

## ORIGINAL RESEARCH

**THE INFLUENCE OF PARAMEDIC QUALIFICATION LEVEL ON THE ADMINISTRATION OF ANALGESIA IN THE PREHOSPITAL SETTING**Bill Lord PhD<sup>1\*</sup>, Toby Keene MPH<sup>2,3</sup>, Cassie Luck BParamedicSc<sup>4</sup>

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**Abstract****Background**

Under treatment of pain has been reported in the paramedic literature, and reasons for these disparities are not well understood.

**Aims**

As the qualification level of the paramedic may affect analgesia administration, the primary aim of this study was to determine the impact of paramedic qualification on the provision of any analgesia for patients reporting pain.

**Methods**

Retrospective study of de-identified patient care records from one Australian ambulance service over a period of 6 months. Inclusion criteria were age was > 17 years, initial pain severity score was > 3/10 and Glasgow Coma Score >13. Paramedics in this setting can administer inhaled methoxyflurane, intravenous/intramuscular morphine sulphate or intranasal fentanyl for pain depending on level of qualification - Ambulance Paramedic (AP) or Intensive Care Paramedic (ICP). Data were descriptively analysed for analgesia administration and type of analgesic by predictor variables: age, sex, pain score and case nature. Pearson's chi-square test was used to test for associations between the outcome of interest and predictor variables. Adjusted logged odds of patients receiving analgesia was tested with binomial logistic regression.

**Findings**

3173 patient records met the inclusion criteria. ICP treated 86% of the sample population. Of those treated by an AP, 76.2% (n=340) received analgesia, whereas 71.6% (n=1952) of patients treated by an ICP received analgesia (p=0.042). Methoxyflurane was the most frequently administered analgesic, with 39.9% of the patients (n=1,264) receiving this agent; 31.1% of patients (n=988) received morphine, and 14.2% (n=452) received fentanyl. The unadjusted regression model found that AP have higher odds of administering analgesia than ICP paramedics (OR 1.264, p <0.05). However, once other covariates are included in the logistic regression, the significance no longer exists.

**Conclusion**

Paramedic qualification is not associated with the administration of analgesia in this setting. This study contributes to the gap in knowledge regarding disparities in analgesia for adults experiencing pain and may inform future research that aims to identify and reduce barriers to appropriate pain management in the paramedic practice setting.

**Keywords:** analgesia; pain management; paramedic; emergency medical service

## Introduction

Access to pain relief is considered a basic human right.(1) In addition to the humanitarian foundation for the management of pain, the early alleviation of acute pain has long term benefits that include a reduced odds of long term sequela such as chronic pain.(2) Pain is a frequently reported symptom in the paramedic practice setting, and as such the effective management of pain is an important component of practice.(3, 4) Pain relief has been identified as an important outcome measure for Emergency Medical Service (EMS) providers,(5) and evidence-based guidelines have been developed that addresses the importance of recognizing, assessing, and treating pain.(6, 7)

Options for alleviating pain are typically prescribed by paramedic clinical practice guidelines, and although paramedic education, qualification and scope of practice will determine the range of analgesic options available, all paramedics providing emergency care in Australia are able to manage pain through pharmacological and non-pharmacological means. Despite this, the under-treatment or non-treatment of pain has been reported in the prehospital literature.(8) Factors affecting pain management span domains of knowledge, experience, communication, organizational aspects and attitudes, (9) with the latter including paramedics' suspicions of drug seeking as a reason for reporting pain.(10, 11) Patient factors may also affect a paramedic's decision to provide analgesia with one study finding women were less likely than men to receive analgesia for isolated limb injuries.(12) Despite this, causes of observed disparities in paramedic pain management practice remain poorly understood.

In Australia, the term paramedic refers to professional staff (as opposed to volunteers and first responders) employed to provide emergency health care by the statutory provider of Emergency Medical Services in each state and territory. There are also paramedic specializations such as critical care, intensive care and flight paramedic. The scope of practice for each is designed to deliver care to high acuity or special needs populations. As with other health professionals, paramedics provide varying degrees of clinical care according to their training and approved scope of practice. In Australia, paramedics have only been registered health professionals since December 2018. However, scope of practice is not determined by the national regulator but instead determined by their employer based on local governance practices.

