

Determining the variables associated with EMS non-conveyance of patients with respiratory complaints in Western Cape, South Africa: A retrospective chart review

by

Mohammed K AlSufayan

Master of Philosophy in Emergency Medicine

ALSMOH021

This study is in partial fulfilment of the requirements for the degree Master of Philosophy in the Faculty of Health Sciences at the University of Cape Town

Supervisor: Dr. Willem Stassen, University of Cape Town
Co- Supervisor[s]: Mr. Wesley Craig, University of Cape Town
Mr. Faisal Binks, University of Cape Town

February 2023

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Plagiarism Declaration

I, Mohammed K AISufayan, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever. I further declare the following:

1. I know that plagiarism is a serious form of academic dishonesty.
2. I have read the document about avoiding plagiarism, am familiar with its contents and have avoided all forms of plagiarism mentioned there.
3. Where I have used the words of others, I have indicated this by the use of quotation marks.
4. I have referenced all quotations and properly acknowledged other ideas borrowed from others.
5. I have not and shall not allow others to plagiarise my work.
6. I declare that this is my own work.
7. I am attaching the summary of the Turnitin match overview.

Signed by candidate

Signature.....Date.....15/1/2023.....

Table of Contents

Plagiarism Declaration	ii
Table of Contents.....	iii
List of Tables	vi
Abbreviations	vii
PART A: BACKGROUND AND LITERATURE REVIEW	1
Background.....	2
Overview of Provincial Government Western Cape Emergency Medical Services Care....	2
Ambulance Non-Conveyance.....	3
Appropriate vs Inappropriate Non-Conveyance	3
Non-Conveyance of Respiratory Complaint Patients	4
Factors Associated to Non-Conveyance.....	5
Literature Review	6
Overview of Emergency Care in South Africa.....	6
Emergency Centre	6
The Increasing Demand for Emergency Care.....	7
Non-Urgent Care Patients	7
Ambulance Non-Conveyance.....	8

Procedures and Protocols for Non-Conveyance and On-Scene Discharge	9
Factors Associated with Ambulance Non-Conveyance.....	10
Non-Conveyance of Patients with Respiratory Complaints	12
Summary	13
References	15
PART B: MANUSCRIPT IN ARTICLE FORMAT	20
Introduction.....	23
Methodology	24
Study Setting.....	25
Data Collection.....	25
Data Analysis	26
Results.....	27
Discussion	31
Prevalence of Non-Conveyance.....	31
Factors that affect non-conveyance.....	32
Conclusion	35
References	36
PART C: PROPOSAL	39
Background.....	1

Clinical risks of non-conveyance	1
Appropriate vs inappropriate non-conveyance	2
Non-conveyance of respiratory complaint patients	2
Factors affecting non-conveyance.....	3
Purpose Of The Study.....	4
Research aim.....	4
Research objectives.....	4
Methodology	4
Study design	4
Characteristics of the study population.....	5
Research procedures and data collection methods	5
Data analysis	6
Description Of Risks And Benefits.....	6
Research Outputs	6
Proposed Timeline	8
References	9
APPENDICES.....	15
Resources and Budget.....	16
Ethics Approval.....	17

List of Tables

Table 1 Patient demographics and call details	27
Table 3: Prehospital interventions.....	28
Table 1: Proposed timeline	8
Table 2: Budget	16

Abbreviations

SA	South Africa
EC	Emergency Centre
EMS	Emergency Medical Services
NDoH	National Department of Health
PGWC	Provincial Government Western Cape
SATS	South African Triage Scale
UK	United Kingdom
WHO	World Health Organisation
CAD	Computer Aided Dispatch
BP	Blood Pressure
RR	Respiratory Rate
ePCR	Electronic Patient Care Record
HR	Heart Rate
COPD	Chronic Obstructive Pulmonary Disease

PART A: BACKGROUND AND LITERATURE REVIEW

Background

The demand for South African emergency care, is on the rise, placing more strain on the Emergency Medical Services (EMS) and the larger healthcare system (1, 2). However, not all patients who call for an ambulance end up being transported to the hospital, despite the severity of their healthcare problems. A significant proportion of ambulance responses result in non-conveyance, based on research conducted in the United States of America (USA) (3, 4, 5). Non-conveyance refers to an appropriate ambulance response where patients are not conveyed to the hospital after on-scene medical examination and/or treatment (4). An estimated 11% (n = 10819) - 52% (n =165293) of conveyances have been noted to be medically unnecessary in the Netherlands and the United Kingdom (6, 7). Furthermore, due to the increasing demand for emergency care, other stakeholders in the emergency care system, such as emergency centres (EC) and primary care, are also under pressure (6, 7). Some solutions, such as on-scene discharge, were established to relieve the unnecessary crowding of ECs (1).

Overview of Provincial Government Western Cape Emergency Medical Services Care

In the event of an emergency, a patient or bystander may call the provincial emergency call centre. The call taker receives important information about the nature of the emergency, location and patient. Based on this information a call priority (more on this below) is assigned. The call information is then sent to the relevant dispatcher based on geographical location. The dispatcher then assigns an available resource (ambulance or response car) to the location of the emergency. The assigning of the resource can depend on the proximity of available resources to the emergency, or it can be based on the level of care that the resource can provide. Emergency Care providers (EC providers) are broadly categorised into basic, intermediate, and advanced life support. These levels of providers differ in their extent of training, clinical knowledge, procedures, and decision-making authority. There are several reasons why some ambulance responses are resolved on the spot without any patients being transported to the hospital. For example, when a patient declines care or transportation, a patient leaves the scene for any reason, and when a transfer between different facilities occurs (1).

Ambulance responses are assigned into one of two codes based on their urgency. The two codes are Priority 1 (P1) or Priority 2 (P2) (2). The information the call-takers gathered from the first phone contact for assistance is used to establish the priority of a call-out.

P1 cases are life-threatening emergencies. Automobile accidents, unconscious patients, heart attacks, near-drowning situations, and consequences from significant medical illnesses are a few examples of this. Ambulances and other EMS resources are assigned to P1 cases first, if there are no P1 cases left, P2 cases are then addressed. In some situations, the use of warning lights and sirens is justified so that these resources may get to the scene and the patient safely as soon as possible. Currently, 80% (n = 400) of P1 call-outs are expected to result in an ambulance being on the site within 15 minutes (2).

P2 cases are non-life-threatening emergencies. Even though the patient is hurt or unwell and needs medical attention, there is less urgency since it is not anticipated that they would deteriorate rapidly. The following subsections provide a detailed background to the problem that this research seeks to address.

Ambulance Non-Conveyance

Non-conveyance can be a result of on-scene discharge or patient refusal (1). On-scene discharge refers to the medical discharge of a patient after receiving treatment from EMS or after having it deemed unnecessary to transport the patient to hospital (4). In South Africa, The only cause of non-conveyance is patient refusal as on-scene discharge is not currently being performed. The non-conveyance of low-acuity patients can be seen as an alleviating factor to the problem of hospital crowding (4). However, the safety of non-conveyance is debatable, as well as the effect on ambulance availability and overall EMS system efficiency.

Appropriate vs Inappropriate Non-Conveyance

Finding a balance between safety and efficiency can be a challenge in emergency care (8). A significant number of non-emergency calls can reduce ambulance availability and deplete human resources, particularly in circumstances when no treatment is required (8). Furthermore, it poses a risk to patients who require immediate transportation or medical attention (9). Underestimating a patient's health status, on the other hand, may result in missed cases increasing the probability of avoidable morbidity and mortality (8). It is critical to understand the characteristics that influence ambulance non-conveyance to enhance the identification of these occurrences and better comprehend the requirements of patients.

Given the significance of clinical risks associated with non-conveyance, a distinction between appropriate and inappropriate conveyance represents an important consideration. According

to previous research (10), the decision not to convey could have been appropriate at the time, or it might have been inappropriate and endangered patient safety (9).

Previous research involved the use of an expert panel to evaluate the propriety of non-conveyance judgments (11). This method, however, takes time and can only be used to evaluate a small number of calls. An alternate strategy, appropriate for large numbers of calls, includes linking routinely accessible data from ambulance services and hospital patient records to identify the following events within a specified time frame (9). Hospitalization and reconnection with ambulance services are examples of these events. The absence of knowledge about particular situations under this approach, however, makes it difficult to judge the appropriateness of the choice not to convey. Previous research into the factors or variables associated with the non-conveyance of patients does not consider the appropriateness of the decision not to transport patients to the hospital.

Non-Conveyance of Respiratory Complaint Patients

Of particular concern to this research is the non-conveyance of respiratory complaint patients who represent a significant proportion of all ambulance non-conveyances within the context of the United Kingdom (UK) and the USA (12). The non-conveyance of respiratory complaint patients within the UK was noted to mitigate hospital crowding; however, these patients are noted to have the highest rates of EMS recontact, hospital admission, and mortality after the fact (12). This represents a major problem and there may be repercussions for the failure to develop newer approaches to the non-conveyance of respiratory complaint patients. A major cause of this problem is the limited knowledge of the prevalence, characteristics, and predictors of the non-conveyance of respiratory complaint patients to inform the EMS dispatch systems.

Respiratory complaints are the most common cause of ambulance dispatch and due to the high prevalence of respiratory diseases in South Africa, in particular the Western Cape, it is important to focus on this population when attempting to determine the variables associated with EMS non-conveyance (13). Furthermore, these calls are associated with higher rates of non-conveyance than other medical complaints (13), making it a suitable focal point for a study. By selecting a cohort of respiratory complaint patients, researchers can focus their efforts on these calls and identify the factors that contribute to non-conveyance. Additionally, a cohort of respiratory complaint patients enables researchers to compare their findings to other medical complaint calls, allowing for a more comprehensive understanding of non-conveyance.

Factors Associated to Non-Conveyance

According to previous research set in Northern Finland, by Hoikka M, 2017, the most common cause for non-conveyance is the lack of a necessity for treatment (14). Furthermore, these patients may have been treated by their primary care physician or did not require any care at all (15). Several variables that determine non-conveyance were discovered in prior studies. The probability of non-conveyance is raised by the urgency of the call, the time of day, the greater distance to a healthcare centre, the age of the patients, and the call occurring in a rural region (3,16, 17). In contrast, urban environments, comorbidities, and patients' advanced age all enhance the likelihood of conveyance (16). In prehospital settings, the decision not to convey patients is difficult. Results from previous research have also shown that vital signs are inadequate markers for assessing the acute care requirements of elderly patients with nonspecific illnesses (16). There are equivocal results about variations in evaluation and treatment between males and females for many types of disorders (1, 16). Non-conveyance judgments are difficult, and the accompanying recommendations have had mixed results in establishing appropriate care levels for non-conveyed patients (5, 15). Some research has emphasized the need for further knowledge of the features of the non-conveyed population to establish procedures with a greater degree of patient safety (5, 18). According to prior studies, the non-conveyance decision-making process appears to be complicated, and it is impacted by several factors from the viewpoints of both EMS personnel and patients (19). However, in the case of South Africa, there is no information on the characteristics linked with hospital non-conveyance.

Appropriate patient non-conveyance is expected to improve the quality of care. It also ensures the optimum use of resources. On the other hand, inappropriate non conveyance has a major impact on patient safety (1,4). Striking a balance between safety and efficiency is challenging, and little is known about non-conveyance, particularly in South Africa. As a result, the purpose of this study is to determine the variables associated with EMS non-conveyance of patients with respiratory distress complaints in Western Cape, South Africa.

Literature Review

The parts that follow address the reviewed literature and provide an overview of emergency care in South Africa as well as challenges with emergency care, their effects, and potential remedies. The topic of non-conveyance of respiratory complaints patients is then discussed.

Overview of Emergency Care in South Africa

The World Health Organisation (WHO) describes emergency care as an “integrated platform to deliver time-sensitive healthcare services for acute illness and injury across the life course” (20). Within the context of South Africa, there is no clear definition of emergency care. However, it was identified as a human right according to the country’s constitution (21). All emergency medical services in the public sector, fall under the Directorate: Emergency Medical Services and Disaster Medicine at the National Department of Health (NDoH), which offers direction to provincial structures in terms of regulation, policy, and oversight (21).

When a medical emergency occurs, patients can go to the emergency centre privately or they can call the public emergency numbers (112 for mobile phones and 10177 for landline) for EMS. They can also call any one of the private ambulance services to request an EMS response (21).

Emergency Centre

When the demand for emergency care exceeds the available capacity, triage mechanisms are used to control the flow of patients. When patients enter the EC, they are evaluated via a triage system to ascertain the seriousness of their health state and prioritize patients with a greater medical need by adhering to a set criteria (22). The South African Triage Scale (SATS) is the most widely used triage system in South Africa (22). ECs represent an important option to access emergency care in South Africa, however, crowding and its associated waiting times have become an ongoing challenge (23). The rising demand for emergency care and the improper use of emergency services by non-urgent patients are two factors contributing to this issue (1, 24, 25).

