CHALLENGES FOR INFECTION PREVENTION AND CONTROL IN PARAMEDIC-LED HEALTHCARE: SELF-REPORTED BEHAVIOURS AND PERCEPTIONS OF AUSTRALIAN PARAMEDICS

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This thesis is submitted in total fulfilment of the requirements for the degree of Doctorate of Philosophy (research)

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Abstract

**Background:** Noncompliance with recommended infection prevention and control (IPC) practices contributes to the transmission of healthcare-associated infections (HAIs) and poor patient outcomes. While international evidence suggests that paramedic compliance with recommended IPC practice is poor, little is known about the IPC practices of Australian paramedics. The purpose of this research was to undertake a sequential mixed-methods research project to explore the self-reported behaviours and perceptions of Australian paramedics regarding their IPC practices in paramedic-led healthcare.

**Methods:** Four sequentially aligned studies were conducted. Study 1 was a content analysis that explored the IPC standard operating procedures and policy documents provided by Australian ambulance services and made a comparison with the National Health and Medical Research Council 2010 IPC guidelines (NHMRC 2010). Study 2 was semi-structured interviews that explored the views of healthcare professionals and academics from a variety of healthcare disciplines regarding the IPC practices of Australian paramedics and the adequacy of IPC guidance provided to paramedics. Study 3 was the development and administration of an online questionnaire that explored the behaviours and perceptions of Australian paramedics regarding IPC practices and the transmission of HAIs in paramedic-led healthcare. Study 4 were focus groups using semi-structured discussions with a small group of Australian paramedics that explored their behaviours and perceptions regarding IPC practices and the transmission of HAIs in paramedic-led healthcare.

**Results:** Study 1 demonstrated a need to adapt the current national risk-based framework for IPC in Australia to paramedicine. Study 2 found support among the experts interviewed for the development of national IPC guidelines for paramedicine. In addition, the experts also commented that compliance failures with recommended IPC practices would continue to be a challenge. Study 3 and 4 found that Australian paramedics consider hand hygiene, cleaning of ambulances and shared medical equipment, aseptic technique and clinical governance to be important. However, these perceptions were not transferring into practice. Most opportunities to perform hand hygiene were missed and gloving practices were interfering with hand hygiene episodes. For the routine management of the physical environment, no participant correctly
described the process for routine cleaning of noncritical items and ambulance interiors, or the management of spills of blood and bodily fluids. There was also reported biocide misuse, inappropriate cleaning methods and inconsistent schedules for the routine and deep cleaning of ambulances. Noncompliance with aseptic technique recommendations was also found as well as a reluctance to officially report noncompliance. Compliance with IPC recommendations was found to vary with the nature of the clinical activity being undertaken and worsened during perceived emergency events. Several barriers including operational pressure, attitudes, knowledge and access to supplies or products were reported to be preventing paramedics from undertaking recommended practices.

**Conclusion:** Evidence from this research suggests that breaches of IPC by Australian paramedics occurs and that substantial improvement in compliance with recommended IPC practices are required. The findings of this research are consistent with studies of paramedics conducted internationally, particularly with regards to hand hygiene and gloving misuse, and environmental hygiene. The use of a public health promotion planning model such as the PROCEDE-PRECEED model in conjunction with risk management systems such as Hazard Analysis and Critical Control Point approach could assist in the implementation of interventions designed to improve paramedic IPC compliance.

The findings of the research have significant operational and educational implications for paramedic-led healthcare in Australia. Twelve recommendations have been made based on the findings of this research to improve paramedic IPC practice. They are collated into the three constructs of predisposing, reinforcing and enabling, and are aimed at Australian EMS and training organisations. Most important is the development of national operating procedures for IPC in paramedicine to minimise behaviours which lead to noncompliance and develop options that can be adjusted to the situation and acuity of a patient. But merely developing nationally consistent operating procedures is not enough as they must be disseminated with strategies in place for correct implementation, and resources need to be available to evaluate the impact of the IPC operating procedures in clinical practice. This cycle will highlight areas requiring revision, improvement or further development and promote a research agenda that investigates better ways of performing IPC in paramedic-led healthcare.
Declaration of originality

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material which has been previously published or written by any person other than the candidate except where due and proper reference has been given in the text.

Signature:

Date: January 10, 2018

Statement of editorial assistance

Professional editor Dr Leigh Findlay (TrueNature Writing & Editing) provided copyediting and proofreading services for chapters 1, 2, 3, 5, 7 and 10 of this thesis, according to the guidelines laid out in the university-endorsed national Guidelines for editing research theses.
Papers and presentations arising from this work


Conference Presentations from this Work


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<tr>
<td><strong>Allied health</strong></td>
<td>Healthcare professions distinct from nursing, medicine, and pharmacy</td>
</tr>
<tr>
<td><strong>Aseptic non-touch technique</strong></td>
<td>A framework for aseptic practice; the principles are intended for use in a range of settings from the operating theatre to the community</td>
</tr>
<tr>
<td><strong>Audit</strong></td>
<td>A quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change</td>
</tr>
<tr>
<td><strong>Clinical governance</strong></td>
<td>A systematic approach to maintaining and improving the quality of patient care within a health system</td>
</tr>
<tr>
<td><strong>Cleaning, routine</strong></td>
<td>The regular cleaning of frequently touched areas inside ambulances</td>
</tr>
<tr>
<td><strong>Cleaning, deep</strong></td>
<td>Thorough clean and disinfection of all internal compartments and equipment in an ambulance</td>
</tr>
<tr>
<td><strong>CAA</strong></td>
<td>The Council of Ambulance Authorities (Australia), which is the representative body for the principal statutory providers of ambulance services in Australia, New Zealand and Papua New Guinea</td>
</tr>
<tr>
<td><strong>Fomite</strong></td>
<td>Any nonliving object or substance capable of carrying infectious organisms</td>
</tr>
<tr>
<td><strong>Framework</strong></td>
<td>A set of principles and long-term goals that form the basis of making rules and guidelines</td>
</tr>
<tr>
<td><strong>Guideline</strong></td>
<td>A statement by which to determine a course of action</td>
</tr>
<tr>
<td><strong>HACCP</strong></td>
<td>Hazzard Analysis and Critical Control Points, a systematic preventive approach to food safety from biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe</td>
</tr>
<tr>
<td><strong>Hand hygiene</strong></td>
<td>The cleaning of hands with soap and water or an alcohol-based hand rub</td>
</tr>
<tr>
<td><strong>Healthcare-associated infections</strong></td>
<td>Infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting</td>
</tr>
<tr>
<td><strong>Infection prevention and control</strong></td>
<td>Policies and procedures used to minimise the risk of spreading infections</td>
</tr>
<tr>
<td><strong>Multidrug-resistant organism</strong></td>
<td>Microorganisms, predominantly bacteria, that are resistant to one or more classes of antimicrobial agents</td>
</tr>
<tr>
<td><strong>National Health Service</strong></td>
<td>The publicly funded national healthcare system in the United Kingdom</td>
</tr>
<tr>
<td><strong>Nosocomial infections</strong></td>
<td>Infections acquired in healthcare facilities</td>
</tr>
<tr>
<td><strong>Paramedic</strong></td>
<td>A person who is trained to do medical work, especially primary emergency healthcare, but is not a qualified doctor. Due to the current absence of national regulation in Australia, the scope of practice for individuals engaged within...</td>
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</table>
paramedicine varies between jurisdictions, practice settings and engaging organisations. The different legislative frameworks in Australia and New Zealand give rise to local variations in practice, for example, controlled substances legislation.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Paramedic-led healthcare</td>
<td>The semi-autonomous practice of paramedics administering healthcare</td>
</tr>
<tr>
<td>Paramedicine</td>
<td>The discipline practiced by paramedics</td>
</tr>
<tr>
<td>Presenteeism</td>
<td>Remaining at work despite being sick with a communicable disease</td>
</tr>
<tr>
<td>Textual data</td>
<td>Refers to systematically collected material consisting of written, printed, or electronically published words, typically either purposefully written or transcribed from speech</td>
</tr>
<tr>
<td>Transmission</td>
<td>The passing of a pathogen causing communicable disease from an infected host individual, group or environment to a particular individual or group</td>
</tr>
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## List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACSQHC</td>
<td>Australian Commission on Safety and Quality in Health Care</td>
</tr>
<tr>
<td>ABHR</td>
<td>alcohol-based hand rub</td>
</tr>
<tr>
<td>ANTT®</td>
<td>aseptic non-touch technique</td>
</tr>
<tr>
<td>APIC</td>
<td>Association for Professionals in Infection Control and Epidemiology (USA)</td>
</tr>
<tr>
<td>AQaI Service</td>
<td>Australian Quarantine Inspection Service</td>
</tr>
<tr>
<td>CAA</td>
<td>The Council of Ambulance Authorities (Australia)</td>
</tr>
<tr>
<td>CA-MRSA</td>
<td>community acquired methicillin-resistant <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>CBT</td>
<td>competency-based training</td>
</tr>
<tr>
<td>CDC</td>
<td>Centres for Disease Control and Prevention</td>
</tr>
<tr>
<td>CHRISP</td>
<td>Centre for Healthcare Related Infection Surveillance and Prevention</td>
</tr>
<tr>
<td>CPD</td>
<td>continuing professional development</td>
</tr>
<tr>
<td>DEM</td>
<td>department of emergency medicine</td>
</tr>
<tr>
<td>DoHA</td>
<td>Department of Health and Aging</td>
</tr>
<tr>
<td>EMS</td>
<td>emergency medical service</td>
</tr>
<tr>
<td>EMT</td>
<td>emergency medical technician</td>
</tr>
<tr>
<td>FTE</td>
<td>full-time equivalent</td>
</tr>
<tr>
<td>HACCP</td>
<td>Hazard Analysis Critical Control Point</td>
</tr>
<tr>
<td>HAI</td>
<td>healthcare-associated infection</td>
</tr>
<tr>
<td>HA-MRSA</td>
<td>hospital acquired methicillin-resistant <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>HBV</td>
<td>hepatitis B virus</td>
</tr>
<tr>
<td>HCV</td>
<td>hepatitis C virus</td>
</tr>
<tr>
<td>HCW</td>
<td>healthcare worker</td>
</tr>
<tr>
<td>HICPAC</td>
<td>Healthcare Infection Control Practices Advisory Committee</td>
</tr>
<tr>
<td>HREC</td>
<td>Human Research Ethics Committee</td>
</tr>
<tr>
<td>IPC</td>
<td>infection prevention and control</td>
</tr>
<tr>
<td>MDRO</td>
<td>multidrug-resistant organism</td>
</tr>
<tr>
<td>MRSA</td>
<td>methicillin-resistant <em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
</tr>
<tr>
<td>NHS</td>
<td>National Health Service (UK)</td>
</tr>
<tr>
<td>NSQHHS</td>
<td>National Safety and Quality Health Service</td>
</tr>
<tr>
<td>PA</td>
<td>Paramedics Australasia (formerly ACAP, the Australian College of Ambulance Professionals)</td>
</tr>
<tr>
<td>PPE</td>
<td>personal protective equipment</td>
</tr>
<tr>
<td>SoPIC</td>
<td>Survey of Paramedics on Infection Control</td>
</tr>
<tr>
<td>SBS</td>
<td>Special Broadcasting Service</td>
</tr>
<tr>
<td>ROG</td>
<td>review of government services</td>
</tr>
<tr>
<td>SCRGSP</td>
<td>Steering Committee for the Review of Government Service Provision</td>
</tr>
<tr>
<td>TB</td>
<td>tuberculosis</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>USC</td>
<td>University of the Sunshine Coast</td>
</tr>
<tr>
<td>VRE</td>
<td>vancomycin-resistant <em>Enterococcus</em>, or vancomycin-resistant enterococci</td>
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Acknowledgments

I would like to express my appreciation to my principal supervisor Dr Mark Holmes. Without his support this project would not have been achieved. Dr Holmes deserves acknowledgment for teaching me the nuances of academic English, which apparently is different to spoken English.

Special thanks need to be given to my co-supervisors, Dr Anne Roiko, Dr Bill Lord and Dr Peter Dunn. Dr Roiko for her willingness to review and improve the survey and guide me through the philosophy of mixed methodologies. Dr Bill Lord for his encouragement and his assistance with organising the administration of the online survey and focus groups. Dr Peter Dunn for assistance with statistics and presenting results.

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My wife and two children for the encouragement and time to work on my thesis. My wife’s continued support by listening to my musings and providing a sounding board even during the most tedious of times means my debt of gratitude is indeed enormous.

I also acknowledge those who piloted the SoPIC survey and provided feedback to shape the final version. And finally, the participants in all four studies who attended the interviews, responded to the SoPIC survey and came to focus groups. These people were supportive of the project and willing to share their professional constructs and experiences. To the many others who also helped me on this journey you are also duly thanked.
1. Introduction

This chapter introduces the research project described in this thesis. Section 1.1 provides a background to the research undertaken. Section 1.2 outlines the purpose statement and research questions for the research conducted in this thesis. Section 1.3 describes the overall structure of the thesis.

1.1 Background

The emergence of healthcare-associated infections (HAIs) in the past 30 years has become a significant problem for Australian healthcare workers (HCWs), including those in the primary emergency healthcare setting (NHMRC 2010). Paramedics provide an entry point to the healthcare system through the treatment and transport of emergency medical, surgical and trauma patients, as well as the provision of patient transport between healthcare facilities. Over the last two decades the scope of practice for paramedics in Australia and internationally has evolved to a more advanced level in emergency care (Mason, Wardrope & Perrin 2003; Raven et al. 2006). The scope of Australian paramedic practice now includes invasive clinical procedures in a healthcare environment that, whilst considered normal by most paramedics, has been described as hostile, generally uncontrolled and unclean (O’Meara & Reynolds 2009).

The importance of compliance with recommended infection prevention and control (IPC) practices by Australian healthcare workers and agencies has been highlighted by a number of high-profile incidents in the past decade. In 2009, at the Bundaberg Hospital Dental Clinic in Queensland, over 200 patients were treated with unsterilised equipment, which potentially exposed the patients to blood-borne diseases (Miles 2009). Also in 2009, 218 patients at Inverell Hospital in New South Wales were placed at risk of contracting blood-borne infections through the reuse of equipment for administering sedation in the operating theatres (Hunter New England Health Service 2009). More recently, in 2015, approximately 12,000 patients being treated at Sydney dental clinics were put at increased risk of contracting HIV and hepatitis due to poor hygiene practices (Australian Broadcasting Commission 2015). All of these incidents led to significant media attention about the risk for patients when IPC practices were breached by
healthcare professionals. To date there have been few reports of breaches of IPC procedures by Australian paramedics. However, one example of a publicised breach of duty of care was a case in Queensland in 2015 of a paramedic working while infected with measles (Queensland Parliament 2015). Nevertheless, a lack of public dissemination of breaches in IPC does not mean that paramedics are compliant with IPC recommendations. Such breaches have possibly gone undetected, unreported or undisclosed.

While it has been shown that paramedics from some ambulance services in Australia have poor knowledge of IPC principles (Shaban 2006; Shaban, Creedy & Clark 2003), there is a paucity of research into IPC practices across the Australian paramedic population. The publication of research concerning the development of HAIs and the transmission of multidrug-resistant bacteria frequently addresses inpatient acute-care facilities rather than emergency medical services. During an event in which an ambulance is utilised, a patient is surrounded by inanimate surfaces and fabrics that may carry pathogenic microorganisms, particularly if they have not been cleaned and disinfected regularly. Although other clinical disciplines such as nursing, medicine and dentistry have adopted evidence-based practices to prevent the transmission of HAIs in the workplace, ambulance services have embraced these practices to a much lesser degree (Shaban 2006).

Though it is acknowledged that HAIs have a large social and financial burden on both individuals and society (Murphy & Resnik 2008), little is known about whether paramedic-led healthcare contributes to the transmission of these pathogens. Studies have found that paramedics have an increased risk of contracting an infectious disease through work (Eustis et al. 1995; Leiss, Sousa & Boal 2009; Shaban, Clark & Creedy 2004; Tippett et al. 2008) and that ambulances are reservoirs for pathogens that cause HAIs (Alves & Bissell 2008; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015). However, research is needed to identify if Australian paramedics are compliant with recommended IPC practices. If paramedics are contributing to the transmission of pathogens that cause HAIs, then establishing processes that minimise
this transmission during paramedic-led healthcare will help to both improve patient welfare and reduce the economic burden of adverse events in healthcare.

1.2 **Purpose statement and research questions**

The purpose of this research was to undertake a sequential mixed-methods research project to explore the self-reported behaviours and perceptions (beliefs and attitudes) of Australian paramedics regarding their IPC practices in paramedic-led healthcare. For this exploration, four research questions were posed:

1. How do the IPC guidelines provided to paramedics by different Australian ambulance services align with national IPC guidelines?
2. What are the views of healthcare professionals and academics from a variety of healthcare disciplines regarding the IPC practices of Australian paramedics and the adequacy of IPC guidance provided to paramedics?
3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare?
4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey?

This research project will help guide the future education of paramedics by characterising their possible role in the transmission of microorganisms to patients in the primary emergency healthcare setting. The research will also inform the development of a nationally consistent, evidence-based framework for managing IPC within ambulance services across Australia.

1.3 **Structure of the thesis**

The thesis begins with a review of the literature (Chapter 2) that outlines the global impact of HAIs, the research concerning IPC, and contemporary paramedic practice. Chapter 2 also provides a brief overview of the risk management for transmission of HAIs in paramedic practice, together with the potential problems in this arena.
Chapter 3 outlines the philosophical approach, research design and methods for the research. This thesis reports on four studies, sequentially aligned with the four research questions:

1. Content analysis of ambulance IPC documents and their alignment with national guidelines.
2. Semi-structured interviews with key informants about IPC practices in paramedic-led healthcare.
3. National online survey of Australian paramedics about their behaviours and perceptions regarding IPC practices.
4. Focus group interviews with Australian paramedics about their behaviours and perceptions regarding IPC practices.

Chapters 4 to 9 tell the story of this sequential mixed methods research project. Chapter 4 presents the findings of studies 1 and 2. Chapters 5 to 9 present the findings of studies 3 and 4 from the online survey and focus groups about the self-reported behaviours and perceptions of Australian paramedics regarding IPC in paramedic-led healthcare. The findings are presented as five distinct themes:

- General perceptions about HAI transmission and IPC compliance (Chapter 5)
- Hand hygiene and gloving practices (Chapter 6)
- Environmental hygiene (Chapter 7)
- Clinical governance (Chapter 8)
- Aseptic technique (Chapter 9)

Chapter 10 closes the thesis by using the PRECEDE-PROCEED planning model to connect the findings from the six results chapters and to provide recommendations that could be implemented to improve IPC practices in paramedic-led healthcare.
2. Literature review

2.1 Introduction

Healthcare-associated infections (HAIs) are acquired following the provision of healthcare and are caused by pathogenic microorganisms such as bacteria, viruses and fungi. HAIs are defined as ‘Infections acquired in healthcare facilities (“nosocomial” infections) and infections that occur as a result of healthcare interventions (“iatrogenic infections”), and which may manifest after people leave the healthcare facility’ (ACSQHC 2012b). The National Health and Medical Research Council (2010) defines a healthcare facility as any facility that delivers healthcare services, and healthcare workers (HCWs) as all people delivering those services. These definitions include paramedic-led healthcare, paramedics and the infections that paramedics may spread through their work.

In Australia, it has been estimated that there are between 180,000 and 200,000 HAI cases in acute healthcare settings each year, making HAIs the most serious adverse event faced by patients during their engagement within the Australian health system (ACSQHC 2012a; NHMRC 2010). These infections can occur after an episode of care, particularly if invasive medical procedures are involved, and are often aggravated by the longer a patient stays in hospital and the lower their immune status. HAIs can develop following medical interventions in all healthcare settings, including the primary emergency healthcare setting, general practice clinics, aged care homes, ambulance transportation, and even a patient’s home. While many HAIs can be treated with antibiotics, the emergence of antibiotic resistant bacteria such as methicillin resistant \textit{Staphylococcus aureus} (MRSA) and vancomycin resistant enterococci (VRE) have posed many challenges for IPC in all healthcare settings.

Paramedics are healthcare professionals who work mostly in the primary emergency healthcare setting where they may be exposed to pathogenic microorganisms through contact with their patients. The widening scope of paramedic practice now includes invasive medical procedures that have the potential to exacerbate the spread of HAIs if conducted under non-aseptic conditions. Paramedics are expected to adhere to infection
prevention and control (IPC) protocols within their scope of clinical practice to protect themselves and their patients from the transmission of HAIs. Many of the factors associated with the transmission of HAIs in the hospital environment also apply to the primary emergency healthcare setting and, therefore, can be controlled using well-described preventive protocols. However, unlike inpatient services in hospitals, the work setting that a paramedic responds to is generally uncontrolled and unclean, and may pose other unique challenges for IPC (McDonell 2008; O’Meara & Reynolds 2009). This makes the provision of IPC in the paramedic-led healthcare setting problematic. In comparison to other healthcare settings, research on the potential and avenues for transmission of HAIs by paramedics is lacking.

This literature review will examine the global impact of HAIs in acute healthcare settings and will outline the prevention and control of the transmission of these infections through the application of standard and transmission-based precautions, and the organisational support for the application of these precautions. An overview of contemporary paramedic practice in Australia will be provided, followed by an account of related issues with HAIs in the primary emergency healthcare setting, and the potential involvement of paramedics as vectors for HAIs. Finally, the adequacy of risk management practices around IPC in the paramedic workplace will be briefly discussed.

2.2 The global impact of HAIs

Before the 1980s, common pathogens such as rotavirus, *Campylobacter, Legionella, Escherichia coli* (*E. coli*) O157 and norovirus were largely unheard of by the general public (Bloomfield, 2007). Furthermore, pathogens such as MRSA, VRE and *Clostridium difficile* were considered ‘nosocomial infections’ acquired in hospitals. Today, these pathogens are considered a major public health and financial concern for healthcare settings across the world, and are now regarded as being HAIs (Bloomfield et al. 2007; David et al. 2008; Nimmo et al. 2006).

There is a significant financial cost to governments, hospitals, private insurers and healthcare consumers once an HAI is acquired. The first investigation into the financial impact of HAIs on the Australian health system was the *Study on the Efficacy of Nosocomial Infection Control* in Victoria in 1988, which estimated the cost of HAIs at
$0.5 million per day, or $180 million per year (Department of Human Services 1998). Active IPC will increase the costs to a healthcare facility through additional staff wages and time associated with additional education and surveillance. On the other hand, effective IPC practices will free up bed days and reduce expenditure on variable costs, such as pharmaceuticals and dressings. HAIs will only affect the fixed cost of running a hospital if there are no waiting lists (ACSQHC 2011). Pragmatically, in the current health arena there are waiting lists for bed use and HAIs will have little impact on the fixed costs of running a health service. Because of the financial reporting issues associated with HAIs, the costs are now couched in terms of bed days lost to an HAI. Data indicates that the mean increase in hospital stay associated with HAIs is 21 days (NSW Health 2011). However, the costs associated with HAIs are more diverse. A patient with an HAI will stay longer in hospital, lose some quality of life, and be at greater risk of dying from infection (ACSQHC 2011). Furthermore, following discharge, patients are likely to use healthcare resources more intensively because they suffer some residual morbidity, will incur out-of-pocket expenses, and there is a risk they may litigate for compensation.

Aquiring an HAI is a complicated interaction between risk factors, pathogenic microorganisms and their modes of transmission, and susceptible hosts. This interaction is called the ‘chain of infection’ (NHMRC 2010). The risk factors that are important predictors of an individual’s outcome after exposure to an infectious agent include immune status, age, comorbidities, severity of illness, surgery or indwelling devices, inter-institutional transfers, prolonged hospitalisation, exposure to invasive devices, and antimicrobial drugs (NHMRC 2010; Safdar & Maki 2002). A demographic trend towards an aging population in Australia also means that the proportion of the population in the community who are more vulnerable to HAIs is increasing. Coupled to this trend is a move towards shorter hospital stays and increased care in the community, which should raise awareness concerning the care of the ‘at-risk’ groups in their home and protection from HAIs.

According to the NHMRC (2010), pathogenic microorganisms in healthcare settings come from either human sources or the environment. Human sources include patients, HCWs, and visitors to the healthcare setting who are colonised by the pathogen and are
either actively sick from the pathogen or are asymptomatic carriers. The other source of pathogenic microorganisms is the patient’s environment and contaminated inanimate objects within it. It is well recognised that inanimate objects in the patient care environment can act as environmental reservoirs and harbour microorganisms. These ‘fomites’ include tourniquets (Golder et al. 2000), fabrics (Neely & Maley 2000), stethoscopes (Marinella, Pierson & Chenoweth 1997; Merlin et al. 2009), ballpoint pens (Datz et al. 1997), electronic equipment (Schultz et al. 2003), lanyards and name badges (Kotsanas et al. 2008) and handrails (Goodman, ER et al. 2008). Furthermore, multidrug-resistant bacteria have been isolated from keyboards and faucet handles (Bures et al. 2000) and patient’s files (Panhotra, Saxena & Al-Mulhim 2005). The ability of pathogens to transfer from inanimate surfaces to a patient depends on the ability of the microorganisms to survive on a particular surface and on the vectors (e.g. HCWs) that transfer the microorganisms from one fomite to another (NHMRC 2010; Siegel et al. 2006). Environmental cultures have been used in acute-care hospital settings to document contamination and confirm that HCWs contaminate their hands or gloves with multidrug-resistant bacteria from inanimate objects or intact skin surfaces of patients, and move these microorganisms to other surfaces within the patients’ rooms or onto portable objects and, potentially, to new patients (Berthelot et al. 2003; Bhalla et al. 2004; Boyce et al. 1997; Hübner et al. 2011; Schultz et al. 2003; Temime et al. 2009; Waters et al. 2004; Wilkins 1993).

The modes of transmission of pathogenic microorganisms to people include contact (direct and indirect), droplet and airborne (NHMRC 2010). Transmission by direct contact occurs when the transfer of microorganisms results from direct physical contact between an infected or colonised individual and a susceptible host, whereas transmission by indirect contact involves the passive transfer of a microorganism to a susceptible host via an intermediate object or fomite. Droplet transmission occurs when respiratory droplets generated by coughing, sneezing or talking come in contact with susceptible mucosal surfaces such as the eyes, nose or mouth. This mode of transmission may also occur when a person touches a fomite that has been contaminated with respiratory droplets, followed by touching a mucosal surface. Since respiratory droplets are large and not able to remain suspended in the air, they are usually dispersed over short distances. Airborne transmission is the spread of pathogenic microorganisms
via droplet nuclei, which is residue from evaporated respiratory droplets. The microorganisms in the droplet nuclei can survive outside the body and remain suspended in the air for long periods, and infect people via the upper and lower respiratory tracts.

Compounding the issue of the transmission of HAIs has been the rise of multidrug resistant organisms (MDROs). These microorganisms are predominantly bacteria that are resistant to one or more of the classes of antimicrobial agents (Siegel et al. 2006). The emergence of MDROs has increased the social and economic burden associated with HAIs. These types of infections are reportedly more severe, more complex to treat, more expensive to diagnose, increase hospital stays for patients, and have limited options for treatment (Alanis 2005; Siegel et al. 2006). Examples of MDROs include methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE) and *Klebsiella* pneumonia. Due to the adaptability of these microorganisms to new antimicrobial agents, the prevention and control of their transmission must be in the forefront of every healthcare professional’s mind.

*Staphylococcus aureus* now ranks as one of the most common pathogens of humans (Deurenberg & Stobberingh 2008; Turnidge et al. 2007). The adaptive power of *S. aureus* has led to the development of both hospital-acquired MRSA (HA-MRSA) and community-acquired MRSA (CA-MRSA). The development of MRSA came soon after the introduction of the antibiotic methicillin. A number of serious outbreaks of MRSA occurred in the 1960s, but the pathogen was controlled in the 1970s (Beedle 1993). During the early 1980s, MRSA re-emerged as a serious HAI and spread rapidly between patients via the hands of carers. MRSA can cause minor skin and soft tissue infections, or very serious wound infections, osteomyelitis, endocarditis and life-threatening bacteraemia. Some researchers have argued that CA-MRSA, which is encountered by paramedics in their workplace, is more virulent than HA-MRSA (Deurenberg & Stobberingh 2008). In the USA, the annual rate of visits to emergency departments for skin and soft tissue infections more than doubled each year from 1993 to 2005, coincidentally with the emergence of CA-MRSA (Pallin et al. 2008). Before the development of antibiotics, the mortality rate from *S. aureus* infection was 80%
(Deurenberg & Stobberingh 2008). This mortality rate may potentially return because antibiotics and vaccines offer little protection against S. aureus.

The picture of prevalence of MDROs within Australian healthcare facilities is inconsistent with a wide range of issues being reported in the research literature. For instance, some authors report that MRSA is endemic in some hospitals (Bates 2000), suggesting a failure of basic IPC practices, while others have found that serious MRSA infections in smaller hospitals are infrequent events that are mostly ‘inherited’ either from the community or other healthcare facilities (Bennett et al. 2007). Despite the varied prevalence of HAIs caused by MDROs among individual institutions, these infections have significantly higher morbidity, mortality and associated costs (Bennett et al. 2007; Mutter et al. 2016; Sydnor & Perl 2011).

2.3 National guidelines for the prevention and control of HAIs

Major changes in IPC practices occurred in the 1980s following the emergence of the human immunodeficiency virus (HIV) throughout the developed world. Before the 1980s, IPC systems had been based on identifying ‘at-risk’ patients in hospital and then isolating them to control the transmission of infection (Department of Health and Aging 2004). This approach ignored the possibility of pathogens being transferred by asymptomatic people, such as carriers of a multidrug-resistant bacteria or a blood-borne virus. During the 1980s, the spotlight shifted to protecting HCWs from acquiring pathogens in their workplace, which resulted in the introduction of universal precautions for blood and body fluids (Centers for Disease Control and Prevention 1987). This approach emphasised the use of precautionary practices concerning blood and body fluids, regardless of a patient’s infection status. In Australia, a broader definition of universal precautions of IPC was adopted. This definition specifies that all blood and body substances are regarded as infectious (Department of Health and Aging 2004).

In the past two decades, a number of Australian national documents have provided IPC advice. Before 2010, strategies were outlined in the now-rescinded Department of Health and Aging’s Infection Control Guidelines for The Prevention of Transmission of
Infectious Diseases in the Healthcare Setting. Currently, the two prominent national documents that outline a multifaceted approach to IPC are the NHMRC (2010) *Australian Guidelines for the Prevention and Control of Infection in Healthcare* and the National Safety and Quality Health Service Standards, which includes *Standard 3: Preventing and Controlling Healthcare-associated Infections* (ACSQHC 2012d).

The NHMRC (2010) *Australian Guidelines for the Prevention and Control of Infection in Healthcare* were developed when the Australian Commission on Safety and Quality in Health Care (ACSQHC) requested that the NHMRC review and update the 2004 Department of Health and Aging (DoHA) guidelines. The NHMRC guidelines are an evidence-based document that drew upon previous national and international IPC guidelines, systematic literature reviews, work on HAI prevention from ACSQHC, national discipline-based IPC guidelines, and Australian standards relevant to IPC. The NHMRC guidelines also support the HAI initiatives of ACSQHC through providing a coordinated approach to the management of HAIs in Australia. The guidelines were developed to establish a nationally accepted approach to IPC, focusing on core principles and priority areas for action.

According to the NHMRC (2010), the NHMRC guidelines are based on and demonstrate the importance of the following core principles:

1. An understanding of the modes of transmission of infectious agents and of risk management.
2. Effective work practices that minimise the risk of transmission of infectious agents.
3. Governance structures that support the implementation, monitoring and reporting of IPC work practices.
4. Compliance with legislation, regulations and standards relevant to IPC.

The NHMRC approach is underpinned by a risk-management framework to ensure the basic principles of IPC can be applied to a wide range of healthcare settings, including office-based practice, long-term care facilities, remote-area health services, and home and community nursing and emergency services. They provide a basis for healthcare workers and healthcare facilities to develop detailed protocols and processes for IPC that are
specific to local settings. A search and review of relevant literature did not reveal a national, evidence-based framework for managing IPC that is contextualised to paramedic-led healthcare in Australia. Instead, individual ambulance services have assumed the responsibility of developing their own operating procedures for their workers.

Following the release of the NHMRC guidelines, the 10 National Safety and Quality Health Service (NSQHS) Standards were developed and released by ACSQHC to improve the quality of health-service provision in Australia. Standard 3: Preventing and Controlling Healthcare-associated Infections was released in 2012 and should be applied in conjunction with both Standard 1: Governance for Safety and Quality in Health Service Organisations, and Standard 2: Partnering with Consumers (ACSQHC 2012d).

2.3.1 Guidance for standard and transmission-based precautions

Standard precautions are defined by the NHMRC (2010) as being the primary strategy for minimising the transmission of HAIs (Table 1). The guidelines emphasise that standard precautions should be used in the handling of blood (including dried blood), all other body substances, secretions and excretions (excluding sweat and regardless of whether they contain visible blood), non-intact skin and mucous membranes.

<table>
<thead>
<tr>
<th>Risks that should be considered at all times</th>
<th>Standard precautions for IPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>people may be placed at risk of infection from others who carry infectious agents; people may be infectious before signs or symptoms of disease are recognised or detected, or before laboratory tests are confirmed in time to contribute to care; people may be at risk from infectious agents present in the surrounding environment including environmental surfaces or from equipment; there may be an increased risk of transmission associated with specific procedures and practices.</td>
<td>hand hygiene, before and after every episode of patient contact; the use of personal protective equipment; the safe use and disposal of sharps; routine environmental cleaning; reprocessing of reusable medical equipment and instruments; respiratory hygiene and cough etiquette; aseptic non-touch technique; waste management; appropriate handling of linen.</td>
</tr>
</tbody>
</table>

*Note: adapted from National Health and Medical Research Council guidelines (NHMRC 2010)*
On the other hand, transmission-based precautions (Table 2) are applied to patients known or suspected to be infected or colonised with pathogens transmitted by contact (e.g. faecal contamination from carriers of VRE), droplet (e.g. rubella, pertussis, influenza) or airborne particles (e.g. pulmonary tuberculosis, chickenpox, measles). The transmission-based precautions are also applied to patients with diseases that have an inherent resistance to standard sterilisation procedures, or where standard precautions alone are not sufficient. The combination of measures used in transmission precautions depend on the route of transmission of the pathogen involved and are always applied in addition to standard precautions. For diseases with multiple routes of transmission, more than one transmission-based precaution category is applied.

Table 2: Summary of the national transmission-based precautions for infection prevention and control

<table>
<thead>
<tr>
<th>Transmission based precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• appropriate use of personal protective equipment (including gloves, apron or gowns, surgical masks or P2 respirators, and protective eyewear);</td>
</tr>
<tr>
<td>• patient-dedicated equipment;</td>
</tr>
<tr>
<td>• allocation of single rooms or the cohorting of patients;</td>
</tr>
<tr>
<td>• appropriate air handling requirements;</td>
</tr>
<tr>
<td>• enhanced cleaning and disinfecting of the patient environment;</td>
</tr>
<tr>
<td>• restricted transfer of patients within and between facilities;</td>
</tr>
<tr>
<td>• a dedicated toilet to prevent transmission of infections that are transmitted primarily by contact with faecal material;</td>
</tr>
<tr>
<td>• rostering of immune healthcare workers to care for certain classes of infectious patients (e.g. those with chickenpox)</td>
</tr>
</tbody>
</table>

*Note: adapted from National Health and Medical Research Council guidelines (NHMRC 2010).*

The following subsections provide a short review of specific items related to standard and transmission-based precautions as described in the NHMRC guidelines.

**Hand hygiene and routine cleaning**

Pathogenic microorganisms can be transmitted to a person by touch (NHMRC 2010). These pathogens either reside normally on the hands as resident flora or are transient flora acquired during activities associated with healthcare. Hand hygiene is generally considered the most important procedure for preventing the spread of these types of pathogens in healthcare facilities (Department of Health and Aging 2004). However, hand washing alone is not sufficient to prevent and control infection and must be used in conjunction with other precautionary procedures.
Factors that affect hand hygiene have been explored. For example, compliance varies among professions, with nurses being more compliant than physicians (Gilbert et al. 2010; Meengs et al. 1994; Pittet et al. 2000); and a mentor’s practice influences a student’s behaviour (Snow et al. 2006). In addition, the type of training (Dierssen-Sotos et al. 2010; Randle, Clarke & Storr 2006), peer feedback (Moongtui, Gauthier & Turner 2000), and hand-hygiene campaigns (Conrad et al. 2010) can all positively influence practice. However, the nature of human behaviour complicates the factors which improve and decrease compliance. For instance, there are diurnal changes, with decreased compliance during nightshifts (Sahay et al. 2009). The sustainability of changes is also an issue: decreased compliance is associated with the length of time since a training intervention (Moongtui, Gauthier & Turner 2000). In one study, hand hygiene of HCWs was poor despite the knowledge that they were being observed (Jenner et al. 2006). The practices observed in this study would suggest that HCWs think it is more important to prevent cross-infection from one patient to another than preventing infection in the same patient. Moreover, compliance is problematic because of substantial differences among knowledge, attitudes and practice (Scott & Vanick 2007; Snow et al. 2006), and because deviations that lower compliance rates are described as ‘acceptable cultural norms’ by study participants (Bellaard-Smith & Gillespie 2012). This observation of culturally accepted practices interfering with, in particular, HCWs’ hand hygiene may partially explain the findings of North American studies showing that, despite paramedic employers requiring hand hygiene training, hand hygiene was poor. Ho, Ansari and Page (2014) found the majority of hand hygiene occurred at the end of patient contact and very low compliance (3.5%) during patient care. In addition, Teter, Millin and Bissell (2015) reported that hand hygiene either before touching patients or between patients is not performed and is an intractable problem despite multifaceted programs to promote hand hygiene in emergency medical service (EMS) personnel (McGuire-Wolfe, Haiduven & Hitchcock 2012). Bledsoe et al. (2014) also found that hand hygiene at the end of cases was conducted by only 27.8% (n = 250; 95% CI: 23.1–30.5) of providers.

Hand Hygiene Australia have adopted the 5 Moments for Hand Hygiene to improve patient safety (Grayson & Russo 2009). The five moments have also become the basis for hand hygiene advice in the NHMRC guidelines (NHMRC 2010). The advice
suggests that hand hygiene must be performed before and after any contact with a patient or a patient’s environment, after a body-fluid exposure risk, and after the removal of disposable gloves. The intervention protocol was designed to protect patients against acquiring pathogens from the hands of a HCW; from pathogens (including their own) entering a patient’s body during a clinical procedure; and to protect HCWs and the healthcare surroundings from acquiring a pathogen from a patient. The 5 Moments for Hand Hygiene was originally developed for HCWs in acute-care hospitals but has been adopted across many healthcare settings. However, recent research is demonstrating that adhering to the protocol is problematic in some workplaces (Rowlands et al. 2014). For example, Rowlands et al. (2014) point out that complete compliance with hand hygiene guidelines that are established for non-operating room environments would consume more than the 60 minutes available in each hour of anaesthesia time, which highlights the need to create more practical yet effective methods of controlling bacterial transmission. In addition the 5 Moments for Hand Hygiene intervention has not been tested for applicability in the paramedic-led healthcare setting, which has unique issues such as no running water, the need for wearing hand accessories (e.g. wrist watches), and constant movement between emergency patients in multi-casualty situations with limited staff.

During the past few decades, hand hygiene products and the techniques for performing hand hygiene have changed. According to Marena et al. (2002), before 2002 soap and water was considered the gold standard because it was associated with the greatest log reduction in microbial contamination. Historically, alcohol-based hand rub (ABHR) was developed for times when hand washing with soap and water was impractical or extremely difficult, such as emergency settings that lack sinks or have a high work load (Zaragoza et al. 1999). Due to the considerable change in alcohol-based products, Hand Hygiene Australia (2013) now recommends ABHR as the standard for hand hygiene of non-soiled hands before standard aseptic non-touch procedures, with soap and water reserved for particular circumstances. The Centers for Disease Control and Prevention (2002) also make this recommendation, which has been shown to decrease infection rates (Hilburn et al. 2003).

Currently, two techniques for hand hygiene using ABHR are promoted internationally:
the 6-step by the World Health Organization and 3-step technique by the Centers for Disease Control and Prevention. The 6-step procedure has been shown to be microbiologically more effective than the 3-step technique at reducing the median log$_{10}$ bacterial count ($P = 0.02$); however, it takes longer to perform (Reilly et al. 2016). Continued developments in ABHR products give rise to further considerations and possible future changes. For example, alcohol-based hand wipes have been shown to be more effective than ABHR in reducing the number of viable bacteria and spores on a person’s hands (D’Antonio et al. 2010). These findings necessitate research into specific processes to enable appropriate hand hygiene practices for paramedics. Furthermore, due to limitations in previous studies, any new research must include MDROs encountered in the field, such as CA-MRSA.

**Environmental hygiene**

The environment is a potential reservoir for hand contamination, and thus transmission of HAI, adding to the difficulties of hand hygiene in the emergency primary healthcare setting. Extensive evidence demonstrates a relationship between poor environmental hygiene and the transmission of pathogens in healthcare settings (CDC 2002; NHMRC 2010; Siegel et al. 2006). In addition, evidence suggests that patients may be inoculated by pathogens through direct contact with the environment or contaminated equipment, or indirectly from the contaminated hands of a HCW.

Microorganisms are found on many surfaces in the healthcare environment (Mitchell et al. 2012), and the closer the proximity to the patient, the more heavily contaminated the environment. Studies using direct and covert observation, or a fluorescent targeting method, have consistently confirmed that most near-patient surfaces in hospitals are not being cleaned in accordance with existing policies (Carling & Bartley 2010; Dancer et al. 2009). These findings imply an increased risk of acquiring microorganisms that result in HAI from high-touch areas close to the patient, because these items provide increased chance for hands to touch and transfer organisms.

International evidence demonstrates that the environmental cleaning problems found in hospitals may also occur in EMSs. A substantial body of evidence has shown that ambulances are reservoirs of pathogens that cause HAIs, including MDROs (Alves &
Further, the importance of the environment as a reservoir is demonstrated in hospital studies that have shown that patients occupying rooms previously occupied by patients with MDROs have a higher risk of acquiring the same pathogen (Drees et al. 2008; Duckro et al. 2005; Hardy et al. 2006; Hayden et al. 2006; Huang, Datta & Platt 2006; Mitchell, Digney & Ferguson 2014; Nseir et al. 2011; Shaughnessy et al. 2011). One study found their risk of acquiring these pathogens is 73% higher than that of patients not occupying such rooms (Carling & Bartley 2010). In contrast, the routine enforcement of environmental cleaning measures, independent of improving hand hygiene practices, was associated with less surface contamination with MDROs, cleaner hands of HCWs, and a significant reduction in cross-transmission (Hayden et al. 2006).

Further evidence of improved environmental hygiene decreasing HAI stems from the work of Passaretti et al. (2013). Their study found that hydrogen peroxide vapour (HPV) significantly decreased the likelihood (by 64%) of a patient acquiring an MDRO when the previous room occupant was colonised or infected with an MDRO.

The NHMRC suggests that all environmental surfaces require regular cleaning. Environmental surfaces can be safely decontaminated and the level of cleaning required depends on the objects involved and the risk of contamination. Surfaces that are likely to be contaminated with pathogenic microorganisms require cleaning between patient consultations. This is particularly important following a spill of blood or other body substance, and between patient uses of a room or patient-care area, especially in acute-care settings (Department of Health and Aging 2004). Pathogens introduced into the body can cause an infection. Hence, any piece of reusable equipment requires cleaning, disinfection and/or sterilisation. Furthermore, all reusable medical equipment must be handled in a way that will prevent patient, HCW and environmental contact with potentially infectious material (NHMRC 2010).

**Personal protective equipment**

The use of personal protective equipment (PPE) protects HCWs from exposure to blood or other body substances. According to the NHMRC (2010), protective clothing and equipment that complies with relevant Australian standards should be readily available.
and accessible in each healthcare facility and may include examination gloves, surgical
gloves, eye and facial protection, respirators, gowns and aprons, and footwear. The
particular type of PPE required will vary according to the nature of the procedure, the
equipment used, the skill of the operator, individual professional judgement, and
organisational policies based on occupational health and safety legislation. When
choosing PPE, the HCW needs to be cognisant of the probability of exposure to blood
and type of body substance, the amount likely to be encountered, and the probable mode
of transmission of pathogens. A range of PPE options must be provided for HCWs to
cater for the high rate of adverse skin reactions to component materials (Foo et al.
2006). In addition, national guidelines and standards outline clearly the correct order of
donning and doffing PPE in order to reduce the transmission of pathogens (NHMRC
2010).

**The safe use and disposal of sharps**
The use of sharp devices can expose the HCW to the risk of injury. Indeed, needle-stick
injuries with hollow-bore devices are a frequent cause of HCW occupational exposure
to blood-borne viruses (CHRISP 2007). Both syringes with needles and steel-winged
infusion sets are implicated in over 90% of needle-stick injuries (Whitby & McLaws
2002). Eliminating this hazard through safe handling and disposal, substitution, or
engineering safety into the design of equipment is the fundamental approach to reducing
harm.

**Hygienic management of clinical waste and linen**
There is no national definition of clinical waste in Australia. Healthcare facilities need
to conform to relevant state or territory legislation and regulations on the management
of clinical waste. The following points need to be considered: when handling waste,
apply standard precautions; perform hand hygiene after handling waste; and segregate
waste at the point of generation and store appropriately (NHMRC 2010).

All used linen should be handled in a manner that avoids both the dispersal of pathogens
into the environment and contact with staff clothing. According to the NHMRC (2010),
the following principles apply when handling linen: wear appropriate PPE during
handling of soiled linen; ‘bag’ linen at the location of use and do not rinse or sort in
patient-care areas, or wash in domestic washing machines; store soiled linen in leak-proof laundry bags for safe transport; and perform hand hygiene after handling used linen. Clean linen must be stored in a clean, dry place that prevents contamination by aerosols, dust, moisture and vermin, and that is separated from used linen.

**Respiratory hygiene and cough etiquette**
Respiratory hygiene and cough etiquette are fundamental precautions that is applied as a standard IPC practice. This practice consists of covering the mouth and nose while sneezing or coughing, which prevents the dispersal of respiratory secretions into the air. The NHMRC recommends that hands are washed with soap and water after coughing, sneezing, using tissues, and contact with respiratory secretions or objects contaminated by these secretions (NHMRC 2010).

**Aseptic non-touch technique**
ANTT® is a standard method of aseptic technique that is used to reduce the rates of HAIs. The technique aims to prevent pathogens being introduced in sufficient quantity to cause infection to susceptible sites by hands or by surfaces and equipment (NHMRC 2010). ANTT® uses a safety approach that considers how much the patient is at risk from the healthcare worker, the technical challenge of the procedure, and the practice environment (Rowley & Clare 2011). In other words, ANTT® takes into account both the technical difficulty of procedures and the clinician’s ability to decide if procedures can be performed without touching key-parts or key-sites directly (NHMRC 2010).

Key-parts are the critical parts of the procedure equipment that, if contaminated, are most likely to cause infection; key-sites are open wounds and access sites for medical devices (Rowley & Clare 2011). Infective precautions are selected to counter the risks identified (NHMRC 2010).

The aim of ANTT® for clinical practice is asepsis for all invasive clinical procedures, despite the complexity (Rowley & Clare 2011). The term *asepsis* refers to the absence of pathogenic microorganisms and has replaced both the terms *sterile technique* and *clean technique*. Sterile technique required the complete absence of microorganisms, which is not possible to achieve in typical healthcare settings due to the prevalence of microorganisms in the air. The term clean technique has been discouraged as it was
considered too ambiguous. ANTT® is achieved by the use of aseptic fields to ensure asepsis of key-parts and key-sites within the immediate procedural environment. The method also improves aseptic practice through standardisation of practice and efficient technique. ANTT® has assisted in the rationalisation of equipment choices and explicit sequencing act to ‘prescribe out’ variable practices (Rowley & Clare 2011).

The ANTT® framework is based on six principles (Table 3). It has a number of important components and requires the clinician to identify the risk of contamination and to choose the correct field and technique to avoid the spread of pathogens. Infective precautions are then selected to counter the risks identified; for example, the use of sterile or non-sterile gloves to maintain asepsis or freedom from infectious (pathogenic) material. Although the principles of aseptic technique remain constant for all procedures, the level of practice will change depending upon a standard risk assessment that considers hand hygiene, gloving, aseptic field, aseptic technique and sequencing.

Table 3: The principles of the Aseptic Non-Touch Technique (ANTT®) framework grouped by clinical practice and organisational management

<table>
<thead>
<tr>
<th>Clinical practice details</th>
<th>Organisational management details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle 1</td>
<td>The aim of ANTT® for invasive and clinical procedures is always asepsis.</td>
</tr>
<tr>
<td>Principle 2</td>
<td>Asepsis is achieved by protecting key-parts and key-sites from microorganism transfer from the healthcare worker and the immediate environment.</td>
</tr>
<tr>
<td>Principle 3</td>
<td>ANTT® needs to be efficient as well as safe. Surgical ANTT® is used for complicated procedures and Standard ANTT® for uncomplicated procedures.</td>
</tr>
<tr>
<td>Principle 4</td>
<td>Choice of Surgical or Standard ANTT® is based on an ANTT® Risk Assessment, according to the technical difficulty of protecting Key-Part and Key-Site Asepsis. This principle relies on four safeguards:</td>
</tr>
<tr>
<td></td>
<td>Safeguard 1 Basic Infective Precautions: Precautions include hand cleaning and environmental controls; significantly reduce the risk of contaminating Key-Parts and Key-Sites.</td>
</tr>
<tr>
<td></td>
<td>Safeguard 2 Identification of Key-Parts and Key-Sites: Key-Parts are the critical parts of the procedure equipment that, if contaminated, are most likely to cause infection. Key-Sites are open wounds and medical device access sites.</td>
</tr>
<tr>
<td></td>
<td>Safeguard 3 Non-Touch Technique: Non-Touch Technique is a critical skill that protects Key-Parts and Key-Sites from the healthcare worker and the procedure environment; used in both Surgical and Standard-ANTT®.</td>
</tr>
<tr>
<td></td>
<td>Safeguard 4 Aseptic Field Management: ANTT® is a critical skill that protects key-parts and key-sites from the healthcare workers and the procedure environment; Surgical and Standard ANTT®, require different aseptic field management.</td>
</tr>
<tr>
<td>Principle 5</td>
<td>Aseptic practice should be standardised.</td>
</tr>
<tr>
<td>Principle 6</td>
<td>Safe aseptic technique relies on effective training of healthcare workers, and environments and equipment that are fit for purpose.</td>
</tr>
</tbody>
</table>

*Note: Adapted from the ANTT® Clinical Practice Framework (The Association for Safe Aseptic Practice 2016).*
2.3.2 Organisational support

Organisational support is required for effective IPC in a healthcare setting. IPC is a health and safety issue, which means that all people working in the healthcare facility (e.g. managers, HCWs, support staff) are responsible for providing a safe environment for their patients and other staff. Organisational support should aim to ensure that clinical work practices provide patient-centred care. According to the NHMRC (2010), organisational support involves embedding IPC into governance and management structures; initiating procedures (e.g. immunisation programs) to ensure that HCWs are protected; instituting processes for surveillance that feed into the overall quality control program; implementing systems for ongoing staff education and training; and incorporating IPC into planning for facility design and maintenance.

