Pain assessment and pain alleviation practices of ambulance officers in Auckland

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Attestation of Authorship

"I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning."

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"We must all die. But that I can save a person from days of torture, that is what I feel is my great and ever-new privilege. Pain is a more terrible lord of mankind than even death itself"

Albert Schweitzer, 1931

Abstract

Pain is a common complaint of many patients that ambulance officers encounter. The prevalence of pain in Auckland is unknown. Little is known about how ambulance officers and paramedics assess and treat pain. More options exist for treating pain than previously, but frequency of use is uncertain.

A retrospective review of ambulance officer patient report forms was carried out (n=371). Patient information including age, gender, chief complaint, and acuity status were recorded. Presence, location and pain assessment variables, including pain scores were abstracted. Documented treatment of pain was also recorded. Crew qualifications were abstracted. Research questions were targeted towards the prevalence of pain, methods and frequency of pain assessment used, pharmacological and non-pharmacological treatment of pain, and if differences existed in how ambulance officers of different qualifications assessed and treated pain.

Pain was reported in 49% of patients. Chest (21%) and abdominal (19%) pain were most common. Ten percent of patients had an initial pain scores documented, the mean pain score being 6.04. Mean follow-up pain score was 2.83. Poor documentation of onset, provokes, quality, radiation, severity, timing and pain scores was evident. Paracetamol was the most frequently administered analgesic (19%). Poor documentation of non-pharmacological treatment noted. Basic life support officers recorded some pain assessments more frequently than other qualifications, but intermediate life support officers recorded pain scores more than others did.

Poor documentation about pain assessment and treatment of pain exists. There are opportunities for further education of ambulance officers, especially assessment of pain in paediatric and cognitively impaired patients. Consideration should be given to assessing the patient's desire for analgesia. This study provides a baseline for future comparison.

Chapter 1: Introduction

Introduction

Ambulance officers in New Zealand have traditionally had limited options for analgesia. Prior to 1990, a 50% oxygen 50% nitrous oxide gas mix (Entonox™) was available to ambulance officers, and selected paramedics were able to use nalbuphine (Nubain™) and pentazocine (Fortral™). In 1990, morphine replaced nalbuphine and pentazocine for use by paramedics. In 1999 morphine was made available to upskilled paramedics, a newly established qualification a step below that of a paramedic (known now as advanced paramedics or advanced life support officers), and increasing analgesia options to a larger group of personnel (R. Howard, 28 April, 2010, personal communication).

Analgesia options were extended in 2007 permitting greater choice for patient analgesia. In addition to Entonox ™ and morphine, paracetamol, methoxyflurane, and ketamine are available for the advanced paramedic to use. Upskilled paramedics have paracetamol, Entonox™, methoxyflurane and morphine in their scope of practice for analgesia options. Ambulance officers have paracetamol, Entonox™ and methoxyflurane available to them.

This study seeks to establish the prevalence of pain encountered by ambulance officers in Auckland, New Zealand, and examine how ambulance officers assess pain. Interventions used for pain relief, both pharmacological and non-pharmacological will be examined.

The aim of this research is to provide a baseline for future research. Little data has been gathered on prehospital practices in New Zealand. To the author's knowledge there has been one other study about ambulance officers in Auckland that focussed on paediatric analgesia.

Structure of the thesis

In this chapter, several background themes are introduced to contextualise pain assessment and management in the prehospital

setting. Defining pain is an important starting point, as well as current and historical prehospital practice in New Zealand is explored. Chapter 2 provides a review of the literature regarding prehospital pain assessment and management. Research design, methodology, data collection, ethics approval, and statistical analysis will be justified in Chapter 3. Results will be presented in Chapter 4. Chapter 5 concludes this thesis with discussion, implications and recommendations for prehospital practice.

Why this research is needed

There is a lack of prehospital research generated in New Zealand. On a national and international basis, prehospital research is frequently conducted by other health professionals such as doctors and nurses, and may not be directly related to the prehospital setting (Bjarkoy, n.d.; Smith & Eastwood, 2009). A significant proportion of prehospital research originates from the United States, usually medical schools based in midsized cities who have a relationship with a municipal emergency medical service [EMS] system. Prehospital research sits within emergency medicine research as a subgroup, and only became a recognised sub-specialty in 2010 (American Board of Emergency Medicine, 2010). In the United States less than one million dollars from the American College of Emergency Physicians [ACEP] and the Society for Academic Emergency Medicine [SAEM] are apportioned specifically for EMS research (Institute of Medicine of the National Academies, 2007).

New Zealand ambulance services are structured differently; the majority being privately owned not-for-profit organisations. St John provides 85% of ambulance services to New Zealand, with Taranaki District Health Board, Wairarapa District Health Board, and Wellington Free Ambulance providing the bulk of the remaining 15% (St John, 2010a). In February, 2011 Taranaki District Health Board contracted their ambulance services to St John. There are also a number of smaller ambulance services providing contracted cover for events and private transfer work.

Research funding in New Zealand is via the Health Research Council. In the 2009-10 fiscal year $83.52 million dollars was budgeted, the majority allocated for Vote Research, Science & Technology ($82.28 million). To the author's knowledge, there is none allocated for prehospital research. Health Research Council priorities for research funding aim to reduce inequalities in health care, particularly for Māori, Pasifika, children, young people, older adults and those with disabilities (Health Research Council of New Zealand, 2009).

Prehospital research has progressed slowly because of a lack of trained researchers who have clinical experience in EMS as well as experience in statistical analysis, methodological set-up, and obtaining informed consent. Other professions such as nursing, medicine, other sciences, and public health experts also need encouragement to conduct research in the EMS setting (Brice, Garrison, & Evans, 2000; Institute of Medicine of the National Academies, 2007; The National EMS Research Agenda Writing Team, 2002). Legal and ethical difficulties in obtaining informed consent in emergency medicine are well documented (Brice et al., 2000; Foex, 2001; Gray, 2001; Institute of Medicine of the National Academies, 2007).

Selection of subjects for inclusion in a study can be problematic. Issues identified include patient acuity, time delays for gaining the consent, discomfort on the part of EMS providers to enrol participants, or an internal conflict on the part of the EMS provider to gain informed consent versus treating the patient promptly (Foex, 2001; Gray, 2001; Institute of Medicine of the National Academies, 2007; Lerner, Mosesso, & Zak, 2002; Mann, Schmidt, & Richardson, 2005; Moscati, 2009; The National EMS Research Agenda Writing Team, 2002).

Data definitions between ambulance providers and hospital emergency departments (ED) are not standardised (Gilbert, Lowenstein, Koziol-McLain, Barta, & Steiner, 1996; Institute of Medicine of the National Academies, 2007; The National EMS Research Agenda Writing Team, 2002). Sharing of data between ambulance researchers and hospital departments in New Zealand can be problematic because of the Privacy Act 1993, as both are discrete organisations.

Many ambulance services (including those in New Zealand) are still using pen and paper records instead of electronic records (Institute of Medicine of the National Academies, 2007; Lerner, Zachariah, & White, 2002; The National EMS Research Agenda Writing Team, 2002). Records are dependent on the ambulance officer completing them to be complete, accurate, impartial and attentive. Illegibility, gaps in information and estimates of time points can create further inaccuracies, confounding results, as well as making data collection difficult (Gilbert et al., 1996; Lerner, Zachariah, et al., 2002; Wu & Ashton, 1997).

Defining pain

Pain has multiple definitions. The International Association for the Study of Pain defines pain as an “unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (International Association for the Study of Pain, 2010, p. 1). Pain is considered to be subjective. Margo McCaffery defined pain as “whatever the experiencing person says it is, existing whenever he says it does"(McCaffery, 1968, p. ix). It could be argued that pain is potentially indefinable.

Between 54-78% of patients presenting in the ED have a chief complaint of pain (Chambers & Guly, 1993; Cordell et al., 2002; Tanabe & Buschmann, 1999). Thirty-four percent reported mild or moderate to severe pain (McLean, Maio, & Domeier, 2002). Pain is seen as the most common reason that people seek medical consultation (Loeser & Melzack, 1999; Lynch, 2001).

The medical perspective views pain as a symptom of disease, and thus is used as a clue in the diagnostic process, which a doctor (or ambulance officer) is then obligated to treat and provide relief for the patient (Fauci et al., 2008). Pain is classified as nociceptive, neuropathic, or mixed nociceptive/neuropathic (Loeser & Melzack, 1999; Lynch, 2001). This reductionist approach views pain as a sensation, separate from the biology of pain, splitting the body and mind in a Cartesian fashion (Bendelow & Williams, 1995b; Gray, 2001).

Proponents of socialistic models argue that pain is a product also of culture and emotion (Bendelow & Williams, 1995b; Jones & Machen, 2003; Kugelmann, 2000).

Ambulance officers' knowledge of pain models is restricted to the bio-medical model, a product of their educational processes. Ambulance officer education is discussed more fully in this chapter, but has been delivered primarily by ambulance officers themselves based upon medical and nursing knowledge sources. An increasing emphasis on evidence-based practice exists, in keeping with the scientific biomedical model (The National EMS Research Agenda Writing Team, 2002).

The role of the ambulance officer

The role of an ambulance officer is a complex one to define; the ambulance officer being expected to assess the patient, form a working diagnosis, and initiate treatment in the out-of-hospital setting, with limited diagnostic tools. Integral roles are preparation for transport, and transport to definitive care. Typically ambulance officers are defined by their occupational tasks, namely "prehospital care and transportation of the sick and injured" (Crosby & Lweallen, 1995, p. xiii).

History gathering and physical assessment are the corner-stones of paramedic assessment. Tantamount is the recognition of patient acuity and clinical decision making skills in order to reach a working diagnosis and initiate appropriate treatment. However, ambulance officers are unique, less so in the skills that they perform, than in the environment in which they practice, demanding an adaptive approach (Bledsoe, Porter, & Cherry, 2006; Campeau, 2008a). This environment was described by Nelson as "a context rife with chaotic, dangerous, and often uncontrollable elements with which hospital-based practitioners need not contend" (B. J. Nelson, 1997, p. 162). Controlling of the 'space' that the paramedic / ambulance officer works in is dependent on establishing a safety zone, reducing uncertainty through social relationships with the patient, bystanders and other emergency services personnel at the scene, controlling clinical and non-clinical tasks,

modifying procedures (such as for extrication from a house, a stair chair may be used) and making trade-offs (a stretcher would be optimal for patient care) (Campeau, 2009).

This necessitates a pragmatic approach to patient care – tasks that need to be done now, or tasks that can be delayed until en route to hospital. Length of time for extrication from the scene of injury or illness, the patient's environment may dictate this. A patient inside their home may have the relative luxury of being in a warm, dry environment, enabling physical examination without exposing the patient to the elements or compromising their privacy. In contrast, the patient lying on the rugby field in the rain and wind necessitates a different approach. In order to prevent hypothermia, and respect the privacy of this person, ambulance officers may elect to remove the patient to the ambulance expeditiously and initiate a more comprehensive assessment and initiate treatment inside the ambulance. Throughout this, the paramedic is charged with first and foremost ensuring the safety of themselves, other crew members and patient. With this in mind, analgesia may be necessary in order to move the patient, or withheld until the patient is moved to a more secure environment.

When determining a cause for the pain and reaching a working diagnosis or 'field diagnosis', a reductionist approach is often used, eliminating life threats as able, having a range of differential diagnoses, narrowing the possibilities down to one or two with the aid of history gathering, physical examination, investigation of the environment around the patient (Bledsoe et al., 2006).

New Zealand ambulance officers have greater independence than some of their international counterparts in their clinical decision-making, as long as they practice within Clinical Procedures (St John Clinical Management Group, 2007, 2009). In parts of the United States, and Emergency Medical Technician (EMT) or paramedic may have to make contact with online medical control via a radiotelephone to gain permission to provide many treatments, including analgesia.

Title and scope of practice

Within New Zealand, different ambulance services have different titles for each qualification and varying scopes of practices. The term 'paramedic' however, is typically associated with someone who has advanced life support skills, especially outside of New Zealand. At present, a paramedic in Wellington and a paramedic in Auckland have differing scopes of practice but share the same qualification name. In this study, the terms 'ambulance officer' and 'paramedic' refer to the occupational group unless specified. Specific reference to practice levels used by ambulance officers in Auckland will be according to those outlined in Table 1. Throughout this study, the term 'ambulance officers' implies all members of the occupational group; and not a particular qualification.

Table 1 Qualifications levels and scope of practice adapted from St John Clinical Management Group (2007, 2009)

Qualification *Other titles in current use*	**Scope of Practice** *(analgesia options are listed in italics)*
Primary care (PC officer) *To be disestablished 2014, replaced with First Responder*	Automated defibrillation, nitrous oxide, aspirin
Ambulance officer (BLS officer) *Emergency Medical Technician*	All of the above plus nasopharyngeal airways, nebulised salbutamol, glyceryl trinitrate spray, intramuscular glucagon, laryngeal mask airway, *methoxyflurane, paracetamol.*
Paramedic (BLS paramedic) *(To be disestablished 2014)*	All of the above plus manual defibrillation, intravenous cannulation, intravenous fluid administration, intravenous glucose, subcutaneous lignocaine for intravenous cannulation, 12 lead ECG acquisition
Upskilled paramedic (ILS officer) *ILS officer*	All of the above plus *morphine*, metaclopramide, naloxone, nebulised adrenaline, intramuscular adrenaline, intravenous adrenaline for cardiac arrest only
Advanced paramedic (ALS officer) *Intensive care paramedic*	All of the above plus laryngoscopy, endotracheal intubation, cricothyrotomy, chest decompression, intraosseous needle access, adrenaline, atropine, frusemide, amiodarone, *midazolam*, 12 lead ECG interpretation, *ketamine*, transcutaneous pacing

St John Clinical Management Group issue Clinical Procedures that all ambulance officers employed by St John work within. Delegated scope of practice is determined by the qualification of the ambulance officer (refer Table 1). There are five current levels: primary care, ambulance officer, paramedic, upskilled paramedic, and advanced paramedic. Qualification titles have recently been reviewed, in an attempt to achieve national consistency with qualification titles and educational standards; these names are italicised in Table 1 (Standards New Zealand, 2008). For the purposes of consistency, qualifications will be identified as basic life support (BLS), basic life support paramedic (BLS-P), intermediate life support (ILS), and advanced life support (ALS), throughout this study.

The formation of the National Ambulance Sector Office [NASO] and the New Zealand Standard Authority NS 8156:2008 'Ambulance and paramedic services', have in part brought about some standardisation of titles (New Zealand Standards Authority, 2008). Standardisation of delegated scopes of practice by industry was necessary to even out contractual requirements of District Health Boards and Accident Compensation Corporation contracts with individual ambulance services. This is a transition step to achieve standardisation while New Zealand ambulance services grapple with the issue of ambulance officer registration. Presently ambulance officers in New Zealand are not recognised by the Health Practitioners' Competence Assurance Act 2003; instead are governed by legislation such as Medicines (Standing Order) Regulations 2002, and designated scope of practice by their relevant Clinical Management Group.

Ambulance officer education in New Zealand

Ambulance officers prior to the 1960s were limited both in training which consisted of a first aid course, and equipment which was little more than bandages, oxygen, splints, blankets and plenty of reassurance. The philosophy of care was 'scoop and run'; the name 'ambulance driver' was apt. Standards around New Zealand varied widely, and there was a push for a national standard of training. The

first Telethon held in 1975 in New Zealand raised $593,878 for the set up of the National Ambulance Officers Training School [NAOTS], which opened in 1977 (Hunt, 2009; Te Ara Encyclopaedia of New Zealand, 2010; Wright-St. Clair, 1977).

In 1984, an independent review was undertaken both of ambulance services and of ambulance officer education, as a consequence of concerns about funding streams. Ambulance services needed to be nationalised to ease contractual negotiations for funding. Concerns by other health professions, such as doctors and nurses, that ambulance officers were extending their scope of practice without input from those professions, potentially usurping the medical role. The advent of ALS paramedics in other countries extending their scope of practice, necessitated formal medical training, and input into the development of national protocols. The recommendation was that NAOTS become affiliated with a technical institute, enabling closer links with tertiary education (Ambulance Transport Advisory Board, 1984; Walton & Offenberger, 1984). Because of the report, NAOTS became a school within the Auckland Technical Institute in 1985, but physical relocation of premises from Pitt St ambulance station to the Akoranga campus in Northcote did not occur until 1990 (B.Costa-Scorse, 6 June, 2011, personal communication). The arrangement continued until 1999 when NAOTS was formally disestablished in favour of private training organisations, set up to deliver qualifications approved by the newly established New Zealand Qualifications Authority (Te Ara Encyclopaedia of New Zealand, 2010).

The trends in ambulance officer education are not unique to New Zealand. Expectations of quality of care, and educational standards have risen over the years, not just by the public, but also by ambulance officers themselves (Shaban, Wyatt-Smith, & Cumming, 2004). Two university-based courses offer degree level education from Auckland University of Technology and Whitireia New Zealand, an Australian university supporting the latter program. Greater knowledge and clinical decision making ability is expected of today's ambulance officer; this expectation increases as the ambulance officer advances in

qualification and scope of practice (Sayre, White, Brown, & McHenry, 2005). Increased autonomy brings increased accountability, but more often than not, the ambulance officer does not have all the information available to them on scene, and there is increased risk in clinical decision making (Campeau, 2008b; Shaban et al., 2004). The ambulance officer must continue to acknowledge that they have limited resources, training, and scope of practice with which to make clinical decisions (Campeau, 2008a).

Campeau's theory of 'space control' (2008a) advanced a theoretical framework underscoring the necessity of controlling the space around the patient, by controlling the activities that take place, in order to best support delivery of prehospital emergency care. Space control includes the following: establishment of a safety zone; reducing uncertainty through social relations including task allocation and negotiation with personnel; controlling the trajectory of the scene including clinical and non-clinical considerations; optimising efficiency, multitasking, and modifying procedure; temporality at the scene including determination of clinical urgency, scene circumstances, uncertainty of diagnosis or prognosis; collateral monitoring such as trade-offs of attention, and optimisation of efficiency. The patient in pain may or may not be central to the achievement of control as trade-offs are made on a constant basis, with decisions about extrication to the ambulance versus the need for analgesia, and the added on-scene delays potentially hampering departure to definitive care.

Currently ambulance officer education delivery is one of two formats. Basic life support is taught within New Zealand as the National Diploma in Ambulance Practice, a level 5 National Diploma qualification. The course offers a "symptom-based approach to clinical management and integrated clinical practice in the ambulance context" (New Zealand Qualifications Authority, 2010, p. 1). Pain assessment is limited to OPQRST approach to describing pain, namely, Onset, Provokes, Quality, Radiation, Severity, and Timing. Pain is encouraged to be rated using patient self-report, using the Numeric Rating Scale, a zero-to- ten scale. Pain management is according to Table 1

Qualifications and Scope of Practice. The emphasis is primarily on pharmacological methods of analgesia, although non-pharmacological methods are included.

The Intermediate Life Support (ILS) practice level was revised and updated from combining previous Paramedic and Paramedic Upskill courses in 2010. Pain theory includes gate control theory of pain, physiology of pain impulse transmission, pain assessment using the 0-10 Numeric Rating Scale, pharmacological and non-pharmacological treatment of pain. ILS officers are able to increased options for pharmacological treatment of pain.

Undergraduate degree graduates from Auckland University of Technology graduate with an advanced (ALS) qualification. Graduates from Whitireia New Zealand graduate at ILS equivalent and ALS qualifications are obtained at postgraduate level. Pain anatomy and physiology are taught in the context of pain assessment and management (B. Costa-Scorse, June 15, 2009, personal communication). Revision of education is taking place nationally, as a result of the National Ambulance Sector Office strategy which aims to "provide leadership for the sector to ensure a cohesive and consistent approach between emergency ambulance providers, with greater national consistency in training, clinical guidelines and oversight and levels of practice" (National Ambulance Sector Office, 2009, p. 4). This is part of an initiative to integrate ambulance services within the wider health sector, by achieving national consistency in clinical competency levels, titles of qualifications, and education standards.

Summary

Ambulance officers deal with patients in pain on a daily basis. Management of pain is fraught with the challenges of limited knowledge, scope of practice capabilities for establishing a working diagnosis and relieving the patient's pain, and dealing with environmental and time constraints. The role of the ambulance officer has grown over the years, along with both the public and industry expectations of capabilities. An ambulance officer has more tools in his

or her tool kit for dealing with the patient in pain, it is unknown is how often they are used.

Aims of this study

The aims of this study are to determine the relationships between the presence of pain, assessment of pain and treatment of pain of patients attended by ambulance officers in Auckland. The research questions are:

1. How many patients report pain in the Auckland district?
2. How is pain documented on patient report forms?
3. What components of standard pain assessment are documented?
4. How is pain managed using pharmacological and non-pharmacological interventions?
5. Is ambulance officer qualification associated with pain assessment?

Conclusion

Chapter 1 has provided background information about the definition of pain, why this research is important, the role of an ambulance officer and the socio-political-cultural environment that the ambulance officer practices in. Chapter 2 presents a literature review of pain assessment, pain interventions both pharmacological and non-pharmacological, within the context of prehospital practice. Chapter 3 outlines and critically examines the research methodology of this study. Chapter 4 presents the research findings and Chapter 5 analyses the findings, incorporating strengths and limitations of the study, drawing conclusions regarding the implications for further research and future practice.

Chapter 2: Literature Review

Introduction

Chapter one focused on the work that ambulance officers do, their scope of practice, how history has shaped the current role and scope of practice today, the environment within which they practice, and challenges associated with prehospital care. This chapter provides a detailed review of the literature commencing with the search strategy employed. Studies are critiqued to examine the context in which the study was undertaken and the research methodology utilised. Findings of studies for the variables of pain measurement, pain tools or scales, pain management and prehospital setting are examined. Application, reliability and validity in the prehospital setting are key factors in drawing conclusions for this literature review. The chapter concludes with justification for the methodology of this study.

Examination of the study context is important as a number of studies relating to emergency care are undertaken within the ED. While this environment has some similarities to the prehospital environment, there are differences in working environment, equipment available both for pain and patient assessment, as well tools to alleviate pain with. Critiquing the literature in the context of the environment that ambulance officers in Auckland practice within needed to be considered as different ambulance services have varying scopes of practice, crewing levels, and resources available for analgesia.

Search strategy

1. A search was conducted using PubMed, CINAHL, Scopus, Google Scholar and by hand using the following MeSH search terms “emergency medical services” or “prehospital” and “pain” as major topic headings. Studies were limited to those in English, and published since 1990. Limited numbers of studies were conducted in the prehospital setting prior to this date; in addition, analgesia options were severely limited in many countries, including New Zealand. Seven hundred and eight-eight articles were located; the

majority of studies were based in ED rather than prehospital setting, so were discounted. Twenty-one articles were reviews of analgesia in the prehospital setting. While not used in the literature review, they were referred to for additional sources of information. Forty-three were original studies set in the prehospital setting and directly related to either pain assessment, pain management or both (refer Appendix A, Figure 1). References from articles were also examined for studies that could be incorporated into the review.

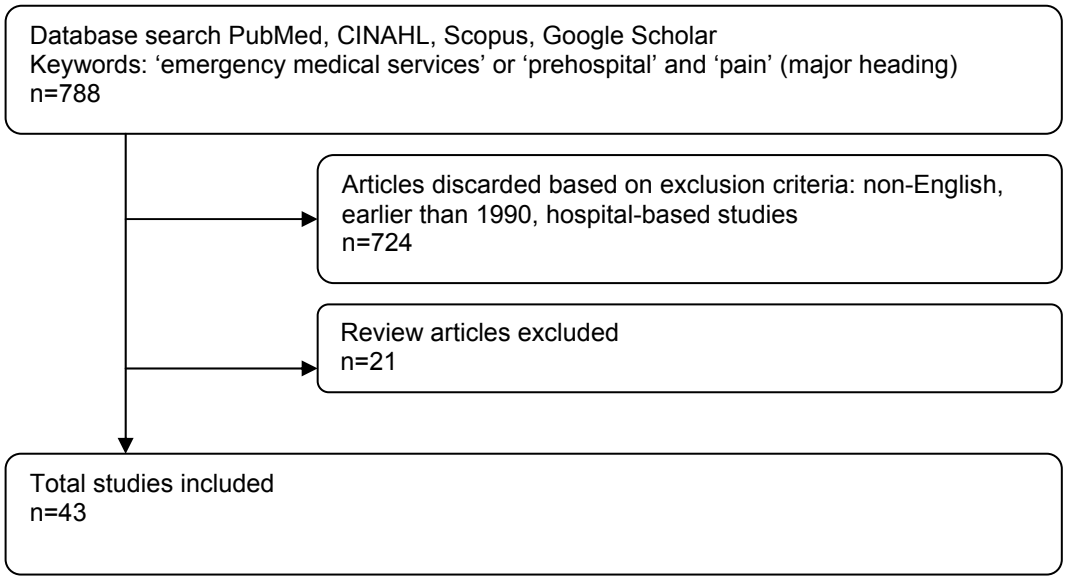


Figure 1 Study design, article inclusion

Defining pain

Pain has been defined by the International Association for the Study of Pain (IASP) as an "unpleasant sensory or emotional experience associated with actual or potential tissue damage" (2010, p. 1). This definition has been cited in some pain studies (Berben et al., 2008; Puntillo, Neighbor, O'Neil, & Nixon, 2003) but many more fail to define pain, despite assessing the effectiveness of analgesia, or self-reporting of pain using pain scales. Descriptive words have been used including aching, burning, cramping, discomfort, headache, pressure, sore, stiffness, tightness, and specific pain syndromes, but have not included words such as anxiety, itching or tingling (Cordell et al., 2002). Physical symptoms have been used to define pain, rather than sensations or emotions. The concept of subjectivity in defining pain was proposed by Margo McCaffery when she stated pain is "whatever the experiencing

person says it is, existing whenever he says it does" (McCaffery, 1968, p. ix). Pain felt depends on the ability of the person to report pain, potentially rendering both the IASP and Margo McCaffery's definition inapplicable, as in the case of preverbal children, those with altered level of consciousness or cognition (Anand & Craig, 1996).

Pain 'language' is further limited by clinicians tending to view pain as a Cartesian duality, separating the body from the mind. Words used by clinicians to describe pain are associated with symptoms, whereas the patient is only able to express their pain creatively as metaphors (Quintner, Cohen, Buchanan, Katz, & Williamson, 2008). The biomedical model assumes that pain is measureable (Bulloch & Tenenbein, 2002a; Gallagher, Liebman, & Bijur, 2001; Karcioglu, Degerli, Larkin, & Karaduman, 2004; Kelly, 1998; Kendrick & Strout, 2005; Strout & Burton, 2004). Sociological or cultural influences on pain are ignored, which the biopsychosocial model tries to incorporate (Anand & Craig, 1996; Bendelow & Williams, 1995a). It could be argued indeed, that pain is indefinable. However, despite the ambiguity about pain definitions, the assumption is made that this study is looking at pain from either the biomedical or biopsychosocial paradigms, as the study is investigating pain measurement in the prehospital setting.

Prevalence of pain

Pain is subjective and commonly referred to as 'pain' by the patient himself or herself during self-report. In determining prevalence, the definition of pain needs to be widened to incorporate words such as discomfort, aching, soreness, or tightness (Cordell et al., 2002). In the prehospital setting, five studies looked at the prevalence of pain (Chambers & Guly, 1993; Galinski et al., 2010; Lord, Cui, & Kelly, 2009; Marinangeli et al., 2009; McLean et al., 2002). One study was set in England (Chambers & Guly, 1993), one in the United States (McLean et al., 2002), one in Italy (Marinangeli et al., 2009), one in Australia (Lord et al., 2009), and one in France (Galinski et al., 2010). Other prehospital studies have incorporated the incidence of pain, but the scope of the studies were limited to either isolated injuries or extremity injuries

(McEachin, Swor, Seguin, & Pascual, 2004; Swor, McEachin, Seguin, & Grall, 2005; White, Cooper, Chambers, & Gradisek, 2000). Two out of the four studies were retrospective (Chambers & Guly, 1993; McLean et al., 2002), while Marinangeli et al (2009) and Galinski et al (2010) used prospective methodology using convenience samples. The study initially undertaken by Chambers and Guly (1993) was intended to be prospective, but a 30% completion rate due to difficulties encountered by both ambulance staff and patients, resulted in the study becoming a retrospective review of patients as they arrived in the ED. It is difficult to ascertain if actual ambulance records were incorporated in the data collection.

In this early study, the majority of patients admitted to the ED were a result of traumatic injury (68%) and 54% of patients were in pain. The authors recorded prehospital analgesia use but noted that 14% of patients required opioids by ED staff on admission, indicating a reasonable level of pain. It should be noted that ambulance officers were unable to provide any other analgesia prehospital than a 50% nitrous oxide 50% oxygen mix (Entonox™). As part of their study, they surveyed sixty-five chief ambulance officers throughout England about analgesia options, all carried Entonox™ , and the three carried nalbuphine (4%) and one ambulance service (1.5%) carried diclofenac for intramuscular use (Chambers & Guly, 1993). The respondents cited legal issues about the carrying of narcotics as a significant barrier to carrying alternative analgesics, and most were anticipating that upcoming changes to legislation would overcome this (Chambers & Guly, 1993).

McLean et al (2002) analysed data calculated from a systematic sample occurring over a 4-week period in 1999, where the data was weighted, standard errors calculated, using 95% confidence intervals. Sample data collected from 112 sampling units and 489 federal hospitals throughout the US reported a 93% return rate for the National Hospital Ambulatory Medical Care Survey. Using a 4-stage probability sample they extrapolated their results from a sample size of 21,103 to that of 14.5 million based upon the number of patients arriving by ambulance (14% of total number of patients arriving at the ED that year). Ninety percent of patients were over eighteen years of age (McLean et al., 2002).