The Increasing Demand for Emergency Care

The demand for emergency care has grown over the last several decades and still rising in all emerging nations, including South Africa (1, 2). Within the context of South Africa, longer life expectancy and an increase in patients with chronic conditions are the causes of the rising need for care (26, 27). Furthermore, Maphumulo WT, 2019 & Schaay N, 2011 have indicated an increase in the disease burden in South Africa (26, 27). Consequently, numerous healthcare facilities that provide urgent care must handle the rising need for care and new challenges.

Maphumulo indicated that ECs have seen an increase in the number of patients seeking care (26). As a consequence of this, patients may experience delays in treatment and/or substandard care (1). In turn, this leads to higher costs of care, increased morbidity, mortality, and reduced patient satisfaction (1, 24, 25). Furthermore, general practitioners have been experiencing an increase in the number of patients who need more care and attention over time (26). Primary care providers (including general practitioners and clinical nurses) have noted an increased burden and this is shown in many countries across the world including South Africa (1, 24, 25, 28).

Non-Urgent Care Patients

“Non-urgent” in the setting of emergency care refers to patients with disorders that do not require immediate medical attention or complicated treatments and that may be safely managed by primary healthcare providers (6, 7). Based on a literature review set within the USA, at least 30% (n = 217) of all EC visits were identified to be non-urgent in nature (29). For this study, “non-urgent” was defined as hospital visits for conditions where a delay of several hours would not increase the likelihood of an adverse outcome. In the context of the Netherlands and the UK, patients with non-urgent problems request EMS care in a range between 11% (n = 10819) and 52% (n = 165293) of all cases (30, 31). Comparatively, evidence from South Africa suggests that 62% (n = 2723) of conveyances are medically unnecessary (1). In this regard, it is possible that the incidence of non-urgent patients requesting EMS care is higher in SA than in other countries. These findings are also similar to those in a WHO study on prehospital care (32). However, the generalisability of these findings is limited because of the limited research on the subject within the context of South Africa.

Within the context of South Africa and Cape Town in particular, the crowding of ECs resulted in greater proportions of patients seeking medical care in primary care clinics and ambulance

services instead of the EC (1, 2, 33). In turn, this led to challenges for primary care and ambulance service administrations where the demand and the response time for treatment has extended (2, 25).

The South African Triage Scale (SATS) is currently being used by PGWC EMS for the purposes of calculating a final triage colour before the patients arrival at hospital (22). While prehospital emergency treatment has been shown to benefit from the SATS (34, 35). It was identified to generally underperform as a triage tool, mainly due to the clinical discriminators (36). In particular, the SATS was identified as having low levels of validity as an indicator of acuity, which means it fails to accurately measure what it is intended to (36). In support, research set in South Africa noted that the SATS could only accurately identify (56.5%, n = 2261) of all emergency cases. With improvements to SATS and provider retraining, many of the problems with employing SATS in the prehospital setting may be resolved.

Ambulance Non-Conveyance

Hoikka M, and Leikkola P (14, 15) looked at the reasons why certain patients are not conveyed. Hoikka, (14) conducted research set in Finland to identify the reasons why the patients were not conveyed to the hospital. The two most frequent justifications offered for not conveying the patient were "no need for medical care" (33.9%, n = 1891) and "medical treatment provided on the scene" (48.2%, n = 2674) (14). The research claims that in (80%, n = 4456) of cases, patients could have gotten care from their primary care doctors or would not have required any treatment at all (14). Other excuses that have been recorded include "transfer by another vehicle," "patient refusal," "patient found dead on the scene," "patient not located," and "patient given over to another authority" (14). The findings from the research by Hoikka, Silfvast (14) were similar to the findings obtained by Leikkola, Mikkola (15) in a separate study. In this study, the primary reasons for non-conveyance were related to the lack of a medical emergency requiring further care (15). In multiple cases, the patients could have sought care from their primary care physician (15). The second most common finding relates to the availability of appropriate on-scene care. Patients may be suitably assessed and treated on-scene without a need for ambulance transportation (15). Third, long-lasting or chronic diseases were another reason for non-conveyance (15, 37). This was particularly true for elderly patients and individuals with chronic illnesses who were deemed to have a lower chance of survival (38). This indicates that in certain cases, the medical personnel felt that it was more beneficial to the patient to not be transported and rather receive home-based care.

Procedures and Protocols for Non-Conveyance and On-Scene Discharge

In the prehospital context, it may be difficult to decide which patients should and should not be transported to the EC (3, 38). The capacity of EMS to identify which patients may be safely treated in the community is often limited by the lack of resources that can be found in ECs (8). Unfortunately, comparators are often sources for potential confounders when determining suitability for on-scene discharge. The appropriateness of the decision for on-scene discharge is often difficult to measure as many variables are involved. One of those variables is patient disposition from the EC, whether it was admission or discharge. Other variables include the occurrence of EMS recontact, return to the EC or patient mortality (15). Prehospital under-triage, which can result in patients being discharged in the scene, can be dangerous (8, 10, 39). Hence, there is the need for the non-conveyance decision to be based on comprehensive and accurate systems and tools.

In South Africa, patients that have a triage status of green can be seen at a primary healthcare centre because they are considered to be "non-urgent" patients (40). These patients could also be discharged on-scene by an EMS personnel due to their low acuity. It is worth noting that some patients may be over-triaged in the prehospital setting, resulting in an unnecessary transportation to an already crowded EC (1, 33). Over triaging can be related to the lack of equipment, lab facilities, and medical expertise required for an accurate diagnosis. This can result in an unnecessary use of resources, as well as a potential for delaying care for those who have more time sensitive disorders.

From a global perspective, abnormal vital functions related to "breathing" (dyspnoea, respiratory distress, respiration rate), abnormal vital functions related to "circulation" (pulse, diastolic/systolic blood pressure), confirmed or suspected ingestion of drugs or alcohol, and an altered level of consciousness are described as the main criteria to guide the decision for non-conveyance (10, 29). These specific non-conveyance protocols are recognised by many advisory bodies, such as the American College of Emergency Physicians, the National Association of EMS Physicians, the ACEP Clinical Policies, the EMS Standards of Practice, and the National EMS Scope of Practice Model (10, 31). Various studies conducted in Europe and North America (8) have described detailed flowcharts, tools, checklists, or SOPs for non-conveyance in general and for specific disorders (patients refusing care, hypoglycaemia, postictal patients etc) (8).

Factors Associated with Ambulance Non-Conveyance

One of the most explored variables of non-conveyance is related to patient age (4). The findings from a systematic review exploring literature from Africa, Asia, Australia, Europe and North America showed that age is not a predictive factor in non-conveyance (4). A potential rationale for this trend is that EC providers are risk averse, limiting the probability of undertriaging sick children or older “frail” patients with multiple comorbidities (39). European studies comparing conveyed patients with non-conveyed patients have shown that the average age of non-conveyed patients is lower than conveyed patients (9, 18, 41). To add more, a retrospective study conducted in the Netherlands indicated that the average age of non-conveyed patients is between 48 and 68 years old (41). According to an examination of earlier research set in the Netherlands, younger adults may not need to be transported to the hospital due to their healthier medical baseline (41).

When comparing the incidents of non-conveyance with patient sex, results are often mixed. This was based on a meta-analysis of 67 research papers (4). Data from the UK indicated an insignificant difference between the likelihood of males and females not being conveyed to hospital (9). Consequently, there is a lack of consensus or consistency on the subject.

The geographical location of callers was another element considered when characterising non-conveyed patients. Studies from South Africa, the Netherlands, and Finland indicated that calls from urban regions are more likely to result in non-conveyance compared to ones from rural areas (22, 35, 41, 42). Findings from the Netherlands suggest that the lack of alternative healthcare services may be a contributing factor for patient non-conveyance due to the restricted referral options available to ambulance crews in rural areas. Based on numerous works of research set in Asia, Europe, Australia, and North America it was found that non-conveyance was more common if the call was from a metropolitan area (4, 5, 41, 42). There is consensus within the current body of knowledge on the issue and this is likely to apply to the case of South Africa.

Adding on, numerous research articles set in numerous contexts across the globe have highlighted the urgency codes of ambulance calls as an additional characteristic of non-conveyed calls (4, 5, 37, 41, 42, 43). However, the generalisability, comparability, and applicability of these findings are limited as different techniques and categories are used in different countries for urgency codes. However, The higher the priority of the call the more likely it was for the patient to not be conveyed (4, 5). The findings from the reviewed literature are counter-intuitive and the justification for this observation was indicated to be the fact that

the priority/urgency levels are often overstated as they are made by emergency call attendants exclusively based on the information provided by callers who have no medical knowledge or expertise as noted by studies from the Netherlands (4, 17, 44). Consequently, most ambulance responses are given a higher priority and later turn out to be non-urgent (4, 17, 44)

The patients prehospital triage code and presenting symptoms were also noted to be conventional indicators. Since different countries utilise different triage procedures and coding, it is difficult to compare the findings. Based on studies in Asia, Europe and North America triage codes which indicated lower acuity were noted to be more likely to result in non-conveyance (4, 8, 44). However, the accuracy of the triaging system has often been deemed inaccurate across the globe as well as in South Africa (8, 17, 33, 35). Research in England found that three to five per cent of patients triaged as "non-urgent" require emergency hospitalisation following additional review in the EC (9). Similarly, the validity of the SATS was noted to be questionable in the prehospital setting as it only identified (56.5%, n = 2261) of emergency cases, thus limiting the instance of patient triage to accurately characterise non-conveyance ambulance responses within the context of this research (22). With regards to the common descriptors among non-conveyed patients, "acute alcohol abuse", "no-disease", "general", and "tiredness/weakness" are the most regular, according to research by Paulin, Kurola (42). Prior research often involved presentations associated with "poisoning, injuries, and other disorders with external origins," "diseases of the circulatory system," and "neurodevelopmental, behavioural, and mental abnormalities" (41). No conclusions can be drawn from these data since the categories discovered in earlier research differ substantially.

The time of an emergency call was noted to represent a significant characteristic of non-conveyance. The findings on the call time indicates that ambulance responses during the late night (often between 00:00 - 08:00 in the morning) are less frequent, while non-conveyance happens frequently throughout the day and evening (4, 5). The day of the week was also identified as a significant determinant of non-conveyance. According to previous research, the likelihood of non-conveyance was noted to be significantly higher during the weekend compared to weekdays (16, 38, 45). The justification for this trend was noted to be the increased demand for emergency care as the prevalence of emergency trauma cases is noted to be higher during weekends as indicated by research from Australia, Asia, Europe and North America (38, 45, 46, 47). Similarly, the demand for EMS was noted to increase during weekends as a result of increased trauma cases within the context of South Africa (1). Consequently, the likelihood of non-conveyance of low acuity and non-trauma cases was noted to be higher.

Previous research further indicated that when patients are not conveyed, they are assessed with guidelines based on vital signs (8). Hence, some works of research have identified patients' vital signs as significant characteristics of non-conveyed ambulance responses. A meta-analysis set in Finland indicated that 15% (n = 133) of the non-conveyed patients had abnormal vital signs (body temperature, Glasgow Coma Scale, blood pressure and O₂ saturation) (11). Similarly, prior research on the vital signs of patients who were not conveyed revealed a mean Glasgow Coma Scale (GCS) of 15, a mean pulse rate of 91.8 beats per minute, and a mean systolic blood pressure of 134.7 mmHg, respectively (48). Alternatively, prior research set in the Netherlands and North America identified that vital signs are poor indicators of the likelihood of non-conveyance (4, 14). This was particularly noted in the assessment of the acute care needs of older patients and children presenting with unspecific complaints (4, 49). Consequently, there is a lack of evidence identifying the vital signs as a characteristic of non-conveyance.

Non-Conveyance of Patients with Respiratory Complaints

Patients with respiratory distress complaints are characterised as having trouble breathing or not getting enough oxygen (50, 51). Some of the presentations of respiratory distress in patients include increased breathing rate; central or peripheral cyanosis; grunting; retractions; nose flaring and wheezing (50, 51). Respiratory complaints are noted to be related to the diagnosis of acute respiratory conditions (asthma, respiratory tract infection, pulmonary embolism, airway foreign body or allergic reactions); acute cardiac conditions (cardiac infarction/ischemia, cardiac dysrhythmia or heart failure); acute neurologic conditions (seizures or transient ischemic attack/stroke) and chronic obstructive pulmonary disease (COPD), (12, 44, 52, 53). Given the diagnostic conditions associated with respiratory complaints, ambulance services often treat them as a high priority (12).