Governance as applied to IPC means to: develop a strategic plan and system for IPC; appoint staff; provide administrative support, including fiscal and human resources for maintaining IPC programs; and to delegate responsibility for incorporating IPC into the objectives of the facility’s patient and occupational safety programs (NHMRC 2010). While all HCWs should be aware of their professional responsibilities for maintaining patient and workplace safety, without this level of support, IPC will not be a priority of a healthcare facility.

Surveillance is an important tool used by healthcare organisations to reduce HAIs. Surveillance data should be used to identify local problem areas and to implement appropriate policy and clinical interventions to improve the quality of care (ACSQHC 2010). In 2008, the project Surveillance of Healthcare Associated Infections: *Staphylococcus aureus* Bacteraemia & *Clostridium difficile* Infection, was begun to monitor HAIs in Australian hospitals (ACSQHC 2010). Ambulance services are not included in this data collection, which is unfortunate because this type of information facilitates improvement by allowing evaluation of intervention effectiveness.

Vaccination prevents acute disease and chronic carriage in HCWs and is associated with a substantial decrease in mortality among patients (Burls et al. 2006; Carman et al. 2000). Mortality has been correlated against workforce immunisation. Carmen et al. (2000) found that the uncorrected rate of mortality in patients was 13.6% in hospitals
promoting vaccination programs, compared with 22.4% in hospitals without a vaccination program. Employers are expected to take all reasonable steps to ensure that their staff are protected against vaccine-preventable diseases. Where HCWs may be at significant occupational risk of acquiring or transmitting a vaccine-preventable disease, a comprehensive occupational vaccination program should be implemented (NHMRC 2010). The recommended program should include a vaccination policy, maintenance of current staff vaccination records, provision concerning vaccine-preventable diseases, and how to manage vaccine refusal.

A picture of barriers to and enablers of immunisation in the healthcare workforce has been built up over time. The factors associated with being immunised have been found to encompass knowledge (Abramson & Levi 2008; Hopman et al. 2011; Looijmans-Van den Akker et al. 2010; Loulergue et al. 2009), risk awareness (Hopman et al. 2011; Hubble, Zontek & Richards 2011; Loulergue et al. 2009), increasing age of the HCW (Abramson & Levi 2008; Hopman et al. 2011; Takayanagi et al. 2007), belief systems (Hopman et al. 2011), past history (Abramson & Levi 2008; Hubble, Zontek & Richards 2011), recommendation by a physician (Abramson & Levi 2008; Carman et al. 2000; Hopman et al. 2011), and convenient time for vaccination (Hopman et al. 2011). The factors associated with not being immunised have also been determined: fear (Abramson & Levi 2008; Goldstein et al. 2004; Lee, Carrillo & Fleming 1997; Loulergue et al. 2009), insufficient knowledge of immunisation and doubts concerning efficacy (Goldstein et al. 2004; Loulergue et al. 2009), and scheduling difficulties (Lee, Carrillo & Fleming 1997).

Although it is argued that coverage with standard vaccines should be improved by supplying complete information on the risks and efficacy of active immunisation (Loulergue et al. 2009), research has demonstrated that simple measures such as education alone do not work. A study concerning influenza vaccination uptake by UK undergraduate medicine, nursing, physiotherapy and dentistry students demonstrated the uptake was 8.0% in trainee HCWs, which was lower than the 13.4% uptake among current HCWs (Blank et al. 2010). Furthermore, compliance rates drop as a factor of time from the last education campaign. For example, in 2003, after education campaigns encouraging HCWs in Brazil to vaccinate against influenza, 34.4% of staff complied
with the recommendation (Takayanagi et al. 2007). The compliance rate dropped significantly in subsequent years to 20.2% in 2004, when the only measure taken was the questionnaire, and to 12.75% in 2005, when no educational intervention was scheduled. Other documented programs designed to increase immunisation rates have produced increases of between 5% and 45% (Burls et al. 2006), but programs need to be repeated on a regular basis to sustain the desired outcome (Looijmans-Van den Akker et al. 2010). Vaccinations have been demonstrated to be highly effective in HCWs, with minimal adverse effects, and are associated with a reduction in client mortality and economic costs (Burls et al. 2006).

2.4 Contemporary paramedic practice in Australia

Paramedics are the principal healthcare professionals responding to medical emergencies in Australia. They provide medical assessment, treatment and care in the primary emergency healthcare setting; they also respond to, assess, manage and transport patients to a healthcare facility for ongoing treatment, or arrange alternative healthcare options (Paramedics Australasia 2013). Paramedics Australasia describes paramedics as being engaged to provide clinical skills and medications in the provision of professional healthcare in the emergency setting (Paramedics Australasia 2013). While most paramedics in Australia are employed by a state or territory ambulance authority, an increasing number are employed by the private sector in areas such as mining and entertainment. Other healthcare professionals also respond to medical emergencies in Australia, such as remote area nurses with the Department of Health and Human Services, the Royal Flying Doctor Service, and hospital-based emergency response teams. However, this literature review will focus primarily on the professional paramedic.

In 2015–2016, there were 16,087 full-time equivalent (FTE) salaried personnel involved in the delivery of ambulance services throughout Australia, with 80.6% being ambulance operatives (SCRGSP 2017). This level of service equates to 47.0 FTE paramedics per 100,000 people. Ambulance services in Australia attended 3.4 million incidents in 2015–2016, of which 40.3% of cases were emergency incidents, 33.9% were urgent incidents, and 25.9% were non-emergency incidents. There is a correlation between demand for ambulance services and hospital departments of emergency
medicine (DEM) presentation rates. Using the National Triage Scale allocated to a patient on arrival at a DEM in 2015–2016, across all triage categories, 24.3% of patients arrived by ambulance, air ambulance or helicopter rescue services. Specifically, 83.0% of DEM patients who were given a triage category indicating that immediate attention was required arrived by ambulance, air ambulance or helicopter rescue services (SCRGSP 2017).

Paramedics have moved beyond being first-aid providers working for a government organisation to now being employed in many areas of public and private employment. In Australia, the use of the term ‘paramedic’ will be nationally restricted in 2018 with the establishment of a national registration system for Australian paramedics (Legal and Constitutional Affairs References Committee 2016). Due to the historical lack of restriction for the title paramedic a variety of titles are used to describe providers of ambulance and on-site pre-hospital care services: first aider, first responder, advanced responder, emergency medical technician (EMT; basic, intermediate and paramedic levels), advanced life support officer, medic, paramedic and intensive care paramedic (Eburn & Bendall 2010). Paramedics Australasia have developed classifications to describe levels of qualification and work function (Table 4).

Industrially, the term ‘professional paramedic’ or ‘career paramedic’ is used in agreements to identify those with a diploma as the minimum education level and are employed as a paramedic or an ambulance officer with a state or territory ambulance authority. Eburn and Bendall (2010) further note that ambulance services, particularly those considered as ‘emergency’ ambulance services, are provided almost exclusively by government-operated statutory authorities. The Australian Health Practitioner Regulation Agency’s national registration for paramedics, expected to be in place in 2018, may change the employment landscape again, particularly for those paramedics employed in the private sector.

For some time it has been recognised that paramedics need to be trained and educated in emergency care at a higher level, with skills that could be used throughout the community (Mason, Wardrope & Perrin 2003). Therefore, training for paramedics has transitioned from the vocational education sector to the university sector in recent years. Paramedic training is now available in 18 Australian universities, with 14 of the
university degrees fully accredited, 7 provisionally accredited and 1 with preliminary accreditation by the Council of Australian Authorities (CAA 2017). Although the training for paramedics has transitioned to university, a range of vocational training is still available through state ambulance services. Hence, it is important to make the distinction between being employed as a paramedic and being employed as an emergency responder by an ambulance service or other organisation. The vocational qualifications range from Certificate II to a diploma. Officers trained to the level of Certificate IV are usually retained on either a voluntary or a casual basis to provide advanced first aid in areas of low case load where the local ambulance service deems that it is not economically feasible to establish an ambulance station with a full-time paramedic staff. These staff are described differently in each jurisdiction; for example, as honorary officers in Queensland and as ambulance community officers in Victoria.

The move to university training of paramedics has coincided with an expansion in the scope of clinical practice of paramedics because of the gap left by skills shortages and the rationalisation and contraction of health services throughout Australia (Hotchin 2008; SCRGSP 2014). Paramedics are beginning to work in hospital emergency departments and clinics, to undertake coordination roles aimed primarily at supporting ambulance volunteers and the community with additional health services as required, and to promote injury and disease prevention (Council of Ambulance Authorities 2008). Moreover, paramedics are now being trained to conduct invasive procedures in the emergency setting, such as advanced airway management (e.g. endotracheal intubation, cricothyrotomy and needle thoracotomy); venepuncture; intravenous and intraosseous needle placement; treatment of life-threatening musculoskeletal injuries, including open fracture reduction; haemorrhage control; and suturing (Ambulance Victoria 2014; McDonell 2008; Mulholland, Stirling & Walker 2009; Queensland Ambulance Service 2015).
### Paramedic professional and technical stream roles

<table>
<thead>
<tr>
<th>Professional Stream</th>
<th>Role Title</th>
<th>Role Description</th>
<th>Other Vocational Titles</th>
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<tbody>
<tr>
<td>Professional Stream</td>
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<tr>
<td></td>
<td>Intensive Care Paramedic (ICP)</td>
<td>An advanced clinical practitioner who provides medical assessment, treatment and care in the out-of-hospital environment for acutely unwell patients with significant illness or injury</td>
<td>Mobile Intensive Care Ambulance (MICA) Paramedic, Intensive Care Paramedic (Advanced Life Support), Level 5 Paramedic, Australian Defence Force: Clinical Manager, Other roles using this level of practice and additional specialist training: Rescue Paramedic, Special Casualty Access Team Paramedic, Underwater Medic (Royal Australian Navy and Australian Army)</td>
</tr>
<tr>
<td></td>
<td>Retrieval Paramedic (RP)</td>
<td>An advanced clinical practitioner who provides medical assessment, treatment and care in the out-of-hospital environment to facilitate the safe and effective transfer of critically unwell patients to a specialist receiving facility</td>
<td>Flight Paramedic, Air Ambulance Paramedic, MICA, Flight Paramedic, Critical Care Paramedic, Flight ICP, Australian Defence Force: Aero Medical Evacuation Medic (Australian Defence Force), Other roles using this level of practice and additional specialist training: Rescue Paramedic, Special Casualty Access Team Paramedic</td>
</tr>
<tr>
<td></td>
<td>General Care Paramedic (GCP)</td>
<td>An advanced clinical practitioner who specialises in facilitating a comprehensive medical history/assessment, initiation of relevant treatment, and appropriate referral for low and medium acuity patients in a variety of community and clinical settings, with an emphasis on managing a patient in their own environment</td>
<td>Extended Care Paramedic, Community Paramedic</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Stream</th>
<th>Role Title</th>
<th>Role Description</th>
<th>Other Vocational Titles</th>
</tr>
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<tbody>
<tr>
<td>Technical Stream</td>
<td>First Responder (FR)</td>
<td>An individual who has completed accredited training in advanced first aid and emergency scene management and responds to emergency situations to provide initial clinical management in the out-of-hospital environment</td>
<td>Ambulance Responder, Community Responder, Primary Care, Australian Defence Force: Combat First Aider, New Zealand Defence Force: Defence First Aider &amp; Combat Life Saver</td>
</tr>
<tr>
<td></td>
<td>Patient Transport Attendant – Level 1 (PTA1)</td>
<td>An individual who has undertaken accredited training in advanced first aid and patient transport and who provides quality care and transport for low acuity and non-ambulant stable patients</td>
<td>Patient Transport Officer, Ambulance Officer</td>
</tr>
<tr>
<td></td>
<td>Patient Transport Attendant – Level 2 (PTA2)</td>
<td>An individual who has completed accredited training in patient transport and management and who provides quality care and transport for medium acuity, stabilised patients between health facilities and/or home</td>
<td>Ambulance Officer (Patient Transport Service)</td>
</tr>
<tr>
<td></td>
<td>Basic Life Support (BLS) Medic</td>
<td>An individual who has undertaken accredited training in emergency patient care to provide rapid access to clinical assessment, treatment and care in the out-of-hospital environment (particularly in rural and remote areas)</td>
<td>Ambulance Officer, Paramedic 1, Ambulance Volunteer, Ambulance Community Officer, Emergency Medical Technician (BLS)</td>
</tr>
</tbody>
</table>

*Note: adapted from Paramedics Australasia classifications (Paramedics Australasia 2009)*
From 1994 to 2008, the annual rate of emergency ambulance transportations in Australia for all age groups increased by 81% from 32 to 58 per 1000 people (Lowthian et al. 2011). People older than 85 years were eight times more likely to be transported by ambulance than those aged 45–69 years (Lowthian et al. 2011). Modelling from these data suggest that ambulance transportations will increase by 46–69% between 2007 and 2015, driven primarily by the aging population. The impact of the significant rise in demand from older patients is illuminated by consideration of the Australian epidemiology of \textit{S. aureus} bacteraemia, a significant HAI (Collignon et al. 2005; Collignon et al. 2006). Australian data indicate a fourfold increase in mortality rate from the 50–59 year age group (6.4%) to the 80–89 year age group (26.1%) for \textit{S. aureus} (Turnidge et al. 2007). Thus, with the increased likelihood of treating and transporting older people, Australian paramedics could contribute to worsening morbidity and mortality of their patients if their IPC practice is poor.

### 2.5 Breaking the transmission of HAIs in paramedic-led healthcare

The inclusion of invasive medical procedures into the scope of clinical practice for paramedics has the potential to increase the risk of transmission of HAIs in paramedic-led healthcare. However, research into whether HAIs are being transmitted by paramedics is limited. Although paramedic-led healthcare is often improvised (Adams, Kuhnne & Schickle-Reim 1995), it does not excuse practice errors that may place patients and other EMS workers at risk of infection. For example, evidence suggests that paramedics have a poor understanding of infectious diseases (Eustis et al. 1995; Leiss, Sousa & Boal 2009; Shaban 2006; Shaban, Clark & Creedy 2004), have an increased prevalence of MDRO colonisation compared with that of the general population, and miss opportunities for hand hygiene (Bledsoe et al. 2014; Emanuelsson et al. 2013; Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015). A search of images in paramedic industry ‘grey literature’ also reinforces the view there may be misunderstanding of gloving practices in paramedicine (Figures 1, 2). Hence, it is vital that paramedics are cognisant of recommended IPC measures.
Research has led to numerous interventions to minimise the spread of HAIs in inpatient settings: improved hand hygiene (CDC 2002); the use of dedicated noncritical medical equipment (NHMRC 2010); increased environmental cleaning and disinfection of frequently touched surfaces such as fabrics, bedrails, charts, bedside commodes, doorknobs and keyboards (Bhalla et al. 2004; Smith & Rusnak 1997); self-sterilising medical equipment (Madkour & Tew 2008); and improved communication about patients with MDROs within and between healthcare facilities (Siegel et al. 2006). Many studies on successful MDRO control in healthcare facilities report that the facilities employed 7–8 different interventions concurrently or sequentially (Siegel et al. 2006). Nevertheless, breaches of the prescribed practices still occur and compliance with hand hygiene and environmental cleanliness are still concerning issues in

Correct hand hygiene, cleaning of medical equipment, and environmental hygiene are essential for the prevention and control of HAI transmission in the primary emergency healthcare setting. Paramedics can contaminate their hands with pathogenic microorganisms by touching a range of environmental surfaces and contaminated equipment (Bhalla et al. 2004). While the NHMRC guidelines (2010) recommend that ‘shared clinical equipment comes into contact with intact skin only’, this is unequivocally not the case in paramedic-led healthcare. High-touch areas and items in the paramedic workplace, such as medical and computerised monitoring equipment, handles, electronic notebooks, styluses, steering wheels, epaulettes, wrist watches and telecommunication equipment (e.g. mobile phones), may become contaminated with pathogenic microorganisms. Bacteria present on wrist watches can contaminate hands if the watch is manipulated (Jeans et al. 2010). Also, contamination of tap handles (Griffith et al. 2003) precludes the paramedic from using handwashing facilities in a patient’s home.

The problem of contamination may be compounded when paramedic care is provided in difficult situations, and if cleaning procedures are known to be inadequate. For instance, despite a level of routine cleaning, the patient care areas of both road ambulances and rotor-wing ambulances have been found to be contaminated with MDROs (Alves & Bissell 2008; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015). More concerning is that recent studies have found poor compliance (<31.6%, CI: 29.0–34.2) with disinfection of reusable medical items such as backboards, ECG monitors and cables, stethoscopes and ambulance interiors (Bledsoe et al. 2014). A study by Alves and Bissell (2008) noted that microorganisms in emergency vehicles were susceptible to the disinfectant agents in common use by the emergency service. Further, the study by Wepler et al. (2015) found the most persistent source of contamination were the areas in direct contact with patients or staff. These findings highlight issues with adherence to cleaning protocols. Although the need for routine cleaning in paramedic practice has been unequivocally demonstrated, concerns about governance remain, particularly about
the division of labour and who is responsible for the cleaning (Dumigan et al. 2010). Governance of cleaning has been an issue in other healthcare settings and should be explored in paramedic clinical practice.

Most ambulance services in Australia use disposable equipment items for patient care, which decreases the need to reprocess equipment between patient cases; however, some non-disposable medical equipment still requires assiduous cleaning. Laryngoscopes are one example. The use of reusable laryngoscope handles and inadequate reprocessing of rigid laryngoscopes can potentially transfer HAIs (Beamer & Cox 1999; Muscarella 2007; Muscarella 2008). For instance, in a recent hospital case in Britain, a laryngoscope handle was not cleaned between patients, which resulted in the cross-infection of up to six patients with Group A Streptococcus, killing one patient and making another three ill (Medicines and Healthcare Products Regulatory Agency 2011). Andrusiek et al. (2015) explored rates of pneumonia in patients after intubation by paramedics. While acknowledging some methodological limitations with this research, the multicentre observational cohort study found higher rates of pneumonia in patients intubated by paramedics than in patients with no invasive airway management. In paramedic practice, non-disposable laryngoscope handles that are poorly cleaned may further contaminate an airway kit in which they are stored. Also, laryngoscope blades are often taken out of packaging when stored in paramedic kits for ease of access in an emergency, which allows for environmental contamination. A solution for this issue may be garnered from the work of Chen et al. (2006), which shows the use of covers over laryngoscope blades may prevent HAI transmission during laryngoscopy.

A number of studies have demonstrated that paramedics are at risk of colonisation with MDROs, and have a higher risk of exposure to blood and body fluid. For example, Amiry et al. (2013) found EMS personnel had a significantly higher ($P = 0.0003$) prevalence of MRSA colonisation: 6.4% compared with a 1.5% prevalence among the general population. In addition, studies show paramedics consistently have a higher risk of exposure to blood and other body fluids during clinical practice (Boal, Hales & Ross 2005; Leiss, 2009; Leiss et al. 2006; Leiss, Sousa & Boal 2009), including a substantial risk of needle-stick injury or mucocutaneous exposure (1.2 per 10,000 calls) (Leiss et al. 2006). Moreover, paramedics have been found to handle sharps inappropriately in
emergency situations (Eustis et al. 1995; Shaban, Clark & Creedy 2004). This behaviour places them at risk of exposure to hepatitis B virus (HBV), hepatitis C virus (HCV) and HIV, which are the most commonly transmitted diseases through occupational injury in Australia (Whitby & McLaws 2002). This risk could be lowered through training, safety device usage, improved adherence to guidelines, substituting risky practices with those carrying less risk, and immunisation (Cullen et al. 2006).

An important area of organisational support for paramedics is immunisation against pathogens when vaccines are available. Immunisation decreases the carriage of pathogens that cause HAIs, protecting both the patient and the paramedic from infection. Nevertheless, immunisation for Australian paramedics is mostly voluntary, except for the mandatory HBV vaccination (Bonanni & Bonaccorsi 2001). Interestingly, firm evidence shows poor compliance among HCWs in relation to non-mandated vaccinations (Abramson & Levi 2008; Goldstein et al. 2004; Hopman et al. 2011; Lee, Carrillo & Fleming 1997; Loulergue et al. 2009). The reasons for this poor compliance are not well understood. Some evidence shows that HCWs believe immunisation is desirable (Abramson & Levi 2008), and that the immunisation of HCWs is associated with lower rates of sick leave (Chan 2007) and a substantial decrease in mortality among patients (Carman et al. 2000). However, international studies have reported a range of HCW immunisation rates, from less than 25% to as high as 65% (Abramson & Levi 2008; Burls et al. 2006; Hubble, Zontek & Richards 2011 ). A 2009 study found that, despite HCWs’ good risk perception and knowledge of acquiring vaccine-preventable diseases, and one-third of them reporting previous percutaneous or mucosal occupational accidents, only 36% were fully immunised (Dinelli et al. 2009). Apparently, immunisation rates in pre-hospital emergency service staff may be lower than rates in other HCWs. Two North American studies and one Swiss study found that the immunisation rates among pre-hospital emergency workers were below recommended values for influenza, ranging from 21% to 48% (Hubble, Zontek & Richards 2011 ; Moser et al. 2016; Rueckmann, Shah & Humiston 2009). These rates were considerably lower than the 65% of emergency department personnel in hospitals who indicated that they had been immunised (Rueckmann, Shah & Humiston 2009). Clearly, an understanding of the barriers to immunisation in pre-hospital emergency workers, including paramedics, is required.
From an ethical standpoint, efforts should be made to improve immunisation rates among paramedics. Paramedics have a duty of care to do no harm to their patients and thus should consider immunisation, especially when the risk of harm from HAIs is significant and the intervention to reduce this risk has a favourable balance of benefit over burden and risk. Mandatory requirements for paramedics to be immunised against all adult vaccine-preventable diseases would significantly improve staff and patient safety in accordance with workplace health and safety requirements, and would avoid the need for continuous interventions. This recommendation becomes especially important when the behaviour of paramedics during pandemics is considered. A survey of first-responders (paramedics) designed to determine if fear of infection would compromise their ability to care for patients potentially infected with smallpox found that 80% of paramedics surveyed would not remain on duty if no vaccine or suitable PPE were available (Mackler, Wilkerson & Cinti 2007). Although 91% of paramedics would remain on duty if they were fully protected, this number falls to 38% if the paramedic believed that his or her immediate family was not protected. The results of this survey are relevant to recent concerns about an influenza pandemic. The ‘Australian Prehospital Pandemic Risk Perception Study’ found that almost 50% of the national ambulance workforce would be unwilling to work in pandemic conditions, and that one-third would be unwilling to work with a partner who had been exposed to a known pandemic influenza (Tippett et al. 2008). Hence, every effort must be made to protect paramedics and their families from vaccine-preventable diseases to maintain a viable workforce.

No national agreements or governing bodies oversee IPC in the Australian paramedic work environment. Instead, the ambulance service in each state and territory has developed its own standards, criteria and standard operating procedures for IPC that may be benchmarked against state or national policy documents, such as those produced by DoHA (2004) and the NHMRC (2010). Major risk factors specific to paramedic practice need to be determined in order to develop appropriate national quality management procedures for IPC. When paramedics are registered as health professionals, as expected by Q3 2018, relevant quality standards for IPC practices could be established by the registration authority.
2.6 Shifting practices: risk management of HAI transmission in paramedic practice.

In 2010, the NHMRC released the updated *Australian Guidelines for the Prevention and Control of Infection in Healthcare*. These guidelines reflect a risk management approach for IPC that involve work practices to prevent the transmission of pathogenic microorganisms through a two-tiered approach of standard and transmission-based precautions. Risk, in terms of IPC, is defined by the NHMRC (2010) as ‘the possibility of acquisition or infection of patients or healthcare workers arising from activities within a healthcare facility’. While understanding how the transmission of pathogens occurs and when to apply particular practices is critical for IPC, other issues must be considered with regard to risk management. To manage IPC, the NHMRC (2010) recommends the use of the Australian/New Zealand Standard on Risk Management AS/NZS ISO 31000:2009 (hereafter referred to as the AS/NZS ISO 31000:2009).

Consistent with this advice, the Australian ambulance services use the AS/NZS ISO 31000:2009 standard for risk management. The AS/NZS ISO 31000:2009 standard considers risk as the effect of uncertainty on objectives (Purdy 2009), and a calculation of the consequences should something happen and the likelihood of those consequences.

While the AS/NZS ISO 31000:2009 is applicable to standardised, static workplaces such as hospitals and long-term aged care facilities, it does not serve as an effective IPC framework in a largely uncontrolled environment such as the primary emergency healthcare setting. This paramedic workplace requires entrepreneurship and lateral thinking when providing primary emergency care. For paramedic practice, the AS/NZS ISO 31000:2009 standard starts with the questionable premise that paramedics are actually in a position to ‘identify risks’, which is a step that involves identifying the pathogen involved, how is it transmitted, and who is at risk. Pragmatically, a paramedic cannot answer this question with any certainty and cannot complete the risk matrix to determine levels of risk. Arguably, the focus of risk management for a paramedic working in an uncontrolled environment needs to shift from quantifying risk to targeting those processes that would lower risk in general. This view is based on the premise that any transmission of HAIs is unacceptable.
The deficit model juxtaposes objective scientific risk appraisal and lay perceptions of risk judgement (Tippett et al. 2008). Experts tend to judge risk in terms of technical estimates, such as likelihood, whereas lay people who lack the technical knowledge to make such judgements view risk in terms of consequence. This traditional approach to risk appraisal is unhelpful in terms of IPC for paramedics. The changes in healthcare provision – patients are discharged from hospital earlier, the elderly and disabled are treated in the community for as long as possible, and paramedic practice has become more sophisticated – have increased the complexity of IPC decisions. The professional paramedic may or may not have the knowledge and skill necessary on a case-by-case basis to appraise and manage risk effectively in this paradigm.

An alternative risk management framework is the Hazard Analysis and Critical Control Point (HACCP) system. HACCP forms the basis for risk-based guidelines in the areas of food safety and drinking water, and may inform an improved approach towards IPC in the emergency primary healthcare setting. The HACCP system is an internationally recognised risk management framework used by the food safety industry (Australian Quarantine and Inspection Service 2005; Bryar 2000; Hulebak & Schlosser 2002). HACCP is concerned primarily with systematically identifying hazards and describing measures for their control to ensure safety (Australian Quarantine and Inspection Service 2005; Food and Agriculture Organization of the United Nations 1993). In other words, it is a systematic approach to the identification and prevention of hazards, with a particular focus on process control to ensure that preventive measures are operating effectively (NHMRC 2011). The HACCP system provides the greatest assurance of safety while reducing dependence on finished product sampling and testing (Hulebak & Schlosser 2002).

To improve paramedic compliance with IPC guidelines, an understanding of cognitive factors that shape behaviour is necessary. The risk management processes used by ambulance services must take account of how people think about and respond to risk; without this understanding, well-intended policies and procedures may be ineffective. Risk perception influences all paramedic behaviour, including IPC practices. Because HAIs mostly result from inappropriate patient-care practices causing cross-transmission,
improving practices implies behaviour modification. The application of social cognitive
models from the social sciences could lead to a better understanding of IPC behaviours.

There are many theories used to explain health behaviour and the ways to modify these
behaviours (Gilbert & Sawyer 2000). The most relevant models of the last 50 years
have been the Theory of Reasoned Action, the Health Belief Model, the
Transtheoretical Model and Social Learning Theory (Gilbert & Sawyer 2000). Social
learning theory is presented as the dominant contemporary theory because it addresses
the underlying determinants of health behaviour and methods of promoting change
(Nutbeam & Harris 1998). This model emphasises the dynamic relationship between the
individual, their behaviour and the environment, and involves four constructs: reciprocal
determinism, expectations, self-efficacy and behavioural capability. In addition,
planning models for health interventions exist at a macroscopic level and serve as an
organising framework for encouraging behaviour-change. A widely applied model is the
PRECEDE-PROCEED planning model (Glasgow 2011; Green & Kreuter 2005). Shown
in Figure 3, this model uses the constructs of predisposing, reinforcing and enabling
factors as determinants of behaviours (Green & Kreuter 2005). Some of these social
cognitive theories and models have been applied to understand or evaluate predictors of
health behaviour but have rarely been applied to behaviour in the field of IPC (Pittet
2004). Intuitively, one would expect interventions informed by social models that
incorporate or acknowledge multiple cognitive determinants to be more successful in
understanding and changing behaviour.

Figure 3: Selected dimensions of the PRECEDE-PROCEED model, adapted from Green and Kreuter
(2005)
2.7 Conclusion

The prevention and control of HAIs remain an international priority due to the attributed financial and social burden. All healthcare agencies, including ambulance services, are affected by the emergence and transmission of HAIs, particularly those caused by bacterial strains resistant to commonly used antibiotics (Siegel et al. 2006). A combination of factors, including organisational pressures to respond to an increased number of cases, the hostile work environment, and an aging client base is likely to contribute to a higher risk of transmission of HAIs in the paramedic workplace.

Research into the IPC practices that are most appropriate for the paramedic workplace is limited. Existing research concerning HAIs emphasises the role of standard and transmission-based precautions, together with organisational support, in breaking the cycle of transmission and infection. Furthermore, the research findings from all health areas demonstrate that the transmission of HAIs is a complex issue that requires a multifaceted approach to prevention and control. The available scientific research into paramedic practice suggests that there are issues with paramedics’ knowledge of standard IPC definitions and infectious diseases, and IPC practices. These issues suggest that significant but undetected breaches of IPC policy and procedure may be occurring.

The paramedic workplace needs to be managed appropriately. It requires focussed attention on risk management through consideration of critical control points and defined critical limits within practices. Strategies for IPC must recognise all of the factors that influence behaviours. Improving IPC practices can be approached in three ways: educational, policy and social-marketing approaches (Mah & Meyers 2006). The educational approach of disseminating information to bring about individual change is entirely voluntary. For example, wash your hands and your patients will have fewer HAIs. The policy approach coerces compliance with desired behaviour through punitive measures. For example, mandatory immunisation (no jab, no job) or, if you neglect to wash your hands before performing an invasive procedure, you will be reported for breaching clinical guidelines. Finally, the social marketing approach influences and then builds on a paramedic’s perceptions, values and needs to promote the desired behaviours; for example, professional paramedics wash their hands.
Research is required to examine the predisposing, reinforcing and enabling forces that influence paramedic behaviours regarding practices for IPC. Exploring Australian paramedics’ self-reported behaviours and perceptions (beliefs and attitudes) in relation to IPC practices in the paramedic-led healthcare will provide critical insights to inform the design, implementation and evaluation of multimodal programs to promote improved IPC practices among paramedics.
3. **Methodology and research design**

The previous chapter described the warrant for this research project. This chapter describes the research design that was adopted to investigate the research questions stated in Chapter 1, Section 1.2. Section 3.1 discusses the philosophical approach underpinning the purpose of the research and the methodology used; Section 3.2 discusses the research strategy and develops further the four research questions for the thesis; Section 3.3 discusses the methods and stages by which the research methodology was implemented. This section also provides an explanation of how the survey of Australian paramedics on their infection prevention and control (IPC) practices was developed, and how the findings of the survey were triangulated with the findings from two semi-structured discussions in small focus groups. Section 3.4 outlines the procedures selected to analyse the structured and unstructured research data. Section 3.5 details the ethical clearance granted for the research project. Section 3.6 outlines the limitations of the research described in this thesis.

### 3.1 Philosophical approach

The purpose of this research was to investigate the self-reported behaviours and perceptions (beliefs and attitudes) of Australian paramedics regarding their IPC practices in paramedic-led healthcare. Given that the focus of this research was exploring the prevailing culture reflected in the behaviours, beliefs and attitudes of professional paramedics, an ethnographical perspective was warranted.

Social constructivism holds that people direct particular meanings towards objects or phenomena through developing subjective meanings of their experiences (Creswell 2009). The meanings that individuals attribute to objects and phenomena are formed through actions with others and through the historical and cultural norms that operate in an individual’s life. According to Creswell (2009), the goal of social constructivist research is to explore the participants’ perceptions on the situation being studied to interpret the meanings others’ hold about the world. Further, Crotty (1998) notes that constructivist research focuses on the context in which people live and work in order to
understand the cultural setting of those subjects, because the generation of meaning arises in and out of interaction with a human community.

To explore these cultural dimensions, the research must draw on the direct experiences and perceptions of those who work in the areas of paramedic-led healthcare and IPC; that is, the lived experiences and the meaning and value that people give to their practices. By grounding this research in the lived experiences of paramedics and IPC experts, the results should form a basis for the design of appropriate interventions to reduce the transmission of HAIs by paramedics.

3.2 Research strategy

The purpose of this research warranted a strategy based on a sequential exploratory mixed-methods approach. This approach has been described as using both qualitative and quantitative data collection and analysis to expand on the findings of one method with another method (Creswell 2009; Tashakkori & Teddlie 2010). The focus of sequential exploratory mixed methods is primarily to explore a phenomenon and is based on the assumption that collecting diverse types of data will lead to a better understanding of the research problem (Creswell 2009). This strategy was chosen to align with the purpose of exploring a particular professional group (paramedics) in order to gain an insight and expanded understanding of IPC practices in paramedic-led healthcare.

The sequencing of the mixed methods was an important consideration in the planning for this study. To address the purpose of the research, four research questions were posed:

1. How do the IPC guidelines provided to paramedics by different Australian ambulance services align with national IPC guidelines? This question formed the basis of Study 1 and was explored through a content analysis of IPC standard operating procedures and policy documents provided by Australian ambulance services and comparison with the NHMRC 2010 guidelines (NHMRC 2010).
2. What are the views of healthcare professionals and academics from a variety of healthcare disciplines regarding the IPC practices of Australian paramedics and the adequacy of IPC guidance provided to paramedics? This question formed the basis of Study 2 and was explored through semi-structured interviews with IPC specialists, senior paramedic educators and managers, infectious disease experts, academics and researchers.

3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics. The findings from studies 1 and 2 were used to inform the development of the questionnaire for Study 3.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey? This question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.

3.3 Methods

The previous section outlined the general approach to the research process: a mixed-methods research project grounded in social constructivism. The specific strategies (research methods) used in conducting the research are now described in detail.

3.3.1 Study 1: Content analysis of ambulance IPC documents and their alignment with national IPC guidelines

This study compared the uniformity of IPC guidelines provided to paramedics by different Australian ambulance services against the contemporary national guidelines. Content analysis was selected for this exploratory study because its purpose was to compare the alignment of IPC guidelines, standard operating procedures, and policies
that are used by the various ambulance services in Australia with the contemporary national guidelines. In October 2010 the Department of Health and Aging’s *Infection Control Guidelines for The Prevention of Transmission of Infectious Diseases in the Healthcare Setting* were rescinded on release of the National Health and Medical Research Council (NHMRC 2010) *Australian Guidelines for the Prevention and Control of Infection in Healthcare* (herein referred to as the NHMRC 2010 guidelines. As such, the NHMRC 2010 guidelines were used for the content analysis.

Stemler (2001) describes content analysis as a systematic and replicable technique that compresses many words of text into fewer content categories based on explicit rules of coding. Content analysis is used to analyse a large amount or broad range of textual data in the clinical and social sciences because it is useful for examining trends and patterns in documents that can help to inform research (MacNamara 2006; Stemler 2001). The approach taken for content analysis was informed by the five sequential steps described by Chelimsky (1989): determine what material to include in the content analysis; select units of analysis; develop coding categories; code the material; and analyse and interpret the results.

For this study, conducted in the second quarter of 2010, the eight Australian ambulance service members of The Council of Ambulance Authorities (CAA) were invited to provide an electronic copy of their operating procedures (e.g. guides, manuals, policy documents) that informed the recommended IPC practices for paramedics working under their jurisdiction.

3.3.2 Study 2: Semi-structured interviews with key informants about IPC practices in paramedic-led healthcare

This study explored the views of Australian healthcare and academic experts from a variety of healthcare disciplines regarding IPC practices in paramedic-led healthcare. Semi-structured interviews were selected to explore the views of experts about the IPC practices of Australian paramedics and the adequacy of the IPC operating procedures provided by ambulance services. This strategy also enabled the interviewer to adapt,
modify and add to the planned themes in response to the interview conversation (DiCicco-Bloom & Crabtree 2006).

Snowball sampling, a type of purposive sampling as described by De Poy and Gitlin (2010), was used to select individuals who had significant involvement with the development of relevant IPC operating procedures. The first experts invited to participate were prominent members of Australian professional associations for IPC. Thereafter, experts from academia, various levels of government, and private consultants were recruited.

Four major topics were used to structure the interview:
1. The scope and adequacy of the key documents that underpin IPC practices for paramedics in Australia;
2. How the IPC practices of paramedics may differ from those within the hospital environment;
3. Hand and environmental hygiene practices in the primary-emergency healthcare setting; and
4. The adequacy of processes for the notification of paramedics who had been exposed unknowingly to patients with communicable diseases.

One hour telephone or in-person interviews were conducted with participants and recruitment was stopped when no new information was gained (De Poy & Gitlin 2010; DiCicco-Bloom & Crabtree 2006).

3.3.3 **Study 3: National online survey of Australian paramedics about their behaviours and perceptions regarding IPC practices**

This study involved the development of an online self-administered questionnaire used to survey Australian paramedics about their self-reported behaviours and perceptions regarding IPC practices in paramedic-led healthcare. The Survey of Paramedics on Infection Control (SoPIC) was a comprehensive custom-designed survey that targeted the four broad IPC areas of hand hygiene and gloving practices, environmental hygiene, aseptic technique and clinical governance.
Questionnaire development

The process outlined by De Vaus (2002) was used to develop the questionnaire. The first step was to identify and list the concepts to be included in the survey. De Vaus (2002, p. 43) defines concepts as ‘abstract summaries of a whole set of behaviours, attitudes and characteristics which we see as having something in common’. Next, nominal definitions were constructed through a literature review and the concepts unpacked by identifying relevant dimensions. The variables and indicators required to move from the abstract to the concrete were then developed. At this point, it was decided to limit the breadth of exploration to only those dimensions that increased risk of HAI transmission to patients, rather than to the paramedics themselves. This limitation allowed completion of the survey within 20 minutes in order to minimise participant dropout. Because the study did not identify any suitable validated surveys in the topic area, indicators were developed by evaluating previously published research. The final step was to pilot the instrument.

The development of the SoPIC questionnaire was informed by the findings of the content analysis in Study 1 and the responses obtained from key informants during Study 2, in conjunction with a wider literature review. Chapter 4 describes and discusses the results from studies 1 and 2. Section 4.3.1 also describes the areas of discrepancy between the nature of the advice provided in the state ambulance IPC operating procedures and the NHMRC 2010 guidelines for both standard and transmission-based precautions, and for organisational support. In addition, Appendix B shows the emerging themes for the survey that arose from the semi-structured interviews. The results from studies 1 and 2 indicated that the concepts that warranted inclusion in the survey were hand hygiene compliance, gloving practices, environmental hygiene, aseptic technique and clinical governance.

The grouping of themes, constructs and variables in the SoPIC questionnaire was determined using the paradigms of predisposing, reinforcing and enabling factors as described in both Social Learning Theory and the PRECEDE-PROCEED planning model (Crosby & Noar 2011; Glasgow 2011; Green & Kreuter 2005). The SoPIC questionnaire contained both open-ended and closed questions eliciting both textual and
non-textual data. The content frame used to develop the specific questions in the SoPIC instrument (Table 5) was based on advice from De Vaus (2002).

<table>
<thead>
<tr>
<th>Content area</th>
<th>Item type</th>
<th>Statement</th>
<th>Response choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belief (what people believe is true/false)</td>
<td>Nominal</td>
<td>Indicate your preferred choice</td>
<td>Agree or Disagree</td>
</tr>
<tr>
<td></td>
<td>List</td>
<td>Indicate all that apply</td>
<td>A, B, C, etc.</td>
</tr>
<tr>
<td>Attitude (what people think is desirable)</td>
<td>5-point Likert</td>
<td>Indicate your level of agreement with the statement</td>
<td>1  Strongly disagree</td>
</tr>
<tr>
<td></td>
<td>List</td>
<td>Indicate all that apply</td>
<td>A, B, C, etc.</td>
</tr>
<tr>
<td>Knowledge (accuracy of beliefs – declarative theory)</td>
<td>Multiple choice questions</td>
<td>Indicate your preferred choice</td>
<td>A, B, C etc.</td>
</tr>
<tr>
<td>Behaviour (what people do)</td>
<td>3-point Likert scale</td>
<td>Indicate your preferred choice</td>
<td>1  Never</td>
</tr>
<tr>
<td></td>
<td>5-point Likert scale</td>
<td>Indicate your preferred choice</td>
<td>1  Never</td>
</tr>
<tr>
<td></td>
<td>Binomial</td>
<td>Indicate your preferred choice</td>
<td>Yes  No</td>
</tr>
<tr>
<td></td>
<td>Nominal</td>
<td>Indicate your preferred choice</td>
<td>A, B, C etc.</td>
</tr>
<tr>
<td>Demographic variables</td>
<td>Continuous/ordinal</td>
<td>Indicate your preferred choice</td>
<td>Scalar</td>
</tr>
<tr>
<td></td>
<td>Nominal</td>
<td>Indicate your preferred choice</td>
<td>A, B, C etc.</td>
</tr>
</tbody>
</table>

*Note:* adapted from De Vaus (2002).

**Piloting of the questionnaire**

The SoPIC questionnaire was piloted following the recommendations of De Vaus (2002) with a small convenience sample from across Australia that included a senior ambulance manager, 10 practising paramedics, 3 paramedic educators, 5 university paramedic academics and 2 IPC experts. The participants for the pilot were selected for two important reasons: first this group resembled those to whom the final questionnaire was administered; second, this group had good knowledge of paramedicine and would highlight questions that would be valuable for tapping the desired concepts and high light problems with language and alert to misunderstandings about the group. Piloting enabled improvement of construct validity, refinement of the question stems and response choices, and ensured that the questionnaire could be completed within 20 minutes. Construct validity was assessed through discussions with pilot participants,
written feedback received, and responses to items. Post-pilot changes to the questionnaire’s functionality were tested online before going live.

Table 6 shows a summary of the constructs, variables or variable groupings and questions details in the final SoPIC instrument. Screen shots of the SoPIC survey are provided in Appendix D.

**Participants and data collection**

To obtain a national perspective, paramedic members of Paramedics Australasia (PA) in each state and territory were surveyed about their professional behaviours and perceptions (beliefs and attitudes) regarding IPC in paramedic-led healthcare. PA was chosen as it is the lead organisation for professionals employed in the delivery of pre-hospital emergency primary healthcare in Australia and is a national platform for policy development in paramedic practice. Choosing this population also protected the anonymity of individual Australian ambulance services. In September 2013 the PA had 2449 financial (active) paramedic members (Hall 2013). Most of the communication with PA members was conducted electronically, either through information posted on the official PA website or via emails. For this reason, the SoPIC was developed as an online, self-administered questionnaire.
<table>
<thead>
<tr>
<th>Theme 1: Demographic variables</th>
<th>Constructs</th>
<th>Variable or variable group</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Universal demographics</strong></td>
<td>Gender</td>
<td>Item 173, binary, 2 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>Item 174, ordinal, 7 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethnicity</td>
<td>Item 175–176, categorical, 9 options + comments</td>
<td></td>
</tr>
<tr>
<td><strong>Paramedic training</strong></td>
<td>Competency-based training</td>
<td>Item 160, categorical, 6 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education level</td>
<td>Item 181–182, 7 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre- or post-employment training</td>
<td>Item 183, binary, 2 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time since first qualification</td>
<td>Item 184, continuous</td>
<td></td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td>Current clinical practice level</td>
<td>Item 177–178, categorical, 9 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current paramedic crew structure</td>
<td>Item 179–180, categorical, 3 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employer type</td>
<td>Item 187–188, categorical, 6 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Employer location</td>
<td>Item 189–190, categorical, 9 options + comments</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Skin irritation from IPC products</td>
<td>Item 190–195, categorical, 5 options</td>
<td></td>
</tr>
<tr>
<td><strong>Theme 2: Self-reported IPC behaviours</strong></td>
<td>General</td>
<td>Change in general IPC practice with an infectious patient</td>
<td>Item 2–3, binary, 2 options + comments</td>
</tr>
<tr>
<td><strong>Hand hygiene and gloving</strong></td>
<td>Use of ABHR to sanitise gloves</td>
<td>Item 18, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of hand hygiene episodes at defined moments</td>
<td>Item 19–26, ordinal, 5 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hand and wrist wear</td>
<td>Item 27–32, ordinal, 5 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length of fingernails</td>
<td>Item 33, binary, 2 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triggers for changing gloves during clinical care</td>
<td>Items 34–42, categorical, 8 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of writing on gloves</td>
<td>Item 43, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hand hygiene and gloving during emergency and non-emergency situations</td>
<td>Item 44–52, categorical, 5 options + comments</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental hygiene</strong></td>
<td>Responsibility for environmental hygiene</td>
<td>Item 53–54, 57–58, binary, 2 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triggers for environmental hygiene</td>
<td>Item 55–56, binary, 2 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of deep cleaning</td>
<td>Item 60–61, categorical, 9 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Records of cleaning</td>
<td>Item 62–65, binary, 2 options; categorical 4, options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleaning process for noncritical medical equipment</td>
<td>Item 66–68, comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Process for spills management</td>
<td>Item 69–72, binary, 2 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>General cleaning process</td>
<td>Item 73, categorical, 6 options</td>
<td></td>
</tr>
<tr>
<td><strong>Aseptic non-touch technique</strong></td>
<td>Compliance with ANTT®</td>
<td>Item 74–81, 3-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Managing breaches of ANTT®</td>
<td>Item 82–90, categorical, 8 options + comments</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical governance</strong></td>
<td>Finding contamination</td>
<td>Item 6–17, categorical, 9 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleaning records</td>
<td>Item 62–63, binary, 2 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Actions taken when a breach of ANTT® is identified</td>
<td>Item 82–90, categorical, 8 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Actions taken when a breach of environmental hygiene is identified</td>
<td>Item 91–97, categorical, 6 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency uptake immunisation</td>
<td>Item 98–108, categorical, 11 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual influenza immunisation uptake</td>
<td>Item 109, categorical, 6 options</td>
<td></td>
</tr>
<tr>
<td>Constructs</td>
<td>Variable ¹</td>
<td>Details</td>
<td></td>
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<td>------------</td>
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<tr>
<td><strong>Theme 3: Perceptions regarding IPC</strong></td>
<td></td>
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<tr>
<td><strong>General</strong></td>
<td>Confidence with own IPC practices</td>
<td>Item 1, categorical, 3 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of observing other paramedic’s hand hygiene prior to intravenous cannula insertion</td>
<td>Item 5, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Relevance of IPC standard operating procedures</td>
<td>Item 120, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Accessibility of IPC guidelines</td>
<td>Item 121, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bare below the elbows policies</td>
<td>Item 137–138, 3-point Likert scales</td>
<td></td>
</tr>
<tr>
<td><strong>Hand hygiene and gloving</strong></td>
<td>Importance of defined moments for performing hand hygiene</td>
<td>Item 111–117, 3-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barriers to performing hand hygiene during clinical care</td>
<td>Item 118–119, binary, 2 options + comments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opinion on whether gloving obviates hand hygiene</td>
<td>Item 4 &amp; 122, binary, 2 options + 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td><strong>Environmental hygiene</strong></td>
<td>Cleanliness of clean patient care areas</td>
<td>Item 123, 140, 141, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleaning shared medical equipment</td>
<td>Item 124, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>P2 mask use</td>
<td>Item 125, 5-point Likert scale</td>
<td></td>
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<td></td>
<td>Triggers for cleaning</td>
<td>Item 56, 139, 5-point Likert scale + comments</td>
<td></td>
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<tr>
<td></td>
<td>Correct cleaning order</td>
<td>Item 142, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Awareness of operating procedures</td>
<td>Item 55, 143–148, binary 2 options and categorical 3 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barriers to performing environmental hygiene</td>
<td>Item 149–154, categorical, 5 options + comments</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical governance</strong></td>
<td>Importance of self-exclusion period with a communicable illness</td>
<td>Item 127, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance of managers excluding staff with a communicable illness</td>
<td>Item 128, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Availability of IPC equipment</td>
<td>Item 129, 5-point Likert scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance of reporting of breaches in environmental hygiene practices</td>
<td>Item 130, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Frequency of managers investigating breaches in IPC</td>
<td>Item 131, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Peers mentoring colleagues after IPC breaches</td>
<td>Item 132, 5-point Likert scale</td>
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<tr>
<td></td>
<td>Accreditation for IPC</td>
<td>Item 133, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Paramedic responsibilities for IPC</td>
<td>Item 134, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Stopping breaches of ANTT®</td>
<td>Item 135, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Importance of immunisation</td>
<td>Item 156, 5-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Record of immunisation</td>
<td>Item 157, categorical, 3 options</td>
<td></td>
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<tr>
<td></td>
<td>Mandatory immunisation</td>
<td>Item 158, categorical, 3 options</td>
<td></td>
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<tr>
<td></td>
<td>Employer provided immunisation</td>
<td>Item 159, categorical, 3 options</td>
<td></td>
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<tr>
<td></td>
<td>Being informed of additional precautions for infectious patients</td>
<td>Item 155–156, binary, 2 options + 3-point Likert scale</td>
<td></td>
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<tr>
<td></td>
<td>Receipt of competency-based training</td>
<td>Item 160–165, categorical, 6 options</td>
<td></td>
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<tr>
<td></td>
<td>Workplace access to IPC guidelines/procedures</td>
<td>Item 166–171, categorical, 6 options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additions to IPC guidelines/procedures</td>
<td>Item 172, comment</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** SoPIC, Survey of Paramedics on Infection Control; IPC, infection prevention and control; ABHR, alcohol-based hand rub; ANTT® aseptic non-touch technique.