Ambulance services in Australia generally attempt to triage requests for assistance such that higher levels of clinical practitioner see the most unwell patients. Thus, more highly qualified paramedics may be more likely to provide analgesia due to their increased exposure to high acuity patients. Although the level of certification and the experience of the paramedic may influence pain management decisions, there is limited evidence of the influence that scope of paramedic clinical practice has on pain management practice. A better understanding of how the different levels of paramedic practice influence the administration of analgesia will inform education and clinical practice. As such, the primary aim of this study was to determine the impact of paramedic scope of practice - referred to as "paramedic qualification" in this study - on the provision of analgesia for patients reporting pain, with a secondary aim the identification of patient and case type factors that may be associated with analgesia administration.

## Materials and methods

### *Study Design and Setting*

This retrospective study analysed de-identified electronic patient care records (ePCR) from the Australian Capital Territory Ambulance Service (ACTAS) over a period of 6 months spanning 1 July 2015 to 31 December 2015. The ACTAS is responsible for providing emergency and non-emergency ambulance services to members of the community throughout the Australian Capital Territory. During the 2014-15 financial year, the service responded to 35,478 emergency and urgent incidents in a region with a population of approximately 400,000.(13) Paramedics are employed as either Ambulance Paramedic (AP) or Intensive Care Paramedic (ICP). Each can administer inhaled methoxyflurane, intravenous/intramuscular (IV/IM) morphine sulphate or intranasal (IN) fentanyl for pain, with the ICP having the additional option of IV/IM ketamine. With the exception of ketamine, both qualification levels receive similar training on the use of

analgesia. A summary of the recommended doses is shown in Table 1.

Medication	Ambulance Paramedic	Intensive Care Paramedic
Methoxyflurane	3ml inhaled via inhaler 1 x repeat as required	3ml inhaled via inhaler 1 x repeat as required
Morphine sulphate	IV: Up to 0.05mg/kg IV, over 2 minutes. May be repeated at 5 minutes intervals, until pain is managed. Up to a maximum of 15mg IM: 0.1mg/kg. Repeat once, after 30 – 45 minutes, if required. Up to a maximum of 15mg	IV: Up to 0.05mg/kg IV, over 2 minutes. May be repeated at 5 minutes intervals, until pain is managed. No dose limit. IM: 0.1mg/kg. Repeat once, after 30 – 45 minutes, if required. No dose limit.
Fentanyl	IN: 30-180 mcg, according to patient weight. Repeat as required every 5-10 minutes until pain is managed. No dose limit.	IN: 30-180 mcg, according to patient weight. Repeat as required every 5-10 minutes until pain is managed. No dose limit.
Ketamine	Not administered	IV: Up to 1mg/kg in increments of 5-20mg at intervals of 30 – 60 seconds. Repeat as required. No dose limit. IM: 0.5-1mg/kg. No dose limit.

Table 1. Summary of the dosing regime authorized for use by each qualification level of paramedic during the study period.

**CMG 2 – PAIN MANAGEMENT**  
(Revised: March 2014)



**RELIEF OF PAIN AND SUFFERING IS A PRIME GOAL OF AMBULANCE CARE**

Pain is what the patient says it is!  
Always offer pain relief to the patient.

Pain assessment (PQRST)

Quantitate if possible (scale and description)

Document on case sheet

Basic care is fundamental to pharmacological management:

ICP	Reassurance	AP
ICP	Posture	AP
ICP	Splinting	AP
ICP	Cooling of burns	AP
ICP	Occlusive dressings	AP
ICP	Control of temperature (especially the cold)	AP
ICP	Gentle handling	AP

If possible, pharmacology should be directed at the apparent underlying cause:

ICP	<b>GTN</b> – sublingually for ischaemic chest pain	AP
ICP	<b>Methoxyflurane</b> – mild to moderate pain; patients unable to have narcotics; management of labour; often best for paediatrics	AP
ICP	<b>Morphine</b> – ischaemic chest pain and for all other pain unless contraindicated	AP
ICP	<b>Fentanyl</b> – moderate to severe pain; patients unable to have morphine sulphate; best for paediatrics – no IV required	AP
ICP	<b>Midazolam</b> – small doses may be added to analgesia for musculoskeletal pain	
ICP	<b>Ketamine</b> – pain management in selected patients. May be used with alternate small doses of morphine.	

**ISCHAEMIC CHEST PAIN: aim for abolition of pain**  
**ALL OTHER PAIN: aim for control of pain to a comfortable level**

Figure 1. ACTAS pain management guideline in use during the study period.

