violates beneficence, non-maleficence and patient autonomy (241,242) and therefore infringes professional standards.

The present study confirmed the lack of availability of Entonox[®], the only medication currently permitted by the scope of practice of non-ALS practitioners, and this is a significant barrier to prehospital analgesia. Although penthroxyflurane may be added soon, the cost of the medication has already been highlighted as a concern and a possible reason for it to not be made available in both private and public services. Currently, the re-introduction of Entonox[®] in EMS systems across SA with the necessary educational, system and monitoring support must be strongly recommended as it is likely to improve prehospital pain care.

From the focus group discussions, it appeared that patients in labour are unlikely to receive pain management in the prehospital setting, due to participants' attitudes toward these patients as well as due to the unavailability of Entonox[®]. The administration of Entonox[®] in labour is the preferred pain relief recommended by the new SA EMS CPGs (45) and was also an indication for its administration in the previous prehospital protocols (258). The new SA EMS CPGs recommend that the mother's pain relief expectation should be met and the administration of opioids (IV or IM) can be considered but the mother needs to be informed that the medication have limited analgesic effect and can cause of nausea and vomiting (258). Several of the participants indicated that they recently attended updates on the new SA EMS CPGs but still pain management during labour seemed unimportant. Jones et al. 2012 (285) found that inhaled analgesia (including nitrous oxide and methoxyflurane) effectively relieve pain in labour, however, causes adverse effects such as nausea/vomiting and drowsiness. Both medications do not significantly decrease uterine contraction, while inhaled nitrous oxide (50/50%) is widely used in obstetrics. Some evidence suggested that mean pain scores were lower after flurane derivatives while women receiving flurane derivatives had a higher likelihood of improved pain scores compared to inhaled

nitrous oxide. Further, flurane derivatives compared to inhaled nitrous oxide were linked to less nausea/vomiting, however, more drowsiness (285).

Participants comments suggest that pain in trauma cases is more prevalent and due to visible cues easier to corroborate, while pain in medical cases is believed to be more difficult to assess due to the perception that patients may be dishonest. International studies suggest medical and gynaecological or obstetric conditions are less common aetiologies of prehospital acute pain (29,31), thus an area for further epidemiological research.

Age appears to play a role in the likelihood of receiving pain medication. Both younger and older patients seem less likely to receive pain medication in the prehospital setting (48,50,163,164). The discussion in the focus groups regarding geriatric patients was limited, however, as mentioned by participants, it is pertinent to consider the challenges associated with pain management in this patient population like comorbidities and the patient's physical condition. In addition, there are several added issues such as under-reporting of pain, atypical pain, age-related pharmacodynamic and pharmacokinetic changes to drugs, other age-related changes and fallacies regarding the ability to tolerate opioids (286) to consider in this patient population. In the current study, some participants seemed reluctant to administer pain medication to paediatrics while others seemed more inclined to provide pharmacological pain management in this patient population, however, medication not requiring IV access will provide further impetus to administer analgesia.

Difficulty to establish IV access is one of the common barriers to pain management reported most frequently in paediatric patient populations (39,152,153,159,160) and may require crews to spend more time on-scene. Due to the on-scene dangers in the SA prehospital setting the re-introduction of Entonox® as well as the addition of inhaled penthroxyflurane to all qualifications and fentanyl, ketamine and paracetamol to some qualifications allow for the administration of analgesia through alternative routes like inhaled, IV, IM and oral. Although IM is still invasive and results in pain, all these routes of administration are quick, easy and most can occur during transportation. Evidence shows no clear benefit in terms of the reduction of pain in the prehospital setting of one medication over another (Entonox®, penthroxyflurane, morphine, fentanyl, paracetamol, and ketamine) nor one route of administration over another with these medications found to be safe and effective for prehospital use (108–110,123–125,127,142,143,287). In addition to ease of administration, the new analgesic medications added to SA scopes of practice also carry added benefits like non-opioid options, faster onset of

action, safer AE profiles, pharmacological management for mild and moderate pain, a variety of uses, etc.

As alluded to by a participant in the current study, pain management in intubated and ventilated patients during critical care transport are essential and to ensure quality standard care, clear interdisciplinary recommendations and guidelines are a necessity. Critically ill and injured patients frequently experience pain which may occur because of intubation and mechanical ventilation (288,289). Additionally, several invasive procedures may be conducted on these patients (289) while interfacility transportation may cause added stressors such as movement, vibration, noise, temperature changes etc. (290,291). To ensure patient comfort and reduce the potential for adverse effects, pain should be appropriately managed (288). Research suggests that patients with adequate pain control may need less to no sedation (288). Further, pain should be assessed using appropriate tools like the NVPS that incorporate physical and behavioural aspects or the CPOT including behavioural components (288).

As mentioned in the literature review, limited evidence related to pain practices in South African EDs could be identified (62,63), however, these support the suggestion by the participants in the present study that pain management in EDs is less than optimal. Thiadens et al. 2011 (63) reported that less than two-thirds of paediatric patients treated at the Red Cross War Memorial Children's' Hospital level 1 Trauma unit received pain medication, although patients with moderate-to-severe pain were more likely to receive analgesia. Awololo et al. 2018 (62) reported that the majority of adults with long-bone fractures admitted to a district hospital ED in Kwa-Zulu Natal had their pain assessed and managed but that the analgesia received was inadequate for the pain severity experienced.

As indicated in Chapter 4, limited evidence shows that prehospital pain educational initiatives improve pain knowledge and perceptions of prehospital practitioners, and pain assessment and management practices (177–179). Several studies investigating barriers to prehospital pain management recognise pain knowledge deficit as a common barrier (36,48,152–154). Most participants in the present study believed that initial and ongoing pain education is neglected therefore, as recommended in Chapter 4 improving pain education for prehospital practitioners in SA, among other interventions, is essential. In the article several recommendations based on the findings of the current study were made, some of which were reaffirmed in the supplementary discussion.

6.5 Chapter Conclusion

This study provided a valuable opportunity to understand prehospital pain assessment and management in the WC, SA from the viewpoints and perspectives of those who care daily for patients in this environment. The findings assisted in understanding the less than ideal traumatic prehospital pain assessment and management practices described in Chapter 5 and further investigated the hindrances and facilitators of pain care in this setting initiated in Chapter 4.

Of interest was the description of the complexities of pain assessment as well as practitioners', organisational, and environmental factors, along with factors related to the receiving facility which emergency care providers consider and navigate during pain management decision-making. The study described that non-ALS practitioners lack access to analgesia as well as the disconnect between prehospital and in-hospital pain care along with ED staffs lack of understanding the prehospital environment.

In future qualitative research efforts, consideration will be given to conducting a pilot study to aid the improvement of the interview/focus group guide and questions as well as to test the criteria for sampling study participants and the construction of homogenous groups of participants. Thought would be given to purposive sampling instead of convenience sampling to enhance coverage of the sample population. In addition, more attention should be given to the possible development of group thinking or power dynamics during focus group discussions, with strategies to counter.

The study supports recommendations made for improvement and further research in Chapters 4 and 5. In addition, EMS organisations need to investigate methods to overcome the barriers which influence practitioners' pain management decision-making with an interdisciplinary approach. Clear pain assessment and management guidelines are needed to underpin acute pain care in SA. Further research is needed to investigate pain assessment strategies suitable for the South African prehospital environment as well as to explore the perspectives of EMS clients and ED staff. The final chapter will summarise and draw conclusions from the findings of the series of studies as well as proposals for improvement.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

The concluding chapter of this dissertation aims to summarise the key research findings and draw conclusions on the four research objectives as well as to make recommendations for further research and implementation.

7.1 Overview of key findings

The first research objective was to identify and map the body of evidence related to acute pain care in the African prehospital setting through a scoping review. This methodology is a rigorous and transparent method to synthesise research evidence (292–294) and proved effective to summarise findings and identify gaps in current acute prehospital pain research in this setting. Limited studies, mainly from SA, were identified and reported no evidence on acute pain prevalence while the aetiology of pain was associated with a variety of traumatic injuries as well as chest pain and non-traumatic pain. Pain assessment using a pain scale was poorly done with limited findings on non-pharmacological pain management while the implementation of pharmacological management was largely insufficient and believed not to conform to current best practice. The findings suggest a paucity of prehospital pain research which the remaining objectives aimed to begin to address.

Through the literature review and confirmed in the scoping review, no KAP survey regarding pain among emergency care providers has previously been published. Consequently, the second objective offered a valuable opportunity to produce new data in prehospital pain research. The survey scores evidenced suboptimal levels of knowledge and attitudes regarding pain among emergency care providers in the WC, SA, and gaps in all aspects of pain knowledge, which may, in part, be addressed through appropriate pain education. Respondents with higher qualifications, more years' experience and who did not attend training on the research topic obtained higher scores, however, the multiple regression model found that only the level of qualification significantly predicted scores. Several studies reported that HCPs' level of qualification influenced knowledge and attitudes regarding pain (67,69,183–185,193,198) while evidence on the impact of years of experience showed conflicting results (67,69,192,193,195,198). Though prior pain education would usually increase knowledge and attitudes scores (184,195), this study found higher scores amongst those not having attended prior pain education. The extent of pain education practitioners received may have influenced knowledge, attitudes, and practices regarding pain; however, this was not the focus of the study. This finding would seem to support the notion that measures in addition to pain education are needed to improve prehospital pain care practices, as well as better strategies to improve

knowledge acquisition and retention. The most frequently cited barrier to prehospital pain assessment and management was patients' alcohol or drug use, whereas the most cited enabler was the availability of higher qualified emergency care providers. Barriers and enablers to pain care in this setting were further investigated through qualitative research methods in the final study. Additional findings in the survey suggested a distrust in self-reported pain and less than optimal pain care practices which were further investigated.

The lack of evidence on the prevalence of prehospital pain in the African setting and limited evidence on pain care practices highlights the limited epidemiological data in this prehospital setting. Objective three aimed to describe pain prevalence and pain care practices among high acuity trauma cases in the WC, SA through the retrospective review of ePCRs. Most trauma patients were adult and between 15 - 44 years of age with assault, transport-related and accidental injuries being the most common incident types. Pain assessment practices were poorer than those reported in most international studies. Pain and moderate-to-severe pain were prevalent among those who had a pain score recorded, but unlike in other published evidence, no inequalities were found between pain score recorded and gender, nor between adults and paediatrics (162,163). The appropriateness of the ePCR pain scale for patient populations other than alert adults was questioned. No disparities were found between analgesia administration and gender nor between adults and paediatrics, again inconsistent with other evidence where children and females were less likely to get analgesia (48,110,162,164,166,167). Less than 3% of trauma patients and less than 8% of patients with moderate-to-severe traumatic pain received analgesia, substantially worse than evidence from well-resourced settings. As in other studies, patients with a pain score recorded (50) and those with severe pain (25,28,165,166,174) were more likely to receive analgesia. Patients treated by an ALS, were more likely to receive analgesia, not surprising since Entonox[®], the only medication allowed for non-ALS practitioners was not commonly available on ambulances and was not administered to any patients.

The fourth and final objective, explored, and described emergency care providers' perspectives of acute pain care in the WC, SA and perceived barriers and facilitators, employing qualitative research methods through focus group discussions. Through qualitative content analysis, five themes emerged namely: assessing pain is difficult in this setting, many factors affect clinical reasoning some unique to this (hostile) setting, non-ALS practitioners' reality of prehospital pain care, the EC does not understand what we do, how we work, what it is like, and, how can we do better.

Pain assessment is predominantly performed using clinical parameters, physical and behavioural attributes rather than pain scales alone while participants distrust self-reported pain and questioned patients' comprehension of pain scales. Perceived low levels of literacy and education were a novel barrier to patient assessment while experience gained was an enabler to assessing pain. Several factors, including pain assessment, patients, practitioners, the organisation, the environment, family members, friends and bystanders, the receiving facility, treatment and pain education and knowledge, were cited as influencing prehospital pain management decision-making. Some of these were unique to the prehospital environment. Non-ALS practitioners were frustrated by the lack of availability of analgesic agents for them to administer and, along with relying on ALS assistance to administer analgesia, are forced to rely mainly on non-pharmacological methods. Hospital EC staff often criticise or are perceived to disapprove of prehospital pain management which was linked to their lack of understanding the prehospital environment and scopes of practice. Finally, participants felt criteria to justify the administration of the current pain medications are lacking, while medication options are restricted. In addition to others, one of the main changes' participants would like to see is the re-introduction of Entonox®.

The four interconnected studies create an understanding of prehospital pain care in the South African prehospital setting in terms of the significance of the problem, depth of knowledge and attitudes among practitioners, scarcity of research and the challenges that practitioners face daily.

7.2 Recommendations

Recommendations for further research and implementation resulting from this series of studies will be noted and described in this section.

7.2.1 Recommendations for further research

Though this series of studies add to the limited research on prehospital pain in Africa, there are several aspects beyond the scope of this work which require investigation. Further research must focus on developing the body of African prehospital pain knowledge as well as to inform clinical practice and advance quality prehospital pain care. Building capacity and investment in prehospital research and knowledge transfer are needed not just to develop prehospital pain care research but for prehospital research in general in Africa.

Specific recommendations for further research include:

1. Gathering epidemiological data on prehospital pain prevalence and prehospital pain care practices for other pain aetiologies such as medical conditions and obstetric cases as well as different patient populations like geriatrics in SA and Africa.
2. Measuring the efficiency of prehospital pain care practices for different pain aetiologies and patient populations through prospective observational studies in SA and Africa.
3. Observational studies to investigate and describe prehospital pain care inequalities in terms of patients (e.g. sex, age, pain severity, ethnicity, time spend in EMS care, pain aetiology, etc.) and prehospital practitioners (e.g. sex, age, and qualification, EMS domain, etc.) in SA and Africa.
4. Investigation of prehospital pain assessment strategies including appropriate pain scales for the African prehospital environment and patient populations and considering the development of a tool more appropriate for the setting.
5. Mapping pain care curricula among emergency care programs at higher education institutions across SA and Africa and the implementation of measures to advance and develop quality and consistency in prehospital pain care curricula and learning outcomes.
6. Investigating the impact of educational initiatives on pain knowledge, attitudes and prehospital pain care practices through innovative teaching and learning strategies and methodologies to improve the acquisition and retention of knowledge.
7. Validate and refine the prehospital knowledge, attitudes, and practices tool for pain survey to evaluate pain education initiatives, allow for measuring prehospital pain knowledge, attitudes, and practices in Africa, identify gaps and allow for comparison between EMS systems.
8. Exploring the decline in pain knowledge and attitudes over time after educational initiatives and the aspects which may influence this decline as well as investigating and describing the relationship between and comparative influence of pain knowledge versus attitudes on prehospital pain care practice and patient satisfaction and whether decline over time is associated with knowledge or attitudes.
9. Developing an evidence-based clinical practice guideline for prehospital pain assessment and management catering for all EMS systems in Africa which includes consideration for:

- a. Recommendations for prehospital pain assessment strategies and adopting appropriate standardised pain assessment tools for different patient populations and pain aetiologies,
 - b. Criteria and recommendations for the management of mild, moderate, and severe pain in different patient populations and pain aetiologies,
 - c. Effective, safe, practical, and cost-effective pain medication options to alleviate pain with different routes of administration for all levels of prehospital care,
 - d. Recommendations for the assessment and management of pain in unconscious and sedated patients,
 - e. Recommendations for pain care endpoints and quality measures,
 - f. Ensuring alignment with emergency medicine pain care recommendations to optimise continuity of care.
10. Qualitative studies to explore and describe:
- a. Cultural influences (of patients and practitioners) on prehospital pain assessment and management in SA and Africa,
 - b. Patients' experiences, perceptions and satisfaction with prehospital pain assessment and management in SA and Africa,
 - c. Emergency care providers attitudes towards pain assessment and management in the prehospital setting (private and public domains) and the factors which influence these attitudes as well as emergency care providers satisfaction with pain medication options in SA and Africa,
 - d. EC staffs' perception of prehospital pain assessment and management in SA and Africa.
11. Investigating and describing prehospital pain care CQI initiatives employing improvement science and the influence on pain assessment and management practices including documentation of pain care practices as well as the implementation and monitoring of quality indicators for prehospital pain care.

7.2.2 Recommendations for implementation

Our research confirmed several areas where improvement in prehospital pain assessment and management can be made, as detailed below.

7.2.2.1 Pain education and training

Pain education should be mandatory and an integral part of undergraduate emergency care curricula as well as an essential component of ongoing education for qualified practitioners.

Ensure quality and consistency in pain education and training curricula implemented through innovative teaching and learning approaches across all levels of emergency care undergraduate studies in SA to ensure better knowledge and understanding of pain assessment and management principles and to foster positive attitudes towards prehospital pain care. Evaluation of the acquisition of pain assessment and management knowledge and skills during undergraduate clinical practice placement and simulated practice should occur.

Provide and promote continuous pain education and training for qualified practitioners through tailored, evidence-based, and innovative pain educational initiatives to address knowledge gaps, promote positive practitioner attitudes and good clinical practice while measuring the effectiveness of these educational initiatives. To prioritise changing attitudes towards pain, educational initiatives should enable emergency care providers to recognise the influences of ethnicity, culture, spirituality, gender, and age on pain behaviour and expression as well as the influence on the patient's expectation of pain relief. Further, efforts must be made to ensure that emergency care providers recognise the unethical nature of placebo analgesia administration in clinical practice and that this must cease.

Although pain education is an obvious starting point for measures to improve prehospital pain assessment and management knowledge, attitudes, and practices, in of itself, pain education will not resolve all issues related to less than ideal current prehospital pain care practices.

7.2.2.2 EMS organisations and emergency care providers

An EMS organisational culture focused on and dedicated to decreasing suffering and promoting quality emergency medical care, among others, must emphasise proper prehospital pain assessment and management practices. EMS organisations and staff should adopt standardised and age-appropriate pain assessment tools as well as tools appropriate for the cognitively impaired and critically ill and injured patients and promote a culture of holistic pain assessment and regular reassessment as well as the proper documentation thereof. Pain assessment remains crucial for pain management decision-making.

Change pain culture in EMS organisations by promoting and prioritising pain assessment and (pharmacological and non-pharmacological) management. Optimise resources to facilitate (pharmacological and non-pharmacological) pain management such as the availability of analgesic medication (inhaled analgesics as well as the new analgesic medications) for all levels of prehospital care and equipment (nasal-atomiser, splints, etc.) for alternative routes of medication administration and non-pharmacological pain management.

Monitor and promote adherence to pain assessment and management evidence-based clinical practice guidelines. Implement, monitor, evaluate, and communicate EMS quality indicators for pain care and develop CQI initiatives to advance prehospital pain care and outcomes through improvement science. CQI initiatives should be underpinned by a just culture.

7.2.2.3 Interdisciplinary collaboration

Interdisciplinary collaboration between prehospital emergency care, emergency medicine, and other inpatient disciplines is needed to achieve common emergency pain care goals, ensure interdisciplinary continuity in acute pain assessment and management and to develop a mutual understanding of the challenges and dilemmas of the respective (prehospital and EC) environments in terms of pain assessment and management as well as a shared understanding of scopes of practice. In addition, collaboration is needed to ensure that prehospital emergency care and emergency medicine evidence-based pain clinical practice guidelines are aligned to facilitate and enhance continuity in emergency pain care.