In this data set, twenty-nine percent of the sample reported mild pain, while forty-two percent reported moderate or severe pain. Unknown or missing pain data was recorded in fifty-two percent of patients, but twenty percent of patients in this data subset reported moderate of severe pain. The missing information could be due to inadequate pain assessment, or inadequate documentation of pain assessment. For some of these patients, pain may have been alleviated or reduced in the prehospital environment, prior to ED admission. The authors concluded that, because of these factors they could not determine the prevalence of pain in the prehospital setting (McLean et al., 2002).

Convenience sampling was the basis for data collection by other studies with sample sizes varying from 383 (Marinangeli et al., 2009) to 2279 (Galinski et al., 2010). Data collection periods ranged between 7 days (Lord et al., 2009), and 11 months (Galinski et al., 2010). Galinski et al, (2010) recorded the lowest incidence of pain at 42% and Marinangeli et al (2009) recording 67.5%. Sample size was varied, 14.5 million, based upon a probability sample of 21103 (McLean et al., 2002), 502 (Chambers & Guly, 1993), 2279 (Galinski et al., 2010), 383 (Marinangeli et al., 2009). Data collection period was unknown (Marinangeli et al., 2009), 11 months (Galinski et al., 2010), 1 year (McLean et al., 2002), 20 days (Chambers & Guly, 1993). Prehospital prevalence of pain ranged between 67.5% (Marinangeli et al., 2009), 54% (Chambers & Guly, 1993), and 42% (Galinski et al., 2010).

Because of the limited data available regarding the prevalence of prehospital pain, ED data was also investigated. A further five studies were located. One study was an analysis of secondary data reporting ED visits (Cordell et al., 2002). The other four ED studies were prospective; used convenience samples, using structured or semi-structured interviews and included the assessment of pain intensity (Berben et al., 2008; Johnston et al., 1998; Tanabe & Buschmann, 1999; Tcherny-Lessenot et al., 2003). Patients presenting with pain ranged from 61.2% (Cordell et al., 2002) to 91% (Berben et al., 2008), but varying inclusion and exclusion criteria were present. Berben et al. (2008) limited eligibility to those with at least one traumatic injury, whereas other studies incorporated pain resulting from medical conditions (Johnston et al., 1998; Tanabe &

Buschmann, 1999; Tcherny-Lessenot et al., 2003). Tanabe and Buschmann (1999) found that pain was reported as the chief complaint in 160 out of 203 patients (78.8%) presenting at ED. This is similar to findings by Tcherny-Lessenot et al (2003) who found that out of 726 patients, 563 (78.8%) reported pain as their chief complaint in a written questionnaire. One study specifically excluded patients admitted by ambulance (Johnston et al., 1998). Exclusion criteria for all studies included age limits, patient acuity, and language comprehension. One study excluded patients with lacerations (Tanabe & Buschmann, 1999). One study included children in the interviews, by interviewing caregivers. This study utilised the Chromatic (Colour) Analogue Scale (Johnston et al., 1998).

In a study by Berben et al. (2008), 91% of patients (n=450) reported pain. The inclusion criteria meant that limited patients were eligible. Criteria for inclusion were patients over the age of sixteen years, traumatic injury, with stable airway, breathing and circulation, GCS >13, and having a single injury. Excluded were those who were intubated, needing continuous intensive care monitoring, attempted suicide, documented cognitive disability, uncooperative with either verbal or physical aggression displayed, or no informed consent obtained. Out of 760 possible patients, a total of 350 were excluded from the study as a result (Berben et al., 2008).

The Numeric Rating Scale was the most frequently used method (Berben et al., 2008; Tanabe & Buschmann, 1999; Tcherny-Lessenot et al., 2003). Other methods of measuring pain intensity were the Verbal Descriptor Scale (Tanabe & Buschmann, 1999), McGill Pain Questionnaire (Berben et al., 2008), and Verbal Pain Intensity Score (Tcherny-Lessenot et al., 2003).

Pain intensity was defined as ‘severe’ by one study as a Numeric Rating Scale score of over five (Tcherny-Lessenot et al., 2003), while others defined ‘severe’ as pain scores between eight and ten (Berben et al., 2008; Johnston et al., 1998; Tanabe & Buschmann, 1999). Interestingly, Tcherny-Lessenot et al (2003) defined patients who did not complain of pain as having ‘no pain’ thus excluding them from further data collection. Some may have had pain, but were not specifically complaining

of it, either because they did not want to participate in the study, or if they had been included, may have varied study findings.

Only one was solely retrospective, using chart review (Cordell et al., 2002). The authors found that 61.2% (n=1019) of 1665 encounters from 1602 patients presented with pain. Of those 1019, 869 reported pain as their chief complaint (85.4%). Assessment of pain intensity was not undertaken, due to the methodology. Pain was considered to be present if words implying pain, including discomfort, aching, soreness or tightness were present, or if a non-steroidal anti-inflammatory (NSAID) or opioid was noted to have been administered on the chart. Pain was further classified by location, duration, aetiology.

Data collection time frames varied from 7 days (Cordell et al., 2002; Tanabe & Buschmann, 1999) to three months (Berben et al., 2008). Time periods for actual data collection were diverse; from 11am to 9pm (Tanabe & Buschmann, 1999), 10am to 10pm (Johnston et al., 1998), or twenty-four hour periods (Berben et al., 2008; Tcherny-Lessenot et al., 2003). Berben et al's (2008) study incorporated collected data for each week day twice, at both sites, thus making a fortnight's worth of data collection. All were at a single site except Berben et al (2008). One study needed to increase the data collection period in order to meet sample size requirements (Tcherny-Lessenot et al., 2003).

Pain assessment in the prehospital setting

Twenty-three studies incorporated pain assessment; however, eleven studies focused on pain assessment in conjunction with evaluation of an intervention. Of the eleven studies, three focused solely on pain assessment (Lord & Parsell, 2003; Luger et al., 2003; McLean et al., 2004).

Two of the eleven studies investigated the introduction of specific interventions, namely fentanyl (Kanowitz, Dunn, Kanowitz, Dunn, & VanBuskirk, 2006) and morphine (Ricard-Hibon, Chollet, Saada, Loridant, & Marty, 1999). Six studies were audit-type activities where rates and effectiveness of analgesia, or adherence to accepted protocols or practices were being investigated (Galinski et al., 2010; Hennes, Kim, &

Pirrallo, 2005; McEachin et al., 2004; Ricard-Hibon et al., 2008; Ricard-Hibon et al., 1999; Rittenberger, Beck, & Paris, 2005).

Sampling and methods

Two studies were randomised double-blind controlled trial (Lang et al., 2007; Silfvast & Saarnivaara, 2001), another sampled every fourth run record (PRF) (McLean et al., 2004). The remaining studies used convenience sampling. Fourteen studies were prospective (Babl, Jamison, Spicer, & Bernard, 2006; Galinski et al., 2010; Lord & Parsell, 2003; Luger et al., 2003; McEachin et al., 2004; Ricard-Hibon et al., 1999) and nine were retrospective using primarily case audit and abstraction techniques (Hennes et al., 2005; Izsak et al., 2008; Kanowitz et al., 2006; Lord et al., 2009; McLean et al., 2004; Rittenberger et al., 2005). One study used a pre- and post-test method, examining data prior to and after an education session (Ricard-Hibon et al., 1999).

Cause of pain was criteria for inclusion into some studies. Specifically, patients with a traumatic injury were included in studies by McEachin et al (2004) and Izsack et al (2008); patients with non-traumatic chest pain were sought by Rittenberger (2005), while Hennes et al (2005) studied patients with chest pain, extremity injuries and burns. This could be in part, because protocols existed for treatment of pain associated with such conditions (Hennes et al., 2005), aligning it with an audit-type activity.

None of the authors differentiated between acute and chronic pain except for Luger (2003); their definition of chronic pain was long-lasting pain unrelated to the acute event, a definition that could be open to clinical interpretation. In their article ‘Prevalence and management of acute pain in prehospital emergency medicine’ Galinski et al. (2010) define acute pain as being ‘pain of recent onset and probably limited duration (p.335), but the inclusion criteria do not demand a specific diagnosis of acute pain. Main disorders included in patient characteristics for this study included those with rheumatic disorders and cancer, suggesting patients with long-term i.e. chronic painful conditions may have been included in the cohort.

Cohorts varied in age as well as sample size. Two studies included adults and children, both were retrospective reviews (Hennes et al., 2005; Kanowitz et al., 2006). One study only included children 16 years and under, specifically limiting the cohort to traumatic injuries (Izsak et al.,

2008). The remainder included patients over a particular age, the youngest was 10 years (Lord & Parsell, 2003; Ricard-Hibon et al., 1999).

The smallest sample size was 62 patients (Luger et al., 2003), the largest was 5583 (Hennes et al., 2005), both prospective studies. Some studies included paramedic crews in their sampling; again, Luger et al (2003) had the smallest sample size of 2 doctors and 10 each emergency medical technician (EMT) crew member and an EMT driver. Hennes et al (2005) surveyed 202 paramedics about their estimated analgesia rates in the past month for adults and children with chest pain, extremity trauma and burns, and compared with actual morphine administration rates. Lord and Parsell (2003) surveyed a convenience sample of 96 paramedics and ambulance officers about pain assessment and pain management.

Ambulance crewing plays an important role in determining the skill-set available to them in terms of managing pain. Three of the studies included doctors, which had a greater range of analgesia options. All three studies were European-based one set in Austria, two in France (Galinski et al., 2010; Luger et al., 2003; Ricard-Hibon et al., 1999). Three studies investigated paramedics with ALS skill-sets (Hennes et al., 2005; Izsak et al., 2008; McLean et al., 2004), while the remaining five studies viewed ambulances crewed with a mix of BLS level EMTs and ALS paramedic (Kanowitz et al., 2006; Lord et al., 2009; Lord & Parsell, 2003; McEachin et al., 2004; Rittenberger et al., 2005). Options available for analgesia administration varied considerably because of this.

Pain assessment methods

There are multiple methods of pain assessment, but the most commonly used assessment methods in the prehospital setting were the Numeric Rating Scale (NRS), Visual Analogue Scale (VAS) and Verbal Descriptor Scale (VDS, VRS) (refer Figure 2).

The NRS was used in five studies – only one study described the scale as being verbally administered i.e. VNRS (Lord & Parsell, 2003), but it is unknown if others were administered as a paper-based form or verbally (Galinski et al., 2010; Hennes et al., 2005; Lord et al., 2009; McLean et al., 2004; Rittenberger et al., 2005). The VAS used in 4 studies (Galinski et al., 2010; Lord & Parsell, 2003; Luger et al., 2003; Ricard-Hibon et al., 1999). Luger et al (2003) and Ricard-Hibon et al (1999)

reported VAS failure rates of 16% and 25% respectively. Reasons for failure included age, severity of injuries, and language barriers; however, both authors stated inability to understand instructions for using the VAS was a reason (Luger et al., 2003; Ricard-Hibon et al., 1999). Ambulance officers commented on the difficulties encountered getting patients to use the VAS; it was easier to misplace and leave in the ambulance. They perceived the VNRS to be an easier and more reliable tool (Lord & Parsell, 2003). A Verbal Descriptor Scale (VDS) or Verbal Rating Scale (VRS) was used in 5 studies, where the patient is asked to rate their pain as either non, mild, moderate, severe (Galinski et al., 2010; Kanowitz et al., 2006; McEachin et al., 2004; McLean et al., 2004; Ricard-Hibon et al., 1999)

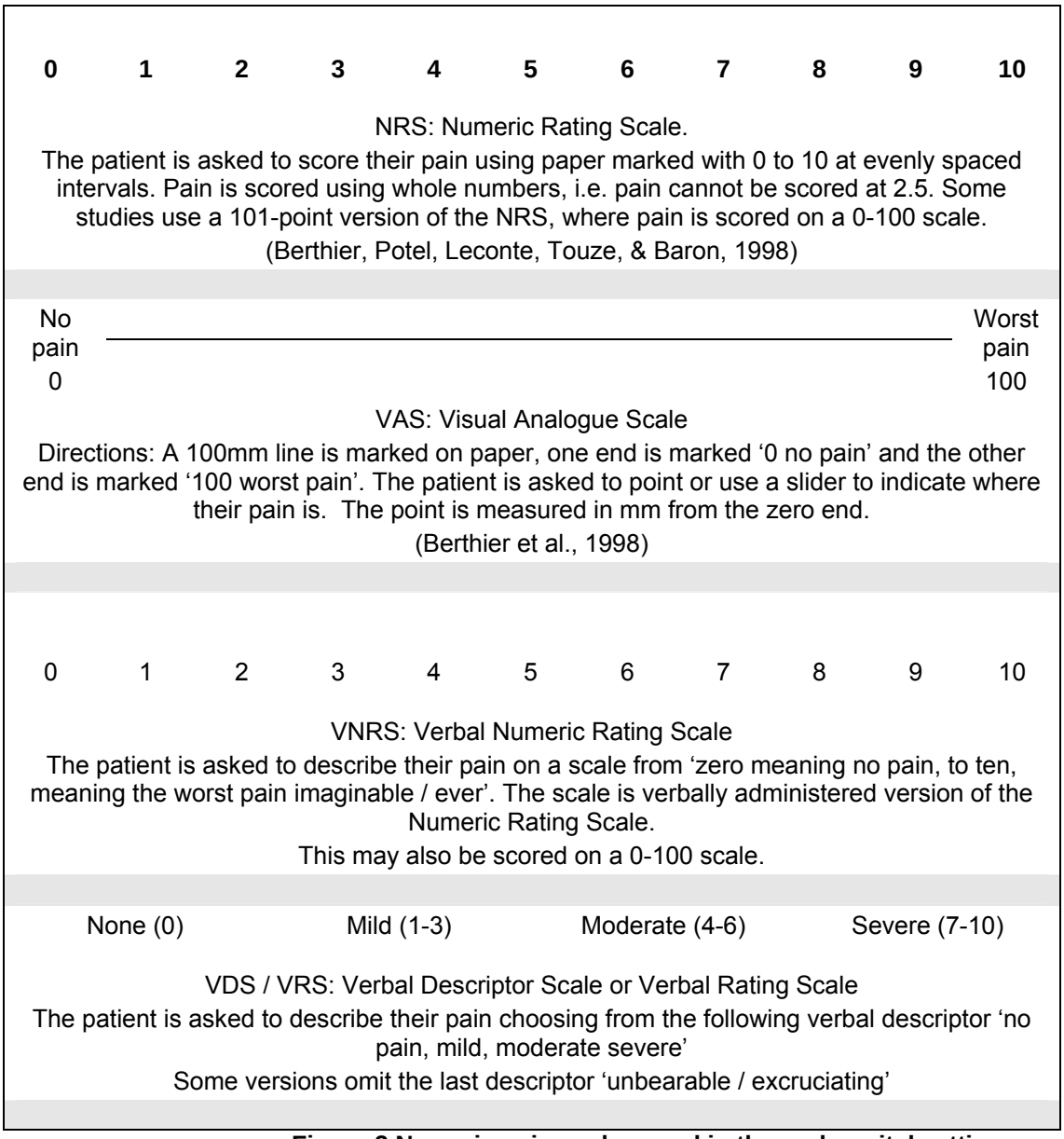


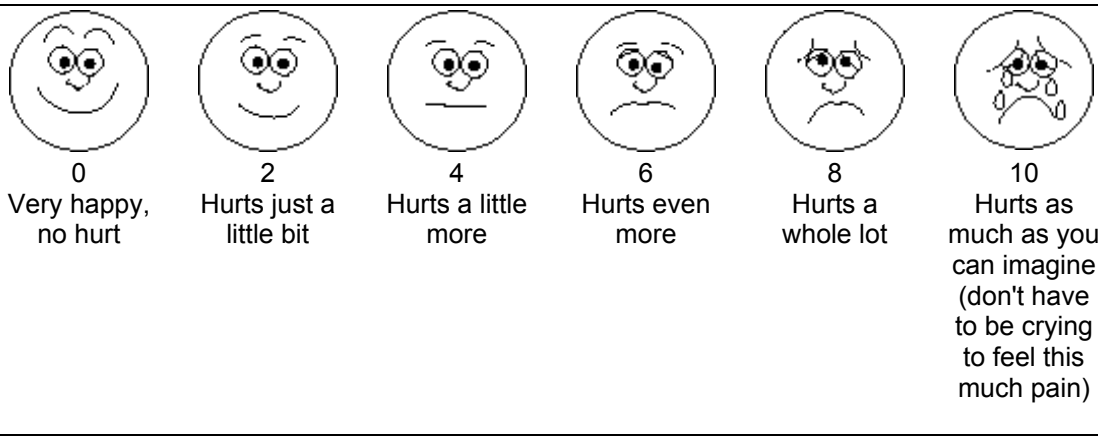
Figure 2 Numeric pain scales used in the prehospital setting

The VRS was used by most (Galinski et al., 2010; Kanowitz et al., 2006; McEachin et al., 2004; McLean et al., 2004; Ricard-Hibon et al., 1999), but only Ricard-Hibon et al (1999) stated his was a 0-4 scale. Other variations of the VRS are based upon a six-point scale developed by Melzack. McEachin et al (2004) stated in results that 81% of patients retrospectively reported moderate to severe pain, but did not state what scale was being used. Pain had been assessed by telephone follow-up on average 18 hrs post EMS arrival. It is possible that variations in descriptors will affect sensitivity of the scale. The inclusion of the descriptor 'unbearable' may affect the numeric value placed on other words describing pain. This in turn, may confuse the patient by providing another variable to describe their pain, or cause the practitioner to interpret the severity of pain differently.

The Paediatric Faces Scale used in one study (Kanowitz et al., 2006) (refer Figure 3). One study assessed OPQRST (Rittenberger et al., 2005) but others included narrative pain assessment as part of their data abstraction (Lord et al., 2009; McLean et al., 2004). Narrative documentation may not be considered part of pain assessment by other authors (Hennes et al., 2005). Some studies gave patient a choice of pain scales to use (Galinski et al., 2010; Kanowitz et al., 2006; McLean et al., 2004). Pain scores were measured more than once by some studies; twice (Lord & Parsell, 2003), three times (Luger et al., 2003), or the highest recorded pain score (Galinski et al., 2010).

Studies reporting high completion rates for pain assessment, had pain assessment as an explicit part of a protocol (Galinski et al., 2010; Kanowitz et al., 2006; McLean et al., 2004). In one study, emergency physicians were contacted regarding missing data on the survey form, and post-facto correction or amendment took place (Galinski et al., 2010). Such data manipulation may render inaccurate results about the reality of practice and compliance with pain assessment documentation. In another study, poor compliance with a protocol that incorporated pain assessment for non-traumatic chest pain was noted (Rittenberger et al., 2005). The high documentation of pain assessment by Kanowitz et al (2006) may be

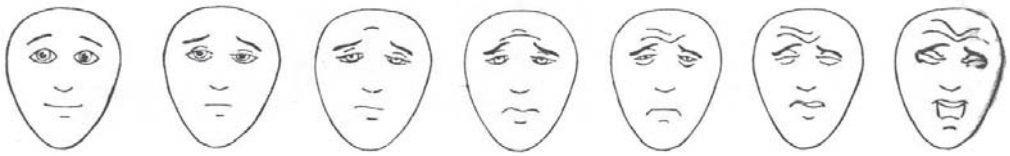
related to the evaluation of a pharmacological intervention, and the desire by paramedics to have extended analgesia options.



WBFS: Wong-Baker Faces Scale

A 6 point scale used primarily for the assessment of pain in children. The child is shown the faces and asked to point to the face that show how much 'hurt' they have now.

(Wong, Hockenberry-Eaton, Wilson, Winklestein, & Schwatrz, 2001, p. 1301)



FPS: Faces Pain Scale

The patient is shown the faces and asked to point to which face shows how they feel inside.

(Bieri, Reeve, Champion, Addicoat, & Ziegler, 1990)

FPS-R: Faces Pain Scale – Revised (Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001). Scale adapted from (Bieri et al., 1990)

The FPS-R was developed to enable scoring on the 0-10 scale, without the use of tears, as crying may not be viewed as appropriate by some cultures. "These faces show how much something can hurt. This face *[point to left-most face]* shows no pain. The faces show more and more pain *[point to each from left to right]* up to this one *[point to right-most face]* – it shows very much pain. Point to the face that shows how much you hurt [right now]." *Score the chosen face 0, 2, 4, 6, 8, or 10, counting left to right, so '0' = 'no pain' and '10' = 'very much pain.' Do not use words like 'happy' and 'sad'. This scale is intended to measure how children feel inside, not how their face looks.*

Figure 3 Face-based pain scales used in the prehospital setting

A small number of studies documented response, on scene and transport times (Kanowitz et al., 2006; Luger et al., 2003; Rittenberger et al., 2005). It has been argued that transportation times affect a

paramedic's decision to assess and treat pain (Hennes et al., 2005; Jones & Machen, 2003; Lord & Parsell, 2003).

McLean et al (2004) introduced pain assessment on patient charts, where VRS and NRS were collected. Reasons for non-collection included non-verbalising patients, language barrier, refusal, and behavioural or psychiatric conditions. Sampling was retrospective using a 1:4 sampling method after excluding inter-hospital transfers, discharge to other hospitals, clinic appointment transports, and patients who died on scene, and children under 13 years of age, resulting in a sample size of 1227. Eighty-eight percent of patients received some form of pain assessment. Eighty-three percent of these had some form of rating scale used, while five percent had narrative description only. Of those patients using a pain rating scale, fifty-eight percent used both VRS and NRS, twenty percent used VRS only, and six percent used NRS only. Initially the NRS was collected using a 0-100 scale, but discarded early in the study, as patients, ED staff and paramedics were more familiar with the 0-10 scale. Forty-eight percent of patients. Forty-eight percent of patients reported no pain, twenty percent reported mild pain (labelled as 1-3 using the NRS), eighteen percent reported moderate pain, and thirteen percent reported severe pain. The highest pain score was recorded if there were serial pain assessments by authors (McLean et al., 2004).

Completion rates of pain assessments varied between studies. The highest rate of pain assessment was 92% of patients receiving fentanyl who had pre and post-analgesia scores using the NRS, VDS (paediatric patients) or Paediatric Faces Scale (Kanowitz et al., 2006). This may have been because the EMS system had protocols incorporating pre- and post-analgesia scores. Disparities existed in other studies however, such as Izsack et al (2008) who found that 64% patients reported pain, but 18% had no documentation of pain. In a survey of estimated pain assessment vs. actual pain assessment, Hennes et al (2005) found that paramedics estimated that they assessed 71% of adult patients with chest pain, when compared with actual run reports (PRF), 37% of adults with chest pain were documented. Four studies specifically documented the presence or absence of pain (Izsak, et al., 2008; Lord, et al., 2009; Lord & Parsell, 2003; Ricard-Hibon, et al., 1999).

There were disparities noted between perceived assessment of pain and actual assessment. Paramedics believed they assessed chest pain in adults more frequently than was noted on run records by 34% (Hennes et al., 2005). A retrospective review of prehospital chest pain patients over 18 years noted errors of omission in regards to pain assessment documentation. Onset was documented in 64% of cases, Provokes 29%, Palliation 23%, Quality, 53%, Region 66%, Radiation 65%, Severity 52%, Scale 51%, Timing 14% (Rittenberger et al., 2005). Clearly, some aspects of pain assessment were documented better than others. The authors noted that failure to document assessment of pain fully could mean misdiagnosis; however, ambulance crews may be asking these questions but not documenting them. Teaching the OPQRST mnemonic commonly occurs in the context of assessment of non-traumatic chest pain, as a platform for distinguishing cardiac from non-cardiac chest pain, angina from myocardial infarction. While readily transferable to other areas of the body in pain assessment, for example, abdominal pain, OPQRST is performed less frequently.

Paediatric patients fared worse than adult patients in regards to pain assessment. The presence of pain was documented in 64% of children under 16 years who had extremity trauma, while 17% denied pain. The remaining 18% had no documentation about the presence of pain. Only one patient out of 696 (0.1%) completed a Verbal Rating Score (Izsak et al., 2008). Yet, children over the age of seven years are able to use a visual analog scale (VAS) (Shields, Palermo, Powers, Grewe, & Smith, 2003). Of 155 paramedic participants, 146 did not recall performing a pain assessment on a child in the past month, 107 adolescents had no pain assessment, in comparison with 14 adult patients having no pain assessment in the past month. Comparison between adults, adolescents and children frequency of pain assessments showed 65%, 5% and 2% respectively (Hennes et al., 2005).

The largest percentage of patients without pain assessment recorded were those with altered mental status (39%). Authors found that advancing age was not a predictor of no pain assessment despite one in three patients were over 75 years of age (McLean et al., 2004).

Several studies demonstrated that patients reported pain but did not receive analgesia. Wilson and Pendleton (1989) first coined the term 'oligoanalgesia' in regards to ED patients, but results demonstrate that it applies equally to the prehospital setting. The highest number of patients receiving no analgesia but reporting moderate to severe pain was 76% (McEachin et al., 2004), while 45% percent of patients reported pain without receiving analgesia (Lord et al., 2009). Non-administration of analgesia may be affected by the crew's analgesia options based upon their scope of practice and protocols, lack of patient awareness that the ambulance crew could provide analgesia (McEachin et al., 2004), or the patient did not want analgesia because the pain was tolerable (Todd et al., 2007). Paramedics reported reasons for not administering analgesia included the inability to assess pain, low pain scores, patient refusal of analgesia, difficult vascular access, delaying transport to hospital, fears of complication, record keeping, other care was adequate, possible drug seeking (Hennes et al., 2005), further increasing patient pain by intravenous cannulation or intramuscular injection (Watkins, 2006).

Conversely, twenty-four percent of patients received analgesia without documentation of pain according to Hennes et al (2005) but this may be because data abstraction included VNRS and working diagnosis, but not narrative descriptions of pain. Fourteen percent of paediatric patients received analgesia but had no documentation of pain, and five percent had documentation of 'no pain' but still received analgesia (Izsak et al., 2008).

Attitudes towards analgesia administration therefore appear to play a role in the assessment of pain and subsequent decisions about analgesia administration. Emergency medical technicians (EMT) and doctors underestimated pain, in particular severe pain, in average 25mm less using the VAS in comparison with patient self-report (Luger et al., 2003). In another study, paramedics believed that they could assess pain without using a normative scale, some believing that a patient would exaggerate their pain if a normative scale was used (Lord & Parsell, 2003). Other paramedics believed that a patient's cultural background was a major factor in how they responded to pain. Pain assessment in this group appeared to be based upon the paramedic's cumulative clinical

experience rather than patient self-report, including facial expression, or physical signs such as swelling or deformity (Jones & Machen, 2003).

Limitations of pain assessment tools

Most pain measurement tools depend on the patient having a level of comprehension that enables them to understand the tool they are being asked to rate their pain against, as well as a sufficient command of English to enable them to both comprehend the instructions, and respond appropriately.

Patient preference is an important factor, as is the ability to use the pain assessment tool. The VAS has been reported to have higher failure rates than the NRS, which is preferred by both patients and health care providers for use (Aubrun, Paqueron, Langeron, Coriat, & Riou, 2005; Lord & Parsell, 2003; Mohan, Ryan, Whelan, & Wakai, 2010; Williamson & Hoggart, 2005). Failures have occurred due to problems with vision, hand-eye coordination, and physical impairment, to place a mark on the scale, or the patients' ability to think about their pain in abstract terms (Polly E Bijur, Silver, & Gallagher, 2001; Li, Xueqin, & Keela, 2007; Luger et al., 2003). As paramedics work in all environmental conditions, the VAS may be challenging to use in wet or windy conditions.

A uni-dimensional approach to pain measurement may prove problematic if the patient has pain in more than one site or acute pain presenting on top of chronic pain. Such tools do not take into account behavioural, psychosocial, and affective factors that influence pain, such as stress, fatigue, anxiety, and how others view their pain (Aydede & Güzeldere, 2002; Loeser & Melzack, 1999; Williams, Davies, & Chadury, 2000).

Some groups have trouble reporting their pain, such as children and elderly with cognitive impairment, or those who speak another language. Children may have difficulty in discriminating pain from fear and anxiety (Belville & Seupaul, 2005; Bulloch & Tenenbein, 2002b), and any alteration in vital signs can be difficult to pinpoint as having a direct relationship with pain specifically (Liebelt, 2000). A recent study by Lord and Woollard (2011) suggests that there is no correlation between vital signs and self-report of pain in adult patients. However, the study was limited to patients over fourteen years old.

While cognitive development varies from child to child, uni-dimensional scales such as the VAS and NRS are ratio-based scales that necessitate that the child understands the relationship between numbers. (Belville & Seupaul, 2005). It is suggested that children should be at least eight years old before using a numeric rating scale, but various faces scales can be used from four years of age, and children as young as three years may be able to use a 'pieces of hurt' scale (Belville & Seupaul, 2005; von Baeyer, 2006). Language skills vary according to childhood development, as well as different race or culture, which limit a patient's understanding of uni-dimensional scales, such as the NRS and VDS (Jennings, Cameron, & Bernard, 2009). Face-based pain assessment tools such as the Wong-Baker Faces Scale (WBFS) and Oucher scale are more reliable in children aged three to seven years of age, and have demonstrated greater validity (Luffy & Grove, 2003).

Speaking another language can hamper interpretation of meaning of verbal descriptors of pain, for example, differentiating between mild and moderate, or severe and excruciating. Pain assessment tools need to be translated and back-translated to avoid misinterpretation by the patient, interpreter and practitioner (Todd, 1996). It is also likely that pain assessment challenges will result in inadequate treatment of pain (Bonham, 2001).