¹The variable column shows variable groupings. A group of variables is indicated by multiple items attached to the variable group listed. For example, frequency of hand hygiene performed at defined moments during patient care has one question for each variable.
Questionnaire administration

The company chosen to host the pilot and final online questionnaire was Clearwater Software Pty/Ltd, a recognised and reputable Australian internet survey company. The questionnaire responses were collected via a set of web-based forms and the data were written to a server-side database as each page was submitted. Participants were able to return to any previous page and modify responses until the final page of the questionnaire was submitted. The completed questionnaire forms were retained in a secure database coordinated by Clearwater Software Pty/Ltd. The database contents were uploaded by the author through a password-protected administrative web page.

The final survey was open for approximately four weeks in 2013 (8th July – 8th August) and advertised through the PA administrators contacting their membership with an email invitation to participate in the survey. The invitation was followed by weekly reminders until the fourth week. In the fourth week there were no further participants recruited for a period of 6 days following a reminder; as such the survey was closed.

3.3.4 Study 4: Focus group interviews with Australian paramedics about their behaviours and perceptions regarding IPC practices

This study explored further the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare through two semi-structured focus groups. Focus groups provide a powerful strategy for qualitative data collection that yield deep insights into meaning, rather than measurement (Punch 2009; Stewart & Shamdasani 2015). The findings from Study 4 were triangulated with the findings from the SoPIC in Study 3. Triangulation is defined by Punch (2009, p. 296) as obtaining ‘complementary quantitative and qualitative data on the same topic, bringing together the different strengths of the two methods’. In this research, the data from studies 3 and 4 were collected sequentially and then brought together at the interpretation-of-results stage.
Format of focus groups
Discussion topics during the focus groups were aligned with the major themes in the SoPIC questionnaire: hand hygiene and gloving practices; environmental hygiene; aseptic technique; and clinical governance. Three a priori themes guided the semi-structured focus group discussions (Table 7). This strategy enabled the interviewer to adapt, modify and add to the planned themes in response to the group discussion (DiCicco-Bloom & Crabtree 2006).

Table 7: Themes used to guide the discussion during the semi-structured focus groups

<table>
<thead>
<tr>
<th>Theme</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Difficulties with maintaining IPC practices during paramedic-led healthcare in Australia</td>
</tr>
<tr>
<td>2</td>
<td>Adequacy of IPC practices of Australian paramedics</td>
</tr>
<tr>
<td>3</td>
<td>Suggestions that could improve IPC practices in paramedic-led healthcare in Australia</td>
</tr>
</tbody>
</table>

Note: IPC, infection prevention and control.

Stimuli and prompts were used to structure the two focus groups (Table 8). Stewart and Shamdasani (2015) describe the use of aides to encourage discussion on particular topics during focus groups. Three short video vignettes of 1–2 minutes that depicted usual paramedic operational events were used to sensitise participants and stimulate discussion about each topic. The vignettes were selected and edited from the Special Broadcasting Service (SBS) Help documentary (episodes 1 and 6) available for public access on the SBS Australia YouTube channel (Special Broadcasting Service 2007).
Table 8: Stimuli and prompts used in the focus groups

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Purpose, content and related themes from Table 7</th>
</tr>
</thead>
</table>
| Video 1  | **Purpose:** to sensitise participants for discussion around glove use and the concept of hand hygiene  
Content: the video showed the primary officer putting gloves on in the car and the driver not wearing gloves. In the scene the video shows that one crew member is wearing gloves and the other is not.  
**Questions and related theme**  
- For what purpose(s) are gloves worn? (Theme 2)  
- When do you don gloves? (Theme 1+2)  
- When do you change gloves? (Theme 1+2)  
- What are the barriers to changing gloves? (Theme 2)  
- What are the difficulties with glove use? (Theme 1)  
- Does the use of gloves obviate the need for hand hygiene? (Theme 2)  
- When do you perform hand hygiene? (Theme 1+2)  
- Does the 5 moments of hand hygiene apply to paramedicine? (Theme 1+2) |
| Video 2  | **Purpose:** to sensitise participants for discussion around preparing for an IV cannulation and associated aseptic technique  
Content: the video showed a paramedic searching in a bag for items with gloves on and the injection of IV glucose and flushes.  
**Questions and related theme**  
- How do you do perform IV cannulation safely and cleanly? (Theme 1+3)  
- How do you avoid spreading pathogens to your patients when performing IV cannulation? (Theme 1+3)  
- No hand hygiene is seen in the video for IV cannulation. Is this normal practice? (Theme 2)  
- What is your process for IV cannulation? (Theme 1,2+3) |
| Video 3  | **Purpose:** to sensitise participants for discussion around cough etiquette and the role of immunisation  
Content: the video showed a coughing female patient who was recently discharged from hospital after treatment for a chest infection. The video also showed the patient receiving nebulised salbutamol and ipratropium bromide while the paramedic was not wearing a P2 mask.  
**Questions and related theme**  
- Are you worried about becoming sick when treating patients with an infectious disease? (Theme 2)  
- Should paramedics wear masks while providing patient care? (Theme 2)  
- Should immunisation against vaccine-preventable diseases be mandatory for paramedics? Who would benefit from this? (Theme 2+3)  
- Is there a process for notifying paramedics who have been in contact with an infectious patient? (Theme 2) |
| Closing questions | **Purpose:** to explore perceptions on training  
**Questions and related theme**  
- What information would you like to see and in what format? (Theme 3)  
- Would a national detailed IPC document be helpful? (Theme 3)  
- How do you access IPC guidelines? (Theme 2+3) |

**Note:** IV, intravenous; ANTT®, aseptic non-touch technique; IPC, infection prevention and control.

**Participants and data collection**

According to Stewart and Shamdasani (2015) data yielded by focus groups can be the product of social dynamics within the group. Therefore, participants for the two semi-structured focus groups conducted during Study 4 were self-selected from an email sent from PA administrators to their members. Participation was voluntary, and data were de-identified. Secondary inclusion criteria were not used because the number of eligible applicants did not exceed the number required for each focus group. The two focus
groups were held before continuing professional development activities of PA; the first was held before a community paramedicine workshop in June 2015, and the second before the PA International Conference in October 2015.

The group interaction was directed by the stimuli explained in Table 8. The researcher in the group acted in the roles described by Punch (2009) of facilitator, moderator, monitor and recorder of the group interaction. In doing so, the researcher tried to gain insights that participants were less likely to share through the SoPIC instrument.

Group cohesiveness was expected due to similarity of professional backgrounds and a discipline with a paramilitary culture (O’Meara & Reynolds 2009). However, to ensure interaction by all members in the focus groups, the interviewing style varied from nondirective to directive. The change in style from time to time ensured all participants had an opportunity to speak, as well as ensuring that discussions of topics not moved along spontaneously could be directed or introduced.

The physical environment of the focus group environment also influences the level of rapport and participation. For example, Stewart and Shamdasani (2015) argue that group interaction in a small room can be more intense and have a greater range of opinions than in a larger room. Furthermore, within these spaces seating arrangements can also influence the degree of participation and patterns of interaction. For Study 4, rooms that were fit-for-purpose were selected to hold the two focus groups. To encourage discussion the seating was arranged in a circle, which maximised the opportunity for eye contact among all group members, including the moderator. The video vignettes described in Table 8 were used to sensitise the participants to the topics of interest. In addition, the audio from the focus groups were recorded; comments were already public in this group setting and thus not expected to affect engagement.

3.4 Data analysis
The approach to analysis was determined by both the type of data that were collected and the research questions. Descriptions are provided of how both the unstructured (textual/qualitative) and structured (non-textual/quantitative) data were analysed.
3.4.1 Unstructured data analysis

In the four studies, thematic analysis was chosen to examine the textual data in order to explore the experiences and perceptions of participants regarding IPC practices in paramedic-led healthcare. The method used has been described by multiple authors (Chelimsky 1989; Cousin 2009; Krippendorf 2004; MacNamara 2006; Stemler 2001; Tashakkori & Teddlie 2010). The data in each study were compared for points of consistency through an interactive process of describing, classifying and connecting information using the *a priori* and *inductive* codes.

**Study 1**

Content analysis based on dichotomous or presence-absence coding (Tashakkori & Teddlie 2010) was used to evaluate the degree of alignment among ambulance service operating procedures, as well as the alignment of procedures with the NHMRC 2010 guidelines. This approach was also used to investigate if there were differences in the level of obligation in guidelines.

Documents were imported into NVivo Version 10 (QSR International) for analysis. To guide the dichotomous coding of the degree of alignment between the ambulance operating procedures and the NHMRC 2010 guidelines, a set of *a priori* codes were selected from the key words and terms found on the contents pages of the NHMRC 2010 guidelines. Specifically, terms within parts B1 and B2 of the NHMRC 2010 guidelines were used to serve as initial anchors within the data (Tashakkori & Teddlie 2010). These anchors provided a broad base of issues around which to compare to documents. Inductive codes (Stemler 2001) were added as new themes emerged during data analysis. To analyse modality only inductive codes were used.

**Studies 2 to 4**

All semi-structured interviews and focus groups were recorded, transcribed verbatim and checked for accuracy before being imported into NVivo Version 10 (QSR International). In these studies, data were individually coded using both the *a priori* and *inductive* codes. Then the coded text was compared for points of consistency through an interactive process of describing, classifying and connecting information (Cousin 2009; De Poy & Gitlin 2010; Stemler 2001; Tashakkori & Teddlie 2010). The method used
the process described by Tashakkori and Teddlie (2010) of grouping codes based on similarities to each other into concepts, and then concepts based on similarities with each other into themes. Appendix B shows the coded text from transcripts of the semi-structured interviews conducted for Study 2. The coded text has been grouped into the themes which emerged from Study 2 and informed the design of Study 3. In addition, quotes used in the presentation of the findings from Study 2 (Chapter 4) have been selected from the coded text shown in Appendix B.

3.4.2 Structured data analysis

The structured non-textual based data (categorical, ordinal and Likert scale) were summarised using descriptive statistics. Inferential statistics were used to test for associations between variables with Pearson chi-square tests, Fisher’s exact test for independence, and the McNemar test, as appropriate. Logistic regression models were fitted to compute adjusted $P$-values. The software IBM SPSS statistics 22 was used to produce the summary statistics of all variables and inferential statistics. The level of statistical significance was set at $P \leq 0.05$.

3.5 Ethical considerations

Ethics approval for studies 1 to 3 of this project was sought from the Human Research Ethics Committee (HREC) of the University of the Sunshine Coast (USC), with conditional approval being granted on 17 March 2010 and unconditional approval being granted on 12 October 2012. The HREC approval code for studies 1 to 3 of this project was S/10/252. Ethics approval for Study 4 was granted by the USC HREC on 12 December 2014, with approval code S/14/719. Copies of the communications and the information sheets about the research project that were sent to potential participants, and the letters of approval from the USC HREC, are provided in Appendix A.

3.6 Limitations

3.6.1 Studies 1 and 2

For Study 1, four of the ambulance services declined to provide their IPC operating procedures, thereby limiting the generalisability of the results to some extent. However, the Australian Bureau of Statistics (2016) data indicate that the services who submitted guidelines operationally cover more than 84% of the Australian population.
For both studies 1 and 2, the method used to compare coverage of issues was limited to
dichotomous coding for the presence and absence of content. Although this reductionist
approach risks important aspects of context being neglected (Tashakkori & Teddlie 2010), contextualisation was maintained by the author identifying the codes and coding in recognition of the nature of the non-numerical material.

The limitations for studies 1 and 2 necessitate further research on IPC areas specifically
developed by state ambulance services before contextualised guidelines for IPC in paramedicine can be developed.

3.6.2 **Studies 3 and 4**
The findings of studies 3 and 4 should be viewed in the context of three limitations.
First, social desirability and identity may have led to the intentional misreporting of IPC behaviours in favour of better compliance by the participants (Brenner & DeLamater 2014; Holtgraves 2004; Zerbe & Paulhus 1987). Evidence for this is that participants reported much higher levels of compliance for themselves than for their colleagues. The anonymous responses to the SoPIC may have helped to limit this bias in the survey (Brenner & DeLamater 2014). Second, the survey and focus group participants were self-selected and a large dropout occurred with the survey. This may bias the study outcomes as the final participants may have been more likely to comply with IPC advice. Third, whether the attributes, behaviours and perceptions of the PA members who participated in this study reflect those of all Australian paramedics is unknown. In addition, the attributes of the participants who did not complete the survey questionnaire are unknown. These limitations affect the generalisability of the study findings, which may overstate compliance with recommended IPC practices.
4. A qualitative exploration of infection prevention and control guidance for Australian paramedics

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). This chapter describes and discusses the findings of studies 1 and 2 (Section 3.3) that are aligned to research questions 1 and 2 of the project (Section 1.2).

4.1 Introduction

Paramedics provide healthcare with limited resources in a work setting that has been described as both dangerous and stressful, and where the episodes of healthcare are unpredictable in time, nature and place (Maguire et al. 2014; O’Meara & Reynolds 2009). In Australia, the range and classification of paramedic roles has expanded significantly over the past two decades (Mulholland, Stirling & Walker 2009; Paramedics Australasia), with the scope of practice now including invasive medical procedures such as venepuncture, intravenous and intraosseous needle placement, needle thoracotomy, intubation, open fracture reduction, haemorrhage control and suturing (Ambulance Victoria 2014; Queensland Ambulance Service 2015). The performance of these procedures across the range of community settings encountered in paramedic practice presents challenges for the successful implementation of recommended infection prevention and control (IPC) practices (McDonell 2008).

While the transmission of pathogens has been extensively researched in hospital and community settings, relatively little is known about transmission in the pre-hospital setting in which paramedics work. Reports suggest that paramedics have a limited understanding of infectious diseases (Leiss 2009; Leiss, Sousa & Boal 2009; Shaban 2006; Shaban, Creedy & Clark 2003) and may demonstrate poor compliance with IPC protocols when caring for patients (Goodman, CS & Cone 2001; Ho, Ansari & Page 2014; Leiss 2009; Leiss, Sousa & Boal 2009; McGuire-Wolfe, Haiduven & Hitchcock 2008).
This poor understanding and compliance is highlighted by a recent government report of a paramedic in Queensland who was infectious with measles and attended four hospitals and a wide range of public locations while on duty (Queensland Parliament 2015). IPC is crucial for reducing healthcare-associated infections (HAIs) that have substantial physical, mental and economic implications (NHMRC 2010). Patients with an HAI will most likely stay in hospital longer, lose some quality of life and be at greater risk of dying from an infection (ACSQHC 2011). Following discharge from acute services, these patients may suffer residual morbidity and are likely to use healthcare resources more intensively and to incur out-of-pocket expenses (ACSQHC 2011). As up to 70% of HAIs are preventable (Graves 2004; Harbarth, Sax & Gastmeier 2003), these burdens can be reduced.

In Australia, the National Health and Medical Research Council (NHMRC) provides extensive health advice and resources for local governments and health professionals. In 2010, the NHMRC released the *Australian Guidelines for the Prevention and Control of Infection in Healthcare* (NHMRC 2010). This document adopted a risk based approach and replaced the now rescinded Department of Health and Aging (DoHA) *Infection Control Guidelines for the Prevention of Transmission of Infectious Diseases in the Health Care Setting* [herein the NHMRC guidelines will be called the NHMRC 2010 guidelines and the DoHA guidelines will be called the DoHA 2004 guidelines]. In 2012, the now mandatory NSQHS Standards were released by the Australian Commission on Safety and Quality in Health Care (ACSQHC 2012d). These documents provide a basis for individual health disciplines to establish IPC protocols that are specific to their healthcare setting, such as in dentistry (ADA 2012) and general medicine (RACGP 2014). This approach has not been undertaken on a national scale for paramedicine; instead, individual ambulance services have assumed the responsibility of developing their own operating procedures for their workers.

The research reported in this chapter addressed research questions 1 and 2 of the project:

1. How do the IPC guidelines provided to paramedics by different Australian ambulance services align with national IPC guidelines? This question formed the basis of Study 1 and was explored through a content analysis of IPC standard
operating procedures and policy documents provided by Australian ambulance services and comparison with the NHMRC 2010 guidelines.

2. What are the views of healthcare professionals and academics from a variety of healthcare disciplines regarding the IPC practices of Australian paramedics and the adequacy of IPC guidance provided to paramedics? This question formed the basis of Study 2 and was explored through semi-structured interviews with IPC specialists, senior paramedic educators and managers, infectious disease experts, academics and researchers.

4.2 Methods
The methods for studies 1 and 2 have been described in Chapter 3. Study 1 was a content analysis (Section 3.3.1) conducted in 2010 to compare the uniformity of IPC guidelines provided to paramedics by different ambulance services against the national IPC guidelines issued by the NHMRC. The eight Australian members of The Council of Ambulance Authorities (CAA) were invited to provide an electronic copy of their operating procedures that informed the recommended IPC practices for paramedics working under their jurisdiction. Study 2 consisted of semi-structured interviews (Section 3.3.2) conducted with experts recruited from IPC professional associations, academia, various levels of government and private consultants between May 2010 and June 2011. The textual data were analysed through an interactive process of describing, classifying and connecting information (Section 3.4.1). This process used a combination of initially collating data around a small number of a priori codes followed by thematic analyses, where inductive codes were utilised to capture emergent themes. Ethical clearance (Section 3.5) and study limitations (Section 3.6) have been described previously.

4.3 Results
4.3.1 Content analysis of ambulance IPC operating procedures
Four state ambulance services agreed to provide us with electronic copies of their IPC operating procedures. Content analysis indicated that substantial sections of these documents were consistent with the advice provided in the NHMRC 2010 guidelines, including the recommended practices to be undertaken following blood and body fluid
exposure, and the management of body fluid spills. However, differences were identified between the nature of the advice provided in the ambulance operating procedures and NHMRC 2010 guidelines for both standard and transmission-based precautions, and organisational support. A summary of important differences is provided in Table 9.

There were also differences in how the information was presented in the operating procedures. For instance, operating procedures varied in length (28 to 50 pages), breadth of topics covered, and level of detail provided. The language used to indicate modality or obligation for compliance also differed, specifically in the use of modal verbs such as may, must and should. A word frequency count of all words in all submitted documents was conducted and found 12,858 individual words across the source documents, excluding automatic ‘stop’ words in NVivo. The list generated was manually searched for modal verbs and other words that indicated the level of direction or requirement. These refer to how compelled a paramedic is to do something by the policy or level of clinician choice. This elimination process reduced the list to 50 possible words. These words were checked for context using word trees (NVivo) and listed words which had modal verbs before or after them were removed from the list. After this step a final list of nine words compelling paramedics to adhere to policy was produced. Table 10 outlines the frequency of these words in the source documents. Table 11 indicates the use of the modal words in the hand hygiene sections of respective ambulance operating procedures and NHMRC 2010 guidelines.
Table 9: Important areas of discrepancy between the nature of the advice provided in the state ambulance infection prevention and control operating procedures when compared to the National Health and Medical Research Council guidelines (NHMRC 2010) for standard and transmission-based precautions, and organisational support.

<table>
<thead>
<tr>
<th>Standard and Transmission-Based Precautions</th>
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<tbody>
<tr>
<td><strong>Hand Hygiene:</strong></td>
</tr>
<tr>
<td>• Differing advice</td>
</tr>
<tr>
<td>• Description of activities that cause hand contamination</td>
</tr>
<tr>
<td>• Level of emphasis placed on the importance for hand hygiene and hand care during operational work</td>
</tr>
<tr>
<td>• Indication for when and how to perform hand hygiene</td>
</tr>
<tr>
<td>• Gloving practices</td>
</tr>
<tr>
<td>• Recommendations for finger nail length and the wearing of artificial nails, jewellery such as wedding and other rings, and accessories such as watches and wrist bands</td>
</tr>
</tbody>
</table>

| Environmental Hygiene:                      |
| • Differing advice                         |
|   • Indications and rationale for when to perform environmental hygiene |
|   • Types of chemicals recommended for different cleaning activities |
|   • Routine and deep cleaning procedures for: |
|     • non-disposable portable essential clinical items (e.g. stethoscopes, computers and extrication equipment) |
|     • ambulance interior surfaces, wall fittings and stretchers |
|     • maintenance of general cleaning equipment following cleaning activities |
|   • Description of the contents of the spills kit carried in ambulances |
|   • Handling and transport of contaminated linen |

| Aseptic Technique:                          |
| • Limited advice was provided about:       |
|   • key components of aseptic technique for standard clinical procedures |
|   • Aseptic technique for more complex clinical procedures, such as intravenous cannulation and treatment and dressing of large, deep open wounds |

<table>
<thead>
<tr>
<th>Organisational Support</th>
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</thead>
<tbody>
<tr>
<td><strong>Governance and Surveillance:</strong></td>
</tr>
<tr>
<td>• Limited advice was available on:</td>
</tr>
<tr>
<td>• infections that may spread amongst patients and healthcare workers</td>
</tr>
<tr>
<td>• specific microorganisms</td>
</tr>
<tr>
<td>• auditing against a defined standard</td>
</tr>
<tr>
<td>• measuring adverse events, such as the detection of drug resistant microorganisms</td>
</tr>
<tr>
<td>• Limited advice was provided on reporting mechanisms for critical incident reviews</td>
</tr>
</tbody>
</table>

| Facility Design                            |
| • Limited advice was available about:      |
|   • vehicle design, including materials for interior surfaces |
|   • maintenance of recirculating air-conditioning systems |
|   • storage of portable equipment, medical devices and general consumables to avoid cross-contamination |

| Staff Health and Safety                    |
| • Limited advice was available for:        |
|   • overall screening of the health status of paramedic staff |
|   • minimum periods of exclusion for paramedic staff with an infectious disease |
|   • additional IPC precautions for staff who are pregnant or immunocompromised |
|   • immunisation guidelines and protocols  |
Table 10: Modal words used in submitted operating procedures and the relevant sections of the National Health and Medical Research Council guidelines (NHMRC 2010).

<table>
<thead>
<tr>
<th>Modal word</th>
<th>Source Documents</th>
<th>NHMRC</th>
<th>OP 1</th>
<th>OP 2</th>
<th>OP 3</th>
<th>OP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>%use</td>
<td>n</td>
<td>%use</td>
<td>n</td>
</tr>
<tr>
<td>Must*</td>
<td></td>
<td>163</td>
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<td>56</td>
<td>31.6</td>
<td>63</td>
</tr>
<tr>
<td>Never*</td>
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<td>6</td>
<td>0.5</td>
<td>2</td>
<td>1.1</td>
<td>2</td>
</tr>
<tr>
<td>Require*</td>
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<td>45</td>
<td>4.0</td>
<td>6</td>
<td>3.4</td>
<td>7</td>
</tr>
<tr>
<td>Vital*</td>
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<td>5</td>
<td>0.5</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>285</td>
<td>25.6</td>
<td>40</td>
<td>22.6</td>
<td>66</td>
</tr>
<tr>
<td>Might</td>
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<td>14</td>
<td>1.3</td>
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</tr>
<tr>
<td>Need</td>
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<td>77</td>
<td>6.9</td>
<td>3</td>
<td>1.7</td>
<td>1</td>
</tr>
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<td>Should</td>
<td></td>
<td>481</td>
<td>43.2</td>
<td>67</td>
<td>37.8</td>
<td>146</td>
</tr>
<tr>
<td>Would</td>
<td></td>
<td>38</td>
<td>3.4</td>
<td>2</td>
<td>1.1</td>
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<tr>
<td>total</td>
<td></td>
<td>1114</td>
<td>-</td>
<td>177</td>
<td>-</td>
<td>290</td>
</tr>
</tbody>
</table>

Note: NHMRC, National Health and Medical Research Council; OP, de-identified submitted operating procedure.

* Indicates stronger level of compulsion

Table 11: Modal words used in hand hygiene sections of submitted operating procedures and relevant sections of the National Health and Medical Research Council guidelines (NHMRC 2010).

<table>
<thead>
<tr>
<th>Modal word</th>
<th>Source documents</th>
<th>NHMRC</th>
<th>OP 1</th>
<th>OP 2</th>
<th>OP 3</th>
<th>OP 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>%use</td>
<td>n</td>
<td>%use</td>
<td>n</td>
</tr>
<tr>
<td>Must*</td>
<td></td>
<td>6</td>
<td>10.5</td>
<td>4</td>
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<td>9</td>
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<tr>
<td>Never*</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Require*</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vital*</td>
<td></td>
<td>1</td>
<td>1.8</td>
<td>0</td>
<td>8.3</td>
<td>0</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td>14</td>
<td>24.5</td>
<td>1</td>
<td>8.3</td>
<td>0</td>
</tr>
<tr>
<td>Need</td>
<td></td>
<td>5</td>
<td>5.3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Should</td>
<td></td>
<td>30</td>
<td>53.6</td>
<td>6</td>
<td>30.0</td>
<td>5</td>
</tr>
<tr>
<td>Would</td>
<td></td>
<td>5</td>
<td>5.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>57</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

Note: NHMRC, National Health and Medical Research Council; OP, de-identified submitted operating procedure.

* Indicates stronger level of compulsion

4.3.2 Semi-structured interviews with health experts

Ten male and four female health experts were recruited via snow-ball sampling to participate in an interview. The participants included senior ambulance managers (n = 5; R1, R5, R6, R7, R8), public health specialists (n = 3; R2, R3, R12), infection control practitioners (n = 4; R4, R10, R13, R14) and university academics (n = 2; R9, R11). The majority (n = 10, 71%) had direct employment with an ambulance service. Hence, the views of these experts correlate with the context of the phenomena and culture of behaviour of the paramedics in the field.

All experts agreed that there are numerous challenges for IPC during the provision of paramedic led healthcare in Australia. Four main themes emerged:

1) Challenges of the paramedic work environment,

2) Factors influencing IPC practices in the paramedic work setting,
3) The need for the development of national guidelines for IPC in paramedicine, and
4) Barriers and enablers to improving IPC practices amongst paramedics.

Each of these themes has been highlighted in Table 12 and will now be dealt with in turn, noting where there was consensus and where views differed between experts. Selected quotes are included to illuminate key points.

The experts recognised that ‘In the case of paramedics, they are dealing with situations which are not predicted, in most cases’ (R9) and they work in a ‘…relatively hostile environment… the moving ambulance… the maintenance and handling of sharps, not having running water… there are obviously significant differences between the hospital and the pre-hospital environment’ (R5). The experts described patient transport vehicles (e.g. ambulances, rescue helicopters) as sophisticated healthcare platforms that are reliant on portable medical equipment and which can be difficult to clean. Several experts noted that the short turnaround times between cases due to operational pressures and design features of transport vehicles and patient care equipment impacted on the rigor of cleaning. One expert commented ‘We’ve built these vehicles that are designed for the task of responding to calls and transporting patients, but not necessarily in being able to be cleaned appropriately or disinfected appropriately’ (R11). Table 12 provides further examples identified by the experts of vehicle design issues that impact on IPC practices among paramedics.

Not all experts agreed about the suitability of recommended IPC practices for the paramedic work environment. On one hand, the senior ambulance managers and a public health specialist asserted that the recommended IPC practices in other healthcare areas should apply to paramedics regardless of the difficulties faced by them in their workplace.

‘So what’s the purpose of saying you’re different? Is it that you don’t have to practice the same high standards of infection control? Or is it a suggestion that you need ways of dealing with those special circumstances?’ also ‘you don’t want to make life difficult but you have to be careful people don’t use difference to excuse themselves from infection control…’ (R1)
Alternatively, other experts from a variety of fields recognised that paramedics often faced difficult emergency situations that may preclude their compliance with recommended IPC practices.

‘… if this is an urgent, emergency type of situation in my mind you're there to save the person's life … are we going to do the five moments? Well, no, you save his life by doing whatever you need to do as safely and as minimising and preventing infection as much as possible.’ (R10)

Table 12: Themes and examples arising from the semi-structured interviews with 14 health experts about the infection prevention and control (IPC) practices by Australian paramedics, and the IPC guidance that they are provided

<table>
<thead>
<tr>
<th>Themes</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenges of the paramedic work environment</strong></td>
<td>• Unpredictability of the types of clinical cases</td>
</tr>
<tr>
<td></td>
<td>• Often operating in a hostile work environment</td>
</tr>
<tr>
<td></td>
<td>• Lack of running water to perform correct IPC practices</td>
</tr>
<tr>
<td></td>
<td>• Possible pathogen contamination from dirty linen transport in ambulances</td>
</tr>
<tr>
<td></td>
<td>• Operational pressures impacting on appropriate environmental cleaning</td>
</tr>
<tr>
<td><strong>Factors influencing IPC practices in the paramedic work setting</strong></td>
<td><strong>Hand hygiene:</strong></td>
</tr>
<tr>
<td></td>
<td>• Unable to perform correct hand hygiene in some difficult clinical cases</td>
</tr>
<tr>
<td></td>
<td>• Over use of gloves, thereby affecting correct hand hygiene</td>
</tr>
<tr>
<td></td>
<td><strong>Environmental hygiene:</strong></td>
</tr>
<tr>
<td></td>
<td>• Varying cleaning standards amongst paramedic staff</td>
</tr>
<tr>
<td></td>
<td>• Difficulties in the management of clinical waste</td>
</tr>
<tr>
<td></td>
<td>• Difficulties in the cleaning of portable medical equipment such as computers, cardiac monitors/defibrillators and stethoscopes</td>
</tr>
<tr>
<td></td>
<td>• Difficulties in cleaning the materials used to house patient care equipment</td>
</tr>
<tr>
<td></td>
<td>• Advice about and surveillance of home laundering of uniforms</td>
</tr>
<tr>
<td></td>
<td>• Difficulty with cohorting patients in multi-stretcher vehicles</td>
</tr>
<tr>
<td></td>
<td><strong>Design considerations for vehicles and patient care equipment:</strong></td>
</tr>
<tr>
<td></td>
<td>• Operating in a confined space with recirculated air, particularly when transporting patients with respiratory conditions</td>
</tr>
<tr>
<td></td>
<td>• Air conditioners with filters and ultraviolet lights to treat recirculated air, especially in the setting of droplet and aerosol transmission of pathogens due to extended periods of time involved with a patient in a closed environment</td>
</tr>
<tr>
<td></td>
<td>• Difficulty in transporting contaminated equipment and linen safely</td>
</tr>
<tr>
<td></td>
<td>• Contamination of mobile patient care equipment</td>
</tr>
<tr>
<td><strong>The need for the development of national guidelines for IPC in paramedicine</strong></td>
<td>• Importance of developing national accreditation standards for IPC in ambulance services</td>
</tr>
<tr>
<td></td>
<td>• Consistency in advice is required across ambulance services in risk assessment and management practices, immunisation protocols for employees, and trigger points to remove a vehicle out of service due to contamination</td>
</tr>
<tr>
<td></td>
<td>• Scarcity of IPC experts within ambulance services</td>
</tr>
<tr>
<td></td>
<td>• Lack of documentation required to log the cleaning of stations, vehicles or equipment and auditing</td>
</tr>
<tr>
<td><strong>Barriers and enablers to improving IPC practices amongst paramedics</strong></td>
<td>• Accepted cultural norms and general apathy amongst paramedics that are lowering compliance with recommended IPC practices</td>
</tr>
<tr>
<td></td>
<td>• Lack of reporting near misses and breaches of IPC practices</td>
</tr>
<tr>
<td></td>
<td>• Difficulty in enforcing policy, governance and surveillance of IPC in a semi-autonomous workforce</td>
</tr>
<tr>
<td></td>
<td>• Difficulty with conducting infield audits of IPC practices in paramedicine</td>
</tr>
<tr>
<td></td>
<td>• Inadequate communication between government health departments and ambulance services on important policy areas, such as the lack of follow up for paramedics post contact with infectious patients</td>
</tr>
<tr>
<td></td>
<td>• In field aide memoirs</td>
</tr>
</tbody>
</table>

**Note:** IPC, infection prevention and control.
The need to develop a national risk assessment framework for IPC that is tailored for paramedicine was voiced consistently by experts from different backgrounds, with two experts commenting that ‘…there needs to be some kind of perhaps standard set by a relevant body for the ambulance service based on the NHMRC guidelines’ (R3) and ‘…when we transitioned into the healthcare system…all of our policies and procedures started to look like policies and procedures from the hospitals and they didn't apply. The environment is different so we have to look at things a little bit different’ (R11). Some experts called for infield tools outlining IPC practices for paramedics such as…’a quick ready-reckoner…what to do when they get told they’ve got someone with a disease. They have no idea what it is and [how] it’s transmitted - they just want to know what to do.’ (R1).

Most of the experts identified the need for ambulance services to link with the Australian health system in a broader context in respect to better inclusion in healthcare debate, policy and operational considerations. According to one expert, this could be achieved through…’accreditation for ambulance that would involve infection control…we’d be one of the few of the only healthcare providers, who don’t require some sort of accreditation from a national body’ (R1).

The senior ambulance managers were concerned that other government health departments have an insufficient understanding of the role of paramedics. One commented ‘…around manual handling, infection control, other types of issues, they always forget ambulance. When I say forget I strongly emphasise forget…We’ve had pandemics, pandemic meetings, and they completely forgot about ambulance’ (R7). They highlighted the potential physical and psychological harm to operational staff when a disconnection from health department advice occurs. For example, ‘the [health department] have traced …back from an infected child back through the parents, the family, the day care centre, the school, wherever it might be, very effectively...However, on a number of occasions, the ambulance simply has [been] forgotten, despite the fact that they were in the middle of the whole process, and they were with the child at the time it was probably highly communicable’ (R5). The managers emphasised that paramedics ‘feel like they have been neglected and put at
risk. They feel like they have fallen between the cracks of the healthcare system…there is no policy around this’ (R13).

The culture of paramedicine was identified by senior ambulance managers as one barrier to IPC compliance. For instance, ‘…there’s generally a fairly apathetic approach or belief perception out there with regards to infection control. I don’t think a lot of our staff see it as a major issue’ and ‘…it’s not just about knowledge, it’s also about compliance... There are people who don’t understand, and then there are those who, whilst they understand, don’t follow and comply with procedures and certain policy’ (R5). The managers suggested that noncompliance was particularly problematic with donning some forms of personal protective equipment (PPE) such as face masks, and undertaking environmental hygiene tasks. One manager commented: ‘I asked them if they could find for me their infection control kit. The interesting thing for me was the officers on duty - and I suspect they were typical of the cross-section of officers - looked at one another, scratched their heads. Neither of them was sure where to find that kit within the car’ (R5).

Social identity was recognised by some of the experts as being another barrier to the application of appropriate IPC practices by some paramedics.

‘…I think we still have the macho, adrenalin junkie, tough guy persona worldwide. We haven't shifted, I think, from the old days of lights and sirens, rapid response…There's a lot of that ‘we're different, we're tougher’, we don't need to do all of these things that the nurses do’ (R11)

Nonetheless, two experts noted a marked change in attitude towards IPC practices among paramedics working during a time of heightened risk perception associated with a pandemic:

‘When SARS hit, [ambulance service] had poor hand washing, poor PPE compliance, poor infection control practices, and they couldn’t understand why so many staff were getting sick and they were in the heart of the SARS...They then concentrated on hygiene, washing their hands. They concentrated on the application of the P2 mask, protective eyewear, gloves. They reinforced the order in which you apply it and then the order in which you remove it…they
immediately, absolutely immediately had a reduction of sick staff and they knew right then and there what the critical issue was. It was PPE and hygiene.’ (R7)
‘… the H1N1 [swine flu] has been a real bonus in terms of changing people’s - the general population, not just paramedics’ - attitudes to washing their hands and so, you know, if you go to most workplaces now there’s hand hygiene stuff everywhere’ (R6)

All experts agreed that if paramedics are well resourced and undertake appropriate IPC practices routinely, they should be well protected during any major disease outbreak.
‘If we were doing everything in our infection control procedures extremely well, then the impact, I think, of even a major issue, like a pandemic, would be minimal.’ (R5).

4.4 Discussion
This exploration of both documented guidance and expert views around IPC has revealed important barriers to best practice in paramedicine. It also found that, while there were some views that were shared by all experts, there were also areas of dissent.

The most consistent finding was the expressed need to operationalise the current national risk-based framework for IPC in Australia to paramedicine. The rationale for this rests primarily on the unique attributes of paramedic work that bring a distinct set of challenges. The experts agreed that the paramedic work environment was quite different to what other healthcare workers encounter. It can be hostile in nature and is certainly unpredictable with respect to caseload, type or place of event. In other words, paramedics deliver ‘unscheduled healthcare’. Nonetheless, it was still argued by most experts that ambulance services have to maintain adequate IPC standards in accordance with the recommended IPC guidelines. What is less clear, and requires further research, is whether any deviation in recommended IPC practices by paramedics should be allowed during emergency cases. The views of some of the experts were in alignment with Hand Hygiene Australia’s statement that in some emergencies, such as ‘hospital codes’ or resuscitation, hand hygiene may become secondary to other clinical practice (Hand Hygiene Australia 2013).
The lack of a consistent approach among the Australian ambulance services with regard to operating procedures for IPC was evident. Unlike other healthcare areas in Australia (ADA 2012; RACGP 2014) there hasn’t been a national approach to the development of IPC policy in paramedicine. This may have led to the variations in IPC operating procedures between the ambulance services in both structure and content when describing standard and transmission-based precautions, and organisational support. This further suggests that divergence in IPC practices may occur among Australian paramedics operating in different ambulance jurisdictions, even though they encounter similar work environments and clinical cases. A national perspective is required to operationalise the principles of IPC as described in the NHMRC 2010 guidelines that are applicable to paramedic-led healthcare.

The development of nationally consistent operating procedures for IPC in paramedicine that is underpinned by current national IPC risk-based frameworks and standards may provide efficiencies not only for Australian ambulance services, but also for public safety agencies and providers in non-traditional areas such as non-government first responders and the remote industrial and mining sector. They would facilitate effective standards and protections for all Australian paramedics and patients treated by them, as well as achieving reductions in the incidence of HAI transmission attributed to paramedics. The guidelines may also assist the compliance and regulatory burdens for service providers with operations throughout Australia.

The National Health Service in the United Kingdom and the Association for Professionals in Infection Control and Epidemiology in the United States of America have both published national IPC guidelines for their respective EMS workers (Association for Professionals in Infection Control and Epidemiology 2013; Healthcare Associated Infection and Cleanliness Division 2008), similar to what this study is recommending for Australian paramedicine. The experts interviewed in this study called for practical and innovative ways to present advice on IPC practices for paramedics in the field. They recommended ready-reckoners and aide memoirs in the form of windscreen stickers, and the use of smart technology applications.
National operating procedures for IPC in paramedicine will need to recognise the idiosyncrasies of the paramedic work setting. While the challenging features of the paramedic work environment were clearly identified in this study, the full consequences of these challenges and how to deal with them is less clear and requires further research. For instance, portable medical equipment items that may be considered noncritical under the Spaulding classification system (Rutala, Weber & Healthcare Infection Control Practices Advisory Committee 2008) in the traditional healthcare setting may present issues in the mobile primary-emergency setting where patients with non-intact skin are treated in quick succession or simultaneously with limited clinical equipment and time pressures. For example, blood pressure cuffs or spine boards are designed as non-critical items. In a hospital setting if these items were contaminated, the Spaulding classification system would provide advice on the level of disinfection required, the equipment would be removed from service and a replacement used until the original piece was disinfected. In the resource limited and time pressured EMS setting, this may not be possible. Hence, specific IPC advice is needed for paramedics when they are required to administer healthcare to multiple trauma patients simultaneously. Such advice might include the use of barriers to transmission such as covers for spine boards or dedicated blood pressure cuffs that remain with each patient.

The development of national IPC operating procedures in paramedicine will also need to be aligned with state/territory health departments to maintain communication and integration. Paramedics Australasia (2011) argue that paramedicine as a profession should be more actively involved in the Australian healthcare debate or policy considerations. The senior ambulance managers in this study spoke of the feeling of being neglected as an industry at an operational level. Symptomatic of the disconnection from health, the adverse consequences of ‘falling through the cracks’ was raised in which the notification of staff exposed to communicable diseases has not occurred. In order for ambulance services to become more prominent in the healthcare discussion, one approach may be to develop national accreditation standards similar to hospitals and day procedure services, which are accredited to the NSQHS Standards (ACSQHC 2014).
The CAA is the representative body for the principal statutory providers of ambulance services in Australia, New Zealand and Papua New Guinea. It is also the accrediting agency for university programs offering entry-to-practice paramedic degrees. The CAA has a ‘Clinical Forum’ whose agenda covers clinical practice, current clinical research projects and related matters, including recommended IPC practices (CAA 2013a). Therefore, the CAA is well positioned to conduct the harmonisation of IPC practices for Australian paramedics, and develop and implement national operating procedures for IPC in paramedicine.

The impetus for the continued commitment of ambulance services to quality reform is to ensure better outcomes for patients and healthcare workers at all times, including during pandemics. Managing risk and risk perception is critical as a recent study predicted a high level of work absenteeism among Australian paramedics in the event of an influenza pandemic, thereby causing disruption to the ability of ambulance services to operate effectively (Tippett et al. 2008). The experts in our study agreed that if paramedics are well informed, resourced and undertake appropriate IPC practices routinely, then they should be well protected during any major disease outbreak.

This study has highlighted that there are cultural issues acting as disincentives to appropriate IPC practices in paramedicine that require further investigation. Poor compliance where guidance policies exist has been demonstrated to be an issue both in Australia and internationally (Alves & Bissell 2008; Eustis et al. 1995; Galtelli, Deschamp & Rogers 2006; McGuire-Wolfe, Haiduven & Hitchcock 2012; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Shaban, Clark & Creedy 2004; Teter, Millin & Bissell 2015; Wepler et al. 2015). Evidence from hospital post-acute care areas suggests that accepted-cultural-norms that lower compliance with recommended healthcare practices (Bellaard-Smith & Gillespie 2012) can be improved over time through collaborative interventions between staff and management (Goodman, ER et al. 2008; McGuire-Wolfe, Haiduven & Hitchcock 2012). Previous studies have suggested that it may be effective to use staff to champion causes and promote transformational change (Bellaard-Smith & Gillespie 2012; Teter, Millin & Bissell 2015). Two of the experts in our study noted that compliance with recommended IPC practices improved during a pandemic, which suggests that an
increased perception of the threat of a serious infectious agent could be an important factor that influences behaviour-change. There are many health theories used to explain ways to modify human behaviour. It would be useful to investigate these issues further with well-established theoretical frameworks for promoting behaviour-change such as social learning theory and planning frameworks such as the PRECEDE-PROCEED model (Crosby & Noar 2011; Glasgow 2011). The lens of such theories may facilitate the development of appropriate intervention strategies to create champions to counter the current cultural issues at play and to promote best practice for IPC in paramedicine that would lead to better outcomes for patients.

4.5 Conclusion

Two broad recommendations arise from this research. First, that there is a need to adapt the current national risk-based framework for IPC in Australia to paramedicine. Second, that targeted research is required to identify the key barriers and enablers to effective IPC practices in paramedicine. An essential component of this research will be to explore the current IPC practices of Australian paramedics, particularly in the areas of hand and environmental hygiene, vehicle design, communication with health regulators and governance and surveillance.

This study has identified considerable differences in the IPC operating procedures provided by four Australian ambulance services to paramedic staff under their jurisdiction. However, what they do have in common is their recognition of some of the unique challenges that occur when delivering healthcare in the mobile primary-emergency environment. National IPC operating procedures for paramedicine will not only recognise the complex and unscheduled nature of paramedic work, but will also build resilience within the workforce nationally and offer risk management strategies for both routine and emergency clinical cases. While the experts interviewed in this study supported the development of national IPC operating procedures, they also recognised that compliance failures with the recommended IPC practices would continue to be a challenge. This is an area that needs to be explored further. In addition, due to the time lapse from beginning of this study, there is an opportunity to perform a new comparison and review changes within individual jurisdictions and at the national
level. This work could be conducted as part of producing nationally consistent contextualised operating procedures for IPC within Australian paramedicine.
5. General perceptions of Australian paramedics regarding healthcare-associated infection transmission and infection prevention and control compliance in paramedic-led healthcare

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). Chapter 4 described and discussed the findings from studies 1 and 2 (Section 3.3), which are aligned to research questions 1 and 2 (Section 1.2). The thesis now changes focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which are presented as five distinct themes. This chapter, Chapter 5, will explore general perceptions about the transmission of healthcare-associated infections (HAIs) and IPC compliance. The next four chapters will explore hand hygiene and gloving practices (Chapter 6), environmental hygiene (Chapter 7), clinical governance (Chapter 8), and aseptic technique (Chapter 9). Chapter 10 closes the thesis and uses the PRECEDE-PROCEED planning model to connect the findings outlined in chapters 4 to 9 and to provide recommendations to improve IPC practices in paramedic-led healthcare.

5.1 Introduction

Compliance with IPC is fundamental to minimising the transmission of HAIs in paramedic-led healthcare. Significant financial and social costs are incurred when HAIs are acquired. Patients who contract HAIs may stay longer in hospital, lose some quality of life, and be at greater risk of dying from infection (ACSQHC 2011). After the discharge of patients from healthcare, the cost of HAIs continues because these patients
often suffer some form of residual morbidity. Hence they are likely to use healthcare resources more intensively, which in turn will incur out-of-pocket expenses.

The transmission of most HAIs between healthcare workers and their patients can be attributed to poor compliance with IPC standards (Boyce 2001; NHMRC 2010; Pittet 2004); at least half of all HAIs are considered preventable (ACSQHC 2012d). Improving IPC compliance relies on successfully modifying clinician behaviour (Pittet 2004). Although individual characteristics such as knowledge, attitudes, beliefs and personality traits can influence clinician behaviour (Borg 2013; Edwards et al. 2011; Kretzer & Larson 1998; Pittet 2004), knowledge and attitudes do not always transfer into clinical practice (Hosseinialhashemi et al. 2015; McGuire-Wolfe, Haiduven & Hitchcock 2012; Pittet 2000). Green and Kreuter (2005) argue that interventions to increase compliance with recommended IPC practices in healthcare organisations would be more successful if a behaviourial science approach cognisant of clinicians’ perceptions about IPC were used.

Several international studies have demonstrated that the compliance of paramedics with IPC practices should be improved substantially in the areas of hand hygiene (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015) and environmental cleanliness (Alves & Bissell 2008; Bledsoe et al. 2014; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015). Australian studies exploring IPC within the emergency medical services (EMS), although small in number, have shown that knowledge of IPC principles and the management of hollow bore sharps require improvement (Shaban 2006; Shaban, Clark & Creedy 2004). However, scant research has explored paramedics’ general perceptions regarding the transmission of HAIs and IPC compliance. The outcomes of this research could form the basis of a planned approach to facilitating behaviour-change in IPC practices among Australian paramedics.

The research reported in this chapter addressed research questions 3 and 4 of the project:
3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey? This question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.

Chapter 5 presents the demographics of the participants in the national online survey conducted in Study 3, and in two focus groups conducted in Study 4. This chapter also describes and discusses the findings from studies 3 and 4 about the general perceptions of Australian paramedics regarding HAI transmission and their IPC compliance in paramedic-led healthcare.

5.2 Methods

The methods for studies 3 and 4 have been described in Chapter 3. Study 3 involved the development of an online, self-administered questionnaire, the Survey of Paramedics on Infection Control (SoPIC). The survey was used to canvass members of Paramedics Australasia (PA) in 2013 about their behaviours and perceptions regarding IPC practices in paramedic-led healthcare (Section 3.3.3). Study 4 consisted of two semi-structured focus groups (FG1 and FG2) conducted with PA members in 2015 before undertaking PA professional development (Section 3.3.4). Discussion topics during the focus groups were aligned with the major themes in the SoPIC questionnaire: hand hygiene and gloving practices; environmental hygiene; aseptic technique; and clinical governance. The findings of the focus groups were triangulated with the findings from the SoPIC.

The textual data were analysed through an interactive process of describing, classifying and connecting information, previously described in Section 3.4.1. This two-stage process comprised an initial collation of data around a small number of a priori codes, followed by thematic analyses in which inductive codes were used to capture emergent
themes. The non-textual data (categorical, ordinal and Likert scale responses) were summarised and inferential statistics (Pearson chi-square tests) used to test for associations between variables, as described in Section 3.4.2.

Ethical clearance (Section 3.5) and study limitations (Section 3.6) have been described previously.

5.3 Results

5.3.1 Demographic attributes of participants from studies 3 and 4

SoPIC participants

In 2013 there were 12,500 full-time equivalent paramedics in Australia (SCRGSP 2014) and the PA had 2449 financial (active) paramedic members (Hall 2013). There were 802 active members of the PA (Hall 2013) who entered the SoPIC questionnaire (32% response rate). Of these, 385 participants dropped out early in the survey before completing enough questions to allow analysis, thereby reducing the usable response rate to 17%. Because demographic details were sought at the end of the survey, no demographic data were available for those who did not complete the survey.