7.3 Conclusion

The purpose of this series of research studies was to gain insight into acute prehospital pain assessment and management in the WC, SA and how to improve this field. The studies analysed and identified gaps in current prehospital pain care research in Africa and investigated and described emergency care providers' knowledge and attitudes regarding pain along with the factors that influence these. Prehospital traumatic pain prevalence together with disparities and the extent of prehospital traumatic pain assessment and management practices were described, as well as emergency care providers' experiences with prehospital pain care and perceived barriers and enablers thereof.

Africa has a scarcity of prehospital pain research with current evidence mainly from SA with prehospital pain care in the WC, SA having a significant gap. Emergency care providers' knowledge and attitudes regarding pain were limited, pain assessment and management practices less than ideal with several factors, some novel, hindering pain care in this environment. These findings were underpinned by limited educational focus, lack of pain prioritisation, practitioner indifference and limited resources in EMS organisations as well as the lack of clear evidence-based prehospital pain CPGs. A joint approach from EMS organisations and educational institutions as well as an interdisciplinary collaboration between prehospital emergency care and emergency medicine are required to facilitate improvement in acute pain care while further

efforts should focus on strengthening the body of prehospital acute pain knowledge in SA and Africa as well as to inform clinical practice and advance the quality of prehospital pain care.

REFERENCES

1. IASP. Unrelieved pain is a major global healthcare problem. *Amaz S3* [Internet]. 2004;1–4. Available from: <http://www.efic.org/04A> Global Day Fact Sheet.pdf%5CnC:%5CEMH%5CScannede artikler referanser%5CRefMan774.pdf%5Cnwww.efic.org
2. Goldberg D, McGee S. Pain as a global public health priority. *BMC Public Health* [Internet]. 2011;11(770):0–11. Available from: <https://doi.org/10.1186/1471-2458-11-770>
3. Morriss W, Goucke R, Huggins L, O'Connor M. Essential Pain Management Workshop Manual [Internet]. 2nd ed. Australian and New Zealand College of Anaesthetists; 2017. 1–65 p. Available from: [https://www.rcoa.ac.uk/sites/default/files/EPM UK Workshop Manual.pdf](https://www.rcoa.ac.uk/sites/default/files/EPM%20UK%20Workshop%20Manual.pdf)
4. Boyd D, Butler M, Carr D, Cohen M, Devor M, Dworkin R, et al. Part III: Pain Terms, A Current List with Definitions and Notes on Usage [Internet]. 2nd ed. IASP Terminology. Seattle: IASP Press; 2011. 209–214 p. Available from: [http://www.iasp-pain.org/Content/NavigationMenu/GeneralResourceLinks/PainDefinitions/default.htm# Pain](http://www.iasp-pain.org/Content/NavigationMenu/GeneralResourceLinks/PainDefinitions/default.htm#Pain)
5. Cohen M, Quintner J, Van Rysewyk S. Reconsidering the International Association for the Study of Pain definition of pain. *PAIN Reports* [Internet]. 2018;3(2):e634. Available from: <https://doi.org/10.1097/PR9.0000000000000634>
6. Macintyre PE, Schug SA, Scott DA, Visser EJ WS. Acute pain management: scientific evidence [Internet]. 3rd Editio. Melbourne; 2010. Available from: <http://www.anzca.edu.au/Documents/Acute-Pain-final-version>
7. Wells N, Pasero C, McCaffery M. Improving the Quality of Care Through Pain Assessment and Management. In: Hughes RG, editor. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses, Vol 1* [Internet]. Rockville, MD: Agency for Healthcare Research and Quality; 2008. p. 474–502. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK2658/>
8. Gélinas C, Arbour C. Pain and Pain Management. In: *Critical Care Nursing, Diagnosis and Management*. 7th ed. USA: Mosby; 2013. p. 143–69.
9. Sinatra R. Causes and Consequences of Inadequate Management of Acute Pain. *Pain Med* [Internet]. 2010;11:1859–71. Available from: <https://doi.org/10.1111/j.1526-4637.2010.00983.x>

10. Aydede M, Shriver A. Recently introduced definition of “nociplastic pain” by the International Association for the Study of Pain needs better formulation. *Pain* [Internet]. 2018;159(6):1176–7. Available from: <https://doi.org/10.1097/j.pain.0000000000001184>
11. Schug, SA, Palmer, GM, Scott, DA, Halliwell, R, Trinca J. *Acute Pain Management: Scientific Evidence* (4th edition). APM: SE Working Group of the Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine. Melbourne: ANZCA & FPM; 2015. 647 p.
12. Saranteas T, Kostroglou A, Anagnostopoulos D, Giannoulis D, Vasiliou P, Mavrogenis AF. Pain is vital in resuscitation in trauma. *SICOT-J* [Internet]. 2019;28(5):1–5. Available from: <https://doi.org/10.1051/sicotj/2019028>
13. Balfour CH. Analgesia and Sedation in the Emergency Environment. *Contin Med Educ* [Internet]. 2004;22(6):315–20. Available from: <https://www.ajol.info/index.php/cme/article/viewFile/43976/27494>
14. McManus JG, Sallee DR. Pain Management in the Prehospital Environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://doi.org/10.1016/j.emc.2004.12.009>
15. Lord B. Pain Management: Can education make a difference? *Australas J Paramed*. 2003;1(3):1–2.
16. Todd KH, Ducharme J, Choiniere M, Crandall CS, Fosnocht DE, Homel P, et al. Pain in the Emergency Department: Results of the Pain and Emergency Medicine Initiative (PEMI) Multicenter Study. *J Pain* [Internet]. 2007;8(6):460–6. Available from: <https://doi.org/10.1016/j.jpain.2006.12.005>
17. Berben SAA, Meijs THJM, van Dongen RTM, van Vugt AB, Vloet LCM, Mintjes-de Groot JJ, et al. Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. *Injury* [Internet]. 2008;39(5):578–85. Available from: <https://doi.org/10.1016/j.injury.2007.04.013>
18. Mura P, Serra E, Marinangeli F, Patti S, Musu M, Piras I, et al. Prospective study on prevalence, intensity, type, and therapy of acute pain in a second-level urban emergency department. *J Pain Res* [Internet]. 2017;10:2781–8. Available from: <https://doi.org/10.2147/JPR.S137992>
19. Gregory J, McGowan L. An examination of the prevalence of acute pain for hospitalised adult patients: A systematic review. *J Clin Nurs* [Internet]. 2016;25(5–6):583–98. Available

from: <https://doi.org/10.1111/jocn.13094>

20. Cordell WH, Keene KK, Giles BK, Jones JB, Jones JH, Brizendine EJ. The high prevalence of pain in emergency medical care. *Am J Emerg Med* [Internet]. 2002;20(3):165–9. Available from: <https://doi.org/10.1053/ajem.2002.32643>
21. Damico V, Murano L, Cazzaniga F, Dal Molin A. Pain prevalence, severity, assessment and management in hospitalized adult patients: a result of a multicenter cross-sectional study. *Ann Ist Super Sanità* [Internet]. 2018;54(3):194–200. Available from: https://doi.org/10.4415/ANN_18_03_05
22. Galinski M, Ruscev M, Gonzalez G, Kavas J, Ameer L, Biens D, et al. Prevalence and management of acute pain in prehospital emergency medicine. *Prehosp Emerg Care* [Internet]. 2010;14(3):334–9. Available from: <https://doi.org/10.3109/10903121003760218>
23. McLean S, Maio R, Domeier R. The epidemiology of pain in the prehospital setting. *Prehosp Emerg Care* [Internet]. 2002;6(4):402–5. Available from: <http://dx.doi.org/10.1136/emj.2010.098954>
24. Iqbal M, Spaight PA, Siriwardena AN. Patients' and emergency clinicians' perceptions of improving pre-hospital pain management: a qualitative study. *Emerg Med J* [Internet]. 2013;30(3):1–6. Available from: <http://dx.doi.org/10.1136/emmermed-2012-201111>
25. Murphy A, McCoy S, O'Reilly K, Fogarty E, Dietz J, Crispino G, et al. A Prevalence and Management Study of Acute Pain in Children Attending Emergency Departments by Ambulance. *Prehosp Emerg Care* [Internet]. 2016;20(1):52–8. Available from: <https://doi.org/10.3109/10903127.2015.1037478>
26. Galinski M, Picco N, Hennequin B, Raphael V, Ayachi A, Beruben A, et al. Out-of-hospital emergency medicine in pediatric patients: Prevalence and management of pain. *Am J Emerg Med* [Internet]. 2011;29(9):1062–6. Available from: <http://dx.doi.org/10.1016/j.ajem.2010.06.031>
27. Albrecht E, Taffe P, Yersin B, Schoettker P, Decosterd I, Hugli O. Undertreatment of acute pain (oligoanalgesia) and medical practice variation in prehospital analgesia of adult trauma patients: A 10 yr retrospective study. *Br J Anaesth* [Internet]. 2013;110(1):96–106. Available from: <http://dx.doi.org/10.1093/bja/aes355>
28. Friesgaard KD, Riddervold IS, Kirkegaard H, Christensen EF, Nikolajsen L. Acute pain in the

- prehospital setting: A register-based study of 41.241 patients. *Scand J Trauma Resusc Emerg Med* [Internet]. 2018;26(1):1–10. Available from: <https://doi.org/10.1186/s13049-018-0521-2>
29. Marinangeli F, Narducci C, Ursini M, Paladini A, Pasqualucci A, Gatti A, et al. Acute pain and availability of analgesia in the prehospital emergency setting in Italy: A problem to be solved. *Pain Pract* [Internet]. 2009;9(4):282–8. Available from: <https://doi.org/10.1111/j.1533-2500.2009.00277.x>
 30. Berben SAA, Schoonhoven L, Meijs THJM, Van Vugt AB, Van Grunsven PM. Prevalence and relief of pain in trauma patients in emergency medical services. *Clin J Pain* [Internet]. 2011;27(7):587–92. Available from: <https://doi.org/10.1097/AJP.0b013e3182169036>
 31. Jennings PA, Cameron P, Bernard S. Epidemiology of prehospital pain: An opportunity for improvement. *Emerg Med J* [Internet]. 2011;28(6):530–1. Available from: <http://dx.doi.org/10.1136/emj.2010.098954>
 32. Prehospital care [Internet]. *Fartex Medical Dictionary*. 2009 [cited 2019 Nov 22]. Available from: <https://medical-dictionary.thefreedictionary.com/prehospital+care>
 33. Emergency Department [Internet]. *Farlex Medical Dictionary*. 2009 [cited 2019 Nov 22]. Available from: <https://medical-dictionary.thefreedictionary.com/emergency+department>
 34. Bendinger T, Plunkett N. Measurement in pain medicine. *BJA Educ* [Internet]. 2016;16(9):310–5. Available from: <https://doi.org/10.1093/bjaed/mkw014>
 35. Jennings PA, Cameron P, Bernard S. Measuring acute pain in the prehospital setting. *Emerg Med J* [Internet]. 2009;26(8):552–5. Available from: <https://doi.org/10.1136/emj.2008.062539>
 36. Jones GE, Machen I. Pre-hospital pain management: The paramedics' perspective. *Accid Emerg Nurs* [Internet]. 2003;11(3):166–72. Available from: [https://doi.org/10.1016/S0965-2302\(02\)00219-9](https://doi.org/10.1016/S0965-2302(02)00219-9)
 37. Luger TJ, Lederer W, Gassner M, Löckinger A, Ulmer H, Lorenz IH, et al. Acute pain is underassessed in out-of-hospital emergencies. *Acad Emerg Med* [Internet]. 2003;10(6):627–32. Available from: <https://doi.org/10.1111/j.1553-2712.2003.tb00046.x>
 38. Solomon P. Congruence between health professionals' and patients' pain ratings: A review of the literature. *Scand J Caring Sci* [Internet]. 2001;15(2):174–80. Available from:

<https://onlinelibrary-wiley-com.ezproxy.uct.ac.za/doi/epdf/10.1046/j.1471-6712.2001.00027.x>

39. Thomas SH, Shewakramani S. Prehospital Trauma Analgesia. *J Emerg Med* [Internet]. 2008;35(1):47–57. Available from: <https://doi.org/10.1016/j.jemermed.2007.05.041>
40. Abbuhl FB, Reed DB. Time to analgesia for patients with painful extremity injuries transported to the Emergency Department by ambulance. *Prehosp Emerg Care* [Internet]. 2009;7(4):445–7. Available from: <https://doi.org/10.1080/312703002156>
41. Hennes H, Kim MK. Prehospital pain management: Current status and future direction. *Clin Pediatr Emerg Med* [Internet]. 2006;7(1):25–30. Available from: <http://dx.doi.org/10.1016/j.cpem.2006.01.008>
42. Sobuwa S, Christopher LD. Emergency care education in South Africa: past, present and future. *Australas J Paramed* [Internet]. 2019;16:1–6. Available from: <https://doi.org/10.33151/ajp.16.647>
43. National Department of Health. National Emergency Care Education and Training Policy [Internet]. 2017 p. 1–16. Available from: <http://www.health.gov.za/index.php/2014-08-15-12-53-24/category/327-2017po?download=2126:national-emergency-care-education-and-training-policy>
44. Vincent-Lambert C. International perspectives: South African ambulance services in 2020. In: Wankhade P, Mackway-Jones K, editors. *Ambulance Services Leadership and Management Perspectives* [Internet]. Springer, Cham; 2015. p. 175–83. Available from: https://doi.org/10.1007/978-3-319-18642-9_15
45. Health Professions Council of South Africa. South African Emergency Medical Services Clinical Practice Guidelines [Internet]. Pretoria; 2018. Available from: http://www.hpcs.co.za/Uploads/editor/UserFiles/downloads/emergency_care/CLINICAL_PRACTICE_GUIDELINES_PROTOCOLS_2018.pdf.
46. Lord B, Parsell B. Measurement of Pain in the Prehospital Setting Using a Visual Analogue Scale. *Prehosp Disaster Med* [Internet]. 2003;18(4):353–8. Available from: <https://doi.org/10.1017/S1049023X000131X>
47. McManus JG, Sallee DR. Pain management in the prehospital environment. *Emerg Med Clin North Am* [Internet]. 2005;23(2):415–31. Available from: <https://doi.org/10.1016/j.emc.2004.12.009>

48. Hennes H, Kim MK, Pirrallo RG. Prehospital pain management: A comparison of providers' perceptions and practices. *Prehosp Emerg Care* [Internet]. 2005;9(1):32–9. Available from: <https://doi.org/10.1080/10903120590891705>
49. Taylor, EM, Boyer, K, Campbell F. Pain in hospitalized children: A prospective cross-sectional survey of pain prevalence, intensity, assessment and management in a Canadian pediatric teaching hospital. *Pain Res Manag* [Internet]. 2008;13(1):25–32. Available from: <http://dx.doi.org/10.1155/2008/478102>
50. Infinger AE, Studnek JR. An assessment of pain management among patients presenting to emergency medical services after suffering a fall. *Prehosp Disaster Med* [Internet]. 2014;29(4):344–9. Available from: <https://doi.org/10.1017/S1049023X14000594>
51. Hebgaards, S, Mannering, A, Zwisler S. Assessment of acute pain in trauma - A retrospective prehospital evaluation. *J Opioid Manag* [Internet]. 2016;12(5):347–53. Available from: <https://doi.org/10.5055/jom.2016.0351>
52. Simpson PM, Bendall JC, Tiedemann A, Lord SR, Close JCT. Provision of Out-of-hospital Analgesia to Older Fallers With Suspected Fractures : Above Par , but Opportunities for Improvement Exist. *Acad Emerg Med* [Internet]. 2013;20(8):761–8. Available from: <https://doi.org/10.1111/acem.12190>
53. Pettus K. Untreated pain in the lower and middle-income countries. *Glob Drug Policy Obs* [Internet]. 2013;(December):4. Available from: <http://www.swansea.ac.uk/media/GDPO Situation Analysis Essential Med.pdf>
54. Morriss WW, Roques CJ. Pain management in low- and middle-income countries. *BJA Educ* [Internet]. 2018;18(9):265–70. Available from: <https://doi.org/10.1016/j.bjae.2018.05.006>
55. Manjiani D, Paul DB, Kunnumpurath S, Kaye AD, Vadivelu N. Availability and utilization of opioids for pain management: Global issues. *Ochsner J* [Internet]. 2014;14(2):208–15. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4052588/pdf/i1524-5012-14-2-208.pdf>
56. Size, M, Soyannwo, OA, Justins D. Pain management in developing countries. *Anaesthesia* [Internet]. 2007;62(Suppl 1):38–43. Available from: <https://doi.org/10.1111/j.1365-2044.2007.05296.x>
57. Goucke R, Morriss W. Pain management in Low and Middle Income Countries (LMIC) just

- put up with it? Egypt J Anaesth [Internet]. 2012;28(1):1–2. Available from: <http://dx.doi.org/10.1016/j.egja.2011.11.005>
58. Ogboli-Nwasor E, Hogans BB. Fact Sheet 8: Pain Education in Low-Resource Countries [Internet]. International Association of the Study of Pain. 2018. p. 1–7. Available from: <https://www.iasp-pain.org/GlobalYear/PainEducation>
 59. Albertyn R, Rode H, Millar AJW, Thomas J. Challenges associated with paediatric pain management in Sub Saharan Africa. Int J Surg [Internet]. 2009;7(2):91–3. Available from: <http://dx.doi.org/10.1016/j.ijsu.2009.01.005>
 60. Onyeka T, Chukwuneke F. Pain research in Africa: a ten-year bibliometric survey. J Anesth [Internet]. 2014;28(4):511–6. Available from: <http://dx.doi.org.ezproxy.uct.ac.za/10.1007/s00540-013-1767-5>
 61. Dilunga GD, Sawe HR, Kulola IB, Mfinanga JA, Lucumay NJ, Mulesi EM, et al. Pain assessment and management of trauma patients in an emergency department of a tertiary hospital in Tanzania. Saf Heal [Internet]. 2018;4(1):8–13. Available from: <https://doi.org/10.1186/s40886-018-0079-8>
 62. Awolola AM, Campbell L, Ross A. Pain management in patients with long-bone fractures in a district hospital in KwaZulu-Natal, South Africa. African J Prim Heal Care Fam Med [Internet]. 2015;7(1):1–5. Available from: <https://doi.org/10.4102/phcfm.v7i1.818>
 63. Thiadens T, Vervat E, Van Dijk M, Albertyn R, Van As AB (Sebastian). Evaluation of pain incidence and pain management in a South African paediatric trauma unit. South African Med J [Internet]. 2011;101(8):533–6. Available from: <http://www.scielo.org.za/pdf/samj/v101n8/v101n8a21.pdf>
 64. Rampanjato RM, Florence M, Patrick NC, Finucane BT. Factors influencing pain management by nurses in emergency departments in Central Africa. Emerg Med J [Internet]. 2007;24(7):475–6. Available from: <http://dx.doi.org.ezproxy.uct.ac.za/10.1136/emj.2006.045815>
 65. Eyob T, Mulatu A, Abrha H. Knowledge And Attitude Towards Pain Management Among Medical And Paramedical Students Of An Ethiopian University. J Pain Reli [Internet]. 2014;03(01):1–5. Available from: <http://www.dx.doi.org/10.4172/2167-0846.1000127>
 66. Germossa GN, Sjetne IS, Hellesø R. The Impact of an In-service Educational Program on Nurses' Knowledge and Attitudes Regarding Pain Management in an Ethiopian University

