An Observational Audit of pain scores post orthopaedic surgery at a Level Two State Hospital in Cape Town

by

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DECLARATION

I, Neil David Hauser, hereby declare that the work on which this dissertation/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.

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Contents:

PART A:

Proposal for an Observational Audit of pain scores post orthopaedic surgery at a Level Two State Hospital in Cape Town

PROPOSAL

An audit cycle of post-operative pain scores and patient satisfaction of pain control in orthopaedic patients at a Level Two State Hospital in Cape Town. In addition as part of the information collected during the research process we will audit the following: Intraoperative anaesthetic techniques, post-operative analgesia consumption and analgesic methods as well as any side effects to analgesic medication used in orthopaedic patients peri-operatively at Victoria Hospital Wynberg (VHW) will also be noted.

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INTRODUCTION

Postoperative pain control is an essential, yet often inadequately managed part of peri-operative patient care. Adequate analgesia is important not only for patient comfort but also for maintaining stable physiology, facilitating recovery from surgery, enabling rehabilitation and to potentially decrease length of hospital stay post-operatively.

International audits have previously shown that pain is poorly managed post-operatively in surgical patients.[1, 2] At facilities in the Western Cape, pilot student audits have shown that management of post-operative pain is also potentially inadequate. This means that surgical patients potentially experience severe pain in the first 48 hours following surgery, increasing the risk of chronic pain development as well as post-operative complications thereby placing a greater burden on already limited health care resources.

These proposed observational audits will look at a population of orthopaedic patients at a Level Two Hospital in Cape Town. The study will be performed at Victoria Hospital Wynberg (VHW). VHW performs a large number of orthopaedic cases each week, giving us access to a potentially large number of patients. The choice of orthopaedic patients is due to the fact that orthopaedic surgery has been shown in some studies to be associated with a greater degree of post-operative pain as rated by patients when compared to other surgical disciplines. The high levels of pain associated with orthopaedic surgery are thought to be due to the degree of tissue trauma and the nature of tissue involved in the surgery itself. [3 – 7]

Information regarding post-operative pain levels in orthopaedic patients as well as analgesic consumption and patient satisfaction of pain control, would allow for potentially improved management of post-operative pain both in orthopaedic patients and patients from other surgical disciplines in the post-operative period at VHW. We assume that if we find the pain scores to be low in this population of orthopaedic patients this would be equally so for other surgical disciplines at VHW due to the fact that all surgical patients are managed in the same wards thus receiving similar care between patient groups. This would then hopefully be the same case for any

interventions employed to improve pain in orthopaedic patients, translating to improved pain control in the other surgical disciplines.

OBJECTIVES

1) To audit and evaluate acute pain post-operatively in orthopaedic patients undergoing surgery at VHW using a Visual Analogue Scale (VAS) over the first 48 hours following the orthopaedic procedure
2) To evaluate orthopaedic patients satisfaction with regards to post-operative pain control
3) To audit the current methods of intra-operative anaesthetic techniques employed at VHW in orthopaedic patients
4) Record the prescribed post-operative analgesia as well as how much analgesia is given by the ward staff post-operatively
5) Record the side effects related to the analgesic medication
6) Should the average post-operative pain score be found to be more than four (4) (on a VAS of 0 – 10) at any measured time point in the first audit, interventions and practice changes to improve pain control will be adopted as per the audit cycle (Appendix 1). Potential interventions and practice changes will be proposed through identification of problems identified in Audit 1 and will be implemented over a period of 1 year before repeating the audit should this be necessary (VAS > 4 at any measured time point in Audit 1).
7) Re-audit patients rating of pain (Audit 2) using VAS pain scores and satisfaction of pain control. This process will be identical to Audit 1 and will effectively measure the effect of interventions employed.

METHODOLOGY

We propose enrolling adult orthopaedic patients (over the age of 18 years), who undergo elective and emergency orthopaedic surgical procedures at VHW. The first audit (Audit 1) will occur between April and June 2011. We estimate that this study will involve roughly 100 orthopaedic patients over the 3 month period and will include both patients

admitted to the ward as well as patients brought in only on the day of their surgery (day-patient cases). For logistical reasons we propose enrolling patients undergoing orthopaedic procedures during office hours only, between 07h30 and 16h00, who receive any form of anaesthesia for an orthopaedic procedure.

At VHW a multitude of orthopaedic pathologies are seen necessitating a variety of anaesthetic techniques. Both regional and general anaesthesia techniques are employed depending on the skill of the anaesthetist and the background pathology of the patient. Anaesthetic techniques are not mutually exclusive and patients receiving a general anaesthetic technique may also receive a supplementary/ concomitant regional anaesthetic which includes neuraxial blocks. The anaesthetic technique employed is at the discretion of the attending anaesthetist on the orthopaedic list that day, after discussion with the senior anaesthetist on duty.

Currently standard post-operative orders for patients admitted to the surgical wards, where no contraindications exist, are written as follows:

1) Morphine 10mg Intra-Muscular Injection (IMI) 4hourly/ PRN (dose altered depending upon age, co-morbidities and weight)
2) Paracetamol 1g per os (PO) 6hourly,
3) Ibuprofen 400mg PO 8hourly / PRN or,
4) Voltaren 50mg PO 8 hourly/ PRN
5) Tramadol 50-100mg PO 8hourly /PRN

This strategy of prescription aims to adopt a multimodal approach to analgesia allowing for control of post-operative pain at various receptor levels. These post-operative orders may be modified at the discretion of either the surgical or the anaesthetic teams during the patient's stay in hospital. For instance, if the patient is coping well and experiencing very little pain, the morphine may be stopped or stepped down to Tramadol only by either the surgeons during their ward rounds or that of the anaesthetists. These post-operative orders are fairly standard for most of the orthopaedic patients at VHW when admitted to the ward following surgery, irrespective of whether they have received a regional, general or combination anaesthetic.

Patients discharged on the day of their surgery receive a combination of Paracetamol, Tramadol and a Non-Steroidal Anti-Inflammatory Drug (NSAID) to take home and are instructed as to how to take the medication correctly prior to discharge from the hospital.

For patients admitted to the High Care Unit (HCU), the IMI Morphine is prescribed as an intravenous (IV) dose titrated to effect. Other instructions relate to whether techniques such as an epidural have been used to provide analgesia for the patients. Patients receiving epidural care are routinely admitted to the HCU and an infusion of 0.1% Bupivicaine is administered via the epidural catheter at a rate of 8-12ml/ hour depending upon the sensory and motor level of the epidural.

We aim to complete the full audit circle in this study namely: (Appendix 1)

1) Select topic – audit of post-operative pain in orthopaedic patients together with patient's satisfaction of pain control post-operatively at VHW

2) Define criteria – an overall VAS of 4 or more at any time point measured for the group of patients will be regarded as an unacceptably high level of pain. This amounts to pain that is described as "Moderate" and "Interfering with tasks" on the VAS to be employed in the audit (Appendix 3)

3) Plan methodology – as outlined above in the proposal

4) Data collection and analysis – the first audit will run from April to June 2011 with a follow up audit should the average overall post-operative pain scores/ VAS be greater 4 at any time point measured. The follow up audit will occur after a period of intervention has occurred. Anaesthetists in the Department of Anaesthetics at VHW will collect data together with interns working in the department of surgery during this 3 month period. The data will be analysed by an independent statistician from Stellenbosch University.

5) Performance Assessment – this will be done against the aim of an overall average VAS score being less than 4.

6) Identify need for change – Should we note that the VAS scores are unacceptably high, the first audit should allow for the identification of problems allowing us to put interventions in place to correct these problems.

7) Implement change – this will be done over a period of time such that the changes become routine practice at VHW should this be needed.

8) Evaluate changes – Audit 2 will be performed to assess the effects of the strategies employed to improve pain control. It will be identical in structure and format as Audit 1 and will again run over a 3-month period.

COLLECTION OF DATA

The investigators will obtain informed consent (Appendix 4) from each patient during the pre-operative anaesthetic assessment. The pre-operative assessment takes place either the day before surgery, as is the case for in-patients or on the day of surgery for day-patient/ outpatient cases. Once consent has been obtained the investigator will then fill in a data sheet for each patient enrolled. The data sheet records basic demographic and clinical information (Appendix 5). Other information recorded includes pre-operative analgesia and/ or sedation prescribed as well as medications that are administered intra-operatively and prescribed for the post-operative period. Side effects to medication will be noted on the data sheet during the 48 hour post-operative period. Patient's satisfaction rating of pain control post-operatively will be assessed at the end of the 48-hour time period and will be divided in to one of four categories:

1) Very Good
2) Good
3) Adequate
4) Poor

The patients will complete the VAS scores for pain at four time points during the investigation. The first time point will be in the recovery room designated 0-hours, defined as when the patient is fully recovered and conscious as in the case of a general anaesthetic. For in-patient surgical cases patients pain scores will again be assessed at 12 hours, 24 hours and 48 hours post procedure. For patients undergoing regional anaesthesia alone time 0-hours will be defined as the time that the patient is assessed to be ready for discharge from the recovery room area, usually an anaesthetic level of T10 as in the case of a neuraxial anaesthetic technique.