Respiratory complaints have been identified as a common reason for calling an ambulance service (2, 12, 25, 52). Although there is data relating to the epidemiology and outcomes of patients with respiratory complaints, the majority of studies are focused on patients who are conveyed to the ECs as opposed to those who are not. Even though a significant proportion of ambulance calls are for respiratory issues, only one study (12) examined the prevalence and characteristics of patients with non-conveyed respiratory complaints. According to O'Cathain (12), EMS employees did not specifically cite respiratory symptoms as a condition that warranted conveyance to the hospital with breathing complaints showing substantially higher levels of non-conveyance than all other causes of ambulance calls combined (12). Exacerbations of COPD and asthma were among the respiratory diseases that were often

unconveyed. Nebulizers were suggested as a typical remedy for respiratory symptoms, obviating the necessity for conveyance to the hospital (12). Male patients, patients older than two years, and patients with low-triage calls were shown to have a greater risk of not being conveyed for respiratory complaints (12). The differences in the non-conveyance of patients with respiratory complaints were observed to not be significantly influenced by any other patient-level factors.

Prior studies undertaken in South Africa revealed that the majority of patients who are conveyed to hospital are often non-traumatic in nature (2, 12, 25, 52). This information is important for determining the decision not to convey (1). Similarly, additional studies found that trauma patients had the lowest likelihood of being admitted to the hospital (8, 11). Trauma patients were indicated to require fewer in-hospital procedures to be performed and hence, non-conveyance and on-scene discharge were noted to be more appropriate (1). The current body of knowledge on the procedures and protocols for non-conveyance and on-scene discharge by EMS in South Africa is currently lacking. There is a lack of empirical evidence on the practical application of the identified criteria as there are no comprehensive guidelines or standard operating procedures.

Summary

The reviewed literature identified the challenges associated with emergency care and EMS. Of note, was the rising demand for emergency care and the increase in “non-urgent” care patient categories. Patient access to emergency care is a critical service delivery problem. For instances where immediate transportation is not required after assessment and on-scene management, non-conveyance is a potentially useful solution to the challenges faced by emergency care services (pre- and in-hospital). Knowing when to transport and when to leave a patient on scene is a critical moral and medico-legal concern. Looking into the variables associated with ambulance non-conveyance could be one step towards understanding and overcoming this dilemma. The results found in this review were telling of some useful variables. The variables associated with non-conveyance included patient age, geographical location (urban vs rural areas); the priority of the call (patients triaged as “non-urgent”) and calls occurring over weekends. From the literature review, there was no apparent association between non-conveyance and patient sex. A noted limitation in this review is the lack of evidence originating from LMICs. There is a disproportionate weighting towards HIC evidence, procedures, and policies. Certainly, some evidence may be transferable to the South African setting, but there is a need for national data to support any understanding or changemaking in the near future. This literature review provides a theoretical foundation to facilitate the

identification of the variables associated with EMS non-conveyance of patients with respiratory complaints.

References

1. Goldstein LN, Sibanyoni S, Vincent-Lambert C. On-scene discharge by Emergency Care Practitioners—a viable option for South Africa? *South African Journal of Pre-Hospital Emergency Care*. 2020;1(1):3-8.
2. Stein C, Wallis L, Adetunji O. Meeting national response time targets for priority 1 incidents in an urban emergency medical services system in South Africa: More ambulances won't help. *South African Medical Journal*. 2015;105(10):840-4.
3. Alanazy ARM, Wark S, Fraser J, Nagle A. Nontransported Cases after Emergency Medical Service Callout in the Rural and Urban Areas of the Riyadh Region. *Saudi Journal of Medicine & Medical Sciences*. 2021;9(1):38.
4. Ebben RH, Castelijns M, Frenken J, Vloet LC. Characteristics of non-conveyance ambulance runs: A retrospective study in the Netherlands. *World Journal of Emergency Medicine*. 2019;10(4):239.
5. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Djärv T. Non-conveyance in the ambulance service: a population-based cohort study in Stockholm, Sweden. *BMJ open*. 2020;10(7):e036659.
6. Gratton MC, Ellison SR, Hunt J, Ma OJ. Prospective determination of medical necessity for ambulance transport by paramedics. *Prehospital Emergency Care*. 2003;7(4):466-9.
7. Weaver MD, Moore CG, Patterson PD, Yealy DM. Medical necessity in emergency medical services transports. *American Journal of Medical Quality*. 2012;27(3):250-5.
8. Ebben RH, Vloet L, Speijers RF, Tönjes NW, Loef J, Pelgrim T, et al. A patient-safety and professional perspective on non-conveyance in ambulance care: a systematic review. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2017;25(1):1-20.
9. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Understanding variation in ambulance service non-conveyance rates: a mixed methods study. *Health Services and Delivery Research*. 2018;6(19):1-224.
10. Oosterwold J, Sagel D, Berben S, Roodbol P, Broekhuis M. Factors influencing the decision to convey or not to convey elderly people to the emergency department after emergency ambulance attendance: a systematic mixed studies review. *BMJ open*. 2018;8(8):e021732.
11. Tohira H, Fatovich D, Williams TA, Bremner AP, Arendts G, Rogers IR, et al. Is it Appropriate for Patients to be Discharged at the Scene by Paramedics? *Prehospital Emergency Care*. 2016;20(4):539-49.
12. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Variation in non-conveyance of patients with breathing problems (work package 4.2).

Understanding variation in ambulance service non-conveyance rates: a mixed methods study: NIHR Journals Library; 2018. p. 87-91.

13. Alshehri M, Pigoga J, Wallis L. A mixed methods investigation of emergency communications centre triage in the Government Emergency Medical Services System, Cape Town, South Africa. *African Journal of Emergency Medicine*. 2020;10:S12-S7.

14. Hoikka M, Silfvast T, Ala-Kokko TI. A high proportion of prehospital emergency patients are not transported by ambulance: a retrospective cohort study in Northern Finland. *Acta Anaesthesiologica Scandinavica*. 2017;61(5):549-56.

15. Leikkola P, Mikkola R, Salminen-Tuomaala M, Paavilainen E. Non-conveyance of patients: Challenges to decision-making in emergency care. *Clinical Nursing Studies*. 2016;4(4):31-9.

16. Forsgårde E-S, Elmqvist C, Fridlund B, Svensson A, Andersson R, Rööst M. Patients' aged ≥ 65 years dispositions during ambulance assignments, including factors associated with non-conveyance to hospital: a longitudinal and comparative study. *BMJ open*. 2020;10(11):e038885.

17. Höglund E, Andersson-Hagiwara M, Schröder A, Möller M, Ohlsson-Nevo E. Characteristics of non-conveyed patients in emergency medical services (EMS): a one-year prospective descriptive and comparative study in a region of Sweden. *BMC emergency medicine*. 2020;20(1):1-11.

18. Hauswald M. Can paramedics safely decide which patients do not need ambulance transport or emergency department care? *Prehospital Emergency Care*. 2002;6(4):383-6.

19. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Ljunggren G, Djärv T. Non-conveyance of older adult patients and association with subsequent clinical and adverse events after initial assessment by ambulance clinicians: a cohort analysis. *BMC emergency medicine*. 2021;21(1):1-11.

20. Lederman J, Löfvenmark C, Djärv T, Lindström V, Elmqvist C. Assessing non-conveyed patients in the ambulance service: a phenomenological interview study with Swedish ambulance clinicians. *BMJ open*. 2019;9(9):e030203.

21. Kannan V, Tenner A, Sawe H, Osiro M, Kyobe T, Nahayo E, et al. Emergency care systems in Africa: a focus on quality. *African Journal of Emergency Medicine*. 2020;10:S65-S72.

22. Tiwari R, Naidoo R, English R, Chikte U. Estimating the emergency care workforce in South Africa. *African Journal of Primary Health Care & Family Medicine*. 2021;13(1):3174.

23. Ndandani M. Living in a hut in 21st century South Africa: African Sun Media; 2015.

24. Dixon J, Burkholder T, Pigoga J, Lee M, Moodley K, de Vries S, et al. Using the South African Triage Scale for prehospital triage: a qualitative study. *BMC emergency medicine*. 2021;21(1):1-10.

25. Anest T, De Ramirez SS, Balhara KS, Hodgkinson P, Wallis L, Hansoti B. Defining and improving the role of emergency medical services in Cape Town, South Africa. *Emergency Medicine Journal*. 2016;33(8):557-61.
26. Newton P, Naidoo R, Brysiewicz P. The appropriateness of emergency medical service responses in the eThekweni district of KwaZulu-Natal, South Africa. *South African Medical Journal*. 2015;105(10):844-7.
27. Moafa HN, van Kuijk SM, Moukhyer ME, Alqahtani DM, Haak HR. Non-Conveyance due to patient-initiated refusal in emergency medical services: a retrospective population-based registry analysis study in Riyadh Province, Saudi Arabia. *International journal of environmental research and public health*. 2021;18(17):9252.
28. Maphumulo WT, Bhengu BR. Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review. *Curationis*. 2019;42(1):1-9.
29. Schaay N, Sanders D, Kruger V, Olver C. Overview of health sector reforms in South Africa. UK Dept for International Development (DFID) Human Development Resource Centre, London www.hisp.org. 2011.
30. Moosa S, Peersman W, Derese A, Kidd M, Pettigrew LM, Howe A, et al. Emerging role of family medicine in South Africa. *BMJ global health*. 2018;3(Suppl 3):e000736.
31. Uscher-Pines L, Pines J, Kellermann A, Gillen E, Mehrotra A. Deciding to visit the emergency department for non-urgent conditions: a systematic review of the literature. *The American journal of managed care*. 2013;19(1):47.
32. Plat FM, Peters YA, Loots FJ, de Groot CJ, Eckhardt T, Keizer E, et al. Ambulance dispatch versus general practitioner home visit for highly urgent out-of-hours primary care. *Family practice*. 2018;35(4):440-5.
33. O'Cathain A, Simpson R, Phillips M, Knowles E. Tendency to call an ambulance or attend an emergency department for minor or non-urgent problems: a vignette-based population survey in Britain. *Emergency Medicine Journal*. 2022;39(6):436-42.
34. Coster JE, Turner JK, Bradbury D, Cantrell A. Why do people choose emergency and urgent care services? A rapid review utilizing a systematic literature search and narrative synthesis. *Academic emergency medicine*. 2017;24(9):1137-49.
35. Rosedale K, Smith Z, Davies H, Wood D. The effectiveness of the South African Triage Score (SATS) in a rural emergency department. *South African Medical Journal*. 2011;101(8):537-40.
36. Meyer GD, Meyer TN, Gaunt CB. Validity of the South African Triage Scale in a rural district hospital. *African Journal of Emergency Medicine*. 2018;8(4):145-9.
37. Mould-Millman N-K, Dixon JM, Burkholder T, Pigoga JL, Lee M, de Vries S, et al. Validity and reliability of the South African Triage Scale in prehospital providers. *BMC emergency medicine*. 2021;21(1):1-9.

38. O’Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Characteristics affecting variation in non-conveyance rates: analysis of routine data (work package 2). Understanding variation in ambulance service non-conveyance rates: a mixed methods study: NIHR Journals Library; 2018.
39. HPCSA. Guidelines for Good Practice in the Health Care Professions. Pretoria: HPCSA Pretoria; 2016.
40. McAlpine DJ, Hodkinson P, Fleming J. Pre-hospital over-triage and potential contributing factors in Cape Town, South Africa. *South African Journal of Pre-Hospital Emergency Care*. 2020;1(2):6-12.
41. Vloet L, de Kreek A, van der Linden E, van Spijk JJ, Theunissen VA, van Wanrooij M, et al. A retrospective comparison between non-conveyed and conveyed patients in ambulance care. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2018;26(1):1-10.
42. Paulin J, Kurola J, Salanterä S, Moen H, Guragain N, Koivisto M, et al. Changing role of EMS—analyses of non-conveyed and conveyed patients in Finland. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2020;28(1):1-14.
43. Watson A, Clubbs Coldron B, Wingfield B, Ruddell N, Clarke C, Masterson S, et al. Exploring variation in ambulance calls and conveyance rates for adults with diabetes mellitus who contact the Northern Ireland Ambulance Service: a retrospective database analysis. *British Paramedic Journal*. 2021;6(3):15-23.
44. Thijssen WA, van Miero E, Willekens M, Rebel J, Sandel MH, Giesen P, et al. Complaints and diagnoses of emergency department patients in the Netherlands: a comparative study of integrated primary and emergency care. *PLoS One*. 2015;10(7):e0129739.
45. Forsell L, Forsberg A, Kisch A, Rantala A. Inequalities and short-term outcome among patients assessed as non-urgent in a Swedish ambulance service setting. *International emergency nursing*. 2021;57:101018.
46. Cantwell K, Morgans A, Smith K, Livingston M, Spelman T, Dietze P. Time of day and day of week trends in EMS demand. *Prehospital Emergency Care*. 2015;19(3):425-31.
47. Horvat AM, Dudic B, Radovanov B, Melovic B, Sedlak O, Davidekova M. Binary programming model for rostering ambulance crew-relevance for the management and business. *Mathematics*. 2020;9(1):64.
48. Staudenmayer K, Hsia R, Wang E, Sporer K, Ghilarducci D, Spain D, et al. The forgotten trauma patient: Outcomes for injured patients evaluated by emergency medical services but not transported to the hospital. *The journal of trauma and acute care surgery*. 2012;72(3):594.
49. Ward C, Zhang A, Brown K, Simpson J, Chamberlain J. National Characteristics of Non-Transported Children by Emergency Medical Services in the United States. *Prehospital Emergency Care*. 2021:1-10.