- Hospital. *Front Public Heal* [Internet]. 2018;6(229):1–7. Available from: <https://doi.org/10.3389/fpubh.2018.00229>
67. Wurjine TH, Nigussie BG. Knowledge, attitudes and practices of nurses regarding to post-operative pain management at hospitals of Arsi zone, Southeast Ethiopia, 2018. *Women's Heal* [Internet]. 2019;7(4):130–5. Available from: <https://doi.org/10.15406/mojwh.2018.07.00183>
 68. Woldehaimanot T, Saketa Y, Zeleke A, Gesesew H, Woldeyohanes T. Pain knowledge and attitude: a survey among nurses in 23 health institutions in Western Ethiopia. *Gaziantep Med J* [Internet]. 2014;20(3):254. Available from: <https://doi.org/10.5455/gmj-30-157196>
 69. Kizza IB, Muliira JK, Kohi TW, Nabirye RC. Nurses' knowledge of the principles of acute pain assessment in critically ill adult patients who are able to self-report. *Int J Africa Nurs Sci* [Internet]. 2016;4:20–7. Available from: <http://dx.doi.org/10.1016/j.ijans.2016.02.001>
 70. Manwere A, Chipfuwa T, Mukwamba MM, Chironda G. Knowledge and attitudes of registered nurses towards pain management of adult medical patients: A case of Bindura Hospital. *Heal Sci J* [Internet]. 2015;9(4):1–6. Available from: <http://www.hsj.gr/medicine/knowledge-and-attitudes-of-registered-nurses-towards-pain-management-of-adult-medical-patients-a-case-of-bindura-hospital.pdf>
 71. Matthews R, McCaul M, Smith W. A description of pharmacological analgesia administration by public sector advanced life support paramedics in the City of Cape Town. *Afr J Emerg Med* [Internet]. 2017;7(1):24–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.01.002>
 72. Vincent-Lambert C, De Kock JM. Use of morphine sulphate by South African paramedics for prehospital pain management. *Pain Res Manag* [Internet]. 2015;20(3):141–4. Available from: <http://dx.doi.org/10.1155/2015/507470>
 73. Mulder RK. Clinical Decision Making By South African Paramedics in the Management of Acute Traumatic Pain [Internet]. Durban University of Technology; 2012. Available from: http://openscholar.dut.ac.za/bitstream/10321/854/1/Mulder_2012.pdf
 74. Kishner, S, Paulk, KL, Schraga, ED. Pain assessment [Internet]. Medscape. 2018. Available from: <https://emedicine.medscape.com/article/1948069-overview#showall>
 75. Hjerstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Med D, et al. Studies Comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for

- Assessment of Pain Intensity in Adults: A Systematic Literature Review. *J Pain Symptom Manage* [Internet]. 2011;41(6):1073–93. Available from: <http://dx.doi.org/10.1016/j.jpainsymman.2010.08.016>
76. Karcioğlu O, Topacoglu H, Dikme O, Dikme O. A systematic review of the pain scales in adults: Which to use? *Am J Emerg Med* [Internet]. 2018;36(4):707–14. Available from: <https://doi.org/10.1016/j.ajem.2018.01.008>
 77. McLean SA, Domeier RM, DeVore HK, Hill EM, Maio RF, Frederiksen S. The feasibility of pain assessment in the prehospital setting. *Prehosp Emerg Care* [Internet]. 2004;8(2):155–6. Available from: <https://doi.org/10.1080/312703004258>
 78. Gordon DB. Acute pain assessment tools: Let us move beyond simple pain ratings. *Curr Opin Anaesthesiol* [Internet]. 2015;28(5):565–9. Available from: <https://doi.org/10.1097/ACO.0000000000000225>
 79. Bahreini M, Jalili M, Moradi-Lakeh M. A comparison of three self-report pain scales in adults with acute pain. *J Emerg Med* [Internet]. 2015;48(1):10–8. Available from: <http://dx.doi.org/10.1016/j.jemermed.2014.07.039>
 80. Göransson KE, Heilborn U, Selberg J, Von Scheele S, Djärv T. Pain rating in the ED—a comparison between 2 scales in a Swedish hospital. *Am J Emerg Med* [Internet]. 2015;33(3):419–22. Available from: <http://dx.doi.org/10.1016/j.ajem.2014.12.069>
 81. Bijur PE, Latimer CT, Gallagher EJ. Validation of a verbally administered numerical rating scale of acute pain for use in the emergency department. *Acad Emerg Med*. 2003;10(4):390–2.
 82. Ismail AK, Abdul Ghafar MA, Shamsuddin NS haz. A, Roslan NA, Kaharuddin H, Nik Muhamad NA. The Assessment of Acute Pain in Pre-Hospital Care Using Verbal Numerical Rating and Visual Analogue Scales. *J Emerg Med* [Internet]. 2015;49(3):287–93. Available from: <http://dx.doi.org/10.1016/j.jemermed.2015.02.043>
 83. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Medica* [Internet]. 2012;22(3):276–82. Available from: <https://hrcak.srce.hr/89395>
 84. Shavit I, Kofman M, Leder M, Hod T, Kozer E. Observational pain assessment versus self-report in paediatric triage. *Emerg Med J* [Internet]. 2008;25(9):552–5. Available from: <http://dx.doi.org/10.1136/emj.2008.058297>
 85. Lord B. Paramedic assessment of pain in the cognitively impaired patient. *BMC Emerg Med*

- [Internet]. 2009;9(20):1–9. Available from: <https://doi.org/10.1186/1471-227X-9-2>
86. Rooney L. Are the current pain assessment tools used by paramedics in Ireland, suitable for use with cognitively impaired (dementia) patients? *Irish J Paramed* [Internet]. 2018;3(2):6. Available from: <http://dx.doi.org/10.32378/ijp.v3i2.143>
 87. Varndell W, Fry M, Elliott D. A systematic review of observational pain assessment instruments for use with nonverbal intubated critically ill adult patients in the emergency department: an assessment of their suitability and psychometric properties. *J Clin Nurs* [Internet]. 2017;26(1–2):7–32. Available from: <https://doi.org/10.1111/jocn.13594>
 88. Paulson-Conger M, Leske J, Maidl C, Hanson A, Dziadulewicz L. Comparison of Two Pain Assessment Tools in Nonverbal Critical Care Patients. *Pain Manag Nurs* [Internet]. 2011;12(4):218–24. Available from: <http://dx.doi.org/10.1016/j.pmn.2010.05.008>
 89. Gausche-Hill M, Brown KM, Oliver ZJ, Sasson C, Dayan PS, Eschmann NM, et al. An evidence-based guideline for prehospital analgesia in trauma. *Prehosp Emerg Care* [Internet]. 2014;18(SUPPL.1):25–34. Available from: <https://doi.org/10.3109/10903127.2013.844873>
 90. Alonso-Serra HM, Wesley K. Prehospital pain management. *Prehosp Emerg Care* [Internet]. 2003;7(4):482–8. Available from: <https://doi.org/10.1080/312703002260>
 91. Onwuasoanya AD. Pain Management and Assessment for Healthcare Practitioners: Review Article. *J Anesth Pain Med* [Internet]. 2016;1(2):1–4. Available from: <https://onlinelibrary.wiley.com/resolve/doi?DOI=10.1197/aemj.10.4.390>
 92. Afrox [Internet]. 2020. Available from: <http://www.afrox.co.za/>
 93. Dißmann PD, Maignan M, Cloves PD, Gutierrez Parres B, Dickerson S, Eberhardt A. A Review of the Burden of Trauma Pain in Emergency Settings in Europe. *Pain Ther* [Internet]. 2018;7(2):179–92. Available from: <https://doi.org/10.1007/s40122-018-0101-1>
 94. Porter KM, Dayan AD, Dickerson S, Middleton PM. The role of inhaled methoxyflurane in acute pain management. *Open Access Emerg Med* [Internet]. 2018;10:149–64. Available from: <https://doi.org/10.2147/OAEM.S181222>
 95. Borland ML, Jacobs I, Rogers IR. Options in prehospital analgesia. *Emerg Med* [Internet]. 2002;14(1):77–84. Available from: <https://doi.org/10.1046/j.1442-2026.2002.00288.x>
 96. O’Sullivan Í, Bengner J. Nitrous oxide in emergency medicine. *Emerg Med J* [Internet].

- 2003;20(3):214–7. Available from: <http://dx.doi.org/10.1136/emj.20.3.214>
97. Sheyklo SG, Hajebrahimi S, Moosavi A, Pournaghi-Azar F, Azami-Aghdash S, Ghojzadeh M. Effect of Entonox for pain management in labor: A systematic review and meta-analysis of randomized controlled trials. *Electron Physician* [Internet]. 2017;9(12):6002–9. Available from: <http://dx.doi.org/10.19082/6002>
98. Ducasse J, Siksik G, Durand-Bechu M, Couarraze S, Valle B, Lecoules N, et al. Nitrous Oxide for Early Analgesia in the Emergency Setting: A Randomized, Double-Blind Multicenter Prehospital Trial. *Acad Emerg Med* [Internet]. 2013;20(2):178–84. Available from: <https://doi.org/10.1111/acem.12072>
99. Faddy SC, Garlick SR. A systematic review of the safety of analgesia with 50% nitrous oxide: Can lay responders use analgesic gases in the prehospital setting? *Emerg Med J* [Internet]. 2005;22(12):901–6. Available from: <http://dx.doi.org/10.1136/emj.2004.020891>
100. Porter KM, Siddiqui MK, Sharma I, Dickerson S, Eberhardt A. Management of trauma pain in the emergency setting: low-dose methoxyflurane or nitrous oxide? A systematic review and indirect treatment comparison. *J Pain Res* [Internet]. 2017;11:11–21. Available from: <https://doi.org/10.2147/JPR.S150600>.
101. Coffey F, Wright J, Hartshorn S, Hunt P, Locker T, Mirza K, et al. STOP!: A randomised, double-blind, placebo-controlled study of the efficacy and safety of methoxyflurane for the treatment of acute pain. *Emerg Med J* [Internet]. 2014;31(8):613–8. Available from: <http://dx.doi.org/10.1136/emmermed-2014-203690>
102. Grindlay J, Babl FE. Efficacy and safety of methoxyflurane analgesia in the emergency department and prehospital setting: Review Article. *Emerg Med Australas* [Internet]. 2009;21(1):4–11. Available from: <https://doi.org/10.1111/j.1742-6723.2009.01153.x>
103. Buntine P, Thom O, Babl F, Bailey M, Bernard S. Prehospital analgesia in adults using inhaled methoxyflurane. *Emerg Med Australas* [Internet]. 2007;19(6):509–14. Available from: <https://doi.org/10.1111/j.1742-6723.2007.01017.x>
104. Hartshorn S, Middleton PM. Efficacy and safety of inhaled low-dose methoxyflurane for acute paediatric pain: A systematic review. *Trauma* [Internet]. 2018;0(0):1–9. Available from: <https://doi.org/10.1177/1460408618798391>
105. Babl FE, Jamison SR, Spicer M, Bernard S. Inhaled methoxyflurane as a prehospital analgesic in children. *Emerg Med Australas* [Internet]. 2006;18(4):404–10. Available from:

<https://doi.org/10.1111/j.1742-6723.2006.00874.x>

106. Hartshorn S, Dissmann P, Coffey F, Lomax M. Low-dose methoxyflurane analgesia in adolescent patients with moderate-to-severe trauma pain : a subgroup analysis of the STOP! study. *J Pain Res* [Internet]. 2019;12:689–700. Available from: <https://doi.org/10.2147/JPR.S188675>
107. Marinangeli F, Reggiardo G, Sblendido A. Prospective, Multicentre Trial of Methoxyflurane for Acute Trauma-Related Pain in Helicopter Emergency Medical Systems and Hostile Environments : METEORA Protocol. *Adv Ther* [Internet]. 2018;35(11):2081–92. Available from: <https://doi.org/10.1007/s12325-018-0816-8>
108. Middleton PM, Simpson PM, Sinclair G, Dobbins TA, Bendall JC. Effectiveness of Morphine, Fentanyl, and Methoxyflurane in the Prehospital Setting. *Prehosp Emerg Care* [Internet]. 2010;14(4):439–47. Available from: <https://www.tandfonline.com/doi/full/10.3109/10903127.2010.497896>
109. Bendall JC, Simpson PM, Middleton PM. Effectiveness of prehospital morphine, fentanyl, and methoxyflurane in pediatric patients. *Prehosp Emerg Care* [Internet]. 2011;15(2):158–65. Available from: <http://doi.org/10.3109/10903127.2010.541980>
110. Bendall JC, Simpson PM, Middleton PM. Prehospital analgesia in New South Wales, Australia. *Prehosp Disaster Med* [Internet]. 2012;26(6):422–6. Available from: <https://doi.org/10.1017/S1049023X12000180>
111. Johnston S, Wilkes GJ, Thompson JA, Ziman M, Brightwell R. Inhaled methoxyflurane and intranasal fentanyl for prehospital management of visceral pain in an Australian ambulance service. *Emerg Med J* [Internet]. 2010;28(1):57–63. Available from: <https://doi.org/10.1136/emj.2009.078717>
112. Lim KJ, Koh ZX, Ng YY, Fook-Chong S, Ho AFW, Doctor NE, et al. Comparison of inhalational methoxyflurane (Penthrox®) and intramuscular tramadol for prehospital analgesia. *Singapore Med J* [Internet]. 2020;1–17. Available from: <https://doi.org/10.11622/smedj.2020035>
113. Fabbri A, Carpinteri G, Bonafede E, Sblendido A, Farina A, Ruggiano G, et al. Methoxyflurane Versus Standard of Care for Acute Trauma-Related Pain in the Emergency Setting: Protocol for a Randomised, Controlled Study in Italy (MEDITA). *Adv Ther* [Internet]. 2019;36(1):244–56. Available from: <https://doi.org/10.1007/s12325-018-0830-x>

114. Mercadante S, Voza A, Serra S, Ruggiano G, Carpinteri G, Gangitano G, et al. Analgesic Efficacy, Practicality and Safety of Inhaled Methoxyflurane Versus Standard Analgesic Treatment for Acute Trauma Pain in the Emergency Setting: A Randomised, Open-Label, Active-Controlled, Multicentre Trial in Italy (MEDITA). *Adv Ther* [Internet]. 2019;36(11):3030–46. Available from: <https://doi.org/10.1007/s12325-019-01055-9>
115. Voza A, Ruggiano G, Intelligente F, Bonafede E, Sblendido A, Farina A. Inhaled Methoxyflurane versus Intravenous Morphine for Severe Trauma Pain in the Emergency Setting: Subgroup Analysis of MEDITA, a Multicenter, Randomized, Controlled, Open-Label Trial. *J Pain Res* [Internet]. 2020;13:491–502. Available from: <https://doi.org/10.2147/JPR.S240911>
116. Bounes V, Charpentier S, Bellard C, Ducassé JL. Is there an ideal morphine dose for prehospital treatment of severe acute pain? A randomized, double-blind comparison of 2 doses. *Am J Emerg Med* [Internet]. 2008;26:148–54. Available from: <https://doi.org/10.1016/j.ajem.2007.04.020>
117. Samuel N, Steiner IP, Shavit I. Prehospital pain management of injured children: A systematic review of current evidence. *Am J Emerg Med* [Internet]. 2015;33(3):451–4. Available from: <http://dx.doi.org/10.1016/j.ajem.2014.12.012>
118. Murphy AP, Hughes M, Mccoy S, Crispino G, Wakai A, O’Sullivan R. Intranasal fentanyl for the prehospital management of acute pain in children. *Eur J Emerg Med* [Internet]. 2017;24(6):450–4. Available from: <https://doi.org/10.1097/MEJ.0000000000000389>
119. Kanowitz A, Dunn TM, Kanowitz EM, Dunn WW, VanBuskirk K. Safety and effectiveness of fentanyl administration for prehospital pain management. *Prehosp Emerg Care* [Internet]. 2006;10(1):1–7. Available from: <https://doi.org/10.1080/10903120500373264>
120. Karlsen APH, Pedersen DMB, Trautner S, Dahl JB, Hansen MS. Safety of intranasal fentanyl in the out-of-hospital setting: A prospective observational study. *Ann Emerg Med* [Internet]. 2014;63(6):699–703. Available from: <http://dx.doi.org/10.1016/j.annemergmed.2013.10.025>
121. Friesgaard KD, Nikolajsen L, Giebner M, Rasmussen CH, Riddervold IS, Kirkegaard H, et al. Efficacy and safety of intravenous fentanyl administered by ambulance personnel. *Acta Anaesthesiol Scand* [Internet]. 2016;60(4):537–43. Available from: <https://doi.org/10.1111/aas.12662>
122. Krauss WC, Shah S, Shah S, Thomas SH. Fentanyl in the out-of-hospital setting: Variables

- associated with hypotension and hypoxemia. *J Emerg Med* [Internet]. 2011;40(2):182–7. Available from: <http://dx.doi.org/10.1016/j.jemermed.2009.02.009>
123. Galinski M, Dolveck F, Borron SW, Tual L, Van Laer V, Lardeur JY, et al. A randomized, double-blind study comparing morphine with fentanyl in prehospital analgesia. *Am J Emerg Med* [Internet]. 2005;23(2):114–9. Available from: <https://doi.org/10.1016/j.ajem.2004.03.010>
124. Rickard C, Meara PO, McGrail M, It G, Garner D, Mclean A, et al. A randomized controlled trial of intranasal fentanyl vs intravenous morphine for analgesia in the prehospital setting. *Am J Emerg Med* [Internet]. 2007;25:911–7. Available from: <https://doi.org/10.1016/j.ajem.2007.02.027>
125. Fleischman, RJ, Frazer, DG, Daya, M, Jui, J, Newgard C. Effectiveness and Safety of Fentanyl Compared with Morphine for Out-of-Hospital Analgesia. *Prehosp Emerg Care* [Internet]. 2011;14(2):167–75. Available from: <https://doi.org/10.3109/10903120903572301>
126. Smith MD, Wang Y, Cudnik M, Smith DA, Pakiela J, Emerman CL. The effectiveness and adverse events of morphine versus fentanyl on a physician-staffed helicopter. *J Emerg Med* [Internet]. 2012;43(1):69–75. Available from: <http://dx.doi.org/10.1016/j.jemermed.2011.05.018>
127. Murphy A, Sullivan OR, Wakai A, Grant T, Mj B, Cronin J, et al. Intranasal fentanyl for the management of acute pain in children. *Cochrane Libr* [Internet]. 2012;(7). Available from: <https://doi.org/10.1002/14651858.CD009942.pub2>
128. Andolfatto G, Innes K, Dick W, Jenneson S, Willman E, Stenstrom R, et al. Prehospital Analgesia With Intranasal Ketamine (PAIN-K): A Randomized Double-Blind Trial in Adults. *Ann Emerg Med* [Internet]. 2019;1–10. Available from: <https://doi.org/10.1016/j.annemergmed.2019.01.048>
129. Jennings PA, Cameron P, Bernard S. Ketamine as an analgesic in the pre-hospital setting: A systematic review. *Acta Anaesthesiol Scand* [Internet]. 2011;55(6):638–43. Available from: <https://doi.org/10.1111/j.1399-6576.2011.02446.x>
130. Walker T, Masci K, Fitzgerald M, Jennings PA, Jolley D, Bernard S, et al. Morphine and Ketamine Is Superior to Morphine Alone for Out-of-Hospital Trauma Analgesia: A Randomized Controlled Trial. *Ann Emerg Med* [Internet]. 2012;59(6):497–503. Available from: <http://dx.doi.org/10.1016/j.annemergmed.2011.11.012>