The administration of analgesia by ACTAS paramedics is governed by a clinical management guideline (see Figure 1 for the guideline in effect during the study period). Paramedics at both qualification levels are authorized to provide analgesia up to the recommended dosage without reference to online medical control. Repeat doses are authorized with the intent to reduce pain to a tolerable level, except for pain associated with Acute Coronary Syndrome (ACS) where the aim is to abolish the pain. Paramedics can administer any of the authorized analgesic agents, singly or in combination, based on their own judgement.

ACTAS paramedics respond to requests for service made via the emergency telephone system. The ACTAS call centre dispatches the closest ambulance using a computer aided dispatch system that tracks the location of ambulances using the global positioning system. The call centre dispatches the closest ambulance to the incident regardless of the qualification level of the attending paramedics. No attempt is made to match requests for service to the responding qualification level. This provides a degree of randomization in terms of the qualification level of the treating paramedic.

#### *Participants and Data Collected*

This study used a convenience contiguous dataset of all cases attended by ACTAS paramedics, with data de-identified and extracted by ACTAS from the electronic patient care record (ePCR) generated by the paramedics for each case attended during the study period. All patients aged 18 years or greater with a Glasgow Coma Score (GCS) of 14 or greater and where the initial pain severity score is greater than 3 were included in the dataset for analysis. The ePCR fields used in the analysis were the case date, treating paramedic's level of practice, pain severity score using an 11-point Verbal Numeric Rating Scale (VNRS; 0-10 and unable to rate), GCS, age (years), gender, cause of pain as recorded by the paramedic (medical or trauma), vital signs, and analgesia type and quantity administered. Cases involving transport from a hospital, non-transport or where analgesia had been administered prior to paramedic arrival were excluded. Case data fields were also searched for evidence of patient reported pain using the treating paramedic's notes in the history section of the ePCR. For cases that met inclusion criteria, the primary outcome measure was administration of any pharmacological analgesia, defined as any administration of methoxyflurane, morphine sulphate, fentanyl, ketamine or any combination of these agents.

#### *Ethical concerns*

Ethics approval was granted by the University of the Sunshine Coast Human Research Ethics Committee (E/16/054). Participant consent was not necessary as this study involves the use of an existing collection of data or records that contain only non-identifiable data about human beings (i.e. data that have never been labelled with individual identifiers or from which identifiers have been permanently removed) in accordance with section 5.1.22 of the Australian Government National Statement on Ethical Conduct in Human Research (2007).

#### *Outcomes of Interest*

The primary outcome of interest was the administration of any analgesic to patients recorded as reporting pain. This outcome is a dichotomized version of the medication received variable. Responses were coded as 1= analgesic administered, and 0= no analgesic administered. Paramedic qualification was the key predictor of interest. Patient sex, age, initial pain score and case nature were included in the analysis as control variables.

#### *Statistical Analysis*

The data were descriptively analysed for analgesia administration and type of analgesic by predictor variables: age, sex, pain score and case nature. Pearson's chi-square test was used to test for associations between the outcome of interest and predictor variables. Following this, the adjusted logged odds of patients receiving analgesia was tested with binomial logistic regression using a stepped modelling approach. A baseline model was established with only paramedic qualification included. Each successive model added in another predictor variable to assess change in the outcome variable. Lastly, statistically

significant models were tested using Likelihood Ratio test to ascertain the model of best fit. Stata version 14 (Stata Corporation, College Station, Texas) was used to undertake the statistical analysis.

**Results**

During the study period, 3173 patient records were identified that met the inclusion criteria (record of pain, age ≥ 18, VNRS ≥ 4, GCS ≥ 14) that were treated and transported by either Ambulance Paramedic (AP) or Intensive Care Paramedic (ICP) (Figure 2). The demographic data for the 3173 cases is shown in Table 2.