Time to first request (TTF), should patients request additional analgesia, will be noted on the data sheet, as well the pain score at that time of the request. The anaesthetist on call for the hospital will make the assessment of pain scores at each time interval that day. This limits the number of investigators recording pain data avoiding interference with the patients scoring of their pain on the VAS. Should the anaesthetist on call not be on site or be unavailable at the time of the 12 hour score, the surgical intern on call will record the 12 hour pain score as the majority of these scores will occur after hours.

Due to the fact that data collection will occur over a 3 month period only a few interns will be used to collect data meaning interference with scores due to multiple investigators will be low. The same protocol will be applied to all patients irrespective of the type of anaesthesia administered. All patients will be assessed for pain at each of the above time intervals. The total amount of analgesic medications administered/ consumed over the preceding time period will be noted and recorded but not used in the final analysis. The same will be for side effects of medication.

For day case patients, pain assessments will be done in recovery at 0 hours and prior to discharge from VHW which will be designated 12 hours. These patients will be contacted telephonically at 24 hours and again at 48 hours depending on their 24 hours response. Should these patients be experiencing uncontrolled pain at 24 hours (VAS > 4) they will be given advice concerning their medication and pain control. They will then be contacted again at 48-hours to establish whether the pain levels have improved. Questioning regarding any other side effects of the medication will also be done telephonically and advice given as needed in order to alleviate any side-effects attributable to the medication. Should day-patients report their pain scores as VAS < 4 at 24 hours they will not be contacted at 48 hours. They will however be given a number to call should they experience further pain or side effects.

RESEARCH ETHICS

This study is an observational audit. However, should a patient be in severe pain there exists an ethical obligation to intervene and provide sufficient and/or further analgesia. We feel that a VAS of 7 or more would be an unacceptably high level of post-operative pain and would require immediate attention. Should a patient give a VAS score of 7 or greater, investigators must first ensure that prescribed medications have been appropriately administered, and may as a secondary intervention order additional analgesic medication.

For patients with epidurals in place a sensory level must be established. Should this level be deemed as inadequate a top-up of local anaesthetic given will be given and an attempt to "re-establish" the epidural will be made prior to the prescription of additional analgesia. Additional analgesia in most cases will usually be in the form of an opioid injection, either IMI or IV. Any interventions and additional analgesia prescribed will be noted on the data form.

Involvement in this study is voluntary and no patient will be discriminated against in any way should they decide not to participate. Consent forms will be available in English and Afrikaans, the most frequently spoken languages of patients attending VHW. Should a patient speak neither of these languages interpreters are available to facilitate the consent process and explanation of the study. Any patient unwilling to participate in the audit or who is unable to communicate, and thus cannot be included in the audit, will still receive the same anaesthetic and post-operative treatment based upon good clinical practice and will not be discriminated against.

All information shared by patients with the investigators will be kept confidential. Strict confidentiality will be maintained within the health care team environment at all times during the audit. That is, should a patient report severe pain to one of the investigators, the investigator will need to share this information with the nursing staff in order for appropriate analgesia to be administered to the patient.

All patients shall be free to withdraw from this audit at any time should they so choose, with no adverse consequences imposed. Patients who decide to withdraw themselves from the study will still receive the identical care to what they would have received had they chosen to remain in the audit. They will however not be asked to rate their pain scores at the chosen times using the VAS.

PROJECTED FOLLOW UP STUDY

An audit analysis will be performed on the information gathered during the data collection period April to June 2011 (Audit 1). Should postoperative pain control be inadequate (average overall VAS > 4 at any measured time point), we plan to implement intervention strategies based upon problems identified during the first audit period. These interventions will focus upon ways to assist staff and patients to better manage post-operative pain. A post intervention audit (Audit 2) will then be done to assess the effectiveness of the strategies on the control of pain after a sufficient time period such that there has been adequate time for the effect of the interventions to be properly assessed.

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PART B:

LITERATURE REVIEW

OBJECTIVES AND SEARCH STRATEGY

A literature search was done on PubMed using the following key words and terms, "post-operative pain", "post-operative pain in orthopaedics", "tools to measure post-operative pain" and "pain control in orthopaedic surgery". Chosen studies were restricted to publications written in English. There were no date restrictions on the published articles. The abstracts obtained from these key word searches were then read looking for review articles and studies on the specific topics of pain in orthopaedic patients and pain assessment tools. Twenty articles were chosen in this way, 9 review articles, 2 observational studies, 3 prospective cohort studies, 3 commentary articles, 2 national surveys and 1 editorial. Additional articles were then found using the references from these 20, as well by using the "related links" function of PubMed. The aim of the literature review was to answer 3 specific questions relating to post-operative pain in patients undergoing orthopaedic surgery:

1) What is pain - how is it defined and why the need to control it?
2) Is the pain associated with orthopaedic surgery rated more highly than that associated with other surgical disciplines?
3) What tools are appropriate to use when assessing post-operative pain?

Pain, how is it defined and why do we need to control it?

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.[1] Pain can be described as either acute or chronic in nature. Typically the pain that is associated with surgery is acute in nature. This may however not always be the case in orthopaedic surgery where patients may suffer with pain chronically for months or even years before undergoing surgery such as a joint replacement. This is illustrated in the definition of peri-operative pain, which has been defined as, "pain existing in the surgical patient because of pre-

existing disease, the surgical procedure (associated wound drains, chest drains, complications etc.) or a combination of disease related and surgical procedure related sources".[2] The above definitions of pain underlie the complexity and individuality of pain as a sensation, emotion and experience.

Pain is feared by many people due to its unpredictable nature and the knowledge that the potential to experience severe and uncontrolled pain exists within all of us.[3] Severe pain has the potential to "force people to close their eyes to the world and reduce them to a single experience dominated by a single desire – for it to stop".[3] It is no surprise then that experiencing pain is one of the concerns most frequently raised by patients undergoing surgery. [4,5]

Surgery is undoubtedly painful. The tissue damage associated with the original injury together with that from the surgery coupled with activation of neural pain pathways and the associated inflammation, all leads to an inevitable experience of pain in the peri-operative period.[6] Control of this pain has implications for the patient as well as the Health Care Provider both immediately and in the future.

Every patient has the right to adequate pain control and pain management[7]. Greater acknowledgement and improved understanding of the pain that is associated with surgery, together with patient expectations for medical care, that includes aggressive pain relief, [1] has led to far greater awareness and improved efforts to control peri-operative pain. Good pain control should be seen as an integral part of high quality health care and will result in improved patient recovery and satisfaction peri-operatively. Thus it should be seen as unethical not to make efforts to control pain.[8] Despite this right to pain control, there have been numerous studies around the world which have shown that, as Health Practitioners, we are falling short when it comes to controlling post-operative pain in our patients[7, 9, 10] and that despite the advances in the science of pain management, pain may still remain undertreated or even untreated in some cases.[11] Forty years of consensus data has shown that at 50-75% of patients postoperatively experience moderate to severe pain.[12 – 14]

As clinicians caring for patients in pain, or with potential pain, it is important for us to remember that pain not only has unpleasant sensory and emotional components but also has effects on patient physiology, which is important in the post-operative period. Uncontrolled pain has been shown to complicate virtually every one of the body systems. Some of the systems affected by uncontrolled post-operative pain include the following:

- *Respiratory* – due to an inability to cough as a result of pain, patients develop atelectasis and are unable to clear their secretions. This results in pooling of secretions in airways providing an ideal environment for bacteria resulting in the potential for pneumonia post-operatively.
- *Cardiovascular* – increased heart rate and myocardial oxygen consumption from the increased sympathetic drive associated with pain can lead to the development of myocardial ischaemia in patients with Ischaemic Heart Disease (IHD). This may be further exacerbated by the activation of the Renin-Angiotensin Aldosterone System (RAAS) and its associated effects.
- *Neurological* – inadequate analgesia at any point in a patient's management peri-operatively, even for only a short period of time, predisposes the patient to sensitisation, inflammation and chronic pain similar to those levels seen in patients with long-term untreated pain.[6]
- *Immunological* – this includes poor wound healing and suppression of immune function, both of which can predispose a patient to the development of post-operative sepsis.[15] A delay in wound healing can result in an increased length of stay in hospital. This may further predispose the patient to a more severe form of infection due to the associated risk of hospital acquired pathogens.
- *Psychological* – pain causes anxiety due to its unpredictable nature, intensity and fear provocation. Poorly controlled pain has been shown to increase the likelihood of the development of delirium in older patients[16, 17] post-operatively.
- *Endocrine systems* – hyperglycaemia complicates the post-operative period. Activation of the RAAS together with platelet dysfunction, increased sodium retention and decreased regional blood flow can also occur[18] leading to numerous deleterious effects.