131. Bronsky ES, Koola C, Orlando A, Redmond D, D'Huyvetter C, Sieracki H, et al. Intravenous Low-Dose Ketamine Provides Greater Pain Control Compared to Fentanyl in a Civilian Prehospital Trauma System: A Propensity-Matched Analysis. *Prehosp Emerg Care* [Internet]. 2019;23(1):1–8. Available from: <https://doi.org/10.1080/10903127.2018.1469704>
132. Tran KP, Nguyen Q, Truong XN, Le V, Le VP, Mai N, et al. A Comparison of Ketamine and Morphine Analgesia in Prehospital Trauma Care: A Cluster Randomized Clinical Trial in rural Quang Tri Province, Vietnam. *Prehosp Emerg Care* [Internet]. 2014;18(2):257–64. Available from: <https://doi.org/10.3109/10903127.2013.851307> Published
133. Motov S, Rockoff B, Cohen V, Pushkar I, Likourezos A, McKay C, et al. Intravenous Subdissociative-Dose Ketamine Versus Morphine for Analgesia in the Emergency Department: A Randomized Controlled Trial. *Ann Emerg Med* [Internet]. 2015;66(3):222–9. Available from: <http://dx.doi.org/10.1016/j.annemergmed.2015.03.004>
134. Mahshidfar B, Rezai M, Abbasi S, Fattahi M, Mofidi M, Hafezi Moghadam P, et al. Acute Pain Management in Emergency Department, Low Dose Ketamine Versus Morphine, A Randomized Clinical Trial. *Anesthesiol Pain Med* [Internet]. 2018;7(7):1–6. Available from: <https://doi.org/10.5812/aapm.60561>
135. Jahanian F, Hosseininejad SM, Amini Ahidashti H, Bozorgi F, Goli Khatir I, Montazar, Seyyed Hosein, Azarfar V. Efficacy and Safety of Morphine and Low Dose Ketamine for Pain Control of Patients with Long Bone Fractures: A Randomized, Double-Blind, Clinical Trial. *Bull Emerg Trauma* [Internet]. 2018;6(1):31–6. Available from: <https://doi.org/10.29252/beat-060105>
136. Miller JP, Schauer SG, Ganem VJ, Bebarta VS. Low-dose ketamine vs morphine for acute pain in the ED: A randomized controlled trial. *Am J Emerg Med* [Internet]. 2015;33(3):402–8. Available from: <http://dx.doi.org/10.1016/j.ajem.2014.12.058>
137. Jalili M, Noori AM, Sedaghat M, Safaie A. Efficacy of intravenous paracetamol versus intravenous morphine in acute limb trauma. *Trauma Mon* [Internet]. 2016;21(1):4–7. Available from: <https://doi.org/10.5812/traumamon.19649>
138. Craig M, Jeavons R, Probert J, Benger J. Randomised comparison of intravenous paracetamol and intravenous morphine for acute traumatic limb pain in the emergency department. *Emerg Med J* [Internet]. 2012;29(1):37–9. Available from: <https://doi.org/10.1136/emj.2010.104687>

139. Grimson S. Is IV paracetamol as effective an analgesic as IV morphine for patients in non-cardiac pain? A literature review. *J Paramed Pract* [Internet]. 2016;8(1):26–33. Available from: <https://doi.org/10.12968/jpar.2016.8.1.26>
140. Luiz T, Scherer G, Wickenkamp A, Blaschke F, Hoffmann W, Schiffer M, Zimmer J, Schaefer S VC. Prehospital analgesia by paramedics in Rhineland-Palatinate: Feasibility, analgesic effectiveness and safety of intravenous paracetamol. *Anaesthetist* [Internet]. 2015;64(12):927–36. Available from: <https://doi.org/10.1007/s00101-015-0089-4>
141. Barnaby DP, Chertoff AE, Restivo AJ, Campbell CM, Pearlman S, White D, et al. Randomized Controlled Trial of Intravenous Acetaminophen Versus Intravenous Hydromorphone for the Treatment of Acute Pain in the Emergency Department. *Ann Emerg Med* [Internet]. 2019;73(2):133–40. Available from: <https://doi.org/10.1016/j.annemergmed.2018.06.019>
142. Häske D, Böttiger BW, Bouillon B, Fischer M, Gaier G, Gliwitzky B, et al. Analgesia in Patients with Trauma. *Dtsch Arztebl Int* [Internet]. 2017;114(46):785–92. Available from: <https://dx.doi.org/10.3238/arztebl.2017.0785>
143. Sobieraj DM, Martinez BK, Miao B, Cicero MX, Kamin RA, Hernandez A V, et al. Comparative Effectiveness of Analgesics to Reduce Acute Pain in the Prehospital Setting. *Prehosp Emerg Care* [Internet]. 2020;24(2):163–74. Available from: <https://doi.org/10.1080/10903127.2019.1657213>
144. Yousefifard M, Askarian-Amiri S, Madani Neishaboori A, Sadeghi M, Saberian P, Baratloo A. Pre-hospital pain management; a systematic review of proposed guidelines. *Arch Acad Emerg Med* [Internet]. 2019;7(1):e55. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/31875209>
<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC6905420>
145. O'Donnell JJ, Maurice SC, Beattie TF. Emergency analgesia in the paediatric population. Part III non-pharmacological measures of pain relief and anxiolysis. *Emerg Med J* [Internet]. 2002;19(3):195–7. Available from: <https://emj.bmj.com/content/emered/19/3/195.full.pdf>
146. El Geziry, A, Toble, Y, Al Kadhi, F, Pervaiz, M A, Nobani M. Non-Pharmacological Pain Management. In: Shallik N, editor. *Pain Management in Special Circumstances* [Internet]. 2018. p. 1–14. Available from: <http://dx.doi.org/10.5772/intechopen.79689>
147. Pak, SC, Micalos, PS, Maria S, Lord B. Nonpharmacological interventions for pain

- management in paramedicine and the emergency setting: A review of the literature. Evidence-based Complement Altern Med [Internet]. 2015;1–8. Available from: <http://dx.doi.org/10.1155/2015/873039>
148. Kober A, Scheck T, Greher M, Lieba F, Fleischhackl R, Fleischhackl S, et al. Prehospital Analgesia with Acupressure in Victims of Minor Trauma: A Prospective, Randomized, Double-Blinded Trial. Anesth Analg [Internet]. 2002;95(16):723–7. Available from: <https://doi.org/10.1213/01.ANE.0000025704.39845.61>
 149. Barker R, Kober A, Hoerauf K, Latzke D, Adel S, Kain ZN, et al. Out-of-hospital auricular acupressure in elder patients with hip fracture: A randomized double-blinded trial. Acad Emerg Med [Internet]. 2006;13(1):19–23. Available from: <https://doi.org/10.1197/j.aem.2005.07.014>
 150. Lang T, Hager H, Funovits V, Barker R, Steinlechner B, Hoerauf K, et al. Prehospital analgesia with acupressure at the Baihui and Hegu points in patients with radial fractures: a prospective, randomized, double-blind trial. Am J Emerg Med [Internet]. 2007;25(8):887–93. Available from: <https://doi.org/10.1016/j.ajem.2007.01.016>
 151. Mota M, Cunha M, Santos MR, Silva D, Santos E. Non-pharmacological interventions for pain management in adult victims of trauma. JBI Database Syst Rev Implement Reports [Internet]. 2019;17(12):2483–90. Available from: <http://dx.doi.org/10.11124/JBISRIR-2017-004036>
 152. Berben SAA, Meijs THJM, Van Grunsven PM, Schoonhoven L, Van Achterberg T. Facilitators and barriers in pain management for trauma patients in the chain of emergency care. Injury [Internet]. 2012;43(9):1397–402. Available from: <http://dx.doi.org/10.1016/j.injury.2011.01.029>
 153. Murphy A, Barrett M, Cronin J, McCoy S, Larkin P, Brenner M, et al. A qualitative study of the barriers to prehospital management of acute pain in children. Emerg Med J [Internet]. 2014;31(6):493–8. Available from: <http://dx.doi.org/10.1136/emmermed-2012-202166>
 154. Walsh B, Cone D, Meyer E, Larkin G. Paramedic attitudes regarding prehospital analgesia. Prehosp Emerg Care [Internet]. 2012;17(1):78–87. Available from: <https://doi.org/10.3109/10903127.2012.717167>
 155. Mellion SA, Adalgais K. Prehospital Pediatric Pain Management: Continued Barriers to Care. Clin Pediatr Emerg Med [Internet]. 2017;18(4):261–7. Available from: <https://doi.org/10.1016/j.cpem.2017.09.007>

156. Vlahaki D, Vlahaki E, Welsford M. Paramedic perceptions of barriers to pre-hospital oral analgesia administration. *Australas J Paramed* [Internet]. 2015;13(3):1–8. Available from: <https://ajp.paramedics.org/index.php/ajp/article/download/505/563>.
157. Rahman A, Curtis S, Debruyne B, Sookram S, Thomson D, Lutz S, et al. Emergency Medical Services Provider Comfort with Prehospital Analgesia Administration to Children. *Prehosp Disaster Med* [Internet]. 2015;30(1):66–71. Available from: <https://doi.org/10.1017/S1049023X14001277>
158. Williams DM, Rindal KE, Cushman JT SM. Barriers to and enablers for prehospital analgesia for pediatric patients. *Prehosp Emerg Care* [Internet]. 2012;16(4):519–26. Available from: <https://doi.org/10.3109/10903127.2012.695436>
159. Whitley DE, Li T, Jones CMC, Cushman JT, Williams DM, Shah MN. An assessment of newly identified barriers to and enablers for prehospital pediatric pain management. *Pediatr Emerg Care* [Internet]. 2017;33(6):381–7. Available from: <http://http//dx.doi.org/10.1097/pec.0000000000000514>
160. Williams DM, Rindal KE, Cushman JT, Shah MN, Williams DM, Rindal KE, et al. Barriers to and Enablers for Prehospital Analgesia for Pediatric Patients. *Prehosp Emerg Care* [Internet]. 2012;16(4):519–26. Available from: <https://doi.org/10.3109/10903127.2012.695436>
161. Parker M, Rodgers A. Management of pain in pre-hospital settings. *Emerg Nurse* [Internet]. 2015;23(3):16–21. Available from: <https://doi.org/10.7748/en.23.3.16.e1445>
162. Hewes HA, Dai M, Mann NC, Baca T, Taillac P. Prehospital Pain Management: Disparity By Age and Race. *Prehosp Emerg Care* [Internet]. 2018;22(2):189–97. Available from: <https://doi.org/10.1080/10903127.2017.1367444>
163. Ramgopal S, Elmer J, Escajeda J, Martin-Gill C. Differences in Prehospital Patient Assessments for Pediatric Versus Adult Patients. *J Pediatr* [Internet]. 2018;199:200–205.e6. Available from: <https://doi.org/10.1016/j.jpeds.2018.03.069>
164. Platts-Mills, TF, Hunold KM, Weaver, MA, Dickey, RM, Fernandez, AR, Fillingim, RB, Cairns, CB, McLean S. Pain Treatment for Older Adults During Prehospital Emergency Care: Variations by Patient Gender and Pain Severity. *J Pain* [Internet]. 2013;14(9):966–74. Available from: <https://doi.org/10.1016/j.jpain.2013.03.014>
165. Siriwardena AN, Asghar Z, Lord B, Pocock H, Phung V, Foster T, et al. Patient and clinician

- factors associated with prehospital pain treatment and outcomes: cross-sectional study. *Am J Emerg Med* [Internet]. 2019;37(2):266–71. Available from: <https://doi.org/10.1016/j.ajem.2018.05.041>
166. Michael GE, Sporer KA, Youngblood GM. Women are less likely than men to receive prehospital analgesia for isolated extremity injuries. *Am J Emerg Med* [Internet]. 2007;25(8):901–6. Available from: <https://doi.org/10.1016/j.ajem.2007.02.001>
 167. Lord B, Bendall JC, Reinten T. The Influence of Paramedic and Patient Gender on the Administration of Analgesics in the Out-of-Hospital Setting. *Prehosp Emerg Care* [Internet]. 2014;18(2):195–200. Available from: <https://doi.org/10.3109/10903127.2013.856502>
 168. Lord B, Cui J, Mb AK. The impact of patient sex on paramedic pain management in the prehospital setting. *Am J Emerg Med* [Internet]. 2009;27(5):525–9. Available from: <http://dx.doi.org/10.1016/j.ajem.2008.04.003>
 169. Lord B, Keene T, Luck C. The influence of paramedic qualification level on the administration of analgesia in the prehospital setting. *Irish J Paramed* [Internet]. 2019;4(2):1–9. Available from: <http://dx.doi.org/10.32378/ijp.v4i2.187>
 170. Kiavialaitis GE, Müller S, Braun J, Rössler J, Donat R, Stein P, et al. Clinical practice of pre-hospital analgesia: an observational study of 20978 missions in Switzerland. *Am J Emerg Med* [Internet]. 2019; Available from: <https://doi.org/10.1016/j.ajem.2019.10.033>
 171. Castrèn M, Lindström V, Hagman Branzell J, Niemi-Murola L. Prehospital personnel's attitudes to pain management. *Scand J Pain* [Internet]. 2015;8(1):17–22. Available from: <http://dx.doi.org/10.1016/j.sjpain.2015.02.003>
 172. Kennel J, Withers E, Parsons N, Woo H. Racial/Ethnic Disparities in Pain Treatment: Evidence from Oregon Emergency Medical Services Agencies. *Med Care* [Internet]. 2019;57(12):924–9. Available from: <https://doi.org/10.1097/MLR.0000000000001208>
 173. Lord B, Khalsa S. Influence of patient race on administration of analgesia by student paramedics. *BMC Emerg Med* [Internet]. 2019;32:1–7. Available from: <https://doi.org/10.1186/s12873-019-0245-2>
 174. Young MF, Hern HG, Alter HJ, Barger J, Vahidnia F. Racial differences in receiving morphine among prehospital patients with blunt trauma. *J Emerg Med* [Internet]. 2013;45(1):46–52. Available from: <http://dx.doi.org/10.1016/j.jemermed.2012.07.088>

175. Friesgaard KD, Christensen EF, Kirkegaard H, Bendtsen MD, Jensen FB, Nikolajsen L. Prehospital intravenous fentanyl to patients with hip fracture: An observational cohort study of risk factors for analgesic non-treatment. *Scand J Trauma Resusc Emerg Med* [Internet]. 2017;25(1):1–11. Available from: <http://dx.doi.org/10.1186/s13049-017-0348-2>
176. Scott JW, Nyinawankusi JDA, Enumah S, Maine R, Uwitonze E, Hu Y, et al. Improving prehospital trauma care in Rwanda through continuous quality improvement: an interrupted time series analysis. *Injury* [Internet]. 2017;48(7):1376–81. Available from: <http://dx.doi.org/10.1016/j.injury.2017.03.050>
177. French SC, Salama NP, Baqai S, Raslavicus S, Chan SB, Ramaker J. Effects of Educational Interventions on Prehospital Pain Management. *Prehosp Emerg Care* [Internet]. 2006;10(1):71–6. Available from: <https://doi.org/10.1080/10903120500366086>
178. French S, Chan S, Ramaker J. Education on Prehospital Pain Management: A Follow-Up Study. *West J Emerg Med* [Internet]. 2013;14(2):96–102. Available from: <https://doi.org/10.5811/westjem.2012.7.6678>
179. Hennes H, Pirralo R, Simpson D, Rehm J, Kim M. PAMPPER; A Pediatric Pain Management Educational Program for EMS Providers. *Prehosp Emerg Care*. 2007;11(1):94–136.
180. Howard I, Cameron P, Wallis L, Castrén M, Lindström V. Identifying quality indicators for prehospital emergency care services in the low to middle income setting: The South African perspective. *Afr J Emerg Med* [Internet]. 2019;9(4):185–92. Available from: <https://doi.org/10.1016/j.afjem.2019.07.003>
181. Ricard-Hibon A, Chollet C, Saada S, Loridant B, Marty J. A Quality Control Program for Acute Pain Management in Out-of-Hospital Critical Care Medicine. *Ann Emerg Med* [Internet]. 1999;34(6):738–44. Available from: [https://doi.org/10.1016/S0196-0644\(99\)70099-5](https://doi.org/10.1016/S0196-0644(99)70099-5)
182. Decosterd I, Hugli O, Tamchès E, Blanc C, Mouhsine E, Givel JC, et al. Oligoanalgesia in the Emergency Department: Short-Term Beneficial Effects of an Education Program on Acute Pain. *Ann Emerg Med* [Internet]. 2007;50(4):462–71. Available from: <https://doi.org/10.1016/j.annemergmed.2007.01.019>
183. Alotaibi, K, Higgins, I, Chan S. Nurses ' Knowledge and Attitude toward Pediatric Pain Management : A Cross-Sectional Study. *Pain Manag Nurs* [Internet]. 2018;1–12. Available from: <https://doi.org/10.1016/j.pmn.2018.09.001>

184. Al Qadire, M, Al Khalaileh M. Jordanian Nurses Knowledge and Attitude Regarding Pain Management. *Pain Manag Nurs* [Internet]. 2014;15(1):220–8. Available from: <http://dx.doi.org/10.1016/j.pmn.2012.08.006>
185. Al-Quliti KW, Alamri MS. Knowledge, attitudes, and practices of health care providers in Almadinah Almunawwarah, Saudi Arabia. *Neurosciences* [Internet]. 2015;20(2):131–6. Available from: <https://doi.org/10.17712/nsj.2015.2.20140546>
186. Eid, T, Manias, E, Bucknall, T, Almazrooa A. Nurses ' Knowledge and Attitudes Regarding Pain in Saudi Arabia. *Pain Manag Nurs* [Internet]. 2014;15(4):e25–36. Available from: <http://dx.doi.org/10.1016/j.pmn.2014.05.014>
187. Samarkandi O. Knowledge and attitudes of nurses toward pain management. *Saudi J Anesth* [Internet]. 2018;12(2):220–6. Available from: http://doi.org/10.4103/sja.SJA_587_17
188. Ortiz MI, Ponce-monter HA, Rangel-flores E, Castro-gamez B, Romero-quezada LC, Brien JPO, et al. Nurses ' and Nursing Students ' Knowledge and Attitudes regarding Pediatric Pain. *Nurs Res Pract* [Internet]. 2015;Article ID:8 pages. Available from: <http://dx.doi.org/10.1155/2015/210860>
189. Huth, MM, Gregg, TL, Lin L. Education Changes Mexican Nurses ' Knowledge and Attitudes Regarding Pediatric Pain. *Pain Manag Nurs* [Internet]. 2010;11(4):201–8. Available from: <http://dx.doi.org/10.1016/j.pmn.2009.11.001>
190. Zanolin ME, Visentin M, Trentin L, Saiani L, Brugnolli A, Grassi M. A Questionnaire to Evaluate the Knowledge and Attitudes of Health Care Providers on Pain. *J Pain Symptom Manage* [Internet]. 2007;33(6):727–36. Available from: <https://doi.org/10.1016/j.jpainsymman.2006.09.032%0A>
191. Lin P-C, Chiang H-W, Chiang T-T, Chen C-S. Pain management: evaluating the effectiveness of an educational programme for surgical nursing staff. *J Clin Nurs* [Internet]. 2008;17(15):2032–41. Available from: <https://doi.org/10.1111/j.1365-2702.2007.02190.x>
192. Lui LYY, So K, Fong DYT. Knowledge and attitudes regarding pain management among nurses in Hong Kong medical units. *J Clin Nurs* [Internet]. 2008;17(15):2014–21. Available from: <https://doi.org/10.1111/j.1365-2702.2007.02183.x>
193. Ekim A, Ocakçı A. Knowledge and Attitudes Regarding Pain Management of Pediatric