In the elderly, challenges with poor motor function due to arthritis, failing vision and hearing may pose issues with accurate pain assessment. Cognitive function may be declining (Rodriguez, 2001; Wynne, Ling, & Remsburg, 2000). Pain assessment tools may need to be specifically developed. Limited research exists in this area. One study, conducted in a nursing home reported a high failure rate on the VRS (49%),VAS (43%), WB-FS (39%), and the McGill Word Scale (27%). Locating pain using a doll brought the highest failure rate (27%), while locating pain using self demonstrated a failure rate of 14%. The authors point out the high overall failure rate and the need for strategies that do no rely on self-report (Wynne et al., 2000). Lord (2009) suggests that paramedics should investigate using an alternative pain assessment tool, the Abbey Pain Scale, for those patients who cannot verbalise. However, it requires a person who is both able to provide a history on behalf of the patient

(including changes to behaviour, physical appearance, and body language), as well as knowledge of the patient's 'baselines' in these areas. This is not always possible in the prehospital environment.

Pain management

Sampling and methods

Forty studies were identified that related to pain management in the prehospital setting. The majority of pain management studies (n= 25) enrolled adult patients; seven were paediatric studies and eight sampled patients from all ages. Twenty-two studies were retrospective, while eighteen were prospective. Six of the paediatric studies were prospective. Ten pain management studies compared one form of analgesia with another (Bounes, Charpentier, Houze-Cerfon, Bellard, & Ducassé, 2008; Fleischman, Frazer, Daya, Jui, & Newgard, 2010; Galinski et al., 2010; Middleton et al., 2010; Rickard et al., 2007; Silfvast & Saarnivaara, 2001; Swor et al., 2005; Vassiliadis, Hitos, & Hill, 2002). Only two studies identified in the literature review had nothing to do with pain management, indicating the tendency towards a clinical focus by ambulance officers (Lord & Parsell, 2003; McLean et al., 2002).

Consideration of analgesia options available to prehospital providers is essential at this point. Some prehospital providers had no pharmacological options available to them because legislative requirements meant that only doctors could administer medications in the prehospital setting. Non-pharmacological treatment of pain was the only option (Lang et al., 2007). Some prehospital providers had solely morphine as their prehospital analgesia option (Bounes, Barniol, Minville, Houze-Cerfon, & Ducassé, 2011; French et al., 2006; Fullerton-Gleason, Crandall, & Sklar, 2002; Hennes et al., 2005; Michael, Sporer, & Youngblood, 2007; Ricard-Hibon et al., 1999; Silfvast & Saarnivaara, 2001). Services staffed with medical doctors and nurses had greater analgesia options. Doctors crewed ambulances primarily in Europe (Bounes et al., 2011; Bounes et al., 2008; Galinski et al., 2010; Luger et al., 2003; Marinangeli et al., 2009; Ricard-Hibon et al., 1999; Silfvast & Saarnivaara, 2001).

Ambulance crewing

Crew mix is a key factor in pain management in the prehospital setting. Some services are crewed by ALS only, others are crewed by both BLS and ALS officers. Eight studies had unknown configuration (refer Table 2).

Table 2 Ambulance crewing for prehospital pain management studies

Crewing	Studies
Doctor or physician	Bounes, et al., (2011) Bounes, et al., (2008) Galinski, et al., (2010) Luger, et al., (2003) Marinangeli, et al., (2009) Ricard-Hibon, et al., (1999) Silfvast & Saarnivaara, (2001)
ALS officers only	Benson, et al., (1997) Fleischman, et al., (2010) French, et al., (2006) Fullerton-Gleason, et al,.(2002) Hennes, et al., (2005) Iszack, et al., (2008) Jones and Machen, (2003) Kanowitz, et al., (2006) Meisel, et al., (2010) Michael, et al., (2007) Swor, et al., (2005)
ALS and BLS officers together	Babl, Jamison, Spicer, and Bernard, (2006) Buntine, Ogilvie, Babl, Bailey, and Bernard, (2007) Chambers and Guly, (1993) Lord, et al., (2009) Lord and Parsell, (2003) McEachin, McDermott, and Swor, (2002) Middleton, et al., (2010) Rickard, et al., (2007) Rittenberger, et al., (2005) Vassiliadis, et al., (2002) Watkins, 2006(2006) White, et al., (2000)
Unknown crewing	Abbuhl and Reed, (2003) Colwell, et al., (2009) Goldman, Crum, Bromberg, Rogovik and Langer, (2006) Johnson and Atherton, (1991) Maimon, Marquest and Goldman, (2007) Michael, et al., (2007) Rothrock, Brandt, Godfrey, Silvestri, and Pagane, (2001)

In two-tiered ambulance services, a BLS unit may respond, and an ALS-crewed ambulance be requested for analgesia. This can cause delays to analgesia for the patient. These delays may be a factor in BLS crews not calling for back-up for analgesia (White et al., 2000). In one study, the majority of patients received ALS response (83%) but 38% of these patients were transported by BLS crews, suggesting that in addition to a downgrade in patient acuity, there would also be reduced options for analgesia (McEachin, McDermott, & Swor, 2002). Twenty-one percent of patients with fractured neck of femur were transported by ALS qualified crews, able to administer morphine, while the remaining patients had inhaled methoxyflurane as their only option for analgesia (Vassiliadis et al., 2002)

Standing orders vs. online medical control

Protocols and delegated scope of practice play a key role in prehospital pain management. Some ambulance services, including St John in New Zealand, use standing orders, which enable prehospital provider to initiate treatment, including analgesia, for specific conditions, with specified drug doses. Other ambulance services require the crews to contact online medical control to gain permission to administer treatments for specified conditions. This undoubtedly influences the provision of prehospital analgesia. Earlier studies, in particular, demonstrated greater degree of online medical control. For example, ambulance officers in one study needed to gain permission to administer oxygen (Benson et al., 1997).

Standing orders or protocols, if present, can empower prehospital personnel to provide treatment including analgesia, or limit them. Empowerment of the paramedic to deliver care without delays in obtaining permission can reduce a patient's pain, as well as potentially improve patient outcome. Limitations of standing orders, is that they tend to be based upon 'classic' patient presentations, and may promote a 'cookbook' approach to patient care. In one study, fentanyl administration was contraindicated under standing orders for patients with chest, head, abdominal or pelvic trauma, with no apparent alternatives (Izsak et al., 2008). The introduction of a new standing order permitting morphine

administration for isolated extremity trauma without online medical control resulted in increased requests were noted for administering morphing to patients with chest pain (Fullerton-Gleason et al., 2002). Ambulance officers in Auckland, who were able to only administer entonox and morphine in 2002, expressed a desire for alternatives such as oral paracetamol (Watkins, 2006).

Education for prehospital providers has a positive impact on pain management. After an educational intervention, French and colleagues (2006) found there was no increase in morphine use, but non-pharmacological treatment of pain increased from 4% to 34%. There was increased reporting of pain intensity (44% to 95%), and pain documentation (18% to 42%). Additionally, paramedics' knowledge and understanding of the pathophysiology of pain, referred pain, and adverse physiological consequence of pain improved. It was reported anecdotally that there were increased requests by paramedics for permission to administer morphine, but these requests were denied. Only paramedics received the education, not the doctors and nurses at the receiving hospital, providing a possible explanation for an apparent increase in morphine use. It seems too, that some patients are unaware that ambulance crews carry analgesia, so there is opportunity for public education, or at the least, ambulance crews to offer analgesia, and give the patient a choice (McEachin et al., 2004).

Gender differences

Three studies investigated gender differences in analgesia provision (Lord et al., 2009; Meisel et al., 2010; Rottman, Schriger, Charlop, Salas, & Lee, 1997). Thirteen percent of females received morphine in comparison with 17% of males (Lord et al., 2009). In isolated limb trauma, 32% of males received morphine in comparison with 26% of females (Michael et al., 2007). Male patients were also more likely to receive aspirin, nitroglycerin, and intravenous access than women in a study that contained an even mix of males and females (Meisel et al., 2010).

In another study with high levels of medical control, ambulance crews were more likely to request permission to treat females over 40 years of age with non-traumatic chest pain, than males over 40 years of age with the same complaint. Crews treating non-white males under 40 years of

age with non-traumatic chest pain requested permission to treat least frequently. Requests to treat ranged from supplemental oxygen, nitroglycerin, and intravenous cannulation. The authors do not state whether 12-lead ECG acquisition or analysis were part of the skill-set of the ambulance personnel, as this may have affected requests for some interventions. In this study, all requests were considered interventions if they were documented on the ambulance case report, even if the request was denied by the physician, in order to obtain data based upon paramedic assessments, rather than assessment of the physician providing online medical control (Benson et al., 1997). In comparison, Meisel et al., (2010) found no differences in the provision of analgesia to white patients and those of other ethnicity, but reported gender differences.

Analgesia administration

Patients in ED receive more analgesia than those in the prehospital setting. Eleven percent of patients with suspected hip fracture or kidney stones received prehospital analgesia, in comparison with 81% of patients in the same study receiving analgesia in the ED. In ED, all patients with kidney stones received analgesia, while 16% of patients with hip fracture received no analgesia. This is despite a mean NRS score of 8.7 for kidney stone patients and 6.5 for hip fracture patients (Goldstein, Dezure, & Swor, 2008). In another study, 12% of patients with isolated extremity trauma received prehospital analgesia in comparison with 88% of the same cohort receiving analgesia in the ED (Abbuhl & Reed, 2003). Fifty-three percent of patients reported pain from medical and traumatic causes; out of this group 45% of this group received analgesia, and 11% declined analgesia (Lord et al., 2009). Collectively, it appears that a number of patients are not offered analgesia, or restrictive analgesia protocols prevent the administration of analgesia.

Children in pain are consistently under-treated by prehospital personnel. Twenty-one percent of children with extremity fracture or burns received analgesia before hospital, in comparison with 79% who received analgesia in the ED (Swor et al., 2005). Using a broader cohort of trauma patients under 17 years of age, 64% reported pain, but only 16% received pharmacological treatment (Izsak et al., 2008). Studies incorporating

analgesia administered by parents and EMS personnel prior to ED have similar results. Comparison of age groups revealed that 22% of children aged 12 to 18 years received analgesia, in comparison with 13% of two to six year-olds, and 2% of children under two years of age (Maimon et al., 2007). However, this study does not specify EMS analgesia rates. No children under five years of age arriving at the ED with limb fracture or burn received analgesia, although 70% were deemed to be in pain by the triage nurse, in comparison with 51% of children over five years receiving analgesia, although 54% were still considered to be in pain at triage (Watkins, 2006). In contrast, Rogovik and Goldman (2007) found that children under six years of age were more likely to receive prehospital analgesia by their parents than older children, but less likely to receive first aid treatment such as cooling, and ice packs.

Inhaled analgesia

Entonox ™ is a 50:50 mix of nitrous oxide and oxygen, and has been used in the prehospital setting for many years for analgesia. Ambulance officers in New Zealand have been using Entonox™ for nearly thirty years. Presently, it is indicated for mild to moderate pain within St John (St John Clinical Management Group, 2009). An early study in the prehospital setting in relation to Entonox found that 77% of patients reported partial relief, 6% complete relief and 15% reported no relief. Fifteen percent reported adverse effects (Johnson & Atherton, 1991). Eighty percent of paediatric patients who received Entonox™ arrived in pain, with 92% of ambulance officers surveyed in the same study reporting that the ability of the child to self-administer Entonox™ was a major factor in their decision to provide it. Pain assessment was however, based on the opinion of the triage nurse, and it is possible the effects of Entonox™ wore off between the ambulance and ED triage (Watkins, 2006). Entonox™ has a duration of effect between two and five minutes (Johnson & Atherton, 1991).

Methoxyflurane is an inhaled anaesthetic used in the prehospital setting, primarily in Australia, for over twenty years (Babl, Barnett, Palmer, Oakley, & Davidson, 2007). It is a clear vapour, belonging to the fluorinated hydrocarbon group, and in low concentrations provides good analgesia, albeit with a distinctive odour (Babl et al., 2006). However, as at anaesthetic levels, there is high potential for nephrotoxicity; consequently

it is not approved in the United States or England for use in humans (Babl et al., 2007; Middleton et al., 2010). Within St John, it is indicated for moderate to severe pain (St John Clinical Management Group, 2009).

Two prehospital studies looked at prehospital methoxyflurane use, reporting high levels of satisfaction by paramedics, patients, and in the paediatric study, of parents. It is interesting to note that in both studies paramedics reported higher levels of satisfaction than patients (Babl et al., 2006; Buntine et al., 2007). Mean reduction in pain was 3.2 in the paediatric study (Babl et al., 2006), and ranged between 2.3 (for acute musculoskeletal injury) and 4.2 (back pain) in the adult group, when analysed by cause of pain (Buntine et al., 2007). Assessment of pain intensity in the paediatric study was based on a combination of patient questioning and the paramedic's assessment, while adults self-reported pain intensity (Babl et al., 2006; Buntine et al., 2007). A further pilot study was undertaken in the ED to assess the efficacy of methoxyflurane use in children undergoing painful procedures, or needing bridging analgesia until intravenous opioids were available. This was a small study with 14 patients enrolled, those with higher pain score of six or greater reporting the greatest reduction (Babl et al., 2007). Mild side effects were reported in 36% of children and 18% of adults (Babl et al., 2006; Buntine et al., 2007).

Methoxyflurane is considered suitable for lower levels of pain (Middleton et al., 2010), this is also reflected in St John Clinical Procedures (St John Clinical Management Group, 2009). Two further studies reported methoxyflurane efficacy at reducing pain when used alone of 42% and 44% respectively, but noted reduced efficacy of pain reduction when compared with other analgesics such as morphine and fentanyl (Lord & Parsell, 2003; Middleton et al., 2010).

Parenteral analgesia

The parenteral route refers to drugs administered by injection (Bryant, Knights, & Salerno, 2003). Parenterally administered analgesia includes morphine, ketamine, fentanyl, and ketamine. This section of the literature review has focused on parenteral analgesia options available to ambulance officers in New Zealand – namely morphine and ketamine. Midazolam is not included, even though it is administered for severe pain

in low doses in conjunction with morphine, if patient care is being significantly impeded. The intended purpose of midazolam in this setting is mild sedation of the patient in order to treat the patient, without loss of ability to obey commands (St John Clinical Management Group, 2009).

Morphine

Morphine has been used as an analgesic for many years in the hospital setting. Morphine is a controlled medicine in most countries, so legislation issues meant that ambulance officers were unable to carry and administer morphine. In New Zealand, ambulance officers were permitted to carry and use morphine in 1990. This had earlier been cited as an barrier to prehospital pain management (Chambers & Guly, 1993).

Nineteen studies incorporated morphine administration by prehospital personnel. Ten studies examined analgesia administration rates, some for specific cohorts of patients. Morphine was compared with other forms of analgesia in eight studies, while two studies looked at optimal dose and adverse effects of morphine alone. Study focus included audit into analgesia administered, implementation of new analgesia protocol, comparison between analgesia medications and dosing requirements, comparison between gender and analgesia administered.

For some, a change in protocol enabled the use of morphine in the prehospital setting (Fullerton-Gleason et al., 2002; Ricard-Hibon et al., 1999). Morphine was compared with intravenous and intranasal fentanyl (Fleischman et al., 2010; Middleton et al., 2010; Rickard et al., 2007), methoxyflurane (Lord et al., 2009; Vassiliadis et al., 2002), alfenatil (Silfvast & Saarnivaara, 2001), meperidine (Swor et al., 2005), and nitrous oxide (White et al., 2000).

Prehospital administration rates of morphine ranged between 0.02% and 67.9%. The higher rates of morphine administration were in EMS systems staffed by doctors (Galinski et al., 2010; Luger et al., 2003). Ambulances crewed by paramedics tended towards lower administration rates, ranging between 0.02% (White et al., 2000) and 15% (Lord et al., 2009). Four percent of patients with fractured neck of femur received morphine in the prehospital setting in comparison with 63% of the same patients receiving morphing in ED, highlighting a tendency towards low administration rates of morphine (Vassiliadis et al., 2002).

Morphine dose calculation was either weight-based or fixed-bolus amounts. Weight-based doses were used by European EMS systems crewed by doctors (Bounes et al., 2011; Bounes et al., 2008; Luger et al., 2003; Ricard-Hibon et al., 2008). Initial intravenous doses ranged between 0.05mg/kg to 0.1mg/kg, although one study included a range of between 0.1-0.2mg/kg. Mean administration rate of initial doses was 0.06mg/kg (Bounes et al., 2011; Galinski et al., 2010). Mean weight-based total doses were 0.12mg/kg (Bounes et al., 2011; Galinski et al., 2010).

Fixed bolus protocols were more likely used by paramedic-based EMS systems (Fleischman et al., 2010; Galinski et al., 2010; Michael et al., 2007; Ricard-Hibon et al., 1999; Rickard et al., 2007; Silfvast & Saarnivaara, 2001; White et al., 2000). All except one study had an initial intravenous bolus of between 2-5mg; an initial bolus range of 4-10mg was permitted (Michael et al., 2007).

Optimal morphine dose was investigated in a randomised controlled trial comparing two morphine protocols (Bounes et al., 2008). The authors reported 40% of patients who received higher boluses of 0.1mg/kg initially followed by 0.05mg/kg had had NRS $\leq$ 3/10 ten minutes after initial administration, whereas the patients in the other group who received lesser doses of morphine reported 17% of patients having NRS $\leq$3/10. However, the group reported double the incidence of adverse effects, and four times the incidence of emesis. The authors found that 30 minutes after administration for both groups, 76% of patients from the higher bolus group had a NRS $\leq$3/10, while 66% of the other group receiving a smaller dose had NRS $\leq$3/10.

Ability to administer repeated doses varies according to protocol, and the qualification of the prehospital provider. Ambulances staffed with medical doctors had greater freedom concerning morphine dose and upper limits (Bounes et al., 2011; Galinski et al., 2010; Luger et al., 2003; Ricard-Hibon et al., 1999). Some paramedic-crewed ambulances were only able to repeat morphine once (Rickard et al., 2007; Silfvast & Saarnivaara, 2001; White et al., 2000), while others had a maximum upper dose, the highest being 20mg (Michael et al., 2007). Repeat fixed-bolus doses ranged between 1-5mg, with time limits as to how soon the doses could be administered (Fleischman et al., 2010; Michael et al., 2007;

Ricard-Hibon et al., 2008; Ricard-Hibon et al., 1999; Rickard et al., 2007; Silfvast & Saarnivaara, 2001; White et al., 2000). There is a significant difference in range of repeat doses, up to 20mg (Fleischman et al., 2010) in comparison with a maximum of 10mg (White et al., 2000).

The majority of studies were involving adult patients. Two studies including paediatric patients set the bolus dose at 0.1mg/kg (Fleischman et al., 2010; White et al., 2000). Only one study permitted paramedics to administer a further single bolus. Despite this, only two patients received morphine, and the authors do not state if they were children or adults (White et al., 2000).

In some services, paramedics had to request permission to administer morphine (Abbuhl & Reed, 2003; French et al., 2006; Fullerton-Gleason et al., 2002). Changes to a protocol permitting paramedics to administer morphine, reduced time to morphine by 11% but did not significantly increase rate of morphine administration. However, this study was limited to patients with isolated extremity trauma, and a wider study population may have increased administration rates. Online medical control appears to have had an effect on morphine administration rates according to French et al. (2006) who provided an educational session about pain and pain management to paramedics, then reported increased requests to base hospital by paramedics to administer morphine, but no corresponding increase in morphine administration rates. The authors noted that ED staff were not included in the educational sessions, and may have contributed to the lack of change in morphine administration.

Two studies specifically included prevalence of adverse effects associated with morphine use (Bounes et al., 2011; Galinski et al., 2010)(Bounes, et al., in press; Galinski, et al., 2010). Both reported nausea as the most prevalent adverse effect. Bounes et al. (2011) reported a nine percent incidence of adverse effects, while Galinski et al. (2010) reported six percent.

Ketamine

In 2007, ketamine was introduced to ALS officers in New Zealand, to treat severe pain “particularly musculoskeletal or burn pain” (St John Clinical Management Group, 2007, p. 84). Ketamine, a dissociative anaesthetic, was discovered in the 1960’s, and since the 1990’s has been

used in the prehospital setting, both ambulance and military (P. R. Wood, 2003).

A literature search found six studies investigating ketamine as an analgesic in the prehospital setting. Other studies have explored the role of ketamine in ED use, airway management, and sedation, but limited studies exist in the analgesia setting. Two studies were prospective; three were retrospective reviews, and the final, a retrospective case series. A number of informative reviews also exist (Hennes & Kim, 2006; Lemonick, 2009; Mackenzie, 2000; Persson, 2010; Thomas & Shewakramani, 2008; P. R. Wood, 2003).

Both prospective studies were limited to trauma patients who were haemodynamically stable, able to score their pain, had no psychiatric history or chronic pain conditions, and had received no analgesia prior. One study further limited inclusion to patients with long bone fractures (Johansson, Kongstad, & Johansson, 2009), while the other limited inclusion to patients with a VAS pain score of ≥60/100 (Galinski et al., 2007).

Both studies included morphine in the study protocol. One study was double-blinded using a placebo (Galinski et al., 2007), while the other study was not blinded, but patients were randomly selected to receive either morphine or morphine and low-dose ketamine (Johansson et al., 2009). Both studies had small sample sizes, 73 and 27 respectively. Pain scores were assessed using the NRS (Johansson et al., 2009) and VAS scales (Galinski et al., 2007). Both studies reported reduction in pain scores, although the morphine-only group in one study had a higher mean initial pain score of 9.0 than the morphine/low-dose ketamine group, which was 7.5.

Johansson et al. (2009) stated that the morphine group reached their maximum prehospital morphine dose of 0.2mg/kg, resulting in higher mean pain scores at hospital of 5.4, in comparison with the morphine/low-dose ketamine group who had a mean hospital pain score of 3.1, but had a reduced mean pain score from the start. Mean treatment time increased by ten minutes in the morphine/low-dose ketamine group. The authors did not state if this was time spent on scene, or time with the patient, including transport. This group received 0.1mg/kg morphine and a mean ketamine

dose of 0.4mg/kg. The protocol was not clear in this study as to which drug was given first and how far apart the two drugs were administered. Galinski et al. (2007) randomly assigned patients to either receive 0.2mg/kg ketamine or placebo over ten minutes, following 0.1mg/kg morphine in a double-blind study. Regular 3mg boluses of morphine were available for both groups at five-minute intervals until VAS score reached 30/100 or less.

Both studies reported increased adverse effects in the groups receiving ketamine. Johansson et al. (2009) reported increased incidence of nausea and vomiting in the group receiving morphine/low-dose ketamine. Galinski et al. (2007) reported a 36% increase in neuropsychological side effects, and reduced 'good' or excellent' satisfaction levels from the ketamine group (56%) in comparison with the placebo group (69%). A number of patients reported more than one side effect. Vital sign changes at thirty minutes were similar to initial baselines, however, vital signs trends recorded at fifteen minutes were not documented in the study.

Vital signs recorded in both studies noted no significant changes in vital signs; however, periods were at least thirty minutes apart in both. Ketamine is associated with transient changes in heart rate and blood pressure, which may have been present in intermediary recordings (Svenson & Abernathy, 2007; P. R. Wood, 2003).

Four studies looked retrospectively at ketamine use, although one was described as a case series (Porter, 2004). Two studies included all ages (Porter, 2004; Svenson & Abernathy, 2007), one limited trauma patients to greater than 15 years (Bredmose, Lockey, Grier, Watts, & Davies, 2009), and another included children with traumatic injuries less than 15 years (Bredmose, Grier, Davies, & Lockey, 2009). Data was collected over 3.5 to 10 year-periods, with sample sizes of between 32 and 164 except for one study which reported on 1030 patients (Bredmose, Lockey, et al., 2009). All studies incorporated sedation and analgesia into study results, making it difficult to differentiate analgesia effects.

Burns and trauma patients received ketamine for both sedation and analgesia (Svenson & Abernathy, 2007), while others, including cardiac and asthmatic patients were administered ketamine for sedation.

Bredmose, Lockey, et al. (2009) used ketamine primarily for analgesia and sedation, with 1.9% of patients receiving ketamine for induction of anaesthesia or continued sedation following rapid sequence induction. It is not clear whether the remaining patients received ketamine for analgesia, sedation or both. Three studies recommended the concomitant use of midazolam to avoid neuropsychological side effects such as agitation or aggression (Bredmose, Grier, et al., 2009; Bredmose, Lockey, et al., 2009; Porter, 2004). In most cases, ketamine was administered intravenously, although a small number of cases received intramuscular ketamine (Bredmose, Grier, et al., 2009; Bredmose, Lockey, et al., 2009; Svenson & Abernathy, 2007). No adverse effects were reported in any of the retrospective studies, although one study stated that physicians were expected to document adverse effects in the free-text section of the data collection form, but there appeared to be little definition of what constituted an adverse event (Bredmose, Lockey, et al., 2009).

Enteral analgesia

Enterally administered analgesia includes those administered by oral, sublingual, or rectal routes (Herd, Babl, Gilhotra, & Huckson, 2009). There are no medications administered rectally by ambulance officers in Auckland, unless the patient is prescribed them, such as rectal diazepam in seizures.

Paracetamol

Paracetamol (or acetaminophen) is administered by ambulance officers for mild pain, as well as an additive to other interventions for moderate pain (St John Clinical Management Group, 2009). Paracetamol was outside an ambulance officer's scope of practice until 2007. Prior to then, a patient could be encouraged to self-administer paracetamol, but an ambulance officer could not determine it was clinically indicated.

Twelve studies reported on prehospital paracetamol administration, but five of these pertained to intravenous paracetamol administration and were not included. The highest percentage of oral paracetamol use was reported at 80% (Bounes et al., 2011). For patients with fractures and soft-tissue injuries, 18% of prehospital analgesia was paracetamol (Rogovik & Goldman, 2007). Marinangeli (2009) reported ten percent of ambulance

services in Italy carry either paracetamol or non-steroidal anti-inflammatory medication (NSAIDs). Paracetamol is not carried by all ambulance services in England, although UK Ambulance Clinical Practice Guidelines mention its use (Joint Royal Colleges Ambulance Liaison Committee & The Ambulance Service Association, 2006; Siriwardena, Shaw, & Bouliotis, 2010). In Australia, prehospital administration of analgesia for patients with suspected neck of femur fracture showed only methoxyflurane and morphine as available (Vassiliadis et al., 2002).

ED use was also examined. Paracetamol is the most frequently administered analgesic in Australian and New Zealand paediatric EDs (Herd et al., 2009). Administration rate of paracetamol in other countries ranged between 61% to 5% respectively (Silka, Roth, Moreno, Merrill, & Geiderman, 2004; Weng, Chang, & Lin, 2010). Morphine was the most frequently administered in some studies (Bulloch & Tenenbein, 2002a; Chisholm, Weaver, Whenmouth, Giles, & Brizendine, 2008; Silka et al., 2004).

Glyceryl trinitrate

Glyceryl trinitrate (GTN or nitroglycerin) is used for the treatment of ischaemic chest pain, or congestive heart failure. Properties including vasodilation can result in reducing chest pain, thus it can be considered to have low analgesic properties (Bounes et al., 2011; Rang, Dale, Ritter, & Flower, 2007). Eight prehospital studies included GTN. Five studies specifically related to non-traumatic chest pain, suspected cardiac chest pain, or ischaemic chest pain (Benson et al., 1997; Engelberg et al., 2000; Meisel et al., 2010; Rittenberger et al., 2005; Rothrock et al., 2001; Rottman et al., 1997). All but two studies were retrospective in design. Three studies focused on gender and/or race inequities with chest pain assessment and treatment. Females were more likely to be given GTN than males in one study recording requests for GTN using online medical control (Benson et al., 1997). However, another study found males were more likely to be administered GTN than females using a protocol-based system (Meisel et al., 2010). In one study, 96% of patients with cardiovascular disease received GTN (Luger et al., 2003), while another study found ambulance service compliance with GTN administration was 73% (Rittenberger et al., 2005). One study documented 7% incidence of

adverse events of all patients receiving GTN, reporting a mean pain score reduction from 6.9 to 2.6. Ten percent of patients in the study reported complete relief from their pain after GTN administration (Engelberg et al., 2000).

Non-pharmacological analgesia

Ten studies examined prehospital non-pharmacological treatment. Four studies investigated the use of acupressure in the relief of pain and anxiety, two studies used Transcutaneous Electrical Nerve Stimulation (TENS). Three studies were specific to paediatric patients, and incorporated treatment of pain provided by caregivers. One study investigated the effect of an educational intervention on pharmacological and non-pharmacological treatment of pain.

Relief from pain and anxiety is possible from non-pharmacological interventions but appears undervalued because of poor documentation of such treatment (Herd et al., 2009; Todd et al., 2007). Other studies have failed to evaluate the effectiveness of non-pharmacological treatment, possibly over-estimating the effectiveness of the pharmacological intervention they have provided (Bounes et al., 2011; Bounes et al., 2008; Kendrick & Strout, 2005; Singer, Garra, Chohan, Dalmedo, & Thode Jr, 2008; Swor et al., 2005; Todd et al., 2007; Weng et al., 2010). Description of non-pharmacological treatment appeared to be limited to interventions related to trauma, such as splinting and ice (Kendrick & Strout, 2005).

Non-pharmacological treatment provided prior to hospital is not limited to ambulance officers. Parents and caregivers may also offer first aid treatment. One study reported 72.9% of patients received non-drug treatment before reaching hospital. Ice or cold was applied 59% of the time, immobilisation 28% to patients with limb or clavicle injuries (Rogovik & Goldman, 2007).

Children presenting with acute limb injuries had parents attempt to relieve their pain in 72% of cases. The most common interventions used were ice packs (50%). Nearly half (44%) of all patients received only non-pharmacological treatment, while 28% received some form of analgesia. Analysis of age groups, found that 6-12 year olds were the largest group receiving only non-pharmacological treatment before hospital, possibly because this age group is able to express pain. In comparison, children

under two years received the highest percentage of no treatment whatsoever for their pain (7%). This highlights that parents of very young children are ill-equipped to manage their child's pain, and further education may be needed (Maimon et al., 2007).