The demographic attributes of the SoPIC participants are summarised in Table 13. Approximately two-thirds (69.8%, n=291) of the survey participants were male, and most were aged between 35 and 54 years (18–34 years: 20.9%; 35–54 years: 69.1%; ≥55 years: 10%). In accordance with the PA definitions for clinical practice (Table 4, section 2.4), participant scope of practice fell within both the professional stream (paramedic: 49.9%; intensive care paramedic: 28.3%; general care or retrieval paramedic: 12.2%) and the technical stream (patient transport attendant: 6.2%). Most participants worked in a two-person crew (64.0%, n = 277) or as a single officer (28.8%, n=120). These groupings have been used to stratify the data for analysis in chapters 6 and 9. A Bachelor degree (34.3%, n=143) was the most frequently reported highest level of education, closely followed by post-graduate study (34.1%, n = 142; postgraduate certificate/diploma: 23.3%, Masters by course work: 7.4%, higher degree by research: 3.4%), and then a certificate/diploma (29.3%, n=122). The three main groupings of years of experience post initial qualification as a paramedic were ≤ 10 years (46.5%, n=194), between 11 and 20 years (30.7%, n=128), and ≥ 20 years
Most participants reported a post-employment model for their paramedic training (74.6%, \( n = 311 \)). An association \( \chi^2 = 45.024, df = 2, P < .001 \) was found between an increased length of time post qualification and training pathway.

Although most participants lacked a qualification in another health discipline (73.9%, \( n = 308 \)), nearly one-fifth (18.9%, \( n = 79 \)) of participants reported training in nursing. Participation across the de-identified state and territory jurisdictions ranged from 5.3% to 26.1% (\( n = 22 \) to 109).

<table>
<thead>
<tr>
<th>Demographic variables of the SoPIC participants (( n = 417 ))</th>
<th>Category (n)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>18-24 (n = 12)</td>
<td>2.9%</td>
</tr>
<tr>
<td></td>
<td>25-34 (n = 75)</td>
<td>18.0%</td>
</tr>
<tr>
<td></td>
<td>35-44 (n = 143)</td>
<td>34.3%</td>
</tr>
<tr>
<td></td>
<td>45-54 (n = 145)</td>
<td>34.8%</td>
</tr>
<tr>
<td></td>
<td>55-64 (n = 41)</td>
<td>9.8%</td>
</tr>
<tr>
<td></td>
<td>&gt;65 (n = 1)</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Male (n = 291)</td>
<td>69.8%</td>
</tr>
<tr>
<td></td>
<td>Female (n = 126)</td>
<td>30.2%</td>
</tr>
<tr>
<td><strong>Competency based training</strong></td>
<td>Infection control guidelines (n = 236)</td>
<td>58.9%</td>
</tr>
<tr>
<td></td>
<td>Aseptic non-touch technique (n = 204)</td>
<td>50.9%</td>
</tr>
<tr>
<td><strong>Clinical practice level(^1)</strong></td>
<td>Paramedic (n = 208)</td>
<td>49.9%</td>
</tr>
<tr>
<td></td>
<td>Intensive Care Paramedic (n = 118)</td>
<td>28.3%</td>
</tr>
<tr>
<td></td>
<td>Retrieval Paramedic &amp; general care (n = 51)</td>
<td>12.2%</td>
</tr>
<tr>
<td></td>
<td>Technical stream role (n = 40)</td>
<td>9.6%</td>
</tr>
<tr>
<td><strong>Paramedic training type</strong></td>
<td>Pre-employment (n = 106)</td>
<td>25.4%</td>
</tr>
<tr>
<td></td>
<td>Post-employment (n = 311)</td>
<td>74.6%</td>
</tr>
<tr>
<td><strong>Highest level of education</strong></td>
<td>Certificate or diploma (n = 122)</td>
<td>30.0%</td>
</tr>
<tr>
<td></td>
<td>Bachelor degree (n = 143)</td>
<td>35.2%</td>
</tr>
<tr>
<td></td>
<td>Post graduate study (n = 142)</td>
<td>34.8%</td>
</tr>
<tr>
<td><strong>Other health discipline</strong></td>
<td>Paramedic only (n = 308)</td>
<td>73.9%</td>
</tr>
<tr>
<td></td>
<td>Nursing(^2) (n = 79)</td>
<td>18.9%</td>
</tr>
<tr>
<td></td>
<td>Other(^3) (n = 30)</td>
<td>7.2%</td>
</tr>
<tr>
<td><strong>Time post qualification</strong></td>
<td>1 - 10 years (n = 194)</td>
<td>46.5%</td>
</tr>
<tr>
<td></td>
<td>11 - 20 years (n = 128)</td>
<td>30.7%</td>
</tr>
<tr>
<td></td>
<td>&gt; 20 years (n = 95)</td>
<td>22.8%</td>
</tr>
<tr>
<td><strong>State or territory</strong></td>
<td>Range(^4) (13 to 109)</td>
<td>3.1 – 26.1%</td>
</tr>
<tr>
<td><strong>Employer</strong></td>
<td>State/territory service(^5) (n = 353)</td>
<td>84.6%</td>
</tr>
<tr>
<td></td>
<td>Private company (n = 46)</td>
<td>11.0%</td>
</tr>
<tr>
<td></td>
<td>Defence force (n = 7)</td>
<td>1.6%</td>
</tr>
<tr>
<td></td>
<td>Missing (n = 11)</td>
<td>2.6%</td>
</tr>
<tr>
<td><strong>Confidence with IPC</strong></td>
<td>Not confident (n = 45)</td>
<td>10.8%</td>
</tr>
<tr>
<td></td>
<td>Unsure (n = 60)</td>
<td>14.4%</td>
</tr>
<tr>
<td></td>
<td>Confident (n = 312)</td>
<td>74.8%</td>
</tr>
<tr>
<td><strong>Crew structure</strong></td>
<td>two person crew (n = 267)</td>
<td>64.0%</td>
</tr>
<tr>
<td></td>
<td>single officer (n = 120)</td>
<td>28.8%</td>
</tr>
<tr>
<td></td>
<td>Other (n = 30)</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

*Note: SoPIC, Survey of Paramedics on Infection Control.*
\(^1\)Roles are described in Table 4. \(^2\)Gender of nurses: male 53.2% (\( n = 42 \)), female 46.8% (\( n = 37 \)). \(^3\)Other health disciplines except for nursing combined due to low numbers. \(^4\)A range has been provided to avoid identifying individual state and territory ambulance services. \(^5\)Includes quasi autonomous nongovernment organisations contracted to run state/territory services (\( n = 53 \)).
Focus group participants

Both focus groups included 6 participants; FG1 included 1 man and 5 women, and FG2 included 5 men and 1 woman. Each participant’s scope of practice included the invasive procedures explored in this research, and ranged from paramedic to intensive care paramedic using the role descriptors in Table 4 (section 2.4).

5.3.2 General perceptions on what contributes to the transmission of HAI in paramedic-led healthcare

Thematic analysis of the SoPIC comments regarding what participants perceived as contributing most to the transmission of HAIs in paramedic-led healthcare discovered four constructs: poor IPC compliance, the working environment, organisational support, and patient attributes (Table 14). The focus group transcripts were triangulated using the themes and constructs that emerged from the SoPIC analysis. The focus group analysis was consistent with the SoPIC responses (Table 14).

Table 14: Constructs and themes arising from the comments of SoPIC participants regarding their perceptions of what contributes to the transmission of healthcare-associated infections in paramedic-led healthcare, and triangulation of transcripts of the focus group discussions to the SoPIC constructs and themes.

<table>
<thead>
<tr>
<th>Construct</th>
<th>SoPIC themes (number of comments)</th>
<th>Focus group discussions triangulated to SoPIC constructs and themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor IPC compliance</td>
<td>IPC generally <em>(n = 120)</em></td>
<td>Noncompliance with routine cleaning of high touch areas in the ambulance and frequently used equipment</td>
</tr>
<tr>
<td></td>
<td>Environmental hygiene <em>(n = 105)</em></td>
<td>Noncompliance with routine cleaning of high touch areas in the ambulance and frequently used equipment</td>
</tr>
<tr>
<td></td>
<td>Hand hygiene <em>(n = 85)</em> and gloving <em>(n = 30)</em></td>
<td>Gloves worn for entire care episode (case) lowering hand hygiene frequency</td>
</tr>
<tr>
<td></td>
<td>Aseptic technique <em>(n = 39)</em></td>
<td>Gloves worn for entire case for self-protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gloves not changed due to difficulties</td>
</tr>
<tr>
<td>Working environment</td>
<td>Operational pressure <em>(n = 45)</em></td>
<td>Patient acuity and perceived lack of time lowers compliance with IPC</td>
</tr>
<tr>
<td></td>
<td>Confined space <em>(n = 45)</em></td>
<td>Patient acuity and perceived lack of time lowers compliance with IPC</td>
</tr>
<tr>
<td></td>
<td>Presenteeism <em>(n = 19)</em></td>
<td>Patient acuity and perceived lack of time lowers compliance with IPC</td>
</tr>
<tr>
<td></td>
<td>Uncontrolled work setting <em>(n = 15)</em></td>
<td>Paramedic work environment presents challenges for compliance with IPC</td>
</tr>
<tr>
<td></td>
<td>Vehicle design <em>(n = 6)</em></td>
<td>Vehicle design affects ability to maintain cleanliness</td>
</tr>
<tr>
<td>Organisational support</td>
<td>Lack of training/knowledge <em>(n = 32)</em></td>
<td>Lack of understanding of: importance of hand hygiene; use of gloves; role of antibiotics; and community acquired MDROs</td>
</tr>
<tr>
<td></td>
<td>Lack of required equipment <em>(n = 17)</em></td>
<td>Poor technique for intravenous cannulation and injections</td>
</tr>
<tr>
<td></td>
<td>Lack of management support <em>(n = 16)</em></td>
<td>Difficulties with hand hygiene due to no soap and water in ambulances</td>
</tr>
<tr>
<td>Patient attributes</td>
<td>Infectious patient <em>(n = 15)</em></td>
<td>No schedules for routine and deep cleaning advised in operating procedures</td>
</tr>
<tr>
<td></td>
<td>Poor hygiene <em>(n = 5)</em></td>
<td>No infield audit of IPC compliance</td>
</tr>
</tbody>
</table>

Note: SoPIC, Survey of Paramedics on Infection Control; IPC, infection prevention and control; MDRO, multidrug-resistant organism.
5.3.3 General perceptions of IPC compliance in paramedic-led healthcare

The SoPIC participants mostly agreed that IPC guidelines, whether provided by the Australian Government or their employers, were relevant to their clinical practice (92.3%, $n = 385$). Thematic analysis of the closing comments provided by 93 participants found that, although they valued IPC (47.3%, $n = 44$), some participants felt that IPC was undervalued by both their peers and organisational staff (38.7%, $n=36$).

Some tension regarding attitudes toward IPC compliance was evident in the responses given by the focus group participants. Some described that IPC compliance had changed over time; two FG2 participants commented that ‘I think it's a generational thing’ and ‘Before the gloves we had a much more humane touch to the patient’ (FG2). However, others countered this perception with references to tradition in paramedicine influencing IPC practice. For example, an FG1 participant stated ‘I think we do a lot of things based on what we've always done’.

Lack of time was perceived as a major contributing factor to noncompliance with IPC guidance. For example, regarding aseptic technique, an FG1 participant stated ‘But you just don't often have time’. Other participants appeared to justify IPC noncompliance when they spoke of extending their personal risk exposure onto their patients. For example, an FG2 participant commented that ‘I might die from whatever heroic thing I might do, but it's an acceptable risk because of the life and death circumstance. So the patient gets lumped into the same condition. Since it's their life and death then they can - if they die of sepsis then, well, at least they didn't die of an airway problem’. Another FG2 participant commented that ‘…we often work in pretty dirty environments. It's very hard to keep them clean and aseptic’. An FG1 participant commented that ‘I think also ambos [sic] have a feeling that they're [the patients are] going to hospital, they'll get antibiotics anyway. So it doesn't matter what you give them’.

The focus group participants further described an uncritical workforce with regard to IPC compliance. One FG2 participant stated ‘It used to horrify me the attitude to immunocompromised people. It was quite blasé’. Another FG2 participant commented
‘…you just don’t think. You’re too busy. Too focused… I see that a lot in practice’.

Other focus group participants indicated that a driver of poor IPC compliance in paramedic-led healthcare was a lack of reflection on the consequences of actions, as well as not knowing the patient trajectory beyond paramedic care. One FG2 participant stated that ‘you are with them for such a short period of time … you don’t see the impact of the infection that may have been caused from, could have been your actions.’ Another commented that ‘the downstream implications of EMS – we keep looking at more and more about what we did in 10 minutes affected their care in 10 weeks. So we can give them sepsis, because if we never see it, it’s not our problem’.

5.4 Discussion

Aquiring an HAI is a complicated interaction between risk factors, pathogenic microorganisms and their modes of transmission, and susceptible hosts (NHMRC 2010). This research found that the Australian paramedics participating in the research appeared to recognise the factors that contribute to the transmission of HAIs in their workplace; they also perceived that IPC compliance is relevant to their professional practice. The paramedics identified that an increased risk of HAI transmission was associated with poor compliance with recommended IPC practices, with cultural and physical challenges within the paramedic work setting, and with organisational issues. The research findings are consistent with those of previous studies in other healthcare areas (Erasmus et al. 2009; Grayson et al. 2013; Pittet 2004; Whitby, McLaws & Ross 2006).

Most HAI transmission is attributable to poor compliance with IPC standards (Boyce 2001; Pittet 2004). Some of the focus group participants had a fatalistic perception about noncompliance in a number of facets of IPC practice known to increase the risk of HAI transmission. They reported that patient acuity and time pressure interfered with compliance with recommended IPC practices. This finding is consistent with those of previous research, which found that the subjective experience of time pressure – the feeling that one has too much to do in the time available – decreases the quality and safety of healthcare provision (Gurses, Carayon & Wall 2009) and decreases hand hygiene compliance in nurses (De Wandel et al. 2010; Whitby, McLaws & Ross 2006). Organisations with low time pressure and a high safety climate have better IPC
compliance than other organisations do (Jimmieson et al. 2016). Therefore, further exploration of how to manage time pressure and safety culture in paramedic-led healthcare is warranted.

Both the SoPIC and focus group participants reported a lack of organisational support regarding training, equipment and quality assurance activities in IPC. Employee safety behaviour is known to be influenced by an organisation’s policies and procedures, as well as the values, attitudes and behaviours of executive managers, line managers and colleagues (Flin et al. 2000; Hale et al. 2010; Jiang et al. 2010; Jimmieson et al. 2016; Morrow et al. 2010; Seo et al. 2004). Because participants in this research perceived that both their peers and other organisational staff undervalued IPC, clearly organisational culture around IPC needs improving.

However, facilitating opinion leaders and champions at all levels of EMS organisations, although necessary, may be insufficient to improve IPC compliance. Morrow et al. (2010) found that organisational factors were not as strong in influencing compliance as were people’s individual tolerance for risk and their ability to perform the job requirements safely. According to Sheeran and Abraham (2003), a worker’s acknowledgement of risk can potentially change intentions and behaviours. Furthermore, Lutze et al. (2017) moots that modifying perceptions of the risk of pathogen transmission may increase motivation to comply with recommended IPC behaviours. Hence, to improve Australian paramedics’ compliance with recommended IPC practices, supplementing competency-based training in IPC with education that covers probability and the risk of HAI transmission may be useful.

5.5 Conclusion
This research found that Australian paramedics perceive four major factors that increase the risk of HAI transmission in paramedic-led healthcare: poor compliance with IPC practices, the working environment, organisational support and patient attributes. The paramedic participants considered the IPC guidelines provided by both the Australian Government and their employer are relevant to paramedicine, and valued the importance of IPC in their clinical work. However, they felt that IPC was undervalued by their peers and other organisational staff, which, when combined with work
constraints such as lack of time during patient cases and the unclean environments in which they sometimes need to apply patient care, may be contributing to poor IPC compliance. These findings suggest that future research into IPC compliance in Australian paramedicine should be targeted at identifying strategies that reduce the perception of time pressures and improving safety culture in paramedic-led healthcare. Workplace cultural issues that diminish compliance may be changed through opinion leaders and champions who challenge established social norms. Chapters 6 to 9 will explore in more detail IPC compliance in Australian paramedic-led healthcare, using the findings of studies 3 and 4 around the themes of hand hygiene and gloving, environmental hygiene, clinical governance and aseptic technique.
6. Hand Hygiene and gloving practices

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). Chapter 4 described and discussed the findings from studies 1 and 2 (Section 3.3), which are aligned with research questions 1 and 2 (Section 1.2). The thesis then changed focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which are presented as five distinct themes. Chapter 5 explored general perceptions about the transmission of healthcare-associated infections (HAIs) and IPC compliance. This chapter, Chapter 6, will explore hand hygiene and gloving practices. The next three chapters will explore environmental hygiene (Chapter 7), clinical governance (Chapter 8), and aseptic technique (Chapter 9). Chapter 10 closes the thesis and uses the PRECEDE-PROCEED planning model to connect the findings outlined in chapters 4 to 9 and to provide recommendations to improve IPC practices in paramedic-led healthcare.

6.1 Introduction

Hand hygiene through the use of alcohol-based hand rubs (ABHR) or washing with soap and water is considered the most effective IPC practice for minimizing the transmission of HAIs in paramedic-led healthcare (APIC 2013; NHMRC 2010). However, three studies in North America have identified noncompliance with hand hygiene practices among emergency medical services (EMS) workers before touching patients, during patient contact, and between patient cases (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015). The noncompliance was attributed to poor access to hand hygiene products (Teter, Millin & Bissell 2015) and fatigue, forgetfulness, operational pressure and lack of training (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012). In one study by Teter, Millin and Bissell (2015) a high bacterial load was found on the hands of the EMS workers after patient care, thereby increasing the risk of transmitting HAIs.
Gloving is another essential IPC practice for EMS workers because of the increased risk of exposure to blood and other body fluids during patient care (APIC 2013; Boal et al. 2010; Leiss et al. 2006; Leiss, Sousa & Boal 2009). Experience in acute healthcare services has shown that the failure to change contaminated gloves at appropriate times during patient care results in poor hand hygiene compliance (Fullera et al. 2011; Girou et al. 2004). North American research has found that EMS workers were not changing gloves at appropriate moments during clinical cases (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012). The extent to which this occurs among Australian paramedics remains unclear.

The Australian healthcare workforce is provided with detailed advice in the form of national guidelines and standards on recommended IPC practices that are aimed at minimising the transmission of HAIs (Australian Commission on Safety and Quality in Health Care 2012d; NHMRC 2010). This advice includes the National Hand Hygiene Initiative implemented by Hand Hygiene Australia (HHA) that provides extensive guidance on appropriate hand hygiene practices (Hand Hygiene Australia 2008). The state and territory ambulance authorities in Australia disseminate advice on IPC practices to their paramedics in the form of operating procedures. Despite this policy rich environment for IPC there is some evidence that Australian paramedics may be breaching recommended IPC practices when caring for their patients (Queensland Parliament 2015; Shaban 2006; Shaban, Clark & Creedy 2004; Shaban, Creedy & Clark 2003). What is not understood is whether these breaches involve fundamental IPC practices such as hand hygiene and gloving.

The research reported in this chapter addressed research questions 3 and 4 of the project:

3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group
discussions triangulate with the findings from the national online survey? This question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.

6.2 Methods
The methods have been previously described in detail in chapters 3 and 5. The textual data were analysed through an interactive process of describing, classifying and connecting information previously described in Section 3.4.1. The non-textual data (categorical, ordinal and Likert scales) were summarised and inferential statistics were used to test for associations between variables, using Pearson chi-square tests and the McNemar test as appropriate. Logistic regression models were fitted to compute adjusted $P$-values (Section 3.4.2).

6.3 Results

6.3.1 Competency based training (CBT) in IPC
Most survey participants were confident with their IPC practices (74.8%). However, the odds of the participants having received CBT for IPC was significantly different across individual states and territories ($\chi^2 = 47.602, df = 7, P<0.001$). The percentage of participants receiving competency-based training for IPC within an Australian state or territory ambulance service ranged from 16.0% to 65.4%.

6.3.2 Hand hygiene practices
The SoPIC participants indicated that hand hygiene had been a minor aspect of their training. One SoPIC participant commented that ‘there should be much better standards of [hand] hygiene across the board, but I don't recall there being much made of it during our training at all’. The focus group participants also indicated that there had been little or no competency-based training in hand hygiene during their training. Two FG2 participants commented that ‘I got more education as a nurse then I ever did as a paramedic about infection control.’ And that ‘…as a student in nursing school you are tested as to how you wash your hands. We don't test paramedic students as to how they wash their hands. Sing Happy Birthday is about as much as you get direction for it.’
The perceptions of the SoPIC participants about the importance of performing hand hygiene during patient care (Figure 1) was incongruous with their self-reported behaviours (Figure 2). Self-reported hand hygiene varied with the type of activity being performed during clinical practice, with less than one-third of the participants indicating that they frequently (often or almost always) performed hand hygiene immediately before (32.8%) or shortly after (28.3%) touching a patient or their items, or before inserting an intravenous cannula (29.5%). The reported frequency of hand hygiene increased with activities at the conclusion of direct patient care, such as before driving and after patient handover. The focus group participants acknowledged that there was a practice gap between the perception of importance of hand hygiene and actually performing it. An FG1 participant commented ‘You know you’re supposed to, but in practice it’s not going to happen’.

![Figure 4: Percentage of SoPIC participants (n = 417) who identified the specified moments during patient care as being important to performing hand hygiene. PPE, personal protective equipment.](image-url)
Figure 5: Percentage of Survey of Paramedics on Infection Control participants (n = 417) who self-reported that they frequently (often or almost always) perform hand hygiene during defined moments of a clinical case. PPE, personal protective equipment

The SoPIC participants considered operational pressure to complete each clinical case in a short turnaround time to be the major barrier to effective hand hygiene practice in paramedic-led healthcare. The FG2 participants agreed that operational pressure was mostly attributed to policies that required ‘…a certain amount of time to get off scene’, such as the ‘…ten and twenty minute artificial time lines at a scene’ and that ‘If you’re there over twenty minutes, it’s tracked’. One FG1 participant commented that ‘hand hygiene will go out the window between patients if there’s multiple patients’.

Other barriers to performing hand hygiene during clinical cases reported by SoPIC participants included: access to appropriate hand hygiene facilities including running water and soap; poor availability of hand-hygiene products such as ABHR; lack of resources for drying hands prior to replacing gloves; and skin reactions to alcohol-based products. Three SoPIC participants noted that ‘When hands are wet/sweaty/sticky donning gloves is IMPOSSIBLE!’ and ‘There is no appropriate facility for hand washing in the ambulances here in Australia’ and ‘Hard to access hand hygiene gear in active situations in remote locations when you have to carry everything on your back’.
The McNemar test was used to assess the changes in self-reported hand hygiene behaviours of the SoPIC participants in both emergency and non-emergency cases prior to undertaking the non-technical skills of using communications equipment (mobile phone and radio handsets), driving, and completing patient care records. Table 15 shows that in every case, the frequency of reported episodes of hand hygiene during an emergency case was significantly less than during a non-emergency case ($P<0.001$).

The SoPIC participants reported that their hand hygiene compliance during an emergency case was compromised by operational pressure (47.5%, $n = 85$), the clinical activity being conducted taking precedence (20.8%, $n = 37$), difficulty in performing hand hygiene procedures in the paramedic work setting (19.2%, $n = 34$), and not having access to appropriate hand hygiene supplies (12.5%, $n = 23$).

Table 15: Difference in self-reported hand hygiene practices of the SoPIC participants during emergency and non-emergency cases prior to performing non-technical skills. $P$-value computed from McNemar’s test

<table>
<thead>
<tr>
<th>Non-technical skill</th>
<th>Situation</th>
<th>Performs hand hygiene prior to non-technical skill</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talking on a mobile phone</td>
<td>Emergency</td>
<td>5.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>($n = 416$)</td>
<td>Non-emergency</td>
<td>26.4</td>
<td></td>
</tr>
<tr>
<td>Talking on a radio handset</td>
<td>Emergency</td>
<td>3.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>($n = 416$)</td>
<td>Non-emergency</td>
<td>18.9</td>
<td></td>
</tr>
<tr>
<td>Driving</td>
<td>Emergency</td>
<td>36.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>($n = 417$)</td>
<td>Non-emergency</td>
<td>51.8</td>
<td></td>
</tr>
<tr>
<td>Filling out a patient care</td>
<td>Emergency</td>
<td>30.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>record any type ($n = 417$)</td>
<td>Non-emergency</td>
<td>44.1</td>
<td></td>
</tr>
</tbody>
</table>

Note: SoPIC, Survey of Paramedics on Infection Control.

6.3.3 **Hand-hygiene during intravenous (IV) cannula insertion**

One-third of the SoPIC participants performed hand hygiene when preparing to insert an IV cannula, with 29.5% indicating that this was done frequently (often or almost always) (Table 16). In contrast, the reported frequency of observing other paramedics performing hand hygiene prior to inserting an IV cannula was never (42.4%), rarely (37.2%), sometimes (16.3%), often (2.2%) and almost always (1.9%). Table 16 shows associations using logistic regression between demographic variables and those who reported that they frequently performed hand hygiene before IV cannula insertion, with $P$-values adjusted for all other demographic attributes in table 16. The categorical variables with statistically significant associations after adjusting were gender, competency-based training, previous or current registration in nursing and time post
qualification and state or territory of employment. No evidence for association was found between frequently performing hand hygiene before IV cannula insertion and scope of practice as outlined in Table 4 (section 2.4).

The perception of having difficulty with hand hygiene was associated with a lower frequency of performing hand hygiene prior to IV cannula insertion ($P = 0.009$, adjusted for variables in Table 16). Hand hygiene prior to IV cannula insertion was 24.5% for those who reported difficulties ($n = 200$) with in-field hand hygiene and 40.9% for those who reported no difficulties ($n = 117$).

Table 16: Associations determined using logistic regression between SoPIC demographic attributes and the SoPIC participants who reported frequently performing hand hygiene before inserting an IV cannula

<table>
<thead>
<tr>
<th>Demographic attributes</th>
<th>Category</th>
<th>Frequently perform hand hygiene before IV cannula insertion (%)</th>
<th>raw $P$ / adjusted $P$ value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender ($n = 417$)</td>
<td>Male ($n = 291$)</td>
<td>29.2</td>
<td>0.85 / 0.031</td>
</tr>
<tr>
<td></td>
<td>Female ($n = 126$)</td>
<td>30.2</td>
<td></td>
</tr>
<tr>
<td>Clinical practice level ($n = 377$)†</td>
<td>Paramedic ($n = 208$)</td>
<td>26.9</td>
<td>0.048 / 0.22</td>
</tr>
<tr>
<td></td>
<td>Intensive care ($n = 118$)</td>
<td>22.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Retrieval &amp; general care ($n = 51$)</td>
<td>41.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excluded†($n = 40$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBT for standard precautions ($n = 417$)</td>
<td>Yes ($n = 295$)</td>
<td>34.2</td>
<td>0.001 / 0.02</td>
</tr>
<tr>
<td></td>
<td>No ($n = 122$)</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>Training type ($n = 417$)</td>
<td>Pre-employment ($n = 106$)</td>
<td>24.5</td>
<td>0.19 / 0.88</td>
</tr>
<tr>
<td></td>
<td>Post-employment ($n = 311$)</td>
<td>31.2</td>
<td></td>
</tr>
<tr>
<td>Highest level of education ($n = 417$)</td>
<td>Certificate or diploma ($n = 122$)</td>
<td>38.5</td>
<td>0.026 / 0.07</td>
</tr>
<tr>
<td></td>
<td>Bachelor degree ($n = 143$)</td>
<td>25.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post graduate study ($n = 142$)</td>
<td>25.4</td>
<td></td>
</tr>
<tr>
<td>Health discipline training ($n = 387$)‡</td>
<td>Paramedic only ($n = 308$)</td>
<td>25.0</td>
<td>0.001 / &lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Paramedic &amp; nursing§ ($n = 79$)</td>
<td>45.6</td>
<td></td>
</tr>
<tr>
<td>Time post qualification ($n = 417$)</td>
<td>1 - 10 years ($n = 194$)</td>
<td>28.8</td>
<td>0.009 / 0.006</td>
</tr>
<tr>
<td></td>
<td>11 - 20 years ($n = 128$)</td>
<td>25.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$&gt; 20$ years ($n = 95$)</td>
<td>43.1</td>
<td></td>
</tr>
<tr>
<td>State or territory of employment</td>
<td>Range¶</td>
<td>8.0 - 46.8</td>
<td>0.002 / 0.008</td>
</tr>
</tbody>
</table>

*Adjusted for all other demographic attributes in the table. Adjusted P values were calculated by fitting a logistic regression model.
†Forty participants were not included in the statistical analysis because of low numbers in a category or roles that do not perform IV cannulation. ‡Health disciplines other than paramedicine and nursing were excluded because of low numbers ($n = 30$). §Gender of nurses were men 53.2% ($n = 42$) and women 46.8% ($n = 37$). ¶A range has been provided to avoid identifying individual state and territory ambulance services.

6.3.4 Gloving practices

All SoPIC participants reported they wore disposable gloves for every clinical case and changed gloves when either the glove integrity was broken by being punctured, torn or ripped (89.2%), or became soiled with either bodily substances (85.9%) or blood (85.6%). If gloves were not soiled or broken, more than half of the participants (57.8%)
reported that they only changed their gloves at the end of a clinical case. One SoPIC participant commented that ‘My gloves stay on from the moment I arrive at the scene until I have completed all the case, including paperwork’. The focus group participants corroborated this finding, with two FG2 participants commenting that ‘When people are in … that moment with that patient, I don’t think swapping gloves and hand hygiene is part of that flow mechanism’ and ‘[I] have the same gloves on for pretty much the entire job because you’re just been too busy to think about it’.

The SoPIC participants reported the frequency of writing case notes on their gloves as never (8.9%), rarely (16.1%), sometimes (23.0%), often (25.7%) or almost always (26.3%). One SoPIC participant commented ‘I write on my glove so never remove it’. Both SoPIC and focus group participants indicated workarounds to avoid changing gloves, including the application of ABHR to sanitise gloves being worn instead of changing gloves and performing hand hygiene; adding a glove over a soiled glove; double-gloving prior to clinical work to enable the quick removal of the top glove if it became contaminated or broken; and the wearing of a glove on one hand for patient care, while using the non-gloved hand for touching other surfaces. An FG2 participant noted that when gloves were contaminated with blood following bandaging or IV cannula insertion that ‘You should take them off, but I think people look, wipe and go again’.

When focus group participants were asked why paramedics were so reliant on wearing gloves during clinical cases, there was consensus that paramedics perceived gloving as being important in protecting themselves from infectious patients, and that the practice of gloving had been driven by the HIV epidemic. An FG2 participant also commented that ‘we are protecting the patient from our own germs’. Most of the focus group participants acknowledged that they usually wore gloves throughout each clinical case and did not perform patient care without them. However, one FG2 participant commented ‘…people with gloves on touch the radio, the keyboard, the patient, the keyboard, the radio and then the bag. Then they take them off and touch the same things again’ highlighting the potential issue of the transmission of pathogens by paramedics.
6.3.5  **Bare below the Elbows**

The SoPIC participants reported the frequent wearing of wrist watches (86.9%), and to a lesser extent wedding rings (45.3%) and wrist bands (11.1%). Most participants also reported that they never wore artificial nails (96.9%), nail polish (90.4%), or two or more finger rings (86.6%), and that they kept their nails shorter than the length of a finger pad (94%).

6.4  **Discussion**

This research has found that Australian paramedics feel confident with their IPC practices and perceive hand hygiene and gloving as being essential in paramedic-led healthcare. However, this research also identified a level of noncompliance by Australian paramedics with recommended hand hygiene and gloving practices, and that compliance varied with the nature of the clinical activity being undertaken and worsened during perceived emergency events. Noncompliance with hand hygiene immediately before touching a patient and before invasive clinical procedures was also identified. These findings are consistent with three North American studies that have reported noncompliance with IPC practices, such as hand hygiene and gloving, amongst EMS workers (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015).

Four major barriers to hand hygiene compliance in paramedic-led healthcare were reported by the research participants. They were: (1) insufficient time to perform hand hygiene because of operational pressure during clinical cases; (2) the physical difficulty of changing gloves in some of the operational environments; (3) poor access to hand hygiene products in the field; and (4) lack of IPC education and training. Similar barriers to IPC practices have been identified in previous studies with EMS workers (McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015) and with healthcare professionals in hospital settings (Grayson et al. 2013). Each of these barriers will be dealt with in turn.

The perception of having too much to do in the time available has been demonstrated as a barrier to compliance with hand hygiene (De Wandel et al. 2010; Whitby, McLaws & Ross 2006). Some of the research participants reported that a target on-scene turnaround
time of less than 20 minutes affected their ability to comply with recommended hand hygiene practices. The Council of Ambulance Authorities (2009) in Australia suggests that reducing the time taken to deliver critical patients to definitive care will improve their clinical outcome. Evidence for this comes from research that demonstrated an association between shorter on-scene turnaround times and lower patient mortality for penetrating trauma (McCoy et al. 2013). Although data for response times to a clinical case are a key performance indicator for EMS in Australia (SCRGSP 2016), the time paramedics are expected to spend on-scene is driven by individual ambulance service policy. Further exploration of the impact that on-scene turnaround time and operational pressure has on paramedic IPC practices is warranted.

Inappropriate gloving is known to interfere with hand hygiene compliance (Cusini et al. 2015; Fullera et al. 2011; Girou et al. 2004; Hessels et al. 2016; Marcil 1993; Pittet et al. 1999) and contributes to the transmission of HAIs (Girou et al. 2004). The findings of this research suggest an over reliance on gloving by Australian paramedics in some clinical cases. As with hand hygiene, the research participants reported operational pressure and patient acuity to be key barriers to changing gloves. They also reported difficulties in changing gloves due to sweaty and swollen hands when hot. Because the hands of healthcare workers are progressively inoculated with pathogens during patient care (Pittet et al. 2006; Pittet et al. 1999), poor hand hygiene practice by paramedics is likely to cause cross contamination of key-sites on the same patient and between patients.

The research participants reported that access to appropriate hand hygiene products was problematic during some clinical cases. Similar to recommendations from other research (Cure & Van Enk 2015; Teter, Millin & Bissell 2015), consideration should be given to improved visibility and accessibility of ABHR dispensers, and the development of products for use in paramedic-led healthcare that minimise skin reactions and do not impede the changing of gloves. A recent study by Teter, Millin and Bissell (2015) has shown that when hand hygiene was poor, the hands of up to 77% of paramedics were heavily contaminated with pathogens on arrival at hospital and up to 47% remained heavily contaminated after hand hygiene.
Participants reported that little emphasis had been placed on hand hygiene practices during their paramedic training. The outcomes of occupational health and safety research across multiple industries has demonstrated that training facilitates workplace culture (Bahn & Barratt-Pugh 2011; DeJoy 2005; Harvey et al. 2001). It is also known that workplace culture can cause substantial differences between knowledge, attitudes and practices (Scott & Vanick 2007; Snow et al. 2006). The entry-to-practice pathway in Australia has migrated over the past 15 years to university-based training. While the longer serving paramedics were mostly trained in an apprenticeship model, those with less than 10 years of experience were mostly university trained. An association was found between better compliance with hand hygiene prior to IV insertion and length of time post qualification. In addition, those survey participants with either a nursing background or who had received competency-based training in IPC, were also more likely to report better compliance with hand hygiene in paramedic-led healthcare. Some of the participants with a nursing background commented that a greater emphasis on IPC and hand hygiene was made in their nursing training and workplace than in their paramedic training program or workplace. Workplace culture and training may be contributing to over reliance on gloving by Australian paramedics as their training curriculum has been criticised for being too focussed on the management of critical medical emergencies and the control of dangers to paramedics (O’Meara, Ruest & Stirling 2014). An emphasis on self-protection has been reported by Jang et al. (2010) in hospital based studies to increase gloving time and decrease hand hygiene compliance. An exploration of the differences between paramedic and nursing entry-to-practice IPC curriculum in Australia is warranted, particularly when many studies have found that nurses have better hand hygiene compliance than members of other health disciplines (Gilbert et al. 2010; Hand Hygiene Australia 2016; Pittet et al. 2000).

The research participants described several ‘workarounds’ to avoid changing gloves and obviate the need for hand hygiene during clinical cases. Double gloving is not recommended because of potential pathogen contamination through micro-perforations and during donning and doffing (Grayson et al. 2013). Although double gloving reduces the risk of percutaneous sharps injury and blood and body fluid contamination (Mischke et al. 2014), it does not obviate hand hygiene. Also, the application of ABHR to sanitise contaminated gloves during patient care instead of doffing and performing
hand hygiene is problematic. HHA advises against this practice because the effect of ABHR products on the integrity of disposable gloves is unknown (Grayson et al. 2013).

Encouraging paramedics to remove gloves and perform hand hygiene at appropriate times during clinical cases is a key challenge for EMS. Improved compliance with correct gloving practices has been achieved in hospital settings through collaborative and comprehensive interventions that involved clinicians, educators and management (Bellaard-Smith & Gillespie 2012; Macbeth & Murphy 2012; Marra et al. 2011). EMS organisations, paramedics and training institutions also need to work together to address gloving noncompliance as knowledge and attitudes do not always transfer into practice (Hosseinialhashemi et al. 2015; McGuire-Wolfe, Haiduven & Hitchcock 2012; Pittet 2000).

Although the 5 Moments for Hand Hygiene is a recommended IPC practice for all healthcare facilities (Grayson, Lindsay. & Russo 2009; World Health Organisation 2009), there is some debate about its suitability in medical areas, such as in anaesthetics and recovery (Rowlands et al. 2014). This research suggests that the 5 Moments for Hand Hygiene needs to be reviewed for paramedic-led healthcare because of the challenges to performing hand hygiene in a mobile out-of-hospital environment with short on-scene turnaround times. Reported compliance with hand hygiene worsened with perceived increased acuity of a case. It is not clear, however, as to what constitutes an emergency case in paramedicine that would preclude recommended hand hygiene practice to ensure patient safety. For instance, it is possible that the workaround of decontamination of disposable gloves with ABHR, whilst not being recommended by HHA, could be a more effective IPC practice in emergency cases with a short on-scene time than changing gloves at specific moments. Research is required to establish ‘critical control points’ (Hulebak & Schlosser 2002) in which hand hygiene and gloving should occur in paramedic-led healthcare at different levels of patient acuity. This in turn could lead to a rigorous infield observational audit process to assist with improving IPC compliance by paramedics. HHA provides an audit tool for compliance with hand hygiene moments but it is not recommended for use outside of Australian acute healthcare facilities (Grayson et al. 2013; Ryan et al. 2012). A similar audit tool for hand hygiene and gloving practices in Australian paramedicine needs to be developed.
6.5 Conclusion

This research has found that the perceptions of Australian paramedics in relation to the importance of hand hygiene and gloving during paramedic-led healthcare may not be transferring into clinical practice. Future research into hand hygiene and gloving practices in paramedic-led healthcare should be targeted at two areas. The first is alleviation of the physical difficulties with performing in-field hand hygiene, including how to decrease the time required to decontaminate hands and replace gloves given the perceived operational pressures on-scene and overall patient acuity. The second is cultural issues and misconceptions concerning over-use of gloves during clinical cases to address perceived barriers. Strong leadership will be required to develop paramedic specific hand hygiene and gloving procedures at different levels of patient acuity, establish competency-based education packages, and to encourage champions to challenge established social norms towards these IPC practices.
7. Environmental hygiene

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). Chapter 4 described and discussed the findings from studies 1 and 2 (Section 3.3), which are aligned with research questions 1 and 2 (Section 1.2). The thesis then changed focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which are presented as five distinct themes. Chapter 5 explored general perceptions about the transmission of healthcare-associated infections (HAIs) and IPC compliance, and Chapter 6 explored hand hygiene and gloving practices. This chapter, Chapter 7, explores environmental hygiene. The next two chapters will explore clinical governance (Chapter 8), and aseptic technique (Chapter 9). Chapter 10 closes the thesis and uses the PRECEDE-PROCEED planning model to connect the findings outlined in chapters 4 to 9 and to provide recommendations to improve IPC practices in paramedic-led healthcare.

7.1 Introduction

The effective management of the physical environment in all healthcare settings is essential for minimising the transmission of pathogens that cause HAIs (Barker, Vipond & Bloomfield 2004; Boyce 2007; Hota 2004; Kramer, Schwebke & Kampf 2006; Mitchell et al. 2012; NHMRC 2010; Roberts et al. 2008). Studies have shown that pathogens can persist on dry inanimate surfaces for months (Kramer, Schwebke & Kampf 2006) and that patients in hospital rooms that were previously occupied by those colonised with a multidrug-resistant organism (MDRO) are at an increased risk of acquiring the same pathogen (Carling & Bartley 2010; Drees et al. 2008; Duckro et al. 2005; Hardy et al. 2006; Hayden et al. 2006; Huang, Datta & Platt 2006; Mitchell, Digney & Ferguson 2014). Accordingly, the enforcement of routine environmental cleaning measures has been associated with a decreased risk of pathogen transmission due to reduced cross-contamination of surfaces and cleaner hands of healthcare workers (Hayden et al. 2006; Otter et al. 2013; Passaretti et al. 2013).
Paramedics provide healthcare in a mobile primary-emergency setting in which episodes of service are unpredictable in time, nature and place (O’Meara & Reynolds 2009). The work undertaken by paramedics presents a challenge for the implementation of recommended environmental hygiene practices. While guidelines for the routine and deep cleaning of ambulances and associated medical equipment used in paramedic-led healthcare have been published by the National Patient Safety Agency (2008) in the UK, several international studies found that recommended cleaning measures were not being implemented effectively by emergency medical service (EMS) workers (Alves & Bissell 2008; Bledsoe et al. 2014; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015). Low compliance with the routine cleaning of shared medical equipment by EMS workers has also been reported (Alves & Bissell 2008; Bledsoe et al. 2014), as has persistent environmental contamination with pathogens that cause HAIs in both road and rotor wing ambulances (Alves & Bissell 2008; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015).

The Australian paramedic workforce has access to advice on recommended environmental hygiene practices through national guidelines and standards published by the ACSQHC (2012d) and the NHMRC (2010), and through operating procedures disseminated by state and territory ambulance authorities. However, Australian paramedics may not be compliant with these recommended practices.

The research reported in this chapter addressed research questions 3 and 4 of the project:

3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey? This
question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.

7.2 Methods

The methods have been previously described in detail in chapters 3 and 5. The non-textual data (categorical, ordinal and Likert scale responses) were summarised and inferential statistics (Pearson chi-square tests) used to test for associations between variables (Section 3.4.2).

The textual data were analysed through an interactive process of describing, classifying and connecting information previously described in Section 3.4.1. In addition to the description presented previously, a coding framework was developed to analyse responses regarding spills management and the cleaning of non-invasive shared medical equipment. In the Survey of Paramedics on Infection Control (SoPIC) questionnaire, the participants were asked to describe how they manage small and large (>10 cm) spills of blood and other bodily fluids, and how they clean shared medical equipment used during paramedic-led healthcare. Current national standards, published by the NHMRC (2010), on spills management and cleaning medical equipment were used to develop the coding framework to analyse this textual data. The elements of each process were grouped into five steps (Table 17) and dichotomous coding was used to compare participant responses for each step. The following criteria were applied to the participant responses: (1) Met standards when steps 1–5 were described in the correct order; (2) Mostly met standards when steps 2–4 were described in the correct order, but Step 1, Step 5, or both (personal protective equipment [PPE] and hand-hygiene) were omitted; and (3) Not met standards when an incorrect process was described (i.e. either an incorrect order of steps was given, or one or more of steps 2–4 were omitted).
Table 17: Criteria for the management of blood and body substance spills and cleaning process of spills and shared medical equipment

<table>
<thead>
<tr>
<th>Task</th>
<th>Step 1: PPE</th>
<th>Step 2: Removal of spill/soiling</th>
<th>Step 3: Detergent clean</th>
<th>Step 4: Disinfection</th>
<th>Step 5: Hand hygiene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small spill management</td>
<td>Protect self by selecting appropriate PPE</td>
<td>Remove the spill by wiping up with absorbent material and place the contaminated material into an impervious container or plastic bag for disposal.</td>
<td>Clean the area with a detergent solution using a disposable cloth or sponge.</td>
<td>Disinfect by wiping the area with sodium hypochlorite and allow to dry.</td>
<td>Remove PPE and perform hand hygiene.</td>
</tr>
<tr>
<td>Large spill management</td>
<td>Protect self by selecting appropriate PPE</td>
<td>Remove the spill by covering the area of the spill with an absorbent clumping agent and allowing to absorb. Use a disposable scraper and pan to scoop up the absorbent material and any unabsorbed blood or bodily substances, and place all contaminated items into an impervious container or plastic bag for disposal.</td>
<td>Clean the area with a detergent solution using a mop.</td>
<td>Disinfect by wiping of mopped area with sodium hypochlorite and allow to dry.</td>
<td>Remove PPE and perform hand hygiene.</td>
</tr>
<tr>
<td>Cleaning non-invasive shared medical equipment</td>
<td>Protect self by selecting appropriate PPE</td>
<td>Remove foreign/organic material from soiled area of objects by rubbing/scrubbing.</td>
<td>Clean item with a detergent solution or one-step disinfectant solution.</td>
<td>Use a disinfectant as necessary.</td>
<td>Remove PPE and perform hand hygiene.</td>
</tr>
</tbody>
</table>

Note: Adapted from the National Health and Medical Research Council guidelines (NHMRC 2010). PPE, personal protective equipment.
1 Small spill was defined as up to 10cm in diameter. 2 Large spill was defined as greater than 10cm in diameter. 3 Using a one-step disinfectant solution was regarded as meeting the criteria in both steps 3 and 4.

7.3 Results

7.3.1 Contamination of ambulances

Most SoPIC participants (89.4%, n = 373) perceived that poor cleanliness of the patient compartment area in ambulances increased the risk of the transmission of HAIs, that stretcher linen should be changed between patients (98.5%, n = 411), and that visible soiling was not a quality indicator of medical items requiring cleaning (92.8%, n = 387). Fewer SoPIC participants agreed that small, noncritical shared medical equipment should be cleaned between patients, including electrocardiogram leads (79.1%, n = 330) and stretcher mattresses (75.0%, n = 313).
Nearly one-third of SoPIC participants (32.4%, $n = 135$) reported that they *often* or *always* worked in a patient compartment of an ambulance that was visibly dirty. A further 42.2% ($n = 176$) of participants reported that this was *sometimes* the case. Most SoPIC participants (96.4%, $n = 402$) reported that they found blood contamination on equipment, supplies and other surfaces in an ambulance at the beginning of a shift more than three times per year (Figure 6). One SoPIC participant commented that ‘The thing I am confident about is that the vehicles are poorly cleaned full stop!!’ Some of the SoPIC participants (12.9%, $n = 54$) reported that the paramedic response bags were never or rarely cleaned.

![Figure 6: The 10 locations of blood contamination inside an ambulance most frequently reported by survey participants. Blood contamination was defined as that found more than three times per year at the beginning of a shift. Results are from the Survey of Paramedics on Infection Control (SoPIC).](image)

The focus group participants were of the view that contamination with community-acquired pathogens was not as harmful as contamination with hospital-acquired pathogens. One FG1 participant remarked that ‘you're more likely to pick up an infection from hospital than you are in someone's home’. Nevertheless, the focus group participants were concerned about potential pathogen transmission from a patient’s living environment to an ambulance. An FG1 participant commented that of ‘all the places we go, and it's particularly into people's homes …bringing things out [pathogens] and leave them in the truck’. A FG2 participant commented that ‘the Jump Bag
[paramedic response kit] … being placed in every single place, picking up all the crap. Then you handle the bag and handle the handle. You never clean the canvas. It never gets thrown in the wash. So we just at every call re-soil it’.

**Routine cleaning of ambulances**

While most SoPIC participants (84.7%, n = 353) indicated that they had not received competency based training on how to clean an ambulance or shared medical equipment routinely, nearly all participants (98.3%, n = 410) considered that it was part of their duties. However, over half of the SoPIC participants reported that either their employer did not have an IPC operating procedure that outlined when an ambulance should be cleaned routinely (30.2%, n = 126) or they were unsure if their employer provided one (26.9%, n = 112). The SoPIC participants who responded that there was no employer guidance on routine cleaning procedures also reported that they used the following triggers to commence routine cleaning: visible surface contamination (48.8%, n = 61); scheduled with shifts (42.4%, n = 53) including at shift change over (29.6%, n = 37), at some time during a daily shift (7.2%, n = 9) or block of shifts (5.6%, n = 7); after each patient case (9.6%, n = 12); after transporting an infectious patient (9.6%, n = 12); and once per month (1.6%, n = 2). A small number of participants (7.2%, n = 9) were unsure when to conduct routine cleaning of an ambulance.

There was consensus among the focus group participants that IPC operating procedures provided by their employer did not outline a recommended routine cleaning schedule for ambulances. Some focus group participants reported that visual inspections were important for making decisions about the routine cleaning of an ambulance, while others acknowledged that contamination was not necessarily visible. One FG1 participant commented that ‘blood's very obvious, but this other stuff [pathogens] we're talking about is not’.

The SoPIC participants reported three major barriers to performing routine cleaning activities in paramedic-led healthcare. The first barrier involved operational pressure or time allowed between cases (90.1%, n = 376). This also included being directed to respond to another patient case rather than perform routine cleaning (69.3%, n = 289). Two SoPIC participants commented that ‘The ambulance never gets thoroughly cleaned
these days. Time does not permit it’ and ‘I’ve lost count of the times I’ve started to clean a vehicle and had to stop to attend a job’. The focus group participants stated that there was not enough time to clean a vehicle at the beginning of a shift in metropolitan stations and that there was no allowance made to stand down from operational duty to conduct routine cleaning activities. One FG1 participant commented that ‘Your vehicle check is checking to make sure everything is there. But… it's 10 minutes and that's not enough to clean a whole ambulance’. It was also suggested that rural paramedics may not face the same issues with routine cleaning. Another FG1 participant commented ‘I'm now in the country and we spend a lot more time caring for the truck than in metro for sure’.