50. Smoliga JM, Mohseni ZS, Berwager JD, Hegedus EJ. Common causes of dyspnoea in athletes: a practical approach for diagnosis and management. *Breathe*. 2016;12(2):e22-e37.
51. Villar J, Blanco J, Kacmarek RM. Current incidence and outcome of the acute respiratory distress syndrome. *Current opinion in critical care*. 2016;22(1):1-6.
52. Meghoo CA, Gaievskiy S, Linchevskyy O, Oommen B, Stetsenko K. Prehospital response to respiratory distress by the public ambulance system in a Ukrainian city. *World Journal of Emergency Medicine*. 2019;10(1):42.
53. Rodgers L, Sheppard M, Smith A, Dietz S, Jayanthi P, Yuan Y, et al. Changes in seasonal respiratory illnesses in the United States during the coronavirus disease 2019 (COVID-19) pandemic. *Clinical Infectious Diseases*. 2021;73(Supplement_1):S110-S7.
54. Rodgers L, Sheppard M, Smith A, Dietz S, Jayanthi P, Yuan Y, et al. Changes in seasonal respiratory illnesses in the United States during the coronavirus disease 2019 (COVID-19) pandemic. *Clinical Infectious Diseases*. 2021;73(Supplement_1):S110-S7.
55. Hardcastle TC, Oosthuizen G, Clarke D, Lutge E. Trauma, a preventable burden of disease in South Africa: review of the evidence, with a focus on KwaZulu-Natal. *South African Health Review*. 2016;2016(1):179-89.
56. Möller A, Hunter L, Kurland L, van Hoving DJ. The association between hospital arrival time, transport method, prehospital time intervals, and in-hospital mortality in trauma patients presenting to Khayelitsha Hospital, Cape Town. *African Journal of Emergency Medicine*. 2018;8(3):89-94.
57. Rickard J, Pohl L, Abahuje E, Kariem N, Englbrecht S, Kloppers C, et al. Indications and outcomes for non-trauma emergency laparotomy: a comparison of Rwanda, South Africa, and the USA. *World journal of surgery*. 2021;45:668-77.
57. WHO. *Global Atlas of Prehospital Care*. Geneva: World Health Organization; 2017.

PART B: MANUSCRIPT IN ARTICLE FORMAT

Determining the variables associated with EMS non-conveyance of patients with respiratory complaints in Western Cape, South Africa: A retrospective chart review

Abstract

Introduction: The South African (SA) demand for emergency care is increasing, placing more strain on the emergency medical services (EMS) and the larger healthcare system. However, not all patients who call EMS require conveyance to hospital. It is intuitive that the increase in ambulance responses has also increased the probability for non-conveyance. By determining the variables associated with non-conveyance, EMS resource utilisation can be adjusted accordingly. Local data on the phenomenon is lacking, however, international data suggests that respiratory complaints are common causes for responses resulting in non-conveyance. The aim of this study is to determine the variables that are associated with the non-conveyance of patients with respiratory complaints serviced by the Provincial Government Western Cape (PGWC) EMS, SA.

Methods: A retrospective chart review was conducted using data from the PGWC EMS computer aided dispatch (CAD) and electronic patient care reports (ePCR). Data were collected over a one-year period (1 October 2018 - 30 September 2019). All records where the emergency was a respiratory complaint, and the ambulance response ended in non-conveyance were included. The rate of non-conveyance was determined using descriptive analysis. Logistic regression was performed to evaluate factors that affect the likelihood of non-conveyance of respiratory complaints.

Results: Out of 33 295 total respiratory complaints, the median patient age was 46 years. Males represented 50.2%(n = 16702) of the sample. There were no significant differences between the age and gender of those who were and were not conveyed. Of the total, 4.48%(n = 1493) were not conveyed to the hospital. Of the non-conveyed calls, 73.34%(n = 1081) were assigned a priority level 1 at dispatch and the remainder were priority 2. The majority, 45.16% (n = 504), of cases had a final triage code of yellow, followed by 31% (n = 356) coded green. Following multivariate regression, the following variables increased the odds of non-conveyance: Green triage (OR 2.04; 95% CI 1.77-2.36; p<0.01), weekends (OR 1.27; 95% CI 1.12-1.44; p<0.01), and nebulisation on scene (OR 1.47; 95% CI 1.23-1.74; p<0.01). Conversely, dispatch priority 2 (less urgent; OR 0.66; 95% CI 0.57-0.76; p<0.01), orange

triage (OR 0.68; 95% CI 0.58-0.80; $p < 0.01$), red triage (OR 0.22; 95% CI 0.13-0.37; $p < 0.01$), and oxygen administration (OR 0.52, 95% CI 0.41-0.67; $p < 0.01$) were all associated with decreased odds of non-conveyance.

Conclusion: Several variables are associated with the non-conveyance of respiratory complaint patients seen to by PGWC EMS. Future research focusing on the predictors for ambulance non-conveyance could lead to raised efficiency and minimisation in operational expenses, and provider fatigue amongst others.

Keywords: EMS, Emergency care, Non-conveyance, Respiratory Distress Complaints

Determining the variables associated with EMS non-conveyance of patients with respiratory complaints in Western Cape, South Africa: A retrospective chart review

Introduction

The demand for South African emergency care, is on the rise, placing more strain on the Emergency Medical Services (EMS) and the larger healthcare system (1, 2). A significant proportion of patient complaints requesting EMS are identified to be non-urgent cases which do not require transportation as indicated in the United States of America (USA) (3). Research set in the Netherlands and the United Kingdom (UK) indicated that 11% (n = 10819) - 52% (n = 165293) of conveyances have been noted to be medically unnecessary (4, 5). These non-urgent cases potentially jeopardise patient access to services, safety and the quality of healthcare (3). Common non-urgent cases encountered by EMS are related to respiratory distress complaints which have a high likelihood of not being transported to the hospital and these adversely affect the resourcing, efficiency and overall operation of EMS (6, 7, 8). A major cause of this problem is a lack of knowledge on the prevalence, characteristics and predictors of respiratory distress complaints with a high likelihood of non-transport to inform the EMS dispatch systems (9). Possible solutions to address the prevailing problem involve examining the variables associated with the non-conveyance of respiratory distress complaint patients by EMS (9). The insights from this examination would facilitate the development of superior EMS dispatch systems and emergency care models within an integrated healthcare system that promotes the appropriate, efficient, and successful operation of EMS.

Non-conveyance refers to an appropriate ambulance response where patients are not conveyed to the hospital after on-scene medical examination, treatment or due to the patients refusal of transportation (7). Non-conveyance can be a result of on-scene discharge or patient refusal (1). On-scene discharge refers to the medical discharge of a patient after receiving treatment from EMS or after it being deemed unnecessary to transport the patient to hospital (7). EMS on-scene discharge is not currently being performed in South Africa. On-scene discharge can speak to the Patient's Rights' Charter for "appropriate use of the health care system" while still allowing patients to "receive health care services" (1). The non-conveyance of low-acuity patients can be seen as an alleviating factor to the problem of

hospital crowding (7). However, the safety of non-conveyance is debatable, as well as the effect on ambulance availability and overall EMS system efficiency.

Of particular concern to this research is the non-conveyance of respiratory complaint patients who often represent a significant proportion of all ambulance non-conveyances as found in the United Kingdom (UK) and the United States of America (USA) (10). The non-conveyance of respiratory complaint patients within the UK was noted to mitigate against hospital crowding; however, these patients are noted to have the highest rates of EMS recontact, hospital admission and mortality after the fact (10). This represents a major problem and there may be repercussions for the failure to develop newer approaches to the non-conveyance of respiratory complaint patients. However, non-conveyance judgments are difficult, and the accompanying recommendations have had mixed results in establishing appropriate care levels for non-conveyed patients and their safety (11, 12). Some research has emphasised the need for further knowledge of the features of the non-conveyed population to establish procedures with a greater degree of patient safety (11, 13).

According to prior studies, the non-conveyance decision-making process appears to be complicated, and it is impacted by several factors from the viewpoints of both EMS personnel and patients (14). Factors that are commonly identified in prior studies to be associated with non-conveyance include patients' sex, age, comorbidities, and mobility; priority/urgency of response; patient triage; time of day; and treatment or medication administered (11, 12). The applicability, usefulness, and generalisability of these findings from previous research are limited as the results varied significantly and were context-bound. In the case of South Africa, there is no information on the characteristics linked with hospital non-conveyance, more so within the context of respiratory distress complaint patients in South Africa. Consequently, the aim of this study is to determine the variables that influence the non-conveyance of patients with respiratory complaints in South Africa based on the case of the Provincial Government Western Cape (PGWC) EMS.

Methodology

A retrospective chart review was performed to describe the variables associated with non-conveyance of patients with respiratory complaints by the PGWC EMS, in South Africa.

Study Setting

The Western Cape is a province of South Africa located along the country's western coast. The population of the Western Cape constitutes 11.83% (n = 7,113,776) out of South Africa's population in 2021 (16). The South African health system has a long history, with the first hospitals being established in the Western Cape in the early 1800s. The country has a comprehensive network of primary healthcare facilities and hospitals, as well as tertiary hospitals and specialist centres. Within the Western Cape, government/public hospitals represent 57.5% of all hospitals, with private hospitals taking the other 42.5%. According to the Council for Medical Schemes, in 2020 approximately 16% of patients in Western Cape Province, South Africa, were private (medical aid) patients, while 84% were government (non-medical aid) patients (16). Approximately 27.7% of all City of Cape Town residents have medical aid. Emergency Medical Services within the province is composed of public and private ambulance services, as well as specialist services such as aeromedical and rescue services. The sample for this study was from an estimated population of 6.94 million individuals serviced by the PGWC EMS was based on the population-based ePCR data on respiratory complaints from 1 October 2018 to 30 September 2019.

Data Collection

The data for this research were collected from the ePCR database for the PGWC EMS. The emergency call inclusion criteria for this study were:

- I. All ambulance responses, divided into those that ended in non-conveyance, (defined as an appropriate ambulance response where patients do not need to be conveyed to the hospital after on-scene medical examination, treatment or refused transportation) (11, 12) and those that were transported.
- II. The patient complaint call was for respiratory complaints, and
- III. The ePCR sheet had complete data.

Ambulance responses that ended with the death of the patient were excluded from the data collection.

From the selected data set, specific data points were collected including the characteristics of the ambulance response, care process, and patient characteristics (computer aided dispatch (CAD) priority, ePCR patient triage colour final, treatment, day of time, medications provided,

first ePCR vital signs, sex, age and mobility. Data from the CAD and from the ePCR were linked by using the unique identification number.

Data Analysis

The statistical analysis for this research was done using R (17), a quantitative data analysis software. Assessment of the trend and prevalence of non-transport of respiratory complaint patients were determined using descriptive statistics. Univariate analysis was used to compare the prevalence of non-conveyances for respiratory complaints across categorical variables (demographic and clinical characteristics). The significance of the findings was determined by a confidence interval of 95% and statistical significance of < 0.05 .

Multivariate logistic regression was performed to assess the extent to which the independent variables explain the dependent variable. The independent variables for this research were the characteristics of the ambulance response, care process, and patient characteristics (CAD Priority, ePCR patient triage colour final, treatment, day/time, medications provided, first ePCR vital signs, gender, age and mobility). The dependent or outcome variable was non-conveyance to hospital. The regression results are presented as odds ratios (ORs) and beta-coefficients with confidence intervals (95% CIs). The criteria for statistical significance of the findings were an alpha value of <0.05 . Any instances where a variable predicted the outcome perfectly, were excluded from the model. Multicollinearity was assessed using the variance inflation factor (VIF), and variables were excluded accordingly.

Results

A total of 33 295 patients with respiratory complaints were included in this study. Of these, 4.48% (n = 1493), were not conveyed to hospital. Table 1 outlines the demographic and call details.

There were 16 702 male respondents in this sample, representing 50.2% and 16 421 female patients representing 49.3%. There were a few records (172) that had missing information on gender/others representing 0.51%. The median age of the patients was 46 years, with an interquartile range between 60 years and 25 years. There were no significant differences between age of those who were transported (46 years) and those who were not transported (44 years). The results on the characteristic of the time of day the calls were mostly prevalent between 18:00-23:59 (37.84%; n = 565). followed by calls indicated to be between 12:00-17:59 (23.24%; n = 347), then calls indicated to be between 06:00-11:59 (19.69%; n = 294), and calls indicated to be between 00:00-05:59 (19.22%; n = 287). On the other hand, the least incidence of these calls was indicated to be between 00:00-05:59 (19.22%; n = 287). The findings from the study indicated the prevalence of non-conveyance respiratory distress complaint ambulance calls in accordance with EMS shifts, office hours (08:00-16:59) and after-hours (17:00-07:59). Based on the research findings, the majority (74.48%; n = 1112) of non-conveyed respiratory distress complaint calls occurred during office hours. On the other hand, the remaining 25.52% (n = 381) were indicated were prevalent during the after-hours.