- Nurses in Turkey. *Pain Manag Nurs* [Internet]. 2013;14(4):e262–7. Available from: <http://dx.doi.org/10.1016/j.pmn.2012.02.004>
194. Lunsford L. Knowledge and Attitudes Regarding Pediatric Pain in Mongolian Nurses. *Pain Manag Nurs* [Internet]. 2015;16(3):346–53. Available from: <http://dx.doi.org/10.1016/j.pmn.2014.08.007>
 195. Brant JM, Mohr C, Coombs NC, Finn S, Wilmarth E. Nurses' Knowledge and Attitudes about Pain: Personal and Professional Characteristics and Patient Reported Pain Satisfaction. *Pain Manag Nurs* [Internet]. 2017;18(4):214–23. Available from: <http://dx.doi.org/10.1016/j.pmn.2017.04.003>
 196. Latchman J. Improving Pain Management at the Nursing Education Level: Evaluating Knowledge and Attitudes. *J Adv Pract Oncol* [Internet]. 2014;5(1):10–6. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4093457/pdf/jadp-05-010.pdf>
 197. Mocerri J, Drevdahl D. Nurses' Knowledge and Attitudes Toward Pain in the Emergency Department. *J Emerg Nurs* [Internet]. 2014;40(1):6–12. Available from: <http://dx.doi.org/10.1016/j.jen.2012.04.014>
 198. Lewthwaite BJB, Jabusch KM, Cmsn C, Jabusch, KM, Wheeler, BJ, Schnell-Hoehn, KN, Mills, J, Estrella-Holder, E, Fedorowicz A. Nurses' Knowledge and Attitudes Regarding Pain Management in Hospitalized Adults. *J Contin Educ Nurs* [Internet]. 2011;42(6):251–7. Available from: <http://doi.org/10.3928/00220124-20110103-03>
 199. Peirce D, Corkish, V, Lane, M, Wilson S. Nurses' Knowledge and Attitudes Regarding Pediatric Pain Management in Western Australia. *Pain Manag Nurs* [Internet]. 2018;19(6):707–17. Available from: <https://doi.org/10.1016/j.pmn.2018.03.002>
 200. Smeland, AH, Twycross, A, Lundeberg, S, Rustøen T. Nurses' Knowledge, Attitudes and Clinical Practice in Pediatric Postoperative Pain Management. *Pain Manag Nurs* [Internet]. 2018;19(6):585–98. Available from: <https://doi.org/10.1016/j.pmn.2018.04.006>
 201. Ung A, Salamonson Y, Hu W, Gallego G. Assessing knowledge, perceptions and attitudes to pain management among medical and nursing students: A review of the literature. *Br J Pain* [Internet]. 2016;10(1):8–21. Available from: <https://doi.org/10.1177/2049463715583142>
 202. Alzghoul BI, Azimah N, Abdullah C. Pain Management Practices by Nurses: An Application of the Knowledge, Attitude and Practices (KAP) Model. *Glob J Health Sci* [Internet].

- 2016;8(6):154–60. Available from: <http://dx.doi.org/10.5539/gjhs.v8n6p154>
203. Schober P, Boer C, Schwarte LA. Correlation Coefficients: Appropriate Use and Interpretation. *Anesth Analg* [Internet]. 2018;126(5):1763–8. Available from: <https://doi.org/10.1213/ANE.0000000000002864%0A>
204. Studnek JR, Fernandez AR, Vandeventer S, Davis S, Garvey L. The Association between Patients' Perception of Their Overall Quality of Care and Their Perception of Pain Management in the Prehospital Setting. *Prehosp Emerg Care* [Internet]. 2013;17(3):386–91. Available from: <https://doi.org/10.3109/10903127.2013.764948>
205. McEachin CM, Swor RA, Seguin D, Pascual RG. EMS Analgesia: The Patient's Perspective. *Prehosp Emerg Care* [Internet]. 2004;8(1):103. Available from: <https://doi.org/10.1080/312703003435>
206. World Health Organization. Injuries and Violence. The Facts 2014 [Internet]. World Health Organization. Geneva: WHO Press; 2014. Available from: <https://apps.who.int/iris/handle/10665/149798>
207. Idang GE. African Culture and Values. *Phronimon* [Internet]. 2015;16(2):97–111. Available from: <https://doi.org/10.25159/2413-3086/3820>
208. Bond M. Pain education issues in developing countries and responses to them by the International Association for the Study of Pain. *Pain Res Manag* [Internet]. 2011;16(6):404–6. Available from: <http://dx.doi.org/10.1155/2011/654746>
209. Hess D. Retrospective studies and chart reviews. *Respir Care* [Internet]. 2004;49(10):1171–4. Available from: <http://rc.rcjournal.com/content/49/10/1171/tab-pdf>
210. Gearing RE, Mian IA, Barber J, Ickowicz A. A Methodology for Conducting Retrospective Chart Review Research in Child and Adolescent Psychiatry. *J Can Acad Child Adolesc Psychiatry* [Internet]. 2006;15(3):126–34. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2277255/pdf/ccap15_3p126.pdf
211. Noordzij M, Dekker W, Zoccali C, Jager J. Study Designs in Clinical Research. 2009;9–12. Available from: <https://www.karger.com/Article/Pdf/235610>
212. Boyko E. Observational Research Opportunities and Limitations. *J Diabetes Complicat* [Internet]. 2014;27(6):1–16. Available from: <https://doi.org/10.1016/j.jdiacomp.2013.07.007>

213. Grimes DA, Schulz KF. Epidemiology series An overview of clinical research : the lay of the land. *Lancet* [Internet]. 2002;359:57–61. Available from: [https://doi.org/10.1016/S0140-6736\(02\)07283-5](https://doi.org/10.1016/S0140-6736(02)07283-5)
214. Covidence systematic review software [Software] [Internet]. Melbourne, Australia: Veritas Health Innovation; Available from: www.covidence.org.
215. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. *Int J Soc Res Methodol Theory Pract* [Internet]. 2005;8(1):19–32. Available from: <https://doi.org/10.1080/1364557032000119616>
216. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 edition/supplement [Internet]. Adelaide: Joanna Briggs Institute; 2015. Available from: http://joannabriggs.org/assets/docs/sumari/Reviewers-Manual_Methodology-for-JBI-Scoping-Reviews_2015_v2.pdf
217. Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* [Internet]. 2015;13(3):141–6. Available from: <https://doi.org/10.1097/XEB.0000000000000050>
218. Peterson J, Pearce PF, Ferguson LA, Langford CA. Understanding scoping reviews: Definition, purpose, and process. *J Am Assoc Nurse Pract* [Internet]. 2017;29(1):12–6. Available from: <https://doi.org/10.1002/2327-6924.12380>
219. Cox SG, Martinez R, Glick A, Numanoglu A, Rode H. A review of community management of paediatric burns. *Burns* [Internet]. 2015;41(8):1805–10. Available from: <http://dx.doi.org/10.1016/j.burns.2015.05.024>
220. Mould-Millman NK, Dixon JM, Sefa N, Yancey A, Hollong BG, Hagahmed M, et al. The state of Emergency Medical Services (EMS) systems in Africa. *Prehosp Disaster Med* [Internet]. 2017;32(3):273–83. Available from: <https://doi.org/10.1017/S1049023X17000061>
221. Kobusingye OC, Hyder AA, Bishai D, Joshipura M, Hicks ER, Mock C. Emergency Medical Services. In: *Disease control priorities in developing countries* [Internet]. 2nd Ed. Washington, DC: World Bank and Oxford University Press; 2006. p. 1261–79. Available from: <https://doi.org/10.1590/S0036-36342006000600011>
222. Lourens A, McCaul M, Parker R, Hodkinson P. Acute Pain in the African Prehospital Setting: A Scoping Review. *Pain Res Manag* [Internet]. 2019;1–13. Available from: <https://doi.org/10.1155/2019/2304507>

223. IBM. SPSS Statistics for Windows [Internet]. Armonk, NY: IBM Corp; 2017. Available from: <https://www.ibm.com/za-en/analytics/spss-statistics-software>
224. SurveyMonkey Inc. [Internet]. San Mateo, California, USA; Available from: www.surveymonkey.com
225. Microsoft. Excel. Redmond, Washington, USA: Microsoft Corporation; 2016.
226. World Health Organisation and Stop TB Partnership. Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys [Internet]. Geneva: World Health Organisation; 2008. 1–68 p. Available from: [papers2://publication/uuid/F52C6E32-6B86-4DCC-A96C-4ED36F8491A8](https://publications.who.int/publication/uuid/F52C6E32-6B86-4DCC-A96C-4ED36F8491A8)
227. Gumucio S, Luhmann N, Guillaume F, Zompi S, Ronsse A, Courcaud A, et al. The KAP Survey Model [Internet]. Médecins Du Monde. 2011. Available from: https://www.researchgate.net/publication/51761253_Measuring_Quality_in_Emergency_Medical_Services_A_Review_of_Clinical_Performance_Indicators
228. Ferrell BR, McCaffery M. Knowledge and Attitudes Survey Regarding Pain [Internet]. Vol. 10, Journal of Palliative Medicine. Available from: [https://prc.coh.org/Knowledge_&Attitude_Survey_7-14_\(1\).pdf](https://prc.coh.org/Knowledge_&Attitude_Survey_7-14_(1).pdf)
229. Manworren R. Development and Testing of the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain. *Pediatr Nurs* [Internet]. 2001;27(2):151–8. Available from: <http://link.galegroup.com/apps/doc/A73827307/AONE?u=unict&sid=AONE&xid=7d19588e>
230. Pocock H. Adaptation of a tool measuring attitudes towards pain in paramedics. *Int Emerg Nurs* [Internet]. 2013;21(3):210–5. Available from: <http://dx.doi.org/10.1016/j.ienj.2012.07.003>
231. Republic of South Africa. Protection of Personal Information, Act 4 of 2013. *Gov Gaz* [Internet]. 2013;(912):1–75. Available from: http://www.gov.za/sites/www.gov.za/files/37067_26-11_Act4of2013ProtectionOfPersonallnfor_correct.pdf
232. Hackshaw A. Small studies: strengths and limitations. *Eur Respir J* [Internet]. 2008;32(5):1141–3. Available from: <https://doi.org/10.1183/09031936.00136408>
233. Glaser P. Response Rates. In: Lavrakas P, editor. *Encyclopedia of Survey Research Methods* [Internet]. Thousand Oaks: Sage Publications, Inc.; 2011. p. 759–61. Available from:

- <http://methods.sagepub.com.ezproxy.uct.ac.za/base/download/ReferenceEntry/encyclo-pedia-of-survey-research-methods/n490.xml>
234. Bowling A. Mode of questionnaire administration can have serious effects on data quality. *J Public Health (Bangkok)* [Internet]. 2005;27(3):281–91. Available from: <https://doi.org/10.1093/pubmed/fdi031>
235. Merkle D. Nonresponse Bias. In: Lavrakas P, editor. *Encyclopedia of Survey Research Methods* [Internet]. Thousand Oaks: SAGE Publications, Inc; 2011. p. 532–3. Available from: <http://methods.sagepub.com.ezproxy.uct.ac.za/base/download/ReferenceEntry/encyclo-pedia-of-survey-research-methods/n340.xml>
236. Pazit B-N. Respondent Fatigue. In: Lavraka P, editor. *Encyclopedia of Survey Research Methods* [Internet]. Thousand Oaks: Sage Publications, Inc.; 2011. p. 743. Available from: <http://methods.sagepub.com.ezproxy.uct.ac.za/base/download/ReferenceEntry/encyclo-pedia-of-survey-research-methods/n480.xml>
237. Government of South Africa. Western Cape [Internet]. South Africa’s provinces. 2019 [cited 2020 Sep 12]. Available from: <https://www.gov.za/about-sa/south-africas-provinces#wc>
238. Western Cape Government. Overview of the Western Cape [Internet]. 2019 [cited 2019 Jun 7]. Available from: https://www.westerncape.gov.za/your_gov/70#overview
239. Lord B, Woollard M. The reliability of vital signs in estimating pain severity among adult patients treated by paramedics. *Emerg Med J* [Internet]. 2011;28:147–50. Available from: <https://doi.org/10.1136/emj.2009.079384>
240. Arbour C, Gélinas C. Are vital signs valid indicators for the assessment of pain in postoperative cardiac surgery ICU adults ? *Intensive Crit Care Nurs* [Internet]. 2010;26:83–90. Available from: <https://doi.org/10.1016/j.iccn.2009.11.003>
241. Arnstein P, Broglio K, Wuhrman E, Kean MB. Use of Placebos in Pain Management. *Pain Manag Nurs* [Internet]. 2011;12(4):225–9. Available from: <http://dx.doi.org/10.1016/j.pmn.2010.10.033>
242. Sullivan M. Ethical Principles in Pain Management. *Pain Med* [Internet]. 2000;1(3):274–9. Available from: <https://doi.org/10.1046/j.1526-4637.2000.00031.x>
243. Stevensen C. Non-pharmacological aspects of acute pain management. *Complement Ther*

- Nurs Midwifery [Internet]. 1995;1(3):77–84. Available from: [https://doi.org/10.1016/S1353-6117\(05\)80081-2](https://doi.org/10.1016/S1353-6117(05)80081-2)
244. Perkin R. Emergency Medicine Specialty Reports: Ethical Issues in Pediatric Emergency Medicine - Children's Rights and Health [Internet]. Emergency Medicine Reports. 2002 [cited 2019 May 2]. Available from: <https://www.reliasmedia.com/articles/80098-emergency-medicine-specialty-reports-ethical-issues-in-pediatric-emergency-medicine-children-8217-s-rights-and-health>
245. Peacock S, Patel S. Cultural Influences on Pain. Rev Pain [Internet]. 2008;1(2):6–9. Available from: <http://journals.sagepub.com/doi/10.1177/204946370800100203>
246. Narayan M. Culture's Effects on Pain Assessment and Management. Am J Nurs [Internet]. 2010;110(4):38–47. Available from: <https://doi.org/10.1097/01.NAJ.0000370157.33223.6d>
247. Lovering S. Cultural Attitudes and Beliefs About Pain. J Transcult Nurs [Internet]. 2006;17(4):389–95. Available from: <https://doi.org/10.1177/1043659606291546>
248. Nortjé N, Albertyn R. The cultural language of pain: A South African study. South African Fam Pract [Internet]. 2015;57(1):24–7. Available from: <http://dx.doi.org/10.1080/20786190.2014.977034>
249. Probst M, Kanzaria H, Schoenfeld E, Menchine M, Breslin M, Walsh C, et al. Shared Decision making in the Emergency Department: Guiding Framework for Clinicians. Ann Emerg Med [Internet]. 2017;70(5):688–95. Available from: <https://doi.org/10.1016/j.annemergmed.2017.03.063>
250. Grudzen CR, Anderson JR, Carpenter CR, Hess EP, Clinic M, Care E. Shared Decision Making in the Emergency Department: Development of a Policy-Relevant Patient-Centered Research Agenda. Acad Emerg Med [Internet]. 2017;23(12):1313–9. Available from: <https://doi.org/10.1111/acem.13047>
251. Ellis JA, McCleary L, Blouin R, Dube K, Rowley B, MacNeil M, et al. Implementing best practice pain management in a pediatric hospital. J Spec Pediatr Nurs [Internet]. 2007;12(4):264–77. Available from: <https://doi.org/10.1111/j.1744-6155.2007.00121.x>
252. Howell, D, Butler, L, Vincent, L, Watt-Watson, J, Stearns N. Influencing Nurses' Knowledge, Attitudes, and Practice in Cancer Pain Management. Cancer Nurs [Internet]. 2000;23(1):55–63. Available from: <https://doi.org/10.1097/00002820-200002000-00009>

253. Glowacki D. Pain Management and Improvements in Patient's Outcomes and Satisfaction. *Crit Care Nurse* [Internet]. 2015;35(3):33–43. Available from: <http://dx.doi.org/10.4037/ccn2015440>
254. Lourens A, Hodkinson P, Parker R. Acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: A Knowledge, Attitudes and Practices Survey. *BMC Emerg Med* [Internet]. 2020;20(31):1–12. Available from: <https://doi.org/10.21203/rs.2.12353/v1>
255. Norman R, Matzopoulos R, Groenewald P, Bradshaw D. The high burden of injuries in South Africa. *Bull World Health Organ* [Internet]. 2007;85(9):695–702. Available from: <https://doi.org/10.2471/BLT.06.037184>
256. Mould-Millman NK, Sasser SM, Wallis LA. Prehospital research in sub-Saharan Africa: Establishing research tenets. *Acad Emerg Med* [Internet]. 2013;20(12):1304–9. Available from: <https://doi.org/10.1111/acem.12269>
257. El Sayed MJ. Measuring Quality in Emergency Medical Services: A Review of Clinical Performance Indicators. *Emerg Med Int* [Internet]. 2011;2012:1–7. Available from: <http://dx.doi.org/10.1155/2012/161630>
258. Health Professions Council of South Africa. Advanced Life Support Protocols [Internet]. 2006. 1–123 p. Available from: https://www.hpcsa.co.za/downloads/emergency_care/advanced_life_support.pdf
259. Dworkin R. Alternative Data Sources. In: *Researching Persons with Mental Illness* [Internet]. Thousand Oaks: SAGE Publications, Inc.; 2011. p. 84–104. Available from: <https://methods-sagepub-com.ezproxy.uct.ac.za/base/download/BookChapter/researching-persons-with-mental-illness/n6.xml>
260. Bradshaw D, Groenewald P, Laubscher R, Nannan N, Nojilana B, Norman R, et al. Initial burden of disease estimates for South Africa, 2000. *South African Med J* [Internet]. 2003;93(9):682–8. Available from: <https://doi.org/10.7196/SAMJ.2327>
261. Nicol A, Knowlton LM, Schuurman N, Matzopoulos R, Zargarani E, Cinnamon J, et al. Trauma Surveillance in Cape Town, South Africa. An Analysis of 9236 Consecutive Trauma Center Admissions. *JAMA Surg* [Internet]. 2014;149(6):549–56. Available from: <http://dx.doi.org/10.1001/jamasurg.2013.5267>