The second barrier was a lack of appropriate cleaning equipment or products, particularly at the transport destination (76.5%, n = 319). One SoPIC participant commented ‘The problem of late [is] no [area] hospitals have this equipment for our use!’ Some participants (37.9%, n = 158) indicated that it was also an issue at their ambulance station. The focus group participants raised concerns about not having the correct cleaning products. One FG1 participant commented that ‘half the things we use to clean things, don't actually deal with viruses’ and another commented that with alcohol you ‘only get the bacteria’.

The third barrier was work place culture. Responses from both the SoPIC and focus group participants indicated that the longer serving paramedics were more compliant with cleaning than recently trained paramedics. For example, one SoPIC participant commented that ‘cleaning has become a secondary requirement and the newer paramedics see it as below them to clean their workplace’. Other SoPIC participants commented that ‘It's not an entrenched [sic] part of the current culture’ and that ‘no one is responsible and no one seems to care’. An FG1 participant commented ‘Well infection control is not really a DRABC word as in danger - protect yourself from getting something. That's about as far as it goes.’

**Deep cleaning of ambulances**

Most SoPIC participants (80.3%, n = 334) acknowledged that the deep cleaning of an ambulance was part of their duties. Of the SoPIC participants who indicated it was not
their role, nearly half (44.6%, n = 37) thought professional cleaners were responsible for deep cleaning ambulances and the remainder (45.4%, n = 45) indicated that they did not know who was responsible. One SoPIC participant commented that ‘No one [sic] is identified in the operational procedures’. The perception that deep cleaning was not part of a paramedic’s role was associated with jurisdiction of employment ($\chi^2 = 38.812$, $df = 7$, $P<0.001$) but was not associated with time post qualification ($\chi^2 = 3.854$, $df = 2$, $P = 0.146$) or clinical practice level ($\chi^2 = 3.612$, $df = 2$, $P = 0.164$)

The majority of SoPIC participants (87.8%, n = 366) indicated that there were no prescribed deep cleaning schedules for ambulances provided by their employers. The rest indicated that they were not sure. Approximately 70% of the SoPIC comments (n = 111) indicated that the participants undertook deep cleaning on a temporal cycle: weekly (37.8%, n = 42), fortnightly (1.8%, n = 2), monthly (17.1%, n = 19), six monthly (0.9%, n = 1), during a roster block rotation (9.9%, n = 11), or at each mechanical service (2.7%, n = 3). A quarter of the comments indicated that participants (26.1%, n = 29) conducted deep cleaning after cases involving significant contamination from the transportation of trauma or infectious patients.

The focus group participants commented that deep cleaning was more likely to occur after transporting a patient known to be colonised with an MDRO. Otherwise deep cleaning was undertaken on an ad hoc basis. Their comments ranged from ‘I've seen one person do it in eight years’ (FG1) and ‘It depends how much time you've got’ (FG1) and ‘It's something that is common practice if you know you've got a patient that's got VRE [Vancomycin-resistant enterococci]’ (FG2).

Management of spills and the cleaning of shared medical equipment
None of the SoPIC participants described correctly the recommended procedures for managing small or large blood or body substance spills, or the cleaning of shared medical equipment (Table 18). The most frequent mistake was omitting the removal or absorption of the spill prior to cleaning the area under the spill. They also omitted steps in the cleaning process or indicated an incorrect order of cleaning, particularly with the order of using detergents and disinfectants. In two subsequent multiple-choice questions, the majority of SoPIC participants (70.5%, n = 294) were unable to identify
the recommended cleaning sequence for small spills, and nearly two-thirds (62.6%, \( n = 261 \)) were unable to identify the correct order in which to use detergents and disinfectants in a two-step cleaning process. These participants either indicated that a disinfectant should be used before a detergent when cleaning (35.5%, \( n = 48 \)) or that they were unsure of the correct order (27.1%, \( n = 113 \)).

Three major noncompliance issues were highlighted in the SoPIC responses for spills management and the cleaning of shared medical equipment. First, some participants reported using high pressure hoses to manage large spills (15.9%, \( n = 56 \)) and to clean large equipment items (13.6%, \( n = 49 \)) and response bags (3.2%, \( n = 11 \)) that were contaminated. Second, many participants indicated that the deep cleaning of noncritical shared medical equipment was initiated only if an equipment item was visibly soiled. Finally, some participants reported the use of alcohol-based disinfectants as the solo cleaning agent for large blood or body substance spills (2.0%, \( n = 7 \)), small equipment items (41.1%, \( n = 153 \)), large equipment items (43.6%, \( n = 157 \)) and response bags (27.4%, \( n = 93 \)).

Table 18: The percentage of comments by SoPIC participants that aligned with national advice provided by the National Health and Medical Research Council (NHMRC 2010) on blood and body substance spill management and cleaning of shared medical equipment as outlined in Table 17, together with the percentage of participant comments that had an omitted step in the recommended practices

<table>
<thead>
<tr>
<th>Task and number of responses</th>
<th>Percentage of comments aligning with NHMRC advice</th>
<th>Percentage of participant comments that had an omitted step in the recommended practices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spills management</strong></td>
<td>Percentage of comments aligning with NHMRC advice</td>
<td>Percentage of participant comments that had an omitted step in the recommended practices</td>
</tr>
<tr>
<td>Small(^a) (( n = 330 ))</td>
<td>Met(^1) Mostly met(^2) Not met(^3)</td>
<td>PPE Remove spill Detergent Disinfection Hand hygiene</td>
</tr>
<tr>
<td></td>
<td>0.0 11.8 88.2</td>
<td>95.5 60.0 50.6 21.2 100.0</td>
</tr>
<tr>
<td>Large(^e) (( n = 353 ))</td>
<td>0.0 3.7(^a) 96.3</td>
<td>95.8 98.3(^*) 52.7 39.4 100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cleaning shared medical equipment</th>
<th>Percentage of comments aligning with NHMRC advice</th>
<th>Percentage of participant comments that had an omitted step in the recommended practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small items (( n = 372 ))</td>
<td>Met Mostly met Not met</td>
<td>PPE Remove soiling Detergent Disinfection Hand hygiene</td>
</tr>
<tr>
<td></td>
<td>0.0 9.7 90.3</td>
<td>98.7 21.8 46.0 19.1 100.0</td>
</tr>
<tr>
<td>Large items (( n = 360 ))</td>
<td>0.0 16.1 83.9</td>
<td>99.2 23.6 47.2 22.2 100.0</td>
</tr>
<tr>
<td>Response bags(^g) (( n = 339 ))</td>
<td>0.0 6.8 93.2</td>
<td>99.7 30.1 51.9 33.9 100.0</td>
</tr>
</tbody>
</table>

Note: adapted from the NHMRC guidelines (NHMRC 2010), NHMRC, National Health and Medical Research Council; SoPIC, Survey of Paramedics on Infection Control; PPE, personal protective equipment.  
\(^1\)Met standards\(^1\) when steps 1-5 were described in the correct order, but PPE and/or hand-hygiene (Step 1 and 5) were omitted.  
\(^2\)Mostly-met standards\(^2\) when steps 2-4 were described in the correct order, but PPE and/or hand-hygiene (Step 1 and 5) were omitted.  
\(^3\)Not-met standards\(^3\) when an incorrect process was described with either an incorrect order of steps or one or more of steps 2-4 were omitted.  
\(^4\)Small’ spill is defined as greater than 10cm in diameter.  
\(^5\)Large spill’ is defined as greater than 10cm in diameter.  
\(^6\)Small spill’ is defined as up to 10cm in diameter.  
\(^7\)Large spill’ is defined as greater than 10cm in diameter.  
\(^8\)Small’ spill is defined as up to 10cm in diameter.  
\(^9\)Large spill’ is defined as greater than 10cm in diameter.  
\(^*\)157 participants indicated they soak up the spill with absorbent material rather than a clumping agent.  
\(^\)5 participants indicated a spills kit was utilised.  
\(^g\)54 participants indicated that paramedic response bags were rarely or not cleaned.
7.4 Discussion

This research has found that Australian paramedics consider environmental hygiene to be an essential part of paramedic-led healthcare and that they understand that poor cleanliness of ambulances adds to the risk of transmission of HAIs. Nevertheless, many of the research participants reported that they often worked in ambulances with patient compartments that were visibly dirty and contained blood contamination on internal surfaces, shared medical equipment and supplies. While the research participants highlighted several barriers to conducting routine and deep cleaning of ambulances, the lack of cleanliness may have been compounded by a level of noncompliance and misunderstanding by them in relation to recommended environmental hygiene practices. The research findings are consistent with previous international studies with EMS workers that documented contamination of ambulances, variance in environmental cleaning techniques, and poor compliance with routine cleaning of shared medical equipment after each patient case (Alves & Bissell 2008; Bledsoe et al. 2014; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Sulis, Estanislao & Wedel 2010; Wepler et al. 2015).

Routine cleaning guidelines for ambulances have been published by the National Patient Safety Agency (2008) for ambulance trusts in the United Kingdom. In Australia, guidelines for routine cleaning procedures are outlined in operating procedures provided by each state and territory ambulance service. The research participants indicated a range of triggers for the routine cleaning of ambulances, with visible contamination and scheduling of work shifts being the two main triggers for cleaning. Only a small proportion of SoPIC participants considered the transportation of an infectious patient to be a trigger for routine cleaning. A wide range of non-compliant routine cleaning practices were reported by the participants and most demonstrated recognition knowledge (Green & Kreuter 2005) of the practices rather than recall knowledge or higher analytic skills for environmental hygiene. A lack of competency based training in environmental hygiene practices and confusion about the existence of employer operational procedures may have contributed to the ad hoc routine cleaning schedules reported by the participants, which warrants further investigation.
Operational pressure due to the lack of time at the end of a case was considered by the research participants to be a major barrier to routine cleaning compliance. Nigam and Cutter (2003) have suggested that the time available for cleaning ambulances between cases is a critical factor for environmental hygiene compliance. The Commonwealth Report on Government Services (Productivity Commission 2017) only collates and compares ambulance response times to a scene in Australia, rather than time spent at hospital or in between cases. Individual state and territory ambulance authorities use different criteria to measure and place targets on the time that an ambulance spends at hospital following patient delivery. For example, the target Hospital Clearance Times in South Australia are 65% within 30 minutes and 85% within 40 minutes (South Australia Health 2016), while the target time for Ambulance Patient Transfer Time in Victoria is set at 90% within 40 minutes (Victoria State Government 2016). These benchmarks do suggest that there is enough time for paramedics to undertake routine cleaning of high touch areas between cases. A review into this by Australian ambulance services is recommended.

A lack of cleaning equipment and cleaning products at transport destinations such as hospitals, and to a lesser degree ambulance stations, was also highlighted by the research participants as being a problem. Some questioned whether the provided cleaning equipment and products were appropriate for decontaminating the internal compartments of ambulances and shared medical equipment. This further links to the finding that a majority of SoPIC participants were unable to describe correctly the NHMRC (2010) recommended procedures for the management of small and large spills of blood or body substances, and the decontamination of shared medical equipment. Previous studies have demonstrated that mobile emergency platforms such as ambulances are potential mediums for the transmission of pathogens causing HAIs (Alves & Bissell 2008; Galtelli, Deschamp & Rogers 2006; Nigam & Cutter 2003; Rago et al. 2012; Roberts et al. 2011; Roline, Crumpecker & Dunn 2007; Wepler et al. 2015). Australian ambulance authorities, therefore, need to consider improving the accessibility that their paramedic workforce have to cleaning equipment and products, and audit compliance with recommended decontamination practices.
There was even more confusion among the research participants about deep cleaning schedules for ambulances. The National Patient Safety Agency in the UK recommends that deep cleaning of ambulances should occur on a weekly basis (National Patient Safety Agency 2008). While most research participants indicated that deep cleaning was an expectation of their work duties, some were not aware of who was responsible for conducting the cleaning. Responses also indicated that there was a lack of guidance as to when deep cleaning of ambulances should take place. Hence, the reported frequency of deep cleaning varied from weekly to 6-monthly, or was completed after mechanical servicing of the vehicle or following the transport of an infectious patient or a patient with major trauma. Unusual cleaning practices were reported, such as high pressure hosing of the back of ambulances and response kits that could generate infectious aerosols. The findings suggest that deep cleaning occurs on an ad hoc basis in Australian ambulance authorities and that a level of consistency with environmental hygiene practices is required within and between jurisdictions.

Research with environmental service workers has shown that attitudes and beliefs, rather than just knowledge, influence the effectiveness of their environmental cleaning practices (Matlow, Wray & Richardson 2012). In this research, participants identified that the longer serving paramedics were more compliant with environmental hygiene practices than less experienced paramedics. The attitudes of Australian paramedics toward environmental hygiene may have changed over the past 15 years with the entry-to-practice training pathways migrating from post-employment models to university-based training. According to the National Patient Safety Agency (2008) environmental hygiene compliance is likely to be improved through better training of staff that includes a clear dissemination of cleaning specifications, individual responsibilities and lines of accountability. Research is required to establish when best to implement this training as previously targeted IPC educational interventions in EMS have had mixed success (McGuire-Wolfe, Haiduven & Hitchcock 2012; Sulis, Estanislaao & Wedel 2010). The Council of Ambulance Authorities in Australia, which accredits tertiary entry-to-practice paramedic programs, could ensure that appropriate competency based environmental hygiene curricula is taught. The transfer of compliant behaviours from training to the workplace could be facilitated by ambulance authorities conducting their own competency based training during the induction of new graduates. Training could
be further reinforced through the use of ‘opinion leaders’ and ‘champions’ to promote and sustain compliance in new and existing staff (Lomas 1991; Lomas, Sisk & Stocking 1993).

Ambulance authorities in Australia will need to provide considerable organisational support to ensure adequate environmental hygiene practices are being conducted. In conjunction with effective competency based training, the enforcement of recommended environmental hygiene practices through auditing and ongoing performance feedback could improve behaviour and overall compliance (Braithwaite & Travaglia 2008; Lomas 1991; Lomas, Sisk & Stocking 1993; Mitchell, Wilson & Wells 2015). Where this has been implemented in fixed-location healthcare facilities, there has been a reduction in surface contamination with pathogens, cleaner hands of healthcare workers and a decreased risk of transmission of HAIs (Hayden et al. 2006; Otter et al. 2013; Passaretti et al. 2013). The development of an audit tool for compliance with environmental hygiene in paramedic-led healthcare in Australia could be modelled on existing national standards (ACSQHC 2012d; NHMRC 2010) and international IPC frameworks (National Patient Safety Agency 2008). This will ensure a harmonised national approach to benchmarking with defined environmental hygiene standards and appropriate assessor training.

Organisational support is required to help improve vehicle design of emergency vehicles and shared medical equipment to facilitate environmental hygiene. The research participants indicated that vehicle design impacted on ease of cleaning due to the types of materials and difficult to access places inside ambulances. Research has shown that microorganisms survive for prolonged periods on porous materials compared to nonporous materials (Vaglenov 2014). Porous materials are found in ambulance patient compartments and parts of shared medical equipment, including patient restraints, splints and equipment bags. The design of ambulances and shared medical equipment is an important consideration for IPC in EMS. Furthermore, consideration needs to be given to the way in which consumables are stored and the environment is maintained inside ambulances. For instance, seals on compartments could be used to indicate when cleaning is required; surfaces could be engineered to contain antimicrobial agents or properties to improve the ease of cleaning; and air-
conditioning could be designed to provide maximum protection to the occupants and the physical environment by exhausting air through High efficiency particulate air (HEPA) filters similar to class 1 biosafety cabinets. Further research into appropriate vehicle and shared equipment design to facilitate IPC in paramedicine is required.

7.5 Conclusion

This research has found that Australian paramedics consider the routine and deep cleaning of ambulances and shared medical equipment to be important. However, several workplace barriers appear to be preventing them from undertaking recommended cleaning procedures, including operational pressure, attitudes, knowledge and access to cleaning products. The ad hoc nature of routine and deep cleaning practices among Australian paramedics needs to be addressed by ambulance authorities so that the physical environment of paramedic-led healthcare does not contribute to the transmission of HAIs. Future research could be targeted at two areas. First, the implementation of education strategies to improve the level of competency among paramedics in managing pathogen contamination in their work setting. And second, investigation into more effective environmental hygiene practices, such as the scheduling and auditing of routine and deep cleaning protocols, the use of one-step detergent/disinfectants and no-touch disinfection systems, and improvements to overall vehicle and shared medical equipment design that enhance compliance with cleaning practices and minimise pathogen contamination on surfaces.
8. Clinical governance

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). Chapter 4 described and discussed the findings from studies 1 and 2 (Section 3.3), which are aligned with research questions 1 and 2 (Section 1.2). The thesis then changed focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which are presented as five distinct themes. Chapter 5, explored general perceptions about the transmission of healthcare-associated infections (HAIs) and IPC compliance, Chapter 6 explored hand hygiene and gloving practices, and Chapter 7 explored environmental hygiene. This chapter, Chapter 8, will explore clinical governance and Chapter 9 will explore aseptic technique. Chapter 10 closes the thesis and uses the PRECEDE-PROCEED planning model to connect the findings outlined in chapters 4 to 9 and to provide recommendations to improve IPC practices in paramedic-led healthcare.

8.1 Introduction

Clinical governance is a system that facilitates quality assurance through a focus on accountability, effective end results, acceptable resource use, and appropriate ways of working and behaving (ACSQHC 2012c). In paramedic-led healthcare, clinicians collect information in order to create and implement patient care-plans (Fisher et al. 2015; O’Meara & Reynolds 2009). However, in some cases, a paramedic’s decisions or actions can lead to adverse events for their patients (Dobbie & Cooke 2008). To minimise these adverse events, clinical governance frameworks promote the development of evidence-based policies and practices, and place the burden of providing safe and effective IPC with both the individual clinicians and managers (ACSQHC 2012c; Braithwaite & Travaglia 2008; NHMRC 2010).

The first models of clinical governance underpinned by legislation were introduced in the UK in the 1990s (Scally & Donaldson 1998). In Australia, legislated requirements for clinical governance arose in the early 2000s to address failures in standards of care
within public hospitals and to provide frameworks to promote improvements in the quality and safety of patient care (ACSQHC 2012c; Braithwaite & Travaglia 2008; Office of Safety and Quality in Health Care 2001; State Government of Victoria 2009). The ten National Safety and Quality Health Service (NSQHS) standards developed by the Australian Commission on Safety and Quality in Health Care (ACSQHC 2012b) set the overarching requirements to achieve clinical governance within health service organisations. One of these standards is Standard 3: Preventing and Controlling Healthcare-Associated Infections. Yet, despite this regulatory environment, near misses in IPC breaches and adverse events still occur in Australian healthcare (Braithwaite & Travaglia 2008; Russell & Dawda 2014).

Clinical governance of paramedic-led healthcare is an important consideration because paramedics deliver unscheduled healthcare to diverse populations in circumstances that makes the provision of IPC challenging (APIC 2013). Yet, there is a paucity of research exploring patient safety in emergency medical services (EMS) and in particular in the area of paramedic IPC. For example, of the 330 studies found by Fisher et al. (2015) in the scoping review of patient safety in ambulance services, only five were focussed on IPC. Hence, clinical governance of IPC in paramedic-led healthcare warrants further exploration.

The research reported in this chapter addressed research questions 3 and 4 of the project:

3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey? This question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.
8.2 Methods

The methods have been previously described in detail in Chapter 3 and 5. The non-textual data (categorical, ordinal and Likert scales) were summarised and inferential statistics were used to test for associations between variables using the Pearson chi-square test. The textual data were analysed through an interactive process of describing, classifying and connecting information previously described in Section 3.4.1.

8.3 Results

A summary of the Pearson’s Chi square test results described in this chapter are shown in Appendix C (Table 43).

8.3.1 Awareness of operating procedures and personal responsibility

The majority of SoPIC participants (92.3%, n = 385) either strongly agreed (60.9%, n = 254) or agreed (31.4%, n = 131) that IPC guidelines were relevant to their clinical practice. Furthermore, most SoPIC participants (97.4%, n = 406) either agreed (40.3%, n = 168) or strongly agreed (57.1%, n = 238) that it is the responsibility of every paramedic to ensure IPC procedures are followed in the workplace. However, a small number of participants (15.8%, n = 66,) indicated that they did not know how to access the IPC operating procedures of their employer (Figure 7). There was strong evidence that the odds of not knowing how to access IPC operating procedures varied with both the state or territory of employment ($\chi^2 = 20.775, df = 7, P = 0.004$; range from 6.4% to 36.0%, Figure 8) and having received competency-based training (CBT) ($\chi^2 = 23.474, df = 1, P<0.001$; unable to access and received training 8.6% compared to unable to access and had not received training n = 26.2%).
Focus group participants raised the concept of developing personal accountability in avoiding the transmission of HAIs. An FG2 participant commented that ‘…you have got to have a real strong sense of why you are doing these things [IPC], and an understanding of the impact if you don't.’ The focus group participants also commented that peer pressure from other health disciplines could cause noncompliance with recommended practice even when there was awareness of IPC polices. For example, an FG2 participant commented that ‘So even if the policy says don't do it, we started doing it [inserting IV cannulas] again because the nurses give us such a better welcome that we did it to please them’. This behaviour was viewed negatively by some FG participants and justified by others. For example, an FG2 participant stated that ‘it irritates me when I see officers, for the practice of it, putting IVs in people that they're not actually…going to use it.’ However, another FG2 participant commented that ‘It's this technical imperative. We can do the skills, so we are going to do it whether the patient needs it, even if they don't need it.’

8.3.2 Accessing IPC information

The main methods for accessing an employer’s operating procedures for IPC were indicated by SoPIC participants as their employer’s website, followed by a hard desk copy, except in two states where the second most accessed method was either reference
material in the ambulance or via a smart device. Figure 8 shows variation across de-identified jurisdictions for points of access to IPC operating procedures.

![Figure 8: Percentage of SoPIC participants who utilised particular methods to access their employer’s infection protection and control operating procedures separated by state or territory (A1 to A8). SoPIC, Survey of Paramedics on Infection Control; IPC, infection prevention and control.](image)

8.3.3 **Clinical governance of breaches**

**Environmental hygiene**

Most SoPIC participants (88.0%, \( n = 367 \)) indicated that no record of cleaning of ambulances was kept by their employer. In the absence of record keeping, approximately half (55.9%, \( n = 205 \)) of these participants indicated that there was no real way of knowing whether an ambulance had been cleaned. Other participants reported that making decisions about the compliance with cleaning was reliant on physical inspection or appearance of the ambulance and associated equipment (24.0%, \( n = 88 \)), being told by another team member (15.3%, \( n = 56 \)), or simply trusting that it had been done on a schedule (3.5%, \( n = 13 \)). Two SoPIC participants commented that the cleaning of vehicles was a ‘Completely ad hoc arrangement’ and that ‘Vehicles are passed between crews and there is no SOP regarding the monitoring of any cleaning at all’. In addition, it was also reported by some of the SoPIC participants that cleanliness of reusable equipment was unknown. One SoPIC participant commented that ‘I can't
know whether equipment, etc. has been properly cleaned, I consider pretty much everything in the ambulance to be contaminated.’

It was outlined in Section 7.3.1 that nearly one-third of SoPIC participants (32.4%, \(n=135\)) reported that they often or always worked in a patient compartment of an ambulance that was visibly dirty, and that most of the SoPIC participants (96.4%, \(n=402\)) have found blood contamination at the beginning of their shift on equipment, supplies or surfaces in the ambulance greater than three times per year. Only half of the SoPIC participants (51.1%, \(n = 213\)) believed that reporting blood or body fluid contamination of an ambulance helped to protect patients from developing HAIs. There was weak evidence (\(\chi^2 = 3.847, df = 1, P = 0.050; \) Table 43 Appendix C) that the odds of this perception varied with receiving competency-based training (perception and not trained 45.3% to perception and trained 55.1%).

The SoPIC participants described a number of ways that they dealt with their concerns after discovering blood contamination in an ambulance or on equipment or supplies left by the previous crew. Under half of the participants (43.6%, \(n = 182\)) indicated that they had spoken to their partner about this issue, and a similar number of participants (42.9%, \(n = 179\)) reported the breach to their training officer or supervisor. However, only a moderate proportion completed an incident report (17.5%, \(n = 73\)) and less (7.6%, \(n = 32\)) indicated that they had spoken with their peers who had used the vehicle previously. This is in contrast to a higher proportion of participants (53.7%, \(n = 224\)) who indicated that they perceived that their peers would normally speak to their fellow paramedics who did not follow IPC operating procedures. For those SoPIC participants who indicated that they had raised the issue of contamination with the responsible crew (peers), styles of communication varied from collegial to aggressive. One SoPIC participant commented that ‘I throw a wobbly’ and another that they ‘Find the culprit and let them have it. This makes me a very angry person and I make sure I tell the individual responsible that this unacceptable and will NOT be tolerated’.

Some SoPIC participants (18.9%, \(n = 79\)) indicated that they would not report the discovery of blood contamination on equipment or supplies in an ambulance at the commencement of their shift. Not reporting the discovery of blood contamination in an
ambulance increased with less years of experience ($\chi^2 = 7.334, df = 2, P = 0.026$; 0-10 years = 23.7%, 11-20 years = 18.0%, >20 years = 10.5%; Table 43). The three main reasons that SoPIC participants provided for not raising or reporting concerns about breaches of environmental hygiene were: 1) it was pointless, for example ‘…whingeing doesn’t get it cleaned’; 2) for workplace harmony, for example ‘People have enough issues with management little alone being hit for procedural issues’; and 3) participants assumed it was an oversight by their peers due to operational pressure, for example ‘time constraints due to high work load including pressure to clear post case’.

**Aseptic technique**

Almost three quarters of participants (70.7%, $n = 295$) reported that they had previously worked with another paramedic who was not compliant with an aseptic technique while inserting an intravenous (IV) cannula. While most participants (82.5%, $n = 344$) agreed or strongly agreed that a paramedic should stop another paramedic who is about to insert an IV cannula using a poor aseptic technique, only a small percentage (2.0%, $n=6$) indicated that they had done so. Rather than stopping the procedure, the SoPIC participants indicated that they had dealt with the situation either by speaking directly with their partner after the case (60.9%, $n = 254$), speaking to their supervising officer/training officer (6.0%, $n = 25$), informing staff at the receiving facility (3.8%, $n=16$), or documenting the breach in the patient care record (3.1%, $n = 13$). A very low proportion of SoPIC participants indicated that they would complete an incident report (1.2%, $n = 5$). Not acting on breaches of aseptic technique (12.0%, $n = 50$) was associated with training category type ($\chi^2 = 4.743, df = 1, P = 0.029$; not acting and post-employment training 10.0% compared to not acting and pre-employment training 17.9%, Table 43). Some of the SoPIC participants commented that it was not a paramedic’s responsibility to report other clinicians’ noncompliance with aseptic technique. For example, one SoPIC participant commented that it was ‘Not my problem. This is the way people are being taught. I am responsible for my own practice’.

**Infield audit**

A lack of infield auditing of IPC in paramedic-led healthcare was described by the focus group participants. Some focus group participants made the observation that
considerable differences existed in the clinical auditing of other health disciplines when compared to paramedicine. An FG2 participant commented that ‘you're so heavily audited [as a nurse] and whereas no one is watching [as a paramedic].’ Another FG2 participant commented that ‘In the hospital system you have a person allocated to follow you on a shift for a certain time frame…Whereas, it's a real shame that we have educators that, CSOs [clinical support officers], whoever they are, will come out to a scene now and audit your practice; but they don't necessarily audit infection control.’

### 8.3.4 Training in IPC

The reported frequency of participants who indicated that they had received CBT for specific IPC procedures are shown in Table 19 on a state by state basis and in Figure 9 grouped by procedure. At the aggregate level, the reported frequency of receiving CBT for different aspects of IPC was IPC guidelines (58.8%, \( n = 245 \)), standard precautions (70.7%, \( n = 283 \)), and aseptic non-touch technique (51.3%, \( n = 214 \)). The reported frequency for CBT for the management of the physical environment was lower (cleaning an ambulance=15.3%, \( n = 64 \); cleaning medical equipment=15.3%, \( n = 64 \); cleaning an ambulance station = 8.2%, \( n = 34 \)). The odds of receiving CBT in IPC guidelines significantly differed with: level of education (\( \chi^2 = 8.952, df = 2, P = 0.011 \); diploma 69.7%, post graduate 57.7% and bachelor degree 51.7%); paramedic training type (\( \chi^2 = 7.869, df = 1, P = 0.005 \); post-employment trained participants more likely to receive training); and jurisdiction (\( \chi^2 = 47.602, df = 7, P<0.001 \); range 16.0-76.1). Receiving CBT in aseptic technique was associated with number of years since first qualifying as a paramedic (\( \chi^2 = 10.932, df = 2, P = 0.004 \); 0-10 years = 42.8%, 11 to 20= years 57.0%, >20 years = 61.1%) and state of employment (\( \chi^2 = 17.605, df = 7, P=0.014 \); range from 31.8% to 68.1%). The SoPIC comments indicated that increased emphasis needs to be placed on CBT for IPC. For example, three SoPIC participants commented that ‘There should be much better standards of hygiene across the board, but I don't recall there being much made of it during our training at all’, and ‘This is a huge issue with minimal education & training included in programs’ and ‘Nearly all my infection control knowledge has been gained from nursing, minimal input from ambulance service’.
Table 19: Percentage of participants (n = 401) who reported receiving competency-based training (CBT) for specific infection prevention and control procedures in de-identified state or territories of employment (A1 to A8).

<table>
<thead>
<tr>
<th>Procedure</th>
<th>% participants who received CBT in each de-identified state/territory of employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A1 (n = 22)</td>
</tr>
<tr>
<td>Infection control guidelines</td>
<td>63.6</td>
</tr>
<tr>
<td>Standard precautions</td>
<td>81.8</td>
</tr>
<tr>
<td>How to clean an ambulance</td>
<td>22.7</td>
</tr>
<tr>
<td>How to clean medical equipment</td>
<td>27.3</td>
</tr>
<tr>
<td>How to clean an ambulance station</td>
<td>9.1</td>
</tr>
<tr>
<td>How to use an aseptic technique</td>
<td>31.8</td>
</tr>
</tbody>
</table>

Figure 9: Percentage of participants (n = 401) who reported receiving competency-based training for specific IPC procedures in de-identified state or territories of employment (A1 to A8).

The focus group participants indicated that IPC training was generally undertaken on an ad hoc basis. Some participants stated that they had not received training at all, while others stated that they had received more training as a nurse than as a paramedic and that training was dependant on broader issues that arise from time to time. An FG 2 participant commented that ‘I got more education as a nurse then I ever did as a paramedic about infection control.’ An FG1 participant commented that ‘The infection control stuff…it's again that rehashing on when something becomes prominent again’.
8.3.5 **Perceptions about supervisors and operating procedures**

*Supervisors*

Less than half of the SoPIC participants (42.5%, \( n = 177 \)) believed that their supervisors would normally speak to paramedics who do not follow IPC operating procedures. There was strong evidence \( P<0.001 \) of an association between an increase in this perception and receiving CBT (no training and agree: 29.7%, and received training and agree: 51.4%; Table 43).

*Staff health*

There was palpable sentiment in the responses given by the FG1 participants regarding the perceptions of their employer’s competence at conducting follow-up investigations of staff exposed to communicable diseases. For example, four FG1 participants commented that ‘I was notified six months after the fact that I was exposed to TB…’, and that ‘I've also had a situation where I had an African lady, unknown history, unknown this, unknown that…We just rang to check on how she was going and all we were told on the phone was, she's got a massive infection…Tried every avenue to follow that up and got nothing’, and ‘…we had this huge period where…we actually did not have any infection control…So people were slipping through the gaps and that sort of stuff because nobody could track it down’ and ‘No-one followed me up’.

*Sick leave and presenteeism*

The SoPIC participants mostly agreed (85.4%, \( n = 356 \)) that they should not go to work if they have a communicable illness such as a cold. Three-quarters of the SoPIC participants (77.7%, \( n = 324 \)) believed that their supervisors (e.g. station officer or team manager) should direct a paramedic with a communicable disease to go home if they present for work. There was some evidence \( \chi^2 = 15.871, df = 7, P = 0.026 \) that the perception that it was acceptable for a paramedic with a communicable disease to be allowed to remain at work (presenteeism) was associated with the state or territory of employment (range from 7.7% to 31.8%, Table 43). The SoPIC comments indicated that some of the participants believed that taking sick leave lowered their prospects of a job promotion. For example, two SoPIC participants commented that ‘Job promotion in [state] can rely on how much sick leave you have used as a basis of whether you get the job or not and therefore people refuse to take sick leave…’, and that ‘…you receive a
‘good’ or congratulate's [sic] letter if you have not taken any sick leave for the year. The message this is sending is- keep turning up for work, don't let the team down, and keep your record clean so your [sic] in for a chance of getting that next job you apply for’.

Another reported barrier to taking sick leave was working in a rural station. For example, a SoPIC participant commented ‘Things we think of and consider are the fact their [sic] is not many of us in the small rural communities’. In contrast, other SoPIC comments indicated that presenteeism causes frustration amongst some staff. For example, one SoPIC participant commented that ‘…the biggest bugbear with me is when others come to work full of the flu or a cold and spread it around to everyone else’.

**Operational pressure**

There was consensus among focus groups participants that policies regarding time allowed to remain on-scene was contributing to operational pressure and noncompliance with IPC. An FG2 participant commented that ‘you've only got a certain amount of time to get off scene…’ another FG2 participant added that ‘…they [ambulance service] actually would send out a spreadsheet with the officer's name attached to the time that they would take on-scene... They would actually identify - your name was in red … if you're at a scene longer than 20 minutes, you're immediately tagged, and it's terrible.’

8.3.6 **Supply of IPC equipment**

Approximately one-third of participants (21.8% agreed, 14.6% strongly agreed) believed that their employer failed to provide the necessary supplies to practice good IPC. There was evidence (Table 43) that an increase in this perception may be associated with a higher level of education ($\chi^2 = 10.104, df = 2, P = 0.006$; 27.9% diploma, 46.5% postgraduate), state of employment ($\chi^2 = 10.104, df = 2, P = 0.004$; ranged from 23.1% to 57.6%), not receiving CBT in IPC guidelines ($\chi^2 = 15.920, df = 1, P<0.001$; 28.6% received training, 47.7% not received training), and gender ($\chi^2 = 4.839, df = 1, P = 0.028$; 28.6% females to 39.9% males). The SoPIC comments on the provision of the necessary supplies for IPC mostly concerned hand hygiene products. For example, two SoPIC participants commented that ‘alcohol based hand cleanser is only kept in the ambulance and therefore not readily available whilst at the scene’ and
‘No alcohol rub. Or spare gloves. It’s not carried with you into the scene’. The focus group participants corroborated the views of the SoPIC participants regarding the supply of appropriate hand hygiene products, as well as with personal protective equipment. An FG1 participant commented that ‘we'd wear masks and stuff… [but] we didn't have proper respirators or anything like that’.

8.3.7 Staff immunisation

Almost a third of the SoPIC participants (30.7%, n = 128) reported that their employer maintained immunisation records on their behalf. A quarter of the SoPIC participants (25.2%, n = 105) reported that their employer provided vaccinations, while over one-third (39.3%, n = 164) did not know if this was the case. Approximately two thirds of SoPIC participants (66.0%, n = 275) agreed that it should be mandatory for all paramedics to be immunised against vaccine preventable diseases included in the National Health and Research Council (NHMRC) Standard Vaccination Schedule for adults, with only 15.7% (n = 63) of the participants reporting that this was the case for their employment.

The percentage of SoPIC participants who had been immunised against the vaccine preventable diseases on the NHMRC Standard Vaccination Schedule for adults is shown in Table 20. No associations were found between the perception of mandatory vaccination and any other of the participant attributes collected (Table 43). Nearly two thirds of the SoPIC participants (61.2%, n = 255) reported annual uptake of the seasonal influenza vaccination (Figure 10). Much less (17.7%, n = 74) had never been immunised against seasonal influenza. Not being immunised against seasonal influenza was associated with type of paramedic training ($\chi^2 = 4.479, df = 1, P = 0.034$; post-employment training=15.4% to pre-employment training=24.5%), nursing training ($\chi^2 = 6.370, df = 1, P = 0.012$; paramedic training only=14.6% to paramedic and nurse training = 26.6%), state of employment ($\chi^2 = 15.015, df = 7, P = 0.036$; 4.5% to 26.9%), and gender ($\chi^2 = 7.241, df = 1, P = 0.007$; male = 14.4% to female = 25.4%; Table 43).
Table 20: Participants (n = 417) who reported receiving vaccinations on the National Health and Medical Research Council Standard Vaccination Schedule for adults (NHMRC 2010)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Yes (%)</th>
<th>No (%)</th>
<th>Doesn't know (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria</td>
<td>79.9</td>
<td>4.6</td>
<td>15.6</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em> type b</td>
<td>30.5</td>
<td>42.2</td>
<td>27.3</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>96.9</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Measles</td>
<td>86.6</td>
<td>7.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Mumps</td>
<td>78.7</td>
<td>11.3</td>
<td>10.1</td>
</tr>
<tr>
<td>Pertussis</td>
<td>82.3</td>
<td>9.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Pneumococcal infections</td>
<td>24.9</td>
<td>42.4</td>
<td>32.6</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>90.2</td>
<td>2.2</td>
<td>7.7</td>
</tr>
<tr>
<td>Rubella</td>
<td>82.3</td>
<td>10.8</td>
<td>7.0</td>
</tr>
<tr>
<td>Seasonal influenza</td>
<td>82.3</td>
<td>17.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Tetanus</td>
<td>97.6</td>
<td>0.7</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Figure 10: Percentage of SoPIC participants (n = 413) who had received the seasonal influenza vaccination in 2013

Focus group participants generally perceived that immunisation was important to protect themselves, their families and their patients from infectious diseases. One FG2 participant commented that immunisation was ‘Critical, and people don't do it… they don't realise they're carrying it themselves…I think it's a huge problem…’ The focus group participants reported that different ambulance services had taken different approaches to immunisation. The approaches range from no mandatory vaccinations to requiring evidence of broad vaccination prior to beginning work as a paramedic. An FG1 participant reported that ‘We're not mandated to have Hep B and all that sort of stuff’, while two further FG1 participants commented that ‘I had to have it
[vaccinations] before I joined’ and that ‘…I had to have blood tests to show that I had antibodies to all of them…I had to have proof to start.’

Different levels of support by employers in providing immunisation to the paramedic workforce were described by focus group participants. Some focus group participants indicated that their employer administered vaccinations at their workplace to all staff. Others commented that they were advised by their employer to have vaccinations but these were not mandated nor provided. For example, an FG1 participant commented that ‘Whooping cough … never got offered. So you would just go to your doctor and get it done if you were concerned’. Another FG1 participant commented that different employees in their organisation were treated differently with vaccination, ‘grads or new students - they are responsible for getting their own vaccinations done.’

8.3.8 Governance of transport of patients with MDRO colonisation

Most participants (88.0%, n = 367) reported that they had transported patients known to be colonised with a multidrug resistant organism (MDRO). However, only one third (33.2%, n = 122) of these participants reported that they had often or always been informed of the precautions that should be taken to minimise transmission of pathogens in those events. There was strong evidence ($\chi^2 = 116.13, df = 7, P<0.001$; Table 43) that the odds of not being informed of the transmission based precautions changes with state of employment (range from 17.9% to 93.3%; table 43) and CBT in infection control ($\chi^2= 4.844, df = 1, P = 0.028$, trained=62.6% to not trained=73.3%; Table 43). One SoPIC participant commented that ‘The main risk with VRE/MRSA patients is that very few hospitals or nursing homes think actually telling the paramedics that the pt [patient] has these infections is in anyway important’.

8.3.9 Suggested improvements to IPC guidance and resources provided by employers

A summary of the SoPIC participants’ suggestions on how employers could improve IPC in paramedic-led healthcare are shown in Table 21. The major themes included improving access to resources, the nature of advice, and organisational support. The focus group discussion raised the value of having an application on smart devices to access infield advice on precautions required with particular communicable diseases.
Table 21: Suggestions by SoPIC participants on how employers could improve infection prevention and control (IPC) in paramedic-led healthcare. Numbers in brackets indicate the number of comments for the specific suggestion.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Specifics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to resources</td>
<td>Dissemination: better access to new information such as through posters, signage, brochure or web links (4), easier access to information (4), smart technology applications (2), inclusion of IPC information as part of clinical practice guidelines (1)</td>
</tr>
<tr>
<td></td>
<td>Equipment: cleaning products to use on equipment (1), suitable to paramedic practice (3)</td>
</tr>
<tr>
<td></td>
<td>Advice: evidence informed best practice (12), best practice - paramedic specific (5)</td>
</tr>
<tr>
<td></td>
<td>Formatting: clearly to improve understanding (8), plain English (5), rationale and concepts (8)</td>
</tr>
<tr>
<td></td>
<td>When to: exclude staff from work (2), report exposure incidents (1), report on IPC issues (1), refuse transport (1), use alternatives to transporting infectious patients e.g. gastroenteritis (1)</td>
</tr>
<tr>
<td></td>
<td>How to: clean: ambulances (20), medical equipment (18), generally (10), ambulance stations (9), patient restraints (2), post infective patient (2), clean post MDRO patient (2), uniforms (1), a computer (1)</td>
</tr>
<tr>
<td></td>
<td>How to: use approved cleaning/disinfecting agents (7), perform hand hygiene/washing technique (6), use PPE (3), use transmission based precautions (4), use standard precautions (2), manage patients with particular pathogens (2), store medical items (1), manage cytotoxic waste (1)</td>
</tr>
<tr>
<td>Organisational support</td>
<td>Mandated: time to perform infection-control activities (13), cleaning schedules (18), minimum time between cases (2), training for aseptic technique (4) and in general (2), records of cleaning (3), auditing for compliance (1)</td>
</tr>
<tr>
<td></td>
<td>Notification system to enable isolation (1)</td>
</tr>
<tr>
<td></td>
<td>Aide memo: practical assessment checklist for hygiene practices (3)</td>
</tr>
<tr>
<td></td>
<td>Immunisation information (2)</td>
</tr>
</tbody>
</table>

*Note: SoPIC, Survey of Paramedic on Infection Control; MDRO, multidrug resistant organism; PPE, personal protective equipment.*

8.4 Discussion

Although there are national frameworks for clinical governance and operating procedures to guide paramedics on IPC, the findings of this research suggest that clinical governance of IPC within Australian paramedic-led healthcare requires improvement. Areas of clinical governance associated with IPC in paramedic-led healthcare requiring improvement fell into both individual clinician and organisational responsibilities. The areas of concern discovered for individual clinicians were awareness of IPC guidelines and immunisation status, and accountability for the notification of breaches of IPC and self-immunisation. On the other hand, the areas of concern discovered for organisations were the provision of CBT, supply of IPC equipment, and surveillance and auditing.

The provision and improvement of IPC as part of safe and effective paramedic-led healthcare is a longitudinal task that requires input from clinicians and managers, amongst other key stake holders (NHMRC 2010). According to the NHMRC (2010), the important elements to ensure the effectiveness of IPC at the clinical level are
providing ongoing staff education and training, embedding IPC into governance and management structures, initiating programs for staff health such as immunisation, and conducting ongoing surveillance. The results from this research will be discussed using the NHMRC advice and NSQHS standards as a lens.

The NSQHS Standard 1.7.1 states that clinical guidelines must be available to the clinical workforce (ACSQHC 2012b). While some of the participants in this research used multiple methods to access IPC information in all ambulance jurisdictions, others were unaware of IPC policies and the odds of this changed significantly across jurisdictions. For those participants who were not aware of IPC operating procedures, it was likely that they also may not be aware of their delegated roles, responsibilities and ongoing training requirements in IPC.

The NSQHS standards provide clear guidance that responsibilities for clinical performance resides with employees at all levels within organisations (ACSQHC 2012b). EMS organisations have a legislated responsibility to maintain a competent and capable workforce that requires provision of ongoing education and CBT to improve the safety and quality of paramedic-led healthcare. This research has found that those paramedics who had received CBT were more likely to report better clinical governance practices and access to guidelines. However, a considerable number of participants reported that they had not received CBT for multiple aspects of IPC. To improve IPC performance of paramedics and patient safety, CBT could be vertically and horizontally integrated into training programs, including both within entry to practice programs and EMS organisations. As such, ongoing CBT is a responsibility of both training institutions and EMS organisations. To inform IPC training for paramedic, the requests made by the research participants must be considered and improvements made to the type and format of advice provided, provision of training as well as improved access to physical resources.

Most of the research participants reported vaccination uptake. However, some participants did not know their immunisation status and did not know whether their employer provided vaccinations or kept records on immunisations. Immunisation protects the workforce and indirectly improves the safety of patients (Burls et al. 2006;
Carman et al. 2000; Larson & Liverman 2011). Although the eradication of some immunisation-preventable disease such as small-pox has been possible, it is not possible for other diseases such as influenza (Valleron 2012). As such, repeated immunisation is important in protecting paramedics and their patients. The rate of reported seasonal influenza immunisation uptake by the research participants was greater than that cited in overseas EMS studies of between 21% and 48% (Hubble, Zontek & Richards 2011; Rueckmann, Shah & Humiston 2009). This suggests that the participants have a heightened level of perceived importance for immunisation compared to paramedics in other countries. Nevertheless, the yearly seasonal influenza vaccination rate for the research participants is less than the 80% required to create herd-immunity for the paramedic workforce (Plans-Rubiò 2012).

Issues with vaccination rates and records found in this research are similar to those of other healthcare workers in Australia (Bull et al. 2007; Seale & MacIntyrer 2011). To improve vaccination rates among paramedics, EMS organisations should provide mandatory vaccination against vaccine preventable diseases included in the NHMRC’s Standard Vaccination Schedule for adults and record these in a database as a component of an overall IPC management program (Larson & Liverman 2011). As most of the participants supported mandatory vaccinations, a signed-opt-out process would be feasible and should improve both critical awareness and the rate of immunisation in ambulance services. A further benefit of the mandatory vaccination of paramedics against communicable diseases is that it would maintain a paramedic workforce, particularly in times of pandemics and provide indirect protection to their high-risk patients (Burls et al. 2006; Tippett et al. 2010).

The NSQHS Standard 1.7.2 requires that both accurate data collection and reporting mechanisms are in place to review clinical and organisational performance on a regular basis (ACSQHC 2012b). This research found that records of IPC activities were generally not made and therefore the auditing and monitoring of the use of agreed IPC clinical guidelines was not occurring. Clinical audits ensure accountability by identifying who is responsible for what and to whom someone is answerable (Braithwaite & Travaglia 2008; National Institute for Clinical Excellence 2002). Support from the managers of ambulance services is required to fund infrastructure and
provide staffing to gather IPC data that is usable, valid and reliable (Quality and Patient Safety Directorate 2013). When IPC practices are assessed against recommended standards, information can be synthesised to provide stakeholders with suitable reports on which to base judgements of their own IPC practices and decisions.

Adherence to recommended IPC is associated with receiving training in standard precautions and other factors that improve patient safety such as having a professional attitude and receiving feedback on safety practices (Brevidelli & Cianciarullo 2009; Hessels & Larson 2016). The NSQHS Standard 1.4 requires that training in the assigned safety and quality roles and responsibilities of a clinician’s position are conducted on an ongoing basis (Standard 1.4.1) so that the workforce is skilled and informed with annual updates (Standard 1.4.2) using CBT (Standard 1.4.4). Training and EMS organisations must consider how to improve clinical governance and adherence to both IPC standards and the active management of breaches. As with studies involving hospital staff (Hessels et al. 2016), this research has shown that strong perceptions of the importance of patient safety is not enough to ensure adherence with IPC guidelines.

A culture of accountability must be generated that encourages paramedics to take responsibility for improving the quality of IPC in paramedic-led healthcare. Although there may be support in the professional workforce for improved IPC through auditing and participation in quality assurance activities, a disincentive to participation for some paramedics may be the fear of negligence litigation or embarrassment (Department of Health 2014; Russell & Dawda 2014). In Australia, various continuous improvement activities are granted legal privilege under qualified conditions to allow clinical professionals to discuss openly patient cases or data with a view to improving patient safety (Braithwaite & Travaglia 2008). Improving IPC in paramedic-led healthcare may initially benefit from this type of disclosure. Encouraging voluntary reporting could assist in understanding causal links between events and harms that coded data cannot. Support needs to be provided by ambulance services to the extent necessary to enable safe and high-quality IPC practices. To enable this the ACSQHC (2011, 2012b, 2013b) argues that a culture of open disclosure facilitates an environment where clinicians feel supported in reporting breaches in IPC so that opportunities for improvements can be
acknowledged. Thus, open disclosure would allow the development of systems of organisational responsibility, while maintaining a culture of professional accountability and therefore avoid blaming individuals when breaches occur.

8.5 Conclusion

The delivery of appropriate and timely healthcare without harming patients is an important bioethical issue. This research has found that Australian paramedics perceived that IPC was an important aspect of their clinical work and that it was the responsibility of all paramedics to ensure IPC procedures were followed in the workplace. The findings of this research also found that the awareness of IPC operating procedures differed in individual state and territory ambulance services, that there was a lack of CBT in IPC procedures, and that there was a culture of not officially reporting IPC breaches. Further, the participants believed that better organisational support was required in the provision of immunisations and for auditing clinician compliance with recommended IPC practices.

To improve the clinical governance of IPC in paramedic-led healthcare, interventions should target CBT, which in turn should improve paramedic awareness of IPC operating procedures and their role and responsibilities in the clinical governance of IPC. Furthermore, a culture of accepting accountability for IPC and openly reporting and managing breaches needs to be developed in Australian ambulance services. Strong leadership will be required to support and develop champions to promote the infield uptake of the clinical governance of IPC activities.
9. Aseptic technique

The previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design and methodology (Chapter 3). Chapter 4 described and discussed the findings from studies 1 and 2 (Section 3.3), which are aligned with research questions 1 and 2 (Section 1.2). The thesis then changed focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which are presented as five distinct themes. Chapter 5, explored general perceptions about the transmission of healthcare-associated infections (HAIs) and IPC compliance, Chapter 6 explored hand hygiene and gloving practices, Chapter 7 explored environmental hygiene, and Chapter 8 explored clinical governance. This chapter, Chapter 9, will explore aseptic technique. Chapter 10 closes the thesis and uses the PRECEDE-PROCEED planning model to connect the findings outlined in chapters 4 to 9 and to provide recommendations to improve IPC practices in paramedic-led healthcare.