Another paediatric trauma study found non-drug interventions were provided 12.4% of the time in comparison with 16.1% receiving pharmacological treatment; pain was present in 64% of patients. Splinting and traction were most common, followed by saline flush and dressing (Izsak et al., 2008). These results contrast with a study by Moore (2006), who reported 15% of paramedic run reports received any treatment for pain. Pharmacological treatment of pain, specifically morphine was provided to three percent of children. Splinting was documented in seven percents of charts, followed by cooling or dressings (3%). A single run report noted the use of distraction. The study does not account for what appears to be missing data. It should be noted that the author reported 81% of children had pain presence documented.

All studies involving the treatment of transcutaneous electrical nerve stimulation (TENS), acupressure or active warming used similar methods. Each study was randomised, and double-blinded so neither paramedic or patient was aware which was the true or sham intervention. Only one study was single-blinded (P. Bertalanffy et al., 2006). All studies used small sample sizes, and recorded pain and anxiety levels using a VAS. Acute lower back pain and women with pelvic pain received TENS, reporting significant decreases in both pain and anxiety for the true intervention group, while the sham group results were largely unchanged (Barker, Lang, et al., 2006; A. Bertalanffy et al., 2005). Acupressure was used to treat anxiety levels in patients with medical conditions, reporting decreases in the true intervention VAS scores for anxiety and pain. The sham intervention group reported increases in both anxiety and pain levels (Kober et al., 2003). Acupressure was also used to treat isolated distal radius fracture and elderly patients with hip fracture, both recording reductions in VAS score for pain and anxiety in the true intervention group, while the sham group reported no change or slight increase (Barker, Kober, et al., 2006; Barker, Lang, et al., 2006; Kober et al., 2003; Lang et al., 2007).

Results for these interventions appear promising, but costs for equipment and training need to be factored into decisions to apply these techniques. Additionally, these interventions were introduced as a solution to legislation that prevents ambulance crews in countries such as Austria from administering analgesics (Barker, Kober, et al., 2006). Cynicism by paramedics towards alternative therapies have been documented until proven as effective (Jones & Machen, 2003).

Education of ambulance officers resulted in better documentation (24%) and utilisation (32%) of non-pharmacological interventions. While this falls short of ideals, it shows promise (French et al., 2006). Others suggest that education should focus on relieving anxiety and pain (Bounes et al., 2011; Kober et al., 2003; Zempsky & Cravero, 2004). Treatment using non-pharmacological methods necessitates the most age-appropriate tool, particularly as children are poorly medicated for pain. While talking, distraction, and the presence of a parent or support person are suitable across all ages, children should be over three years of age to apply techniques such as staying in control of themselves, imagining being somewhere else, and understanding the truth about impending pain, for example, from an injection. Children over five years of age, are considered to be old enough to understand explanations to remove fear of the unknown and provide warning (Hennes & Kim, 2006). Knowledge of when to apply non-pharmacological techniques to relieve pain is another aspect of education to consider. One study recommends utilisation of non-pharmacological techniques for cases where there are shorter transport times, although another argues that those patients who have received pharmacological treatment for pain, tend to be triaged at a higher level than those who have not (Izsak et al., 2008; Vassiliadis et al., 2002). Such triaging may ultimately benefit the patient as they wait for treatment in ED, as delays to analgesia at ED are well documented (Abbuhl & Reed, 2003; Todd et al., 2007; Vassiliadis et al., 2002).

Non-administration of analgesia

Six prehospital studies have considered reasons for possible non-administration of analgesia. Patients undergoing critical care transport were more likely to be offered analgesia if their numeric rating scale score was 4 or greater (91%) in comparison with those with a NRS of <4 (57%).

Ten percent (n =22) of patients refused analgesia (Frakes, Lord, Kociszewski, & Wedel, 2009). Bounes, et al. (2011) did not measure pain management unless a numeric rating scale of greater than 5 was reported, indicating a possible bias towards offering analgesia to patients reporting greater pain intensity.

Inadequate education about pain assessment and pain management appear to be at the root of several concerns by prehospital providers, including poor understanding of pain theory (French et al., 2006; Hennes et al., 2005; McEachin et al., 2002). Concerns about adverse side effects of analgesia, particularly opioids, including respiratory depression, interactions with other medications, possibility of addiction, masking injury or symptoms (Hennes et al., 2005; McEachin et al., 2002; Vassiliadis et al., 2002; Watkins, 2006). Ambulance officers noted concerns for fear of addiction among paediatric patients, or drug seeking behaviours in both adults and children (Hennes et al., 2005). Another concern was the fear of causing additional pain by injection (Watkins, 2006).

Patient refusal is cited as a factor for non-administration of analgesia (Blumstein & Moore, 2003; Frakes et al., 2009; Hennes et al., 2005; Vassiliadis et al., 2002). However, there also is a need to ask patients if they desire analgesia (McEachin et al., 2002; Singer et al., 2008; Weng et al., 2010). Adult patients with chest or abdominal pain, or pain secondary to trauma recorded pain intensity using the VAS on presenting to the emergency department, and found that the VAS pain score did not discriminate between patients who desired analgesia and those who did not. Those desiring analgesia reported a mean VAS of 66, while those who did not reported a mean VAS of 45 (Blumstein & Moore, 2003). Another study investigating patients' desire for analgesia asked patients at triage in emergency department about pain score using the numeric rating scale as well as their reasons for not wanting analgesia. Fifty-one percent of patients wanted analgesia, but 47% of those who did not want analgesia stated that their pain was tolerable, 11% had already had analgesia, and 7% wanted to remain alert. Thirty-nine percent of all patients had taken analgesia at home prior to this visit (Singer et al., 2008). There also appears to be a need to ensure patients are aware of

analgesia options, and to offer analgesia (McEachin et al., 2002; Weng et al., 2010).

Operational issues are potentially another reason for non-administration of analgesia. Ambulance officer qualification and skill-set may influence analgesia decisions (McEachin et al., 2002; Vassiliadis et al., 2002; Watkins, 2006). Restrictive pain protocols may hamper efforts to give analgesia as well as legislative issues about the carrying of drugs, in particular opioids, could be a reason for non-administration (McEachin et al., 2002). Concerns over time delays either on-scene or in transportation were cited by Watkins (2006). Pain relief may not be considered to be an important outcome in prehospital care (McEachin et al., 2002).

Conclusions

Although there is much written about pain assessment and pain management, there is limited data in the prehospital setting. A significant number of patients report pain, but equally there are gaps in reporting of pain, suggesting this is an area that requires further investigation. Little data exists in the specifically area of pain assessment. There is little correlation between those patients reporting pain, and having their pain assessed. Pain assessment tools need to be functional for the prehospital environment, and the NRS appears to be most frequently used, but it is unclear if it was used verbally or in written form. Barriers to pain assessment include paramedic attitude, age, cognitive ability and language skills, both in comprehension and expression.

Pain management is largely pharmacological, and little data exists about non-pharmacological treatment of pain. Some studies have reported the efficacy of a pharmacological intervention, but have not considered the effect of concurrent non-pharmacological treatments that may have been provided. Pharmacological treatment was either provided by doctors without apparent protocols, or paramedics, who were confined to standing orders or online medical control. Over recent years, there appears to be more evidence of standing orders in the literature, suggesting online medical control features less in prehospital pain management. Crew configuration impacts on analgesia options, and thus pain management

provided. Morphine is the most commonly used pharmacological intervention for pain.

Non-administration of analgesia is poorly documented. Some patients do not wish to have treatment for pain, but this not always reported. Other patients decline analgesia because of incorrect perceptions about possible addiction or sedation. Paramedic education can have a positive influence on the treatment of pain in the prehospital setting. To address these gaps in the literature, this study addressed the following questions:

1. How many patients report pain in the Auckland district?
2. How is pain documented on patient report forms?
3. What components of standard pain assessment are documented?
4. How is pain managed using pharmacological and non-pharmacological interventions?
5. Is ambulance officer qualification associated with pain assessment?

Chapter 3: Research Design

Introduction

Chapter 2 reviewed the literature and aided the formulation of the research questions. The following research questions were answered on the basis of review of a random sample of patient report forms completed by ambulance officers in Auckland.

6. How many patients report pain in the Auckland district?
7. How is pain documented on patient report forms?
8. What components of standard pain assessment are documented?
9. How is pain managed using pharmacological and non-pharmacological interventions?
10. Is ambulance officer qualification associated with pain assessment?

The measurement of the presence of pain and intensity experienced by the patient, as well as interventions for pain require a positivist approach for this study. This chapter outlines and analyses the positivist methodology, study methods, and data collection. Discussion includes consideration of ethical and Treaty of Waitangi issues that have influenced the study.

Methodology

This study is embedded in a positivist paradigm for several reasons; the first being the assumption that pain prevalence and intensity is measureable. The scientific method demands an orderly and systematic approach to attempt to gain knowledge, with the intention of describing the phenomena, exploring the incidence of the phenomena, and explaining why the phenomena occur. The positivist approach assumes that questions can be answered with facts. The positivist paradigm assumes that everything has a cause, and is explainable. However, there are limitations with this paradigm. Not everything can be measured, and human beings are complex, making generalisation difficult (Polit & Hungler, 1995). Gathering baseline data about the prevalence of pain, how pain is assessed and treated necessitates a positivist approach.

Study design

A retrospective descriptive review was chosen for this study. Data has been collected from patient report forms, using a data abstraction instrument developed by the author. The scarcity of data concerning ambulance officers in New Zealand, including that of pain management indicates a need to establish a baseline for future pain studies. One study has been undertaken in New Zealand looking at pain management practices of ambulance officers in 2002. This study focused on paediatric patients arriving in the paediatric emergency department with either a burn or limb fracture, but precedes the introduction of paracetamol, methoxyflurane, and ketamine to assist in treatment of pain (Watkins, 2006).

Some state that prospective studies should be performed at every possible opportunity (Hess, 2004), as retrospective reviews are considered Level III evidence, but if conducted with sufficient rigour, can add to a developing knowledge base (Lerner, Zachariah, et al., 2002). However, retrospective studies form the majority of out-of-hospital emergency medicine research at 53%, but in terms of outcomes measured, 'discomfort' was measured in 6% of studies analysed between 1985 and 1994 (Brice et al., 2000). Well constructed retrospective studies can still contribute to furthering an EMS knowledge base (Lerner, Zachariah, et al., 2002).

Using a prospective study to answer these questions would take much longer, necessitating the placement of the author or research assistant on an ambulance, collecting data from each patient encountered, which typically occurs one at a time, potentially increasing attrition bias. Costs associated with undertaking such research would escalate, and may even prove prohibitive. In the prehospital setting, where space in an ambulance is restricted, an observer conducting research may prove a hindrance. Thus, many pain assessment and pain management studies are retrospective. However, documentation on a patient's chart may be a poor substitute for actual pain assessment undertaken, and result in mis-reporting of data (Chisholm et al., 2008).

Chart review provides a rich source of data that is not available elsewhere (Allison et al., 2000) and is commonly associated with studies

of incidence and prevalence (Wu & Ashton, 1997). Retrospective reviews demand that the researcher and study subjects remain separate from each other (Grant & Giddings, 2002). This ensures objectivity, enabling measurement of data. However, this distance between researcher and patient is at least two steps according to Allison et al., (2000) namely: the clinician examines the patient, transcribes their findings to the chart, the data is then abstracted by the researcher from the chart in data collection. Opportunities can therefore arise for transcription error in both recording by the clinician, and again by the data abstractor. The information contained in the chart may be incomplete, thus not truly representative (Rittenberger et al., 2005). In the context of this study, pain assessment may have been carried out but not documented (Chisholm et al., 2008).

A chart review should be specific to topic, as well as the data abstracted, making generalisation difficult. All too often data is abstracted for another purpose (Johnston et al., 1998). Quality of data collected is dependent on wording of research question, specifying variables, data abstraction tool developed and used, abstractors using the tool correctly, and the completeness of data. The researcher needs to consider the differences existing between explicit chart review, or specific data collected, and implicit or data abstracted based on clinical judgement (Allison et al., 2000).

Steps can be taken to ensure a retrospective review has sufficient rigour. Research question needs to be defined. The data source should be well-understood. Data collection should be abstracted consistently from the same section of the chart. Data abstraction should be based on a standardised abstraction tool and protocol. A pilot study should be undertaken, and consideration given to opinions offered by data collectors before beginning the actual study and statistical analysis (Engel, Henderson, & Colantonio, 2008; Gilbert et al., 1996).

Study setting

This study is set in the Auckland District of St John (Northern Region), where there are on average, 3000 ambulance responses per day in the Auckland District. This includes Patient Transfer Service (PTS) responses, attendance at events, standby for Police or Fire Service,

private hire, and non-transport cases. The average number of patients transported is 68.4% (M. Holt, 2009, personal communication). A rapid response unit may be responded initially, triage any patient(s) but not transport, or provide ALS back-up. Likewise, multiple ambulances may be responded to an incident, but not all transported. Finally, not all patients require transport to hospital. Ambulance officers complete a PRF on every patient assessed. The only exception to this is if there are several patients assessed but not transported after road traffic accident, in which case multiple patients would be included on a single PRF (St John, 2010b). Typically, the busiest days for ambulance responses and transports are Sunday, Monday and Tuesday (M. Holt, personal communication, 2009). This may be due to reduced access to medical centres over the weekend; a person may visit their GP after the weekend and subsequently be referred to hospital.

Data Source

Understanding the data source is a key component of retrospective reviews. PRFs are printed in triplicate, one copy staying with the patient, another is used for accounts and Accident Compensation Corporation claims, while the third is used for clinical audit, and thereafter stored in a secure location (refer Figure 4) (St John, 2010b) . A copy of a PRF is shown below (Figure 5). Patient report forms are stored according to date at St John Regional Headquarters in Mt Wellington, Auckland for a period of three months prior to being sent to secure storage facilities off-site. There are no guarantees as to data completeness as a few patient report forms may be remaining on station, awaiting completion of clinical audit.

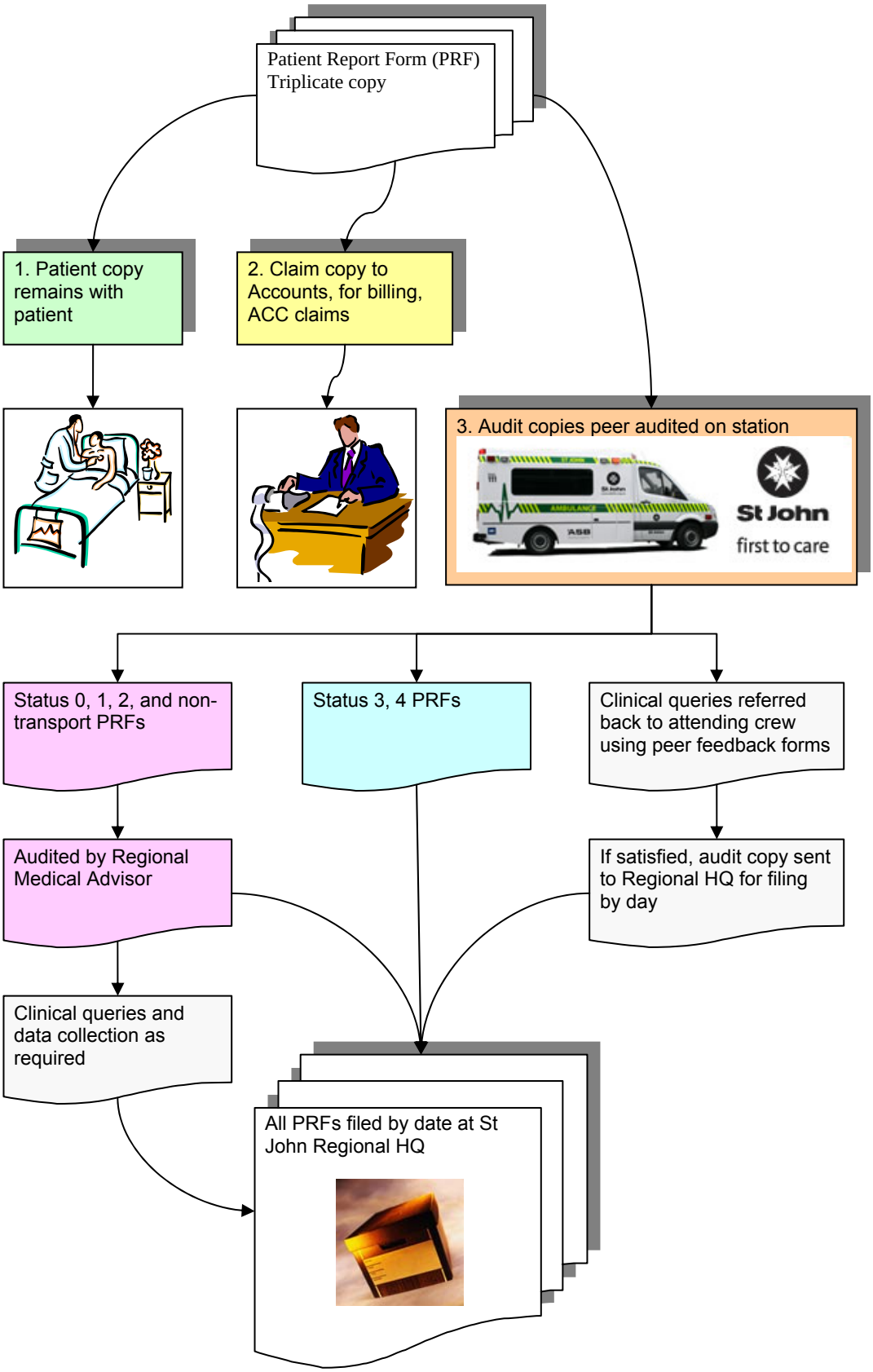


Figure 4 Audit trail of patient report forms (PRF)

PATIENT REPORT FORM

St John

the first to car

PART A: DATA

DAY MONTH YEAR | JOB NO | CASE CODE | UNIT | AREA | PATIENT STATUS 0 1 2 3 SCENE ED 0 1 2 3

DESPATCH | LOCATED | DEPART SCENE | DESTINATION | NHI No

ACC45 No | READ CODE | Is the injury over 24 hours? yes / no (circle one)

St John Supporters Scheme? YES/NO Member No. | KILOMETERS (See Note) Start Finish

PART B: PERSONAL DETAILS

Mr Mrs Ms Miss Child

Family Name | First Names | M/F | DOB | Age

Address | Phone No | Pts GP

Account to:

Incident Location

Destination | Ethnicity: Maori ☐ Pacific Island ☐ Other ☐ Not Stated ☐

PART C: PATIENT INFORMATION

NON-TRANSPORT OF PATIENT (AO to read statement on card insert)

If Patient refuses/declines transport - Patient Signature:

Non-transport code: or other

Chief Complaint:

History

MEDICATIONS

ALLERGIES

PART D: TREATMENT DETAILS

Time	Drugs/Interventions	Dose	Route	Resp	Pulse	BP	GCS	(E	V	M)	O_2 Sat	Bld Gluc

Signature of main treating Officer(s):

Crew surname Number Qual | Crew surname Number Qual | PRIME/Crew surname Number

HOSPITAL / PATIENT COPY

Figure 5 Patient report form (PRF)

Sampling

Sample size

A sample size of 377 was calculated with a 50% response distribution, and a desired confidence interval of 95% ± 5% to ensure maximal sample size was obtained (Raosoft Inc., 2004). The larger sample size is necessary to ensure a representative sample is achieved, and allow for missing or incomplete records. Chambers and Guly (1993) noted a thirty percent completion rate in emergency department records. To achieve even sampling over a seven-day period, the sample size was increased to 385, requiring 55 cases sampled per day.

Sampling strategy

Patient report forms were sampled using a random numbers table over a consecutive seven-day period to give a spread over twenty four hours and day of the week variances. Using a random table for sampling adds rigour, by providing equal opportunity for eligible cases to be selected (Worster & Haines, 2004).The seven-day period prior to archiving was selected to allow clinical audit activities to take place, and patient report forms to be received at regional headquarters. Patient report forms are stored in boxes by date, in no particular order.

First, the number of patient report forms for each date was counted. Second, within the total possible for each day, 55 random numbers were selected using a table of random numbers. Third, a starting place within each daily box was selected at random followed by selection of the patient report forms corresponding to the 55 selected random numbers (based on order of forms in the daily box).

In order to maximise the data, all patient report forms for the day were included, including patients assessed, but not transported, as they may have presented with pain but decline ambulance transport. Excluded from data analysis were PRFs written by the author, PTS cases, patients who were deceased at the scene, and accidental personal alarm activations. Within emergency services research, 53% of all studies are retrospective in nature, but acceptable levels of rigour can be obtained by

explicitly stating inclusion and exclusion criteria (Lerner, Zachariah, et al., 2002).

Study instrument

A study instrument was developed collecting patient demographic data, as well as that of ambulance office qualification. Confidentiality of patient and ambulance crew was maintained by abstracting data to a separate form, ensuring no data was being taken off-site. Each patient report form abstracted for data collection was individually assigned a study identifying number (refer Appendix D). Definitions of variables guided the abstraction process to ensure reliability (refer Appendix C).

Demographic details of the patient were limited to gender, age, and identified ethnicity (Māori, Pacific Islander, Other, or Not Stated). Anecdotally, ambulance officers do not ask specifically about race, unless the patient's name, skin colour, or language suggests they belong to either Māori or Pacific Islander ethnicity. Free-text variables should be limited for use in quality improvement projects, but for pain assessment and pain measurement this is unavoidable (Allison et al., 2000). Ambulance officer data was limited to qualification, as this would affect their analgesia decisions, in accordance with their scope of practice.

Time intervals for each call were collected. Response times from time of dispatch to location at the incident, time spent on scene, and transport time to hospital. A prolonged transport time may result in greater time for ongoing assessment of a person's pain, and permit more time to be spent on pain relief.

Patient acuity status, location and cause of pain were documented. Patient status refers to the acuity of the patient (refer Table 3). A status 1 or critically ill person may mean that less time is spent on analgesia, as the need to transport the patient to definitive care could potentially overshadow pain assessment and pain management. Cause of pain was categorised as non-traumatic or traumatic in origin, based on history.

Table 3 Patient status codes (St John, 2010c)

Status code	Patient condition	Threat to life	Examples include, but are not limited to…
Status zero	Deceased	-	-
Status one	Critical and unstable patient	Immediate	Conditions that are threats to life or limb and require immediate, aggressive intervention. Examples are cardiac or respiratory arrest, severe head injury, severe shock, severe compromise to airway, breathing or circulation
Status two	Serious and unstable patient	Potential	The patient's condition is serious enough or deteriorating with potential threat to life, or time-critical treatment is required to have an effect on clinical outcome. Examples are airway risk, respiratory distress, circulatory compromise, chest pain that does not respond to normal meds, multi-trauma (requiring trauma call), limb at risk
Status three	Moderate, stable patient	Unlikely	No immediate risk to airway, breathing, and circulation. Need for acute treatment remains such as head injury (GCS>13), Moderate limb injury and fractures, trauma with high risk mechanism
Status four	Minor, stable patient	None	Patient's symptoms or conditions warrant assessment or treatment by a medical practitioner at a treatment facility within 2 hours, or require ongoing monitoring of their condition. Examples are minor limb trauma – sprained ankle, minor head injury with no loss of consciousness

VNRS were documented both before and after analgesia if available, along with duration, and narrative pain descriptions using the PQRST format (Rittenberger et al., 2005; Slaughter, Pasero, & Manworren, 2002). Attempts to explain inability to document pain scores included inability to verbalise, poor understanding of English, refusal to answer questions about pain, and behavioural or psychiatric condition that prevents them from answering questions about pain.

Ambulance officers commonly use this method to describe pain:

1. Provokes – what provoked the pain?

2. Quality – how is the pain described? This may include words such as heavy, tearing, stabbing, or fluctuating.
3. Region / Radiation – where is the pain, and does it radiate to anywhere else?
4. Severity – how bad is the pain?
5. Time – since the onset of pain?

Interventions provided by the ambulance officer, including non-pharmacological interventions (if noted) were recorded. Pharmacological interventions included initial dose, total dose (if appropriate), route, and if analgesia was declined.

Pilot study

A pilot study was undertaken comprising of 30 PRFs; originally 20 PRFs were to be abstracted, but missing data made interpretation challenging. Data was collected from a convenience sample of patient report forms on a single ambulance station. Pre-pilot questions and desired data were compared with the actual PRF for cohesion of data collection. After the pilot study, the data abstraction instrument was edited to flow with the PRF, as the original tool was cumbersome to navigate during pilot data collection. Conducting a pilot study identified questions that were ambiguous and open to variances in interpretation. Free-text word descriptors of pain were edited, as quality of pain could be confused with radiation or pain or location of pain. Lists of synonyms were developed to streamline the data abstraction instrument (refer Appendix C).

Patient demographic data was either numeric or categoric, while verbal descriptors of pain were considered free-text (Allison et al., 2000). Abstracting free-text data increased time for data collection, and at times, required clinical judgement – for example a patient in the pilot data was not overtly assessed for pain, but the chief complaint was a suspected fractured jaw from an assault; clinical opinion would suggest that this patient would have been experiencing pain, even though it was not documented on the patient report form.

Pilot study results found that 77% of patients had a medical complaint, 50% were female (refer Table 4). Mean age was 46 years. Sixty

percent (n=18) of patients reported pain, but 23% (n=7) had no documentation about presence of absence of pain.

Table 4 Pilot study findings

Variable	Frequency (n=30)	Percent %
Age	Mean	47.3 ± 27.9
Gender	Female Male Missing	50% 46% 3%
Race	Other Not documented	27% 73%
Status	Status 0 Status 1 Status 2 Status 3 Status 4	0% 10% 27% 47% 17%
Cause	Medical Trauma Not documented	77% 20% 3%
Pain presence	Yes No Not documented	60% 17% 23%
Pain primary location	Head/neck Chest Abdomen/GU Extremities Denies pain Not documented	20% 7% 27% 7% 23% 17%
Pain score pre-treatment	Documented Not documented	3% 97%
OPQRST	Onset Provokes Quality Radiates Severity Timing	0% 0% 7% 0% 3% 20%
Pharmacological treatment	Entonox Paracetamol Morphine Ketamine Midazolam	3% 13% 0% 0% 3% (seizures)
Anaglesia declined	Yes No Not documented	3% 14% 83%
Non-pharmacological treatment	Yes No Not documented	0% 0% 100%
Pain score post-treatment	Yes No Not documented	0% 0% 100%

During the pilot study, it was found that a Glasgow Coma Score (GCS) of the patient would have been useful to determine if incomplete assessment of pain was a reflection of the patient's ability to answer questions about their pain. In terms of scope of practice, paramedics were the most frequent (39%, n=11) followed by ambulance officers (28%, n=8) and advanced paramedics (14%, n=2). Documentation using the OPQRST format was poorly documented, with time being the most frequently documented component (20%,n= 6). No instances of Onset, Provokes, or Radiation were documented. The pilot study based time frames on Cordell, et al (2002) who used time intervals of less than 24 hours, 24 hrs to one week, one week to one month, over one month. However, 27% of pilot study patients reported pain of 24 hours of less, and it was determined that this number needed to be divided into smaller intervals. The most frequently administered analgesia was paracetamol with four patients receiving it (13%), although two of these patients had concomitant fever. One patient declined analgesia (3%), and there were no cases of non-pharmacological treatment being administered such as splinting or ice.

Study procedures

Data management

All patient report forms were treated in the same manner. Once randomisation had occurred for that day's patient report forms, they were removed from the storage box, and data was abstracted onto a separate form for each patient report form. Data was entered in the Statistical Package for Social Sciences (SPSS version 16). Patient report forms were returned to the appropriate day's box after abstraction. Completed abstraction forms were locked in filing cabinet.

Data checking took place using two methods. Accuracy of data entry was checked by randomly selecting ten percent of data. Errors were primarily in calculation of time intervals, but remained less than five percent. In addition, logic checks were performed between some variables. Patient status and transport options was selected, because deceased patients are rarely transported. Presence of pain and location of pain was used, because if pain is present, a location would probably be

identified. Lastly, the presence or absence of pain assessment and reason for no pain assessment, as evidence of pain assessment would contradict non-assessment of pain. Screening of data for outliers and missing values took place; corrections were made prior to data analysis.

Statistical procedures

Data was initially analysed as one dataset to determine descriptive statistics, including mean, median, range, standard deviation. Confidence intervals were set at 95% and *p*-value set at 0.05. Crosstab bivariate analysis was used to explore relationships between two variables. Chi-square tests were conducted to compare results between ambulance officer qualifications, as much of the data collected is nominal. Data was analysed using the Statistical Package for Social Sciences (SPSS, Version 17).

Ethical and cultural considerations

Ethics approval was granted by the Ministry of Health NTX/10/EXP/188 and by AUTEC 10/269. National Ethics Advisory Committee defines this type of study as an observational study, where outcomes are observed and the investigator has no control over study variables, and thus low-risk (National Ethics Advisory Committee, 2006). To preserve patient confidentiality, data was de-identified. Likewise to protect ambulance officers, data was limited to qualification as times, ambulance job number, and actual time of day would result in potential identification. Only the data abstractor saw the patient report forms, and abstraction was carried out on-site. Completed abstraction forms were locked in a filing cabinet on St John premises.

Consultation took place between St John Roopu, Te Roopu o Te Waka Kawe e Turoro o Hato Hoane, about the study. Because no identifying information was being obtained, there were no issues, but feedback was made about the importance of collecting non-pharmacological interventions if documented, because of the use of herbal and traditional remedies in Māori illness (mate). The accuracy of Māori ethnicity data gathered was questioned, as anecdotally, ambulance officers determine ethnicity by name, skin colour or language spoken,

resulting in potentially inaccurate data collection. It is unknown if this results in under-reporting or over-reporting.