Uncontrolled pain in the acute setting has been shown to increase the likelihood of the development of chronic pain at a later stage[6]. Persistent acute peri-operative pain leads to "central sensitization" which further perpetuates and enhances the experience of pain.[19] In addition uncontrolled pain has also been shown to potentially increase the length of hospital stay post-surgery, to consume greater health resources, to increase the morbidity associated with surgery and to delay the return to previous functional levels.[11] Due to the fact that health care is becoming increasingly cost driven and that pain is a major health care problem perhaps one of the most compelling reasons, outside of obvious patient comfort, for controlling pain is the financial demand it places on our already resource strapped health care system.[5]

As can be seen, uncontrolled pain can have an impact on the patient, the hospital and the health care team alike. The patient is at risk for multiple complications both directly and indirectly as a consequence of uncontrolled pain. The hospital which may already be struggling with resource allocation, will have added bed pressures due to potentially unnecessary increased length of stay, added rates of complications and increased resource consumption such as medication and health care worker time. The health care team will also be required to treat complications both acutely and in the future, increasing the workload of the team further.

No previous audit had been done in patients measuring their postoperative pain levels at Victoria Hospital Wynberg (VHW) and little is known formerly about the degree of pain and pain control experienced by patients in Western Cape hospitals. As such we decided to perform an audit of post-operative pain in orthopaedic patients at VHW endeavoring to complete the audit cycle by applying interventions should we find pain to be inadequately controlled and then re-auditing the pain scores after a suitable length of time.

Orthopaedic pain, is it worse than other surgical disciplines?

The question as to why orthopaedic patients were chosen for the audit stems from the fact that research has shown that not all surgical pain is rated equally. [8,11] Studies suggest that the pain associated with certain surgical disciplines, as rated by patients, is different in both its intensity and severity. Clinically bone pain is a particularly intense form of somatic pain. Bone pain, whether caused by trauma, fractures, elective orthopaedic surgery, neoplasia or simply inflammation, is transmitted and mediated by nerve fibers found in multiple layers of the bone. These layers include the periosteum, cortex and marrow.[20] The periosteal layer of bone is particularly sensitive to pain, as it has been shown to be richly innervated with sensory nerves.[20] Disruption of the periosteum, as will occur with bone fractures and elective surgery, is believed to be one of the reasons patients rate the intensity of orthopaedic pain so highly.

Thus if we measure the pain experienced by orthopaedic patients, which is typically rated as very painful, and are able to improve their post-operative pain levels, by implementing the same strategies for other patient populations it may allow us to improve their pain management in the post-operative period.

While one person can never truly feel another's pain,[2] as mentioned certain surgical procedures/ disciplines are known to be more painful and to require greater amounts of analgesia. A meta-analysis review of established painful procedures showed that abdominal, orthopaedic and thoracic procedures are all associated with high levels of pain peri-operatively.[21] The same review showed that emergency surgery, prolonged surgery, high levels of patient anxiety and higher levels of pre-operative pain were further associated with higher analgesic requirements.[21] It can thus be seen why orthopaedic surgery is potentially so painful. Orthopaedic procedures are commonly required acutely following trauma involving fractures, may be of a long duration and are associated with high levels of pre-operative pain due to the nature of the tissues involved. These are all predictors of increased analgesic requirement and infer higher levels of pain post-operatively.

Reports exist which suggest that pain from joints and bones is more intense in nature than that experienced by trauma to abdominal viscera and musculature.[22] Orthopaedic surgery and in particular joint replacement surgery, involving both bones and joint structures, which are commonly performed at the VHW, would therefore be assumed to be very painful indeed.[23 – 25] The nature of orthopaedic surgery itself further contributes to the pain experienced by patients post-operatively. In one study done in a Post-Anaesthetic High Care Unit (PAHCU) in Israel they found that orthopaedic surgery was associated with a two-fold higher incidence of severe pain as rated by the patients when compared with patients undergoing emergency laparotomies.[25] In the same Israeli PAHCU study they found that orthopaedic patients consumed greater amounts of analgesia than patients undergoing emergency laparotomy and despite the greater consumption of analgesia orthopaedic patients still had a higher cumulative pain score and rated their pain as "severe" more frequently.[25]

Pre-operatively many orthopaedic patients have chronic persistent pain that may contribute to the difficulty of controlling orthopaedic surgery pain post-operatively [26]. This is likely due to the "wind-up" and sensitisation that occurs in the sensory system with prolonged uncontrolled or untreated pain. The adverse effects described above are commonly seen in orthopaedic patient's post-operatively.[16, 26] This again is due to both the nature of orthopaedic surgery and often the location of the surgery. These effects if unmanaged can have far-reaching consequences to both the patient and to hospital resources. All of the above lead us to want to measure to what degree pain was being controlled in our population of orthopaedic patients at VHW post-operatively and if there were any strategies we could employ to improve pain levels.

Measuring pain, how do we do this?

Pain as mentioned before is a very individual experience. How then is the best way to measure it in an individual and in a group of patients? Pain is a complex multi-dimensional phenomenon modulated by physiological, psychological and environmental factors such as previous events, culture, prognosis, coping strategies, fear and anxiety.[27] Due to this complexity numerous tools have been developed in order to assess and

quantify the pain experience.[28-30] All of these tools have limitations and provide different levels of information on a patient's perceived level of pain. Knowing the limitations of each tool is the key to their correct application.

One method of quantifying pain is the Visual Analogue Scale (VAS). [6] It is one of the most commonly used pain rating scales, in both research and clinical domains, providing a measure of pain intensity and allowing a numerical value to be assigned to a patient's level of perceived pain.[31] Due to its wide usage it has been analyzed and studied extensively providing users with the knowledge of both its advantages and disadvantages allowing investigators to hopefully minimize error.

The VAS is a 10 cm/ 100 mm line upon which patients indicate their level of pain. Zero (0) representing no pain and 10/ 100 representing the worst imaginable, most excruciating pain. The VAS is simple to use, is readily available to investigators, is unobtrusive, can be easily reproduced and does not require the patient to be literate, as numbers have also been substituted for faces for such cases.[6, 31] The VAS is also known to be conceptually relatively simple if explained correctly. There are also VAS's that have been developed in order to measure the pain experience as opposed to the intensity and uses descriptive terms in place of numbers.[31]

VAS's have been shown to be sensitive to both pharmacological and non-pharmacological measures that alter the sensation of pain.[32, 33] This further supported the use of a VAS tool in our study due to the fact that both pharmacological and non-pharmacological interventions are commonly employed to help alleviate pain peri-operatively in orthopaedic patients at VHW. The VAS is most useful when it tracks the changes of pain in a patient.[6] This is necessary in an audit of post-operative pain as it follows each individual patient's pain intensity over the 48-hour period, starting from his or her discharge from the recovery unit in the theatre complex.

Further advantages of the VAS's lie in their ratio scale property.[31, 34-36] This means that equality of ratios is true and is not implied as occurs with some other scales of measurement for pain intensity.[34-36] In other words a score of 1 when compared to a

score of 2 in an individual patient indicates to the investigator that at that point in time the patient's pain intensity was double that measured before. This then allows investigators to act promptly should a patient rate their pain intensity above a certain level and additional analgesia can then be given to control the patient's pain.

VAS's are not without limitations and these limitations need to be considered when undertaking any study looking to measure pain by using a VAS. While it is generally very easy to use, in patients with perceptual or visual problems and in patients who cannot grasp the concept, the VAS may become impractical.[31] One of the major disadvantages to the VAS is the assumption that it makes of pain being a unidimensional experience measureable on a single-item scale.[37] While intensity of pain is unidimensional, intensity only forms one part of the quality that is pain. One author stated that when pain was described only as an intensity, it would be much the same as "…specifying the visual world only in terms of light flux without regard to pattern, color, texture, and the many other aspects of visual experience".[31] The VAS unfortunately therefore does give an incomplete representation of the actual total pain experience.[25]

This has been partially overcome by using VAS's that also describe the effect and unpleasantness of pain. We have tried to combine all 3 into our VAS by using descriptive terms, visual cues and numbers to allow patients to rate their pain. Although multidimensional scales do exist they are generally more useful for measuring chronic pain and there is little evidence for their use in acute pain measurement as seen in the perioperative period.[6]

Although the VAS itself is a single measurement and is one-dimensional it may be influenced by external factors. The staff that administers the VAS may alter the patients rating of their pain intensity. It has been shown that the attitude of the staff, pleasant and warm versus cold and aloof, affects a patients rating of their pain intensity.[38] Similarly the number of investigators that patients interact with may influence the scores and limiting the number of investigators has been shown to create a more constant and thus truly representative response.[38] This was one of the reasons that we tried to limit the

number of investigators involved in collecting pain scores from patients during the two audits.

Repeated reproduction of the VAS itself through photocopying can distort the image and its quality making it potentially less reliable. Investigators need to ensure that the VAS remains constant across all patients over the whole study time period so as to avoid these potential errors.[38] Furthermore changes in the angle of the line can alter the perception of the length of the line and thus the patients rating of their pain score. Allowing patients to see their previous pain score may improve their pain ratings as blinding them to their previous scores has been shown to cause patients to overestimate their pain.[39] All patients in the audit would be able to see their previous score if they were uncertain of how they had rated their pain previously or if they requested to see their previous scores.