Table 1 Patient demographics and call details

	Conveyance, n (%)	Non- Conveyance, n (%)	TOTAL, n
	31,802 (95.52%)	1,493 (4.48%)	33295
Sex			
Male	15971 (95.62%)	731 (4.38%)	16702
Female	15667 (95.41%)	754 (4.59%)	16421
Others/unknown	164 (95.35%)	8 (4.65%)	172
Age, mean (SD)	41.8 (24.7) years	40.6 (22.6) years	41.7 (24.7) years
EMS Shift			
08:00-16:59	23,086 (95.40%)	1,112 (4.60%)	24,198
17:00-07:59	8,716 (95.81%)	381 (4.19%)	9,097
Time of the day			
00:00-05:59	6079 (95.49)	287 (4.51)	6 366
06:00-11:59	8563 (96.68)	294 (3.32)	8 857
12:00-17:59	6975 (95.26)	347 (4.74)	7 322
18:00-23:59	10185 (94.74)	565 (5.26)	10 750
Day of the week			
Weekdays	22104 (95.86%)	954 (4.14%)	23058
Week Ends	9698 (94.73%)	539 (5.27%)	10237

Table 2: Patient Clinical Characteristics

	Conveyance, n(%)	Non- Conveyance, n(%)	Total, n
	31,802 (95.52%)	1,493 (4.48%)	33295
Patient Priority			
P1	21183 (95.14%)	1081 (4.86%)	22264
P2	10505 (96.39%)	393 (3.61%)	10898
Triage			
Green	5598 (17.63%)	346 (31.00%)	5944
Yellow	14146 (44.56%)	504 (45.16%)	14650
Orange	9501 (29.93%)	249 (22.31%)	9750
Red	2182 (6.87%)	16 (1.43%)	2198
Mobility			
Walking	11223 (93.98%)	719 (6.02%)	11942
Walking with help	10105.1 (98.15%)	354.9 (1.85%)	10460
Unable to walk	76 (96.20%)	3 (3.80%)	79
Stretcher/Immobile	4402 (99.17%)	37 (0.83%)	4 439

Table 2: Prehospital interventions

	Conveyance, n(%)	Non- Conveyance, n(%)	Total, n
	31,802 (95.52%)	1,493 (4.48%)	33295
Advanced Airway Procedure	16(100%)	0	16
Airway Other	117(97.5%)	3(2.5%)	120
Airway Suction	39(100%)	0	39
Basic Airway Manoeuvres	130(94.89%)	7(5.10%)	137
Basic Airway Procedure	29(96.66%)	1(3.33%)	30
Burns Dressing	2(100%)	0	2
Direct Pressure	7(100%)	0	7
Dressing Application	28(96.55%)	1(3.44%)	29
Incubator	2(100%)	0	2
Inter costal drain	3(100%)	0	3
Limb Elevation	1(100%)	0	1
Limb Splinting	3(100%)	0	3
Maternity	3(100%)	0	3
Nebulization	6954(94.15%)	432(5.84%)	7386
Oxygen Administration	4890(98.41%)	79(1.59%)	4969
Pelvis Splinting	1(100%)	0	1
Pressure Dressing	2(100%)	0	2
Spinal Immobilisation	11(100%)	0	11
Synchronized Cardioversion	2(100%)	0	2
Tourniquet Application	1(100%)	0	1
Urinary Catheter	12(100%)	0	12
Ventilation	12(100%)	0	12

No treatment provided	20429(95.29%)	1008(4.70%)	21437
<u>Medications administered</u>			
Aspirin	100(100%)	0	100
Adenosine	3(100%)	0	3
Adrenaline	49(100%)	0	49
Amiodarone	6(100%)	0	6
Atropine	2(100%)	0	2
Calcium Chloride	6(100%)	0	6
Activated Charcoal	2(100%)	0	2
Clopidogrel	1(100%)	0	1
Dextrose	86(95.55%)	4(4.44%)	90
Diazepam	8(100%)	0	8
Entonox	7(100%)	0	7
Etomidate	2(100%)	0	2
Fenoterol	1702(92.90%)	130(7.09%)	1832
Flumazenil	1(100%)	0	1
Furosemide	83(100%)	0	83
Glucogel	50(98.04%)	1(1.96%)	51
Isordil	47(100%)	0	47
Hexoprenaline	1(100%)	0	1
Hydrocortisone	219(97.33%)	6(2.66%)	225
H_Monohyd~de	103(99.04%)	1(0.96%)	104
Ipratropium Bromide	4629(93.61%)	316(6.39%)	4945
Ketamine	1(100%)	0	1
Lorazepam	1(100%)	0	1
Magnesium Sulphate	175(98.87%)	2(1.13%)	177
M_MonoH	3(100%)	0	3
Midazolam	11(100%)	0	11
Morphine Sulphate	23(100%)	0	23
Naloxone	1(100%)	0	1
Prednisone	82(93.18%)	6(6.81%)	88
Promethazine	2(66.66%)	1(33.33%)	3
Rocuronium	2(100%)	0	2
Salbutamol	4366(93.91%)	283(6.08%)	4649
Sodium Bicarbonate	45(88.23%)	6(11.76%)	51
Sodium Chloride	1(100%)	0	1
Thiamine	4(100%)	0	4
No medication administered	25265(95.94%)	1067(4.05%)	26332

Table 2 compared the clinical characteristics of those conveyed and not conveyed using the specific variables of patient priority, triage, mobility, treatment required, day of the week, and medication administered. As indicated, patient priority of the non-conveyed calls, the majority representing 73.34% (n = 1081) were assigned a priority level of P1 and the remaining 26.66% (n = 393) were assigned a priority level of P2. On the other hand, with the conveyed calls, the majority representing 95.14% (n = 21183) were assigned a priority level of P1 and the remaining 33.15% (n = 10505) were assigned a priority level of P2. P1 (life-threatening

sickness, injury, or circumstance) were more likely to be transported. Non-life-threatening emergencies are classified as Priority 2 (P2) were less likely to be transported. Regarding the patient triage colour coding, as indicated in the triage the majority, 45.16% (n = 504), of respiratory complaint calls that ended in non-conveyance had a final triage colour code of Yellow, followed by 31.00% (n = 346) coded Green, 22.31% (n = 249) coded Orange, 1.43% (n = 16) coded Red. On the other hand, the majority, 44.56% (n = 14146), of respiratory complaint calls that ended in conveyance had a final triage colour code of Yellow, followed by 29.93% (n = 9501) coded Orange, 17.63% (n = 5598) coded Green, and 6.87% (n = 2182) coded Red. Furthermore, patients' common triage mobility was walking 719 representing 64.48% and arrived with help 193 representing 17.31%. Fewer were normal for age 163 representing 14.62%, or brought on stretchers 37 representing 3.32%, and only 3 were unable to walk as representing 0.27%. It was uncommon for the patients to be unable to move. Pertaining to the ambulance call characteristic of treatment received, the majority of non-conveyed patients (65.84%, n = 1008) received no treatment, while 28.22% (n = 432) received nebulisation, 5.16% (n = 79) were administered oxygen. Additional treatments that were indicated included basic airway manoeuvres 0.46% (n = 7), 0.2% (n = 3) received other airway treatments, 0.07% (n = 1) received basic airway procedure, and 0.07% (n = 1) required dressing application. Based on the findings, the prevalence of non-conveyance of respiratory distress patients during the week was noted to account for 63.90% (n = 954). On the other hand, the remaining 36.10% (n = 539) of non-conveyance calls were prevalent during the weekend. Moreover, based on the findings regarding medication administered, it is worth noting that the majority of the non-conveyed calls (58.53%; n = 1067) had no indication of any medication being administered. On the other hand, a significant number of non-conveyed calls were noted to have received I_Bromide (17.33%; n = 316), Salbutamol (15.52%; n = 283), and Feneterol (7.13%; n = 130).

Multivariate regression analysis

Following multivariate regression ($R^2 = 0.047$; Area under ROC curve = 0.68; Prob > $\chi^2 = 0.0000$), the following variables increased the odds of non-conveyance: Green triage (OR 2.04; 95% CI 1.77-2.36; $p < 0.01$), weekends (OR 1.27; 95% CI 1.12-1.44; $p < 0.01$), and nebulisation on scene (OR 1.47; 95% CI 1.23-1.74; $p < 0.01$). Conversely, dispatch priority 2 (less urgent; OR 0.66; 95% CI 0.57-0.76; $p < 0.01$), orange triage (OR 0.68; 95% CI 0.58-0.80; $p < 0.01$), red triage (OR 0.22; 95% CI 0.13-0.37; $p < 0.01$), and oxygen administration (OR 0.52, 95% CI 0.41-0.67; $p < 0.01$) were all associated with decreased odds of non-conveyance.

Discussion

This study aimed to evaluate the variables associated with the non-conveyance of patients with respiratory complaints in Western Cape, South Africa, over a one year period. 33254 calls were analysed for the variables associated with non-conveyance. The following is a discussion of the key results that were obtained from the data analysis presented in the previous section the results.

Prevalence of Non-Conveyance

The results show that 4.5% (n = 1,493) patients with respiratory complaints in this study were not conveyed, much lower than rates observed elsewhere (7). According to a recent systematic review of non-conveyance, non-conveyance occurs in all types of EMS-systems, and non-conveyance rates for general patient groups range from 3.7 to 93.7%(7). For example, a study in the UK shows that half of the patients who received a response over the phone or in person were not conveyed to an emergency centre (3). In a study from Sweden, a total of 2691 (12%) patients out of 23,250 served during the research period were not conveyed (18). Additionally, non-conveyance rates identified in other contexts are lower than this rate (18). Consequently, the findings from this study aligned with those from the reviewed literature (7). However, the findings from this study were specific to the non-conveyance of respiratory distress complaints, a topic not previously explored.

The findings from a South African study indicated that every year, there are more patients who are not conveyed to hospital (6). The introduction of defensive dispatch triage systems, the inability of the emergency medical dispatcher to effectively determine the severity of the issue, and the fact that an ambulance is dispatched “to be safe” are all factors contributing to this rise in the number of non-conveyances (6). Some patients are likely not to have other means of transportation. The reason for this could be South Africa’s diverse population and individual socio-economic status.

Compared to South African Triage Scale (SATS), a defensive dispatch triage system is a system designed to help prioritize the dispatch of emergency response personnel and resources to an incident (4). It involves assessing the incident and then making decisions about which responders and resources should be dispatched, and in what order. This system is designed to help first responders better manage incidents and ensure the safety of personnel and the public. A defensive system aims to minimise risks, while an offensive system aims to maximise gains (27).

In addition, one study in the UK found that patients often lack confidence in their primary care physicians, especially after-hours (19).

In another study from Sweden, there is another form of contradictory exposure to the physicians. They had to undergo difficulties after performing non-conveyance assessments due to limited access to medical records and data. Physicians also felt that they are provided care without the support of other healthcare professionals. They endured frustration and lack of knowledge (14).

Additionally, physicians could undergo dissatisfaction due to lack of knowledge in certain areas. For that reason they might be concerned to make false assessments that would affect the patients (14).

Factors that affect non-conveyance

Cases triaged as “Green” (or non-urgent) was a strong predictor of non-conveyance, while orange (urgent) and red (emergent) triage codes were predictors of conveyance. In the reviewed literature, patients’ triage codes were noted to have a significant impact on the likelihood of non-conveyance, with lower patient triage rankings/scores being significantly associated with a higher likelihood of not being transported to hospital (10). This implies that EMS may be more likely to leave patients on scene if they are deemed to have a lower acuity level.

However, there are some potential implications of relying on triage colours to determine which patients are sent to the hospital. For example, EMS professionals may have difficulty in identifying subtle signs of illness that could lead to a patient’s deterioration, especially if the vital signs have not changed to influence the triage code. Additionally, there can be a lack of access to medical resources in certain areas, which can lead to a delay in treatment and, in some cases, lead to potentially life-threatening consequences. Overall, triage colours can be a useful tool for quickly identifying those patients who need to be sent to the hospital for further treatment, but it is important to be aware of the potential implications of relying too heavily on this system.

The research findings further indicated that the odds of non-conveyance were higher during weekends. These findings were also identified in previous research which identified higher

non-conveyance rates during weekends compared to weekdays (18, 20, 21). One explanation for this might be that many community health centres or public transport services do not operate during weekends, leaving patients no choice but to seek care via the emergency medical services.