Chapter 4: Results

Introduction

This chapter explores demographic data about patients and ambulance crews, and outlines the findings of each of the following research questions:

1. How many patients report pain in the Auckland district?
2. How is pain documented on patient report forms?
3. What components of standard pain assessment are documented?
4. How pain is managed using pharmacological and non-pharmacological interventions.
5. Is ambulance officer qualification associated with pain assessment?

Sample characteristics

Sample size was set at 385, based on 55 cases per day over a seven-day period. During data collection, cases were briefly reviewed for eligibility, and twenty-eight cases were substituted, selected again using random sampling from the table of random numbers. During data analysis, a further fourteen cases were deemed ineligible because they were classified as false alarm callouts or PTS transfers, resulting in a final sample size of 371 (refer Table 5

).

Eighty-seven percent (n=317) of patients were over sixteen years of age. Fifty percent were female. Ethnicity was either Not Stated or not documented in the 55.2% (n= 205) of patients. Ethnicity options on the patient report form are Maori, Pacific Island, Other, Not Stated. Where no option was selected, ethnicity was noted as not documented.

Seventy-four percent (n=274) of cases were non-traumatic in origin. Twelve patients had no documentation that indicated traumatic or non-traumatic origin. Eighty percent of patients were classed as potentially unstable (status 3) or stable (status 4) (80.8%, n= 296). The remaining twenty percent were classed as critically ill or unstable, status one and two respectively (20.3%, n=75). Over eighty percent of patients had a Glasgow

Coma Score of 15, indicating potential to answer questions about their pain (82.2%, n=305). Twelve patients had no Glasgow Coma Score recorded (3.2%).

Table 5 Sample characteristics

Variable		(n=)	Percent %
Patient characteristics			
Age (n=364, 7 missing)	< 16 years 16-64 years > 64 years Mean 51.77 yrs ± 28.36 Maximum 95.85 years	47 163 154	12.9 44.8 42.3
Gender (n=371)	Male Female Not documented	183 185 3	49.3 49.9 0.8
Ethnicity (n=371)	Other Not Stated Not documented Pacific Island Maori	125 110 95 32 9	33.7 29.6 25.6 8.6 2.4
Traumatic cause (n=371)	No Yes Not doc	274 84 12	74.1 22.6 3.2
Status (n=371)	Critically ill Unstable Potentially unstable Stable	11 64 201 95	3 17.3 54.2 25.6
GCS (n=371)	15 < 15 Not documented	305 54 12	82.2 14.6 3.2
Crew characteristics			
Highest qualification (n=371)	PC1 BLS BLS paramedic ILS ALS	0 38 77 120 136	0 10.2 20.8 32.3 36.7
Student (n=371)	Yes	71	19.1
Triple crewed (n=371)	No Yes	224 147	60.4 39.6
Case characteristics			
Response Time (n=371)	Maximum (mins) 49 Mean ± SD 10:30 ± 6:55 Median 9:00		
On Scene Time (n=369)	Maximum (mins) 62 Mean ± SD 15:50 ± 9:53 Median 14:00		
Transport Time (n=319)	Maximum (mins) 105 Mean ± SD 19:31 ± 12:10 Median 18:00		

Transport Options (n=371)	Hospital ED A&M clinic GP referral Not transported, private car Not required, minor Refused	308 8 2 7 33 13	83 2.2 0.5 1.9 8.9 3.5

ILS and ALS officers crewed ambulances 69% of the time (n= 256), providing greater opportunities for analgesia to be administered. Ambulances were crewed by three officers 39.6% of the time (n= 147) with either new recruits, ambulance officers undergoing clinical mentoring, or paramedic student observers. With a higher degree of triple crewing it may mean a teaching and learning environment is being fostered, promoting a higher standard of care. An additional person may mean that patient care is provided in a timelier manner, including the provision of analgesia.

Mean response time was 10:30 ± 6.55 minutes; mean on-scene time was 15:50 ±9:53 minutes. For the 319 patients transported, the mean transport time was 19:31 ±12:10 minutes. Transported patients were taken to hospital emergency departments 83% of the time (n=308), accident and medical clinics (2.7% n=8), or a GP practice (0.5%, n=2). The remaining 14.3% (n=53) were not transported because they self-referred to a medical facility, did not require transport due to a minor illness or injury, or refused transport (refer Table 5).

Pain prevalence in Auckland district

Of 371 patients, 49% (n= 182) reported pain, while 26% (n=98) denied pain. A further one percent (n=5) were considered to not be in pain by ambulance officers during assessment, three of these were children, and the remaining two adult patients were considered to have functional or organic impairment. Twenty-three percent (n=86) had no documentation regarding the presence of absence of pain.

Pain was then categorised by location, excluding those patients denying pain (n=279). Chest pain was the most commonly reported location (21.5%, n=60) followed by abdominal / flank pain (19%, n=53). Pain location was not documented in 33% of patients (refer Figure 6).Some patients may have had location of pain documented but not been in any pain, for example chest pain that was relieved by self-medication

prior to ambulance arrival. However, on the PRF this was still documented as ‘chest pain’. Conversely, nearly all patients who reported pain on questioning by ambulance crews, had location documented (96%, n=180).

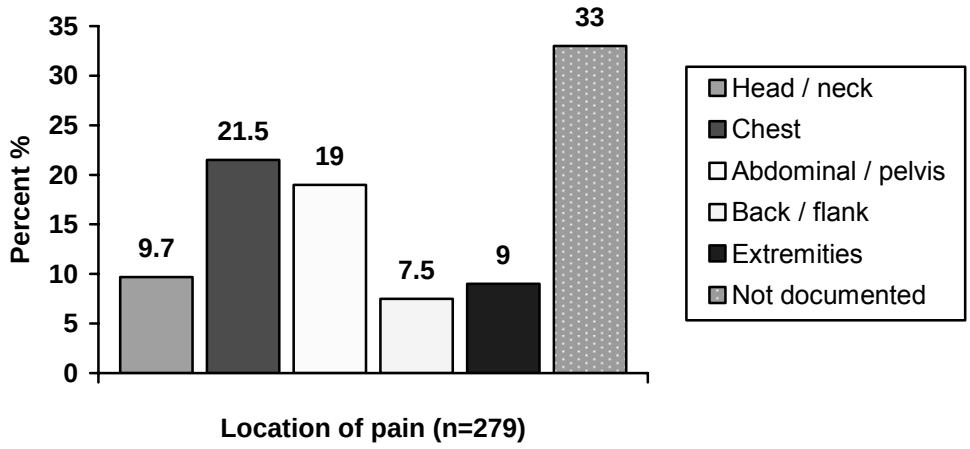


Figure 6 Location of pain (%)

Documentation of pain scores

Of all 371 patients, 38 patients (10%, n=38) had an initial pain score recorded (refer Table 6 and Figure 7) of all patients. Not all these patients were in pain. Of the 188 who reported pain, 20% (n=38) had an initial pain score documented. Mean initial pain score was 6.04 $\pm$ 2.881. Median pain score was 9.0. Sixty percent (n= 23) of these patients reported a pain score of 7-10, indicating severe pain. A possible explanation is that a patient experiencing severe pain is more likely to receive some form of analgesia, thus prompting the ambulance crew to record pain scores. No pain score was documented for sixty-four percent (n=238) of all patients.

Follow-up pain scores were recorded for 24 patients (n=255, 9.4%), or 12.8% of those 188 patients reporting pain. Mean follow-up pain score was 2.83 $\pm$ 2.353. Median pain score was 2.0. Forty-five percent of patients recorded a pain score between one and three, suggesting mild pain on follow-up. Twenty patients (n=38, 52.6%) had both initial and follow-up pain scores.

Table 6 Frequency of Initial and follow-up pain scores

Pain score	0 (no pain)	1-3 (mild)	4-6 (moderate)	7-10 (severe)	Not documented	Not applicable
Initial pain score (n=371)	1 (	5	9	23	238 (64.2%)	95 * no pain on self report
Follow-up pain score (n=371)	2	10	6	2	231 (62.2%)	116 *not all patients transported

Those patients having an initial pain score recorded, 60% reported severe pain. Following analgesia, 24 patients had a follow-up pain score recorded, 46% reporting mild pain, and a further 21% denying pain (refer Figure 7).

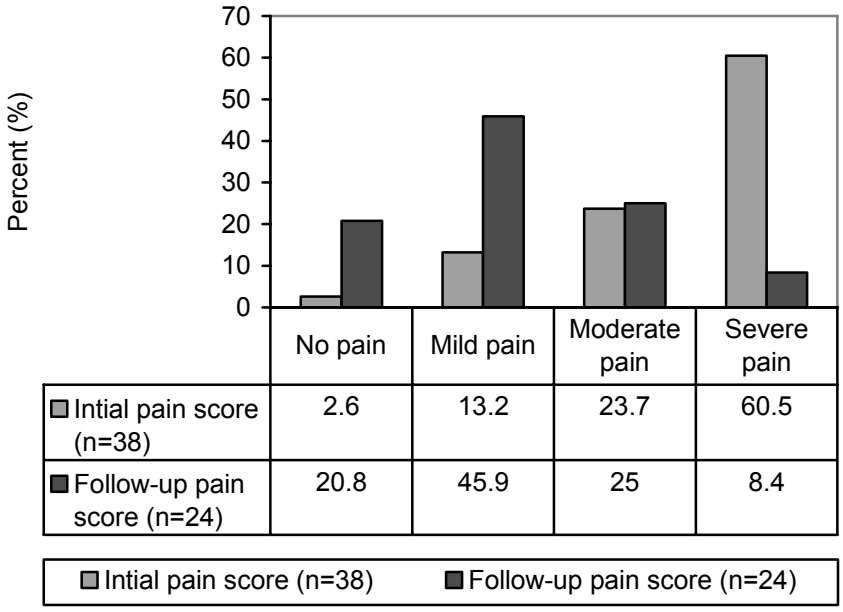


Figure 7 Initial and follow-up pain scores

Documentation of pain assessment using OPQRST

Poor documentation of pain assessment was evident, even when pain was present. At the time of assessment, not all patients reported pain, but may have had elements of pain assessment documented, as part of the history gathered by the ambulance crew. Of those patients reporting

pain, timing was the most frequently documented assessment (50.8%), followed by provocation (39.2%). Radiation was the least documented assessment (24.9%) (refer Table 7).

Table 7 Components of pain assessment documented

Pain assessment variable (n=277)	Assessed %	Not documented (%)	Pain assessment variable – patients reporting pain (n=188)	Assessed %	Not documented %
Onset (n=64)	23.1	76.9	Onset (n=61)	33.7	66.3
Provokes (n=73)	26.4	73.6	Provokes (n=71)	39.2	60.8
Quality (n=72)	26	74	Quality (n=68)	37.6	62.4
Radiation (n=47)	17	83	Radiation (n=45)	24.9	75.1
Severity (n=51)	18.4	81.6	Severity (n=49)	27.1	72.9
Timing (n=99)	35.6	64.4	Timing (n=92)	50.8	49.2

Duration was missing in 43% of patients in pain. The most frequent duration of pain was less than six hours (28%) (refer Table 8).

Table 8 Frequency of pain duration

Duration	Frequency % (n=188)
<6 hours	28.7
>6-12 hours	2.8
>12-24 hours	8.3
>24 hours - 7 days	12.7
>7 days	3.9
Not documented	43.6

Cross-tab analysis was used to determine frequency of OPQRST assessment by location of pain (refer Table 9). Onset was documented most frequently in extremity pain (40%), provocation assessed in back/flank pain (47%), quality and radiation in chest pain (61% and 40% respectively). Severity and timing were most frequently documented in extremity pain (36% and 56% respectively). Timing was defined as the

recording of some time interval on the patient report form; duration was the time interval documented. Duration was most frequently observed in back/flank pain (47%). Both initial and follow-up pain scores were most frequently assessed in extremity pain (28% and 16% respectively).

Table 9 OPQRST assessment by pain location

Location (n=187)	Initial pain score Freq (%)	Follow-up pain score Freq (%)	O Freq (%)	P Freq (%)	Q Freq (%)	R Freq (%)	S Freq (%)	T Freq (%)	Dura-tion Freq (%)
Head neck (n=28)	5 17.9	3 10.7	8 28.6	8 28.6	3 10.7	3 10.7	6 21.4	14 50	16 57
Chest (n=60)	13 21.7	10 10.7	20 33.3	24 40	37 61.7	24 40	14 23.8	28 46.7	33 55
Abdo pelvis (n=53)	9 17	6 11.3	16 30.2	22 41.5	22 41.5	15 28.3	17 32.1	30 56.6	52 60.4
Back flank (n=21)	4 19	1 4.8	8 38.1	10 47.6	7 33.3	5 23.8	5 23.8	9 42.9	10 47.6
Extremities (n=25)	7 28	4 16	10 40	9 36	2 8	0 0	9 36	14 56	16 64

Four patients denied pain on assessment, but had components of pain assessed, for pain presumably prior to ambulance arrival. Three of these patients had chest pain relived by rest and or medication prior to the ambulance arriving.

Cross-tabulation was examined between assessment of pain, and those patients who did not have their pain assessed, and possible reasons why assessment did not take place. Of all 371 patients, 193 (52%) were included in analysis. The remaining 178 (48%) were classed as missing data; the primary reason for was because there was evidence of pain being assessed in this cohort of patients.

Patients who did not have pain assessed were classed according to refusal of assessment (0.5%, n=1), functional or organic impairment 17.1% n=33). Functional or organic impairment was noted where the patient recorded a Glasgow Coma Score of less than 15, or there was documentation suggestive of impaired cognition such as alcohol or drug intoxication, or dementia. Patients who were unable to understand English accounted for 5.2% of non-assessment (n=10). Patients who were unable to answer questions about their pain, including young children or aphasic patients, made up 10.9% (n=21). No reason was given for non-

documentation of pain assessment in 66% of cases (n=128) (refer Table 10).

Table 10 Reasons for non-assessment of pain

Reasons for non-assessment of pain	(n=193)	Percent %
Refused	1	0.5
Unable to understand English	10	5.2
Non-verbalising	21	10.9
Functional or organic impairment	33	17.1
No reason documented	128	66.3

Pain management – pharmacological

The most frequently used analgesia was paracetamol (15.1%, n=56) followed by Entonox™ (8.1%, n=30), and glyceryl trinitrate (5.4%, n=20) (refer Table 11). Paracetamol is indicated for mild pain and fever (St John Clinical Management Group, 2009). Fever was noted in the chief complaint in 27.2% of patients reporting pain and with a chief complaint of fever (n=55). It was not possible to determine if paracetamol was being administered for pain, fever, or both. Entonox ™ was administered to 30 patients (16% of patients reporting pain). No patients received methoxyflurane. Glyceryl trinitrate was administered to 20 patients, one patient received 0.4mg as an initial dose, all others received 0.8mg. Total dose administered ranged between 0.4mg and 2.4mg.

Table 11 Frequency of pharmacological analgesia administration

Drug used	Frequency (%) (n=371)	Frequency – pain present (%) (n= 188)
Entonox™	30 (8.1)	30 (16)
Paracetamol	56 (15.1)	36 (19.1)
Methoxyflurane	2 (0.5)	2 (1.1)
Glyceryl trinitrate	20 (5.4)	18 (9.6)
Morphine IM	2 (0.5)	2 (1.1)
Morphine IV	15 (4)	15 (8)
Ketamine PO	1 (0.3)	1 (0.5)
Ketamine IV	0 (0)	0 (0)
Midazolam IM	1 (0.3)	0 (0)
Midazolam IV	1 (0.3)	0 (0)

Morphine was administered to 9% of patients with pain. Two patients (1%) received intramuscular morphine, both received a single dose of

10mg. Eight percent received intravenous morphine. Mean initial intravenous morphine dose was 2.43mg ± 1.237. Mean total intravenous morphine dose was 7.567 ± 5.716. One patient received a total of 25mg of intravenous morphine.

One patient was administered ketamine orally, with a dose of 40mg, based on 1mg/kg dose (St John Clinical Management Group, 2009). No patients received intravenous ketamine. One patient (0.3%) received intranasal midazolam and a further one patient (0.3%) received intravenous midazolam. Both patients had a chief complaint of seizures.

Analgesia was declined by 20 patients out of 177 who self-reported pain (6.8%), 46.8% accepted analgesia (n=83) while 46.3% had no documentation about analgesia being offered and/or declined (n=82).

Sixty-two patients (16%) had taken analgesia prior to ambulance arrival. Fifty-six percent of patients had no documentation about prior administration of analgesia.

Pain management – non-pharmacological

Non-pharmacological analgesia was considered to be application of ice or cold, heat or warmth, a splint, dressing, positioning, providing distraction, or reassurance. Documentation of any of these interventions was noted in data collection (refer Table 12). Documentation was generally poor in this area. Dressing were most documented (n=11), followed by ice or cold and positioning (n=8).

Table 12 Frequency of non-pharmacological analgesia administration

Non-pharmacological treatment	Frequency n=371 (%)	Frequency – pain present n=188 (%)
Ice or cold	8 (2.2)	6 (3.2)
Heat or warmth	0 (0)	0 (0)
Splint	7 (1.9)	7 (3.7)
Dressing	11 (3)	4 (2.1)
Positioning	8 (2.2)	8 (4.3)
Distraction	0 (0)	0 (0)
Reassurance	6 (1.6)	3 (1.6)

Pain assessment and ambulance officer qualification

Overall, crews assessed patients for the presence of pain 76.8% (n=285) of the time, while 23.2% (n=86) were not assessed. Determining who was responsible for patient care was challenging. Illegible signatures, the potential for a more qualified officer to back up the initial crew and become involved in patient care, or conversely, a rapid response unit requiring an ambulance crew to transport the patient, were seen to be primary issues. For this reason, the highest qualified officer on each patient report form was recorded, to determine maximum analgesia options in patient care, whether or not those options were exercised.

Highest crew qualification was cross-tabulated against onset, provocation, radiation, severity and timing components of pain assessment, as well as initial and follow-up pain scores, assessing for documentation of each variable. There were no cases where the most qualified officer was primary care.

BLS officers recorded timing most frequently (48.1%), followed by severity (37%) and provokes (33.3%). BLS-P officers documented quality (31.5%) and radiation (24.9%) most frequently. ILS officers recorded both initial and follow-up pain scores most frequently (36.8% and 41.7% respectively). ALS officers documented onset most frequently (29.2%). BLS-P officers recorded onset, provocation, timing and both initial and follow-up pain scores least overall.

Out of 371 patients, pain scores were initially recorded in 10.4% (n=38), and 6.5% of patients had a follow-up pain score recorded (n=24). Further analysis by qualification showed that ILS officers were most frequently recording initial and follow-up pain scores. BLS-P officers were least frequently recording pain scores (refer Table 13, Figure 8).

Table 13 Frequency of pain assessments by qualifications

Qualification (n=277)	BLS Ambulance officer (n=27)	BLS-P Paramedic (n=54)	ILS Upskilled paramedic (n=90)	ALS Advanced paramedic (n=106)
Onset % (n=277)	25.9% (7)	18.5% (10)	19.8% (16)	29.2% (31)
Provokes % (n=277)	33.3% (9)	24.1% (13)	27.8% (25)	24.5% (26)
Quality % (n=277)	18.5% (5)	31.5% (17)	26.7% (24)	24.5% (26)
Radiation % (n=277)	18.5% (5)	24.9% (13)	15.6% (14)	14.2% (15)
Severity % (n=277)	37% (10)	18.5% (10)	18.9% (17)	13.2% (92)
Timing % (n=277)	48.1% (13)	29.6% (16)	35.2% (32)	35.8% (68)
Pain score (initial) % (n=371)	18.4% (7)	10.5% (4)	36.8% (14)	34.2% (13)
Pain score (follow-up) % (n=371)	20.8%(5)	8.3% (2)	41.7% (10)	29.2% (7)

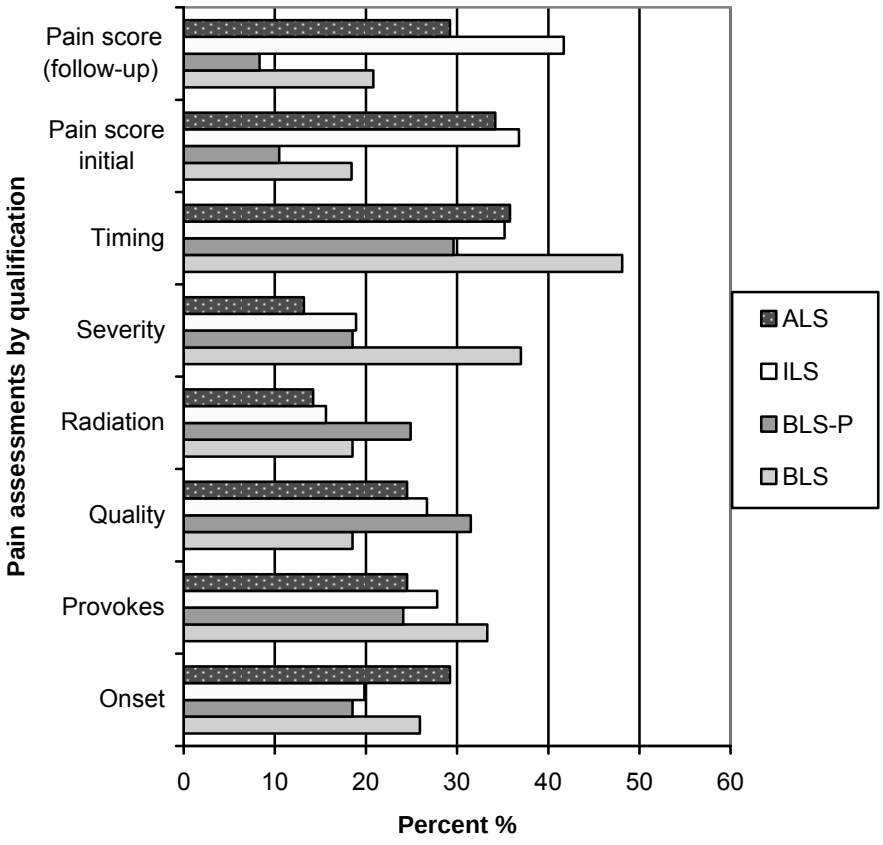


Figure 8 Frequency of pain assessments by qualification

BLS-P and ILS paramedics equally reported greatest numbers of patients declining analgesia (35.7%, n=5 for each group).

ALS paramedics were least likely to document those patients declining analgesia (n=57.1%, n=60). Advanced life support officers (advanced paramedics) and intermediate life support officers (upskilled paramedics) had the greatest frequency of analgesia not being declined (42.6% n=43, 32.7% n=32 respectively). This may be because these two qualifications may have been requested to back up a lesser qualified crew and administer analgesia. Chi-squared analysis to determine any relationship between ambulance officer qualification and pain assessment carried out, showed no significant relationship $\chi 2 = 2.949$, DF 3, p=0.4 (refer Figure 9).

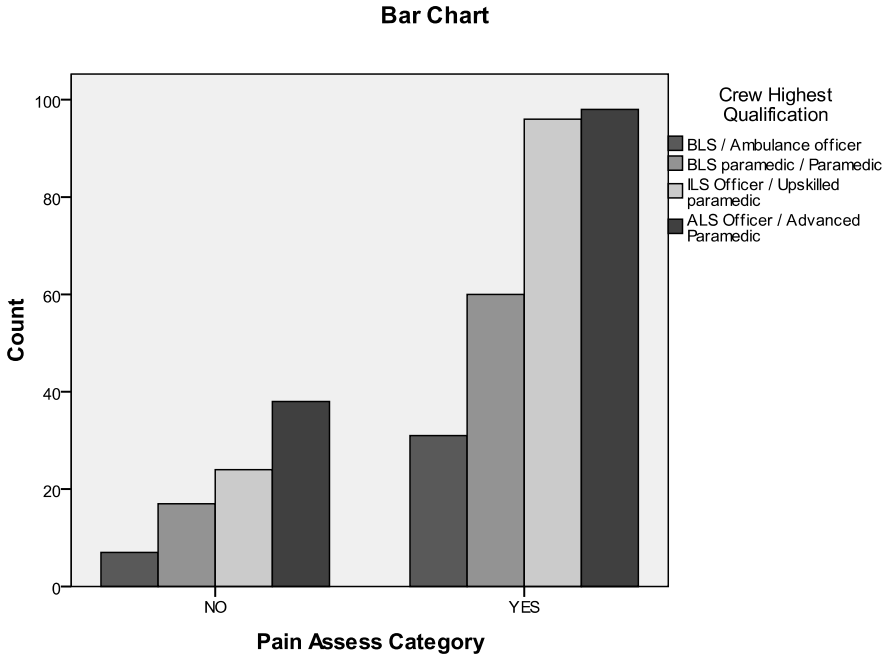


Figure 9 Pain assessment by qualification

Conclusion

A total of 371 patients were eligible for analysis. Methods of data screening, analysis and results have been discussed based on the research question. Forty-nine percent of patients reported pain. Pain assessment and pain scoring was poorly documented. Paracetamol was the most frequently administered analgesic, but may have been given for fever in some cases. Non-pharmacological treatment of pain was poorly

documented. Crews where the highest qualified officer was an BLS officer documented pain assessment components better than crews with higher qualifications, however, ILS officers were better at recording initial pain scores and follow-up pain scores. There was poor documentation regarding patients declining analgesia.

Chapter 5: Discussion

Introduction

This chapter discusses the findings of this study, namely, the prevalence of pain in the Auckland district, documentation of pain assessment and pain management by ambulance officers. The study strengths and limitations will be discussed, implications for future practice and research, followed by the conclusion.

Summary of key findings

Three hundred and seventy-one patients were eligible for analysis. Forty-nine percent of patients reported pain; however, 23% of patients had no documentation regarding the presence or absence of pain. Pain assessment and pain scoring was poorly documented. Paracetamol was the most frequently administered analgesic, but in some cases may have been administered for fever. There was poor documentation of non-pharmacological treatment of pain. BLS officers documented OPQRST pain assessments more frequently than other qualifications. ILS officers were better at recording initial pain scores and follow-up pain scores. There was poor documentation regarding patients who declined analgesia.

Study strengths and limitations

The aim of this study was to identify frequency of pain assessment in the prehospital setting and treatment of pain. There is a growing collection of studies relating to this area in the prehospital setting, but as yet, only one other study has been published in New Zealand relating to ambulance officers' assessment and management of pain, which was restricted to paediatric patients with isolated burns or limb fractures (Watkins, 2006). To assess prevalence of pain, a retrospective chart review was selected to obtain pain assessment and management data by ambulance officers employed by St John, Auckland District. Hand-written patient report forms required data be manually abstracted.

Sampling

Each day's box of patient report forms included Patient Transfer Service (PTS) patients and deceased patients, meaning they needed to be included in data collection initially, and then excluded. Patient Transfer Service patients were excluded as information gathered is primarily for billing purposes. This created an extra step in the data collection process. This was unavoidable due to how patient report forms were stored. Original sample size was estimated at 377, but increased to 385, to ensure even sampling across the seven-day sampling period. Inclusion, then exclusion of PTS cases and deceased patients caused a miscalculation in sampling, resulting in 371 patient report forms being eligible for analysis, slightly below the original sample of 377. This error was not realised until data abstraction was completed, and further opportunities to access data were unavailable. Study findings may be underpowered as a result, or mask a Type II error (Polit & Hungler, 1995). However, sampling was based on a 50% response distribution to obtain the maximal sample size with a 95% confidence interval.

Validity of the study

Several things achieve validity in a study: training of chart abstractors, explicit case selection protocols, accurate definition of variables, standardised data abstraction forms, meetings to review coding rules, monitoring performance of chart abstractors, blinding, and interrater reliability testing (Gilbert et al., 1996).

The importance of undertaking a pilot study was an important lesson learned. Pilot study data identified chart abstraction issues and provided time estimates for data abstraction. Also highlighted was the need to include other variables such as Glasgow Coma Score (GCS), reasons for non-assessment of pain, and alter the study design to incorporate more than one form of analgesia administered to a patient. The pilot study identified poor documentation as an issue, and contributed to selection of a 50% response distribution when calculating sample size. Sample size and power is one of the least reported aspects in medical record reviews (Badcock, Kelly, Kerr, & Reade, 2005).

Case selection was clear, using random sampling as explained in Chapter 3. However, the over-sampling, then inadvertent subsequent

under-sampling, highlights the need for accurate record keeping when dealing with sampling by hand, and would be made easier if electronic patient report forms were used. All patient report forms were included, then randomly sampled from the box for that particular date. Currently St John is investigating the feasibility of electronic patient report forms (T. Smith, personal communication, 2010).

A data dictionary was vital for referring to during data collection, as data collection was not continuous. Clarity was required, to ensure the data collected was relevant to the research questions, and did not over-complicate data collection. In particular, the creation of variables for pain assessment and pain presence, required unambiguous definition of both, so that the correct variable was used in statistical analysis.

Consistency of data abstraction and interrater reliability was tested prior to data collection. Ten patient report forms were abstracted by both the author and supervisor. Consensus was reached primarily over the following variables; presence of pain, primary location of pain, and analgesia prior to ambulance arrival. Initially, interrater reliability was poor. A key issues highlighted was that of fatigue, and inattention during abstraction, caused errors with interpretation of the PRF and subsequent abstraction (Wu & Ashton, 1997). Interrater reliability was re-run with another ten patient report forms, with improved agreement. Because data is being abstracted from free-text patient report forms, inferences may need to be drawn, making 100% interrater reliability unachievable (Engel et al., 2008; Worster & Haines, 2004).

Data was abstracted manually to the chart abstraction form, then entered into the statistical software programme. Whilst not desirable, as it meant double handling, it was primarily so a data portable. Checks done prior to data analysis on a small random sample for accuracy of data entry demonstrated 95% accuracy. Free-text sections of the patient report form were searched for applicable information, particularly relating to onset, provocation, radiation, severity, timing of pain, and prior administration of analgesia, or analgesia being declined. While a rich source of data, it is open to misinterpretation (Worster & Haines, 2004).