262. Zaidi AA, Dixon J, Lupez K, De Vries S, Wallis LA, Ginde A, et al. The burden of trauma at a district hospital in the Western Cape Province of South Africa. *Afr J Emerg Med* [Internet]. 2019;9:S14–20. Available from: <https://doi.org/10.1016/j.afjem.2019.01.007>
263. Marco CA, Plewa MC, Buderer N, Hymel G, Cooper J. Self-reported Pain Scores in the Emergency Department: Lack of Association with Vital Signs. *Acad Emerg Med* [Internet]. 2006;13(9):974–9. Available from: <https://doi.org/10.1197/j.aem.2006.04.015>
264. Bendall JC, Simpson PM, Middleton PM. Prehospital vital signs can predict pain severity: Analysis using ordinal logistic regression. *Eur J Emerg Med* [Internet]. 2011;18(6):334–9. Available from: <https://doi.org/10.1097/MEJ.0b013e328344fdf2>
265. Herr K, Coyne PJ, Mccaffery M, Manworren R, Merkel S. Position Statement Pain Assessment in the Patient Unable to Self-Report: Position Statement with Clinical Practice Recommendations. *Pain Manag Nurs* [Internet]. 2011;12(4):230–50. Available from: <http://dx.doi.org/10.1016/j.pmn.2011.10.002>
266. Keene DD, Rea WE, Aldington D. Acute pain management in trauma. *Trauma* [Internet]. 2011;13(3):167–79. Available from: <https://doi.org/10.1177/1460408611400813>
267. Ahmadi A, Bazargan-hejazi S, Zadi ZH, Euasobhon P, Keturman P, Karbasfrushan A, et al. Pain management in trauma: A review study. *Inj Violence* [Internet]. 2016;8(2):89–98. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4967367/pdf/jivr-08-89.pdf>
268. Browne LR, Studnek JR, Shah MI, Brousseau DC, Guse CE, Lerner EB. Prehospital Opioid Administration in the Emergency Care of Injured Children. *Prehosp Emerg Care* [Internet]. 2016;20(1):59–65. Available from: <https://doi.org/10.3109/10903127.2015.1056897>
269. Swor R, McEachin CM, Seguin D, Grall KH. Prehospital Pain Management in Children Suffering Traumatic Injury. *Prehosp Emerg Care* [Internet]. 2009;9(1):40–3. Available from: <https://doi.org/10.1080/10903120590891930>
270. McEachin CC, McDermott JT, Swor R. Few Emergency Medical Services Patients With Lower-Extremity Fractures Receive Prehospital Analgesia. *Prehosp Emerg Care* [Internet]. 2009;6(4):406–10. Available from: <https://doi.org/10.1080/10903120290938030>
271. Patrick PA, Rosenthal BM, Iezzi CA, Brand DA. Timely Pain Management in the Emergency Department. *J Emerg Med* [Internet]. 2015;48(3):267–73. Available from: <http://dx.doi.org/10.1016/j.jemermed.2014.09.009>

272. Department of Health. Emergency Medical Services Regulations. Gov Gaz [Internet]. 2017;Government(41287). Available from: www.gpwonline.co.za
273. Vassar M, Holzmann M. The retrospective chart review: important methodological considerations. *J Educ Eval Health Prof* [Internet]. 2013;10:12. Available from: <https://doi.org/10.3352/jeehp.2013.10.12>
274. Lourens A, Parker R, Hodkinson P. Prehospital acute traumatic pain assessment and management practices in the Western Cape, South Africa: a retrospective review. *Int J Emerg Med* [Internet]. 2020;13(21):1–10. Available from: <https://doi.org/10.1186/s12245-020-00278-w>
275. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. *Afr J Emerg Med* [Internet]. 2017;7(3):93–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2017.08.001>
276. QSR International Pty Ltd. NVivo qualitative data analysis software [Internet]. 2018. Available from: <https://www.qsrinternational.com/nvivo/support-overview/downloads>
277. Erlingsson C, Brysiewicz P. Orientation among multiple truths: An introduction to qualitative research. *Afr J Emerg Med* [Internet]. 2013;3(2):92–9. Available from: <http://dx.doi.org/10.1016/j.afjem.2012.04.005>
278. Morse JM. Critical Analysis of Strategies for Determining Rigor in Qualitative Inquiry. *Qual Health Res* [Internet]. 2015;25(9):1212–22. Available from: <https://doi.org/10.1177/1049732315588501>
279. Coghill RC. Individual differences in the subjective experience of pain: New insights into mechanisms and models. *Headache* [Internet]. 2010;50(9):1531–5. Available from: <https://doi.org/10.1111/j.1526-4610.2010.01763.x>
280. Schiavenato M, Craig KD. Pain assessment as a social transaction: Beyond the “gold standard.” *Clin J Pain* [Internet]. 2010;26(8):667–76. Available from: <https://doi.org/10.1097/AJP.0b013e3181e72507>
281. Chiaretti A, Pierri F, Valentini P, Russo I, Gargiullo L, Riccardi R. Current practice and recent advances in pediatric pain management. *Eur Rev Med Pharmacol Sci* [Internet]. 2013;17(Suppl 1):112–26. Available from: <https://www.europeanreview.org/wp/wp-content/uploads/112-126.pdf>
282. Morogiello J, Murray NG, Hunt TN, Harris BS, Szekely BJ, George W. The effect of acute

- pain on executive function. *J Clin Transl Res* [Internet]. 2018;4(2):113–21. Available from: <http://dx.doi.org/10.18053/jctres.04.201802.003>
283. Watson A, Power A, Brown C, El-Deredy W, Jones A. Placebo analgesia: Cognitive influences on therapeutic outcome. *Arthritis Res Ther* [Internet]. 2012;14(3):1–7. Available from: <https://doi.org/10.1186/ar3783>
284. Medoff ZM, Colloca L. Placebo analgesia: understanding the mechanisms. *Pain Manag* [Internet]. 2015;5(2):89–96. Available from: <https://doi.org/10.2217/pmt.15.3>
285. Jones L, Othman M, Dowswell T, Alfirevic Z, Gates S, Newburn M, Jordan S, Lavender T NJ. Pain management for women in labour: an overview of systematic reviews. *Cochrane Database Syst Rev* [Internet]. 2012;(3):Art. No.: CD009234. Available from: <https://doi.org/10.1002/14651858.CD009234.pub2>
286. Kaye AD, Baluch AR, Kaye RJ, Niaz RS, Kaye AJ, Liu H, et al. Geriatric pain management, pharmacological nonpharmacological considerations. *Psychol Neurosci* [Internet]. 2014;7(1):15–26. Available from: <https://doi.org/10.3922/j.psns.2014.1.04>
287. Hansen MS, Dahl JB. Limited evidence for intranasal fentanyl in the emergency department and the prehospital setting - a systematic review. *Dan Med J* [Internet]. 2013;60(1):1–6. Available from: https://ugeskriftet.dk/files/scientific_article_files/2018-12/a4563.pdf
288. Patel SB, Kress JP. Sedation and analgesia in the mechanically ventilated patient. *Am J Respir Crit Care Med* [Internet]. 2012;185(5):486–97. Available from: <https://doi.org/10.1164/rccm.201102-0273CI>
289. Birnbaum K, Kozyfman A. Post-intubation analgesia/sedation regimens in ED: Pearls & Pitfalls [Internet]. *emDOCs Practical updates*. 2016 [cited 2020 May 21]. Available from: <http://www.emdocs.net/post-intubation-analgesiasedation-regimens-ed-pearls-pitfalls/>
290. Johnston D, Franklin K, Rigby P, Bergman K, Davidson SB. Sedation and Analgesia in Transportation of Acutely and Critically Ill Patients. *Crit Care Nurs Clin North Am* [Internet]. 2016;28(2):137–54. Available from: <http://dx.doi.org/10.1016/j.cnc.2016.02.004>
291. Harding J, Goode D. Physical stresses related to the transport of the critically ill: optimal nursing management. *Aust Crit Care* [Internet]. 2003;16(3):93–100. Available from: [https://doi.org/10.1016/S1036-7314\(03\)80006-1](https://doi.org/10.1016/S1036-7314(03)80006-1)
292. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review

- of scoping reviews: Advancing the approach and enhancing the consistency. *Res Synth Methods* [Internet]. 2014;5(4):371–85. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4491356/pdf/jrsm0005-0371.pdf>.
293. Colquhoun HL, Levac D, O’Brien KK, Straus S, Tricco AC, Perrier L, et al. Scoping reviews: Time for clarity in definition, methods, and reporting. *J Clin Epidemiol* [Internet]. 2014;67(12):1291–4. Available from: <http://dx.doi.org/10.1016/j.jclinepi.2014.03.013>
294. Tricco AC, Lillie E, Zarin W, O’Brien K, Colquhoun H, Kastner M, et al. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* [Internet]. 2016;16(1):1–10. Available from: <http://dx.doi.org/10.1186/s12874-016-0116-4>

APPENDICES

Appendix 1: University of Cape Town HREC Original Approval (220/2017)



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone (021) 406 6492
Email: gumavah.ari@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

01 June 2017

HREC REF: 220/2017

Dr P Hodgkinson
Division of Emergency Medicine
F-51
OMB

Dear Dr Hodgkinson

PROJECT TITLE: DEVELOPING AN IN-DEPTH UNDERSTANDING OF ACUTE PAIN ASSESSMENT AND MANAGEMENT IN THE WESTERN CAPE, SOUTH AFRICAN PRE-HOSPITAL SETTING, THE FACTORS INFLUENCING PRACTICE AND WHAT IMPROVEMENT MEASURE COULD ADVANCE PRE-HOSPITAL ACUTE PAIN MANAGEMENT (PHD CANDIDATE - MS A LOURENS)

Thank you for your response letter dated 30 May 2017, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has formally approved the above-mentioned study.

Approval is granted for one year until the 30 June 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student, A Lourens will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate Institutional approval before the research may occur.

Yours sincerely

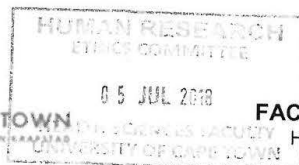
Signature Removed

PROFESSOR M. BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

HREC 220/2017



UNIVERSITY OF CAPE TOWN
UNIVERSITEIT VAN KAPSTAD



FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee



FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
<input checked="" type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30/07/2019
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	6/7/18

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	5 July 2018		
HREC REF Number	220/2017	Current Ethics Approval was granted until	30 June 2018
Protocol title	Developing an in-depth understanding of acute pain assessment and management in the Western Cape, South African pre-hospital setting, the factors influencing practice and what improvement measure could advance pre-hospital acute pain management.		
Protocol number (if applicable)	220/2017		
Are there any sub-studies linked to this study?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Dr Peter Hodkinson		
Department / Office Internal Mail Address	c/o Ms Vathiswa Mzamo, Division of Emergency Medicine F51 Old Main Building		



FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
<input checked="" type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30.07.2020
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	31/7/2019

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	30 July 2019		
HREC REF Number	220/2017	Current Ethics Approval was granted until	30 July 2019
Protocol title	Developing an in-depth understanding of acute pain assessment and management in the Western Cape, South African pre-hospital setting, the factors influencing practice and what improvement measure could advance pre-hospital acute pain management.		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	AProf Peter Hodkinson		
Department / Office Internal Mail Address	Division of Emergency Medicine (UCT) / peter.hodkinson@uct.ac.za		

1.1 Does this protocol receive US Federal funding?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
--	------------------------------	--

Appendix 2: Western Cape Government (WC_2017RP54_569)



STRATEGY & HEALTH SUPPORT

Health.Research@westerncape.gov.za
tel: +27 21 483 0866 fax: +27 21 483 9895
5th Floor, Norton Rose House,, 8 Riebeeck Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: WC_2017RP54_569
ENQUIRIES: Dr Sabela Petros

University of Cape Town

Anzio Road

Observatory

Cape Town

7925

For attention: Dr Peter Hodgkinson, Dr Romy Parker, Dr Andrit Lourens

Re: Pre-hospital acute traumatic pain assessment and management practices in the Western Cape, South Africa: Retrospective review of Electronic Patient Care Report Forms.

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.

Please contact following people to assist you with any further enquiries in accessing the following sites:

Emergency Medical Services

Dr Shaheem de Vries

021 508 4523

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (**annexure 9**) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).

3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

Signature Removed

DR A HAWKRIDGE

DIRECTOR: HEALTH IMPACT ASSESSMENT

DATE:

10/2017.

Attention: Ms Andrit Lourens

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH – DEVELOPING AN IN-DEPTH UNDERSTANDING OF ACUTE PAIN ASSESSMENT AND MANAGEMENT IN THE WESTERN CAPE, SOUTH AFRICAN PRE-HOSPITAL SETTING

Dear Andrit

Your request on the above matter refers.

Thank you for the request to conduct research within the Western Cape Government Emergency Medical Services. Your proposal has been evaluated by the Emergency Medicine Division Research Committee and has been recommended for approval by this office.

I am therefore pleased to inform you that such approval is hereby granted.

I wish you well in your endeavor and trust that you will keep this office and its department informed of your findings when these become available. I am so looking forward to the insights that your research will afford us (and to call you Dr Lourens ☺ - finally).

Yours sincerely

Signature Removed

Dr Shaheem de Vries
Head: Emergency Medical Services
Western Cape Government Health

Date: 11th September 2017



**RESEARCH OPERATIONS COMMITTEE FINAL APPROVAL OF
RESEARCH**

Approval number: UNIV-2018-0039

Ms Andri Lourens

E mail: andritl@gmail.com

Dear Ms Lourens

RE: DEVELOPING AN IN-DEPTH UNDERSTANDING OF ACUTE PAIN ASSESSMENT AND MANAGEMENT IN THE WESTERN CAPE, SOUTH AFRICAN PRE-HOSPITAL SETTING, THE FACTORS INFLUENCING PRACTICE AND WHAT IMPROVEMENT MEASURE COULD ADVANCE PRE-HOSPITAL ACUTE PAIN MANAGEMENT

The above-mentioned research was reviewed by the Research Operations Committee's delegated members and it is with pleasure that we inform you that your application to conduct this research at Private Emergency Services, has been approved, subject to the following:

- i) Research may now commence with this FINAL APPROVAL from the Committee.
- ii) All information regarding the Company will be treated as legally privileged and confidential.
- iii) The Company's name will not be mentioned without written consent from the Committee.
- iv) All legal requirements with regards to participants' rights and confidentiality will be complied with.
- v) All data extracted may only be used in an anonymised, aggregated format and for the purposes of this specific study as specified in the proposal. The data may under no circumstances be used for any other purpose whatsoever.
- vi) The Company must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from the Committee as well as a FINAL REPORT with reference to intention to publish and probable journals for publication, on completion of the study.
- vii) A copy of the research report will be provided to the Committee once it is finally approved by the relevant primary party or tertiary institution, or once complete or if discontinued for any reason whatsoever prior to the expected completion date.

Signature Removed

- viii) The Company has the right to implement any recommendations from the research.
- ix) The Company reserves the right to withdraw the approval for research at any time during the process, should the research prove to be detrimental to the subjects/ Company or should the researcher not comply with the conditions of approval.
- x) APPROVAL IS VALID FOR A PERIOD OF 36 MONTHS FROM DATE OF THIS LETTER OR COMPLETION OR DISCONTINUATION OF THE STUDY, WHICHEVER IS THE FIRST.

We wish you success in your research.

Yours faithfully

Signature Removed

19/9/18

Prof Dion Di Alessis

Full member: Research Operations Committee & Medical Practitioner evaluating research applications as per Management and Governance Policy

Shannon Neil

Chairperson: Research Operations Committee

Date: 26/9/2018

Signature Removed

This letter has been anonymised to ensure confidentiality in the research report. The original letter is available with author of research



Mediciniis Corporate Office
25 Du Toit Street
Stellenbosch 7600

PO Box 456
Stellenbosch 7559

www.er24.co.za

12 September 2018

Ms A Lourens
University of Cape Town

Dear Ms Lourens

RE: PROJECT 08/2018
PROJECT TITLE: Developing an In-depth understanding of acute pain assessment and management in the Western Cape, South African pre-hospital setting, the factors influencing practice and what improvement measure could advance pre-hospital acute pain management.

The above research protocol has been reviewed by the ER24 Research Committee and I am pleased to inform you that your request has been approved.

Should your methodology change or any concerns arise during the data collection period, it is your responsibility to inform the ER24 Research Committee in due course. You are also required to forward the completed project to ER24.

I look forward to viewing the results of your study. I am positive that the science that you will generate will be of benefit to the profession.