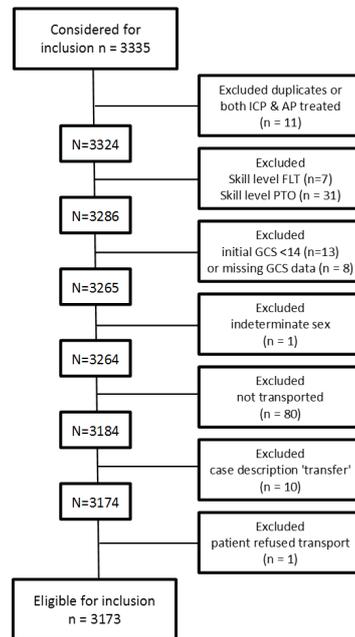


Figure 2: Excluded cases (FLT: Flight Paramedic; PTO: Patient Transport Officer)

Category	Variable	N (%)	Analgesic	P-value
Sex	Female	1863 (59%)	1335 (72%)	0.388
	Male	1310 (41%)	957 (73%)	
Paramedic Qualification	AP	446 (14%)	340 (76.2%)	0.042
	ICP	2727 (86%)	1952 (71.6%)	
Age (Yrs)	18-40	1012 (32%)	739 (73%)	0.185
	41-60	867 (27%)	643 (74%)	
	61-80	848 (27%)	602 (71%)	
	81-100	446 (14%)	308 (69%)	
Pain Score	Moderate pain (VNRS 4-6)	1814 (57%)	1087 (60%)	<0.001
	Severe pain (VNRS 7-10)	1359 (43%)	1205 (89%)	
Case Nature	Traumatic	832 (26%)	709 (85%)	<0.001
	Medical	2291 (72%)	1556 (68%)	
	Other	50 (2%)	27 (61%)	
Methoxyflurane use <sup>1</sup>	AP	446 (14%)	204 (16%)	0.006
	ICP	2727 (86%)	1060 (84%)	
Fentanyl use <sup>1</sup>	AP	446 (14%)	78 (17%)	0.035
	ICP	2727 (86%)	374 (83%)	
Morphine use <sup>1</sup>	AP	446 (14%)	144 (15%)	0.572
	ICP	2727 (86%)	844 (85%)	

Table 2: Sample Population Characteristics (n, column by percent) by analgesic administration (n, row percent with chi-square characteristic). Note: 1 Some patients received more than one analgesic agent.

ICP treated 86% of the sample population. Moderate pain of 3-6 VNRS was reported in 57% of all cases and 74% of all cases had non-traumatic pain (Table 2). In total, 72% (n=2292) of the sample received analgesia from the treating paramedic. Of those treated by an AP, 76.2% (n=340) received analgesia, and 71.6% (n=1952) of patients treated by an ICP received analgesia. Table 2 presents a statistically significant association between paramedic qualification level and analgesic administration ( $p < 0.05$ ). Patient sex was not associated with analgesia administration ( $p = 0.388$ ). Patients in severe pain (VNRS 7-10) received analgesia in 89% of cases, as compared to 60% of patients reporting moderate pain (Table 2). This association was found to be statistically significant ( $p < 0.001$ ), indicating an association between analgesic administration based on the initial pain score. Traumatic case nature was also found to be statistically significantly associated with analgesic administration ( $p < 0.001$ ).

The unadjusted regression model found that AP have higher odds ratio (OR) of administering analgesia than ICP paramedics (OR 1.264,  $p < 0.05$ ). However, once other covariates are included in the logistic regression, the significance no longer exists. When adding the variables of sex and age, the Pseudo R-squared does not change significantly, indicating no change in the overall goodness of fit of the model in explaining variation in the dependent variable- analgesia administration. With the addition of pain severity category to the model using moderate pain as the base (comparison) category, the odds ratio suggests that patients in severe pain have highly statistically significant larger odds of receiving analgesia than patients in moderate pain (OR 5.219,  $p < 0.001$ ).

Variable	OR	95% CI	P Value
Skill Level			
ICP	1.00*		
AP	1.153	0.90-1.49	0.243
Sex			
Male	1.00*		
Female	0.884	0.74-1.04	0.139
Age category(years)			
18-40	1.00*		
41-60	1.016	0.82-1.27	0.863
61-80	0.920	0.74-1.15	0.460
81-100	0.856	0.66-1.12	0.255
Initial Pain Score category			
moderate pain	1.00*		
severe pain	<b>5.559</b>	4.57-6.76	<b>&lt;0.001</b>
Case Nature			
Medical case	1.00*		
traumatic case	<b>3.168</b>	2.54-3.95	<b>&lt;0.001</b>
other case	0.751	0.389-1.45	0.397
Observations	3173		
Pseudo $R^2$	0.126		

\* Referent: multivariate model included skill level, sex, age, initial pain score and case nature.