When reviewing the pain scores and looking for a statistical significance in a reduction of pain it is important to consider whether this is in fact a clinically significant difference in pain reduction. A VAS has a potential measurement error of 15-20mm in individual scores.[27] Differences of less than this may not translate in to a clinically significant change in individual patients.[27] Because we are not comparing the same patient group or individual in each audit this is less of an issue as we are measuring pain as a whole in a sample of orthopaedic patients as opposed to an individual followed up over a period of time.

A further measurement of pain that has been used to evaluate post-operative pain is the consumption of analgesia. This is a commonly employed metric of pain and has been used previously in studies of post-operative pain.[27] The premise assumes that the greater a patient's consumption of analgesia is the worse the associated pain must be. A comparison can then be drawn between the intensity of pain and the amount of analgesia consumed. It does however not take in to account the individuality of pain perception and pain thresholds nor the ability of nursing/ ward staff to be able to give all prescribed medication timeously. Therefore this measure of pain is at best a surrogate measure of pain[25] due to the fact that it is influenced by many factors including patient preconceptions, staffing issues and attitudes, availability of medicine and individual

preferences of prescription by doctors for ward patients. It was not our intention to use this as a measure of pain from the outset, but the total analgesia consumed between measured VAS time points was recorded and noted during both audits. It was however not used as part of the data analysis.

Need for further research

Pain is very complex and although there is a greater understanding of the neurobiological pathways underlying pain there is still a great deal that remains unknown about pain as an entity. This remains true for both acute and chronic pain. Long term follow up studies on patients who experience uncontrolled acute post-operative pain are lacking, meaning that we do not know how many of these patients experiencing uncontrolled acute pain go on to develop avoidable chronic pain and other related complications.

Locally and internationally, due to the high levels of pain associated with orthopaedic surgery, a lot of emphasis is placed on the control of post-operative pain in orthopaedic patients.[21-25] There is however limited data relating to the measurement and control of post-operative pain in orthopaedic patients in centers located in South Africa. This is also true for other surgical disciplines. In addition to this there are no comparisons done locally between the levels of pain post-operatively in orthopaedic patients and that of other surgical disciplines as have been done in other centers internationally.[21] This needs to be investigated so that we can reliably translate improved pain scores in orthopaedic patients post-operatively to that in patients from other surgical disciplines.

Although the control of acute pain is gaining more prominence in South Africa, as is seen internationally, little is known about the peri-operative pain services in our hospitals. More audits are needed looking at these pain services. How many of these services exist? How effective are they in controlling pain? What are patient's perception of these services and the pain control delivered by them? These questions need to be audited across a wider range of surgical disciplines so that there is a better understanding of post-operative pain control throughout South African health care services. Pain

service strategies and their outcomes need to be audited so as to gather information on the achieved levels of pain control, patient's satisfaction of pain control and the types of anaesthetic techniques used as well as their effectiveness in controlling pain acutely.

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Part C: Manuscript

AN OBSERVATIONAL AUDIT OF PAIN SCORES POST ORTHOPAEDIC SURGERY AT A LEVEL TWO STATE HOSPITAL IN CAPE TOWN

ABSTRACT

Background: In view of perceived poor pain control, acute post-operative pain scores, anaesthesia techniques, and patient satisfaction with pain control were audited in patients undergoing orthopaedic surgery at a Level Two State Hospital in Cape Town.

Methods: Two audits were performed 12 months apart. Patients admitted to hospital following major surgery rated their perceived pain over 48 hours, using a Visual Analogue Scale (VAS). Day case patients scored their pain in hospital, were then contacted telephonically at 24 hours and, if required, at 48 hours. A VAS score ≥ 4 was regarded as unacceptable. The interventions employed after the first audit were: 1) Pain rounds, 2) Staff education and training 3) Increased post-operative epidural time, 4) Indwelling femoral catheters following total knee replacement, and 5) Patient controlled analgesia pumps.

Results: After 17 patients were lost to follow-up, data were analysed from 71 patients in each audit. In audit 1, mean VAS scores were unacceptable 12- and 24 hours after major surgery (range 4.0 - 5.1). Following the introduction of the above interventions, the mean pain scores were < 4 at every measurement time, and significantly lower than in Audit 1 at most assessment times ($p<0.05$). Patient satisfaction with pain control improved from 32.4% in audit 1 to 54.9% in Audit 2.

Conclusions: Acute postoperative pain is an important clinical problem. Following the demonstration of unacceptable postoperative pain scores in the first audit, specific interventions were shown in the follow-up audit to significantly improve pain control.

Keywords: Pain, post-operative pain, orthopaedics, pain reduction strategies, measuring pain.

INTRODUCTION

Pain is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage"[1]. Pain is feared by many people due to its unpredictable nature and the knowledge that the potential to experience severe and uncontrolled pain exists within all of us[2]. Severe pain has the potential to "force people to close their eyes to the world and reduce them to a single experience dominated by a single desire – for it to stop".[2] It is therefore no surprise that pain is one of the concerns most frequently raised by patients prior to surgery.[3, 4]

In the literature, locally and internationally, the control of acute peri-operative pain is gaining increasing prominence. Consensus data from the last 40 years indicate that 50-75% of patients experience moderate to severe pain post-operatively.[1, 5, 6] This is despite knowledge that the control of post-operative pain is physiologically important in terms of limiting the stress and cardiovascular responses, decreasing tissue breakdown and limiting immune impairment, limiting fluid retention, and potentially shortening hospital stay and thus postoperative health cost expenditure.[7-9]

A change in the perception of post-operative pain management has occurred, with patients expecting a care plan that includes aggressive post-operative pain control.[1] There is limited data available on the levels of post-operative pain in South Africa. With this in mind an audit cycle was performed to score post-operative pain in patients undergoing orthopaedic surgery at a Level Two State Hospital in Cape Town. This study population was chosen because pain associated with orthopaedic surgery, as shown by meta-analyses, is rated as very severe by patients.[10] Some reports indicate that pain associated with bone and joint surgery is more intense than that experienced by patients undergoing abdominal/ visceral surgery.[11] A considerable number and variety of orthopaedic surgery cases are performed each month at Victoria Hospital Wynberg (VHW), providing access to a relatively large study population. All surgical patients at VHW are managed together in the same surgical wards, and it was hoped that by auditing a specific surgical group that is shown to rate their pain as high, this could translate into improved pain scores in this as well as other surgical disciplines.

METHOD

Approval was obtained for both observational audits, from the Human Research Ethics Committee (HREC) of the University of Cape Town. Audit 1 took place from April to June 2011, and enrolled consenting patients older than 18 years, undergoing elective and emergency orthopaedic surgery during office hours. Anaesthesia technique was at the discretion of the attending anaesthesiologist after discussion with the consultant anaesthesiologist, taking into consideration the comorbidities of the patient and the nature of the surgery. Regional and general anaesthesia techniques could be used in combination in appropriate cases. The administration of intraoperative analgesia, determined by the clinical response of the patient to surgery, was also at the discretion of the attending anaesthesiologist.

Surgical procedures were divided into major or minor surgery, and patients would be analysed separately as either hospital- or day-cases. The primary outcome was a comparison of mean post-operative pain scores in Audit 1 and Audit 2. Comparisons were made at each measurement time point for all enrolled patients. For analysis, patients were divided into both major and minor surgical cases, as well as patients who did or did not receive central and/ or peripheral nerve blockade. Patient demographics, pre- and intra-operative analgesia, post-operative orders, and side effects to medication were also recorded for analysis. For day-cases the take-home analgesia was similar to that administered in the post-operative orders of hospital cases. An audit of anaesthesia technique was done using the information obtained from the data sheets. Total post-operative analgesia consumed by patients was also noted but not used in the analysis.

Post-operatively, patients were asked to rate their pain scores using a Visual Analogue Scale (VAS) [Figure 1] at 4 time points, both at rest and on movement (for assessment of pain on movement, patients were asked to attempt moving the affected area): 0-hours, defined as the time at which the patient was ready for discharge from the recovery area to the ward, and then again at 12-, 24-, and 48 hours post-operatively. For day-case patients, the 12 hour time point was defined as the point at which the patient was ready for discharge from the hospital. For day-cases, telephonic contact was made to establish

their 24 hour pain score. Depending on the 24 hour response, day-cases might be contacted again at 48 hours. Patients were also asked to report their satisfaction with pain control as one of 4 options: 1) *Very good,* 2) *Good,* 3) *Adequate,* and 4) *Poor*. Data were collected by members of the Department of Anaesthesia and by surgical interns for the 12 hour score when the anaesthesiologist was unavailable. This helped limit inter-rater variability.