Regards,

Signature Removed

Craig Wylie
Research Committee
ER24

realhelprealfast

ER24 EMS (Pty) Ltd/via ER24 Registration Number 2000/06657/07
VAT Registration No. 4730193887

Appendix 5: PubMed Search Strategy

Appendix 1: PubMed Search Strategy

#1 Developing Countries[Mesh:noexp] OR Africa[Mesh:noexp] OR Africa, Northern[Mesh:noexp] OR Africa South of the Sahara[Mesh:noexp] OR Africa, Central[Mesh:noexp] OR Africa, Eastern[Mesh:noexp] OR Africa, Southern[Mesh:noexp] OR Africa, Western[Mesh:noexp] OR Angola[Mesh:noexp] OR Benin[Mesh:noexp] OR Botswana[Mesh:noexp] OR Burkina Faso[Mesh:noexp] OR Burundi[Mesh:noexp] OR Cameroon[Mesh:noexp] OR Cape Verde[Mesh:noexp] OR Central African Republic[Mesh:noexp] OR Chad[Mesh:noexp] OR Comoros[Mesh:noexp] OR Congo[Mesh:noexp] OR Cote d'Ivoire[Mesh:noexp] OR Djibouti[Mesh:noexp] OR "Democratic Republic of the Congo"[Mesh:noexp] OR Eritrea[Mesh:noexp] OR Ethiopia[Mesh:noexp] OR Gabon[Mesh:noexp] OR Gambia[Mesh:noexp] OR Ghana[Mesh:noexp] OR Guinea[Mesh:noexp] OR Guinea-Bissau[Mesh:noexp] OR Kenya[Mesh:noexp] OR Lesotho[Mesh:noexp] OR Liberia[Mesh:noexp] OR Libya[Mesh:noexp] OR Madagascar[Mesh:noexp] OR Malawi[Mesh:noexp] OR Mali[Mesh:noexp] OR Mauritania[Mesh:noexp] OR Mauritius[Mesh:noexp] OR Mozambique[Mesh:noexp] OR Namibia[Mesh:noexp] OR Niger[Mesh:noexp] OR Nigeria[Mesh:noexp] OR Rwanda[Mesh:noexp] OR Senegal[Mesh:noexp] OR Seychelles[Mesh:noexp] OR Sierra Leone[Mesh:noexp] OR Somalia[Mesh:noexp] OR South Africa[Mesh:noexp] OR Sudan[Mesh:noexp] OR Swaziland[Mesh:noexp] OR Tanzania[Mesh:noexp] OR Togo[Mesh:noexp] OR Uganda[Mesh:noexp] OR Zambia[Mesh:noexp] OR Zimbabwe[Mesh:noexp]

#2 Madagascar[tw] OR Malagasy Republic[tw] OR Malawi[tw] OR Nyasaland[tw] OR Mali[tw] OR Mauritania[tw] OR Mauritius[tw] OR Agalega Islands[tw] OR Mozambique[tw] OR Namibia[tw] OR Niger[tw] OR Nigeria[tw] OR Rwanda[tw] OR Ruanda[tw] OR Sao Tome[tw] OR Senegal[tw] OR Seychelles[tw] OR Sierra Leone[tw] OR Somalia[tw] OR Sudan[tw] OR Swaziland[tw] OR Tanzania[tw] OR Togo[tw] OR Togolese Republic[tw] OR Uganda[tw] OR Zambia[tw] OR Zimbabwe[tw] OR Rhodesia[tw]

#3 Africa[tw] OR Angola[tw] OR Benin[tw] OR Botswana[tw] OR Burkina Faso[tw] OR Burkina Fasso[tw] OR Upper Volta[tw] OR Burundi[tw] OR Urundi[tw] OR Cameroon[tw] OR Cameroons[tw] OR Cameron[tw] OR Camerons[tw] OR Cape Verde[tw] OR Central African Republic[tw] OR Chad[tw] OR Comoros[tw] OR Comoro Islands[tw] OR Comores[tw] OR Mayotte[tw] OR Congo[tw] OR Zaire[tw] OR Cote d'Ivoire[tw] OR Ivory Coast[tw] OR Djibouti[tw] OR French Somaliland[tw] OR Ethiopia[tw] OR Gabon[tw] OR Gabonese Republic[tw] OR Gambia[tw] OR Ghana[tw] OR Gold Coast[tw] OR Guinea[tw] OR Guiana[tw] OR Kenya[tw] OR Lesotho[tw] OR Basutoland[tw] OR Liberia[tw] OR Libya[tw]

#4 "developing country"[tw] OR "developing countries"[tw] OR "developing nation"[tw] OR "developing nations"[tw] OR "developing population"[tw] OR "developing populations"[tw] OR "developing world"[tw] OR "less developed country"[tw] OR "less developed countries"[tw] OR "less developed nation"[tw] OR "less developed nations"[tw] OR "less developed population"[tw] OR "less developed populations"[tw] OR "less developed world"[tw] OR "lesser developed country"[tw] OR "lesser developed countries"[tw] OR "lesser developed nation"[tw] OR "lesser developed nations"[tw] OR "lesser developed population"[tw] OR "lesser developed populations"[tw] OR "lesser developed world"[tw] OR "under developed country"[tw] OR "under developed countries"[tw] OR "under developed nation"[tw] OR "under developed nations"[tw] OR "under developed population"[tw] OR "under developed populations"[tw] OR "under developed world"[tw] OR "underdeveloped country"[tw] OR "underdeveloped countries"[tw] OR "underdeveloped nation"[tw] OR "underdeveloped nations"[tw] OR "underdeveloped population"[tw] OR "underdeveloped populations"[tw] OR "underdeveloped world"[tw] OR "middle income country"[tw] OR "middle income

countries"[tw] OR "middle income nation"[tw] OR "middle income nations"[tw] OR "middle income population"[tw] OR "middle income populations"[tw] OR "low income country"[tw] OR "low income countries"[tw] OR "low income nation"[tw] OR "low income nations"[tw] OR "low income population"[tw] OR "low income populations"[tw] OR "lower income country"[tw] OR "lower income countries"[tw] OR "lower income nation"[tw] OR "lower income nations"[tw] OR "lower income population"[tw] OR "lower income populations"[tw] OR "underserved country"[tw] OR "underserved countries"[tw] OR "underserved nation"[tw] OR "underserved nations"[tw] OR "underserved population"[tw] OR "underserved populations"[tw] OR "underserved world"[tw] OR "under served country"[tw] OR "under served countries"[tw] OR "under served nation"[tw] OR "under served nations"[tw] OR "under served population"[tw] OR "under served populations"[tw] OR "under served world"[tw] OR "deprived country"[tw] OR "deprived countries"[tw] OR "deprived nation"[tw] OR "deprived nations"[tw] OR "deprived population"[tw] OR "deprived populations"[tw] OR "deprived world"[tw] OR "poor country"[tw] OR "poor countries"[tw] OR "poor nation"[tw] OR "poor nations"[tw] OR "poor population"[tw] OR "poor populations"[tw] OR "poor world"[tw] OR "poorer country"[tw] OR "poorer countries"[tw] OR "poorer nation"[tw] OR "poorer nations"[tw] OR "poorer population"[tw] OR "poorer populations"[tw] OR "poorer world"[tw] OR "developing economy"[tw] OR "developing economies"[tw] OR "less developed economy"[tw] OR "less developed economies"[tw] OR "lesser developed economy"[tw] OR "lesser developed economies"[tw] OR "under developed economy"[tw] OR "under developed economies"[tw] OR "underdeveloped economy"[tw] OR "underdeveloped economies"[tw] OR "middle income economy"[tw] OR "middle income economies"[tw] OR "low income economy"[tw] OR "low income economies"[tw] OR "lower income economy"[tw] OR "lower income economies"[tw] OR "low gdp"[tw] OR "low gnp"[tw] OR "low gross domestic"[tw] OR "low gross national"[tw] OR "lower gdp"[tw] OR "lower gnp"[tw] OR "lower gross domestic"[tw] OR "lower gross national"[tw] OR lmic[tw] OR "lmics"[tw] OR "third world"[tw] OR "lami country"[tw] OR "lami countries"[tw] OR "transitional country"[tw] OR "transitional countries"[tw]

#5 #1 OR #2 OR #3 OR #4

#6 "Emergency Medical Services"[Mesh] OR "Emergency Medicine"[Mesh] OR "Emergency Treatment"[Mesh] OR emergenc* OR prehospital* OR pre-hospital* OR out-of-hospital OR "out of hospital" OR "before hospital" OR "prior to hospital" OR ambulance* OR "Ambulances"[Mesh] OR paramedic* OR "Emergency Medical Technicians"[Mesh] OR "Emergency Responders"[Majr]

#7 "Acute Pain"[Mesh] OR "Pain"[Mesh] OR pain OR "Analgesia"[Mesh] OR analgesia OR "Pain Management"[Mesh]

#8 #5 AND #6 AND #7

#9 #8 AND Filters: Publication date from 2000/01/01

Appendix 6: Eligibility form

Acute Pain in the African Pre-hospital Setting: A Scoping Review

Scoping Review Eligibility Form:

Scoping Review Aim:
The overall aim of this review is to identify and map the body of evidence related to acute pain assessment and management in the pre-hospital setting, in Africa and to identify gaps in current evidence.

Reviewer Details:

Reviewer:	Date Assessed:
Choose an item.	

Study Details:

Authors:	Year Published:
Study Title:	Reference Number:

1) Type of Research:

Question:		
Do the study design include a design as stipulate (inclusion criteria) in the list below?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Unclear	<input type="checkbox"/>
<ul style="list-style-type: none"> Review research designs: Systematic reviews and meta-analysis Experimental designs: Randomized Controlled Trials (RCT) or Non-randomized controlled trails or quasi-experimental Observational studies: Cohort studies, Case-control studies, Cross-sectional studies or Surveys Qualitative design Evidence-based guidelines 		
Note: The following study designs will not be included: Literature reviews, Case Reports and Case Series		

2) Type of Participants:

Question:		
Do the study population include adults and paediatrics (> 28 days or 1 month) participants?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Unclear	<input type="checkbox"/>
OR		
Pain assessment and management by emergency care providers, physicians and/or nurses in the pre-hospital setting.		
Note: Neonates (0-28 days) will not be included.		

3) Timeframe:

Question:		
Was the study conducted on or after the 1st of January 2000?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
Note: Studies conducted before the 1 st of January 2000 will not be included.	Unclear	<input type="checkbox"/>

4) Study Setting:

Question:		
Is the study conducted in the pre-hospital setting in Africa [studies conducted in the aero-medical (helicopter and fixed-wing) setting and ground ambulance services will be included]?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Unclear	<input type="checkbox"/>
Note: Studies conducted in-hospital and studies related to inter-facility transfers of critically ill and injured patients will not be included.		

5) Eligible for Inclusion:

Question:		
Do the study meet all the inclusion criteria?	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>
	Unclear	<input type="checkbox"/>

6) Comments (stipulate any comments, concerns or uncertainty regarding eligibility):

Appendix 7: Data Extraction from

Acute Pain in the African Pre-hospital Setting: A Scoping Review

Scoping Review Data Extraction Form

Reviewer Details:

Reviewer:	Date Assessed:
Choose an item.	

Study Details:

Authors:	Year Published:
Study Title:	Reference Number:

1) Research aims:

Click or tap here to enter text.

2) Study Location and Study Setting (if information available):

- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.

3) Year of publication and study period:

- Click or tap here to enter text.
- Click or tap here to enter text.

4) Publication type (journal article, dissertation, conference processing, etc.)

- Click or tap here to enter text.
- Click or tap here to enter text.
- Click or tap here to enter text.

Methodology:

5) Type of Study Design:

- Choose an item.
- Click or tap here to enter text.

6) Data collection method (interviews, questionnaires, patient care report reviews, etc.)

- Click or tap here to enter text.
- Click or tap here to enter text.

7) Sampling Strategy and Sample size:

- Click or tap here to enter text.
- Click or tap here to enter text.

8) Data Collection:

Click or tap here to enter text.

9) Data analysis and measures:

Click or tap here to enter text.

Participants:

10) Participant or Practitioner level of qualification/s:

- Click or tap here to enter text.

11) Type of participant:

- **Medical or Trauma:** Choose an item.
- Click or tap here to enter text.
- **Patient type:** Choose an item.
- Click or tap here to enter text.

If applicable:

12) Type of pain assessment tool or tools

1. Click or tap here to enter text.
Click or tap here to enter text.
2. Click or tap here to enter text.
Click or tap here to enter text.
3. Click or tap here to enter text.
Click or tap here to enter text.

13) Medication administered to patients:

- Choose an item.

14) Medication information (provide if Question 10 was answered Yes’):

- **Class of medication/s:** Click or tap here to enter text.
- **Medication/s administered:** Click or tap here to enter text.
- **Dose administered:** Click or tap here to enter text.
- **Repeated dosages:** Click or tap here to enter text.
- **Rescue analgesia:** Click or tap here to enter text.
- Click or tap here to enter text.

15) Non-Pharmacological Management of Pain:

- Click or tap here to enter text.

16) Route of administration for each medication (inhaled, oral, intranasal, intramuscular, intravenous)

- Click or tap here to enter text.

Acute Pain in the African Pre-hospital Setting: A Scoping Review

Key findings related to the Scoping Reviews aims and objectives:

Aim:	The overall aim of this review is to identify and map the body of evidence related to acute pain assessment and management in the pre-hospital setting, in Africa and to identify gaps in current evidence.
Objectives:	<ul style="list-style-type: none"> • To identify and map the range and nature of evidence in relation to acute pain assessment and management in the pre-hospital setting, in Africa. • To identify research gaps in the existing literature related to acute pain assessment in the pre-hospital setting, in Africa. • To summarize research findings related to acute pain assessment and management in the pre-hospital setting, in Africa. • To inform future research related to acute pain assessment in the pre-hospital setting, in Africa.

17) Results (Quantitative data):

No:	Primary Outcome:	Details:
1	Click or tap here to enter text.	Click or tap here to enter text.
2	Click or tap here to enter text.	Click or tap here to enter text.
3	Click or tap here to enter text.	Click or tap here to enter text.
4	Click or tap here to enter text.	Click or tap here to enter text.
5	Click or tap here to enter text.	Click or tap here to enter text.
6	Click or tap here to enter text.	Click or tap here to enter text.
7	Click or tap here to enter text.	Click or tap here to enter text.
8	Click or tap here to enter text.	Click or tap here to enter text.
9	Click or tap here to enter text.	Click or tap here to enter text.
10	Click or tap here to enter text.	Click or tap here to enter text.
11	Click or tap here to enter text.	Click or tap here to enter text.
12	Click or tap here to enter text.	Click or tap here to enter text.

18) Results (Qualitative data):

No:	Themes:	Description:
1	Click or tap here to enter text.	Click or tap here to enter text.
2	Click or tap here to enter text.	Click or tap here to enter text.
3	Click or tap here to enter text.	Click or tap here to enter text.
4	Click or tap here to enter text.	Click or tap here to enter text.
5	Click or tap here to enter text.	Click or tap here to enter text.
6	Click or tap here to enter text.	Click or tap here to enter text.
7	Click or tap here to enter text.	Click or tap here to enter text.
8	Click or tap here to enter text.	Click or tap here to enter text.

19) Other information:

Click or tap here to enter text.

Click or tap here to enter text.

Click or tap here to enter text.

Click or tap here to enter text.

Click or tap here to enter text.

20) Comments (stipulate any comments, concerns or uncertainty regarding eligibility):

Click or tap here to enter text.

Appendix 8: Consent and KAP Questionnaire

Welcome to the KAP Survey

Dear Emergency Care Provider,

You are invited to part take in a Knowledge, Attitude and Practice (KAP) survey on acute pain assessment and management in the South African pre-hospital setting. This KAP survey forms part of a larger study in fulfilment of a Doctoral of Philosophy (PhD) in Emergency Medicine at the University of Cape Town. The main aim of the overall research project is to develop an in-depth understanding of current acute pain assessment and management practices by Emergency Care Providers in the pre-hospital setting, in the Western Cape, South Africa and make recommendations for improvement initiatives.

The project specifically focuses on acute pain assessment and management in the pre-hospital setting which is an area in dire need of emphasis. The researcher believes that this KAP survey and the project as a whole will assist in developing a better understanding of the problem at hand, add to the knowledge base and research evidence and must importantly assist in improving quality care in the pre-hospital setting. The questionnaire consists of 46 questions (demographically information, true/false, likert scales, MCQ, etc.) and we are quite aware of the demand made on people to complete a survey of this nature. However, given the importance of the study for our profession and the quality of care we provide as well as the fact that it should take you no more than 20 minutes to complete, we sincerely hope that you will take the time to complete the survey. The outcomes of the research will be shared via Emergency Medical Services in the Western Cape.

Participation in this online survey is voluntary and there are no known or anticipated risks. This study has received formal ethical clearance from the Human Research Ethics Committee of the University of Cape Town. You may decline to participate or exit the survey at any time. Participants can withdraw until they submit the survey, at which point it will be anonymized. Should you wish to ask any further questions or require clarity on any aspect of the survey before making the decision whether to participate or not, please send an e-mail to andritl@gmail.com.

Sincerely

Andrit Lourens

1. Electronic Consent: Clicking on the "agree" button below indicates that

- You have read the above information
- You voluntarily agree to participate

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

- Agree
- Disagree

Section 1: Demographic Information

The section on demographic information requires no personal identification information. Kindly complete.

2. Indicate your gender

- Male
- Female

3. Indicate your age in years (numbers only) _____

4. Indicate your highest clinical qualification related to the profession of Emergency Medical Care (EMC)

- Basic Ambulance Assistant (BAA)
- Ambulance Emergency Assistant (ANA)
- Emergency Care Assistant (ECA)
- Emergency Care Technician (ECT)
- Critical Care Assistant (CCA) Paramedic
- National Diploma in Emergency Medical Care (EMC)
- B Tech in Emergency Medical Care (EMC) or Bachelor of Emergency Medical Care (BEMC)

5. Indicate the region in which you are currently practicing

- West Coast District
- Cape Winelands District
- Overberg District
- Eden District
- Central Karoo District
- Cape Town Metropolitan
- Other (please specify) _____

6. Total years of experience in Emergency Medical Care or Emergency Medical Services (EMS) (years working in the pre-hospital setting, any qualification) _____

7. Current employment within Emergency Medical Services (EMS), indicate most appropriate option for main function/responsibility

- Operational Emergency Care Provider
- Supervisor / Manager
- Education (Further Education and Training)
- Education (Higher Education)
- Rescue
- Continuous Quality Improvement / Patient Safety
- Communications
- Student (Emergency Medical Care)
- NOT currently working within EMS (please specify) _____

8. Indicate sector of current employment

- Public/Government
- Sector Private Sector
- Other (please specify) _____

9. Did you receive continuous medical education (CME) on the topic, acute pain assessment and/or management in the last two (2) years?

- Yes
- No

Section 2: True/False

Evaluate the 18 statements below and select TRUE, FALSE or DON'T KNOW.

10. Vital signs are always reliable (good) indicators of the intensity or severity of a patient's pain.

- True
- False
- Don't know

11. Due to an underdeveloped nervous system, children younger than 2 years, have decreased sensitivity to pain and limited memory of painful experiences.

- True
- False
- Don't know

12. Adult and paediatric patients who can be distracted from their pain are usually not experiencing severe pain.

- True
- False
- Don't know

13. Children younger than 11 years cannot reliably report pain therefore clinicians should rely solely on the parent's assessment of the child's pain intensity.

- True
- False
- Don't know

14. Giving patient's sterile water by injection (placebo) is a useful test to determine if their pain is real.

- True
- False
- Don't know

15. If the source of a patient's pain is unknown, opioids / narcotics (like morphine) should not be used during the pain evaluation period, as this could mask the ability to correctly diagnose the cause of pain.

- True
- False
- Don't know

16. Pain can be defined as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."

- True
- False
- Don't know

17. Similar or comparable stimuli, in different people, will produce the same intensity or severity of pain.

- True
- False
- Don't know

18. Young infants, less than 6 months of age, cannot tolerate opioids / narcotics (like morphine) for pain relief.

- True
- False
- Don't know

19. Non-pharmacological methods, such as splinting, are effective methods to * assist pain relief.

- True
- False
- Don't know

20. In the event that a patient's pain is not managed, their overall clinical condition may deteriorate (progressively worsen).

- True
- False
- Don't know

21. Entonox® (Nitrous Oxide) is a potent analgesic with a very rapid onset of action and is quickly eliminated from the body.

- True
- False
- Don't know

22. Unconscious patients do not experience pain.

- Yes
- No
- Don't know

23. The experience and expression of pain is influenced by a patient's culture and/or spiritual beliefs.

- Yes
- No
- Don't know

24. If you do not consider the condition to be painful the patient should not receive analgesia (pain relief).

- True
- False
- Don't know

25. Patient behaviour is a more reliable (good) indicator of pain than a patient's self-report.

- True
- False
- Don't know

26. In the pre-hospital environment, patients should not receive analgesia for chronic medical conditions.

- True
- False
- Don't know

27. Self-reports of pain according to the numeric rating scale (pain assessment tool) are the quickest way to assess pain.

- True
- False
- Don't know

Section 3: Likert-Scale

Please review the following 8 statements and select based on your opinion whether you agree, neither agree or disagree or disagree with the statements on the provided scale.

28. It is better to be stoic (endure pain or hardship without showing their feelings or complaining) about pain than totally open about it.

- Agree
- Neither agree nor disagree
- Disagree

29. Using a pain assessment tool is a necessary instrument in pain assessment and pain management decision making.

- Agree
- Neither agree nor disagree
- Disagree

30. I believe that my prior experience dealing with patients in pain allows me to score patients' pain more accurately than the patient themselves.