Table 3: Multivariate analysis of characteristics significantly associated with receiving analgesia

Lastly, case nature was added in the regression model, with trauma and other case types compared with medical cases. The odds ratio indicates that patients with case type coded as trauma have highly statistically significant larger odds of receiving analgesia than medical case patients (OR 3.142,  $p < 0.001$ ). The exponentiated coefficient for severe pain increased in this model, suggesting a correlation between case nature and pain level. Overall, the regression analysis found that both pain severity and case nature explain variation in analgesic administration, more so than paramedic qualification level.

Methoxyflurane was the most frequently administered analgesic, with 39.9% of the patients (n=1,264) receiving this agent; 31.1% of patients (n=988) received morphine, and 14.2% (n=452) received fentanyl. Ketamine was administered to 1% (n=33). There was no statistical difference in administration of analgesic by clinical level, with the exception of methoxyflurane where AP were more likely to administer this agent

( $p < 0.01$ ). This difference remained when controlling for patient sex, age, initial pain severity score and case nature, which showed an adjusted odds ratio of 1.30 for methoxyflurane administration by AP (95% CI 1.05-1.60). Table 3 shows the multivariate analysis of variables associated with the odds of receiving analgesia.

### **Discussion**

Pain management is an important component of care provided by paramedics. Despite the availability of evidence-based guidelines, pain has been shown to be under assessed and undertreated.(14-19) Several predictors of disparity in the provision of analgesia by paramedics have been described, including sex and age.(20, 21) However, there is scant evidence of the effect of paramedic qualification level on analgesic administration in a setting where paramedics at all levels of qualification can provide pharmacological management of pain. This study aimed to determine whether the practice level of the paramedic was associated in differences in the frequency of analgesia administration. Although the ICP is an advanced level of practitioner with a higher level of education and training, and with access to an extended scope of practice including additional analgesic option, this advanced scope of practice was not associated with differences in analgesia for patients with moderate to severe pain.

Patients with severe pain (a VNRS greater than 7/10) were more likely to receive analgesia as were those with pain that was coded by the paramedic as traumatic in origin. The latter requires further investigation to explain this difference. However, disparities in analgesic administration by patient gender that has been described in previous studies were not found in this study.(12, 20) This study also failed to find an effect of patient age on odds of analgesic administration.

This study found that the majority of patients reporting moderate to severe pain received analgesia, and this is in contrast with other studies that show frequency of analgesia administration by paramedics.(16, 19, 22) This may reflect the importance placed on the assessment and early management of pain by the ambulance service and/or the clinical capabilities of paramedics employed by this agency. The effect of organizational or cultural influences on pain management may be a useful line on inquiry.

While our results are encouraging compared to other studies, overall only 72% of patients reporting pain overall and only 60% of patients reporting moderate pain received any analgesia. The difference between pharmacological management of moderate versus severe pain may be explained by the pharmaceutical agents the paramedics had to choose from. Current guidelines advocate the use of paracetamol and/or non-steroidal anti-inflammatory drugs for moderate pain rather than opioids. However, paramedic practice guidelines may not include these agents, and paramedics may be reluctant to administer parenteral opioids to patients with moderate pain. Other possibilities include situational factors such as distance to hospital and undocumented patient refusal of analgesics. The current study did not attempt to address these factors, and further research should consider this.

### *Limitations*

This study has some limitations that should be considered when interpreting the results. Errors in the documentation of care cannot be identified in this retrospective study of patient care records. The study involved data from a single Australian ambulance service and as such this may limit the generalizability of the results. Paramedics in this study setting generally work in pairs with either the same skill set or a mix of the skill sets that were included in this study.

Although the qualification level of the treating paramedic was extracted for analysis, the interactions between crew members may have influenced decisions to treat. This possibility was not studied. The study was also unable to control for the effect of any non-pharmacological methods that may have been used to alleviate pain. In addition, the temporal nature of the pain could not be determined from the available data, and as such it is not possible to differentiate acute and chronic pain. The study only considered initial reported pain score, not final score. As such, it is unable to comment on the effectiveness of analgesia received by patients.

### Conclusion

Paramedic qualification is not associated with the administration of analgesia in this pre-hospital setting. This study contributes to the gap in paramedic science literature on paramedic qualification and administration of analgesia in the prehospital setting regarding factors associated with analgesia administration and may inform future research that aims to identify and reduce barriers to appropriate pain management in the paramedic practice setting.

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