Interestingly, nebulisation was noted to be significantly associated with non-conveyance. These findings were in line with those from the reviewed literature which identified that nebulisation was suggested as a typical remedy for respiratory symptoms, obviating the necessity for conveyance to the hospital (10). This perhaps makes an important point for community-based primary care services to be developed to treat patients with low acuity respiratory complaints at home. Nebulisation for bronchospasm typically consists of a mixture of Salbutamol, Ipratropium Bromide, and Normal Saline 0.9%. However, given that none of the inhalant medications were found to affect the odds of non-conveyance, it can be assumed that either the data is being captured incorrectly (with EC providers only recording the fact that they initiated nebulisation, and not recording the medication) or that only nebulisation with saline, was administered. This might also be related to the scope of practice of the ambulance crew as only intermediate life support or higher were permitted to administer nebulised medications. Future research should explore this a bit more deeply, including mechanisms to follow up on these patients. This could help determine rates of repeat ambulance requests, and their outcomes.

The administration of oxygen was associated with a lower likelihood of non-conveyance. Oxygen is indicated for patients who are hypoxemic on assessment and may indicate some respiratory instability or compromise. This may have elevated the index of suspicion of prehospital providers for severe disease, leaving them more likely to transport the patient to hospital. Future research should determine whether oxygen was truly indicated in these patients, and whether they truly did have clinically significant pathology.

The study findings noted that a priority designation of P2 was significantly less likely to result in non-conveyance compared to a designation of P1. Ambulance calls that received a higher priority level were more likely to result in non-conveyance. These findings were in line with those from the reviewed literature which noted that the greater the urgency level of an ambulance call, the higher the likelihood of non-conveyance (7, 11). A potential reason behind this observation is that the urgency level of the call is typically determined by the caller's assessment of the situation's severity, and the call-takers interpretation of available the information. Consequently, when EC providers examine the patient, they may realise that patient's condition does not necessitate urgent transportation to the hospital.

When undertaking future work to determine the appropriateness of decisions not to convey the patients (outcome data), it is important to carefully consider the time intervals under study. Employing a short time frame may omit events related to the non-conveyance decision, while using a longer period of time may result in the inclusion of events unrelated to the non-conveyance decision (9). Previous research found that a three-day interval was appropriate since events occurring during this time are likely to be related to the choice of not to convey (22). Future research should also consider the perspective of the patient and public, seeking to understand their specific needs and reasons for seeking emergency medical services care.

A literature study, set in the UK, revealed that patients thought that primary care was difficult to access, and it required long waiting times (19). Adding on, another problem is the lack of awareness about after-hours care providers or alternative services. This is also mentioned by Baier, Geissler (23), who said that the healthcare system has to be properly guided since patients do not completely understand it. A systematic review was set in Australia, Denmark, England, France, Germany, and the Netherlands concluded that stronger regulations may improve the coordination of primary care and emergency care (23). Non-emergency calls constitutes significant proportion of non-conveyed patients as shown in previous research in various contexts. The utilisation of EMS services by non-urgent patients are universally identified to have a detrimental impact on patient outcomes, diminishing productivity, and resulting in financial losses (20, 22). These adverse effects are expounded by the fact that non-urgent patients represent a significant proportion of requests for EMS services in numerous settings across the globe, including South Africa (1, 3, 12, 24, 25). However, from the results in this study it does not appear to result in non-conveyance and referral to primary care facilities. This may be for a number of reasons, including lack of training and prehospital discharge protocols, poor communication, and fear of legal consequences (26).

Conclusion

Compared to national and international levels, the our results indicated a lower ratio of patients with respiratory complaints who were not conveyed. In the non-conveyed patient group, there were no statistically significant differences among gender or age. Patients were more likely to not be conveyed if they were triaged as “green” (non-urgent), if they presented on the weekends or if they received nebulisation on scene. Conversely, dispatch priority 2 (less urgent), orange (urgent) and red (emergent) triage, and oxygen administration were all associated with decreased odds of non-conveyance.

It is, however, unclear whether these decisions were clinically appropriate, or whether they resulted in patient harm. Future research should seek to investigate the outcomes of patients who were not conveyed to hospital as well as those who were transported and not admitted. A key point missing in this study is also the publics perspective on whether non-conveyance is an acceptable approach to care in this setting. Importantly though, non-emergency use of EMS resources can impose a substantial burden on emergency response systems and the communities they serve, as it increases the response time for life-threatening cases. This is especially true in resource constrained settings like South Africa.

References

1. Goldstein LN, Sibanyoni S, Vincent-Lambert C. On-scene discharge by Emergency Care Practitioners—a viable option for South Africa? *South African Journal of Pre-Hospital Emergency Care*. 2020;1(1):3-8.
2. Stein C, Wallis L, Adetunji O. Meeting national response time targets for priority 1 incidents in an urban emergency medical services system in South Africa: More ambulances won't help. *South African Medical Journal*. 2015;105(10):840-4.
3. Ebben RH, Vloet L, Speijers RF, Tönjes NW, Loef J, Pelgrim T, et al. A patient-safety and professional perspective on non-conveyance in ambulance care: a systematic review. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2017;25(1):1-20.
4. Gratton MC, Ellison SR, Hunt J, Ma OJ. Prospective determination of medical necessity for ambulance transport by paramedics. *Prehospital Emergency Care*. 2003;7(4):466-9.
5. Weaver MD, Moore CG, Patterson PD, Yealy DM. Medical necessity in emergency medical services transports. *American Journal of Medical Quality*. 2012;27(3):250-5.
6. Alshehri M, Pigoga J, Wallis L. A mixed methods investigation of emergency communications centre triage in the Government Emergency Medical Services System, Cape Town, South Africa. *African Journal of Emergency Medicine*. 2020;10:S12-S7.
7. Ebben RH, Castelijns M, Frenken J, Vloet LC. Characteristics of non-conveyance ambulance runs: A retrospective study in the Netherlands. *World Journal of Emergency Medicine*. 2019;10(4):239.
8. Meghoo CA, Gaievskyy S, Linchevskyy O, Oommen B, Stetsenko K. Prehospital response to respiratory distress by the public ambulance system in a Ukrainian city. *World Journal of Emergency Medicine*. 2019;10(1):42.
9. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Characteristics affecting variation in non-conveyance rates: analysis of routine data (work package 2). *Understanding variation in ambulance service non-conveyance rates: a mixed methods study*: NIHR Journals Library; 2018.
10. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Variation in non-conveyance of patients with breathing problems (work package 4.2). *Understanding variation in ambulance service non-conveyance rates: a mixed methods study*: NIHR Journals Library; 2018. p. 87-91.
11. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Djärv T. Non-conveyance in the ambulance service: a population-based cohort study in Stockholm, Sweden. *BMJ open*. 2020;10(7):e036659.

12. Leikkola P, Mikkola R, Salminen-Tuomaala M, Paavilainen E. Non-conveyance of patients: Challenges to decision-making in emergency care. *Clinical Nursing Studies*. 2016;4(4):31-9.
13. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Ljunggren G, Djärv T. Non-conveyance of older adult patients and association with subsequent clinical and adverse events after initial assessment by ambulance clinicians: a cohort analysis. *BMC emergency medicine*. 2021;21(1):1-11.
14. Lederman J, Löfvenmark C, Djärv T, Lindström V, Elmqvist C. Assessing non-conveyed patients in the ambulance service: a phenomenological interview study with Swedish ambulance clinicians. *BMJ open*. 2019;9(9):e030203.
15. Chiwire P, Beaudart C, Evers SM, Mahomed H, Hiligsmann M. Enhancing Public Participation in Public Health Offerings: Patient Preferences for Facilities in the Western Cape Province Using a Discrete Choice Experiment. *International Journal of Environmental Research and Public Health*. 2022;19(1):590.
16. Office SAS. South Africa's Provincial Population Estimates (2022)2022; (10 February 2023). Available from: <https://www.statssa.gov.za/publications/P0302/P03022021.pdf>.
17. Reimann C, Filzmoser P, Garrett R, Dutter R. *Statistical data analysis explained: applied environmental statistics with R*: John Wiley & Sons; 2011.
18. Forsgårde E-S, Elmqvist C, Fridlund B, Svensson A, Andersson R, Röst M. Patients' aged ≥ 65 years dispositions during ambulance assignments, including factors associated with non-conveyance to hospital: a longitudinal and comparative study. *BMJ open*. 2020;10(11):e038885.
19. Coster JE, Turner JK, Bradbury D, Cantrell A. Why do people choose emergency and urgent care services? A rapid review utilizing a systematic literature search and narrative synthesis. *Academic emergency medicine*. 2017;24(9):1137-49.
20. Forsell L, Forsberg A, Kisch A, Rantala A. Inequalities and short-term outcome among patients assessed as non-urgent in a Swedish ambulance service setting. *International emergency nursing*. 2021;57:101018.
21. Moafa HN, van Kuijk SM, Moukhyer ME, Alqahtani DM, Haak HR. Non-Conveyance due to patient-initiated refusal in emergency medical services: a retrospective population-based registry analysis study in Riyadh Province, Saudi Arabia. *International journal of environmental research and public health*. 2021;18(17):9252.
22. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Understanding variation in ambulance service non-conveyance rates: a mixed methods study. *Health Services and Delivery Research*. 2018;6(19):1-224.
23. Baier N, Geissler A, Bech M, Bernstein D, Cowling TE, Jackson T, et al. Emergency and urgent care systems in Australia, Denmark, England, France, Germany and the Netherlands—Analyzing organization, payment and reforms. *Health Policy*. 2019;123(1):1-10.

24. Hoikka M, Silfvast T, Ala-Kokko TI. A high proportion of prehospital emergency patients are not transported by ambulance: a retrospective cohort study in Northern Finland. *Acta Anaesthesiologica Scandinavica*. 2017;61(5):549-56.
25. Kannan V, Tenner A, Sawe H, Osiro M, Kyobe T, Nahayo E, et al. Emergency care systems in Africa: a focus on quality. *African Journal of Emergency Medicine*. 2020;10:S65-S72.
26. O'Cathain A, Simpson R, Phillips M, Knowles E. Tendency to call an ambulance or attend an emergency department for minor or non-urgent problems: a vignette-based population survey in Britain. *Emergency Medicine Journal*. 2022;39(6):436-42.
27. Vloet L, de Kreek A, van der Linden E, van Spijk JJ, Theunissen VA, van Wanrooij M, et al. A retrospective comparison between non-conveyed and conveyed patients in ambulance care. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2018;26(1):1-10.

PART C: PROPOSAL

Proposal

Determining the variables associated with EMS non-conveyance of patients with respiratory complaints in Western Cape, South Africa: A retrospective chart review.

Student name: Mohammed K AISufayan

Student ID No: ALSMOH021

Email address: ALSMOH021@myuct.ac.za

Supervisors:

Dr Willem Stassen, B. Tech EMC, MPHIL EM, PhD EM, University of Cape Town

Co- Supervisors:

Mr. Faisal Binks, University of Cape Town

Mr. Wesley Craig, BEMC, MEMC, University of Cape Town

TABLE OF CONTENTS

Plagiarism Declaration	ii
Table of Contents.....	iii
List of Tables	vi
Abbreviations	vii
PART A: BACKGROUND AND LITERATURE REVIEW	1
Background.....	2
Overview of Provincial Government Western Cape Emergency Medical Services Care....	2
Ambulance Non-Conveyance.....	3
Appropriate vs Inappropriate Non-Conveyance	3
Non-Conveyance of Respiratory Complaint Patients	4
Factors Associated to Non-Conveyance.....	5
Literature Review	6
Overview of Emergency Care in South Africa.....	6
Emergency Centre	6
The Increasing Demand for Emergency Care.....	7
Non-Urgent Care Patients	7
Ambulance Non-Conveyance.....	8
Procedures and Protocols for Non-Conveyance and On-Scene Discharge	9

Factors Associated with Ambulance Non-Conveyance.....	10
Non-Conveyance of Patients with Respiratory Complaints	12
Summary	13
References	15
PART B: MANUSCRIPT IN ARTICLE FORMAT	20
Introduction	23
Methodology	24
Study Setting.....	25
Data Collection.....	25
Data Analysis	26
Results.....	27
Discussion	31
Prevalence of Non-Conveyance.....	31
Factors that affect non-conveyance.....	32
Conclusion	35
References	36
PART C: PROPOSAL	39
Background.....	1
Clinical risks of non-conveyance	1

Appropriate vs inappropriate non-conveyance	2
Non-conveyance of respiratory complaint patients	2
Factors affecting non-conveyance.....	3
Purpose Of The Study.....	4
Research aim.....	4
Research objectives.....	4
Methodology	4
Study design	4
Characteristics of the study population.....	5
Research procedures and data collection methods	5
Data analysis	6
Description Of Risks And Benefits.....	6
Research Outputs	6
Proposed Timeline	8
References	9
APPENDICES.....	15
Resources and Budget.....	16
Ethics Approval.....	17

Background

Across the world and in South Africa (the study setting), there is an increasing trend of emergency service demand for ambulances, commonly known as emergency medical services (EMS). This has led to increasing pressure on ambulance capacity and the broader healthcare system (1, 2). However, not all patients who call for an ambulance require conveyance to hospital, regardless of the acuity of their healthcare problems. A significant proportion of ambulance responses result in non-conveyance. Across the globe, an estimated 11%-61% of conveyances have been noted to be medically unnecessary (6, 7). Furthermore, due to increased demand for treatment and non-urgent patients, other stakeholders in the emergency care system, such as emergency departments (ED) and primary care, are under pressure (6, 7). Some solutions, such as ambulance non-conveyance, were established in response to these issues in order to relieve the burden (1). Overall, these measures aid healthcare practitioners in lowering demand for services and this could also result in the increase in healthcare practitioners' workload who now have to perform on-scene discharge (1). However, this frequently results in patients switching from one healthcare service provider to another (1).