- Agree
- Neither agree nor disagree
- Disagree

31. The main reason for administering analgesia (pain relief) is to enable the patient to get to the ambulance.

- Agree
- Neither agree nor disagree
- Disagree

32. Parents or guardians of children should not be present during * painful procedures.

- Agree
- Neither agree nor disagree
- Disagree

33. Patients should not be included in the pain management decision-making process.

- Agree
- Neither agree nor disagree
- Disagree

34. Expectations of my peers or the company/EMS service I work for, strongly influence my pain management practice.

- Agree
- Neither agree nor disagree
- Disagree

35. The current HPCSA protocols provide sufficient and appropriate options for pain management in the pre-hospital setting in South Africa.

- Agree
- Neither agree nor disagree
- Disagree

Section 4: Multiple Choice Questions

Review the 5 multiple choice questions below and select the most appropriate answer to the questions.

36. The correct wording when using the Numeric Rating Scale is:

- Can you give your pain a score between 0 and 10 with zero (0) being no pain and 10 the worst imaginable pain?
- Can you give your pain a score between 0 and 10 with 10 being no pain and zero (0) the worst imaginable pain?
- Can you give your pain a score between 1 and 10 with zero (0) being no pain and 10 the worst imaginable pain?

Can you give your pain a score between 1 and 10 with 10 being no pain and zero (0) the worst imaginable pain?

37. The most accurate judge of the intensity of the patient's pain is:

- The treating doctor
- The emergency care provider
- The patient
- The patient's spouse, parent or family

38. Pain is believed to play a major part in the activation of the 'stress' response to injury, leading to all of the below, EXCEPT:

- Increase in sympathetic nervous system activity
- Impair immune function
- Decreased coagulability
- Catabolic hormone release

39. Effective management of acute pain is a fundamental component of:

- Clinical documentation
- Continuous care
- Quality patient care
- Emergency care

40. With regards to pain, all of the following descriptors are applicable EXCEPT:

- Always subjective
- Often undertreated
- Always associated with actual tissue damage
- A primary reason patient seeks medical advice

Section 5: Barriers and Enablers

41. Barriers to Pain Assessment and Management: In your opinion which of the below are possible barriers to (obstacle to or preventing) effective pain assessment and management in your previous and/or current work environments (select all that apply and please add any additional not listed in the box below).

- Workload and lack of time
- Service-related standard operating procedures or policy
- Culture in the emergency service or work environment
- Lack of available clinical practice guidelines to guide decision making

- Unfamiliarity with protocols, medications or indications for pain management
- Lack of resources (medications, disposables, nasal atomizers, etc.) to manage pain
- Insufficient availability of clinical education
- Practitioners reluctance to administer medication to manage pain
- Concerns about causing more pain
- Concerns about adverse effects secondary to analgesic agents
- Difficulty to calculate medication dosages
- Difficulty to assess pain
- Uncooperative patient
- Inability to determine adequate history/allergies
- Patient spiritual, cultural or religious believes
- Paediatric patients
- Parental influence or involvement
- Patient reluctance to report pain
- Patient alcohol or drug use
- Patient reluctance to receive analgesic agents
- Language
- Other (add any other barriers) _____

42. Enablers to Pain Assessment and Management: Enablers of Pain Assessment and Management: In your opinion, which of the below are possible enablers (allows achievement) of effective pain assessment and management in your work current and/or previous environment (select all that apply and please add any additional not listed in the box below).

- Availability of higher qualified emergency care providers
- Available clinical practice guidelines which guides decision-making
- Service or company prioritize pain management
- Service-related standard operating procedures or policy
- Regular pain assessment facilitates good pain management
- Supportive management and leadership structure with work environment or emergency service
- Resources (medications, disposables, monitoring equipment) always available
- Regular clinical education
- Cooperative patients
- Regular clinical audits
- Pain management is important
- Other (add any other enablers) _____

Section 6: Case Studies

Review the two case studies below. For each patient indicate your decision about the patient's pain scale and the management you would provide.

Andrew is 25 years old and this is his first day following abdominal surgery. As you enter his room, he smiles and continues talking and joking with his visitor. You are required to transport him to a hospital closer to home. Your assessment reveals the following information: BP = 120/80 mmHg; Heart Rate = 80 bpm; Respiratory Rate = 18 bpm. When questioned about his pain, on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort) he rates his pain as 8.

43. On the patient record care report form, you are required to indicate his pain score. Select the number on the below scale that represents your assessment of Andrew's pain.

44. Indicate how you will manage Andrew's pain.

Robert is 25 years old and this is his first day following abdominal surgery. As you enter his room, he is lying quietly in bed and grimaces as he turns in bed. You are required to transport him to a hospital closer to home. Your assessment reveals the following information: BP = 120/80mmHg; Heart Rate = 80 bpm; Respiratory rate = 18 bpm. When questioned about his pain, on a scale of 0 to 10 (0 = no pain/discomfort, 10 = worst pain/discomfort) he rates his pain as 8.

45. On the patient record care report form, you are required to indicate his pain score. Select the number on the below scale that represents your assessment of Robert's pain.

46. Indicate how you will manage Robert's pain.

Pre-hospital Pain Assessment and Management: Knowledge, Attitude and Practices (KAP) Survey

To ALL Emergency Care Providers
(All levels of qualifications in Emergency Care)
You are hereby invited to take part in a Knowledge, Attitude and Practice (KAP) survey on acute pain assessment and management in the South African Pre-hospital setting.

This KAP survey forms part of a larger study in fulfillment of a PhD in Emergency Medicine at the University of Cape Town.

The main aim of the overall research project is to develop an in-depth understanding of current acute pain assessment and management practices by Emergency Care Providers in the Pre-hospital setting, in the Western Cape, South Africa and make recommendations for improvement initiatives.

For further information about the survey

kindly follow the web

link: <https://tinyurl.com/y76n29jp>

OR

Scan the QR code.



Appendix 10: Recruitment email

Dear Emergency Care Provider,

Please reply and indicate whether you are interested to participate in the study. We will then arrange a suitable date and time for the (focus group) discussion.

Invitation:

You are hereby invited to take part in research to gain, from the viewpoint and experience of emergency care providers, a deeper understanding of acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa and to obtain insight into perceived barriers to and facilitators of acute pain assessment and management in this setting. The research is in partial fulfilment of a Doctoral of Philosophy (PhD) in Emergency Medicine at the University of Cape Town (UCT).

Why is the research important?

The project focuses on an area of prehospital emergency care in dire need of emphasis and given the importance, we sincerely hope that you will earnestly consider participating.

Eligible to participate?

Emergency Care Providers, trained in South Africa, registered under the Professional Board of Emergency Care with the Health Professional Council of South Africa with at least 3 years' experience and currently working in an operational role in EMS industry in the Western Cape, South Africa is eligible. However, participation is voluntary, and all data collected will be treated as confidential and your anonymity (privacy) will be protected in any reports or publications produced from the study. None of what you share during the discussion will be identifiable to you personally or reported to the organisation which employ you.

What will participation entail?

Participants will part-take in a discussion (focus group) between 6 to 8 emergency care providers (colleagues) of a similar level of qualification in a neutral setting in English to share experiences, opinions and beliefs in terms of acute pain assessment and management in the pre-hospital setting. No EMS managers or shift supervisors will participate or be present during the discussion.

With the agreement of the participants, the interview will be audio-recorded for later transcription (written version of discussion) and analysis. There is no anticipated risk, but should the participant feel uncomfortable with any questions raised, they must indicate their apprehension to the research student. Refreshments will be provided.

Should you require **any further information**, please do not hesitate to contact me at andritl@gmail.com and lnand002@myuct.ac.za.

Looking forward to hearing from you,

Yours sincerely,

Andrit Lourens

Appendix 11: Focus group guide

Study Title: Emergency care providers' perspectives of acute pain assessment and management in the prehospital setting, in the Western Cape, South Africa: A qualitative study.

Study Aim: The aim of the qualitative study is to gain, from the viewpoint and experience of emergency care providers, a deeper understanding of acute pain assessment and management in the prehospital setting, in the WC, SA and to obtain insight into perceived barriers to and facilitators of acute pain assessment and management in this setting.

Focus group discussion number: _____

Number of participants: _____

Participant type:

ALS practitioners

ILS/BLS practitioners

Indicate the number of each qualification:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

Date: _____

Time: _____

Venue: _____

Time: 1-2 Hours with 15-minute breaks as needed

Overview:

- Welcome (3 minutes)
- Informed consent (10 minutes)
- Ground rules (4 minutes)
- Introductions (go around the table and introduce yourself) followed by Focus group discussion (80 minutes)
- Demographic information (5 minutes)
- Closing (2 minutes)

Welcome:

Good morning/afternoon, I am Andrit Lourens. I will be facilitating the discussion. For those of you who may not know me, I am a paramedic by profession previously employed by the Western Cape Emergency Medical Service in the Cape Winelands District (Worcester).

Thank you for agreeing to participate in the discussion. I appreciate your willingness to share your time and expertise. We are interested in your experiences and opinions about acute pain assessment and management in the prehospital setting in South Africa and the information you provide will help improve prehospital pain care. I hope the questions will stimulate discussion among you. I will not contribute to the discussion, but I am here to moderate the process and ensure that all the relevant issues are covered. My research so far has looked at the evidence behind prehospital pain management (and found very little from our setting), and then I have studied a year's worth of ePCRs from WCEMS trauma patients to get a picture of what you all do in terms of pain assessment and management (or at least what you document that you do). So now I want to give you a chance to tell me about it from your side directly. Please ask me to repeat a question if the need arises or any aspect of the question is unclear during the discussion.

Informed Consent:

Before sharing the ground rules for the focus group discussion, I would like to provide you with the following information regarding the research study and PhD project as a whole (refer to informed consent form part 1) for you to provide informed consent to participate. Please feel free to stop me at any point and ask any questions for clarity regarding any aspect of the information shared.

Request all participants together with the facilitator to sign part 2 of the informed consent.

Once we are done with the discussion, please take five minutes to assist me in completing the demographic information document.

Ground rules for focus group discussion:

- We're on a first-name basis.
- Please remember that English is the official language of communication for this session.
- I want everyone to feel comfortable when sharing sensitive issues. By signing the consent form participants agree to respect the confidentiality and anonymity of other participants however as the focus group facilitator, I cannot control the actions of participants. Confidentiality and anonymity of the focus group discussion are dependent on the integrity of each participant.
- There are no right or wrong answers, only differing points of view and I want to hear a wide range of opinions. Every person's experiences and opinions are important. Although, you don't need to agree with others, please listen respectfully as others share their views.
- Please be honest, respectful, and non-judgemental towards other members.
- Talk to each other but please do not have side discussions as I would like to hear all your input.
- I would like everyone to participate in the discussion and I may call on you if I haven't heard from you in a while. I'm voice recording (just so that I can go over again later in detail and make sure I am clear on everything that was said), so we please ask that one person speaks at a time and that you speak clearly.
- Since we are recording the discussion, I would like you to remember that the recording will not pick up on non-verbal action like nodding in agreement. So kindly verbalise whether you agree or in fact disagree with anyone but please do not interrupt each other.
- I kindly ask that you place your phones on silent. I further, kindly ask that you do not answer your phones during the discussion. If you cannot and if you must respond to a call, please do so as quietly as possible and re-join us as quickly as you can.
- Please let me know when you need to take a break.

Introduction (please introduce yourself) followed by Focus group discussion

1. What do you understand by pain assessment and how do you go about it? How do you recognition pain?
2. A. Could you think back and describe your own past experiences with patients and acute pain assessment in the prehospital setting?
B. Could you think back and describe your own past experiences with patients and the management of pain in the prehospital setting?
 - Cultural issues related to patients and/or practitioners

- How do hospital staff (doctors and nurses) perceive prehospital pain management?
 - Have you personally experienced acute pain in the past? If yes, how, if at all, has it influenced your management of pain in the prehospital setting, subsequently?
3. A. What are your views and opinions about the assessment of acute pain in the prehospital setting?
- B. What are your views and opinions about the management of acute pain in the prehospital setting?
- How are we doing?
 - Do you think it is a priority? And why?
 - What is culture within your organisation? Is it a priority in your organisation?
 - Comment on the pain education received during initial training and ongoing training
 - What your views and opinion about guidelines/protocols?
 - What are the risks versus benefits of optimal prehospital pain management?
 - Trauma vs medical
 - Adult vs child vs neonate
 - Short vs long transfer
4. How would you approach a male patient with a tib/fib fracture in terms of his pain?
Pain recognition, pain assessment, pharmacological and non-pharmacological pain management
5. How would your approach differ if the patient was?
- 5.1. A screaming 11-month old child with a tib/fib fracture and an inconsolable mother
 - 5.2. An adult with 20% partial thickness burns to his left arm and leg after falling into a fire
 - 5.3. A 17-year-old female, primigravida in labour
 - 5.4. A 30-year-old male patient complaining of side and lower back pain, nausea, and vomiting, burning sensation when urinating and a history of kidney calculi (stones) two years prior
6. Pain management decision-making:
ALS Group (See probes):
- ALS: What factors make you more or less likely to manage pain?
 - ECT: How do you go about requesting permission to administer analgesia (morphine)?
 - ECP/CCA: What factors do you consider when consulting with an ECT requiring permission to administer analgesia?

BLS/ILS Group (*See probes*):

Could you tell me about requesting assistance from a higher qualified practitioner to facilitate pain management? What factors do you consider?

- Medical or trauma
 - Adult or paediatric
 - Environmental influences – red zones, dynamic environment
 - Visual appearance, vital signs?
 - Pain score
 - On request
7. A. What barriers to pain assessment have you experienced during your clinical practice?
B. What facilitators to pain assessment have you experienced during your clinical practice?
8. A. What barriers to pain management have you experienced during your clinical practice?
B. What facilitators to pain management have you experienced during your clinical practice?
- o Probe to consider 7 A/B and 8 A/B:
 - Medical versus trauma cases
 - Adult versus paediatric patients
9. If you could change a few things in your system, would you change pain control? If so, how would you change the process of pain control in EMS?
10. Are there any final opinions or experiences related to prehospital pain assessment and management you wish to share?

Those are all the questions I have for you today. Does anyone have any questions for me?

General probing questions:

- o Can you elaborate on what you mean by?
- o Could you give more detail on that specific aspect of pain assessment and management?
- o Do you have any examples of that?
- o You mean that?
- o Is it correct that?
- o Anyone or anything else?
- o Could you give me some examples?
- o Has anyone had a different experience?
- o Does anyone see it differently?
- o What about other points of view?

Complete demographics of participants

Closing:

Thank you again for your valuable contributions, it has been greatly appreciated. Thank you for your time and patience. I will keep you informed of the findings of the research.

If you have any questions about the focus group discussion or the project, please feel free to contact, my, the researcher, the project supervisors or the University of Cape Town (UCT) Human Research Ethics Committee (HREC). Thank you again and have a safe journey!

Appendix 12: Informed consent form

Part 1: Information Sheet

- *Introduction:*

I, Andrit Lourens, have been working in the pre-hospital environment for more than 22 years and obtained a Bachelor of Technology (BTech) in Emergency Medical Care (EMC) at the Cape Peninsula University of Technology (CPUT) and a Master of Science in Clinical Epidemiology at Stellenbosch University (SUN).

The study you are invited to participate in forms part of a larger project in fulfilment of a Doctoral of Philosophy (PhD) in Emergency Medicine at the University of Cape Town (UCT). The main aim of the overall PhD research project is to develop an in-depth understanding of current acute pain assessment and management practices by Emergency Care Providers in the South African pre-hospital setting and make recommendations for improvement initiatives.

- *Purpose of the Research:*

The aim of the study (objective 4 of the overall research project) is to gain, from the viewpoint and experience of emergency care providers, a deeper understanding of acute pain assessment and management in the prehospital setting, in the WC, SA and to obtain insight into perceived barriers to and facilitators of acute pain assessment and management in this setting.

- *Type of Research Intervention:*

Six to eight emergency care providers of a similar level of qualification will participate in a discussion in English to share their experiences, opinions and beliefs about pain assessment and management in the prehospital setting. With the agreement of the participants, the focus group discussion will be audio-recorded for later transcription (written version of the discussion) and analysis.

- *Participant Selection:*

You were recruited to participate in the research. Focus was placed on selecting participants with experience and who is currently working in the operational capacity. Further, to ensure diversity, the sample will include participants of all three levels of ALS or ILS/BLS qualifications, various districts within the province, various years of experience and participants from both genders.

- *Ethical Approval:*

This study has received formal ethical clearance from the Human Research Ethics Committee of the University of Cape Town (HREC 220/2017).

- *Voluntary Participation:*

Your participation in the research is entirely voluntary and you may withdraw participation at any time should you wish to do so. There is no anticipated risk, but should you feel uncomfortable with any questions raised, please indicate your apprehension to the research student.

All data collected (including the audio-recording) will be treated as confidential and your anonymity (privacy) will be protected in any reports or publications produced from the study. None of what you share during the discussion will be identifiable to you personally or reported to the organisation which employ you. The researcher would like to remind participants to respect the privacy of fellow focus group participants. Please do not repeat what is discussed in the focus group or to maintain the anonymity of the participants outside of the focus group do not share participant identities with others. You are free to ask any questions for clarity prior to deciding on whether to participate. You will receive a copy of the signed consent form, should you agree to the participant.

- *Who to contact:*

Should you require any further information or want to report any concerns, please do not hesitate to contact me, my main supervisor or the chair of the UCT Human Research Ethics Committee (HREC). Our contact details are as follows:

- Research Student:
 - Name: Andrit Lourens
 - E-mail: andritl@gamil.com
- Internal Supervisor (UCT):
 - Name: Dr Peter Hodkinson
 - E-mail: peter.hodkinson@uct.ac.za
- Chair of UCT Human Research Ethics Committee (HREC):
 - Name: Prof Marc Blockman
 - E-mail: marc.blockman@uct.ac.za

Part 2: Certification of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked has been answered to my satisfaction. I consent voluntarily to be a participant in this study, and I will respect the confidentiality of other participants.

Print Name of Participant: _____

Signature of Participant: _____

Date: _____ Day/Month/Year

Statement by the research student/person taking consent:

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1. In-depth, semi-structured, one-on-one interview
2. Interview will be recorded for later transcription

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability.

I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Print Name of Research student/Person taking Consent _____

Signature of Research student/Person taking Consent _____

Date _____ Day/month/year

Appendix 13: Qualitative Research Methods Certificate



Appendix 14: Demographics of focus group participants

Demographics:

Focus group number: _____

Participant: _____

1. Gender:

Male Female

2. Age (in years): _____

3. Total years of EMC experience: _____

4. Highest qualification: _____

5. Years post qualification (highest): _____

6. All other qualifications (Note year qualified)

Basic Ambulance Assistant _____

Emergency Ambulance Assistant _____

Emergency Care Technician _____

Critical Care Assistant _____

National Diploma in Emergency Medical Care _____

Other: _____

7. Other provinces, district, or countries previously practised (excluding current):

8. Continuous Professional Development (CPD): Can you recall attending any recent CME activity of pain, pain assessment and/or pain management? Can you provide any detail about the educational activity?

Appendix 15: Turnitin report

ORIGINALITY REPORT			
38%	32%	30%	11%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
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