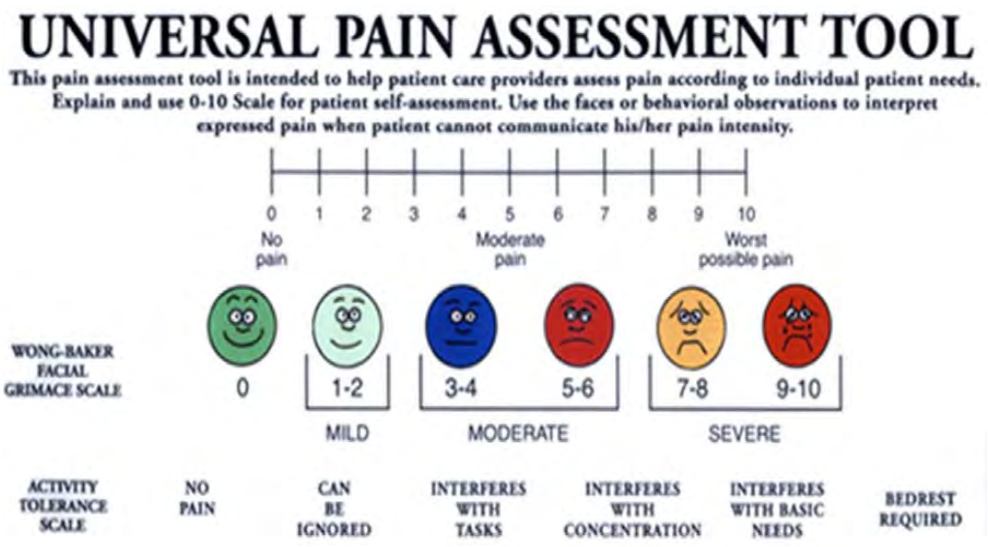

Figure 1: Universal Pain Assessment Tool

Consensus was that a VAS ≥ 4 (Scale 0-10) would be determined as an unacceptable level of pain, based upon the Universal Pain Assessment Tool [Figure 1]. Should the average pain score in Audit 1 be greater than 4 at any time point, an intervention and repeat assessment would be done in order to assess the effectiveness of the employed interventions, thereby completing the Audit cycle [Figure 2].

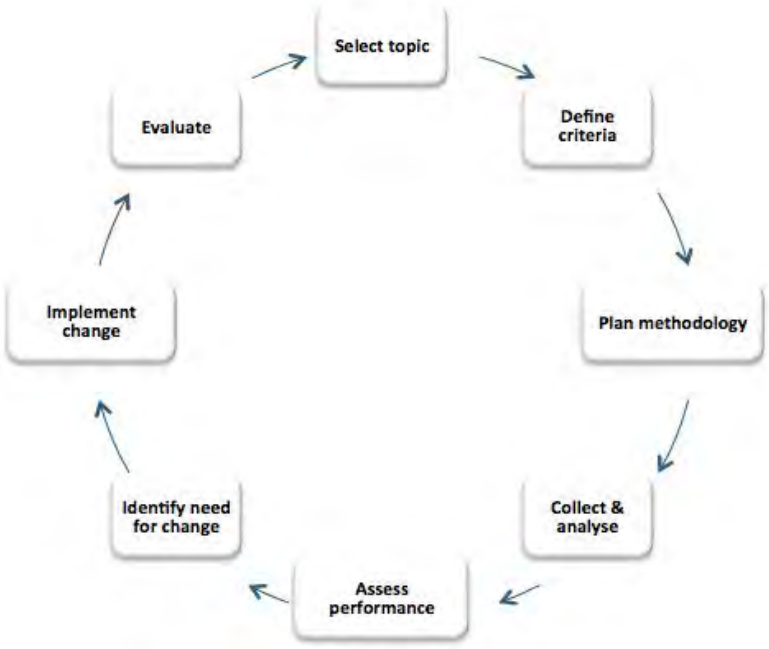

Figure 2: Audit Cycle

The five interventions employed after Audit 1 were:

1) Daily pain rounds in the surgical wards, in the form of a multidisciplinary ward round
2) Staff education and training, including a regional anaesthesia workshop for the Anaesthesia Department staff,
3) Increased duration of epidural care from the previous 24 hours protocol, to 48 hours as a standard of care,
4) The introduction of patient controlled analgesia (PCA) pumps containing a standard mixture of morphine (100 mg), ketamine (25 mg) and droperidol (2.5 mg) diluted to a total volume of 100 ml delivering 1 ml on demand every 8 minutes and
5) The placement of indwelling catheters for femoral nerve blocks in patients undergoing total knee replacement (TKR).

These interventions were introduced at VHW during the year July 2011 to July 2012, and became the standard of postoperative care during this time. Audit 2 was then completed between August 2012 and October 2012. Audit 2 was identical to Audit 1 in terms of format and structure.

Although both audits are observational, there was an ethical obligation to intervene if a patient rated their VAS score as ≥ 7 at any time point. The investigator was obliged to

check that all prescribed analgesia had been administered appropriately, and then to order additional analgesia as required.

The data from both audits were analysed as follows. One-sided t-tests, assuming unequal variances, were used to determine if there was a reduction in the pain scores from Audit 1 to Audit 2. In addition, Wilcoxon rank-sum tests were performed, as normality of the data was not formerly tested. Since the at rest and on movement VAS scores per patient were positively correlated, the two scores per patient per time point were combined into one by calculating the average, giving a more accurate and precise estimate of overall pain scores. The means and medians of these average scores were used to test for a reduction in pain scores from Audit 1 to Audit 2. In addition to the overall pain scores per time point, the at rest and with movement scores were also analysed separately. A statistical significance level of 5% was used throughout. All statistical calculations were performed using the R-language and programming environment[12].

RESULTS

A total of 159 patients were enrolled in the two observational audits. Audit 1 had 84 patients (52 in-patients, 19 day-cases and 13 who were lost to follow-up). Audit 2 had 75 patients (55 in-patients, 16 day-cases and 4 lost to follow-up). The total number of patients included in the final analysis was thus 142 (71 in each audit cycle). The demographic details of the patients in Audit 1 and 2 were similar in terms of age and gender. Typically, major surgical procedures necessitated admission to the wards, classifying patients as in-patients, and minor procedures were done as day-cases.

In Audit 1, 62% of patients underwent a major orthopaedic surgical procedure and 38% underwent a minor procedure. In Audit 2, 73% of patients underwent major surgery and minor surgery was performed in 27% of patients. The anaesthesia techniques employed in the 2 Audits are shown in Figure 3. A general anaesthesia technique was performed in 61% of patients in Audit 1 and 78% of patients in Audit 2. Regional anaesthesia was administered in 56% of patients in Audit 1, and in 35% Audit 2. Audit 1 had a total of 15 patients that received a combination of a general anaesthesia technique and a peripheral

nerve block, 3 day-case and 12 in-patient cases. Sixteen patients in Audit 2 received a combination of general anaesthesia and a peripheral nerve block, 1 day-case and 15 in-patient cases.

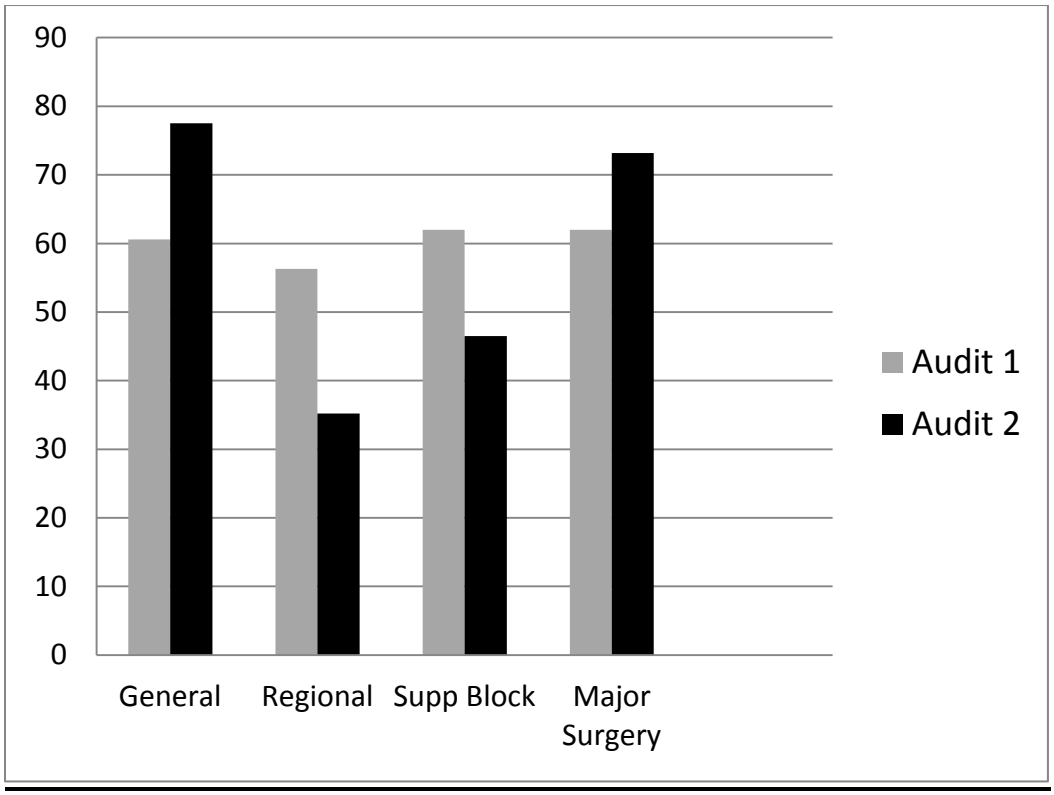

Figure 3: Anaesthetic technique as a percentage

A lower number of supplementary blocks (including neuraxial techniques) were performed in Audit 2 (47% vs. 62% Audit 1). Spinal anaesthesia was performed in 15 patients in Audit 1 and 13 in Audit 2. Epidural catheters were inserted in 10 patients in audit 1 and 6 in Audit 2. No indwelling femoral catheters were placed in Audit 1, while nine were placed in Audit 2, 5 together with general anaesthesia and 4 in conjunction with a neuraxial block. Thus no comparison can be made between Audit 1 and 2 for the use of indwelling femoral catheters. In both Audits, 4 single-shot femoral blocks were performed. A summary of the blocks performed is shown in Table 1.