Ambulance non-conveyance

Non-conveyance refers to an appropriate ambulance deployment in which patients do not need to be conveyed to hospital after being examined and/or treated on-scene (5). Non-conveyance can also be caused by on-scene discharge (1). On the other hand, the patient's refusal to be transported is another cause non-conveyance (4). Both these causes of on-scene discharge potential come down to the low acuity of patients (4). In South Africa, however, this difference is not made for Emergency Care Practitioners (ECPs) (1). The non-conveyance of low-acuity patients is used as a solution to the problem of hospital crowding (5). However, the safety of non-conveyance is debatable, and it affects ambulance availability and, as a result, EMS system efficiency.

Clinical risks of non-conveyance

Finding a balance between safety and efficiency is one of the most difficult tasks in ambulance care (8). A significant number of non-conveyances can reduce ambulance availability and deplete human resources, particularly in circumstances where no care is offered (8). Furthermore, it poses a risk to patients who require transportation or immediate medical attention (9). To minimise poor health outcomes and inappropriate resource allocation, more

efficiency and accuracy in dispatching ambulances is required. While this is desirable, underestimating a patient's health status, may result in health issues (8). It is critical to understand the characteristics that influence ambulance non-conveyance in order to enhance the identification of these occurrences and better comprehend the requirements of patients.

Appropriate vs inappropriate non-conveyance

Given the significance of clinical risks associated with non-conveyance, a distinction between appropriate and inappropriate conveyance represents an important consideration. According to previous research (10), the decision not to convey could have been appropriate at the time, or it might have been inappropriate and endangered patient safety. It is difficult to tell the difference between predictable subsequent events (like patients dying at an advanced age) and possibly avoidable subsequent events (like a child being admitted to the hospital with a fever) (9).

Some researchers employed an expert panel to evaluate the propriety of non-conveyance judgments (11). This method, however, takes time and can only be used to evaluate a small number of calls. An alternate strategy, appropriate for large numbers of calls, includes linking routinely accessible data from ambulance services and hospital patient records to identify following events within a specified time frame (9). Hospitalisation and reconnection with ambulance services are examples of these events. The absence of knowledge about particular situations under this approach, however, makes it difficult to judge the appropriateness of the choice not to convey.

The time interval for measuring future events after non-conveyance is unknown. Employing a short time frame may omit events related to the non-conveyance decision, while using a lengthy time period may result in the inclusion of events unrelated to the non-conveyance decision (9). Previous research found that a three-day interval was appropriate since events occurring during this time are likely to be related to the choice not to convey (9).

Previous research into the factors or variables associated with the non-conveyance of patients does not consider the appropriateness of the decision not to transport patients to hospital. This represents a gap that the present study will address in determining the variables affecting, specifically, appropriate non-conveyance of patients to hospital.

Non-conveyance of respiratory complaint patients

Of particular concern to this research is the non-conveyance of respiratory complaint patients whom represent a significant proportion of all ambulance non-conveyances as indicated in a UK study (12). The non-conveyance of respiratory complaint patients significantly mitigates against hospital crowding; however, these patients are noted to have the highest rates of EMS recontact, hospital admission and mortality after the fact (12). This represents a major problem and there may be repercussions for the failure to develop newer approaches to the non-conveyance of respiratory complaint patients. A major cause of this problem is the limited knowledge on the prevalence, characteristics and predictors of the non-conveyance of respiratory complaint patients to inform the EMS dispatch systems. Possible solutions involve addressing the current knowledge gap by examining the prevalence, characteristics, and predictors of respiratory complaints with a high likelihood of non-conveyance encountered by EMS.

Factors affecting non-conveyance

There is little knowledge of the reasons for the appropriate non-conveyance of patients to the hospital. According to previous Finnish research, the most common cause for non-transportation is the lack of a necessity for treatment (14). Furthermore, these patients may have been treated by their primary care physician or did not require any care at all (15). Several variables that determine non-conveyance was discovered in prior studies. The probability of non-conveyance is raised by the urgency of the call, the time of day, a greater distance to a healthcare centre (16), the patient's higher educational level (17), the patients' younger age, and a rural region (3). In contrast, urban environments, comorbidities, and patients' advanced age all enhance the likelihood of conveyance (16).

When patients are not conveyed, levels of urgency and vital signs-based guidelines are used to assess them (57). Results from previous research have shown that vital signs are inadequate markers for assessing the acute care requirements of elderly patients with non-specific illness (16). There are equivocal results about variations in evaluation and treatment between males and females for many types of disorders (1, 16). Non-conveyance judgments are difficult, and the accompanying recommendations have had mixed results in establishing appropriate care levels for non-conveyed patients (5, 15). Some research has emphasised the need for further knowledge into the features of the non-conveyed population in order to establish procedures with a greater degree of patient safety (5, 18). According to prior studies, the non-conveyance decision-making process appears to be complicated, and it is impacted by a number of factors from the viewpoints of both EMS personnel and patients (19). However,

in the case of South Africa, there is no information on the characteristics linked with hospital non-conveyance.

In summary, in the South African EMS setting, the rising need for emergency care and transport pose issues (2). To increase the quality of care and efficiently use resources, more optimum use of care and more appropriate patient conveyance are required. Since it was shown that non-conveyance is typically a source of inefficiency, the problem has received greater attention recently (1, 6, 7). Reduced inefficiencies might aid ambulance care in operating efficiently and effectively. However, striking a balance between safety and efficiency is challenging, and little is known about non-conveyance, particularly in South Africa. As a result, the purpose of this study is to present an overview of the variables associated with EMS non-conveyance of respiratory complaints in the Western Cape of South Africa. Furthermore, an understanding of the causes of non-conveyance patients to the hospital and their predictions.

Purpose Of The Study

Research aim

The aim of this study is to determine the variables that are associated with the non-conveyance of patients with respiratory complaints in South Africa based on the cases of the Provincial Government Western Cape (PGWC) EMS. The following research question translates this aim: "What are the characteristics of EMS non-conveyance of respiratory complaint patients in the Western Cape Province of South Africa?"

Research objectives

The aim of this research will be achieved through the attainment of the following research objectives:

1. To assess the prevalence and trend of the non-conveyance of respiratory complaints patients by the PGWC EMS
2. To identify the factors associated with the non-conveyance of respiratory complaints patients by the PGWC EMS.

Methodology

Study design

This research will adopt a retrospective chart review design, a study design involving the use of pre-recorded data to address one or more research questions (58). The retrospective chart review design will be chosen as it is a useful method in instances where data has been recorded on a database and an analysis of the data elements needs to be done (58). This study will consist of a sub-analysis of data already collected and approved (HREC 546/2019). Given that this research will be based on ambulance conveyance and non-conveyance records of respiratory complaints obtained from the Electronic Patient Care Report (ePCR) database of the PGWC EMS, the adoption of the retrospective chart review design is well justified, as it includes both Tx and not Tx data. The retrospective chart review methods in this study will be informed by Gilbert, Lowenstein (59) and will involve selecting patients to be studied, assembling of necessary charts, locating the desired information, coding information, performing the appropriate statistical analysis, and drawing inferences.

Characteristics of the study population

The data for this research will be sampled from an estimated population of 6.94 million individuals serviced by the PGWC EMS. The sample for this study will be based on the population-based ePCR data on respiratory complaints from 1 October 2018 to 30 September 2019. The study sample will be selected using census , involving the selection of cases that meet specific inclusion and exclusion criteria identified in the next section. The sample size of the calls that will be included in this study will be 213 461 individuals from the targeted population.

Research procedures and data collection methods

The data for this research will be collected from the ePCR database for the PGWC EMS. The ambulance calls that will be selected based on the following inclusion criteria:

- I. Ended in non-conveyance, but including conveyance for more accurate comparison
- II. The patient complaint call was for respiratory complaints, and
- III. The ePCR had complete data (complete for the data points this study requires)

In addition, ambulance responses which ended in the death of the patient will be excluded from the sample.

The ambulance calls that meet the criteria above will be used for the research. From the selected data set, specific data points will be collected including the characteristics of the

ambulance response, care process, and patient characteristics (Computer Aided Dispatch (CAD) Priority, electronic patient care report (ePCR) patient triage colour final, treatment, day, time, medications provided, first ePCR vital signs, Gender, Age and Mobility). Data from dispatch and from the actual ambulance response were linked by using the unique identification number.

Data analysis

The statistical analysis for this research will be done using R (21), a quantitative data analysis software. Assessment of the trend and prevalence of the non-transport of respiratory complaint patients will be determined using descriptive statistics. Univariate analysis will be used to compare the prevalence of non-conveyances for respiratory complaints across categorical variables (demographic and clinical characteristics). The significance of the findings will be determined by confidence intervals of 95% and statistical significance of < 0.05.

Multivariate logistic and linear regressions will be used to assess the extent to which the independent variables explain the dependent variable. The independent variables for this research will be the characteristics of the ambulance response, care process, and patient characteristics (CAD Priority, ePCR Patient Triage colour final, Treatment, day/time, Medications provided, First ePCR vital signs, Gender, Age and Mobility). On the other hand, the dependent or outcome variable will be non-conveyance to hospital. The regression results will be presented as odds ratios (ORs) and beta-coefficients with confidence intervals (95% CIs). The criteria for statistical significance of the findings will be an alpha value of <0.05.

Description Of Risks And Benefits

This study utilizes data that directly obtained from human participants, however, it poses little to no risk or harm to humans. The design and conducting of this entire research will abide by the research policy guidelines laid out by the University of Cape Town (UCT). This research will also be conducted with ethical clearance from UCT Human Research Ethics Committee (HREC) as well as with written permission from the PGWC EMS. This research will make use of anonymised electronic patient records from an ePCR database registered with UCT. The study is a sub-analysis of anonymised data gathered in the PhD study (**UCT HREC Ref 546/2019**). Therefore, a waiver of informed consent will be sought

Research Outputs

The deliverables from this study will include the following:

1. Determination of the prevalence and characteristics of respiratory complaint patients who are not conveyed by PGWC EMS.
2. Identification of the independent and dependent variables for the non-conveyance of respiratory complaint patients encountered by the PGWC EMS.
3. A thesis available at the UCT repository.
4. A research article to be published in an internationally recognised peer-reviewed medical journal, addressing the gap in the current body of knowledge on the prevalence and determinants of the non-conveyance of respiratory complaint patients in South Africa.

Proposed Timeline

The proposed timeline for this research is illustrated in the following Table 1 above.

Table 3: Proposed timeline

	July	August	September	October	November	December
EMDRC						
Data Collection						
Data Analysis						
Write up						
Submission						

References

1. Goldstein LN, Sibanyoni S, Vincent-Lambert C. On-scene discharge by Emergency Care Practitioners—a viable option for South Africa? *South African Journal of Pre-Hospital Emergency Care*. 2020;1(1):3-8.
2. Stein C, Wallis L, Adetunji O. Meeting national response time targets for priority 1 incidents in an urban emergency medical services system in South Africa: More ambulances won't help. *South African Medical Journal*. 2015;105(10):840-4.
3. Alanazy ARM, Wark S, Fraser J, Nagle A. Nontransported Cases after Emergency Medical Service Callout in the Rural and Urban Areas of the Riyadh Region. *Saudi Journal of Medicine & Medical Sciences*. 2021;9(1):38.
4. Ebben RH, Castelijns M, Frenken J, Vloet LC. Characteristics of non-conveyance ambulance runs: A retrospective study in the Netherlands. *World Journal of Emergency Medicine*. 2019;10(4):239.
5. Lederman J, Lindström V, Elmquist C, Löfvenmark C, Djärv T. Non-conveyance in the ambulance service: a population-based cohort study in Stockholm, Sweden. *BMJ open*. 2020;10(7):e036659.
6. Gratton MC, Ellison SR, Hunt J, Ma OJ. Prospective determination of medical necessity for ambulance transport by paramedics. *Prehospital Emergency Care*. 2003;7(4):466-9.
7. Weaver MD, Moore CG, Patterson PD, Yealy DM. Medical necessity in emergency medical services transports. *American Journal of Medical Quality*. 2012;27(3):250-5.
8. Ebben RH, Vloet L, Speijers RF, Tönjes NW, Loef J, Pelgrim T, et al. A patient-safety and professional perspective on non-conveyance in ambulance care: a systematic review. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2017;25(1):1-20.
9. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Understanding variation in ambulance service non-conveyance rates: a mixed methods study. *Health Services and Delivery Research*. 2018;6(19):1-224.
10. Oosterwold J, Sagel D, Berben S, Roodbol P, Broekhuis M. Factors influencing the decision to convey or not to convey elderly people to the emergency department after emergency ambulance attendance: a systematic mixed studies review. *BMJ open*. 2018;8(8):e021732.