Study limitations

As previously discussed, St John's storage of patient report forms required the collection then discarding of Patient Transfer Service cases, and deceased patients. The resultant sample size was slightly less than the planned sample size, which may have caused the study to be underpowered.

Retrospective reviews are dependent on accurate documentation of patient report forms. Chart reviews are considered a rich source of data (Wu & Ashton, 1997), but incompleteness needs to be factored into sample size estimation. However, a study comparing prospective interviewing and retrospective chart review of the same patients with chest pain revealed more than half the data was not documented on the chart (Nagurney et al., 2005). It is possible, that further pain assessment and treatment of pain, was undertaken, but not recorded on the patient report form (Engel et al., 2008).

Another issue associated with documentation is the accuracy of interpretation of information. Inaccurate documentation may be a result of patient misinterpretation of the question, or the ambulance officer misinterpreting or falsifying the patient report form. The patient may also choose to falsify their response (Wu & Ashton, 1997). Data also needs to be legible, this was an issue particularly in the free-text section of the patient report form (Allison et al., 2000; Engel, Henderson, Fergenbaum, & Colantonio, 2009; Worster & Haines, 2004).

The presence or absence of pain caused variations in cohort size when undertaking statistical analysis. On ambulance arrival some patients did not report pain, but had their original episode of pain assessed. Thus, slight variations in numbers for pain location, pain presence and aspects of pain assessment were noted in the results. If an aspect of pain assessment was undertaken, for example noting timing, pain assessment was considered to be have carried out. However, this does not necessarily mean a full pain assessment was undertaken.

Sample characteristics

Data collected for patient demographics was largely complete. Gender was evenly split, with a small number showing no gender on

documentation. Studies have shown that women experience more severe pain and receive less analgesia than males (Lord et al., 2009; Meisel et al., 2010). These were subsequently cross-checked and were all PTS cases. Ethnicity options on the patient report form were limited – Maori, Pacific Island, Other, Not Documented. It is uncommon for ambulance officers to ask the patient their ethnicity; it may be inferred from the patient's name, skin colour or environs. An under-representation of Maori, Pacific Island populations may be inferred from this, especially when compared with the high percentage of cases with no documented ethnicity.

Trauma comprised a smaller percentage of the cases (22.6%), which may have influenced results. The week that data collection took place, there were 3006 ambulance responses within the Auckland District. Traumatic injuries or accidents made up 17% (n=525), medical 58% (n=1770), and 20% (n=603) of cases were PTS transfers or private hire. The remaining four percent (n=121) of cases were events, exercises, ambulance standby, or cases where ambulance was not required. The high number of ambulance responses does not reflect in the actual incidents; this may include duplications of responses where more than one ambulance responds to an incident.

The Glasgow Coma Scale score was 15 in 82% of patients, suggesting the majority of patients should have been able to be assessed for pain and effectiveness of pain interventions. Pain assessment can be assessed in less responsive patients by searching for causes of pathological pain and observation of pain behaviours such as facial expression, activity levels, vocalisation, interaction with others and environment can provide clues (Herr et al., 2006). Ambulance officer education is limited, even inaccurate, in this area across all qualification levels; an example of this is the misconception that changes in vital signs are a reliable indicator of pain intensity, recently refuted by Lord and Woollard (2011). For instance, the author witnessed the use of the FLACC score in an adult with altered level of consciousness due to trauma. This scale was developed

Ambulance officer qualifications were higher than the nationally reported averages of qualification levels of paid staff in the Auckland

District. There were more ALS and ILS officers, potentially offering greater analgesia options for patients. Nationally, 19% of paid staff are practicing at ALS level, 20% ILS, 48% BLS (including BLS-P), and 13% are below BLS level (J. Wood, 2010). Statistics provided by St John, divided the workforce into pain and volunteer groups (T. Dodds, personal communication, 22 July, 2010). The majority of ambulance offices in the Auckland District are paid. Auckland also has a high rate of triple crewing due to university students on clinical placements, and new fulltime staff undergoing induction. Triple crewing may not necessarily provide higher qualified staff in the ambulance, but provide better opportunity for pain assessment and management as two officers provide care for the patient, while the third officer drives.

Key Performance Indicators (KPIs) of ambulance responses are based upon time taken to respond to cases. In the urban areas, 50% of priority one responses should arrive within eight minutes, 95% within 20 minutes. Priority two responses have targets of 80% response rate in 20 minutes. Rural responses have a priority one target of 50% within 12 minutes, and 95% within 30 minutes, while priority two responses have an 80% within 30 minutes (C. Bartlett, personal communication, 23 March, 2011; M. Holt, personal communication, 18 March, 2011). Patient report forms do not contain priority dispatch coding; this data is only available on the Computer Assisted Dispatch (CAD) system, so comparison between mean response times was not possible. Study data was drawn from a mix of urban and rural areas. Therefore, the mean response time of ten minutes seems reasonable.

On-scene time and transport times are important to note, as this is the window of opportunity for ambulance crews to assess their patient, develop a working diagnosis, instigate treatment, and monitor its effectiveness. For patients in pain, this is the time when pain assessment and management takes place. Cases with short on-scene times and transport times will have less opportunity to assess and manage their patient's pain, than those with a longer on-scene and transport time. While the mean on-scene time was 15 minutes, the maximum on-scene time was over one hour. Similarly, the mean transport time was 19 minutes, but the maximum transport time was 105 minutes.

Tension exists between transport time versus time spent on-scene. Anecdotally, patients with short transport times to hospital receive less treatment as the ambulance crews consider the time to definitive care a priority, perhaps over pain management, and compromising optimal patient care. “Paramedics feel a constant pressure to manage the scene relative to the passage of time. They know that the longer they stay on scene, the longer the delay in the patient receiving definitive care” (Campeau, 2008a, p. 298). Concerns by management was also cited by Campeau (2008a) as a reason for avoiding protracted on-scene times. Officers may be unaware of the delays patients encounter in the emergency department before receiving analgesia (Abbuhl & Reed, 2003; Herd et al., 2009; Vassiliadis et al., 2002).

How many patients report pain in the Auckland district?

Prevalence of pain was commensurate with other study findings. Forty-nine percent of patients in this study reported pain. Pain was considered present if the patient complained of pain, or the crew considered the patient to be in pain, and this was documented on the patient report form. Twenty-three percent of patients had no documentation of pain. It is reasonable to assume that some of these patients may have been in pain. PTS patients, while not included in this study, may have also been in pain. Re-categorisation of data to exclude non-documented pain presence increased prevalence to 66%, but the missing 23% is significant. Reasons for non-documentation is an area for future research. Ambulance crews may have asked if the patient was in pain, but not documented this (Chisholm et al., 2008). In order to accurately ascertain pain presence or absence, ambulance crews need to explicitly ask, and document, the presence or absence of pain (Singer et al., 2008).

Cordell et al. (2002) reported 52% of patients had missing or unknown data, but reported 52% reported pain as a chief complaint, and an overall pain prevalence of 61%. Galinski et al. (2010) reported 42% of patients had pain present, however the study inclusion protocol required that the patient be asked if they were in pain from the outset. Authors were able to get emergency department physicians to amend their records if

data was missing or inconsistent. Patients under sixteen years were excluded. The authors reported that 252 of the patients had no pain assessed (8% of the initial sample), and a further 518 patients were excluded from the study (16%), for reasons including altered level of consciousness, language and respiratory distress, potentially increasing incidence of patients in pain. Marinangeli et al. (2009) described 63% of patients reporting a pain category of mild, moderate, severe, or unbearable. A further 32% reported no pain, possibly corresponding to 32% having no defined location, or having an altered level of consciousness. Lord, et al. (2009) found 53% of patients reported pain, despite excluding patients under fifteen years and a GCS less than 13.

Absence of pain was based loosely upon documentation of 'nil pain', including the documentation of pertinent negatives such as 'denies chest pain'. Use of pertinent negatives is commonplace in patient report forms, but may miss the presence of pain elsewhere in the body, particularly if it was pre-existing or chronic (Williams et al., 2000). Another study considered denial of localised pain to be a focal pain assessment, therefore not a global assessment as to the absence of pain (McLean et al., 2004). Thus, the 26% of patients with 'no pain' recorded in this study could be over-estimated. Due to the retrospective nature of this study, it was not possible to determine if the denial of localised pain indicated a complete absence of pain. Nor could 'new pain' versus 'old pain' be distinguished.

Only five cases reported the patient did not appear to be in pain, three non-verbal paediatric patients and two adults with functional or organic impairment; all assessments appear based upon behavioural cues such as smiling and interaction with ambulance officer or caregiver. It has been consistently demonstrated that health providers and caregivers underestimate pain levels of patients (Chisholm et al., 2008; Guru & Dubinsky, 2000; Hennes et al., 2005; Jones & Machen, 2003; Lord & Parsell, 2003; Luger et al., 2003; Puntillo et al., 2003; Shavit, Kofman, Leder, Hod, & Kozer, 2008). No cases were reported where ambulance officers assessed a patient as being in pain, implying self-report is the primary method used in pain assessment. Ambulance officer education has been limited in pain assessment, particularly those patients who may

not be able to verbalise their pain. Currently no standardised tools are used by ambulance officers. Some may utilise various pain-scoring tools they have sourced elsewhere. Further education regarding pain assessment in non-verbal patients, including those with altered mental status and paediatrics, is necessary, as well as provision of an appropriate pain assessment tool. Adopting standard pain assessments such as the VNRS for adults and FPS-R for children, and those who have difficulty in correlating their pain to a number is recommended. Since the completing of data collection, there has been continuing education sessions for ambulance officers nation-wide about pain pathology, assessment of pain using OPQRST, NRS, VAS and WBFS. However, no clear recommendation has been made about which tools is best suitable for which populations. The OPQRST has been described as a key competency for all operational officers in St John (i.e. those with a clinical role) (St John, 2011).

How is pain documented on patient report forms?

This research question was primarily focused on documentation about pain scoring and location of pain. Standard components of pain assessment such as Onset, Provokes, Quality, Radiation, Severity, and Timing are discussed in the following research question.

Forty percent of patients complained of chest or abdominal pain in this study. Anatomical location of pain documentation for other studies was variable. Some studies used specific aetiology to categorise pain (Cordell et al., 2002; Galinski et al., 2010; Marinangeli et al., 2009). Others incorporated trauma or non-traumatic causes into pain location (Bounes et al., 2011; Middleton et al., 2010). One study utilised similar categories to this study, however was limited to patients 18 years and over. The results in their study showed extremity pain was most prevalent (35%), followed by abdominal and back pain (19.7% each). No pain location was documented in 32% of cases, corresponding with the similar number of patients who denied pain. The authors also reported similar levels of documentation of pain location for those patients complaining of pain (96%) (Baumann et al., 2007).

Some years ago, a diagram was present on the main page of the PRF, enabling ambulance officers to draw pain locations. Due to space limitations, this diagram is now situated on the back of the PRF, but rarely used. Electronic PRFs are likely to be introduced in the future. A diagram should be included. In the short term, ambulance officers need encouragement to complete this section to enhance documentation about pain location.

Initial pain scores were completed for 38 patients out of an eligible 276 patients (13.7%). If a patient reported no pain from the outset and had no pain score documented, they were not included in analysis. One patient had a pain score of zero documented on the patient report form, which was included. Patients with severe pain, considered greater than 7/10 or greater, had the highest percentage of documentation (60%, n=23).

Galinksi et al., (2010) reported that 71% of patients rated their pain as intense or severe; intense pain was a VAS score greater than 3/10, and severe pain was a VAS score ≥6/10. Another study reported 14% of patients with mild pain, 20% with moderate or severe pain, using a VDS, rather than NRS. Differentiation between mild, moderate and severe pain is unknown (McLean et al., 2002). Using a NRS, 20% reported mild pain, 18% moderate pain, and 13% severe pain. Mild pain was considered a score of 1-3, moderate pain 4-7, and severe pain 8-10, which differs slightly from categories of pain in this study. Less patients may report severe pain as a result of this. Initially pain scores were measured on a 0-100 scale, then altered part-way through to a 0-10 scale as it was easier to understand and use by patients, paramedics and nurses alike (McLean et al., 2004). A telephone interview of patients with extremity trauma found 81% of patients reported their pain as moderate or severe (McEachin et al., 2004). In a study of 392, Singer, et al. (2008) documented 66% of adult patients in pain reported a pain score of 7/10 or more.

Pain scoring by ambulance officers in Auckland is not mandatory. In the PRF, there is no dedicated space for recording pain scores, although blank columns can be used for this purpose. This may partly explain the low levels of pain scoring; there has been no formal requirement to document pain scores, nor has there been a dedicated space, offering a visual reminder to officers. Frequency of pain score documentation was

higher for severe pain (≥7/10) than other lesser levels of pain intensity. It may be because these patients were more likely to receive analgesia, thus pain score was noted as a measure of analgesia effectiveness. Even so, overall documentation of pain scores remain low.

St John will shortly be commencing reporting of median pain score reduction in adults with an isolated traumatic limb injury as a Key Performance Indicator to the Ministry of Health (M. Deoki, personal communication, 18 February, 2011). Continuing education sessions have been undertaken nationally in 2011. This implies that there will be increased emphasis on pain scoring as an outcome measure, correlating with Emergency Medical Services Outcomes Project (EMSOP), which identified relief from discomfort as a major outcome measure of EMS effectiveness(Maio et al., 1999). Further recommendations by the EMSOP group recommended the use of the Adjective Rating Scale, using the variables none, mild, moderate, severe, agonising to describe pain, and the Numeric Response Scale, based on the 0-100 scale, for adults. It is noteworthy that EMSOP themselves have not used standardised pain scales in their recommendations. A further update is that the Ministry of Health reporting has been postponed as data abstraction is considered too challenging without the aid of electronic PRFs (M. Deoki, personal communication, 23 May, 2011).

In this study, 238 patients did not have initial pain scores documented. Of these, 188 patients reported pain. Pain scoring is not required for all patients, but is considered good practice. This may account for the low result. Recording pain scores is variable in other studies. In one study, pain scores were recorded in 65% of adult patients (Hennes et al., 2005), while another found that 27% of patients were missing an initial pain score and 34% of patient were missing a follow-up pain score before reaching emergency department (Fleischman et al., 2010). Following an educational intervention to paramedics, initial pain score rate rose from 44% to 95%. However, follow-up pain scores increased by only 11% following the educational intervention (French et al., 2006). Introduction of a templated chart, demonstrated an increase from 26% to 40% in pain score documentation (Baumann et al., 2007).

Critics of pain rating scales argue that they have little effect on analgesia administration rates (French et al., 2006; Jadav, Lloyd, McLauchlan, & Hayes, 2009). Conversely, Nelson et al. (2004) reported analgesia administration rates improved from 25% to 36% following the introduction of a mandated pain scale, and reduced time to analgesia administration from 152 to 113 minutes. Similarly, analgesia rates improved for those patients with a documented pain score by 27% (Silka et al., 2004). In alert adult patients, with suspected acute myocardial infarction or fractures, analgesia administration was more likely when pain assessment had been undertaken (Siriwardena et al., 2010). A correlation exists between pain scores and analgesia provision; out of 113 adult patients in pain six percent received analgesia if the NRS was between zero and four, 18% for scores between five and seven, and 68% for pain scores between eight and ten (Guru & Dubinsky, 2000).

Twenty-four patients had follow-up pain scores documented. Patients with severe pain reduced from 60.5% to 8.4%. One patient with chest pain, shortness of breath and tachycardia reported initial and follow-up pain scores of 9. Twenty percent reported no pain on follow-up, suggesting that some patients receive relief from their pain. The mean reduction in pain score from 6.04 to 2.83 suggests that those patients with pain scores recorded received analgesia. Researchers suggest the mean clinical significant difference (MCSD) lies between 9-14mm for the VAS (Holdgate, Asha, Craig, & Thompson, 2003; Kelly, 1998; Todd, 1996), while the VNRS has shown to have a MCSD of between 1.25-1.4 (Polly E Bijur, Latimer, & Gallagher, 2003; Holdgate et al., 2003; Kendrick & Strout, 2005; Mohan et al., 2010). For some studies a pain reduction of 2 points or greater is considered clinically significant (Bounes et al., 2011; Guru & Dubinsky, 2000), or a 30% reduction of pain intensity (Middleton et al., 2010).

The youngest patient to have a pain score documented in this was study was eleven years old. Numeric rating scales can be used by children over eight years of age, although there is limited research as to validity, in comparison with various faces pain scales (von Baeyer, 2006). EMSOP group recommended the Oucher™ scale for paediatric patients(Maio et al., 1999). The Faces Pain Scale was preferred over the Oucher ™ by

children with sickle cell anaemia, when asked to rate painful procedures, but showed similar validity for both scales (Luffy & Grove, 2003). Further education and pain scoring tools should be available to ambulance officers, and routine use encouraged for both adult and paediatric patients.

Despite the significant reduction in mean pain scores, there exists a large number of patients that reported pain but no pain score was documented. Sixty-five patients (33.6%) had a documented reason for non-assessment of any aspect of pain based upon refusal, functional or organic impairment, non-verbalising, or unable to understand English. Reasons for non-pain assessment are not clear, and outside the scope of this study, although other studies have suggested paramedics place little emphasis on pain scores. Attaching meaning to the pain score value depends on the ambulance officer's knowledge and experience. One study found that 33% of ambulance officers believed they did not need a pain score to assess a patient's pain, and 19% believed that the use of a pain score encouraged patients to overstate their pain (Lord & Parsell, 2003). Jones and Machen (2003) found that paramedics felt that patients both exaggerated and downplayed the presence and intensity of pain in order to be treated more promptly, while others downplayed or denied pain. Hopefully, once the proposed reporting of pain intensity as a key performance indicator is implemented, recording of pain scores will improve, not only for the isolated extremity injuries.

Assessment and documentation of pain

Pain components typically assessed by ambulance officers include Onset, Provocation, Quality, Radiation, Severity and Timing. Pain was considered assessed if there was documentation regarding the presence or absence of pain on either self-report or crew assessment. Pain was considered to not be assessed, if there was no documentation about the presence or absence of pain. Some component of pain was assessed in 76% of patients (n=285). Documentation of other elements of pain assessment (OPQRST) were noted, and weighted equally.

Two other studies incorporated OPQRST assessment of pain in their investigations; one a prehospital study investigating prehospital assessment of non-traumatic chest pain, another investigated pain

documentation by physicians in ED patients over eight years of age (Baumann et al., 2007; Rittenberger et al., 2005). Physicians assessed onset and duration most frequently (90%) prior to the introduction of a pain assessment template. Interestingly, their study did not include radiation as a pain assessment variable, but included undefined variables named context and modifiers, that may have incorporated radiation (Baumann et al., 2007).

Quality of pain was identified by descriptors used in the narrative of the patient report form. Greatest frequency of documentation was noted in chest pain where quality is considered a valuable diagnostic tool, particularly for differentiation of cardiac from non-cardiac pain. A variety of word descriptors were identified (refer Appendix C, Data Dictionary). Word descriptors were determined after scanning the literature for applicable studies where quality and words describing pain were listed (Cordell et al., 2002). Quality of pain is particularly open to the interpretation of the ambulance officer who is documenting the patient's pain, as well as that of the researcher abstracting the data. Nagurney et al. (2005) described instances where 22% of patients described their pain as an 'ache' during interview, but 13% of charts recorded this.

Overall, documentation of pain assessment variables was less than other studies recorded. Chest pain reported greatest frequency of OPQRST assessment, followed by abdominal pain. Application of OPQRST is easier in these two pain locations. Poor documentation of pain, in particular pertinent negatives of pain documentation such as non-radiation of pain need further educational emphasis. A limitation of OPQRST narrative is the limited space in this section of the patient report form, which may result in non-documentation.

Severity was observed in 49 patients (27.1%) in pain compared with 38 (20%) patients having a pain score recorded due to verbal descriptors of pain such as mild, moderate or severe being noted in the patient report form without a pain score being recorded. Baumann et al. (2007) noted a higher incidence of severity noted in either text or pain score (40.9%) in comparison with pain score alone (26.6%). Rittenberger et al. (2005) noted a mean 52% recording of severity amongst the four ambulance

services being audited. Severity of chest pain is considered an important diagnostic clue when differentiating aetiology.

Timing of pain was the most frequently noted in this study, in contrast with a reporting rate of 32.7% and 14% respectively (Baumann et al., 2007; Rittenberger et al., 2005). Better documentation of this variable may be due to the requirement by Accident Compensation Corporation that claims for trauma cases may only be made for injuries sustained less that 24 hours previously. Discrepancies may also occur converting vague statements into time of onset, such as on waking, to a standardised time (Nagurney et al., 2005). If no specific time was able to be deduced, then timing was noted as present but duration was considered not documented. With fluctuating pain intensity, pain duration was selected using the initial onset of pain as the starting point, even though pain may have abated then returned. This may account for increased incidence of duration from 24 hours and longer. Collection of data about fluctuating pain may have been beneficial to identify duration with greater accuracy.

Assessment of pain variables was not possible for some patients, the greatest reason being functional or organic impairment (17%). Patients with a Glasgow Coma Scale of 14 or less were included in this group, as were patients considered to be under the influence of drugs and or alcohol. Further analysis of pain assessments undertaken for patients with a GCS<15, showed low percentages of patients having pain assessment. Timing was the most frequently assessed (10.9%, n=5), followed by quality (8.9%, n=4). Initial pain scores were recorded in four patients, and follow up pain scores in three patients. It appears that a GCS less than 15, still permits pain assessment in some patients. Silka et al. (2004) after initially including trauma patients with a GCS of 8 or greater in a pain score study, concluded that patients with a GCS<15 not be included as they experienced pain assessment failure resulting from altered mental status, and lowered GCS resulting from injury, intoxication or clinical instability. Another study included patients with a GCS greater than 12, but there was no rationale for selection of this (Lord et al., 2009). Non-verbalising patients were all children two years of age and under. It is possible that patients may be unable to verbalise for other reasons, such as aphasia.

Non-documentation of pain variables is an issue for concern, as results do not compare favourably with other studies. Aspects of pain such as pertinent negatives, form an important aspect of diagnosis, and should be documented on the PRF. In patients with chest and abdominal pain, OPQRST appears easier to apply to patient questioning. However, the questions should be considered just as relevant for other locations of pain. As an example, a patient whose headache is provoked by light, raises a differential diagnosis of meningitis, until proven otherwise. A continuing education module was delivered in the first six months of 2010 about the importance of documentation, specifically pertinent negatives. Data collection for this study was undertaken in November 2010; the low level of documentation suggests further education is needed.

This study has set out to document the presence or absence of OPQRST pain assessments and pain scoring. Some patient report forms were comprehensively written, and contained more pain assessment information than others. Further analysis on a case by case basis was outside the scope of this study. Likewise, a different methodological approach would have been required to evaluate the quality of pain assessment documentation. This may be an area for future research, in order to determine which aspects of pain assessment are being performed better than others.

How is pain managed using pharmacological and non-pharmacological interventions?

Pharmacological intervention

Analgesia was administered 126 times. Some patients will have received more than one medication, lowering the actual incidence of analgesia administration. Paracetamol was the most frequently administered drug for patients in pain (19.1%, n=56). Given that paracetamol can be administered by basic life support officers and upwards, this result is unsurprising, even though the majority of scores indicated severe pain. Forty-seven percent of patients received 1000mg dose. Paracetamol doses are weight-based for adults and children. An adult between 50-70 kg receives 1000mg, while a person over 70 kg receives 1500mg. Paracetamol is carried in the ambulance in both tablet

and elixir form, however, anecdotally many patients receive elixir, as water is not routinely carried in Auckland for patient use in the ambulance. In other parts of New Zealand, for example Christchurch, small sealed water cups are carried, meaning tablets are easier and more economical to administer.

Twenty-seven percent of patients were noted to have fever, another indication for paracetamol administration (St John Clinical Management Group, 2009). However, a recent survey of ambulance officers in Auckland indicated poor understanding of what constituted a fever, and when to administer paracetamol. This may be due in part to St John protocols having no formal guidelines about this. Research found 33% of patients who were given paracetamol by ambulance officers did not meet criteria of local paediatric emergency departments for paracetamol administration (Edwards, 2010).

Entonox™, the second most frequently administered drug is able to be administered by officers with Primary Care scope of practice and above. All front-line ambulances in Auckland Distract carry Entonox™ as it was found to be more economical in areas of greater use.

There was no methoxyflurane use in this study. Initially methoxyflurane was introduced in 2007, with the intention of phasing out Entonox™ use; however, this has not happened. Entonox™ cylinders can be used by more than one patient, requiring only a clean filter and mask or mouthpiece, while methoxyflurane is single-use only. Remote stations and specialist vehicles including rapid response units and Specialist Emergency Rescue Team (SERT) still carry methoxyflurane as it is more portable, and requires less storage space. Entonox™ is indicated for mild to moderate pain, while methoxyflurane is used for moderate to severe pain, making it possibly the more effective analgesia (St John Clinical Management Group, 2009). However, some ambulance officers reported greater side effects due to passive inhalation of methoxyflurane during patient use.

Entonox™ administration was associated more with trauma patients (60%) than non-trauma. Findings correspond with another, that 32% of patients with a fracture received Entonox™ in comparison with 5% of those with suspected myocardial infarction. The authors also found

ambulance technicians, equivalent with BLS officers, more likely to administer Entonox™ than paramedics, who have greater options for analgesia. (Siriwardena et al., 2010). The current study found ALS officers administered Entonox™ ten times, as did ILS officers. Initial analgesia may be offered by lesser-qualified officers, while awaiting backup by a higher qualified officer for additional analgesia.

Glyceryl trinitrate (GTN) was included as an analgesic for the purposes of this study, even though it is classed as an anti-anginal drug, because of its effects on relieving cardiac chest pain (Rang et al., 2007). GTN was administered to twenty patients (5.4%). In comparison, 21% of patients reported chest pain. This may be because not all pain was considered to be cardiac in origin. St John procedures state 0.4-0.8mg doses are administered for cardiac chest pain and acute cardiogenic pulmonary oedema, however all but one patient was administered 0.8mg. It is unknown why nearly all patients received the higher dose of GTN. Further GTN was administered to eleven patients, 4 patients receiving a total of 2.4mg.

Intramuscular morphine was administered to two patients, one aged 52 years with abdominal pain, the other a fourteen year old girl with a fractured ankle. Fifteen patients received intravenous morphine (4%). In contrast, sixty percent of patients reported severe pain, suggesting uner-utilisation of opiates. Weight was not noted on the PRF, but the mean initial IV dose and mean total IV dose in this study suggest under-dosing of morphine, if compared with recommended 0.05mg/kg bolus (Bounes et al., 2011; Galinski et al., 2010). One patient received a total of 25mg morphine intravenously, which raised the total mean dose administered.

Ketamine was administered to one patient orally. No patients received intravenous ketamine; similar findings were reported by Galinski et al (2010), where three patients receiving ketamine. Comparative data was sought within St John to check if results were atypical. Between March 2008 and October 2010, ketamine was administered 102 times, 99 intravenously, and three orally. The documentation on ketamine usage was based on self-report, but poor compliance to this request, has made accurate data collection impossible (M. Deoki, personal communication, 8 March, 2011).

Non-pharmacological intervention

The most frequently performed intervention was ice and positioning. Forty interventions in total were documented; the most common was a dressing (3%, n=97). Again, a single patient may receive several treatments, potentially reducing overall rate of administration. In comparison with other studies, splints were applied with greater frequency (Izsak et al., 2008; Moore, 2006).

Though 22% of cases in this study were traumatic in origin, non-pharmacological interventions are not limited to splints and dressings as suggested by Kendrick and Strout (2005). Reassurance, distraction, truth-telling, and the presence of a support person are recommended by the National Association of Emergency Medical Services Physicians (Alonso-Serra & Wesley, 2003).

Previous administration of analgesia was poorly documented (21%). A patient who has taken paracetamol within the past four hours, would need alternative pain relief according to Clinical Procedures (St John Clinical Management Group, 2009). Similarly, a patient who has taken a synthetic opiate such as tramadol may need adjustment of morphine doses to avoid potential medication interactions. One study of 101 adults reported as many as 41% of patients had taken acetaminophen or NSAIDs prior to emergency department evaluation (Axelband, Lopez-Rodriguez, Jacoby, & Heller, 2004). Previous self-medication may be a contributing reason for non-administration of analgesia. This is an area where documentation is needs improving, if ambulance officers are to obtain a clearer clinical picture of the need for analgesia.

Not all patients desire analgesia. In this study, a small number of patients declined analgesia, but nearly half of the patients reporting pain potentially had no documentation about their desire for analgesia. Axelbrand et al (2004) found that 57% patients desired analgesia. In another study of adults with pain, 104 patients reported pain, but 64 desired analgesia, while 40 declined. The mean VAS was 66 $\pm$23.1 for the group wanting analgesia, and 45 $\pm$29.4 for the group that did not. Because of the large overlap in standard deviations, the authors felt there would be patients who wanted analgesia that would miss out if an arbitrary VAS score, say of 60, triggered analgesia administration. Conversely, there

may be patients receiving analgesia that do not need it (Blumstein & Moore, 2003). Of 392 adults with pain, 199 (51%) desired analgesia. Those declining analgesia did so because the pain was tolerable (47%), they had taken analgesia prior to their emergency department visit (11%), or wanted to stay alert (7%). Patients with chest pain were more likely to decline analgesia than others (Singer et al., 2008). In another study of 386 paediatric patients with long bone fractures, a recommendation that the patient or family was asked if they desired analgesia instead of using a pain scale (Weng et al., 2010). This notion is worthy of consideration. Ambulance officers have shown a tendency to disbelieve a patient's pain score at times (Jones & Machen, 2003; Lord & Parsell, 2003), and misinterpreted pain levels (Hennes et al., 2005; Luger et al., 2003). Documentation of the patient's response is equally crucial. No studies have been published regarding a patient's desire for analgesia in the prehospital setting; all were based in emergency departments.