Table I: Summary of regional techniques

Block type	Audit 1 (n)	Audit 2 (n)
Spinal	15	9
Epidural	10	6
Biers	4	-
Femoral catheter	-	5
Single shot femoral	4	4
Spinal & femoral catheter	-	4
Wrist	3	-
Other	8	5

The overall mean pain scores at rest and on movement were calculated for each time point in both audits. The results of the parametric t-test and non-parametric Wilcoxon rank sum tests were shown to concur for all analyses made. The mean VAS scores per audit at each time point are shown in Table II.

Table II: Mean VAS score per time point, and the overall mean of the 48 hours

	0 hours		12 hours		24 hours		48 hours		Overall	
Audit	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Major surgery	2.2	1.0	5.1	3.7	4.3	3.2	3.3	2.5	3.8	2.6
Minor surgery	1.4	0.5	2.4	2.2	3.0	1.7	1.8	2.1	2.2	1.4
Block	1.0	0.4	4.1	2.9	3.8	2.7	3.1	2.4	3.0	2.0
No Block	3.4	1.3	4.0	3.6	3.8	2.8	2.9	2.4	3.5	2.5
Total	1.9	0.9	4.0	3.3	3.8	2.8	3.0	2.4	3.2	2.3

An average pain score was calculated for the pain at rest and on movement for each patient, and the mean of these averages is given. The mean VAS pain scores for Audit 2 were significantly lower than those in Audit 1, with the effect most pronounced in 2 groups, namely those that underwent major surgery and those that received a supplementary block. There was a similar trend seen in the mean pain scores over the 48 hour periods in both Audits [Figure 4]. A peak in the mean VAS scores occurred at 12 hours, followed by a progressive decrease in scores towards 48 hours.

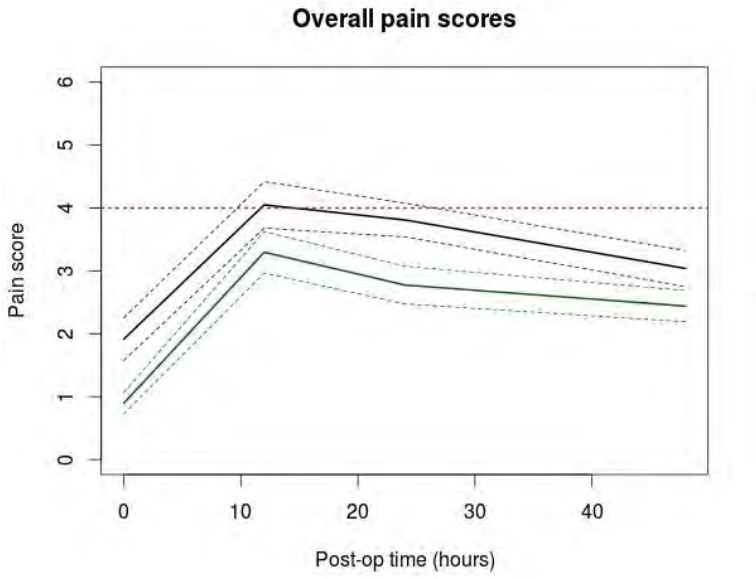

Figure 4: Combined Mean VAS for Audit 1 and 2

Mean average pain scores for the two audits. The solid black and green lines indicate the average pain scores for Audit 1 and 2 respectively. The dashed lines indicate the standard errors of the means. The dotted red line indicates the VAS score of 4, corresponding to an unacceptable pain score.

The mean VAS scores were significantly lower in Audit 2 for most groups at 0-, 12- and 24 hours, while only the major surgery group had a significant decrease in mean score at 48 hours. There were no significant differences in the minor surgery group, except at 24 hours, and in patients receiving no nerve block, except at 0 hour post-operatively [Table III].

Table III: Differences in mean VAS scores (at rest and on movement) from Audit 1 to 2. The one-sided p-value for t-tests is given in brackets.

	0 hours	12 hours	24 hours	48 hours	Overall
Major surgery	-1.2 (0.0100)	-1.4 (0.0097)	-1.1 (0.0081)	-0.9 (0.0207)	-1.2 (0.0003)
Minor surgery	-0.9 (0.0571)	-0.2 (0.4027)	-1.3 (0.0463)	0.3 (0.6140)	-0.8 (0.0541)
Block	-0.6 (0.0397)	-1.2 (0.0533)	-1.1 (0.0294)	-0.7 (0.0864)	-0.9 (0.0111)
No block	-2.0 (0.0036)	-0.4 (0.3065)	-0.9 (0.0548)	-0.4 (0.2274)	-1.0 (0.0133)
Total	-1.0 (0.0042)	-0.8 (0.0651)	-1.0 (0.0056)	-0.6 (0.0590)	-0.9 (0.0012)

Calculation of the mean VAS scores of patients at rest showed similar significant differences between Audits 1 and 2. The change in mean VAS scores at rest from the first to the second audit, as well as differences from zero, are shown in Table IV. With the exception of patients undergoing minor surgery and those not receiving a nerve block, most of the between audit differences in mean VAS scores at rest differed significantly.

Table IV: Differences in mean VAS scores at rest between Audit 1 and Audit 2. The one-sided p values for t-tests are given in brackets.

	0 hours	12 hours	24 hours	48 hours
Major surgery	-1.1 (0.0131)	-1.6 (0.0032)	-1.2 (0.0020)	-1.1 (0.0036)
Minor surgery	-0.9 (0.0536)	-0.3 (0.3503)	-1.2 (0.0506)	0.1 (0.5411)
Block	-0.7 (0.0237)	-1.2 (0.0470)	-1.2 (0.0153)	-1.1 (0.0106)
No block	-1.7 (0.0076)	-0.7 (0.1585)	-1.0 (0.0296)	-0.4 (0.2232)
Total	-1.0 (0.0043)	-0.9 (0.0237)	-1.1 (0.0016)	-0.8 (0.009)

The differences in mean VAS scores on movement between the first and the second audit are shown in Table V. Overall, the change in mean VAS scores on movement were significant at 0- and 24 hours but not at the 12- and 48 hour time points. The greatest significance in mean score decrease was again seen in the major surgery group. Overall a negative change in mean pain scores is noted (decreased mean scores for all time points during the 48-hour period) between the 2 audits.

Table V: Differences in mean VAS scores on movement between Audit 1 and Audit 2. The one-sided p values for t-tests are given in brackets.

	0 hours		12 hours		24 hours		48 hours	
Major surgery	-1.4	(0.0120)	-1.2	(0.0317)	-1.0	(0.0315)	-0.6	(0.1015)
Minor surgery	-0.9	(0.0622)	-0.1	(0.4477)	-1.4	(0.0555)	0.6	(0.6572)
Block	-0.6	(0.0662)	-1.2	(0.0646)	-1.1	(0.0577)	-0.3	(0.3244)
No block	-2.3	(0.0034)	0.0	(0.4771)	-0.8	(0.1088)	-0.4	(0.2659)
Total	-1.1	(0.006)	-0.6	(0.1497)	-1.0	(0.0213)	-0.3	(0.2238)

Table VI shows a comparison of overall satisfaction levels of patients between the 2 audits. There was an improvement in patient satisfaction in the *Adequate* and *Very good* groups, of which the last made up the majority of patients in the second audit.

Table VI: Overall patient satisfaction

Overall satisfaction	**Audit 1**	**Audit 2**
Poor	2.8%	1.4%
Adequate	22.5%	7.0%
Good	42.3%	36.6%
Very good	32.4%	54.9%

DISCUSSION

These 2 observational audits done in 2011 and 2012 at a Level Two State Hospital in Cape Town have shown that simple, achievable interventions can decrease pain scores after orthopaedic surgery in adult patients. There was a significant decrease in pain scores from Audit 1 to Audit 2 in the following groups:

- Major surgery at 0-, 12-, 24-, 48 hours and overall.
- Minor surgery at 24 hours.
- Patients receiving either a central neuraxial or peripheral nerve block, at 0-hours, 24 hours, and overall.
- Patients in whom no neuraxial or peripheral nerve block was performed, at 0 hours, and overall.