9.1 Introduction

In Australia, compliance with aseptic technique is a key component of the National Safety and Quality Health Service (NSQHS) Standard 3: Preventing and Controlling Healthcare-associated Infections as it ensures clinical procedures are as free from pathogenic microorganisms as possible (ACQSHC 2012d). The National Health and Medical Research Council (NHMRC 2010) recommends that an aseptic technique should be used during any procedure that breaches the body’s natural defences so as to prevent the transmission of infectious agents into sterile tissues. A standardised framework for aseptic practice is the Aseptic Non-Touch Technique (ANTT®), which prevents pathogens from being introduced in sufficient quantity to ‘key-parts’ of procedural equipment and ‘key-sites’ of the body from a healthcare worker or the immediate healthcare environment (Rowley & Clare 2011).

Paramedic clinical care often includes procedures that breach the body’s natural defences. In doing so, it is critical that ‘key-parts’ and ‘key-sites’ are protected to
decrease the risk of transmitting HAIs. ANTT® is achieved by the use of aseptic fields within the immediate procedural environment to ensure asepsis of key-parts and key-sites. In paramedic-led healthcare, common key-parts include intravenous cannula (IVC) and medication ports, and key-sites include open wounds or sites chosen to attempt the insertion of an IVC. The ANTT® framework includes a choice between standard and surgical aseptic techniques (see Table 3, Chapter 2) to protect these routes of transmission. The standard aseptic technique would be suitable most of the time in paramedic-led healthcare as most of the clinical procedures undertaken by paramedics are short in duration and technically simple. It utilises a general aseptic field, critical micro-aseptic fields, hand hygiene, non-touch technique and non-sterile gloves to achieve a safe level of asepsis for procedures that involve few key-parts or key-sites (Healthcare Associated Infection and Cleanliness Division 2008).

There is a paucity of research exploring paramedic compliance with aseptic technique. Studies conducted in the UK have shown that that paramedic aseptic technique during IVC is poor (Siriwardena et al. 2009) and that unnecessary cannulations were being performed by EMS workers infield (Siriwardena et al. 2008; Snooks et al. 2000). The Australian paramedic workforce has access to advice on recommended aseptic technique through national NHMRC 2010 guidelines and operating procedures disseminated by state and territory ambulance services. However, it is not understood whether paramedics are compliant with these recommended IPC guidelines for aseptic technique during their clinical work.

The research reported in this chapter addressed research questions 3 and 4 of the project:

3. How do Australian paramedics participating in a national online survey describe their behaviours and perceptions (beliefs and attitudes) regarding IPC practices and the transmission of HAIs in paramedic-led healthcare? This question formed the basis of Study 3 and was explored through the development of a questionnaire instrument for an online survey of Australian paramedics.

4. How do the behaviours and perceptions of Australian paramedics regarding IPC practices in paramedic-led healthcare that are reported during focus group discussions triangulate with the findings from the national online survey? This
question formed the basis of Study 4 and was explored through focus groups using semi-structured discussions with a small group of Australian paramedics.

9.2 Methods
The methods have been previously described in detail in chapters 3 and 5. The non-textual data (categorical, ordinal and Likert scales) were summarised and inferential statistics were used to test for associations between variables using the Pearson chi-square test. The textual data were analysed through an interactive process of describing, classifying and connecting information previously described in Section 3.4.1.

9.3 Results
9.3.1 Contamination of key-sites
Contamination of key-sites during the clinical procedure of IV cannulation was identified by both the SoPIC and focus group participants. A third of the SoPIC participants (37.9%, n = 158) reported that they touched a key-site selected to insert an IVC after preparing it with a disinfectant. State and territory of employment was the only SoPIC demographic variable that was found to be associated with compliance of not touching a key site following disinfection ($P = 0.034$, Table 22). As shown in Table 23, associations were found between better compliance with aseptic technique and not writing notes on gloves (adjusted $P = 0.037$), perceiving difficulties with hand hygiene in the field (adjusted $P = 0.020$), and perceived importance of hand hygiene prior to IVC insertion (adjusted $P = 0.006$). Factors associated with writing on gloves were state or territory of employment (adjusted $P = 0.011$) and time post qualification (adjusted $P = 0.026$) with the odds of reporting writing on gloves decreasing with increasing length of service. No evidence for association was found between compliance of not touching a key site following disinfection and scope of practice as outlined in Table 4 (section 2.4). The focus group participants corroborated the SoPIC data as they had observed paramedics contaminating key-sites prior to performing IVC insertion. One FG1 participant commented that ‘Most people then touch a vein and get it up after they've cleaned it, oh there's the vein and jab it'
Table 22: Associations determined using logistic regression between SoPIC demographic attributes and the SoPIC participants who reported never touching a selected intravenous cannula insertion site after disinfection

<table>
<thead>
<tr>
<th>Demographic attributes</th>
<th>Proportion of category who never touched a selected IVC insertion site after disinfection (%)</th>
<th>raw P / adjusted P value¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n = 291)</td>
<td>61.5</td>
<td>P = 0.70 / 0.93</td>
</tr>
<tr>
<td>Female (n = 126)</td>
<td>63.5</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical practice level²</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paramedic (n = 208)</td>
<td>63.0</td>
<td>P = 0.27 / 0.30</td>
</tr>
<tr>
<td>ICP (n = 118)</td>
<td>62.7</td>
<td></td>
</tr>
<tr>
<td>RP/GCP (n = 51)</td>
<td>51.0</td>
<td></td>
</tr>
<tr>
<td><strong>CBT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Included Standard precautions (n = 295)</td>
<td>61.7</td>
<td>P = 0.79 / 0.38</td>
</tr>
<tr>
<td>Excluded standard precautions (n = 122)</td>
<td>63.1</td>
<td></td>
</tr>
<tr>
<td><strong>Training type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-employment (n = 106)</td>
<td>63.2</td>
<td>P = 0.79 / 0.68</td>
</tr>
<tr>
<td>Post-employment (n = 311)</td>
<td>61.7</td>
<td></td>
</tr>
<tr>
<td><strong>Highest level of education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificate or diploma (n = 122)</td>
<td>62.3</td>
<td>P = 0.045 / 0.85</td>
</tr>
<tr>
<td>Bachelor degree (n = 143)</td>
<td>68.5</td>
<td></td>
</tr>
<tr>
<td>Post graduate study (n = 142)</td>
<td>54.2</td>
<td></td>
</tr>
<tr>
<td><strong>Health discipline training³</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paramedic only (n = 308)</td>
<td>62.3</td>
<td>P = 0.80 / 0.37</td>
</tr>
<tr>
<td>Paramedic &amp; nursing registration (n = 79)</td>
<td>60.8</td>
<td></td>
</tr>
<tr>
<td><strong>Time post qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 10 years (n = 194)</td>
<td>61.9</td>
<td>P = 0.99 / 0.73</td>
</tr>
<tr>
<td>11 - 20 years (n = 128)</td>
<td>62.5</td>
<td></td>
</tr>
<tr>
<td>&gt; 20 years (n = 95)</td>
<td>62.1</td>
<td></td>
</tr>
<tr>
<td><strong>State/territory of employment⁴</strong></td>
<td>40.0 – 61.5</td>
<td>P = 0.040 / 0.034</td>
</tr>
</tbody>
</table>

Note: IVC, intravenous cannula; ICP, intensive care paramedic; RP, retrieval paramedic; GCP, general care paramedic; CBT, competency-based training.

¹Adjusted for all other demographic attributes in Table 22. Adjusted P-values were calculated by fitting a logistic regression model.
²Forty participants not included in analysis due to low numbers and either students or patient transport roles not performing intravenous cannulation.
³Health disciplines other than paramedicine and nursing were excluded due to low numbers (n = 30).
⁴A range has been provided to avoid identifying individual state and territory ambulance services.

Table 23: Associations determined using logistic regression between SoPIC response variables and the SoPIC participants who reported never touching a selected intravenous cannula insertion site after disinfection

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage of participants who never touched a selected IVC insertion site after disinfection</th>
<th>Raw P / adjusted P value¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch wearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently worn (n = 362)</td>
<td>61.6</td>
<td>P = 0.59 / 0.53</td>
</tr>
<tr>
<td>Rarely worn (n = 55)</td>
<td>65.5</td>
<td></td>
</tr>
<tr>
<td>Write notes on gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently (n = 217)</td>
<td>56.7</td>
<td>P = 0.033 / 0.037</td>
</tr>
<tr>
<td>Infrequently (n = 163)</td>
<td>66.3</td>
<td></td>
</tr>
<tr>
<td>Never (n = 37)</td>
<td>75.7</td>
<td></td>
</tr>
<tr>
<td>Perceived difficulties with performing HH in the field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulties Perceived (n = 290)</td>
<td>58.3</td>
<td>P = 0.015 / 0.020</td>
</tr>
<tr>
<td>Difficulties not perceived (n = 127)</td>
<td>70.9</td>
<td></td>
</tr>
<tr>
<td>Perceived importance of HH prior to IVC insertion²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important (n = 401)</td>
<td>63.3</td>
<td>P = 0.016 / 0.006</td>
</tr>
<tr>
<td>Not important (n = 16)</td>
<td>31.3</td>
<td></td>
</tr>
</tbody>
</table>

Note: HH, hand hygiene; IVC, intravenous cannula.

¹Adjusted P-values were calculated by fitting a logistic regression model (binary logistic using all demographic attributes in Table 22. ²Fisher’s Exact Test used due to low count in one of the cells.
9.3.2 Aseptic fields and contamination of key-parts

Figure 11 shows that 60.4% \( (n = 252) \) of the SoPIC participants indicated that they had made a clean field rather than an aseptic field by using an absorbent bed protection pad (bluey) or a kidney dish prior to performing a medical procedure that included IVC insertion (usually = 28.3%, sometimes = 32.1%). The focus group participants held differing views with regard to making a clean field with a bluey. One FG1 participant stated that they used blueys to ‘put my stuff out as organised as I can’, while another claimed that ‘you just don't often have time to do that’. Some focus group participants noted that making clean fields for medical items with blueys can be difficult in their work setting due to a lack of stable surfaces. One FG1 participant elaborated that when setting up consumables for medical procedures in a patient’s environment at times ‘the whole lot falls on the floor upside down’. Other focus group members stated that they did not attempt to make a clean field and simply placed items directly on the surfaces in their working environment. One FG1 participant stated that they used items ‘…off the ground or out of your dirty kit. Or it's sitting on their [patient’s] lap or the couch…’. Another FG1 participant stated that they used the drug pouch to set up on ‘because you know it's going to be flat and stable’.

Figure 11: Self-reported behaviours of SoPIC participants that affect the contamination of key-parts.

SoPIC, Survey of Paramedics on Infection Control.

The focus group participants also described using the packaging of consumable items to make aseptic microfields. An FG1 participant commented that ‘…they're all in their
packet, they're not on the ground’. Other participants described using their partner to pass over each item with a key-part as it is required to avoid contamination rather than placing items on a makeshift clean field. One FG1 participant commented that ‘We work as teams - your partner will be the one who will pass you the bung in its package. So it's not put anywhere…the handing across is very useful’.

With regards to the storage of airway adjuncts in paramedic response kits, approximately only half of the SoPIC participants (54.2%, n = 226) indicated that they kept oropharyngeal airways stored in the original packaging. This proportion substantially increased for both endotracheal tubes (91.1%, n = 380) and laryngeal mask airways (94.2%, n = 393).

Most of the participants indicated that they usually (59.5%, n = 248) or sometimes (24.2%, n = 101) swabbed an intravenous medication port prior to use. Participants in both focus groups commented that paramedics are not taught to swab medication ports prior to use, unlike in other healthcare disciplines. An FG1 participant stated that ‘…a lot of people don't swab the bung before they give something. Whereas in nursing that was what you were always taught to’.

9.3.3 Barriers to compliance with aseptic technique

Only half of the SoPIC participants (51.3%, n = 214) reported that they had received competency-based training (CBT) for aseptic technique. However, receiving CBT in aseptic technique was not associated with reported improvement in protecting key-sites during IVC insertion ($\chi^2 = 0.626$, $df = 1$, $P = 0.429$). The focus group participants commented that some paramedics had not been taught aseptic technique and of those who had been taught aseptic technique, they chose to ignore the practice.

The focus group participants commented that the paramedics they worked with tended to lack discipline and rush interventions, which affects their compliance with aseptic technique. Moreover, some believed that although paramedics were appropriately resourced, they chose not to be compliant with aseptic technique. For example, an FG2 participant commented that ‘we have the gear we just don't necessarily use it’. Other
focus group participants commented that their paramedic peers had a laissez-faire attitude toward transmission of HAIs because these infections could be treated with antibiotics. For example, an FG1 participant commented that ‘I think also ambos have a feeling that they're [patients] going to hospital, they'll get antibiotics anyway. So it doesn't matter what you give them’. Focus group participants also commented that there was a lack of time to perform procedures using an aseptic technique with high acuity patients. When a tension arose in a case between maintaining aseptic technique and performing a lifesaving procedure, the time-criticality of a patient was the expressed reason that aseptic technique was not a priority. An FG1 participant stated that during an intervention to deal with a life-threatening condition that ‘you tend to go for the primary save first and hope later that they'll survive the VRE [HAI] that you just gave them’. And another that ‘an infection probably wasn't as important at that minute as keeping his heartbeat’. Other focus group members commented that compliance with aseptic technique was more likely to occur during non-emergency cases. FG2 participants stated that during non-emergency cases ‘you've got a bit more time’ and another that ‘There's the time-critical one where maybe that time limits is saying you've got to do something now’.

While focus group participants conveyed that time pressures due to the time-criticality of some patients lowered compliance with aseptic technique, a further point of unnecessarily rushing interventions was also made. Other comments were made indicating that the perceived time pressures stemmed from rushing all interventions. One FG2 participant noted that with IVC insertion ‘There's this just trying to rush it through’. Another FG2 participant commented that ‘…we have an artificial time line on this thing. We think that we're - we need to do this within a minute or two, and that's not true...We have that syndrome all across our interventions’.

A challenging work environment was another barrier reported by focus group participants to lower compliance with aseptic technique by paramedics. While some focus group participants were cognisant that during invasive procedures they ‘obviously don't want to introduce any infection to the patient’ (FG2 participant), other focus group participants felt at a disadvantage in the paramedic-led healthcare environment when compared to a static healthcare environment. One FG1 participant stated that 'the reality
is that you don't have that environment, you will have to do whatever you've got to do in someone's bedroom or someone's lounge room and those houses where your feet stick to the floor… You look around for a cleanish [sic] place to put your kit, you try not to touch things - or you touch things as little as you can...you do it as clean as you can’. Another FG1 participant noted that ‘you are opening your kit on the floor and you're doing the best with what you've got’.

The focus group participants raised the issue of paramedics performing unnecessary invasive procedures particularly in the setting of poor compliance with aseptic technique. One FG2 participant stated that ‘… it irritates me when I see officers - for the practice of it - putting IVs in’. Other FG2 participants suggested that this may have been done for cultural reasons as the technical skill ‘distinguished you as an ICP [intensive care paramedic]. So I saw thousands of IV's put in unnecessarily’ and that it created the perception of competence in the eyes of other clinicians as to arrive at the emergency department ‘without an IV then you were incompetent’. Other FG2 participants commented that patients will ‘get one [IV cannula] regardless’ of need and with alternative medication administration pathways that ‘there's actually less and less of a reason to start an IV’. To improve compliance with aseptic technique during IVC insertion, some FG2 participants spoke positively about the benefit of bundling procedures. They stated that bundling involved packaging together of most of the consumables used during an invasive procedure because ‘it was almost like a step one, Betadine. Step two, alcohol, Step three, this dry cloth. It was a much stronger process, and they were all packaged together’. Amongst the focus group participants who had not been exposed to bundling, there was agreement that it would improve compliance. One FG2 participant stated that ‘I think that would improve practice if we had that…that would encourage me to actually utilise it more if I had it all sitting there in a kit like that’.

9.4 Discussion
This research has identified a level of noncompliance among Australian paramedics with aseptic technique during clinical procedures such as IVC insertion. The findings are consistent with prior international research exploring compliance with aseptic technique among healthcare workers in emergency medical services (EMS) and other
emergency settings (Al-Damouk, Pudney & Bleetman 2004; Geller et al. 2010; Guh et al. 2012; Siriwardena et al. 2009; Snooks et al. 2000; Unsworth & Collins 2011). While the research participants acknowledged that they did not want to transmit HAIs through poor aseptic technique, compliance with recommended practice appears to require substantial improvement. In previous chapters, it was reported that Australian paramedics appear to have poor hand hygiene, gloving and environmental hygiene practices which was also congruent with international paramedic research (Ho, Ansari & Page 2014; McGuire-Wolfe, Haiduven & Hitchcock 2012; Teter, Millin & Bissell 2015). The research presented in this chapter has demonstrated poor compliance with using aseptic fields and protecting key-sites and key-parts. Although the research participants acknowledged that aseptic technique decreased the likelihood of HAI transmission, they identified four barriers to compliance: lack of CBT, lack of discipline, a perceived need to rush during clinical work, and difficulties within the physical workplace environment.

Participants in this research reported a wide range of practices concerning the protection of key-parts during IVC insertions. Some participants reported that they did not use any fields to protect key-parts, others reported using clean fields instead of aseptic fields, and others reported having another paramedic pass items with key-parts in a way to maintain asepsis and thereby avoiding the use of aseptic fields. It is the responsibility of paramedics to understand how to apply the principles of aseptic technique in order to avoid breaches during paramedic-led healthcare. The issue of noncompliance could be improved with targeted CBT in aseptic technique to improve decisions about risks and practices such as hand hygiene, gloving, aseptic fields, aseptic technique and sequencing (Leung 2002; ten Cate & Scheele 2007). Siriwardena et al. (2009) demonstrated that a CBT package that targeted IVC insertion, improved paramedic compliance with the recommended aseptic technique during IVC insertion and reduced the rate of inappropriate IVC insertions. A standardised approach to making aseptic fields and using non-touch technique are essential for ensuring the integrity of asepsis during clinical procedures (Rowley & Clare 2011). The development of training packages for Australian paramedics based on the ANTT® could promote the importance of aseptic technique during invasive procedures and reduce perceptions that patient acuity and time are barriers to compliance. Further, CBT may facilitate a cultural shift.
and encourage paramedics to accept responsibility for their actions when compliance with asepsis has not been maintained. Accepting responsibility for noncompliance with aseptic technique should include the communication of noncompliance to the receiving healthcare providers at handover and in the paramedic’s written record of patient care (Healthcare Associated Infection and Cleanliness Division 2008). Mandating this type of communication may also encourage paramedics to carefully consider the balance of risks and benefits for any clinical procedure undertaken in conditions where asepsis cannot be maintained.

While some research participants believed that paramedics were able to use the standard aseptic technique in field, most considered the physical work environment as a major barrier to compliance with aseptic technique. The research participants reported lower compliance with asepsis during cases with a higher level of patient acuity. This finding is incongruent with studies undertaken with doctors working in emergency departments. Al-Damouk, Pudney & Bleetman (2004) demonstrated that doctors had better compliance with aseptic technique in urgent clinical situations. As such, workplace culture in paramedicine may be contributing to noncompliance with aseptic technique recommendations. The importance of understanding why compliance with aseptic technique is lower in the setting of higher acuity patients is more pressing when consideration is given to the ACSQHC (2013a) Aseptic Technique Risk Matrix.

According to the ACSQHC (2013a), the matrix can be used to define the levels of risk according to frequency of invasive procedures and level of control in the environment. This information can be used to identify areas where aseptic technique is required and to consider how to lower the risks identified. The uncontrolled paramedic workplace produces a risk level of high to very high when coupled with occasional to frequent invasive procedures.

Those SoPIC participants who indicated that they had other difficulties with IPC in the field, such as with hand hygiene, also reported lower compliance with protecting key-sites for asepsis. Further, those SoPIC participants who were more experienced or reported that they never wrote notes on their gloves were more likely to protect key-sites. These factors suggest an element of cognitive overload may be contributing to lower compliance with aseptic technique in paramedic-led healthcare.
Cognitive load theory proposes that working memory has a limited capacity and that an individual’s performance is diminished when they deal with new information that surpasses their working memory (Sweller, Ayres & Kalyuga 2011). According to Ericsson and Charness (1994), it is critical that experts in clinical practice respond accurately and rapidly in dynamically changing situations. A clinician must perceive and encode the current situation to implement a rapid series of actions. Ericsson and Charness (1994) also argue that working memory has no known limits when dealing with previously organized information that is retrieved from long-term memory. This suggests that complex situations such as paramedic-led healthcare can be dealt with by working memory, providing that it has first been organised and stored in long-term memory. This may explain why longer serving paramedics are more likely to be compliant with aseptic technique during clinical care. Pre-packaged kits or bundles for clinical procedures in other areas of healthcare are effective in reducing procedural mistakes (Fenik et al. 2013). Bundles for clinical procedures such as IVC insertion, may improve compliance with aseptic technique for less experienced paramedics by decreasing the cognitive load during clinical procedures. Thus, further exploration of how to improve aseptic technique through bundling clinical procedures in paramedic-led healthcare warrants further exploration.

9.5 Conclusion

This research has found that the perceptions of Australian paramedics in relation to the importance of an aseptic technique in paramedic-led healthcare may not be transferring into clinical practice. Compliance with aseptic technique in all situations, especially non-urgent procedures, needs to be improved. However there may be a need for some compromise in standards of asepsis in the high acuity emergency patient due to the urgency of the clinical situation. Future research into aseptic technique in paramedic-led healthcare should be targeted at two areas. First, a standardised approach to maintaining asepsis in paramedic-led healthcare should be developed. This approach would assist to minimise behaviours that lead to noncompliance and develop options that can be adjusted to the situation and acuity of a patient. Second, a cultural shift is required to improve the accountability of paramedics for clinical interventions undertaken and to minimise unnecessary procedures that can transmit HAIs. Strong
leadership will be required to develop paramedic specific aseptic techniques for
different levels of patient acuity, establish competency-based education packages, and
to encourage champions to challenge established social norms towards this essential
IPC practice.
10. Improving infection prevention and control in Australian paramedic-led healthcare

Previous chapters presented the thesis introduction (Chapter 1), literature review (Chapter 2) and the research design (Chapter 3). The findings of the research were presented in chapters 4 to 9. Chapter 4 described and discussed the findings of studies 1 and 2 (Section 3.3), which aligned with research questions 1 and 2 (Section 1.2). The thesis then changed focus to present the findings of studies 3 and 4 (Section 3.3) relating to the self-reported behaviours and perceptions of Australian paramedics regarding infection prevention and control (IPC) in paramedic-led healthcare, which were presented as five distinct themes: general perceptions on IPC and transmission of healthcare-associated infections (HAIs) (Chapter 5); hand hygiene and gloving practices (Chapter 6); environmental hygiene (Chapter 7); clinical governance (Chapter 8); and aseptic technique (Chapter 9). This chapter, Chapter 10, closes the thesis and begins by providing a rationale for using a planned approach in facilitating behaviour-change and then articulates a diagnosis using the PRECEDE-PROCEED planning model. The chapter then shifts the focus towards describing how emergency medical services and training organisations could drive transformational change to improve IPC in paramedic-led healthcare.

10.1 Introduction

The purpose of the research conducted in this thesis was to explore the self-reported behaviours and perceptions (beliefs and attitudes) of Australian paramedics regarding IPC practices in paramedic-led healthcare. The research has further highlighted the challenges that paramedics face with maintaining IPC while delivering patient care in the out-of-hospital environment (Chapter 4). While most of the participants in this research perceived IPC as important in paramedic-led healthcare (chapters 4 and 5), the research findings have clearly demonstrated compliance issues with IPC practices in paramedicine in areas such as hand hygiene and gloving (Chapter 6), environmental hygiene (Chapter 7), clinical governance (Chapter 8) and aseptic technique (Chapter 9). Most of the research participants recognised the importance of having access to
comprehensive IPC guidelines for paramedicine. However, this research has highlighted the need to develop national IPC guidelines for Australian paramedicine that include current national recommendations and standards and that contain advice on how to maintain IPC in light of the challenges associated with delivering paramedic-led healthcare. As such, there is a warrant to design interventions with the objective of changing paramedics’ IPC behaviours, in order to improve compliance with recommended IPC practices.

According to the World Health Organization (2009), behaviour-change theories are based on the concepts that behaviour is affected by multiple levels of influence and that behaviour both influences and is influenced by the social environment. These concepts are congruent with Lewin’s field theory (1947) that stipulates that group behaviour is a complex set of symbolic interactions and forces that affects group structures and modifies individual behaviours. Because paramedicine is a distinct ethnographic group with its own workplace culture (McCann et al. 2015; O’Meara & Reynolds 2009), a planned approach to paramedics’ behaviour-change around IPC practices is required.

The PRECEDE-PROCEED model of health promotion (Figure 12) was developed to facilitate the linking of findings from individual studies in order to discover what is necessary to prevent or short-circuit illness and injury (Green & Kreuter 2005). This model uses both an ecological and an educational approach to assessment and planning of interventions in public health (Green & Glasgow 2006; Green & Kreuter 2005). The ecological approach recognises context and relationships by exploring the actions that we take or don’t take as individuals or groups, as well as the wider range of social and environmental factors; the educational approach recognises that each workplace and discipline has its own history and learned traditions, which enable people to perform their duties and reinforce a particular way of doing things. The PRECEDE component of the model refers to predisposing, reinforcing and enabling constructs in ecological diagnosis and evaluation. The PROCEED component of the model refers to policy, regulatory and organisational constructs in educational and ecological development.

In this chapter, the PRECEDE component of the PRECEDE-PROCEED model will be applied to the findings of studies 1 to 4 to identify the influencing factors that must be
reduced or strengthened in order to both improve IPC in paramedic-led healthcare and reduce the possible transmission of HAIs. This diagnosis will be used to propose interventions that could be applied by emergency medical services (EMS) and training organisations in Australia in an effort to drive positive transformational change in IPC in paramedic-led healthcare. As part of the solution, it is proposed to develop national guidelines for IPC in Australian paramedicine. These guidelines must be built on evidence-based practice and concurrent use of a rigorous auditing processes (e.g. the Hazard Analysis and Critical Control Points [HACCP] system) to manage of identified risk in IPC in paramedicine. With this in mind, 12 recommendations have been proposed at the end of this chapter. The recommendations, which focus on predisposing factors and the enabling and reinforcing of good IPC practices, are designed to improve IPC in Australian paramedicine.

Figure 12: An overview of the PRECEDE-PROCEED model (Green 2005)
10.2 Diagnosis of IPC practices in Australian paramedic-led healthcare using the PRECEDE-PROCEED model

10.2.1 Social assessment and situational analysis

The success of any intervention that is designed to improve IPC compliance will depend partly on the degree to which those with a stake in the intervention’s activities are engaged (O’Dwyer 2004). The importance of conducting a social assessment and situational analysis is based on the assumption that behaviour changes are voluntary and that planned and evaluated interventions are more likely to be effective (Green & Kreuter 2005). According to Green and Kreuter, social assessment and situational analysis identifies the cultural and social circumstances that are unique to a population and affect the outcome of behaviour-change interventions.

Consideration of the social assessment improves the likelihood of the success of interventions by identifying the perceptions that may improve or hinder intervention outcomes. The survey and focus-group participants reported that IPC was important in their practice and that they were confident with their own IPC practices (Chapter 5). In contrast, many of these participants perceived that their peers had a much lower compliance with IPC and that their organisation’s management did not value IPC. The research participants also perceived several barriers to compliance with IPC regarding hand hygiene and gloving, environmental hygiene, clinical governance and aseptic technique (chapters 6 to 9). These barriers have been summarised in Table 24. Operational pressure was described as a major disincentive for good practice in hand hygiene, environmental hygiene and aseptic technique. Cultural issues were also highlighted; for example, little emphasis on IPC during training, and the undervaluing of IPC by peers and other staff such as communication-room staff and supervisors. Some of the research participants also thought that particular supplied products used in IPC were not appropriate for their clinical tasks. Many participants regarded the work environment as challenging for hand hygiene, gloving and applying aseptic technique; they felt they lacked knowledge and training in particular technique associated with these IPC practices.
Table 24: Summary of the research participants’ perceived barriers to good practices in infection prevention and control in paramedic-led healthcare, as reported in chapters 6 to 9 of this thesis

<table>
<thead>
<tr>
<th>Perceived barrier to good practice</th>
<th>Hand hygiene and gloving (Chapter 6)</th>
<th>Environmental hygiene (Chapter 7)</th>
<th>Clinical governance (Chapter 8)</th>
<th>Aseptic technique (Chapter 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient time (operational pressure &amp; scene time limits)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Cultural norms and attitudes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Access to products</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriateness of products</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived difficulty</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Lack of training</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Insufficient knowledge</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Challenging environment</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The situational analysis explored in the literature review ([Section 2.4](#)) highlighted that paramedicine in Australia is a discipline in transition. The model of Australian paramedicine education has moved almost entirely from a post-employment training model to a pre-employment tertiary degree model. This transition has occurred during a time of rapid expansion in the scope of practice of paramedics. Prominent changes in the national landscape for IPC have also occurred while the research in this thesis was being conducted. For example, the Department of Health and Aging (DoHA) 2004 guidelines were rescinded and replaced with the National Health and Medical Research Council (NHMRC) guidelines in 2010, and the National Safety and Quality Health Service (NSQHS) Standards were released in 2012. Studies 1 and 2 (Chapter 4) found that critical alignment of guidance for IPC practices and contemporary paramedicine at both the national and local level requires review. Study 1 demonstrated that all of the IPC operating procedures submitted by the ambulance services contained important IPC information. However, the procedures of various services had different omissions, levels of information and presentation structures. The experts interviewed in Study 2 described the paramedic work environment as challenging and commented on a number of barriers to good IPC practice in paramedic-led healthcare. These barriers included: the unpredictability of case types; hostile work environment; operational pressures; misuse of gloves; varied cleaning standards; difficulty in cleaning portable medical equipment; vehicle design hindering appropriate cleaning; lack of accreditation standards for IPC in paramedic-led healthcare at a national level; and insufficient documentation and auditing of IPC practices (Table 12, Chapter 4).
10.2.2 Epidemiological assessment

An epidemiological assessment identifies factors from an environmental and behavioural perspective that may affect the issues discovered during the social and situational assessment (Green & Kreuter 2005). The assessment has two parts. First, the determination of who the stakeholders are and to what extent they are engaged; and second, the identification of problematic environmental and behavioural factors.

The stakeholders in Australian paramedicine are paramedics and the EMS organisations that they work for, such as the state and territory ambulance services. Engaging paramedics and ambulance services during this research was problematic. Despite follow-up phone calls, messages and emails, only four of the eight Australian members of the Council of Ambulance Authorities submitted their IPC operating procedures for analysis (Chapter 4, Section 4.3.1). Furthermore, the response rate for the survey (SoPIC) and focus group interviews was low (Chapter 5, Section 5.2.1), which may indicate that the stakeholders do not view IPC with keen interest.

The environmental factors that could affect paramedic IPC behaviours were described in Chapter 4 (Section 4.3.2). Many of the experts interviewed during Study 2 indicated that paramedics work in an environment that makes compliance with recommended IPC practices difficult. The experts described the paramedic workplace as challenging due to the unpredictability of the types of clinical cases and having to often operate in a hostile work environment. The other main environmental issue identified in the research was that paramedics often work in semi-autonomous pairs, which increases the challenges for auditing the IPC behaviours of individual clinicians.

The responsibility in paramedic-led healthcare for providing competent IPC during patient care falls squarely on individual clinicians and EMS management (Braithwaite & Travaglia 2008; Fisher et al. 2015). As part of an epidemiological assessment of IPC in paramedicine, the patterns of behaviour of individuals or groups that affect the application of IPC in paramedic-led healthcare must be considered. Compliance with recommended IPC practices was described in chapters 5 to 9. In all areas explored in the SoPIC and focus groups, poor compliance with recommended behaviours was reported by most participants. The research participants reported that most opportunities to
perform hand hygiene during patient care were missed and that gloving practices were interfering with hand-hygiene episodes. Hence, there appears to be a substantial level of noncompliance by Australian paramedics with recommended hand hygiene and gloving practices. Compliance also varied with the nature of the clinical activity being undertaken, and worsened during perceived emergency events. The problematic behaviours extended into the routine management of the physical environment. No participant correctly described the process for routine cleaning of noncritical items and ambulance interiors, or the management of spills of blood and bodily fluids. Biocide misuse, inappropriate cleaning methods and inconsistent schedules for the routine and deep cleaning of ambulances were also reported. In addition, some of the participants’ responses indicated recognition knowledge but not recall knowledge. With regard to clinical governance, an unwillingness to report breaches of IPC was described by most participants; further, improvements in training, supply of necessary IPC supplies and immunisation were suggested. Problematic behaviours were also found in the use of aseptic technique; for example, touching of key-sites after disinfection, reliance on aseptic microfields (use of sterile packaging as an aseptic field) rather than using larger aseptic fields, and the storage of some items that contact mucous membranes out of their packets.

10.2.3 Educational and ecological assessment

The educational and ecological assessment in the PRECEDE-PROCEED model identifies factors that must be addressed or acknowledged in order to initiate and sustain the process of behavioural and environmental change. The interaction of predisposing, enabling and reinforcing factors for this assessment, as described by Green and Kreuter (2005), are represented in Figure 13.
The predisposing factors are the antecedents to a behaviour and include awareness, beliefs, attitudes, values and knowledge (Green & Kreuter 2005). Enabling factors are also antecedents to a behaviour that enable a motivation to be realised and include training, the availability and accessibility of resources, and policy settings. In other words, the enabling factors are the skills and resources that can help realise the desired behavioural changes, while their absence can hinder change (Green & Kreuter 2005). Reinforcing factors are subsequent to a behaviour and contribute to its repetition through interactions with peers, teachers or instructors, leaders, managers and other healthcare workers (Green & Kreuter 2005). In other words, reinforcing factors are the consequences of actions that determine whether the individual receives positive or negative feedback. Positive feedback in the form of social support, peer influences, and advice and feedback from supervisors and other agencies leads to the adoption of a behaviour. Reinforcing factors also include negative feedback or punishments that can lead to an extinction of a behaviour, such as comments from supervisors and peers regarding noncompliance.

The predisposing, enabling and reinforcing factors that arose from the findings of studies 1 to 4 have been described in chapters 4 to 9 and are summarised in Table 25. The influence of each factor is classified as either positive when it supports a behavioural change or negative when it opposes or challenges a behavioural change.
These factors must be addressed in any intervention designed to improve the IPC practices of paramedics.

Table 25: Influence of identified predisposing, enabling and reinforcing factors that arose from the findings of studies 1 to 4, and were described in chapters 4 to 9

<table>
<thead>
<tr>
<th>Influence</th>
<th>Predisposing factors</th>
<th>Enabling factors</th>
<th>Reinforcing factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Perceived importance of IPC including HH and EH (Study 3)</td>
<td>Adequacy of some IPC guidelines (Study 1)</td>
<td>Peers will raise concerns with peers after breaches of IPC occurs (Study 3)</td>
</tr>
<tr>
<td></td>
<td>Glove use (Studies 3+4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self-protection (studies 2-4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ABHR use (studies 3+4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>Tough guy persona and self-protection (studies 2,3+4)</td>
<td>Lack of harmonisation of IPC guidelines (Study 1)</td>
<td>Culture of not officially reporting IPC breaches (studies 2+3)</td>
</tr>
<tr>
<td>(Challenges)</td>
<td>Difficulty in auditing IPC (Study 2)</td>
<td>Lack of CBT in HH and EH (studies 3+4)</td>
<td>Culture of not stopping breaches (Study 3)</td>
</tr>
<tr>
<td></td>
<td>Glove misuse (studies 3+4)</td>
<td>Poor access to resources (Study 3)</td>
<td>Little if any audit or feedback by managers (Study 2)</td>
</tr>
<tr>
<td></td>
<td>Poor knowledge of IPC guidelines (studies 3+4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor awareness of how to access IPC guidelines (studies 3+4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skill deficit (study 3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: positive influence supports behavioural change; negative influence opposes behavioural change. HH, hand hygiene; EH, environmental hygiene; ABHR, alcohol based hand rub; IPC, infection prevention and control; CBT, competency-based training.

10.2.4 Assessment and intervention alignment

The final phase of the PRECEDE component involves an analysis of the proposed intervention with reference to prevailing policies, resources and circumstances that could hinder or facilitate its implementation (Green & Kreuter 2005). This assessment is designed to facilitate the determination of what program components and interventions are needed to effect the changes specified in previous PRECEDE phases.

Although this research did not explore organisations that train Australian paramedics directly, such as universities and ambulance services, the research participants did report a lack of emphasis on IPC during their training. Clinician behaviours that contribute to the transmission of pathogens should not be considered in isolation from the social and environmental context in which the clinician works (Green & Kreuter 2005). According to Jones et al. (2013), a transformational change in workplace behaviour is facilitated when the work environment assists in the transfer of ideas learnt during training to new workplace behaviours. Hence, EMS organisations, universities
and clinicians must work collaboratively to improve IPC in paramedicine through developing, implementing and participating in interventions that optimise the three types of factors: enabling, predisposing and reinforcing factors. Interventions to achieve this improvement will be explored in Section 10.3.

10.3 Interventions to improve IPC in Australian paramedicine-led healthcare

The findings of this research have highlighted two priority areas. The first priority is the contextualisation and harmonisation of the various currently available IPC guidelines and standards into a set of national guidelines for IPC in Australian paramedicine. The national guidelines should be based on current research and rigorous evidence. Attention must be paid to the structure, content and complexity of the guidelines; further, stakeholders should be engaged in the development of the guidelines. The second priority is to consider how transformational change in the IPC practices of Australian paramedics can best be achieved. That is, how can policy information be effectively disseminated, and how can paramedics be best equipped to conduct effective IPC? The answers to these questions should make use of the predisposing perception of the participants in this research that IPC is important during their clinical work. In addition, better compliance with recommended IPC practices will require paramedics to develop their knowledge and improve their skills, including critical thinking. Finally, for sustained transformational change in IPC practices, EMS organisations must provide strong leadership, encourage champions and provide meaningful feedback to clinicians on their performance in IPC. The next two sections will discuss these two priority areas in detail.

10.3.1 Development of national guidelines for IPC in paramedicine

When laws differ among Australia’s six states and two territories, healthcare workers who perform similar work and face similar risks have differing levels of obligation and are afforded different levels of protection depending on the jurisdiction they work in. Johnstone (2008) noted a trend towards harmonisation in broad areas of workplace safety such as transport, environmental regulation of hazardous waste, and occupational health and safety frameworks to prevent workplace injury and illnesses. However,
intentional harmonisation of IPC guidelines for Australian paramedic-led healthcare is required so that all paramedics in Australia have the same level of obligation and advice concerning IPC. The harmonisation of frameworks for paramedic IPC has occurred to some extent in other countries; for example, the *Guide to Infection Prevention in Emergency Medical Services*, which was developed by the US Association for Professionals in Infection Control and Epidemiology (2013) and *The National Specifications for Cleanliness in the NHS: A Framework for Setting and Measuring Performance Outcomes in Ambulance Trusts*, which was developed in the UK by the National Patient Safety Agency (2008). Harmonisation of IPC guidelines for Australian paramedicine will contribute to an environment that is conducive to improved compliance with IPC recommendations.

**Structure and content of evidence based policy and practice guidelines**

Guidelines are a method of deliberately articulating a concept to influence future decisions and behaviours (Merriam-Webster 2016). In the clinical arena, guidelines help to ensure that activities can continue safely while achieving the best possible health outcomes (Bahn & Barratt-Pugh 2011; NHMRC 1998). The research in this thesis has identified the requirement to mandate what needs to be done by whom, when and how it should be done, and how these activities can be quality assured. Comprehensive national guidelines for IPC in paramedicine must be drafted; a large shift in culture and behaviour is required to improve IPC compliance. During the drafting process of guidelines, Ernst (2014) believes these constructs must be considered and incorporated as elements in any policy document: staff responsibility, monitoring and reporting procedures, and staff education and training. Within each of these constructs, particular questions should be considered during the drafting of IPC guidelines for Australian paramedicine (Table 26).

To increase the impact of guidelines, the information should be presented in a format and style that is suitable for the target audience (NHMRC 1998). The SoPIC participants indicated that they sought information on the following regarding IPC policies: the rationale or basis for a policy, indications of when to apply the policy, and advice about how to implement a policy. They also thought that a policy should mandate particular aspects or actions rather than simply providing choices (Chapter 8, Table 21). By examining guidelines from various countries as exemplars (APIC 2013;
NICE 2002; NHMRC 2010; NHS 2008) and in conjunction with considering the findings from chapters 4 and 5, a recommended outline of content areas for a comprehensive contextualised guide for IPC in paramedicine has been developed, along with a suggested structure for these guidelines (Table 27).

Table 26: Considerations during the drafting of national guidelines for infection prevention and control (IPC) in paramedicine

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff responsibility:</td>
</tr>
<tr>
<td>Who should undertake the IPC practices?</td>
</tr>
<tr>
<td>When should the IPC skills be used?</td>
</tr>
<tr>
<td>How should the IPC skills be used?</td>
</tr>
<tr>
<td>Monitoring and reporting:</td>
</tr>
<tr>
<td>How will IPC compliance be monitored?</td>
</tr>
<tr>
<td>How frequently will monitoring of IPC by staff occur?</td>
</tr>
<tr>
<td>Who is responsible for monitoring IPC compliance?</td>
</tr>
<tr>
<td>Education and training:</td>
</tr>
<tr>
<td>How will paramedics be trained in IPC practices?</td>
</tr>
<tr>
<td>When will the training occur?</td>
</tr>
<tr>
<td>How often will training be repeated?</td>
</tr>
<tr>
<td>Who is responsible for conducting the IPC training?</td>
</tr>
<tr>
<td>How will competency be assessed and kept top-of-mind?</td>
</tr>
</tbody>
</table>

Note: adapted from Ernst (2014).

Table 27: Recommended content and structure of contextualised guidance for infection prevention and control in Australian paramedicine

<table>
<thead>
<tr>
<th>Content areas</th>
<th>Section structure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application of standard precautions</strong></td>
<td>1. Definition of concept</td>
</tr>
<tr>
<td>• hand hygiene and personal protective equipment</td>
<td>2. Rationale</td>
</tr>
<tr>
<td>• routine management of the physical environment</td>
<td>3. Indication</td>
</tr>
<tr>
<td>(environmental hygiene)</td>
<td>4. Evidence including epidemiology as applicable</td>
</tr>
<tr>
<td>• environmental cleaning</td>
<td>5. Responsible person(s)</td>
</tr>
<tr>
<td>• reprocessing of reusable equipment</td>
<td>6. Procedure guide with exemplars describing</td>
</tr>
<tr>
<td>• management of clinical waste</td>
<td>acceptable deviations/variations (e.g. changes</td>
</tr>
<tr>
<td>• respiratory hygiene and cough etiquette</td>
<td>in practice for emergency and non-</td>
</tr>
<tr>
<td>• laundering uniforms</td>
<td>emergency patient cases)</td>
</tr>
<tr>
<td>• aseptic technique (ANTT®)</td>
<td>7. Practical tips for navigating difficulties</td>
</tr>
<tr>
<td><strong>Application of transmission-based precautions</strong></td>
<td></td>
</tr>
<tr>
<td>• contact precautions</td>
<td></td>
</tr>
<tr>
<td>• droplet precautions</td>
<td></td>
</tr>
<tr>
<td>• airborne precautions</td>
<td></td>
</tr>
<tr>
<td><strong>Organisational Support</strong></td>
<td></td>
</tr>
<tr>
<td>• clinical governance</td>
<td></td>
</tr>
<tr>
<td>• staff health – immunisation</td>
<td></td>
</tr>
<tr>
<td>• presenteeism and exclusion periods for</td>
<td></td>
</tr>
<tr>
<td>paramedics with acute infections</td>
<td></td>
</tr>
<tr>
<td>• education and training</td>
<td></td>
</tr>
</tbody>
</table>

Note: ANTT®, aseptic non-touch technique.
Engagement of stakeholders to develop guidelines

Griew (2010) argues that policymakers often have difficulty implementing the principles of evidence-based policy (EBP) in the real world. To minimise this problem, Griew recommends including input from those who use EBP, such as experienced practitioners, in combination with rigorous evidence to ensure that EBP is appropriate, applicable and consistent (NHMRC 1998; O’Dwyer 2004; Rogers 2010). According to Edwards and Evans (2011), the advantage of a collaboration among a broad range of stakeholders is that it creates an action-based approach to develop ‘explanatory’, ‘descriptive’ and ‘prescriptive’ objectives to maximise EBP. This research has identified that experienced practitioners should be drawn from paramedics, risk managers within ambulance services, and special-interest groups within industry bodies, such as Paramedics Australasia or the Council of Ambulance Authorities.

Complexity of EBP guidelines and interventions in paramedic-led healthcare

The findings from this research suggest that any IPC guidelines developed for paramedicine will need to consider a range of IPC issues that differ in complexity. Head (2010) believes that problems for which policy is required can be conceived on scales and with varying levels of complexity. Complexity can be viewed as ranging from simple to complex (Rogers 2010), or viewed on a range from micro to macro and include other dimensions such as coverage of one issue only to coverage of nested issues (Head 2010). Furthermore, Head (2010) argues that one’s view of complexity changes how policy issues are couched, discussed and researched.

Rogers (2010) describes the complexity of EBP as a continuum ranging from simple to complex (Table 28). Simple EBPs and interventions consist of a single, well-defined and predictable process that works in the same way for different people in different settings. One example is vaccination against a communicable disease. Almost everyone who is vaccinated against the disease will develop immunity. Hence, the policy and interventions for a vaccination process are usually simple to implement for nearly everyone. Complicated EBPs and interventions have multiple components that work differently in different situations. The question underpinning complicated EBP and subsequent interventions changes from what works to what works in what
circumstances (Rogers 2010). One example of a complicated EBP and intervention that requires development for Australian paramedic-led healthcare is a standardised approach to aseptic technique. Clinical interventions that require asepsis in paramedic-led healthcare have complicated aspects that differ in different situations. When an intervention works only in particular situations, the EBP needs to specify the conditions under which it is to be used (Head 2010; Rogers 2010). For example, paramedic-led healthcare is bound to the dual context of emergency versus non-emergency cases. The findings from Chapter 6 highlighted that compliance with correct hand hygiene and gloving practices worsened during emergency cases. EBP for IPC in paramedicine will need to provide clear instructions on maintaining standard IPC practices during non-emergency cases, and also on maintaining IPC during difficult emergency cases.

Complex EBPs and interventions emerge in response to changing needs, opportunities and understandings of what is working (Rogers 2010). As such, Rogers states that the question guiding the formation of the complex EBP is what is working and how? One example of a complex EBP and intervention that requires development for Australian paramedic-led healthcare is the paramedic response to a spillover-event that causes the transmission of the paramyxovirus that causes SARS (Quammen 2012). Outbreaks of SARS have caused deadly pandemics (Chan-Yeung & Xu 2003) across the globe, during which paramedics are normally required to treat and transport an infected person.

The development process for EBPs
Although EBPs support clinical practice and good patient outcomes, Turner et al. (2008) argue that the production of EBPs is not being realised because most are poorly developed and ineffectively implemented. The NHMRC (1998) advocates the following process for the development of EBP. First, specialists in evaluating medical evidence should carry out a systematic literature review that is converted into a set of draft guidelines by professional technical and scientific writers. Second, the draft guidelines should be released for public consultation and submissions invited. After submissions are considered, the policy should be re-drafted, with the required changes made by the technical and scientific writers. Third, the guidelines are then reviewed by an independent expert reviewer before being subjected to peer review. Fourth, the guidelines are published and disseminated.
Table 28: Complexity: Aspects and considerations of evidence-based policy design

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Simple (e.g. vaccination)</th>
<th>Complicated (e.g. ANTT®)</th>
<th>Complex (e.g. SARS virus outbreak)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What interventions look like</td>
<td>Discrete, standardised intervention</td>
<td>Interventions that differ in different situations, or that work only in conjunction with other components</td>
<td>Non-standardised and changing, adaptive, and emerge in response to changing needs, opportunities and understandings of what is working</td>
</tr>
<tr>
<td>How interventions work</td>
<td>Much the same everywhere</td>
<td>Differently in different situations (i.e. implementation environments), which can be clearly identified</td>
<td>Generalisations rapidly decay, and results are sensitive to initial conditions as well as to context</td>
</tr>
<tr>
<td>Question needed for EBP</td>
<td>What works?</td>
<td>What works for whom in what contexts?</td>
<td>What is working and how?</td>
</tr>
<tr>
<td>Nature of advice given in policy</td>
<td>Single way to do it</td>
<td>Contingent</td>
<td>Dynamic and emergent</td>
</tr>
<tr>
<td></td>
<td>Best practices</td>
<td>Good practices in particular situations</td>
<td>Principles</td>
</tr>
<tr>
<td>Process needed for evidence uptake</td>
<td>Knowledge transfer to new situations</td>
<td>Knowledge translation</td>
<td>Ongoing knowledge generation</td>
</tr>
</tbody>
</table>

**Note:** adapted from Rogers (2010).

**Using evidence to inform guidelines**

A broad range of both quantitative and qualitative research data are usually required to develop informed EBP, particularly when policy interventions increase in complexity (Davies, Nutley & Smith 2000; Head 2010; O’Dwyer 2004). In addition, a diverse range of considerations that require different types of data are explored during the development of EBP. The considerations include: the needs and factors producing problems, the availability of resources and infrastructure, how previous interventions have been implemented, what different stakeholders value in terms of results and processes, and identification of ethical issues.