There still exists a need to determine clinical significance of pain. A pain score of two or three is considered to be treatable, and a "low-hanging fruit" for improving patient care at an organisational level (Frakes et al., 2009, p. 52). Australasia's Council of Ambulance Authorities (CAA) has recommended member services adopt clinical indicators that include reduction in pain as a measure of compassion and care (Lord et al., 2009). The concurrent introduction of the a key performance indicator of median pain score reduction is pleasing to see, as poor management of pain is unnecessary, indeed "inhumane" (Singer et al., 2008, p. 690).

It is fortuitous that completion of data collection for this study occurred ahead of the introduction of both an education package and KPI reporting, as a true baseline of analgesia practices is now established.

Effect of ambulance officer qualification on pain assessment and treatment?

Highest ambulance officer qualification was cross-tabulated with pain assessments including OPQRST and pain scores, to determine if there was any relationship between qualification and pain assessment. While there were no statistically significant differences in pain assessment between qualifications, some findings warrant exploration.

BLS officers demonstrated better pain assessment documentation than higher qualifications in provocation, severity and timing. Possible explanations are that BLS officers are less experienced, and more conscientious at documenting pain assessment. A number of paramedic graduate interns practice at BLS level in Auckland. This cohort of officers have a greater theoretical knowledge than those who have completed a National Diploma or National Certificate course, and may have a greater appreciation of the importance of thorough documentation.

BLS-P officers documented pain assessments poorly, recording lowest frequency for onset, provocation, timing, initial and follow-up pain scores. They performed quality and radiation assessments more frequently than other qualifications. This group of officers have no additional skills to offer the patient in pain (refer Table 1). This may be de-motivating to officers. Of note, this qualification will be phased out by September 2014 as part of the St John 'Road to Clinical Excellence' programme, and affected officers will transitioned into intermediate life support or basic life support scope of practice (Blaber & Brooke, 2010).

ILS officers performed initial and follow-up pain scores most frequently. This scope of practice emphasises pain management by virtue of authorisation to administer morphine. Educational programmes at this level have traditionally emphasised the value of documenting initial and follow-up pain scores as a gauge of analgesia effectiveness.

ALS officers documented onset more frequently than other assessments. Initial pain scores were slightly less than ILS officers, however follow-up pain scores were significantly less documented. This group of officers also recorded the least frequent incidence of analgesia declined in comparison with other qualifications. A number of the cases would be to provide analgesia back-up to lesser qualified officers.

Expectations of ambulance officers, particularly of ILS and ALS officers have grown over the past ten years, with the inception of degree-level education, and the introduction of the Road to Clinical Excellence. By 2014, ILS education will align at undergraduate degree level and ALS education will align with post-graduate level. In an effort to improve patient care, regular Continuing Clinical Education (CCE) has also begun in February 2010. In 2011, every ambulance officer within St John, New

Zealand will receive 40 hours of ongoing training per year (Blaber & Brooke, 2010). Prior to this, there was no formal continuing education at a national level, except for biennial clinical procedure updates. The 'Road to Clinical Excellence' requires a paradigm shift within St John, and forms part of a strategy to move towards both a national qualification structure, and the possibility of ambulance officer registration under the Health Practitioners' Competence Assurance Act 2003 for some, if not all, scopes of practice. At a national level, this issue is being investigated. If registration ensues, personal accountability for practice will increase, beyond the delegated scope of practice that ambulance officers currently practice within.

This study was set in Auckland District, where there are a greater number of full-time ambulance officers, who arguably could gain greater depths of experience in shorter timeframes, because of workload. There are also higher number of ILS and ALS officers in Auckland District, and triple crewing, in comparison with the rest of New Zealand. Because of these reasons, it could be argued that higher levels of pain assessment and treatment would be noted in Auckland than the rest of New Zealand. Further study in a national capacity is needed to determine pain assessment and treatment practices throughout the whole of New Zealand.

Reflections on the research journey

During the writing of this thesis, I have learned many lessons about the research process. The importance of having clearly written research questions are like a lighthouse in fog; illuminating relevant issues, and re-focussing attention. Pre-empting research results is unhelpful. Pilot studies are incredibly beneficial to hone study design, research variables, and data collected. Research tables are equally valuable. A realisation about how little prehospital research exists globally and in New Zealand, and how green the research fields are. The challenge of maximising opportunities, communicating research findings, and time management.

Conclusions

This study has determined a baseline for future comparison. Documentation was globally poor, particularly in terms of pain assessment and non-pharmacological treatment of pain. Issues stem from education about pain assessment and pain management.

Standardised pain assessment tools need to be utilised for adults and children. The use of OPQRST should be encouraged for all types of pain, with an emphasis on documentation as a means of aiding diagnosis. Further tools need to be available to ambulance crews for pain assessment in those patients who are unable to self-report their pain – specifically young children, and patients with cognitive impairment.

Any patient reporting pain should have a pain score recorded, and follow-up pain scores if pain is treated. Asking patients if they desire analgesia is a useful way of giving the patient control over their pain, as well as valuing pain as the patient's subjective experience, not the ambulance officers. However, this required the ambulance officer to be accepting of the patient's self-report of pain without prejudice. Pharmacological treatment of pain can then be based upon patient's requirements for analgesia. If the patient has had previous analgesia, this should be documented as it could affect analgesia decisions made by the ambulance officer.

Non-pharmacological treatment of pain needs addressing further in future educational strategies, in terms of merit, techniques to utilise, and documentation of these on patient report forms. Part of this process is a culture shift away from a pharmacological approach and towards a holistic approach to pain management. Reporting on key performance indicators may promote this process.

Further research opportunities exist to examine ambulance officer attitudes towards pain assessment and treatment, and patient desire for analgesia in the prehospital setting.

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Appendix A: Research table

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Abbuhl, et al	2003	R			✓	Analgesia prior to ED Time to analgesia	Adults > 18yrs Painful isolated extremity injury Received parenteral analgesia by EMS Data collection 18mths n=104 E: multiple trauma pts, haemodynamically unstable, head injured pts, intoxicated pts, altered mental status or dementia, interfacility transfers	12% rec'd parenteral analgesia by EMS 88% did not receive analgesia until ED. Mean time to analgesia (EMS) 23 mins Mean time to analgesia (ED) 113 mins No pts with hip fracture rec'd analgesia	Exclusion criteria may mean more pts should have had analgesia? How accurate was time keeping (no evidence of clock synchronisations) Unknown what analgesia options available Unknown crew skill mix Did not include pts receiving oral analgesia in study.
Babl, et al	2007	P		VAS Bieri Faces Pain scale - Revised	✓	Methoxyflurane Procedures	Children 5-13yrs n=14pts. ED setting, cooperative children needing procedural analgesia eg fracture reduction. MF inhalers weighed to gauge usage.	4 pts with initial low pain scores had poor satisfaction 4 pts had large drops in pain scores	Very small sample size. Observational case series set in ED. Pain measured using VAS >7yo or Bieri Faces Pain Scale – Revised 5-7yo. Parental satisfaction measured using Likert scale.
Babl, et al	2006	P		VNRS	✓	Methoxyflurane	Children n=105 15mths-17yo	Patient and crew satisfaction with methoxyflurane. Pain score decreased from 7.9 to 4.5at 2-5mins, 3.2 at 10mins. Most common side effect was drowsiness (25%), tasted funny (good / bad)	Observational case series. Criteria in prehosp (MAS) for methoxy use: conscious, pain score >2, self-administration, no pre-existing renal impairment, no tetracyclines. Limitations included pain score based on combination of questioning pt and subjective assessment by paramedic.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Benson, et al	1997	R			✓	Demographic variations	Adults >17yo Acute non-traumatic chest pain Data collection over 6mths n=169	56% female 75% >40yrs Mean transport time 7 mins Whites had more interventions requested than others, esp. white males.	EMS requested supplemental oxygen, virtually all treatment needs online authorisation. Not all ambulance run reports were included in study, missing data? No identification of chest pain cause eg cardiac vs non cardiac Highlights how dependent paramedics were for providing interventions
Bounes, et al	2010	P		VNRS	✓	Morphine Predictors of adverse events in patients rec'g opioids	Adults VNRS >5 needing opioids n=277 E: <18yo, altered LOC, unable to give oral consent	56% trauma pts, 44% non-trauma 80% rec'd opioid plus another analgesic. High initial pain scores a predictor for analgesia failure. 9% had adverse events, nausea and/or vomiting. Initial median morphine dose 0.08mg/kg; median total morphine dose 0.1mg/kg	2-tier system BLS crewed by EMTs/ firemen, ALS crewed by Dr/ Nurse. Scored pain <3/10 @ ED, goal to reduce pain by at least 2/10 (MCSD). 38% pts achieved this. Study didn't consider non-drug treatment in relief of pain

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Bounes, et al	2008	P			✓	Morphine Ideal morphine dose?	Adults VNRS >60/100, acute pain >18yrs randomised to receive 0.05mg/kg then 0.025mg/kg OR 0.1mg/kg then 0.05mg/kg q5 mins (all IV). n=106 E: <18yo, chronic pain, renal / cardiorespiratory / hepatic insufficiency, allergies to opioid/ acetaminophen, haemodynamically unstable, GCS <14, drug addiction, pregnancy, prev analgesic <6hrs ago (including self-administered).	Pts in Group B more satisfied with their analgesia 76% reported pain scores <30/100 cf Group A (66%). Group B pts reported double of adverse effects. Group A had slightly more trauma pts 72% cf 66% for Group B. Patient vs Dr reports of analgesia satisfaction differed: Group A pts reported 85% satisfaction with analgesia (Drs 73%); Group B pts reported 97% satisfaction (Drs 88%). Group B pts more likely to experience pain relief (<30/100) by 10mins than Group A	Pain scores >60/100 considered severe. Success was pain <30/100 within 30mins of first injection Chronic pain not defined Vital sign criteria explicit Pain scores assessed q5 min. All pts rec'd 1g acetaminophen IV as well as opioid, so not a pure test of opioid effectiveness. A lesser dose of opioid may be necessary. 4% pts rec'd non-protocol treatment. All pts white. Non-drug treatment not included in study, authors hypothesise there would be similar results, but Group A had more trauma
Buntine, et al	2007	P		VNRS	✓	Methoxyfluran e	Adults >18yo n=83 (95 enrolled, 12 exluded during study) Data collected over 10 mths, single ED destination, E: unable to consent, unable to complete NRS, dispatch data issues, needing urgent tx. Pain and sedation scores prior, T5, T10, T20, on arrival at ED	18% reported adverse effects, some more than one – nausea, euphoria, dizziness most frequently reported. T5 mean pain score reduction 2-3 T10 mean pain score reduction 3 T20 mean pain score reduction 3.3 ED score reduction similar to T20.	Assessed sedation, VNRS, adverse effects. Also completed pt & paramedic satisfaction score (likert). Staffing issues / busy workload meant potential patients not enrolled. Multiple people asking VNRS scores, potential for inter-rater reliability issues. Other analgesics administered too, confounding effect.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Chambers, et al	1993	R	✓				Emergency department patients arriving by ambulance in need of analgesia	54% patients reported pain (49% trauma, 6% non-trauma)	Initially, a prospective study but 30% response rate from ambulance crews. Only prehospital analgesia available was Entonox for majority of ambulance services, 4% carried nalbuphine. Authors discussed upcoming legislation changes that may permit ambulance staff to carry controlled drugs.
Colwell, et al	2009	R			✓	Adherence to protocol	Adults Non-traumatic chest pain n=586 randomly chosen from 1758 pts Data collected over 6 mths	92% pts rec'd oxygen 62% rec'd aspirin 97% had lung sounds assessed 99% had vital signs taken 84% rec'd IV 92% rec'd ECG 73% assessed for cardiac risk factors Mean age 52 yrs Cardiac risk factors assessed 57% of 20-39yrs, cf 71% 40-50yrs, 79% >50yrs	Electronic PRF limits chest pain choices to 3 check boxes Pts taking daily aspirin may not have received aspirin by EMS
Engelberg, et al	2000	R		VNRS	✓	Glyceryl trinitrate	Adults patients receiving GTN Data collection 18 mths n=1662 VNRS assessed pre and post GTN administration, noting adverse events including BP <90mmHg, syncope, dysrhythmias,	GTN reduced pain score from 6.9 to 4.4 10% reported complete relief from chest pain post GTN. Mean systolic BP drop 11mmHg 12 adverse events associated with GTN, mainly BP decreases, and syncope	ALS run sheets reviewed, not sure if BLS providers also in service. Online medical approval for all ALS skills (inc. GTN?) Authors considered pain relief to be a '0' score (cf with other studies)

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Fleischman, et al	2010	R			✓	Morphine Fentanyl comparison of safety & efficacy	Adults >13yo Data collection 9mths prior, 9mths post protocol change. n= 355 morphine n=362 fentanyl	Mean starting pain score 8.3 fentanyl and 8.1 morphine. Mean reduction in pain score 3.1 fentanyl and 2.9 morphine. Similar rates of adverse effects, most common nausea Average time to 2nd pain score 10mins	Change of protocol from morphine to fentanyl Children <13yo excluded because VNRS unable to be used by them (cf with other studies that suggest that younger children can use VNRS?) Of note, 24 and 27% pts were missing initial pain score, 33% missing final ambulance pain scores, 24% missing ED pain scores
French, et al	2006	P			✓	Education session for paramedics	Adults Children 3 hr educational session for paramedics Data collection for 2mths (n=243 run reports) and 1mth after (n= 196 run reports) education intervention (EI) n=206 paramedics (98% male) surveyed about knowledge pre and post EI.	Biggest changes in knowledge by paramedics were: negative physiological consequences of pain 69-85%, nociception system knowledge 4-39%, pathophysiology of referred pain 34-70%. Non-drug tx for pain increased 4-34%. Recording of pain scale increased 44-95% (1-10 scale ?verbal or paper based) Pain characteristic documentation 18-42%. Administration of morphine did not increase (see comments column)	Multiple agencies involved, pts transported to single ED. Paramedics only had morphine available, online permission needed for all pts except chest pain, so increase of non-drug tx coloured by this? Gender of paramedics – is this an issue? What was the agenda for this study? Greater freedom with analgesia protocols?? Education only delivered to paramedics, not ED Drs / nurses, so less working together to reduce pain?? Anecdotal evidence that paramedics requested morphine use but were denied until pt in ED. Were non-drug tx improved, or just better documented? SOP introduced after this for analgesia.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Fullerton-Gleason, et al	2002	R			✓	Morphine protocol for isolated extremity injuries	Data collection 10 mths post new protocol, 9 mths prior n=492 prior to change n=471 post protocol change I: isolated extremity injuries, including fracture, dislocation, laceration or extremities, shoulder, hands, feet, hips, arms, legs E: head trauma, abnormal vital signs, impaired by drugs or alcohol	59% female overall 18mins to morphine prior 16 mins to morphine post 11% reduction in time to morphine adminsitration 62% rec'd morphine on scene prior 69% rec'd morphine on scene post 34% pts contacted for morphine permission	Prior to protocol change online permission necessary. Unclear what the protocol was prior and post, other than there was a change. Not sure why there were small changes in results.
Galinski, et al	2010	P	✓	✓ Presence VAS or VNRS or VDS	✓	Prevalence of pain, pain assessment, management and options used. Morphine Paracetamol NSAIDs Local anaesthetic	Adults >16 yrs n=2279 data collected over 11 months	79% male, 72% over 75 yrs. 42% reported pain (64% reported severe to intense pain) 40% used NRS 34% used VAS 19% VDS	High % of males and elderly Dr crew ambulance. Intense pain 3-6/10, severe pain 7/10 + Pain relief if pain reduced by 3/10+
Goldstein, et al	2008	R			✓	Prehospital analgesia administration comparing renal colic and hip fracture	Adults >16yo Medical vs trauma Data collection over 6 mths Collected information about ED and EMS pain severity, EMS response and treatment characateristics, parenteral narcotic	61% female, mean age 80yo. 90% had hip fracture, 9.9% renal colic. 81% rec'd ED analgesia, 11% rec'd prehospital analgesia. Kidney stone pts had higher pain scores cf hip fracture pts (8.7 cf 6.5) 16% hip fracture pts rec'd prehospital analgesia, no renal colic pts	Identification of pts from ED database What were the analgesia options? Was analgesia available using standing orders / protocols or needing online consultation?

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Hennes, et al	2005	R		✓ VNRS	✓	Estimated vs actual incidence of pain and analgesia administration. Morphine via protocol (max dose 4 x 2mg boluses adults) then online medical control Other treatment eg splinting, dressing	Adults n=5099 Children n= 284 (188 teens, 96 children 0-7 yrs) Paramedic survey for estimates of analgesia rates in past month n=202 (77% completion rate) Chest pain, burns and extremity injuries examined as pain protocols exist for these	Pain estimates: 65% adult pts had pain scored, 5% teens, 2% children. Pain assess actual: Adult CP 71%, extremity inj 23%, burns 25% Teen CP 17%, extremity inj 5%, burns 0% Child CP 0%, extremity inj 3%, burn 0%. Pain tx: Adult CP 37% cf 4%. Adult extremity inj 24% cf 12%. Adult burns 89% cf 14%. Teen CP 0% actual Teen extremity inj 4% actual Teen burns 33% actual. Children rec'd no morphine at all. Actual morphine administration 4.8% across all ages (258 pts). 64/258 (24%) rec'd morphine with no documented pain assessment, 56/64 had no documented reassessment post-morphine (87.5%) Adult NRS estimated 50% in past month Teen NRS est. 31% in past month Child NRS est. 6% in past month	ALS paramedics only but provides an ALS-BLS crew mix. Unclear why survey covered only last month of practice estimates, but run report included 12 months data. Cf perceptions of pain with actual tx of adults and children in pain. EMT-B and EMT-P surveyed. Chest pain pts better assessed, is it because we are better conditioned to using OPQRST for this condition, than others? Barriers cited for giving morphine included inability to assess pain, low pain score, 81% were concerned in adults by possible drug-seeking.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Izsack, et al	2008	R		✓	✓	Assessment and management of traumatic pain in children. Pharmacological Non-drug tx	Children <17yrs Trauma pts only n=696 data collected over 3 yrs	64% had pain, 17% had 'no pain'. 18% no documentation of pain 1 pt had VRS used (0.2%) for a 7yo. 13% of patients with pain rec'd tx for pain, 16% rec'd drugs, 12% rec'd non-drug. 86% pts rec'd no tx for pain	ALS system – fentanyl for peds mg/kg dose (standing order) Analgesia contraindicated for pts with major trauma to head, chest, abdo, pelvis. Pain assessment not mandatory
Johnson, et al	1991	R		0-3 scale 3= severe pain (writihing, groaning) 2=spontaneous complaints of pain 1= complains only when asked 0=no pain / complaints	✓	Entonox	n=200 Adult pts 4 ambulance services participated in study Data collection 26 mths	77% partial relief 15% no relief 3 pts unable to use entonox 15% reported side effects – dizziness, nausea, drowsy	Entonox contraindicated for: altered LOC, suspected pneumothorax, severe maxillofacial trauma, decompression sickness, pregnancy (1st trimester), hypotensive pts, bowel obstruction, COPD. Validity of pain scoring method

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Jones, et al	2003	P			✓	Paramedic attitude	Paramedics (qual) UK paramedics n=6 recruited by researcher, based on their knowledge, reflective practice, willingness to talk about experiences Semi-structured interviews, using 9 open-ended questions	4 main themes: Patients experience of pain changes with age, and culture affects a patient's experience / reporting of pain. Pain isn't recognised by one single sign, but non-verbal signs are considered the most obvious along with physical signs eg swelling, deformity. Paramedics believed that some pts aren't honest in reporting their pain, some exaggerate, some deny. Patient-led analgesia, if the pt is in pain, then it should be made available. Consideration given to time to hospital, scene delays, road conditions, and difficulty in gaining IV access. Pain is subjective, so can't be protocol-based. Alternative methods include gaining trust and reassurance. Massage wasn't considered practical, and participants weren't willing to try iot. If alternative methods were provien to be effective, some would consider them more.	Clarke 1998 suggests prehospital analgesia has evolved rather than been developed . Small sample size, did not include EMTs, just paramedics. Opinions of the paramedics may be different to how they practice.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Kanowitz, et al	2006	R		✓ VNRS adults VDS adults / children or Pedi faces scale	✓	Prehospital fentanyl protocol effectiveness	Adults >8yrsk Children <8yrs n=2129 data collected over 2 yrs.	92% had pain assessed	Authors were studying effectiveness of prehospital fentanyl protocol, no dose limit but requires base hosp contact. Fentanyl used in combination with other drugs excluded from study. No separation of fentanyl admin vs non-drug analgesia
Lang, et al	2007	P		VAS used for pain and anxiety 0-100	✓	Acupressure	Adults Isolated distal radial fracture Austria n=32 (70 eligible) Randomised, double-blind trial using actual acupressure sites and sham ones E: poor German language, presence of neurological or psychiatric disorder, taking analgesics for chronic pain, VAS pain score of >80mm.	VAS scores for pain 20mm less for treatment group cf control group (36 vs 56mm) VAS scores for anxiety 15mm less for treatment group cf control group (34mm vs 53mm)	Ambulance crews unable to provide any analgesia for pts prehospital – can only be administered by Drs.
Lord, Cui, et al	2009	R	✓	✓ VNRS	✓	Gender variations in pain assessment and tx. Morphine Methoxyfluran e	Female vs male >14yrs GCS >12 n=3357, data collected over 7 days	53% reported pain 95% pts had pain assessed, 71% used VNRS 45% reported pain but rec'd no analgesia. 11% declined analgesia. 15% rec'd morphine 34% rec'd methoxy 6% rec'd both Females reported more severe pain 8-10 than males. Females less likely to rec' morphine 13% vs 17% males.	Looking at gender inequities No distinction between medical vs traumatic pain CAA see quality of analgesia as a surrogate measure of compassion, recommending development of clinical quality indicators that include reduction of pain

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Lord, et al	2003	P		✓ VAS		VAS scale Survey for paramedics about attitude to pain measurement	n=262 patients >10 yrs Reporting pain Paramedic attitudinal survey n=96 Data collection period unknown, taken from 4 stations (took longer than thought, B Lord personal comms)	35% response rate to paramedic attitudinal survey BLS & ALS officers in survey? VAS appeared reliable indicator of assessing pain. Survey results 33% of paras believed they could assess pts pain without using a pain scale; comments indicated paras believed exaggerated pain when using a scale.	Tried to introduce VAS, other ambulance services using VNRS. No mandatory recording of pain scores on PRF. No sample size for paramedics interviewed. Limited Likert scale, no form included in article.
Luger, et al	2003	P		✓ VAS	✓	VAS scoring between pt, Dr, EMT crew and EMT driver	n=62 pts. Data collected over 12 months. EMS personnel: 2 Drs, EMT technician & EMT driver x10 Austria Adult patients >16 yrs Acute pain Excl. chronic pain, polytrauma, altered mental state, refusal.	Av. pt contact time 34 min. 5 pts could not understand VAS, 4 too injured resulting in VAS failure. Mean diff between pt score and EMS crew was greater for severe pain (25mm, cf much closer correlation for mod & mild pain). 60% pts under-assessed for pain by Dr & EMT, 68% by EMT driver. 92% pts rec'd some form of analgesia – 67% opiates, 33% no opiates, didn't include GTN & aspirin for ACS.	2 Drs only in study and 10 EMTs and EMT drivers. EMS crew blinded to each other's responses. Assessed pain prior to analgesia, after loading into ambulance, at hospital Pain mild 0-40mm, mod 40-60mm, sev >60mm.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Maimon, et al	2007	P		Wong-Baker faces 3-6yo VAS 6-18yo	✓	Analgesia administered by parents prior to ED	Children 0-18yo Limb injury Canada Data collected 0900-2400hr over 3 mth period. n=214 enrolled (potential for 567, but there were refusals, exclusions etc). E: non-English speaking, brought to ED by non-guardian, lacs or FBs, conditions predisposing them to limb pain, conditions affecting perception of pain / pain expression, using analgesia drugs regularly, multisystem trauma, physical abuse	72% administered analgesia prior to ED visit. 44% used non-drug tx, half used ice packs, 28% rec'd analgesic meds prior to ED. Older children more likely to receive analgesia 22% of 12-18yo, cf 3% 0-2yo receiving analgesia, 13% 2-6yo. Main reason for withholding medication was concern over masking symptoms (21%) not enough pain to need analgesia (18%)	Not sure why 2mths of data wasn't collected post EI? Lots of exclusions, potentially altering results? Recall bias for those pts arriving in ED some hours post injury?
Marinangeli, et al	2009	P	✓		✓	Available options	Italy	67.5% patients reported pain 32% unable to report pain site (due to altered level of consciousness), 3.75% unable to report pain intensity due to altered level of consciousness. 10% of survey respondents had no analgesia options available to them 80% had opioids available, 78% carried morphine	Survey included helo providers Types of analgesia available to providers Different EMS system – some first aiders, some Drs in the mix

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
McEachin, et al	2002	R			✓	Frequency of analgesia administration for hip fracture and lower limb fracture	Adults Lower limb fractures Hip fractures n=124 Data collection over 4mths E: <18yo, ankle fractures, multi-trauma pts, no fracture	16% were seen by BLS ambulance. 38% seen by ALS ambulance. 18% total rec'd prehospital analgesia, more likely to have lower limb fracture. 69% female, mean age 74yrs. 83% rec'd ALS response, , 38% rec'd BLS transport. 62% had hip fractures. 91% rec'd analgesia in ED, 70% before X-ray.	Ankle fracture pts often transported to a different hospital, hence reason for exclusion. Initial response is ALS, pts may be triaged down to BLS – how many in this category, this would affect analgesia rates? ALS options morphine and meperidine. Low analgesia rates in prehospital setting cf ED. Value of analgesia placed by paramedics? In MI time is muscle, what is the benefit for trauma pts? Predominantly white pts.
McEachin, et al	2004	P		✓ VDS??	✓	Telephone survey post-injury about prehospital pain levels and pain management 5/12 period.	n=110 Telephone survey patient's perspective	n=110. 81% stated in telephone interview 18hrs post EMS arrival they had mod-severe pain. 23% rec'd parenteral analgesia, with 50% having some reduction in pain	Not sure how pain was assessed, presumably verbal descriptor scales? 76% of patients who didn't receive analgesia self-reported mod-severe pain, 63% didn't realise EMS were able to administer it Doesn't mention crew skill-mix in regards to analgesia options.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
McLean, et al	2004	R		✓ VDS VNRS *		Feasibility of pain assessment in prehospital setting	Adults >13yrs n=1227 Data collected over 3 months in 2 week blocks 1:4 run sheets (systematic sampling) Patients >13 yrs Exluded from sample if dead on scene, discharge from hospital, interhospital transfer, or clinic transport	31% had mod-severe pain (4/10 +) 1:3 pts >75 yrs 84% pts conscious 20% had VDS, nil NRS. No pain assessment due to altered level of consciousness in 39% of this group.	Initially 0-100 but ED & paramedic staff more familiar with 0-10, so changed All ALS crew. Absence of pain defined as global absence of pain cf focal absence (eg nil neck pain)
Meisel, et al	2010	R			✓	Gender Adherence to protocol	Adults >30yrs Chest pain Data collection 12 mths E: pts transported by BLS crews n= 342 women n=341 men Randomised cohort study of pts with chest pain E: known allergy to aspirin or GTN, hypotensive, use of drugs for erectile dysfunction in past 24 hrs,	Median age 54yrs 32% men rec'd aspirin cf 24% women 33% men rec'd GTN cf 26% women 80% men rec'd IV access cf 69% women No differences between white and other ethnicities	Only ALS crewed ambulance pts studied Pain measured? Accuracy of diagnosis? Accuracy of hx gathered by paramedics and diagnosis?