Significant differences in pain scores were not seen extending to 48 hours, but this was as expected, since pain levels post-orthopaedic surgery usually decrease significantly by this time.[13] In addition to this, the insignificant decrease in pain scores across audits in the minor surgery group was also expected. In Audit 1 this group already rated their pain levels low, making a significant decrease difficult to achieve.

Not only did patients in the second audit rate their pain scores lower than those in the first, but the percentage number of patients rating their pain control as *very good* increased markedly in the audit performed after the interventions were introduced. Thus both pain scores and patient satisfaction of pain control were improved.

The significant decrease in pain scores in Audit 2 were achieved despite the higher number of patients undergoing major surgery in the repeat audit (73% vs. 62%). This indicates that the ability to control pain is likely to have improved after the introduction of the interventions as it is assumed that the pain experienced by patients following major surgery would be rated as higher.

The employed interventions were not analysed separately to determine each individual contribution, but were rather seen as an overall process for improved pain control.

1) *Daily pain ward rounds*

These took the form of daily multi-disciplinary ward rounds in the male and female surgical wards. Organized management of acute pain is a relatively recent phenomenon gaining increased awareness since its beginnings in the 1980's, when anaesthesiologists started organizing acute pain services.[14 - 16] Acute pain ward rounds provide an ideal opportunity to teach service providers, address misconceptions, discuss pain-related issues with patients, and adapt prescription charts to improve pain control as needed.

2) *Staff education, including a regional anaesthesia workshop for the Anaesthesia Department staff*

Education and training of staff and patients is the key to improved pain control.[17] Goodacre and Roden were able to demonstrate improved pain control in patients with just a few hours of focused teaching.[17] Several aspects of staff education were addressed following Audit 1. Informal lectures, together with question and answer sessions were held at the weekly hospital academic meetings. All members of staff from the various disciplines were invited to these sessions. Topics covered included the physiology of pain, "step-wise" analgesia, the results of Audit 1, and discussions around the proposed interventions. Attendance at a regional anaesthesia workshop by all anaesthesiologists working in the Department of Anaesthesia at VHW, formed part of the education process and is believed to have contributed to the improved scores seen in patients receiving regional anaesthesia during Audit 2.

3) *Management of epidural analgesia*

A longer duration of epidural analgesia was shown, in Audit 2, to be a highly effective means of decreasing the pain scores. By simply increasing the duration of the epidural analgesia from 24- to 48 hours, there was a clinically significant decrease in pain scores.

Epidural anaesthesia is an ideal technique for lower limb total joint- and regional orthopaedic surgery. This method effectively provides good postoperative analgesia, and may reduce venous thrombo-embolism (VTE), respiratory morbidity, and blood loss, as well as facilitating rehabilitation.[18-20]

Although fewer epidural catheters were placed in Audit 2, the total epidural time increased from 240 to 288 hours, ensuring adequate pain relief for the entire investigation period.

4) PCA pumps

Unfortunately, due to the size of wards and the limited number of staff, medication is not always administered as prescribed. One international study estimated that up to 25% of prescribed analgesic medication is not given postoperatively.[21] Interrogation of prescription charts on the wards after Audit 1 showed that often either the oral medication or the intramuscular morphine was given without the other. This results in an unintentional unimodal analgesic strategy. During the present audits, this became one of the focuses of staff education, as well as a motivation for the introduction of PCA pumps.

PCA affords patients control of their own analgesic administration, meaning that patients no longer depend upon nursing staff to administer opioids. Research has consistently shown that patients with IV PCA pumps use less opioid compared with standard IM regimens,[22 - 24] potentially decreasing side effects. The use of PCA pumps consistently improves patient satisfaction with regards to pain control, but there is conflicting evidence as to whether they produce significantly lower VAS scores.[25] The institution of PCA pumps will most likely have contributed to the increased patient satisfaction seen in Audit 2, with an indeterminate contribution to lowered pain scores.

5) *Catheter placement for femoral nerve blocks*

The placement of catheters for continuous femoral nerve local anaesthetic infiltration was an intervention introduced during the period between the two audits. These were primarily used for patients undergoing TKR. Patients with a femoral catheter were not required to be admitted to the high care unit postoperatively. Femoral catheters were used as part of a multi-modal approach to analgesia and not as a unimodal technique. The scores obtained in patients receiving indwelling femoral catheters showed them to be a consistently effective means of controlling post-operative pain during the investigation period. Single shot regional blocks are notorious for their "wear-off" phenomenon and this effect may be eliminated by the use of indwelling catheters with a continuous infiltration of local anaesthetic.[26]

The development of continuous peri-neural local anaesthetic infiltrating devices has been described as one of the most important advances in the management of postoperative pain following orthopaedic surgery.[26] A continuous peri-neural infiltration of local anaesthetic eliminates the relatively short duration of a single shot femoral nerve block. By incorporating a local-anaesthetic agent as part of the multi-modal strategy, it is possible to significantly reduce opioid consumption and side effects.[27] Local-anaesthetic agents have been shown to provide both effective analgesia and inhibition of the inflammatory response produced by surgical trauma.[27]

CONCLUSION

Pain remains a problem in surgical wards throughout the world, yet little research has been done to evaluate the magnitude of this problem in our patient populations. This audit cycle has shown that pain following orthopaedic surgery at a Level Two Hospital in Cape Town was not well controlled, with unacceptable post-operative pain scores recorded at measured time points in Audit 1. Encouragingly, the introduction of 5 simple interventions aimed at decreasing post-operative pain, was shown to result in a significant improvement in post-operative VAS scores in Audit 2. In order for strategies

aimed at decreasing pain to be effective, agreement on the implementation of the intervention strategies is required, as well as ongoing commitment from all health workers involved in the postoperative care of patients.

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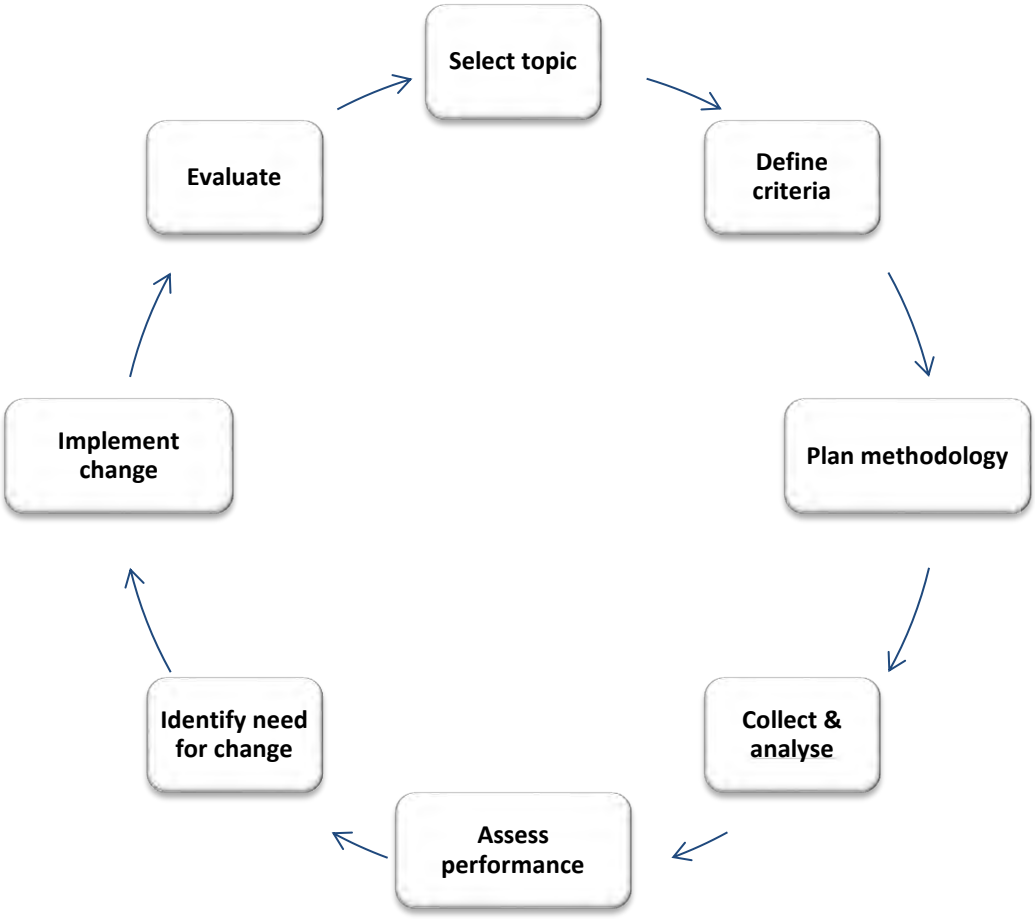
Part D: Appendices