11. Tohira H, Fatovich D, Williams TA, Bremner AP, Arendts G, Rogers IR, et al. Is it Appropriate for Patients to be Discharged at the Scene by Paramedics? *Prehospital Emergency Care*. 2016;20(4):539-49.
12. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Variation in non-conveyance of patients with breathing problems (work package 4.2). Understanding variation in ambulance service non-conveyance rates: a mixed methods study: NIHR Journals Library; 2018. p. 87-91.
13. Alshehri M, Pigoga J, Wallis L. A mixed methods investigation of emergency communications centre triage in the Government Emergency Medical Services System, Cape Town, South Africa. *African Journal of Emergency Medicine*. 2020;10:S12-S7.
14. Hoikka M, Silfvast T, Ala-Kokko TI. A high proportion of prehospital emergency patients are not transported by ambulance: a retrospective cohort study in Northern Finland. *Acta Anaesthesiologica Scandinavica*. 2017;61(5):549-56.
15. Leikkola P, Mikkola R, Salminen-Tuomaala M, Paavilainen E. Non-conveyance of patients: Challenges to decision-making in emergency care. *Clinical Nursing Studies*. 2016;4(4):31-9.
16. Forsgårde E-S, Elmqvist C, Fridlund B, Svensson A, Andersson R, Rööst M. Patients' aged ≥ 65 years dispositions during ambulance assignments, including factors associated with non-conveyance to hospital: a longitudinal and comparative study. *BMJ open*. 2020;10(11):e038885.
17. Höglund E, Andersson-Hagiwara M, Schröder A, Möller M, Ohlsson-Nevo E. Characteristics of non-conveyed patients in emergency medical services (EMS): a one-year prospective descriptive and comparative study in a region of Sweden. *BMC emergency medicine*. 2020;20(1):1-11.
18. Lederman J, Lindström V, Elmqvist C, Löfvenmark C, Ljunggren G, Djärv T. Non-conveyance of older adult patients and association with subsequent clinical and adverse events after initial assessment by ambulance clinicians: a cohort analysis. *BMC emergency medicine*. 2021;21(1):1-11.
19. Lederman J, Löfvenmark C, Djärv T, Lindström V, Elmqvist C. Assessing non-conveyed patients in the ambulance service: a phenomenological interview study with Swedish ambulance clinicians. *BMJ open*. 2019;9(9):e030203.
20. Kannan V, Tenner A, Sawe H, Osiro M, Kyobe T, Nahayo E, et al. Emergency care systems in Africa: a focus on quality. *African Journal of Emergency Medicine*. 2020;10:S65-S72.

21. Tiwari R, Naidoo R, English R, Chikte U. Estimating the emergency care workforce in South Africa. *African Journal of Primary Health Care & Family Medicine*. 2021;13(1):3174.
22. Dixon J, Burkholder T, Pigoga J, Lee M, Moodley K, de Vries S, et al. Using the South African Triage Scale for prehospital triage: a qualitative study. *BMC emergency medicine*. 2021;21(1):1-10.
23. Ndandani M. Living in a hut in 21st century South Africa: African Sun Media; 2015.
24. Anest T, De Ramirez SS, Balhara KS, Hodkinson P, Wallis L, Hansoti B. Defining and improving the role of emergency medical services in Cape Town, South Africa. *Emergency Medicine Journal*. 2016;33(8):557-61.
25. Newton P, Naidoo R, Brysiewicz P. The appropriateness of emergency medical service responses in the eThekweni district of KwaZulu-Natal, South Africa. *South African Medical Journal*. 2015;105(10):844-7.
26. Maphumulo WT, Bhengu BR. Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review. *Curationis*. 2019;42(1):1-9.
27. Schaay N, Sanders D, Kruger V, Olver C. Overview of health sector reforms in South Africa. UK Dept for International Development (DFID) Human Development Resource Centre, London www.hisp.org. 2011.
28. Moosa S, Peersman W, Derese A, Kidd M, Pettigrew LM, Howe A, et al. Emerging role of family medicine in South Africa. *BMJ global health*. 2018;3(Suppl 3):e000736.
29. Uscher-Pines L, Pines J, Kellermann A, Gillen E, Mehrotra A. Deciding to visit the emergency department for non-urgent conditions: a systematic review of the literature. *The American journal of managed care*. 2013;19(1):47.
30. Plat FM, Peters YA, Loots FJ, de Groot CJ, Eckhardt T, Keizer E, et al. Ambulance dispatch versus general practitioner home visit for highly urgent out-of-hours primary care. *Family practice*. 2018;35(4):440-5.
31. O'Cathain A, Simpson R, Phillips M, Knowles E. Tendency to call an ambulance or attend an emergency department for minor or non-urgent problems: a vignette-based population survey in Britain. *Emergency Medicine Journal*. 2022;39(6):436-42.
32. WHO. *Global Atlas of Prehospital Care*. Geneva: World Health Organization; 2017.

33. McAlpine DJ, Hodkinson P, Fleming J. Pre-hospital over-triage and potential contributing factors in Cape Town, South Africa. *South African Journal of Pre-Hospital Emergency Care*. 2020;1(2):6-12.
34. Rosedale K, Smith Z, Davies H, Wood D. The effectiveness of the South African Triage Score (SATS) in a rural emergency department. *South African Medical Journal*. 2011;101(8):537-40.
35. Meyer GD, Meyer TN, Gaunt CB. Validity of the South African Triage Scale in a rural district hospital. *African Journal of Emergency Medicine*. 2018;8(4):145-9.
36. Mould-Millman N-K, Dixon JM, Burkholder T, Pigoga JL, Lee M, de Vries S, et al. Validity and reliability of the South African Triage Scale in prehospital providers. *BMC emergency medicine*. 2021;21(1):1-9.
37. O'Cathain A, Knowles E, Bishop-Edwards L, Coster J, Crum A, Jacques R, et al. Characteristics affecting variation in non-conveyance rates: analysis of routine data (work package 2). *Understanding variation in ambulance service non-conveyance rates: a mixed methods study*: NIHR Journals Library; 2018.
38. Moafa HN, van Kuijk SM, Moukhyer ME, Alqahtani DM, Haak HR. Non-Conveyance due to patient-initiated refusal in emergency medical services: a retrospective population-based registry analysis study in Riyadh Province, Saudi Arabia. *International journal of environmental research and public health*. 2021;18(17):9252.
39. Coster JE, Turner JK, Bradbury D, Cantrell A. Why do people choose emergency and urgent care services? A rapid review utilizing a systematic literature search and narrative synthesis. *Academic emergency medicine*. 2017;24(9):1137-49.
40. HPCSA. *Guidelines for Good Practice in the Health Care Professions*. Pretoria: HPCSA Pretoria; 2016.
41. Vloet L, de Kreek A, van der Linden E, van Spijk JJ, Theunissen VA, van Wanrooij M, et al. A retrospective comparison between non-conveyed and conveyed patients in ambulance care. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2018;26(1):1-10.
42. Paulin J, Kurola J, Salanterä S, Moen H, Guragain N, Koivisto M, et al. Changing role of EMS—analyses of non-conveyed and conveyed patients in Finland. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2020;28(1):1-14.
43. Watson A, Clubbs Coldron B, Wingfield B, Ruddell N, Clarke C, Masterson S, et al. Exploring variation in ambulance calls and conveyance rates for adults with diabetes mellitus who contact the Northern Ireland Ambulance Service: a retrospective database analysis. *British Paramedic Journal*. 2021;6(3):15-23.

44. Thijssen WA, van Miero E, Willekens M, Rebel J, Sandel MH, Giesen P, et al. Complaints and diagnoses of emergency department patients in the Netherlands: a comparative study of integrated primary and emergency care. *PLoS One*. 2015;10(7):e0129739.
45. Forsell L, Forsberg A, Kisch A, Rantala A. Inequalities and short-term outcome among patients assessed as non-urgent in a Swedish ambulance service setting. *International emergency nursing*. 2021;57:101018.
46. Cantwell K, Morgans A, Smith K, Livingston M, Spelman T, Dietze P. Time of day and day of week trends in EMS demand. *Prehospital Emergency Care*. 2015;19(3):425-31.
47. Horvat AM, Dudic B, Radovanov B, Melovic B, Sedlak O, Davidekova M. Binary programming model for rostering ambulance crew-relevance for the management and business. *Mathematics*. 2020;9(1):64.
48. Staudenmayer K, Hsia R, Wang E, Sporer K, Ghilarducci D, Spain D, et al. The forgotten trauma patient: Outcomes for injured patients evaluated by emergency medical services but not transported to the hospital. *The journal of trauma and acute care surgery*. 2012;72(3):594.
49. Ward C, Zhang A, Brown K, Simpson J, Chamberlain J. National Characteristics of Non-Transported Children by Emergency Medical Services in the United States. *Prehospital Emergency Care*. 2021:1-10.
50. Smoliga JM, Mohseni ZS, Berwager JD, Hegedus EJ. Common causes of dyspnoea in athletes: a practical approach for diagnosis and management. *Breathe*. 2016;12(2):e22-e37.
51. Villar J, Blanco J, Kacmarek RM. Current incidence and outcome of the acute respiratory distress syndrome. *Current opinion in critical care*. 2016;22(1):1-6.
52. Meghoo CA, Gaievskyy S, Linchevskyy O, Oommen B, Stetsenko K. Prehospital response to respiratory distress by the public ambulance system in a Ukrainian city. *World Journal of Emergency Medicine*. 2019;10(1):42.
53. Rodgers L, Sheppard M, Smith A, Dietz S, Jayanthi P, Yuan Y, et al. Changes in seasonal respiratory illnesses in the United States during the coronavirus disease 2019 (COVID-19) pandemic. *Clinical Infectious Diseases*. 2021;73(Supplement_1):S110-S7.
54. Chiwire P, Beaudart C, Evers SM, Mahomed H, Hilgsmann M. Enhancing Public Participation in Public Health Offerings: Patient Preferences for Facilities in the Western Cape Province Using a Discrete Choice Experiment. *International Journal of Environmental Research and Public Health*. 2022;19(1):590.

55. Office SAS. South Africa's Provincial Population Estimates (2022)2022; (10 February 2023). Available from: <https://www.statssa.gov.za/publications/P0302/P03022021.pdf>.
56. Reimann C, Filzmoser P, Garrett R, Dutter R. Statistical data analysis explained: applied environmental statistics with R: John Wiley & Sons; 2011.
57. Hauswald M. Can paramedics safely decide which patients do not need ambulance transport or emergency department care? Prehospital Emergency Care. 2002;6(4):383-6.
58. Buxton PS. The Retrospective Record Review: A Methodological Option for Educational Research. Journal of Research in Education. 2021;30(2):17-34.
59. Gilbert EH, Lowenstein SR, Koziol-McLain J, Barta DC, Steiner J. Chart reviews in emergency medicine research: Where are the methods? Ann Emerg Med. 1996;27(3):305-8.

APPENDICES

Resources and Budget

Procurement of all the funds required for this research will be the responsibility of the principal investigator, consequently, this will be self-funded research. The following are the resources required for this research:

1. Access to online databases for primary and secondary data
2. Access to supervision for guidance throughout the research process
3. Access to computing hardware and software
4. Access to a statistician for data analysis
5. Money to cover expenses associated with the research
6. Time to conduct the entire research project.

The study will be self-funded (Table 2) and there will be no applications for funding.

Table 4: Budget

Resources	Description	Amount
Office supplies	Stationery	R500
Printing	Manuscript, submission and reports	R1000
Statistician Services	Consultation and data analysis	R6000
Internet and editing	Editing and language editor, UCT internet access	R2000
Total		R9500

Ethics Approval



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room 4B E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hres-submissions@uct.ac.za
Website: <https://health.uct.ac.za/home/human-research-ethics>

25 October 2022

HREC REF: 649/2022

Dr W Stassen
Division of Emergency Medicine
Γ-51 OMB
Email: willem.stassen@uct.ac.za
Student: mksufayan@gmail.com

Dear Dr Stassen

PROJECT TITLE: DETERMINING THE VARIABLES ASSOCIATED WITH EMS NON-CONVEYANCE OF PATIENTS WITH RESPIRATORY COMPLAINTS IN WESTERN CAPE, SOUTH AFRICA: A RETROSPECTIVE CHART REVIEW SUB-STUDY LINKED TO 546/2019- (MPHIL CANDIDATE-MR MOHAMMED ALSUFAYAN)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

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 October 2023.

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)

The HREC acknowledge that the student: Mr Mohammed Alsufayan will also be involved in this study.

Please quote the HREC REF 649/2022 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, where necessary, **before** the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

HREC 649/2022