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Michael, et al	2007	R			✓	Morphine	All ages. Isolated suspected extremity fractures, dislocation laceration, n=983 Data collected over 12mths E: pts with head trauma, altered mental status, BP<90mmHg, no other obvious head / chest / abdominal injury. Compared with census data / median area income	29% rec'd morphine (32% males, cf 26% female) Logistic regression found persistent link between sex and analgesia	Data collected included: pt age, ethnicity, sex, initial pain score NRS, time with EMS, IV morphine administration. Standing order for IV morphine, IM if no IV access. Doesn't include non-drug tx such as splinting, dressing, etc. Did not record refusal of analgesia to account for low analgesia administration rates.
Middleton, et al	2010	R		VNRS	✓	Morphine IV Fentanyl IN Methoxyflurane Comparison of effectiveness of analgesia	Data collected over 35mths n=52046 pts Ages 16-100yrs Pain score ≥ 5/10	Morphine 81% effective Fentanyl 80% effective Methoxyflurane 59% effective 30% rec'd morphine 8% rec'd fentanyl 44% rec'd methoxyflurane 16% rec'd combo of more than 1 analgesia Mean pain scores 8.3 for all except pts receiving multiple analgesics 8.9 Morphine, fentanyl given for 40% trauma pts (majority). Methoxyflurane given for 27% abdominal pain pts Combo given to 60% trauma pts	Effectiveness was >30% reduction in pain score Paramedics could administer methoxyflurane, ICP could use morphine, selected paramedics could use IN fentanyl. IN fentanyl introduced 27mths into study. Time stopped if pt contact time >240mins. Low fentanyl rate due to late introduction into service? Only half the pts had a pain score taken.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Ricard-Hibon, et al	1999	P		✓ VAS VDS (0-4)	✓	Pre-test survey of pain assessment and tx. Post-test after education session and introduction of morphine.	Adults >10yrs n=108 (pre) n=105 (post) Data collected over 8 months	42% had pain 75% completed VAS, failures d/t too old, not understanding instructions, language barrier Relief from pain 47% pre, 67% post No analgesia rec'd 36% pre, 7% post	Dr on crew, first study using own analgesia options, then post education. Pain considered clinically significant if >3/10 or 3 on VDS Pain score at first contact with pt, then on arrival at hospital.
Rickard, et al	2007	P		NRS	✓	Fentanyl IN Morphine IV Effectiveness to baseline NRS	Adults Australia Randomised controlled open-label trial to either receive IN fentanyl or IV morphine according to study protocol. n=258 VNRS >5/10 cardiac pain post GTN tx, or V >2/10 noncardiac pain ("severe" pain) E: protocol based, hypoxia, hypotension, abnormal HR, GCS <15, vomiting, known allergy, opiate use in past 24 hrs, unable to provide VNRS. n=122 IV morphine, 9 protocol violations n=136 IN fentanyl, 4 protocol violations	Mean VNRS 8.2 prior to analgesia for both groups. Didn't get planned sample of 400 in study period of 18mths. IN fentanyl quicker to administer than IV morphine (by 2 mins on average). Little difference between IN fentanyl and IV morphine in baseline VNRS scores. Mean reduction in VNRS 8 to 4 for both cohorts. 25% of IN fentanyl and 32% if IV morphine rec'd rescue analgesia. Back pain pts seemed to respond better to IN fentanyl with pain scores reducing by 2 points more than IV morphine.IN Fentanyl pts had double rate of adverse effects cf IV morphine.	Set in Australia, multi-centre trial Rural Ambulance Victoria and South Australia Ambulance Service. Each ambulance staffed by paramedic and ICP. Distinction between 5/10 cardiac and 2/10 noncardiac – considering it severe? Rescue analgesia available for both groups if pain >3/10 Pts with noncardiac pain also allowed methoxyflurane. Time to administration. 7% pts unable to receive IV morphine due to cannulation probs, 2% further cannulated with difficulty. 3% refused morphine (? Needles or drug aversion)

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Rittenberger, et al	2005	R		✓ OPQRST	✓	Adherence to chest pain protocol (documentation)	Adults >18 yrs. Data collected over 5mths. Non-traumatic chest pain, requiring transport n=300, 75 cases from 4 different ambulance services. 3 urban, 1 rural.	Onset 64% Provoke 29% Palliation 20% Quality 53% Region 66% Radiation 65% Scale 51% Severity 51% Time 14%	Investigating errors of omission by paramedics in tx of chest pain. Found significant deviations in protocol, and inadequate documentation. Included in data collection was heart sounds, bilateral pulses, are these routinely taught? BLS & ALS crew mixes Av response time 6 mins, on scene time 21 mins, transport 13.5 mins
Rogovik, et al	2007	P		Wong Baker 3-6yo VAS 7yo +	✓	Analgesia administered out of hospital by and EMS Fracture pts receive more prehospital analgesia than soft tissue injury pts?	Children 3-18yrs Fracture limb and clavicle Soft-tissue injuries n=310 Canada. Data collected over 7 mths. 0900-2300hrs every day.	78% had prehospital analgesia, 73% of these rec'd first aid, 37% rec'd medication. 90% pts reported pain, 60% mod-severe pain. Prehospital analgesia given sooner for fractures than STI (5 vs 15 mins). Children <6yo rec'd more pharmacological analgesia (esp acetaminophen), shorter times to analgesia, greater first aid given by family prior to ED.	Included transports by ambulance in data collection, but small numbers (total 5%, fracture group 7%, soft tissue injury 1%) Doesn't record accuracy / failure of pain scores.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Rothrock, et al	2001	R			✓	Gender differences in treatment of acute chest pain	> 45 yrs Non-traumatic chest pain n=2853, 53% women Data collection 12 months. Data recorded chief complaint, rate of transport refusal, age, ethinicity, sex, oxygen, nitroglycerin, aspirin, narcotic administration	Males more likely to receive aspirin 42% cf 35% females, ECGs 46% vs 39%. No differences in transport refusal, oxygen administration, narcotic administration, application of cardiac monitor, nitroglycerin administration	Females older than males Chief complaint is chest pain, but females present with different complaints, not necessarily chest pain, vague sx, especially with older pts, gastrointestinal sx, back pain, fatigue, dyspnoea, more likely to downplay sx. Study doesn't explain lower aspirin rates or 12 lead rates
Silfvast, et al	2001	P		50mm VAS	✓	Morphine Alfentanil Comparison between the two.	Adults Myocardial ischaemic pain n=40 Helsinki, Finland Randomised double blind I: ischaemic chest pain >30 mins, BP >80mmHg, HR >50/min, ECG ischemic changes but not MI.	20 pts rec'd morphine 16 pts rec'd alfentanil Pts rec'g alfentanil reported quicker relief and lower pain scores than morphine pts. 4 pts experienced side effects of dizziness and nausea cf morphine group had 1 pt experience fatigue. Analgesia effects appeared to wear off quicker in the alfenatil group than the morphine group.	2-tiered system, EMTs respond first, give O2 and GTN, backed up by Dr who does the rest. Shorter VAS than standard… Short followup period (T0 – T15mins), did not want to remain on scene to continue monitoring… could this not continue during transport?
Svenson, et al	2007	R			✓	Ketamine	Aeromedical transport Children Adults n=40 Data collection 42 mths (3.5yrs)	23 pts trauma, 4 burns, 4 cardiac, 9 other medical 12 pts needed repeat doses of ketamine 4 pts rec'd IM ketamine, remainder IV	Authors report no adverse effects, but don't define these. Eg dissociative state considered an adverse effect or not? No analysis of effectiveness

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Swor, et al	2005	R			✓	Morphine IV Meperidine IV	Children < 21 yrs cf adults with same injuries, and analgesia rates Extremity fracture Burns Data collection 6 mths n=73 E: >21yrs, multiple trauma, interfacility transfer	67% male Mean age 12 yrs 21% pts rec'd prehospital analgesia 79% rec'd analgesia in ED 35% fractured tib/fib 29% due to sports injury 21% children rec'd prehospital analgesia cf 26% adults (comparison group)	Data collected from ED records with confirmed diagnosis of extremity fracture or burn. Analgesia options only IV. No pain scoring No assessment of analgesia effectiveness
Vassiliadis, et al	2002	R			✓	Methoxyfluran e Morphine IV	Adults Fractured NOF (or suspected) n=176 Data collection 11 mths E: fractured NOF sustained in hospital, admitted directly to ward or interhospital transfer, no ASNSW run report in clinical records, arrival in ED with private transport	69% clinical diagnosis # NOF 49% no analgesia given Pts triaged higher / treated quicker in ED if analgesia given 93 female, 35 male Median age 82yrs Prehospital analgesia directly influenced pts receiving a higher triage category in ED.	No pain scores so dependent on description of pain as mild, moderate, severe. Varying BLS, ALS providers 58% paramedic, 21% ALS with IV opioids (5% rec'd opioids Contraindications, allergies, other meds etc not considered in data analysis.

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
Watkins	2006	P			✓	Entonox Morphine IV	Children 5-15yo. n=45 Limb fracture Burn Auckland, New Zealand Data collected over 2 mths Questionnaire to AOs and Paramedics about tx of burns, fractures and factors influencing decision to give analgesia n=115 (28 paramedics able to give morphine) I: minor isolated injury Triage nurse assessed pain, adequacy of tx for burn or fracture (eg splinting, dressing) Automatically in pain if triage nurse deemed so, or Dr prescribed IV analgesia Data collected included ambulance on scene times	34/37 fractures adequately treated; 4/8 burns adequately treated – at triage No pts <5yo rec'd analgesia, but 7/10 pts were deemed to be in pain at triage. 51% pts >5yo rec'd analgesia, 54% were deemed to be in pain at triage. Of children > 5yo: 9/17 rec'd no analgesia but were in pain at ED triage. 8/10 given entonox but in pain on arrival at triage 2/8 given morphine but in pain at ED triage Survey: 72% respondents were in favour of having paracetamol elixir 45% response rate overall, 82% of morphine qualified officers Scene delays of 7 mins for entonox, 13 mins for morphine… 52% paramedics concerned about pain of injection vs injury pain.	Triage nurse made judgement about degree of pain and effectiveness of dressing / splint. Criteria not set out by author Perceptions from paramedic about morphine use vs actual use differ (like Hennes et al found out) Scene delays – due to tx of fracture / burns too?

Author	Year	Method	Pain prevalence	Pain assessment	Pain management	Interventions	Population	Results	Comments
White, et al	2000	R			✓	Morphine IV Nitrous oxide	Adults Children Suspected extremity fractures n=1073 Data collection 13 mths	17% rec'd ice packs 16% rec'd bandage / dressing 25% rec'd air splint 1.8% rec'd analgesia (16 nitrous oxide, 2 morphine) = 1.6% entonox, 0.2% morphine 20% fractured leg On scene time 10 mins longer for those receiving analgesia Mean on scene time 23 mins	Single agency Protocols don't permit analgesia for: altered LOC, alcohol / drug use, allergy to nitrous oxide or morphine, hypotension, head injury, chest injury with suspected pneumothorax, abdo pain with possible bowel obstruction, symptomatic asthma, COPD or respiratory distress. No pain scores abstracted. 2-tier EMS system, analgesia administration would need backup, and increase job time / on scene time. Medics need to exchange nitrous oxide cylinder in a different part of the city, making cylinder changes difficult (increased time out of service)

Appendix B: Ethics application approval

MEMORANDUM

Auckland University of Technology Ethics Committee (AUTEC)

To:	Jane Koziol-McLain
From:	**Madeline Banda** Executive Secretary, AUTEC
Date:	26 November 2010
Subject:	Ethics Application Number 10/269 **Current pain measurement and pain alleviation practices of ambulance officers in Auckland.**

Dear Jane

I am pleased to advise that the Auckland University of Technology Ethics Committee (AUTEC) approved your ethics application at their meeting on 8 November 2010. Your application is now approved for a period of three years until 8 November 2013.

I advise that as part of the ethics approval process, you are required to submit to AUTEC the following:

- A brief annual progress report using form EA2, which is available online through http://www.aut.ac.nz/research/research-ethics/ethics. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 8 November 2013;
- A brief report on the status of the project using form EA3, which is available online through http://www.aut.ac.nz/research/research-ethics/ethics. This report is to be submitted either when the approval expires on 8 November 2013 or on completion of the project, whichever comes sooner;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are reminded that, as applicant, you are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

Please note that AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to make the arrangements necessary to obtain this. Also, if your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply within that jurisdiction.

When communicating with us about this application, we ask that you use the application number and study title to enable us to provide you with prompt service. Should you have any further enquiries regarding this matter, you are welcome to contact Charles Grinter, Ethics Coordinator, by email at ethics@aut.ac.nz or by telephone on 921 9999 at extension 8860.

On behalf of the AUTEC and myself, I wish you success with your research and look forward to reading about it in your reports.

Yours sincerely

Madeline Banda
Executive Secretary
Auckland University of Technology Ethics Committee

Health and Disability Ethics Committees

5 October 2010

Northern X Regional Ethics Committee
Ministry of Health
3rd Floor, Unisys Building
650 Great South Road, Penrose
Private Bag 92 522
Wellesley Street, Auckland
Phone (09) 580 9105
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Postal:
Private Bag 92 522
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(09) 580 9063
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cheh_chua@moh.govt.nz

Ms Sarah Werner
St John Clinical Education Unit
Private Bag 14902
Panmure
Auckland 1741

Dear Sarah

Re: Ethics ref: **NTX/10/EXP/188** (please quote in all correspondence)
Study title: Current pain measurement and pain alleviation practices of ambulance officers in Auckland
Investigators: Ms Sarah Werner
Supervisor: Prof Jane Koziol-McLain

Thank you for your application received 30 September 2010. The above study has been given ethical approval by the Deputy Chairperson of the **Northern X Regional** Ethics Committee under delegated authority.

Approved Documents

- Protocol number [undated, received 30/9/10]
- Data collection form [undated, received 30/9/10]

This approval is valid until **5 April 2011**.

Amendments and Protocol Deviations

All significant amendments to this proposal must receive prior approval from the Committee. Significant amendments include (but are not limited to) changes to:

- the researcher responsible for the conduct of the study at a study site
- the addition of an extra study site
- the design or duration of the study
- the method of recruitment
- information sheets and informed consent procedures.

Significant deviations from the approved protocol must be reported to the Committee as soon as possible.

Final Report

A Final Report is required at the conclusion of the study. The Final Report Form is also available at www.ethicscommittees.health.govt.nz. If the study is ongoing, a progress report is required by **5 April 2011.** The same form can be used as the final report form found at the website.

We wish you all the best with your study.

Yours sincerely

Cheh Chua-Ethics Committees
Administrator
Northern X Regional Ethics Committee
Email: cheh_chua-ethics_committees@moh.govt.nz

St John
first to care

7 September 2010

Sarah Werner
Clinical Education Tutor
St John

125 years 1885-2010

Dear Sarah

Re: Your Planned Thesis on Pain Assessment and Management by Ambulance Officers

We have reviewed your plans and we support you undertaking your thesis. We wish you all the best with it.

Yours sincerely

Tony Smith
Medical Advisor
Northern Region

Murray Holt
Regional Operations Manager
Northern Region

THE ORDER OF ST JOHN

ASB Working Together

2 Harrison Road, Mt Wellington, Auckland.
Private Bag 14902, Panmure, Auckland.
T 09 526 0528 F 09 526 0592 W www.stjohn.org.nz

Sarah Werner
c/- St John Clinical Education
8 Harrison Road
Mt Wellington
Auckland

Kia Ora Sarah,

On behalf of Te Roopu o Te Waka Kawe e Turoro o Hato Hoane, I would like to advise you that we are more than happy with your research project and the inclusion of Te Ao Maori where possible in your study.

If you require any further input please feel free to contact me.

Naku Noa

Carlton Irving
On Behalf of Te Waka Kawe e Turoro
3 Cooper Ave
Rotorua
0275222286

Appendix C: Data dictionary

Response data	Type of data	Coding explanations
Patient record #	Ordinal	Patient number based on data abstraction of 55 PRFs per day over a 7 day period
Date	Date	dd:mm:yy Record from PRF
Times		
Dispatch time	Date	hh:mm Time of ambulance dispatch, based on mobile data terminal times Missing data on PRF may sourced from Computer Aided Dispatch system
Located time	Date	hh:mm Time of ambulance arrival on location, based on mobile data terminal times 99:00 Time missing. Missing data on PRF may sourced from Computer Aided Dispatch system
Departed time	Date	hh:mm Time ambulance departed the scene, based on mobile data terminal times 99:00 Time missing. Missing data on PRF may sourced from Computer Aided Dispatch system
At Destination	Date	hh:mm Time ambulance arrives at destination, based on mobile data terminal times 99:00 Non-transport of patient. Missing data on PRF may sourced from Computer Aided Dispatch system
Status	Nominal	Patient acuity status, abstract from 'Scene' status 0= deceased 1= critically ill 2= unstable 3= potentially unstable 4= stable 7 = not applicable, relates to patient transfers / discharge from hospital / transfer to rest home / private hospital where a full PRF is not completed ie. Patient Transfer Service (PTS) cases, e.g. assistance with lifting or moving a patient. Also includes false alarm callouts, e.g. accidental personal alarm activation. Missing data on PRF may sourced from Computer Aided Dispatch system

Transport	Nominal	0= transport to DHB hospital eg APH / APHED, Starship, WHED, MMH / MMED, Kidz First ED, NSHED / NSH 1= transport to accident and medical clinic (A&M) 2= GP referral or follow up: GP is contacted by crew, patient either taken to GPs or arranged for GP to see patient 3= Not transported, the patient travels to seek medical attention by private car, with family or friends 4= Not transported, due to minor injury or illness. Crew may provide on-scene treatment but transport to seek medical advice not indicated. Follow-up advice may include the option of seeking further medical advice if problems arise. 5= Refused; the patient refuses assessment, treatment and / or transport, even if recommended by ambulance crew on scene. 6=Private hire 7=Deceased 8=Accidental personal alarm activation Missing data on PRF may sourced from Computer Aided Dispatch system
Crew data 1	Nominal	Qualification based on PRF, 1st name 0= Student / observer 1= Primary care 1 (PC1 or PC2) 2= Basic life support officer / Ambulance officer / EMT (AO or EMT) 3= Basic life support paramedic / Paramedic / BLS paramedic (P) 4= Intermediate life support officer / Paramedic upskill / ILS officer (PU, UP, ILS) 5= Advanced life support officer / Advanced paramedic / ALS officer (AP, ALS) 6= Doctor (DR) Missing data on PRF sourced from Computer Aided Dispatch system
Crew data 2	Nominal	Qualification based on PRF, 2nd name 0= Student / observer 1= Primary care 1 (PC1 or PC2) 2= Basic life support officer / Ambulance officer / EMT (AO or EMT) 3= Basic life support paramedic / Paramedic / BLS paramedic (P) 4= Intermediate life support officer / Paramedic upskill / ILS officer (PU, UP, ILS) 5= Advanced life support officer / Advanced paramedic / ALS officer (AP, ALS)) 6= Doctor (DR) 9= none Missing data on PRF sourced from Computer Aided Dispatch system

Crew data 3	Nominal	Qualification based on PRF, 3rd name 0= Student / observer 1= Primary care 1 (PC1 or PC2) 2= Basic life support officer / Ambulance officer / EMT (AO or EMT) 3= Basic life support paramedic / Paramedic / BLS paramedic (P) 4= Intermediate life support officer / Paramedic upskill / ILS officer (PU, UP, ILS) 5= Advanced life support officer / Advanced paramedic / ALS officer (AP, ALS) 6= Doctor (DR) 9= none Missing data on PRF sourced from Computer Aided Dispatch system
Gender	Nominal	As per PRF: 0=male 1=female 9= not documented.
Patient demographic data		
Age	Interval	As per PRF. If less than 1yr old, use months Y =years M= months W = weeks 999= not documented. Ambulance crews may not be able to ascertain age in unidentified patients with altered level of consciousness.
Ethnicity	Nominal	As per PRF: 1= Maori 2= Pacific Island 3= Other 4= Not stated 9 = Not documented
Trauma	Nominal	0= No. The cause appears to be medical in origin. 1= Yes. A case is considered to be trauma if an ACC number is recorded on the PRF. Trauma includes abuse, accidents, sprains, assault, burns, road traffic crash (RTC), poisonings, fractures, dislocations, lacerations, concussion. The PRF may record the words suggestive of mechanism of injury (MOI) such as fall, trip, slip, road traffic crash (RTC). If the injury is over 24 hours old or the patient is not transported, an ACC number may not be generated, but can still be recorded as trauma if the history suggests such. 9= Not documented. This can include painful conditions where the cause is not clearly traumatic or non-traumatic in origin.

GCS	Nominal	Glasgow Coma Score recorded as per initial GCS on PRF 777=Not applicable. GCS not recorded in PTS cases. 999= Not documented
Chief complaint	Nominal / string	The chief complaint as written in this section of the PRF. Additional information may be found in comments. Prefix with the following as applicable: R35= Patients not transported. GP= GP referral Fever= Patients with a recorded temperature ≥38 deg C.
Presence of pain	Nominal	Data recorded from PRF. 0= No on self report. The patient denies presence of pain or discomfort, and is documented on PRF. This includes the use of pertinent negatives BUT if presence of pain noted elsewhere, YES should be documented 1= Yes on self report. The patient complains of pain or discomfort, and is documented on the PRF 2= Yes on crew assessment. Patient is not complaining of pain, but crew have documented patient appears to be in pain or discomfort 3= No on crew assessment. Patient may or may not be complaining of pain, but crew have documented that the patient appears to be in no pain. 7= Not applicable e.g. PTS cases, deceased, ambulance not required. 9= Presence or absence of pain is not documented on the PRF
Location of pain	Nominal	If pain present in more than one body part, refer to patient's chief complaint on PRF 1= Head / neck 2= Chest 3= Abdomen/pelvis 4= Back 5= Extremities 7= Not applicable e.g. no pain, or PTS transfer 9= Not documented
Pain score	Interval	Pain score (initial) if documented on PRF 777 = Not applicable e.g. no pain, or PTS transfer 999 = Not documented
OPQRST – Onset	Nominal	Activity at time of onset of pain, what were your doing when the pain began? 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented

OPQRST – Provoke	Nominal	What worsens the pain, activity, rest, eating, movement? 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented
OPQRST – Quality	Nominal	Description of pain or pain equivalent words; ache, burn, discomfort, hurt, sharp, dull, heavy, crushing, tearing, shooting, stiffness, tightness, pressure, comes and goes, peristaltic, colicky, undulating, intermittent. Pain described as itching, dizziness, parathesia, weakness are NOT classified as pain 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented
OPQRST – Radiation	Nominal	Pain travels to, radiates, or non-radiating. In association with description of body part 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented
OPQRST – Severity	Nominal	Pain is categorised as mild, moderate, severe, unbearable, 0-10 scale, description of Wong-Baker faces scale. Denies pain, no pain, nil pain are described as 'no pain' if there is no recording of pain / discomfort on the PRF elsewhere 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented
OPQRST – Time	Nominal	Mins, hours, days, where pain is described in a measureable time interval or time range 1= documented 7= Not applicable e.g. denies pain, or PTS transfer, or deceased 9= Not documented
Duration	Nominal	Based on description in PRF 1= 0-6 hrs 2= >6 -12 hrs 3= >12 – 24 hrs 4= >24 hrs – 7 days 5= >7 days 7 = Not applicable e.g. no pain, or PTS transfer, deceased 9= not documented

No pain assessment	Nominal	Reasons for possible non-pain assessment documented. 1= Refused 2= Functional or organic impairment 3= Unable to understand English 4= Non-verbal e.g. Responsive person but unable to communicate e.g. preverbal child, aphasia or dysphasia 9= Reason not documented
Analgesia prior to ambulance arrival	Nominal	0= No 1= Yes, analgesia administered prior to ambulance arrival e.g. by GP, self-administered, family, first responder 7= Not applicable 9= Not documented
Entonox	Nominal	If administered: 0= No 1= Yes 7= Not applicable e.g. no pain, or PTS transfer, deceased 9= Not documented accurately
Paracetamol	Ordinal	If administered, document total dose in mg 0= No 7= Not applicable e.g. no pain, or PTS transfer, deceased 9= Not documented accurately
Methoxyflurane	Ordinal	If administered, document total dose in mg 0= No 7= Not applicable e.g. no pain, or PTS transfer, deceased 9= Not documented accurately
GTN initial dose	Ordinal	If administered, document initial dose in mg 0= No 7= Not applicable e.g. no pain, or PTS transfer, deceased 9= Not documented accurately
GTN total dose	Ordinal	If administered, document total dose in mg 0= No 7= Not applicable e.g. no pain, or PTS transfer, deceased 9= Not documented accurately
Morphine IM initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Morphine IM total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Morphine IV initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately

Morphine IV total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Ketamine PO initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Ketamine PO total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Ketamine IV initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Ketamine IV total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Midazolam IM initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Midazolam IM total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Midazolam IV initial dose	Ordinal	If administered, document initial dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately
Midazolam IV total dose	Ordinal	If administered, document total dose in mg 0= No 777= Not applicable e.g. no pain, or PTS transfer, deceased 999= Not documented accurately

Analgesia declined	Nominal	Was analgesia offered and patient has refused or declined analgesia (and documented on PRF)? 0= No. Use if analgesia administered on PRF, indicating patient did not decline analgesia. 1= Yes. Use if 'patient declined' or 'patient refused' analgesia noted on PRF. 7= Not applicable e.g. no pain, or PTS transfer 9= Not documented accurately, unable to determine if patient offered and declined analgesia from PRF.
Ice or cold pack	Nominal	If documented on PRF, the application of cold or ice pack 0= No 1= Yes
Heat	Nominal	If documented on PRF, the application of heat or ice pack 0= No 1= Yes
Splint	Nominal	If splint or immobilisation of injured body part is documented on PRF. Does not include the application of a rigid cervical collar post-injury 0=No 1= Yes
Dressing	Nominal	If dressing or bandage is applied to injured body part and is documented on PRF. 0= No 1= Yes
Positioning	Nominal	If sling applied, or patient is positioned in a position to reduced pain, and is documented on PRF. 0= No 1= Yes
Distraction	Nominal	If distraction is used as a means to reduce pain or anxiety and is documented on PRF 0= No 1= Yes
Reassurance	Nominal	If reassurance is used as a means to reduce pain or anxiety and is documented on PRF 0= No 1= Yes
Pain score post-treatment	Interval	Pain score (final) if documented on PRF 777 = Not applicable e.g. no pain, PTS transfer, deceased, false alarm activation, patient not transported 999 = Not documented, but patient transported.
Response time	Date	Located time – response time hh:mm Time difference between responding and arriving at incident location
On scene time	Date	Depart time – located time hh:mm Time spent on location prior to ambulance departure from the incident

Transport time	Date	At hospital – depart time hh:mm Time difference between time incident location departed from, and arrival at hospital
Age_cat	Ordinal	1= under 16 years old 2= 16-64 years old 3= over 64 years old
Crew_hi		Calculates highest qualified officer on crew 1= Primary care 2= Basic life support officer 3= BLS paramedic 4= Intermediate life support officer 5= advanced life support officer
Pain_assess_cat	Nominal	Converts pain presence variable to a single option, inidicating that pain has either been assessed as being present or not. 0= presence of pain not assessed. Patient denies pain on self-report, considered No pain on crew assessment, Not applicable e.g. PTS transfer, accidental alarm activation or Not documented. 1= presence of pain assessed; Yes if any
Pain_presence_cat	Nominal	Converts pain presence variable to a single option 0= Patient denies pain on self-report, No pain on crew assessment, Not applicable e.g PTS transfer, accidental alarm activation, or Not documented 1=

Appendix D: Data abstraction form

Data (record data in this column)	**Options**	**Coding**	**Actual code**
Patient record #			
Date		dd:mm:yy	
Response data	Times		
	Dispatch	hh:mm 99:00 missing	
	Located	hh:mm 99:00 missing	
	Departed	hh:mm 99:00 missing	
	At destination	hh:mm 99:00 missing	
Status	Deceased Critically ill Unstable Potentially unstable Stable Not applicable / PTS	0 1 2 3 4 7	
Transport	Transport ED Transport A&M clinic GP referral or follow up Not transported, private car Not required, minor injury or illness Refused Private hire / PTS transfer Deceased Accidental alarm activation	0 1 2 3 4 5 6 7 8	
Crew data *(crew 1 is treating officer)* ▪ Crew 1 ▪ Crew 2 ▪ Crew 3	Student / observer Primary care 1 Ambulance officer / EMT Paramedic / BLS paramedic Paramedic upskill / ILS officer Advanced paramedic / ALS officer Doctor None	0 1 2 3 4 5 6 9	
Gender	Male Female Not documented	0 1 9	
Age	Years Months Weeks Not documented	As per PRF Y= years, M= months, W= weeks 999	Y / M / W
Ethnicity	Maori Pacific Island Other Not stated Not documented	1 2 3 4 9	
Trauma	No Yes Not documented	0 1 9	

Data (record data in this column)	**Options**	**Coding**	**Actual code**
GCS (total score)	As per initial GCS on PRF Not applicable Not documented	As per PRF 777 999	
Chief complaint		As per PRF	
Presence of pain	No on self report Yes on self report Yes on crew assessment No on crew assessment Not applicable Not documented	0 1 2 3 7 9	
Location of pain	Head / neck Chest Abdomen / pelvis Back / Flank Extremities Not applicable Not documented	1 2 3 4 5 7 9	
Pain score / 10	Initial pain score Not applicable Not documented	As per PRF 777 999	
PQRST – onset	Yes N/A Not documented	1 7 9	
PQRST – provoke	Yes N/A Not documented	1 7 9	
PQRST – quality	Yes N/A Not documented	1 7 9	
PQRST – radiation	Yes N/A Not documented	1 7 9	
PQRST – severity	Yes N/A Not documented	1 7 9	
PQRST – time	Yes N/A Not documented	1 7 9	
Duration	0-6 hrs >6-12 hrs >12-24 hrs >24 hrs – 7 days >7 days N/A Not documented	1 2 3 4 5 7 9	
Reason for no pain assessment	Refused Functional or organic impairment Unable to understand English Other … Not applicable Not documented	1 2 3 4 7 9	

Data (record data in this column)	**Options**	**Coding**	**Actual code**	
Analgesia prior to ambulance arrival	No Yes N/A Not documented	0 1 7 9		
Entonox	No Yes N/A Not documented	0 1 7 9		
Paracetamol (dose in mg)	No Yes N/A Not documented	0 Dose in mg 7 99		
Methoxyflurane (dose in ml)	No Yes N/A Not documented	0 Dose in ml 7 9		
GTN initial (dose in mg). GTN total (dose in mg).	No Yes N/A Not documented	0 Dose in mg 7 9	Init.	Total
Morphine IM initial (mg). GTN total (dose in mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Morphine IV initial (mg) Morphine total (dose in mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Ketamine PO initial (dose in mg) Ketamine PO total (dose in mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Ketamine IV initial (mg) Ketamine IV total (mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Midazolam IM initial (dose in mg) Midazolam IM total (dose in mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Midazolam IV initial (dose in mg) Midazolam IV total (dose in mg)	No Yes N/A Not documented	0 Dose in mg 777 999	Init.	Total
Analgesia declined	No Yes Not applicable Not documented	0 1 7 9		
Ice /cold	No Yes	0 1		
Heat	No Yes	0 1		

Data (record data in this column)	**Options**	**Coding**	**Actual code**
Splint	No Yes	0 1	
Dressing	No Yes	0 1	
Positioning	No Yes	0 1	
Distraction	No Yes	0 1	
Reassurance	No Yes	0 1	
Pain score / 10	Last pain score Not applicable Not documented	As per PRF 777 999	
Notes			

888 = Missing / illegible data: data is unable to be interpreted.

777 = Not applicable: patient is not in pain, or Patient Transfer Services case where no PRF is completed, other than for billing purposes.