According to O’Dwyer (2004), EBP development is a rational, rigorous and systematic approach based on the premise that policy development is better informed by the analysis of available evidence. In other words, policy that is based on meaningful, reliable and trustworthy evidence will improve outcomes. Despite this, in the healthcare setting, some have urged for the increased use of evidence from randomised controlled trials (RCTs) to inform policy, at the exclusion of high-quality evidence from other
research designs (Leigh 2010; O’Dwyer 2004; Rogers 2010). Similar to other types of rigorous research, RCTs have their own potential quality issues that can affect the validity of conclusions (Rogers 2010). Thus, the evidence base used to develop national guidelines for IPC in paramedicine must be broad and must include research that has undergone quality assurance and scrutiny, rather than being based on intuition, tradition, politics or existing practice (Head 2010; O’Dwyer 2004).

The collation of evidence is necessary, but not sufficient, when making recommendations for policy. Using evidence to inform clinically useful recommendations also depends on the judgment, experience and wisdom of EBP developers (NHMRC 1998). A limiting factor in paramedic-led healthcare is the paucity of quality research exploring IPC and patient safety in EMS; hence policy makers and clinicians must be wary of claims to knowledge (Leigh 2010). There is little research evidence from RCTs and meta-analyses in paramedicine IPC that can be used to develop EBP, and using only certain types of evidence may generate misleading conclusions (Rogers 2010). According to Fisher et al. (2015), most research on patient safety in EMS settings lacks either the statistical power to demonstrate an effect or the details to understand the generalisability and applicability of the findings. As such, care must be taken when generalising research from EMS and other healthcare areas to paramedicine until a suitable depth of paramedic research has been published.

Evidence from differing research methodologies can be brought together and rigorously analysed using frameworks such as the General Elimination Methodology (Sciven 2008) and the Multiple Lines and Levels of Evidence (Hill 1965; Schleier et al. 2015). The limitations of experimental, practice-based and qualitative evidence must be considered. Experimental designs are important for determining efficacy or effectiveness (internal validity), but some designs may lack external validity or generalisability and applicability due to unrepresentative samples and lack of real-world contextual variables (Kelly et al. 2013). In contrast, evidence from practice-based research lacks internal validity because of the absence of control groups, although large population effects may be demonstrated. In addition, qualitative research has an explanatory role, particularly for human behaviour, but has been traditionally devalued because it is more vulnerable to error and bias (O’Dwyer 2004). Accordingly, a balance
needs to be struck between experimental designs, practice-based evidence and qualitative research to inform the development of national IPC guidelines for paramedicine.

10.3.2 **Encouraging transformational change**

A comprehensive range of strategies needs to be developed to improve IPC practices and compliance amongst paramedics. Lomas (1991, p. 55) proposed that ‘Words, whether credible or not, rarely flow automatically into action’. A common reason that programs for behaviour-change fail when applied in community settings is that they are not implemented with the same level of skill or consistency as that in the trials that demonstrated the efficacy of the intervention (Green & Glasgow 2006).

Transformational change is influenced by factors such as training, expertise, supervision, and competing work responsibilities. In addition, systems that are most likely to respond easily and quickly to challenges are the ones that have a culture of creativity, innovation and strong, committed leadership (Sanson-Fisher 2004). Strategies that are effective in changing the behaviours of clinicians include: employing media marketing, opinion leaders and ‘champions’; providing educational materials, seminars and conferences; using feedback from audit data; and procuring local involvement in evaluation (Lomas 1991; Lomas, Sisk & Stocking 1993). As such, detailed advice on how a program will be delivered and the level of training required to implement the program successfully, must be provided.

Managing change is also aided by considering implementation science and taking a broad view of dissemination (Gannaway et al. 2011; Rogers 2010; Rogers et al. 2005). According to Sanson-Fisher (2004), important elements that together determine how and whether a new activity is adopted or diffused are relative advantage, compatibility, complexity, ‘trialability’ and observability. Each of these elements contain important factors to consider for both EMS and training organisations in Australia. These elements will be briefly discussed.

**Relative advantage**

Relative advantage is the degree to which an innovation is perceived as better practice than current practice. Sanson-Fisher (2004) argues that the objective data may be less
important than the clinician’s perception of whether the innovation will be advantageous. The social assessment (Section 10.2.1) indicated that the research participants valued IPC and had a positive attitude toward improvement. However, the epidemiological assessment (Section 10.2.2) highlighted that, while IPC was viewed by the research participants as important, their perceptions failed to transfer into practice. This anomaly suggests that such positive perceptions could be used by organisations to improve the likelihood of clinicians’ compliance. The relative advantage must be scaffolded by EMS organisations through consistent policy and actions to either reinforce or extinguish certain behaviours. For instance, the use of opinion leaders or champions could help to reinforce compliance. According to Rogers (1995), the support of champions significantly improves the chances of successful innovation. Further, Markham (1998) argues that good personal relationships between the champion and others are more important in a champion’s influence over their peers than are the champion’s tactics per se. Therefore, EMS training organisations could use existing goodwill by ensuring IPC is prominent in the curriculum. Moreover, opinion leaders within a training organisations’ staff or student body could help to create the emotional environment necessary to promote accountability and responsibility regarding IPC behaviours.

**Compatibility**

Sanson-Fisher (2004) describes compatibility as the degree to which a change in practice is perceived as being compatible with existing values, past experiences, and the needs of potential adopters. Thus, interventions to improve IPC must be compatible with existing values, past experiences, and the needs of paramedics. Decisions about implementing evidence-based practice are driven by both patient welfare and the interplay among the interests of the patient, the clinician and the healthcare system (Sanson-Fisher 2004). In other words, all policies must critically align to promote compliance with IPC, and must delegate responsibility for ensuring that effective IPC occurs. The situational analysis (Section 10.2.1) highlighted policy omissions and substantial differences among the operating procedures of individual ambulance services in Australia. In addition, the paramedic work setting presents unique challenges for compliance with IPC due to the unscheduled nature of paramedic-led healthcare and
the semi-autonomous roles of paramedics (Chapter 4). National IPC guidelines in paramedicine (Section 10.3.1) would alleviate some of these issues.

Operational pressure, that is, the perception of too much to do in too little time, was reported as a major barrier to compliance with most aspects of IPC (chapters 6 to 9). EMS boards and management are responsible for ensuring that policies promote rather than hinder IPC compliance (Braithwaite & Travaglia 2008; Russell & Dawda 2014). Thus, scene-time policies that add to operational pressure need rectifying because they will affect the paramedic’s compliance with IPC policies. EMS organisations can also reinforce expectations of professional behaviours by improving the availability of information to the end user. This research found that paramedics need to access information in the mobile environment of paramedic-led healthcare (Chapter 4). Some experts interviewed suggested a ‘ready reckoner’ that outlines recommended IPC practices in order to improve access to information (e.g. stickers on windscreens and mobile phone applications). Simple text-messaging improves IPC compliance (Kerbaj et al. 2017); these messages could be provided via existing computer-aided dispatch technologies to the Mobile Data Terminals, computer tablets or phones used by paramedics.

Other ways that EMS organisations could assist with compatibility is through encouraging accountability and responsibility for actions. The research participants reported that improved access to appropriate products was required in order to increase compliance with IPC (Chapter 6). Improved convenience through better placement of ease-of-use hand hygiene and cleaning products is one factor that should improve IPC compliance by paramedics. In addition, the NSQHS Standard 1.14.1 (ACSQHC 2012b) states that organisations must have processes in place to support their workforce. Hence, a driver of compliance might be to assist the workforce to recognise both breaches of IPC and ‘near misses’. Providing tools for incident reporting that are easy to access and complete should promote open disclosure.

Culture change to reinforce accountability should begin within entry-to-practice training programs, as training is a powerful factor in improving safety culture (Bahn & Barratt-Pugh 2011; DeJoy 2005; Harvey et al. 2001; Jones et al. 2013). The SoPIC and focus
group participants reported a lack of emphasis placed on IPC during their training (Chapter 6, 7 and 9). Australian universities can assist in compatibility by embedding competency-based IPC training in entry-to-practice curriculum, both horizontally and vertically. Further, curriculum designers must be cognisant of current evidence and any future nationally contextualised, paramedic-specific IPC guidelines. However, training is not the sole jurisdiction of universities. Under NSQHS Standard 1.12.1 (ACSQHC 2012b) EMS organisations are responsible for providing ongoing safety and quality education and training for identified professional and personal development. Recurring competency-based training (CBT) in IPC could be conducted at mandatory corporate inductions and targeted refresher and general-training opportunities.

A new body that will have great impact on how the EMS industry in Australia approaches IPC will be the Paramedicine Board, which will be incorporated in 2018 and will be responsible for the registration of paramedics under the Australian Health Practitioner Regulation Agency. The Paramedicine Board will be in a position to ensure that the accreditation standards for entry-to-practice training programs in Australia include adequate IPC curriculum. The board could also ensure that guidelines are published as booklets, ready reckoners and online resources in order to disseminate comprehensive information from a central authority. In addition, summaries of the guidelines could be published in other ways that are useful to the end user (e.g. in professional paramedicine journals, and newsletters and magazines of professional paramedic associations). Further, these avenues could garner input from paramedics and other stakeholders when guideline development activities are occurring (Lomas, Sisk & Stocking 1993).

**Complexity**

The complexity of a clinical procedure affects the likelihood of its adoption. If the procedure is well defined, it is more likely to be taken up (Sanson-Fisher 2004). The analysis in Section 10.2.3 identified a complex environment in which paramedics had poor knowledge of IPC and were given little if any feedback from managers. Because the paramedic work environment is complex and unique, it requires linking of complicated EBP, critical thinking and problem solving in order to apply effective IPC in many situations. Universities should consider the introduction of IPC knowledge and
practices in a scaffolded, critically aligned way (Biggs & Tang 2007) to allow paramedic students to develop a deep understanding of IPC principles, from simple to complex. Bundling complex procedures is effective at reducing noncompliance with recommended practices during complex procedures (NHMRC 2010). Bundling care involves using a small number (3 to 5) of straightforward set of evidence-based practices that, when performed collectively and reliably, improve patient outcomes. Bundling steps in complex IPC during paramedic-led healthcare may improve adoption and could be emulated in student training.

**Trialability and observability**

Trialability is defined as the degree to which a process can be piloted and modified to improve its fit for purpose; observability is the degree to which the results of the innovation are visible to others (Sanson-Fisher 2004). Simulation in EMS or training organisations provides a consequence free environment for students, clinicians and educators to explore the implementation of IPC during clinical procedures. When competence has been achieved, the new skills should transfer to the work environment.

Observability could be facilitated through disseminating data generated through targeted auditing and surveillance (Section 10.3.1) to paramedic managers and clinicians. An approach based on the *Hazard Analysis and Critical Control Points* (HACCP) system could guide responses to the issues discovered in this research, and facilitate change. HACCP is a systematic approach to the identifying and preventing hazards, with a particular focus on process control to ensure that preventive measures are operating successfully (Food and Agriculture Organization of the United Nations 1993; NHMRC 2011). The HACCP system is a science-based tool for increasing safety (AQaI Service 2005) and is used throughout many industries because it can accommodate change, such as modifications in equipment, design, processes and technological advancements. These aspects make the system a useful lens through which to examine EBP and procedures in paramedic-led healthcare, including IPC practices. Because of its overall approach, HACCP can account for the idiosyncrasies of paramedic-led healthcare, such as the duality of emergency and non-emergency situations. Furthermore, using the HACCP system could establish which time-critical circumstances in paramedicine
preclude compliance with recommended IPC practices and, more importantly, the appropriate control measures for these circumstances.

The value of the HACCP approach is that it integrates both research evidence and the day-to-day reality faced by staff. It is a useful tool for drawing on stakeholder knowledge to drive policy development, implementation and evaluation (AQaI Service 2005). The HACCP system has been used extensively and effectively in the Australian food industry. The NHMRC (2011) recommends the use of HACCP to produce potable drinking water in Australia, but as yet has not produced HACCP-based advice for IPC in healthcare. However, the process could be extended to broader health areas such as IPC in paramedic-led healthcare. According to the NHMRC (2011), the framework for the HACCP approach involves seven steps that must be applied in a logical sequence (Table 29). The HACCP system uses knowledge from research, experts, clinicians and consumers to inform policy and procedures in order to respond to challenges and opportunities.

Clinical audits ensure the quality of care provided by clinicians (National Institute for Clinical Excellence 2002; Quality and Patient Safety Directorate 2013). A rigorous surveillance program is a central tenet of any HACCP system because rigorous infield observational auditing is essential to the design of corrective actions and for verifying their efficacy. A focus on surveillance may also have the benefit of combatting the reluctance of paramedics to report IPC breaches (Chapter 8 and Section 10.2.3, Table 25). An exploration of how to conduct IPC surveillance and auditing in paramedic-led healthcare is required because paramedics are semi-autonomous clinicians who usually work in pairs remotely from their managers. Many of the validated audit tools for fixed-location healthcare services are not recommended for the paramedic work setting. For example, the standardised Hand Hygiene Australia audit tool is not recommended for use outside of Australian acute care facilities (Grayson et al. 2013; Ryan et al. 2012). A similar audit tool for hand hygiene and gloving in Australian paramedicine needs to be developed (Chapter 6).

Table 29: Steps involved in the Hazard Analysis and Critical Control Point (HACCP) approach and a suggested logical sequence for its application.

<table>
<thead>
<tr>
<th>Steps involved in the HACCP approach</th>
<th>Sequence for the application of HACCP</th>
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Hazard identification and preventive measures

- Assemble HACCP team
- Describe processes
- Construct a flow diagram
- List all potential hazards, construct a hazard analysis, consider control measures

Critical control points (CCP)

- Determine CCP (i.e. the point[s] in a process at which things could go wrong – e.g. breaking of aseptic technique)

Critical limits

- Determine the critical limits for operational monitoring

Monitoring system for each CCP

- Establish a monitoring system for each CCP

Corrective actions

- Establish corrective actions

Verification/validation

- Establish verification procedures

Documentation and record keeping

- Establish documentation and record keeping

Note: steps adapted from National Health and Medical Research Council (NHMRC 2011); sequence adapted from Food and Agriculture Organization of the United Nations (1993).

Clinical audits ensure the quality of care provided by clinicians (National Institute for Clinical Excellence 2002; Quality and Patient Safety Directorate 2013). A rigorous surveillance program is a central tenet of any HACCP system because rigorous infield observational auditing is essential for designing corrective actions and for verifying their efficacy. A focus on surveillance may also combat the reluctance of paramedics to report IPC breaches (Chapter 8 and Section 10.2.3, Table 25). How to conduct IPC surveillance and auditing in paramedic-led healthcare requires exploration because paramedics are semi-autonomous clinicians who usually work in pairs remotely from their managers. Many of the validated audit tools for fixed-location healthcare services are not recommended for the paramedic work setting. For example, the standardised Hand Hygiene Australia audit tool is not recommended for use outside Australian acute-care facilities (Grayson et al. 2013; Ryan et al. 2012). Therefore, a similar audit tool specifically for hand hygiene and gloving in Australian paramedicine needs to be developed (Chapter 6).

Rigorous auditing is required to ensure sustained compliance with IPC in paramedic-led healthcare, consistent with that in other healthcare areas. For example, fixed-location acute health services in Australia are monitored for IPC compliance through performance measures such as exploring compliance with hospital cleaning standards and compliance of healthcare workers with hand hygiene protocols (Victorian Auditor-General 2013). The findings of this research indicate that substantial improvement is
required in these IPC performance measures in Australian paramedic-led healthcare (chapters 6 to 9). However, the actual IPC performance of paramedics will remain unknown until rigorous surveillance programs are undertaken.

### 10.4 Conclusion

Evidence from this research demonstrates that breaches of IPC by Australian paramedics occurs and that substantial improvement in compliance with recommended IPC practices is required. The findings suggest that most opportunities to perform hand hygiene are missed and that gloving practices interfere with hand hygiene episodes. Regarding the routine management of the physical environment, none of the survey participants correctly described the process for either the routine cleaning of noncritical items and ambulance interiors or the management of spills of blood and bodily fluids. Participants also reported biocide misuse, inappropriate cleaning methods and inconsistent schedules for the routine and deep cleaning of ambulances. Noncompliance with aseptic technique was also found, as was a reluctance to officially report noncompliance with IPC practices. Further, compliance issues varied with the nature of the clinical activity being undertaken by paramedics, and compliance worsened during perceived emergency events. These findings are also consistent with previous international studies with EMS workers.

To lower the risk of transmission of HAIs and to improve patient safety, a suite of strategies aimed at minimising noncompliance with the IPC guidance is required. The use of a planning model from public health promotion, such as the PRECEDE-PROCEED model, in conjunction with a risk management system such as HACCP, could assist in implementing interventions designed to improve paramedic IPC compliance. Four critical actions are required to drive improvement: develop nationally contextualised IPC operating procedures specific to paramedicine that can be adjusted to the situation and acuity of a patient; improve competency-based training in IPC in paramedic curricula; develop specific tools to audit IPC in paramedic-led healthcare; and develop a national database for the results of IPC auditing. Properly developed, paramedic-specific IPC operating procedures are essential to improve paramedic practice and health outcomes. But merely developing the procedures is not enough; they must be disseminated with strategies in place for correct
implementation, and resources must be available to evaluate the impact of the IPC
guidance in clinical practice. A cycle of dissemination, implementation and evaluation
will highlight areas requiring revision, improvement or further development.

## 10.5 Recommendations

The research reported in this thesis has explored the possible role of paramedics in the
transmission of HAIs through their IPC practices. The findings of the research have
significant operational and educational implications for paramedic-led healthcare in
Australia. Twelve recommendations to improve paramedic IPC practice have been
developed from this research. They are collated into the three constructs of
predisposing, reinforcing and enabling, and are aimed at Australian EMS and training
organisations.

**Recommendations for predisposing factors:**

1. That training organisations in Australia involved with educating paramedic students
   base their curricula on national guidelines and standards for infection prevention and
   control in paramedicine.
2. That training organisations in Australia involved with educating paramedic students
   horizontally and vertically integrate competency-based training and assessment in
   their teaching curricula to improve declarative knowledge and the practice of
   infection prevention and control.
3. That the Australian body responsible for the accreditation of entry-to-practice
   programs in paramedicine (currently the Council of Ambulance Authorities) ensures
   that all program curricula offered by training organisations meet national guidelines
   and standards for infection prevention and control.
4. That training organisations prepare students to be agents of change for infection
   prevention and control in paramedicine through leadership training and critical
   reflection.

**Recommendations to enable practice**

5. That national guidelines for infection prevention and control in Australian
   paramedicine are operationalised for paramedicine through collaboration between
   universities, researchers, emergency medical service organisations and professional
bodies, and that these national operating procedures are based on the best research evidence available.

6. That nationally standardised audit tools for compliance with infection prevention and control practices are developed through collaboration between universities, researchers, emergency medical service organisations and professional bodies in Australia.

7. That Australian emergency medical service and training organisations develop a national data base of infection prevention and control audit outcomes as a basis for quality improvement and research.

8. That Australian emergency medical service and training organisations ensure appropriate access to resources for infection prevention and control during training and clinical practice.

**Recommendations to reinforce practice**

9. That existing accreditation agencies use the National Safety and Quality Health Service (NSQHS) standards as the basis for accreditation and accreditation audits of emergency medical service organisations in infection prevention and control.

10. That Australian emergency medical service and training organisations ensure simple, streamlined processes for reporting breaches of infection prevention and control.

11. That through professional development activities Australian emergency medical service and training organisations encourage the development of accountability and responsibility in paramedics regarding their infection prevention and control practice.

12. That emergency medical service boards and executives ensure their organisation participates in appropriate infection prevention and control accreditation processes, and reviews policies that act as disincentives to compliance with infection prevention and control practice.
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12. Appendices

12.1 Appendix A: Research project information sheet (RPIS) and consent details
Dear Volunteer,

We would like to invite you to participate in an applied research project that is being conducted on the following topic:

‘The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment’.

Participation in this research is voluntary, and the information provided below is supplied to enable you to decide whether to do so, in which case you will need to give your informed consent. You do not need to give any reason if you decide not to participate. Furthermore, if you decide to take part in the research project, you may discontinue participation at any time without penalty or the need to provide an explanation, in which case any information pertaining to you will be excluded from the analysis.

What is the Purpose of this Study?

In recent years there has been a move by Australian ambulance services to educate and train paramedic practitioners to a more advanced level in emergency care with medical skills that can be used across all sectors of the community. This has resulted in a dramatic advancement of the clinical scope of practice for paramedics. The widening scope of paramedic practice includes invasive procedures such as needle thoracotomy, intra-osseous needle placement and suturing. Along with this widening scope of practice, however, comes the possibility of the contribution by paramedics to the transmission of pathogenic microorganisms, such as antibiotic–resistant bacteria.

The publication of research concerning the transmission of pathogenic microorganisms frequently addresses inpatient acute-care facilities rather than outpatient and other health-care agencies. However, all health-care agencies are affected by the emergence and transmission of pathogenic microorganisms. During a health crisis event in which an ambulance is requested, a patient is surrounded by inanimate surfaces and fabrics that may carry microorganisms, particularly if they have not been cleaned and disinfected regularly. Research is needed to identify if patients are at risk of contracting pathogenic microorganisms whilst being treated by paramedics in the out-of-hospital environment, particularly if there is poor adherence to recommended infection control procedures by the attending paramedics.

The aim of this study is to survey Australian paramedics about their behaviours, perceptions and opinions towards infection control practices in the out-of-hospital environment. The outcomes from this study should inform the different ambulance authorities in Australia as to whether there is a need to implement improved infection control guidelines for their paramedic staff working in the out-of-hospital environment, and whether all ambulance services should follow a set of national guidelines for infection control.

Description of the Research Project? (*Alternate passages for different groups)

This research study, which will form the basis of a Masters of Science program for the Principal Investigator, will be undertaken in three phases as follows:

- **Phase 1.** Content analysis of national infection control documents used by different ambulance authorities. This will inform the design of the survey questionnaire to be used in Phase 3.
- **Phase 2.** Semi-structured interviews of key informants, who will be infectious control specialists from various organisations in Australia. The comments and suggestions received from the key informants will also inform the design of the survey questionnaire to be used in Phase 3.
- **Phase 3.** Design and administration of a survey questionnaire. Following Phases 1 and 2, we will be designing a questionnaire that we plan to pilot with a small number of Australian paramedic academics. The final questionnaire will be administered online by
a reputable internet survey company called Clearwater Software (Cairns, Australia) so that we can survey members of the Australian College of Ambulance Professionals (ACAP) about their behaviours, perceptions and opinions towards infection control practices by paramedics in the out-of-hospital environment.

* Group 1 - Key Informants insert
As an <<insert specialty e.g. infectious disease specialist>> we would like to invite you to participate in Phase 2 of our study as a Key Informant. If you agree to participate in the study, we would like to undertake a semi-structured interview with you to discuss your perceptions and opinions about current infection control practices in the out-of-hospital environment, and how they may differ to practices in the hospital or laboratory environments. We expect that the interview will take no longer than 1-hour at a venue of your own convenience. During the interview, we will discuss the following themes:

1. Advice about key documents that underpin infection control practices in Australia (and internationally if possible).
2. Perceptions and opinions on current out-of-hospital infection control practices, and how these may differ to infection control practices in the hospital environment, such as in the emergency and intensive-care departments.
3. Perceptions and opinions on what may be required to improve infection control practices in the out-of-hospital environment.
4. Opinions on issues associated with the notification of paramedics who have unknowingly been exposed to patients with serious infections.
5. Advice about protocols for the management of surfaces (fomites) in patient care areas (e.g. ambulances) in the out-of-hospital environment.
6. Details about their own professional engagement and experience in infection control practices, and whether they have had experience with infection control in the out-of-hospital health-care sector, including ambulance services.

With your permission, we would like to record the interview for coding during analysis. The information that we obtain from you during the interview will be re-identifiable but kept confidential and secure. Your comments will assist us with the design of a questionnaire to survey Australian paramedics during Phase 3 of our study (see above).

* Group 2 – Survey Pilot Participant insert
As a << insert role, e.g. paramedic academic>> we would like to invite you to pilot the survey questionnaire that we have designed for Phase 3 of the study. A copy of the questionnaire is enclosed. Your comments and feedback will assist us in preparing the questionnaire for online administration during Phase 3 of the study. The questionnaire should only take about 20 minutes to complete.

* Group 3 - Survey Paramedics insert
As a member of ACAP, we like to invite you to participate in an online survey that is designed to explore the behaviours, perceptions and opinions of Australia paramedics towards infection control practices in the out-of-hospital environment. This is Phase 3 of our study (see above). To access the questionnaire, you will need to go to the secure website <URL to be inserted>. You will find the questionnaire easy to complete and it should only take 20 minutes of your time. When you submit your responses, the software will automatically code the responses and place them in a secure database. Your responses will be non-identifiable, thus maintaining your privacy. The research team will be able to access the database to undertake statistical analysis on the responses to the questionnaire.

Consent to participate in the study. (*Alternate passages for different groups)

* Phase two - Group 1 – Key Informants:
We will require your informed consent if you decide to participate in our research study. To do this, we would like you to read and sign a ‘Consent to Participate’ form (see copy enclosed) either prior to or after the interview.

*Phase three Group Two – Pilot Participants:
We will require your informed consent if you decide to participate in our research study. Consent to participate in the study will be provided by returning a signed consent form (see copy enclosed) with your comments and feedback about our survey questionnaire.

*Phase three Group Three – Survey Paramedics:
We will require your informed consent if you decide to participate in our research study. Consent to participate in the study will be provided by completing the online questionnaire on the secure website. After completing the questionnaire, you will be invited to enter a draw for movie tickets. While we will require your contact details for the movie ticket draw, the draw will be conducted at a secure website (also hosted by Clearwater Software) that is separate to the website for the questionnaire. This will ensure that your questionnaire responses are not linked to your personal details.

Who are the Research Investigators?
Name: Paramedic Mr Nigel Barr (Principal Investigator)
Position: Lecturer (Clinical), Faculty of Science, Health and Education, USC
Phone: 0435 597 500
E-mail: nbarr@usc.edu.au
Expertise: Currently conducting research into the behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment. This study will form the basis of a Master of Science program for the Principal Investigator.

Name: Dr Mark Holmes (Co-investigator)
Position: Senior Lecturer, Faculty of Science, Health and Education, USC
Phone: (07) 5430 2844
E-mail: mholmes@usc.edu.au
Expertise: Dr Holmes is the Leader for Biomedical and Paramedic Discipline at USC. He has over 20 years of experience in teaching metabolic, clinical and nutritional biochemistry to general science and health science students. Dr Holmes has been the supervisor/co-supervisor for several science Honours and Masters of Science students at USC.

Name: Dr Anne Roiko (Co-investigator)
Position: Lecturer, Faculty of Science, Health and Education, USC
Phone: (07) 5430 2898
E-mail: ARoiko@usc.edu.au
Expertise: Dr Roiko has over 20 years of experience in the public health sector as a researcher and tertiary educator. Dr Roiko is currently a supervisor/co-supervisor for science Honours, Master of Science and PhD students at USC.

Name: Paramedic Nick Prass (Co-investigator)
Position: Lecturer, Faculty of Science, Health and Education, USC
Phone: (07) 5430 1234
E-mail: nprass@usc.edu.au
Expertise: Paramedic Prass joined the biomedical team within the School of Health and Sport Sciences at USC to develop and lead the new Bachelor of Paramedic Science program in 2006. His current research interests are professionally broad but his focus is primarily on his PhD which is clinical in nature and related to how
Are There Any Risks or Benefits to Participating?

There is a minimal chance that you will be affected through participation in the research project. There will be no judgements made on your responses and your responses will be kept private and confidential. Your privacy will be respected at all times. You will be able to withdraw from the study at any time without giving reasons, in which case any information pertaining to you will be excluded from the data analysis.

Any information obtained or provided by you during the course of the study will be used only for the purposes of the research project. All information that is provided for this research project by participants will be de-identified and stored under lock to achieve complete confidentiality of information. This information will only be accessible by the research team.

Through collecting this information, our research team hopes to characterise the behaviours, perceptions and opinions of Australian paramedics towards infection control practices in the environment. There is a paucity of research information studying the possible role of Australian paramedics in the transmission of pathogenic microorganisms. The research team expects to use the outcomes of the study to develop further research questions in this very important health area. The research findings from this project will be reported in a Master of Science thesis and it is envisaged that the outcomes will be published in a scientific journal and/or presented at professional conferences.

Further Information

You are advised to take your time to think about whether you wish to participate in this study. If you decide that you would like to participate, then we would like you to provide consent as outlined above. If you have any concerns about this research, or you would like any further information regarding the research topic, then please feel free to call any of the research investigators on the contact number/e-mail addresses provided above. We would be very happy to answer any questions that you may have.

On behalf of our research group and the University of the Sunshine Coast, I would like to thank you for assisting in this project.

Yours sincerely

Mr Nigel Barr
Lecturer (Clinical) Paramedic Science

If you have any complaints about the way this research project is being conducted you can either raise them with the Principal Investigator or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: c/-The Committees Officer, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 54594574
12.1.2 Email and consent for the pilot of the SoPIC

Dear Participant,

RE: Invitation to be a participant in a pilot study

My name is Nigel Barr and I am a Lecturer (Clinical) in the Bachelor of Paramedic Science program at the University of the Sunshine Coast (USC). Concurrently with my position at USC, I am also employed on a casual basis by the Queensland Ambulance Service as an intensive care paramedic.

I am currently undertaking a Master of Science program at USC with a project entitled ‘Healthcare-Associated Infections: Behaviours and Perceptions of Australian Paramedics’ My supervisors for this project are Dr Mark Holmes, Dr Anne Roiko. The professional background for each of my supervisors is provided in an attachment to this letter.

I am writing to invite you to participate in a pilot of a questionnaire that I have designed to survey Australian paramedics about their behaviours, perceptions and opinions towards infection control procedures in paramedic practice. The questionnaire is designed for online administration and I plan to recruit members of Paramedics Australasia (PA) to participate in the survey in order to obtain a national perception on this topic. Please refer to the attached ‘Research Project Information Sheet’ that provides a more detailed overview of the research project. The questionnaire is found at the following address http://survey.clearwater.com.au/sopic/

As a paramedic, academic or key informant in previous phases of this study, I would value your comments and feedback about the design of the pilot questionnaire. I am particularly interested in feedback in the following areas:

- How long did the questionnaire take to complete?
- Which questions annoyed you?
- Which questions were hard to understand?
- Which questions were too long to answer?
- Which questions were ill conceived? and
- Can you suggest any other changes?

The questionnaire should only take about 20 minutes to complete. Your suggestions will be used to refine the design of the questionnaire before it is used to survey the ACAP members. Unfortunately you will not be able to make remarks online. I suggest that you make notes on a pad or on a word document as you go through the survey. These notes can then be either emailed to me or sent to my postal address.

I would like to thank you in appreciation of giving this request consideration. Please feel free to contact me if you have any questions about the research study or if you would like to accept this invitation to participate in my research study.

Yours sincerely,

Nigel Barr
Lecturer (Clinical) Paramedic Science
School of Health & Sport Sciences
University of the Sunshine Coast

(UNIVERSITY) 07 54565020
(M) 0435597500
(e) n barr@usc.edu.au
Dear Volunteer,

We would like to invite you to participate in an applied research project that is being conducted on the following topic:

‘The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment’.

Participation in this research is voluntary, and the information provided below is supplied to enable you to decide whether to do so, in which case you will need to give your informed consent. You do not need to give any reason if you decide not to participate. Furthermore, if you decide to take part in the research project, you may discontinue participation at any time without penalty or the need to provide an explanation, in which case any information pertaining to you will be excluded from the analysis.

What is the Purpose of this Study?

In recent years there has been a move by Australian ambulance services to educate and train paramedic practitioners to a more advanced level in emergency care with medical skills that can be used across all sectors of the community. This has resulted in a dramatic advancement of the clinical scope of practice for paramedics. The widening scope of paramedic practice includes invasive procedures such as needle thoracotomy, intra-osseous needle placement and suturing. Along with this widening scope of practice, however, comes the possibility of the contribution by paramedics to the transmission of pathogenic microorganisms, such as antibiotic-resistant bacteria.

The publication of research concerning the transmission of pathogenic microorganisms frequently addresses inpatient acute-care facilities rather than outpatient and other health-care agencies. However, all health-care agencies are affected by the emergence and transmission of pathogenic microorganisms. During a health crisis event in which an ambulance is requested, a patient is surrounded by inanimate surfaces and fabrics that may carry microorganisms, particularly if they have not been cleaned and disinfected regularly. Research is needed to identify if patients are at risk of contracting pathogenic microorganisms whilst being treated by paramedics in the out-of-hospital environment, particularly if there is poor adherence to recommended infection control procedures by the attending paramedics.

The aim of this study is to survey Australian paramedics about their behaviours, perceptions and opinions towards infection control practices in the out-of-hospital environment. The outcomes from this study should inform the different ambulance authorities in Australia as to whether there is a need to implement improved infection control guidelines for their paramedic staff working in the out-of-hospital environment, and whether all ambulance services should follow a set of national guidelines for infection control.

Description of the Research Project? (*Alternate passages for different groups)

This research study, which will form the basis of a Masters of Science program for the Principal Investigator, will be undertaken in three phases as follows:

- **Phase 1.** Content analysis of national infection control documents used by different ambulance authorities. This will inform the design of the survey questionnaire to be used in Phase 3.
• **Phase 2.** Semi-structured interviews of key informants, who will be infectious control specialists from various organisations in Australia. The comments and suggestions received from the key informants will also inform the design of the survey questionnaire to be used in Phase 3.

• **Phase 3.** Design and administration of a survey questionnaire. Following Phases 1 and 2, we will be designing a questionnaire that we plan to pilot with a small number of Australian paramedics and academics. The final questionnaire will be administered online by a reputable internet survey company called Clearwater Software (Cairns, Australia) so that we can survey members of the Australian College of Ambulance Professionals (ACAP) about their behaviours, perceptions and opinions towards infection control practices by paramedics in the out-of-hospital environment.

We would like to invite you to pilot the survey questionnaire that we have designed for Phase 3 of the study. A link to the questionnaire is [http://survey.clearwater.com.au/sopic/](http://survey.clearwater.com.au/sopic/), this is also included in the email. Your comments and feedback will assist us in preparing the questionnaire for online administration during Phase 3 of the study. The questionnaire should only take about 20 minutes to complete.

**Consent to participate in the study.** (*Alternate passages for different groups*)

We will require your informed consent if you decide to participate in our research study. Consent to participate in the study will be provided by completing the online questionnaire on the secure website and returning your comments and feedback via email.

**Who are the Research Investigators?**

Name: Paramedic Mr Nigel Barr (Principal Investigator)
Position: Lecturer (Clinical), Faculty of Science, Health and Education, USC
Phone: 0435 597 500
E-mail: nbarr@usc.edu.au
Expertise: Currently conducting research into the behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment. This study will form the basis of a Master of Science program for the Principal Investigator.

Name: Dr Mark Holmes (Co-investigator)
Position: Senior Lecturer, Faculty of Science, Health and Education, USC
Phone: (07) 5430 2844
E-mail: mholmes@usc.edu.au
Expertise: Dr Holmes is the Leader for Biomedical and Paramedic Discipline at USC. He has over 20 years of experience in teaching metabolic, clinical and nutritional biochemistry to general science and health science students. Dr Holmes has been the supervisor/co-supervisor for several science Honours and Masters of Science students at USC.

Name: Dr Anne Roiko (Co-investigator)
Position: Lecturer, Faculty of Science, Health and Education, USC
Phone: (07) 5430 2898
E-mail: ARoiko@usc.edu.au
Dr Roiko has over 20 years of experience in the public health sector as a researcher and tertiary educator. Dr Roiko is currently a supervisor/co-supervisor for science Honours, Master of Science and PhD students at USC.

**Are There Any Risks or Benefits to Participating?**

There is a minimal chance that you will be affected through participation in the research project. There will be no judgements made on your responses and your responses will be kept private and confidential. Your privacy will be respected at all times. You will be able to withdraw from the study at any time without giving reasons, in which case any information pertaining to you will be excluded from the data analysis.

Any information obtained or provided by you during the course of the study will be used only for the purposes of the research project. All information that is provided for this research project by participants will be de-identified and stored under lock to achieve complete confidentiality of information. This information will only be accessible by the research team.

Through collecting this information, our research team hopes to characterise the behaviours, perceptions and opinions of Australian paramedics towards infection control practices in the environment. There is a paucity of research information studying the possible role of Australian paramedics in the transmission of pathogenic microorganisms. The research team expects to use the outcomes of the study to develop further research questions in this very important health area. The research findings from this project will be reported in a Master of Science thesis and it is envisaged that the outcomes will be published in a scientific journal and/or presented at professional conferences.

**Further Information**

You are advised to take your time to think about whether you wish to participate in this study. If you decide that you would like to participate, then we would like you to provide consent as outlined above. If you have any concerns about this research, or you would like any further information regarding the research topic, then please feel free to call any of the research investigators on the contact number/e-mail addresses provided above. We would be very happy to answer any questions that you may have.

On behalf of our research group and the University of the Sunshine Coast, I would like to thank you for assisting in this project.

Yours sincerely

Mr Nigel Barr
Lecturer (Clinical) Paramedic Science

If you have any complaints about the way this research project is being conducted you can either raise them with the Principal Investigator or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: c/- The Committees Officer, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 54594574
12.1.4 Online RPIS and consent details for the SoPIC

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

INFORMATION FOR PARTICIPANTS

To thank you for the time taken to complete the survey we will be drawing a raffle for a Samsung galaxy tablet and 5 double gold pass movie tickets. If you would like to be entered into this draw please follow the link at the end of the survey to provide an email address. This email contact will not be linked to your responses and will only be accessed by the research team. When the survey is concluded, participants will be chosen randomly and contacted on the email address provided.

The survey is concerned with infection prevention and control practices and Healthcare Acquired Infections (HAIs). HAIs are defined as any infection a patient develops due to the healthcare which they have received.

The following information sheets provide further background to this research:

- Research Participant Information Sheet
- Research Supervisor's Professional Experience

A completion indicator is provided so that you can monitor your progress through the questionnaire.

Some sections will be very quick to complete, while others inviting comments may take slightly longer.

By clicking NEXT below you are consenting to your participation in the survey. This survey should take about 30 minutes to complete. We thank you for taking the time to complete the questionnaire.

The hyperlinks in the web page directed participants to the following information:

**Project Title**

The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment.

**Brief Description of Research Project**

In recent years there has been a move by Australian ambulance services to educate and train paramedic practitioners to a more advanced level in emergency care with
medical skills that can be used across all sectors of the community. This has resulted in a dramatic advancement of the clinical scope of practice for paramedics, especially in aero-medical applications and the rural sector, as other health services contract through rationalisation or skills shortages. The widening scope of paramedic practice includes invasive procedures such as needle thoracotomy, intra-osseous needle placement and suturing. Along with this widening scope of practice for paramedics, however, comes the possibility that paramedics may also have a role in the transmission of pathogenic microorganisms. To date there has been a paucity of research into the infection control practices of paramedics.

The aim of this study is to survey Australian paramedics about their behaviours, perceptions and opinions towards infection control practices in the out-of-hospital environment. The outcomes from this study should inform the different ambulance authorities in Australia as to whether there is a need to implement improved infection control guidelines for their paramedic staff working in the out-of-hospital environment, and whether all ambulance services should follow a set of national guidelines for infection control.

*Freedom of Consent*

I have read and understand the *Research Project Information Sheet* for the proposed research study, which provides an outline of the purpose, experimental design and privacy aspects of this research study.

‘I understand that:

- I do not have to participate in this research study if I do not want to;
- I can withdraw from the study at any time and I do not have to give any reasons for withdrawing;
- Feedback will be provided to me in the form of a summary report of the overall outcomes of the research work, if requested; and
• Any personal information provided by or obtained about me will be kept confidential, and only de-identified data will be used in any publications or presentations resulting from this research project.

I understand the contents of the Research Project Information Sheet for the research project ‘The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment’. I agree to participate in this research project and give my consent freely. I understand that the project will be carried out as described on the Research Project Information Sheet, a copy of which I have kept. I realise that whether or not I decide to participate is my decision. I also realise that I can withdraw from the project at any time and that I do not have to give any reasons for withdrawing. Any questions I had about this research project and my participation in it have been answered to my satisfaction.
Dear Volunteer,

We would like to invite you to participate in an applied research project, with HREC approval number S14719, being conducted on the following topic:

‘The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment’.

Participation in this research study is voluntary, and the information below is supplied to enable you to decide whether to do so. You do not need to give any reason if you decide not to participate. Furthermore, if you decide to take part in the research project, you may discontinue participation at any time without penalty or the need to provide an explanation, in which case any information pertaining to you will be excluded from the analysis.

What is the Purpose of this Study?
Over the last two decades the scope of practice of paramedics working across Australia has evolved rapidly. Today paramedics are qualified to conduct invasive medical procedures in the emergency setting. The invasive procedures performed include venepuncture, intravenous and interosseous needle placement, needle thoracotomy, intubation, open fracture reduction, haemorrhage control, and suturing. This presents unique challenges for infection control by paramedics, particularly when the medical procedures are conducted in hostile, unpleasant and disorganised environments.

All health-care agencies are affected by the emergence and transmission of pathogenic microorganisms. Yet, little is known of the value paramedics place on infection control within their practices. Research is needed to identify how paramedics manage the risk of transmission of pathogens in their workplace.

The aim of this study is to canvass Australian paramedics about their practices to maintain infection control in the out-of-hospital environment. The outcomes from this study should inform ambulance authorities in Australia whether there is a need to implement improved infection control guidelines for their paramedic staff working in the out-of-hospital environment and inform the development of educational resources.

Description of the Research Project?
This research study is the fourth part of a PhD study. The first three phases included: a content analysis of national infection control documents and state ambulance operating procedures; semi-structured interviews of key experts in infection control and ambulance management; and a survey questionnaire of paramedics on infection control practices and perceptions. As a paramedic member of Paramedics Australasia, we invite you to participate in a focus group to discuss the concept of infection control in the paramedic work setting and how it may differ to practices in the hospital or laboratory environments. The focus group will be held on <<date>> at <<location>> immediately prior to <<PA CPD evening>>. We expect that the focus group will take no longer than 1-hour.

With your permission, we would like to record and transcribe the discussion from the focus group to enable critical review and analysis. The information that we obtain from you during the focus group will be de-identified and kept confidential and secure.

Consent to participate in the study
We will regard the returning an RSVP by email to the focus group invitation and attendance at the focus group as giving your consent to participate.

**Who are the Research Investigators?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position and Contact</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr Nigel Barr (Principal Investigator)</td>
<td>Lecturer (Clinical), Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast. (07) 54565020. <a href="mailto:nbarr@usc.edu.au">nbarr@usc.edu.au</a></td>
<td>Paramedic lecturer Research into learning and teaching of paramedicine, and infection control practices of paramedics</td>
</tr>
<tr>
<td>Dr Mark Holmes (Co-investigator)</td>
<td>Senior Lecturer, Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast. (07) 5430 2844. <a href="mailto:mholmes@.usc.edu.au">mholmes@.usc.edu.au</a></td>
<td>Discipline Leader for Biomedical science. Research into metabolic, clinical and nutritional biochemistry</td>
</tr>
<tr>
<td>Dr Anne Roiko (Co-investigator)</td>
<td>Associate Professor, School of Medicine, Griffith University (07) 5552 7870 <a href="mailto:a.roiko@griffith.edu.au">a.roiko@griffith.edu.au</a></td>
<td>Program Director- Bachelor of Environmental Health Research into water-related health risks and the transfer of risk-based evidence into policy, the impacts of climate change on health risks and climate change adaptation.</td>
</tr>
<tr>
<td>Dr Bill Lord (Co-investigator)</td>
<td>Associate Professor, Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast. (07) 54594875. <a href="mailto:w.lord@usc.edu.au">w.lord@usc.edu.au</a></td>
<td>Discipline Leader Paramedic Science Research into learning and teaching of paramedicine, and paramedic pain management practices</td>
</tr>
</tbody>
</table>

**Are There Any Risks or Benefits to Participating?**

There is a minimal chance that you will be affected through participation in the research project. There will be no judgements made on your responses and your responses will be kept private and confidential. Your privacy will be respected at all times. You will be able to withdraw from the study at any time without giving reasons, in which case any information pertaining to you will be excluded from the data analysis.

Any information obtained or provided by you during the course of the study will be used only for the purposes of the research project. All information that is provided for this research project by
participants will be de-identified and stored under lock to achieve complete confidentiality of information. This information will only be accessible by the research team.

Through collecting this information, our research team hopes to characterise the behaviours, perceptions and opinions of Australian paramedics towards infection control practices. There is a paucity of research information studying the possible role of Australian paramedics in the transmission of pathogenic microorganisms. The research team expects to use the outcomes of the study to develop further research questions in this very important health area. The research findings from this project will be reported in a PhD thesis and it is envisaged that the outcomes will be published in a scientific journal and/or presented at professional conferences.

**Further Information**

You are advised to take your time to think about whether you wish to participate in this study. If you decide that you would like to participate, then we would like you to provide consent as outlined above. If you have any concerns about this research, or you would like any further information regarding the research topic, then please feel free to call any of the research investigators on the contact number/e-mail addresses provided above. We would be very happy to answer any questions that you may have. In addition after analysis of the focus group discussions an aggregated format of the findings will be available. You will be able to obtain this information by emailing the principle investigator on nbarr@usc.edu.au.

On behalf of our research group and the University of the Sunshine Coast, I would like to thank you for assisting in this project.

Yours sincerely

Mr Nigel Barr

If you have any complaints about the way this research project is being conducted you can either raise them with the Principal Investigator or, if you prefer an independent person, contact the Chairperson of the Human Research Ethics Committee at the University of the Sunshine Coast: c/- The Committees Officer, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 54594574
12.1.6 Ethics committee approval letters

Studies 1 to 3

12 May 2010

Mr Nigel Barr
Dr Mark Holmes
Dr Anne Roiko
Mr Nick Prass
Faculty of Science, Health and Education

Dear Nigel, Mark, Anne and Nick

Expedited ethics approval for research project: The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital ambulance environment (S/10/252)

This letter is to confirm that on 11 May 2010, following review of the application for ethics approval of the research project, The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital ambulance environment (S/10/252), the Chairperson of the Human Research Ethics Committee of the University of the Sunshine Coast granted conditional expedited ethics approval for the project.

The Human Research Ethics Committee will review the Chairperson’s grant of approval and the conditions of approval at its next meeting and, should there be any variation of the conditions of approval, you will be informed as soon as practicable.

The period of ethics approval is from 11 May 2010 to 30 December 2011.

Could you please note that the ethics approval number for the project is HREC: S/10/232.

The specific conditions of ethics approval are that you submit the pilot questionnaire and the final questionnaire to the Chairperson when they are finalised and before use, as stated by you in your application.

The standard conditions of approval for this project are that you:

1. conduct the research project strictly in accordance with the research proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee (except as

Web: www.usc.edu.au | Telephone: +61 7 5459 1234 | Manoora, QLD 4864 | Sippy Downs Drive
Fax: +61 7 5459 1111 | Australia | Sippy Downs, QLD 4554 | Australia
2. inform the Human Research Ethics Committee immediately of anything which may warrant review of ethics approval of the research project, including: serious or unexpected adverse effects on participants; proposed changes in the protocol; unforeseen events that might affect continued ethical acceptability of the project; and a written report of any adverse occurrence or unforeseen event that might affect the continued ethical acceptability of the research project must be submitted to the Chairperson of the Human Research Ethics Committee by no later than the next working day after recognition of an adverse occurrence/event.

3. provide the Committee with a written Annual Report on the research project by 11 May 2011 and on completion of the project on 30 December 2011 using the proforma "Annual Report on Approved Research Project Involving Humans"

4. if the research project is discontinued, advise the Committee in writing within 24 hours of the discontinuation.

5. make no change to the project as approved in its entirety by the Committee, including any wording in any document approved as part of the project, without prior written approval of the Committee for any change.

6. comply with each and all of the above conditions of approval and any additional conditions or any modification of conditions which may be made subsequently by the Human Research Ethics Committee.

You are advised that failure to comply with the conditions of approval and the National Statement on Ethical Conduct in Research Involving Humans may result in withdrawal of approval for the project.

You are required to advise the Committee in writing within 24 hours if this project does not proceed for any reason.

Should you require an extension of ethics approval, please submit a written request for this purpose using the proforma ‘Annual Report on Approved Research Project Involving Humans’ (see Section 9).

An Annual Report on this activity will be due by no later than 11 May 2011.

An electronic version of ‘Annual Report on Approved Research Project Involving Humans’ may be accessed on the University of the Sunshine Coast portal at: Research and Research Training>Research Ethics> Human Research Ethics>Forms>Annual Report Form.
Material submitted to the Chairperson can be forwarded to the Research Ethics Officer, at internal mailing list ML 26, Locked Bag 4, Maroochydore 4558; or alternatively emailed to humanethics@usc.edu.au.

If you have any queries in relation to this ethics approval or if you require further information please contact the Research Ethics Officer by email at humanethics@usc.edu.au or by telephone on +61 7 5459 4574.

I wish you well with the success of your project.

Yours sincerely

Barbara Palmer
Manager, Office of Research
Studies 1 to 3: Extension for ethics approval

11 September 2012

Barbara Palmer
Manager, Office of Research
T: +61 7 5459 4574
F: +61 7 5459 4727
E: humanethics@usc.edu.au

Mr Nigel Barr
Dr Mark Holmes
Dr Anne Rolko
Faculty of Science, Health and Education

Dear Nigel, Mark and Anne,

Expediting ethics approval for amended research project: The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital ambulance environment (S/10/252)

This letter is to confirm that on 11 September 2012, the Chairperson of the Human Research Ethics Committee of the University of the Sunshine Coast granted expediting ethics approval for an amendment to the project, The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital ambulance environment (S/10/252).

The amendment of the project refers to an extension of the ethics approval from 30 December 2012 to 10 May 2013.