Appendix 1: Audit Cycle



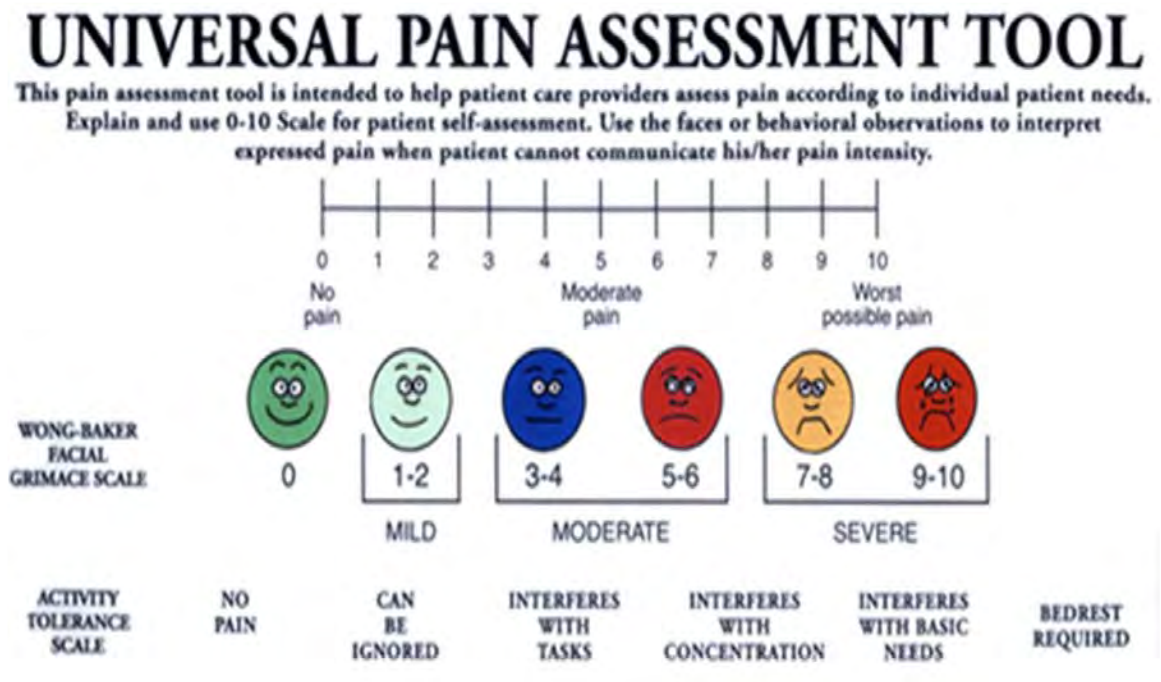
The audit cycle was used as the basis for the design of the study with the intention to complete the audit cycle as outlined in the proposal.

Appendix 2: Patient demographics

Audit 1			**Audit 2**		
Day cases:	**Number**	**Av age (years)**	**Day cases:**	**Number**	**Av age (years)**
Female	N = 13	46.67	**Female**	N =7	54.86
Male	N = 6	40.66	**Male**	N = 9	36.11
Total	N = 19	44.67	**Total**	N= 16	44.31
In-patients:			**In-patients:**		
Female	N =26	59.78	**Female**	N = 33	61.55
Male	N = 26	48.19	**Male**	N = 22	49.14
Total	N = 52	53.63	**Total**	N = 55	55.69
Total patients			**Total patients**		
Female	N = 39	55.29	**Female**	N = 40	60.38
Male	N = 32	46.78	**Male**	N = 31	45.23
Female and Male	N = 71	51.23	**Female and Male**	N = 71	53.13
Lost to follow up	N = 13		**Lost to follow up**	N = 4	

The demographic details of the patients in Audit 1 and Audit 2 can be seen to be similar, as mentioned above in the manuscript, from the table in terms of gender and age for both day case surgical patients and patients admitted to the wards post surgery. There were fewer patients lost to follow up during the second audit and this is thought to be due to the fact that the anaesthesiologists collecting the data were more familiar with the process and became more efficient at completing the necessary data on the forms.

Appendix 3: Universal Pain Assessment Tool



The universal pain assessment tool makes use of a Visual Analogue Scale (0-10), which forms the basis of the data collection in terms of pain control post operatively, together with facial images and a description of pain interference. The facial grimace scale and their associated colours provide people that are illiterate a means to rate their pain correlating facial grimaces to VAS scores. There is also a description of the degree of limitation of activity due to pain that helps patients who have difficulty communicating their pain intensity to rate their pain more accurately.

Appendix 4: Letter of consent

Consent Form – Clinical Audit of Postoperative Pain Victoria Hospital

Dear Patient

We would like to find out how much pain our patients are experiencing after surgery. To do this we are conducting a study in which we will ask our patients to rate their pain on a numerical scale at intervals after their surgery.

Participants in our study will receive the operation and analgesia which their illness requires, this will not differ from the treatment you will receive if you choose not to participate. Participants will be asked to rate their pain according to a pain scale when they are fully awake after surgery and again at 12, 24 and 48 hours after surgery if they are admitted to hospital. For participants who are discharged after surgery they will be contacted telephonically the day after surgery to find out whether they are experiencing any pain, and if needed they will be contacted again on the following day. Should you be experiencing any pain, we will immediately provide you with adequate pain relief.

This study is being run by Dr Fuller, head of the Anaesthetic Department at Victoria Hospital as well as Dr Hauser and Dr Van der Walt, medical officers in this department. Also we are being assisted by a few intern doctors from the surgical department of our hospital.

Any information which you share with us will remain confidential. You may also withdraw from this study at any time without compromise to your care as a patient at this hospital.

We would appreciate your participation in this study!

Patient Sticker

I, ----------, consent to be enrol led in the above clinical audit. The study has been fully explained to me by the doctor below.

---------- Patient ---------- Witness

---------- Doctor ---------- Date

If there are any queries or concerns regarding this study please contact:

Dr Fuller, Dr Obelholzer or Dr Hauser 021 799 1167.

The letter of consent was attached to each data collection form and was signed by the patient prior to their enrollment in the audit. It was available in English and in Afrikaans, the two languages most commonly spoken by patients at Victoria Hospital. Should a patient not be able to read or speak English or Afrikaans a translator was used to gain the consent of the patient. These consent forms were typically shown to patients the day before surgery during the pre-operative anaesthetic assessment. For day-cases, consent was obtained in the pre-admission area on the day of surgery. Patients were free to decline participation in the audit without any negative impact on the treatment that they would receive.

Appendix 5: Data Collection Form

PATIENT NAME **PATIENT FOLDER NUMBER** **AGE**

CLINICAL INFORMATION	
Regional or General Anaesthesia	
Indication for orthopaedic procedure	
Contraindication to NSAID's	
Preoperative medication /analgesia	
Intraoperative analgesia given	
Duration of surgery	
Approximate blood loss	

Time Postoperatively	**VAS at rest**	**VAS on movement**
0-hours		
12-hour		
24-hour		
48-hours		
Time to first request		

Analgesia boarded	**Dose and interval**	**Time after operation at which the dose was administered**				
Morphine						
Paracetamol						
Other						

Investigator intervention	**Time**

Side effects	
Nausea	
Vomiting	
Pruritus	
Other	

Overall patient satisfaction with respect to analgesia	
Very good	
Good	
Adequate	
Poor	

Data was recorded from each procedure on to the data sheets above. The anaesthesiologist on duty for that particular case recorded initial data. The anaesthesiologist on call the following day obtained each of the follow up VAS scores post operatively. The post-operative orders in terms of analgesia were recorded on the forms and it was possible to determine how much of the prescribed medication was actually given by the ward staff. In addition there was place to record any further interventions ordered by any of the anaesthesiology staff as outlined in the protocol.

Appendix 6: PCA record Victoria Hospital

Date and time.....

Patient name.....

Date of birth.....

Anaesthetist on call OR Surgical Intern on call……

Procedure.....

Drug concentration: Morphine..... Ketamine.....

Droperidol..... Other.....

Please note:

- PCA extension set must be connected to a **dedicated** and separate intravenous canula without an injection port.
- The PCA extension set must **not be piggybacked** onto the patient's intravenous line.
- **40 % O_2 facemask** to be used for the **first 12 hours**.
- Patients should **not receive other opiates** while PCA in use. **Monitor and record 1 hourly (first 6 Hrs):** respiratory rate heart rate blood pressure pulse oximetry (saturation) and sedation score

CALL DOCTOR IF:

- **If respiratory rate below 8 per minute**
- **Saturation less than 90%**
- **Sedation score >1 And Immediately do the following steps**:
  1. **Actively wake patient,**
  2. **Give 100% O_2 and**
  3. **Administer 0.4mg naloxone intravenously and 0.1mg/kg intravenously or intramuscularly if patient is less than 40kg.**

Level of Sedation	**Score**
Awake and orientated	0
Drowsy but wakes on verbal command	1
Drowsy but wakes on pain stimulus	2
Deeply sedated not able to wake	3

The Victoria Hospital PCA form was attached to the front of the prescription chart of every patient that received a PCA in either the High Care Unit (HCU) or the wards. Next to the section Anaesthetist OR Surgical Intern on call was written the cellphone number of the respective person, which made contacting them very easy for the wards in case of an emergency or potential overdose. Clear instructions were also written as to what should be done by the ward staff prior to the arrival of the on call doctor. These forms were universally used in the hospital for all patients with PCA pumps post surgery.

Appendix 6: South African Journal of Anaesthesia and Analgesia

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The following are sample references:

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