The conditions for ethics approval for this project as outlined in our letter of 12 April 2010 continue to apply.

If you have any queries in relation to this ethics approval or if you require further information please contact the Research Ethics Officer by email at humanethics@usc.edu.au or by telephone on +61 7 5459 4574.

Yours sincerely,

Barbara Palmer
Manager, Office of Research
**Study 4**

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12 December 2014

Michelle Searle  
Director, Office of Research  
Tel: +61 7 5459 4574  
Email: humanethics@usc.edu.au

- F23700

Mr Nigel Barr  
Dr Mark Holmes  
Dr Anne Risko  
Dr Bill Lord  
University of the Sunshine Coast

Dear Nigel, Mark, Anne and Bill

Expedited ethics approval for research project: The professional behaviours, perceptions and opinions of Australian paramedics towards infection control in the out-of-hospital environment – Phase 4 (5/14/719)

This letter is to confirm that on 12 December 2014, following review of the application for ethics approval of the above named research project, the Chairperson of the Human Research Ethics Committee of the University of the Sunshine Coast granted expedited ethics approval for the project.

The Human Research Ethics Committee will review the Chairperson’s grant of approval and the conditions of approval at its next meeting and, should there be any variation of the conditions of approval, you will be informed as soon as practicable.

The period of ethics approval is from 12 December 2014 to 30 November 2015. Could you please note that the ethics approval number for the project is HREC 5/14/719. This number should be quoted in your Research Project Information Sheet and in any written communication when you are recruiting participants.

The standard conditions of ethics approval are listed overleaf. If you have any queries in relation to this ethics approval or if you require further information please contact a Research Ethics Officer by email at humanethics@usc.edu.au or by telephone on +61 7 5459 4574 or 5430 2823.

I wish you well with the success of your project.

Yours sincerely  

Michelle Searle  
Director, Office of Research

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Web: www.usc.edu.au  
Telephone: +61 7 5459 1234  
Fax: +61 7 5459 1111  
Murdoch University Qld 4558  
Sippy Downs Qld 4566  
Australia

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12.2 **Appendix B: Emerging themes from Study 2 to inform the SoPIC development**

Tables 30 to 42 show the coded information from the semi-structured interviews, conducted in Study 2, grouped into themes.

Table 30: A challenging work environment for paramedics

<table>
<thead>
<tr>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ‘So, what’s the purpose of saying you’re different? Is it that you don’t have to practice the same high standards of infection control? Or is it a suggestion that you need ways of dealing with those special circumstances?’ (R1)</td>
</tr>
<tr>
<td>• ‘You don’t want to make life difficult but you have to be careful people don’t use difference to excuse themselves from infection control…’ (R1)</td>
</tr>
<tr>
<td>• ‘…the relatively hostile environment of the pre-hospital environment, the moving ambulance …’ (R5)</td>
</tr>
<tr>
<td>• ‘There are obviously significant differences between the hospital and the pre-hospital environment.’ (R5).</td>
</tr>
<tr>
<td>• ‘Clearly, not having, for example, a very simple thing - running water, a sink, in the back of an ambulance - things that are obviously second nature to anyone working in a facility - a healthcare facility’ (R5)</td>
</tr>
<tr>
<td>• ‘the [health agency] have traced - as part of public health mandatory reporting and tracing of communicable disease notifiable events - they’ve traced back from an infected child back through the parents, the family, the day care centre, the school, wherever it might be, very effectively when they’ve discovered a child has a particular infectious notifiable disease. However, on a number of occasions, the ambulance simply has forgotten, despite the fact that they were in the middle of the whole process, and they were with the child at the time it was probably highly communicable’ (R5)</td>
</tr>
<tr>
<td>• ‘We’ve identified there’s a lot of literature in [state] around manual handling, infection control, other types of issues, they always forget ambulance. When I say forget I strongly emphasise forget’ (R7)</td>
</tr>
<tr>
<td>• ‘We’ve gone to hospitals, nursing, rural district nursing, et cetera, and they said, we didn’t even think about you guys. We - because what I suspect happens is they link ambulance in with emergency services, like fire and police, but they don’t see the clinical link from ambulance.’ (R7)</td>
</tr>
<tr>
<td>• ‘We’ve had pandemics, pandemic meetings, and I’ve had [name] who’s our manager of emergency management unit, come back to us and say, they had a meeting prior to his involvement and they completely forgot about ambulance’ (R7)</td>
</tr>
<tr>
<td>• ‘In the case of paramedics, they are dealing with situations which are not predicted, in most cases’ (R9)</td>
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<td>• ‘We’ve built these vehicles that are designed for the task of responding to calls and transporting patients, but not necessarily in being able to be cleaned appropriately or disinfected appropriately’ (R11).</td>
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<td>• ‘…when we transitioned into the healthcare system…all of our policies and procedures started to look like policies and procedures from the hospitals and they didn't apply. The environment is different so we have to look at things a little bit different’ (R11).</td>
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Table 31: Paramedic hand hygiene compliance

- ‘Regardless of whether you wear gloves or not, the 5 Moments for hand hygiene still apply.’ (R3)
- ‘One of the things about five moments is it’s designed for an acute setting so they’re talking about going from patient to patient. But the actual moments still apply regardless.’ (R4)
- ‘So you’ve been treating a patient, you’ve been not touching anything and now you’re going to insert a device or you’re going to manage an open wound. You need to do hand hygiene before that. So those things are still there. The question is how do we do them in a non-hospital setting; particularly in an emergency setting? But I think they’re still appropriate to consider and I think it works.’ (R4)
- ‘most paramedics take their gloves off and wash their hands and do that and they are certainly encouraged to do that’ (R6)
- ‘…if this is an urgent, emergency type of situation in my mind you're there to save the person's life …are we going to do the five moments? Well, no, you save his life by doing whatever you need to do as safely and as minimising and preventing infection as much as possible. I'm not sure about the five moments.’ (R10)
- ‘Most of the other countries from what I’ve read on this subject it's really like in a hospital situation where you're going from patient to patient, or resident to resident, rather than when you're dealing with a particular individual and then transporting that individual to somewhere and then leaving that individual.’ (R10)
- ‘I asked them if they could find for me their infection control kit. The interesting thing for me was the officers on duty - and I suspect they were typical of the cross-section of officers - looked at one another, scratched their heads. Neither of them was sure where to find that kit within the car.’ (R5)
- ‘I think we still have the macho, adrenalin junkie, tough guy persona worldwide. We haven't shifted, I think, from the old days of lights and sirens, rapid response, who can run to being real professionals. There's a lot of that ‘we're different, we're tougher’, we don't need to do all of these things that the nurses - the young girls in the hospital do’. (R11)
- ‘They feel like they have been neglected and put at risk. They feel like they have fallen between the cracks of the healthcare system’ (R13)

Table 32: Paramedic gloving practices

- ‘People wear gloves to protect themselves and they don’t wear gloves to protect patients at all’. (R1)
- ‘…they’ve got the gloves on because they want to protect themselves. (R1)
- ‘I tried a couple of years ago to put the concept that you don’t need to wear gloves on every patient [contact] and people were horrified at the suggestion that you would put someone on the stretcher and actually touch their skin with your hands.’ (R1)
- ‘…because of the use of gloves, there is a really poor compliance of hand hygiene, because it's just reliance that my gloves are clean, and they're not.’ (R3)
- ‘You’ll see paramedics, ambulance staff driving with gloves on. You'll see them walk into hospitals with gloves on and touching everything around that hospital environment when they come in. Gloves are there to be protect you against blood and bodily fluids. Immediately, when that risk is negated, they need to be removed.’ (R3)
- ‘They’re very good now at ensuring that they gloves on before they attend a patient. We shouldn’t allow people to say, it’s an emergency, I don’t have to put my gloves on. Because the problem with that is that if they then do get an exposure … they are being exposed to a virus in a way that they could enter their body’ (R4)
- ‘…you virtually see no one with no gloves on anymore’ (R6)
• ‘wearing gloves all the time for everything…you see a patient being transported, laying on a stretcher, sitting there chatting to the paramedics … with their gloves on.’ (R10)
• ‘Out in the field, and certainly in the hospital, I think that they have a feeling that the gloves … protect them but they totally forget the rest of the hand hygiene.’ (R11)
• ‘…it is actually so much harder to do good infection control wearing gloves and it’s become like a seatbelt to them. Some people are so emotionally attached to their gloves that they cannot touch patient’s skin anymore.’ (R13)
• ‘Some people are so emotionally attached to their gloves that they cannot touch patient’s skin anymore.’ (R13)
• ‘Now if you wear gloves instead of washing your hands you will still cop infection, but the person themselves will feel protected.’ (R13)

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<th>Table 33: Paramedic environmental hygiene compliance</th>
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• ‘We went through a cultural change where if it wasn’t a clinical issue, they didn’t want to know about it. They saw cleaning as just being a more military type reason for it, rather than what actually is a clinical issue’. (R1)
• ‘Yeah, that’s a real issue and we’ve got the problem… with environmental cleaning.’ (R2)
• ‘…we’ve identified areas that aren’t addressed in the national guidelines for the state and written those’ (R1)
• ‘This is an issue - in terms of the environmental cleanliness, the issue of governance, the issue of responsibility for undertaking those tasks, is the reason, I believe, that a lot of these things don't get done.’ (R3)
• ‘A lot of our officers know and understand things but, on the day they choose, for one reason or another, not to comply with procedures, regulations or other.’ (R5)
• ‘People think it is only ambulances that we have to clean, but those stations, all (number) of them are healthcare facilities. They are storing our sterile stock. They are rest areas for our clinical staff. They are areas for cleaning of our clinical equipment. They are technically healthcare facilities and their cleaning regime should be appropriate to a healthcare facility.’ (R13)
• ‘…the first thing that was apparent to me was that there was virtually nothing available in the pre-hospital area’ (R5)
• ‘I think it’s what’s pragmatic and what’s achievable versus the ideal world and then [it] doesn’t really make a difference. All the data and stuff I have seen so far, well, yes, if we swabbed down the ambulances we grow things but I have seen no data say we are causing transmission to our patients’ (R6)
• ‘I guess pragmatically with relative fast turnaround times unless they [ambulances] seem reasonably soiled, they are only going to wipe down the areas where patients have been in contact and that probably is enough, in all honesty, as long as the vehicle has probably had a certain clean every you know, it might be every 72 hours has a decent clean and relatively speaking, that’s what we do but maybe we need to mandate that’ (R6).
• ‘We are looking at all our equipment and we are hoping to make all our equipment disposable’ (R6).
• ‘So there is a whole heap of very expensive, difficult issues to work on here. So we are in the process now, we have done some basic audits which says, the answer is that we were pretty crap at cleaning and that we have not a lot of knowledge or systems in place.’ (R13)
• ‘…we asked staff how often they would clean patient care equipment such as a stretcher, a stethoscope, a blood pressure cuff and things like that. Not one person of the, I don’t know 20 people that we did capture in the mini survey that we did, not one person said after every patient.’ (R13)
Table 34: The role of the environment as a reservoir of pathogens, risk and rationale

- ‘I mean the environment's different in that it's in a more open environment. Risks of transmission are probably not as great for environmental pathogens being held up in ambulances as in a hospital you create a false environment where things are much more easily transmitted around. In ambulance I feel that it's slight different - not to say that you don’t need to do the same level of cleaning for things, because you do.’ (R1)
- ‘...we actually make people sick by not having proper facilities for them to be cared for’ (R1).
- ‘I’ve heard people who should know much better talk about disinfectants and assume that they’re widespread in use in hospitals and they’re not. Now again this is one of those transitions, and even in the current National Infection Control Guidelines there are statements sort of saying they’re really only appropriate in specialised circumstances. You know for particular pathogens or particular circumstances such as dealing with endoscopes et cetera.’ (R2)
- ‘There is no doubt of the role of the environment in the spread of infection. It doesn't necessarily equate to an infection. It equates to just acquiring the organisms that live normally on your skin, and subsequently down the track you might acquire an infection as a result of that’ (R3).
- ‘So I think the protocols to cover the routine and then the blood spill, the body fluid, urine and whatever else is a really important one. I don't think that the practices need to be any different for that.’ (R10)
- ‘So I’d say most don't and I think a lot of that is driven from the media and publishing, there's lots of things that you can spray and fog and mist and things like that, that are going to kill all the germs but sort of something that really does need – the role of the physical environment I think its emerging infection prevention control is smaller than the physical and the direct and indirect contact aspects. However, our physical environment is becoming more and more sophisticated.’ (R10)
- ‘The other one that really comes up often is we're transporting an ‘infectious’ patient, somebody who has got chickenpox or somebody who has got H1N1 and then that leads on to the environmental contamination and the waste disposal of that as well.’ (R10)
- ‘Most people ... are very concerned that something else may be in there that's either going to compromise them or the next patient they transfer. That's the most common thing and I always go back to the chain of infection and talk about the role of the reservoir and the transmission.’ (R10)
- ‘...people think it is only ambulances that we have to clean, but those stations, all 250ish of them are healthcare facilities. They are storing our sterile stock. They are rest areas for our clinical staff. They are areas for cleaning of our clinical equipment. They are technically healthcare facilities and their cleaning regime should be appropriate to a healthcare facility. So there is a whole heap of very expensive, difficult issues to work on here.’ (R13)

Table 35: Factors affecting paramedic compliance with environmental cleaning

- ‘I use the analogy that when I started in the ambulance service we used to wash the ambulances and clean them and shine them and they looked sparkling. But we did it from fear of getting told off because it looked dirty. Today I want the same thing but I have an understanding that because that’s a safe environment to put vulnerable people in.’ (R1)
- ‘But I certainly think 10 years ago - that group in between - it was difficult. If it wasn’t - we went through a cultural change where if it wasn’t a clinical issue, they didn’t want to know about it. They saw cleaning as just being a more military type reason for it - a more compliance for that aspect, rather than what actually is a clinical issue.’ (R1)
- ‘...it’s difficult for paramedics to justify why you would clean or do a double clean after a VRE case, when the very next person you put in there has lived on the streets from the last six years, hasn’t had a shower for three months and has defecated everywhere.’ (R1)
• ‘You’ve also got differing practices across different professions. So if you go into a hospital you’ve got the infection control practitioners putting the emphasis on the use of detergents. If you go into the kitchens you’ve had environmental health officers saying you’ve got to sanitise.’ (R2)
• ‘I think if you rely entirely on them as the only mechanism of ensuring compliance, it often doesn’t work…You’ve got to have people well-trained, they need to understand - really understand the concepts and principles about why you’re actually doing what you’re doing. It’s not just doing it for the sake of it, but there’s actually a good reason for it, and they need to understand and believe in that. I think that’s the first issue and one that we haven’t done particularly well.’ (R5)
• ‘If you don’t have the corporate governance in place, then the officers simply can’t adhere to the policy because they’ve got no capacity to do so.’ (R5)
• ‘Look, it’s an interesting subject. I think it’s what’s pragmatic and what’s achievable versus the ideal world and then doesn’t really make a difference. All the data and stuff I have seen so far, well, yes, if we swabbed down the ambulances we grow things but I have seen no data say we are causing transmission to our patients.’ (R6)
• ‘I think we need to get down to the way that I see it for everywhere, is top down, bottom up. So if the people from the top are committed to helping people to practice getting infection prevention and control, giving them the resources, giving them the training, giving them access to consultants or other people who can maybe help them get the answers for their specific situation, it's the people from the bottom, the front line workers up, also have that.’ (R10)
• ‘Sometimes maybe some of the thought into the design of the ambulance and how things are actually set up, although that is designed for the treatment of the patient’ (R10)
• ‘Ambulance manufacturers are still behind producing vehicles that are easy to clean (R11)
• ‘I think that they're smart individuals, very good clinicians who care about patients, so they do understand that they play a role. I think they underestimate the role that they play and the long term consequences. We see our patients for such a short period of time that we don't see the long term effects of poor hygiene or poor infection control practices on those patients’ (R11)
• ‘I think we can do a whole lot better in all sorts of ways, but there is never going to be a one size fits all solution either because you have got the really quiet rural stations where it would be just ludicrous to send in someone to clean their vehicle or someone to clean their station.’ (R13)
• ‘They have got time to do it, but how well they do it. Who taught them how to clean? I don’t think there is anything in our ambulance training that teaches them how to clean the station…It’s all about, well who taught you how to clean? Probably your mother, if your mother was good at cleaning, you might be good at cleaning too. That’s about it and I think we can do a hell of a lot better.’ (R13)

Table 36: Monitoring and reporting of paramedic compliance with IPC

• ‘The accreditation for ambulance, which is a bigger story altogether - that would involve infection control, along with a whole heap of other things. But I think for any ambulance service to practice - we’d be one of the few of the only healthcare providers, who don’t require some sort of accreditation from a national body.’ (R1)
• ‘It’s difficult when you have two people who work autonomously and remotely from systems that you would normally set up to audit and review, which makes it very difficult for us.’ (R1)
• ‘So you don’t want to make life difficult but you have to be careful people don’t use difference to excuse themselves from infection control.’ (R2)
• ‘You can’t have a bog standard response to everything because it would be either overkill in some areas or it would be insufficient in others. That’s why it really needs to be assessed on an individual basis.’ (R3)
‘…be clear about who is responsible for that level of detail, who is responsible for cleaning, for example after you've transported patients. Now, that will change depending on the department, depending on the IR rule, EBA agreements, statement of duties, et cetera. But the accountability needs to sit with the executive or the higher level of governance, with the relevant department or organisation you're talking about. What they need to ensure is that someone is doing it. That's the bottom line.’ (R3)

‘…it goes back to no set methodology to do that in terms of what's a good compliance rate, so it goes back to the individual organisation to set their own standards’. And ‘What's their self-reported compliance or understanding of cleanliness in the paramedic environment…it'd be really interesting to know what people are reporting that they're actually doing.’ (R3)

‘…this is a really tricky one because you ask people how often they wash their hands and then you observe them and they are totally different.’ (R4)

‘I think there’s a poor amount of reporting’ (R5)

‘Unless we audit it or do the test or some sort of swab test I’m not sure.’ (R7)

‘So there’s a compliance issue there as well.’ (R8)

‘It's a really difficult one when you're actually working often by yourself, often in adverse situations and it is that semi-autonomous thing.’ (R10)

‘I think some of it's what is everyone's role, responsibility and accountability, top down, bottom up’ (R10)

‘Everybody needs to be involved in governance.’ (R10)

‘When I took over the job, we actually had quite an alarming rate of needle stick injuries’ (R11)

‘We need to be more open which creates some challenge because, of course, now we have to compromise because we can't do things just on our own. We have to be part of the bigger system...any kind of patient safety reporting, incident reporting is extremely low…I think that the processes are often too difficult for individual staff members to report’ (R11)

‘All of those exposures are not reported. Probably only a fraction are reported that we actually see in the field.’ (R11)

‘We do need to see it [reporting breaches] because that practice is often a marker for bad practice…’ (R11).

‘I think that the processes are often too difficult for individual staff members to report those sorts of exposures.’ (R11)

‘We have the information out there. We have the education there, but what we don’t have is any auditing or survey loop at this point in time. We have done a small amount of surveying, for example of environmental cleaning practices because we felt this was a very big lack and a very big gap in our programme.’ (R13)

The big ticket items would be the improvements and the funding behind that for the environmental cleaning strategies and some kind of governance issue. So closing off that quality loop and actually now auditing what we are doing and perhaps getting infection control a little bit more out there in the field, watching what they are doing.’ (R13)

‘That’s quite difficult. I’m trying to currently think how I could put in a hand hygiene auditing survey/system. How can I be assured and how can we assure the wider health and the general public that our paramedics are cleaning their hands when they should?’ Without setting up a dibber-dobber attitude…This is the end of the quality circle that we are not closing at this point in time. We have the information out there. We have the education there, but what we don’t have is any auditing or survey loop at this point in time. (R13)

‘…we don't audit enough maybe here when there's only one or two staff members because - I have to think about that one.’ (R14)
Table 37: Ensuring paramedic compliance with IPC

- ‘In our CAD system, we’ll ask for infectious diseases… That will automatically make the precautions required into the job and then the [unclear] get told that the patients got a particular disease and the precautions start with from that.’ (R1)
- ‘I think it needs to be at a state level where the guidelines say what is expected of ambulance, so that all ambulance services will comply with that’ (R1)
- ‘In a CAD - system … will automatically make the precautions required into the job and then the paramedics get told that the patients got a particular disease and the precautions start with from that…They don’t have to know what the disease is and understand it, to do that, to take the right precautions and do the right cleaning’ (R1)
- ‘Again it goes back to no set methodology to do that in terms of what’s a good compliance rate’ (R1)
- ‘Crews are dispatched on the case…if there are precautions in there, they’ll be given those or be like a P and an L. …they have the windscreen stickers there so they can look it up and go which one’s that - it tells them. If a crew gets a case and they’re … not told the precautions, they will ask for it…they don’t even get told what disease it is, they just go you’ve got to wear gloves because it says so. They can look it up and they know which ones [precautions] to do it on.’ (R1)
- ‘There’s been less concern about … having the procedures where you’re utilising things such as hand washing’ (R2)
- ‘there needs to be operationalisation of the guidelines… there needs to be some kind of perhaps standard set by a relevant body for the ambulance service based on the NHMRC guidelines. That's what you'll see probably a lot of associations or organisations doing.’(R3)
- ‘It’s not just about knowledge, it’s also about compliance. A lot of our officers know and understand things but, on the day they choose, for one reason or another, not to comply with procedures’ (R5)
- ‘if you rely entirely on them as the only mechanism of ensuring compliance, it often doesn’t work’ (R5)
- ‘You have to make processes simple. It’s a bit like when you get into your car. You just, without thinking, subliminally put your seatbelt on. I think if we make processes like the wearing of gloves, washing of hands, cleaning of equipment, et cetera routine and subliminal, then you’ve got a much greater chance of getting compliance’ (R5)
- ‘If we were doing everything in our infection control procedures extremely well, then the impact, I think, of even a major issue, like a pandemic, would be minimal.’ (R5).
- ‘There’s certain areas and I feel a degree of frustration in that, I guess the compliance of the PPE and maybe - it’s when a pandemic arrives that we seem to get a bit of operational management energy behind it, but when we don’t have a - we just feel that we’re not supported as well from the operational areas, and other departments too I guess.’ (R7)
- ‘We actually trialled a gel, a hand gel in a little dispenser. The issue we thought we had was that people wouldn’t seek to wash their hands or seek a sanitiser, but if they had it on their belt they would use it….It was very clever the way it was designed…But we trialled it at a branch location and because they weren’t complimentary we just didn’t go with it any further.’ (R7)
- ‘The move towards disposable items for basically everything.’ (R8)
- ‘I think the biggest problem is the nature of the actual work’ (R10)
- ‘the pocket protocols are with them or they should be all the time’ (R13)
Table 38: Workplace cultural factors affecting paramedic IPC practice

- ‘The impact is misunderstood as well - even within the health system. I don’t think people see ambulance as being a major contributor to the transmission of disease.’ (R1)
- ‘We used to wash the ambulances and clean them and shine them and they looked sparkling. But we did it from fear of getting told off because it looked dirty. Today I want the same thing but I have an understanding that because that’s a safe environment to put vulnerable people in.’ (R1)
- ‘I know that if a crew gets a case and they’re told the patient has some sort of disease and they’re not told the precautions, they will ask for it.’ (R1)
- ‘…accepting responsibility, also determining what they accept as adequate’ (R1)
- ‘All they want to know is, how do I not get it? So that’s the basis of that’ (R1)
- ‘The old age thing is we’re just too busy. If they could only realise that by not doing it, they’re actually creating more work in the long term for themselves by giving the patients infections’ (R1)
- ‘It’s difficult for paramedics to justify why you would clean or do a double clean after a VRE case, when the very next person you put in there has lived on the streets from the last six years, hasn’t had a shower for three months and has defecated everywhere.’ (R1)
- ‘The complexity of the ambulance services across the country would be rather diverse’ (R2)
- ‘I think a significant number of our staff don’t see infection control as being as important as they should… neither of them was sure where to find that kit within the car…It isn’t good enough to say that purely the service has an infection control it; it has to be - officers need to be aware of what it is, when they need to use it, the importance of it, how to get another one’ (R5)
- ‘There are people who don’t understand, and then there are those who, whilst they understand, don’t follow and comply with procedures and certain policy’ (R5)
- ‘in terms of reporting near misses and understanding issues regarding infection control, I don’t think there’s a good understanding’ (R5)
- ‘Any amount education…if the understanding isn’t there and if the belief in the need for it isn’t there…seem to be pretty ineffective’ (R5)
- ‘I think there’s generally a fairly apathetic approach or belief perception out there with regards to infection control. . .I don’t think a lot of our staff see it as a major issue’ (R5)
- ‘most paramedics won’t clean down every surface’ (R6)
- ‘The key is to ensure that our new graduates are absolutely drilled in it. It’s for the university to increasingly have an importance there and then they will be the cultural leaders of it.’ (R6)
- ‘… the H1N1 has been a real bonus in terms of changing people’s - the general population, not just paramedics’ - attitudes to washing their hands and so, you know, if you go to most workplaces now there’s hand hygiene stuff everywhere’ (R6)
- ‘We need to get down to the way that I see it for everywhere, is top down, bottom up. So if the people from the top are committed to helping people to practice getting infection prevention and control’ (R10)
- ‘They don't see the value or the importance of reporting those things.’ (R11)
- ‘any kind of patient safety reporting, incident reporting is extremely low’ (R11)
- ‘There's not a lot of people like yourself that are really passionate about infection control from a pre-hospital and care environment’ (R11)
- ‘Went to an all needleless injection system so all of our intravenous and our medication administration that was done was needleless. We improved the uniform issue. We went with a better quality of safety glasses and invested in prescription safety glasses for paramedics that wore eye glasses, so that the compliance with wearing glasses went up as much as we could get it to. We invested in the better nitrile gloves’ (R11)
- ‘I don't think there's enough positive peer influence being exerted in the field. It's something that probably is taboo to talk about. You wouldn't tell you partner, oh you should wear gloves for that one, or why don't you put your glasses on? I still think that's a cultural shift that's yet to come…It takes champions inside systems to make it work.’ (R11)
‘We asked staff how often they would clean patient care equipment such as a stretcher, a stethoscope, a blood pressure cuff and things like that… not one person said after every patient.’ (R13)

‘It is all about habits because we try and get them practising’ (R13)

‘Whether that needs a network of infection control people/champions/something, I’m not quite sure.’ (R13)

‘Management want them to work. If you have X number of short absences without a doctor’s certificate you actually will get a letter. So we [paramedics] just come to work if we have got the sniffles or this or that, …they have me lecturing to them [staff] saying if you are sick don’t go to work because you could make someone very ill. My pet hate is soldier on and then they do feel sick and in that 24 hours they can infect a lot of people and actually maybe people will die of the flu. People with heart disease or chronic chest conditions and things they just don’t [tolerate] this… the other thing is, sometimes you struggle to find staff to fill, so basically if you want to come to work they [management] will take you.’ (R13)

‘I started nursing before aids came along. I call that a bit of a watershed of infection control. That was an era of looking for the infectious patient before that and now we have got the era of assuming that everybody has got that infection’ (R13)

‘I mean an infection control programme is a one person department, but basically there’s not one person in the ambulance service it doesn’t involve in some way, shape or fashion.’ (R13)

‘Some people would take every last sick day almost on schedule and other people will never take a sick day and take huge pride in the fact as well.’ (R13)

Table 39: The role of training in facilitating paramedic IPC compliance

‘Having people who understand how vulnerable people in the community, who if exposed to these sorts of organisms, can affect their lives and in fact can actually take their life.’ (R1)

‘I think education and understanding of infection control is probably more important than infectious diseases… it boils down to very simple and basic processes that we use to protect ourselves and our patients.’ (R1)

‘All they want to know is, how do I not get it? So that’s the basis of that.’ (R1)

‘people confuse risk assessment and risk management’ (R2)

‘They need to understand the fundamentals of infection control. So some of it is about the behaviour of bacteria and viruses because that’s primarily what you’re dealing with. Because you know there are some pretty basic concepts that sometimes we take for granted but are slightly misunderstood… without some of those fundamental understandings of how infections are spread, modes of transmission, risk assessment, then often you can get a stilted view of how to deal with a particular situation’ (R2)

‘you need to be aware of modes of transmission… understand why we might deal with a case of influenza differently to a meningococcal case’ (R2)

‘It is having that training so it’s automatic.’ (R2)

‘The level of understanding in acute settings is, I would say, needs improvement’ (R3)

‘Infection control, you’re talking about ‘how are things transmitted’ and ‘what are the risks of that’. So you can apply that model then to any infection that you come across…I think it's much more practical; people can understand that.’ (R3)

‘There needs to be a level of understanding of what is the risk involved.’ (R3)

‘So you make sure that you’re wearing gloves or any protective attire appropriately when you’re in contact with blood and body fluids… That should be an innate thing in everybody's practice and that’s across every setting… we need to change people’s behaviours so that these things are engrained in them. To teach people to prevent that exposure, not worry about what the particular bug is’ (R4)
• ‘They need to understand - really understand the concepts and principles about why you’re actually doing what you’re doing… I think there’s a lack of understanding of those types of principles.’ (R5)
• ‘our paramedics have got to be able to treat and transport patients and do that in a safe way… to give a requisite amount of knowledge that’s going to enable the officers to do the job’ (R5)
• ‘officers having absolutely no understanding… even the senior officers’ (R5)
• ‘it is a struggle - to profile the importance of infection control within the ambulance environment’ (R5)
• ‘it’s the principles to manage them’ (R6)
• ‘They probably don’t have the knowledge they should have.’ (R6)
• ‘work on the chain of infection and then how are you going to break the chain of infection for the specific context and setting’ (R6)
• ‘We did like a spot audit with some of the graduates - and they said, look I know we got trained in some of this stuff but I can’t remember it.’ (R7)
• ‘What we didn’t do was provide any education around the benefits of ensuring you have regular hand sanitise’ (R7)
• ‘When SARS hit, [ambulance service] had poor hand washing, poor PPE compliance, poor infection control practices, and they couldn’t understand why so many staff were getting sick and they were in the heart of the SARS…They then concentrated on hygiene, washing their hands. They concentrated on the application of the P2 mask, protective eyewear, gloves. They reinforced the order in which you apply it and then the order in which you remove it…they immediately, absolutely immediately had a reduction of sick staff and they knew right then and there what the critical issue was. It was PPE and hygiene.’ (R7)
• ‘it should be part of the training of paramedics, that when they meet a patient, they identify as a basic rule what type of [infection control] category or sub-class of a patient you have to deal with… we need to educate people so they are aware of the level of danger.’ (R9)
• ‘…most of the groups I'm seeing are…including infection control as part of occ health and safety’ (R10)
• ‘What do I need to do? What don't I need to do? What is the PPE I need? Is there anything else I should be thinking of?’ (R10)
• ‘this is actually to protect everybody in the chain of infection’ (R10)
• ‘You need to have people really well trained in…an ambulance that could be called out to anything’ (R10)
• ‘This is the only infection control to get in the whole program. It's a one hour lecture and a one hour tutorial. That's PPE use, all of the infectious diseases, hand hygiene. All of that stuff is in one hour of lecture and one hour of tutorial which isn't enough… I think we need to know the basics of infectious diseases, how diseases are transmitted’ (R11)
• ‘They’re smart individuals, very good clinicians who care about patients, so they do understand that they play a role. I think they underestimate the role that they play and the long term consequences… We don’t… see the big impact that their actions have.’ (R11)
• ‘That everything that you do to a patient you should do a risk assessment as part of your work.’ (R12)
• ‘if they don’t know what they are meant to do they won’t be able to do it…never let an opportunity go by…grab them and use them and teach them if we can’ (R13)
• ‘It’s all about, well who taught you how to clean? Probably your mother… That’s about it and I think we can do a hell of a lot better.’ (R13)

Table 40: Immunisation of paramedics

• ‘…people will line up to be vaccinated against Hep B because it protects them but if you try and get them to take the flu vac because it protects their patients, they’re not really that keen…some of our staff want to get vaccinated against things, … to protect themselves. I want to give it to them
so that when they treat the paediatric patients they’re not going to pass it on…and there are others who just don’t want to be vaccinated against anything’ (R1)

- ‘We haven’t tried to vaccinate people against anything more than Hep B or influenza and whilst there are requirements to do that, to get support for that from an organisational perception has been very difficult because it’s very expensive’ (R1)
- ‘it’s one way of reducing the transmission of disease that we don’t do very well’ (R1)
- ‘it’s really a weakness I think in the system that we don’t have a high level of compliance with immunisation recommendations… that reflects some of the community attitudes to immunisation… but organisations don’t take responsibility for keeping records either… they haven’t had the approach that they’ve got in abattoirs of saying no jab, no job’ (R2)
- ‘we’ve got low rates of vaccination in healthcare workers and that’s a real problem out there’ (R2)
- ‘…where staff don’t want to be immunised, they would need to get a medical certificate in most cases to justify why’ (R3)
- ‘…things such as influenza are more difficult because they're annual and they do pose a risk…. it's not you wearing the consequences, it's the patient. In those circumstances, I think there's a remit for stronger mandates to have staff immunised’ (R3)
- ‘Hepatitis B is the easiest disease to catch. You can get it off a toothbrush. So from that point of view, hepatitis B is essential. Other vaccinations - it’s kind of debatable as to what risk they are in a hospital setting, even for an ambulance service… So wherever there is a disease that the healthcare worker could give to the patient, then there has been some recommendations that we should do that’ (R4)
- ‘It would be great to have a national database’ (R4)
- ‘I think immunisation of our workforce is a major issue actually… We’re at clearly higher risk than the general public…our officers should, as a minimum, be immunised against the full range of adult immunisations’ (R5)
- ‘It was almost an impossible task from the perspective that officers who’d had greater than 20 years of service invariably came through an era where immunisation didn’t exist. …when you ask these folk have you ever been immunised against this? Most people shrug their shoulders and say I don’t know… People in a more modern era had a greater sense of, yes, I’ve been immunised and here’s all the dates’ (R5)
- ‘We recommend everyone has measles, mumps and rubella - pertussis, diphtheria, pertussis and varicella we recommend but industrially we can’t. The Hepatitis B is the only one we can.’ (R6)
- ‘Nothing’s mandatory… We have pretty good compliance in metropolitan region. We’ve got poorer compliance in rural region…paramedics have to be trained in cold chain to ensure the integrity of the Fluvax’ (R7)
- ‘just about every team manager being trained up as a mobile vaccinator’ (R7)
- ‘It's a very difficult thing in Australia. I find we have a very egalitarian State, she'll be right, I'll be right, you'll be right until someone gets exposed to someone with hep B and then why didn't you make me have a hep B vaccination… I just think we are being a little lax in Australia but part of it is the actual culture of Australia and part of it is that it's not an expectation’ (R10)
- ‘They use literature from the internet and say why it's bad for them to have these immunisations which really surprises me, that they don't take responsibility for their own health as individuals.’ (R11)
- ‘Healthcare workers should be immunised. They should be immunised to protect themselves. Also that protects the patient.’ (R12)
- ‘[Health Department] has mandated a vaccination programme for all healthcare workers so they have helped us out… most paramedics took it up with great thankfulness’ (R13)
- ‘opt out if you don’t want it, that’s the strength of the recommendation’ (R13)
Table 41: Surveillance of IPC in paramedicine

- ‘If we could find out what the barriers are too - because time’s probably not the main thing for us.’ (R1)
- ‘It’s difficult when you have two people who work autonomously and remotely from systems that you would normally set up to audit and review, which makes it very difficult for us.’ (R1)
- ‘Because we don’t know what happens outside the hospital setting, any IV that comes in should be changed within 24 hours of admission.’ (R4)
- ‘Putting in an IV, if that’s not done correctly or in a sterile sort of way, that could introduce staphylococci into the bloodstream and they could get a staphylococcal bacteraemia which has a 30 per cent mortality rate.’ (R12)
- ‘The lack of close supervision… Working away from that supervisory eye you don’t have that luxury of the close supervision.’ (R13)
- ‘I’m trying to currently think how I could put in a hand hygiene auditing survey/system… This is the end of the quality circle that we are not closing at this point in time. We have the information out there. We have the education there, but what we don’t have is any auditing or survey loop at this point in time.’ (R13)

Table 42: Look back investigations in paramedicine

- ‘I’d like to think that our staff trust our system that we have and if we tell them you’re fine, they believe us.’ (R1)
- ‘So it’s an issue of how do you inform the paramedics and not have them over-react too?’ (R2)
- ‘if it’s sort of automatic and you’re well trained then you should have done it and so when you think oh, what about the infection, you can say well I did this, this, this and this and there wasn’t the opportunity. Rather than an anxiety because that’s sort of what I’ve often dealt with occupationally, you know quarantine officers for instance. They tell you all about the patient but what they’re really concerned about is themselves and you’re trying to address that concern.’ (R2)
- ‘I think this highlights another problem that people forget about the paramedics’ (R2)
- ‘We, I think, had a problem around meningococcal and notification back at the ambulance officers who transported that patient.’ (R3)
- ‘But they need to be able to trust… what can affect that trust is when they see instances of not being notified of cases’ (R3)
- ‘on a number of occasions, the ambulance simply has forgotten, despite the fact that they were in the middle of the whole process, and they were with the child at the time it was probably highly communicable’ (R5)
- ‘If it is a risk to public health… we try to put it through one point and we will chase people down’ (R6).
- ‘… the staff, as in nurse or medical staff sort of were of the view that it’s medical confidentiality, we don’t need to tell the paramedics the clinical condition of the patient.’ (R7)
- ‘I don’t think we’ll ever have a perfect system because of, you know the number of different hospitals, and each hospital having its own different processes… it’s a matter of ignorance. We’ve been forgotten.’ (R8)
- ‘we see a lot of the privacy walls come up and our paramedics aren’t notified… the system's aren't notifying them when there's an infectious disease identified later on’ (R11)
- ‘Because we read their case sheet, they weren’t at risk, we didn’t feel that there was any need to notify, but what really pisses them off is when they don’t get told and they don’t have an opportunity to have a say or ask questions… They feel like they have been neglected and put at risk. They feel like they have fallen between the cracks of the healthcare system’ (R13)
- ‘There is no policy around this’ (R13)
### 12.3 Appendix C: Data table supporting Chapter 8

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Clinical practice level</th>
<th>level education</th>
<th>paramedic training</th>
<th>Nursing training</th>
<th>Years of experience</th>
<th>State of employment</th>
<th>CBT in ICG</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to access employers</td>
<td>$\chi^2=4.94, df = 2, P = 0.085$</td>
<td>$\chi^2=1.76, df = 2, P = 0.415$</td>
<td>$\chi^2=2.59, df = 1, P = 0.075$</td>
<td>$\chi^2=1.428, df = 1, P = 0.232$</td>
<td>$\chi^2=0.10, df = 2, P = 0.953$</td>
<td>$\chi^2=20.77, df = 7, P = 0.004$</td>
<td>$\chi^2=23.47, df = 1, P = 0.001$</td>
<td>$\chi^2=0.01, df = 1, P = 0.987$</td>
</tr>
<tr>
<td>IPC guidelines</td>
<td>present</td>
<td>$\chi^2=0.468$</td>
<td>$\chi^2=0.266$</td>
<td>$\chi^2=0.383$</td>
<td>$\chi^2=0.68, df = 2, P = 0.598$</td>
<td>$\chi^2=0.713$</td>
<td>$\chi^2=0.826$</td>
<td>$\chi^2=0.01, df = 1, P = 0.987$</td>
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<tr>
<td>Presenteeism</td>
<td>$\chi^2=1.98, df = 2, P = 0.371$</td>
<td>$\chi^2=1.52, df = 2, P = 0.468$</td>
<td>$\chi^2=1.24, df = 1, P = 0.262$</td>
<td>$\chi^2=0.76, df = 1, P = 0.383$</td>
<td>$\chi^2=15.87, df = 7, P = 0.002$</td>
<td>$\chi^2=116.1, df = 7, P = 0.002$</td>
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<td>$\chi^2=0.98, df = 1, P = 0.323$</td>
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<tr>
<td>informed of TBPs for pt with MDRO</td>
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<td>$\chi^2=5.442, df = 2, P = 0.066$</td>
<td>$\chi^2=0.832, df = 1, P = 0.362$</td>
<td>$\chi^2=1.585, df = 1, P = 0.208$</td>
<td>$\chi^2=3.35, df = 1, P = 0.062$</td>
<td>$\chi^2=11.90, df = 7, P = 0.004$</td>
<td>$\chi^2=3.85, df = 1, P = 0.050$</td>
<td>$\chi^2=0.25, df = 1, P = 0.615$</td>
</tr>
<tr>
<td>report found BBF contaminatio in lowers tubes</td>
<td>$\chi^2=5.56, df = 2, P = 0.062$</td>
<td>$\chi^2=1.89, df = 2, P = 0.388$</td>
<td>$\chi^2=0.37, df = 1, P = 0.847$</td>
<td>$\chi^2=0.82, df = 1, P = 0.366$</td>
<td>$\chi^2=0.15, df = 2, P = 0.927$</td>
<td>$\chi^2=11.90, df = 7, P = 0.004$</td>
<td>$\chi^2=3.85, df = 1, P = 0.050$</td>
<td>$\chi^2=0.25, df = 1, P = 0.615$</td>
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<tr>
<td>fails to provide IPC supplies</td>
<td>$\chi^2=1.52, df = 2, P = 0.468$</td>
<td>$\chi^2=10.10, df = 2, P = 0.006$</td>
<td>$\chi^2=1.04, df = 1, P = 0.308$</td>
<td>$\chi^2=0.01, df = 2, P = 0.922$</td>
<td>$\chi^2=0.09, df = 2, P = 0.956$</td>
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<td>mandatory immunisatio for work</td>
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<td>$\chi^2=0.05, df = 1, P = 0.830$</td>
<td>$\chi^2=2.98, df = 1, P = 0.084$</td>
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<td>$\chi^2=7.87, df = 1, P = 0.005$</td>
<td>$\chi^2=3.48, df = 1, P = 0.062$</td>
<td>$\chi^2=4.87, df = 2, P = 0.087$</td>
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<td>$\chi^2=5.28, df = 2, P = 0.071$</td>
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<tr>
<td>CBT in aseptic technique</td>
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<td>$\chi^2=1.86, df = 2, P = 0.601$</td>
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<td>$\chi^2=2.43, df = 1, P = 0.119$</td>
<td>$\chi^2=10.93, df = 2, P = 0.004$</td>
<td>$\chi^2=17.61, df = 7, P&lt;0.001$</td>
<td>$\chi^2=3.42, df = 1, P = 0.065$</td>
<td>$\chi^2=5.28, df = 2, P = 0.071$</td>
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<tr>
<td>Not immunised against influenza</td>
<td>$\chi^2=1.016, df = 2, P = 0.601$</td>
<td>$\chi^2=0.45, df = 2, P = 0.799$</td>
<td>$\chi^2=4.48, df = 1, P = 0.034$</td>
<td>$\chi^2=6.37, df = 1, P = 0.012$</td>
<td>$\chi^2=5.04, df = 2, P = 0.081$</td>
<td>$\chi^2=15.02, df = 7, P&lt;0.001$</td>
<td>$\chi^2=2.03, df = 1, P = 0.154$</td>
<td>$\chi^2=7.24, df = 1, P = 0.007$</td>
</tr>
<tr>
<td>Not reporting partner breach in AT</td>
<td>$\chi^2=0.77, df = 2, P = 0.680$</td>
<td>$\chi^2=5.70, df = 2, P = 0.062$</td>
<td>$\chi^2=4.743, df = 1, P = 0.029$</td>
<td>$\chi^2=1.979, df = 1, P = 0.160$</td>
<td>$\chi^2=8.931, df = 2, P = 0.011$</td>
<td>$\chi^2=4.490, df = 7, P = 0.722$</td>
<td>$\chi^2=0.386, df = 1, P = 0.535$</td>
<td></td>
</tr>
<tr>
<td>Not reporting BBF contaminatio</td>
<td>$\chi^2=2.36, df = 2, P = 0.240$</td>
<td>$\chi^2=3.63, df = 2, P = 0.163$</td>
<td>$\chi^2=0.01, df = 1, P = 0.981$</td>
<td>$\chi^2=0.01, df = 1, P = 0.924$</td>
<td>$\chi^2=7.33, df = 2, P = 0.026$</td>
<td>$\chi^2=7.12, df = 7, P = 0.418$</td>
<td>$\chi^2=3.54, df = 1, P = 0.060$</td>
<td>$\chi^2=0.56, df = 1, P = 0.813$</td>
</tr>
<tr>
<td>Supervisors speak to staff who don’t follow IPC procedures</td>
<td>$\chi^2=0.12, df = 2, P = 0.127$</td>
<td>$\chi^2=5.89, df = 2, P = 0.053$</td>
<td>$\chi^2=0.42, df = 1, P = 0.648$</td>
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<td>$\chi^2=0.11, df = 1, P = 0.747$</td>
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</table>

*Note: * $P$ values have not been adjusted for multiple testing. This is due to the purpose being to explore future areas of research; Perceptions were dichotomised from a 5 point Likert scale to agree/disagree and associations tested using Chi-square tests.
12.4 Appendix D: SoPIC questionnaire

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

INFORMATION FOR PARTICIPANTS

To thank you for the time taken to complete the survey we will be drawing a raffle for a Samsung galaxy tablet and 5 double gold pass movie tickets. If you would like to be entered into this draw please follow the link at the end of the survey to provide an email address. This email contact will not be linked to your responses and will only be accessed by the research team. When the survey is concluded, participants will be chosen randomly and contacted on the email address provided.

The survey is concerned with infection prevention and control practices and Healthcare Acquired Infections (HAIs). HAIs are defined as any infection a patient develops due to the healthcare which they have received.

The following information sheets provide further background to this research:

- Research Participant Information Sheet
- Research Supervisor's Professional Experience

A completion indicator is provided so that you can monitor your progress through the questionnaire.

Some sections will be very quick to complete, while others inviting comments may take slightly longer.

By clicking NEXT below you are consenting to your participation in the survey. This survey should take about 30 minutes to complete. We thank you for taking the time to complete the questionnaire.
## General Opening Questions about Infection Control

We would like to start by asking a few general background questions. This section contains six questions. Space has been provided in some of these questions for further comment.

### 1) How confident are you about your CURRENT infection control practice while working as a paramedic?

- I am confident
- Unsure
- I am not confident at all

### 2) Do your personal infection control practices change if you are treating a person who appears infectious?

- No, I follow the same practices irrespective of a patient's clinical condition
- Yes, My practices do change

### 3) Do you consider that the wearing of gloves is an appropriate substitute for hand cleaning?

- Yes
- No

### 4) How often have you observed paramedics cleaning their hands immediately prior to inserting an intravenous cannula?

- Never
- Rarely
- Sometimes
- Often
- Almost always

### 5) How often have you worked in the patient compartment area of ambulance vehicles that appeared visibly dirty?

- Never
- Rarely
- Sometimes
- Often
- Almost always
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

General Opening Questions about Infection Control

6) How often have you found blood contamination on either equipment, supplies or other surfaces in an ambulance vehicle?

☐ never
☐ infrequently
☐ frequently (greater than 3 times per year)

[Back] [Next]

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

General Opening Questions about Infection Control

If you have observed blood contamination, please indicate where you have observed it.

Tick all that apply.

☐ In the internal compartment of the ambulance
☐ On computerised patient care equipment
☐ On patient care supplies (consumables)
☐ On extrication equipment
☐ On the stretcher frame
☐ On the stretcher mattress
☐ On patient restraint harnesses
☐ I have not found blood contamination
☐ Other, please list: __________________________

[Back] [Next]
8) How often do you use an alcohol based hand hygiene product to clean the gloves you are wearing instead of changing your gloves and cleaning your hands?

- Never
- Rarely
- Sometimes
- Often
- Almost always
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

9) For this question hand hygiene is defined as using either alcohol based products or soap and water to clean your hands, rather than the wearing of gloves or cleaning of your gloves. Please indicate how often during your clinical practice you would normally perform hand hygiene at the defined moments below:

<table>
<thead>
<tr>
<th>Moment</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately before touching the patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately before inserting an intravenous cannula</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortly after inserting an intravenous cannula</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortly after touching items in the patient's surroundings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately prior to the recording of your notes or ‘patient care record’, either paper based or electronic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior to ‘clearing’ after you have handed over the patient or left the patient at their final destination (e.g. at hospital or clinic, or at the patient’s home)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately after removing your gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately before driving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### The 2013 National Survey of Paramedics on Infection Control (SoPIC)

#### Your Self-Reported Practice

**10) During your clinical work as a paramedic, how often do you wear any of the following on your wrists or hands?**

- **Wrist watch**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

- **Wrist bands (e.g. bangles or friendship bands)**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

- **Wedding ring**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

- **Two or more finger rings**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

- **Nail polish**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

- **Artificial / acrylic nails**
  - Never
  - Rarely
  - Sometimes
  - Often
  - Almost always

---

**11) At approximately what length do you usually keep your finger nails?**

- Short length - up to the length of the finger pad but not protruding past
- Longer than the length of the finger pad

---

17% **[link]**

20% **[link]**
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

12) The wearing of gloves has become commonplace in clinical practice. At what times do you usually change your gloves? Tick all that apply.

- I don’t wear gloves
- When the gloves I am wearing become soiled with blood
- When the gloves I am wearing become soiled with bodily substances
- When the gloves I am wearing are punctured, torn or ripped open
- When I am preparing to insert an intravenous (IV) cannula
- When I am moving between different patients to provide care during the same case
- Unless soiled/broken, I would usually remove my gloves at the end of the case.
- Other, please specify

[Self]

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

16) Please indicate how often you would write on your gloves during a case.

- Never
- Rarely
- Sometimes
- Often
- Almost always

[Self]
**The 2013 National Survey of Paramedics on Infection Control (SoPIC)**

### Your Self-Reported Practice

**Question 17:**
Consider that you are wearing gloves during a case and that you have provided patient care. Before doing any of the following listed activities please indicate whether you would normally leave your gloves on, remove your gloves, or remove your gloves and perform hand hygiene. Please record responses for both EMERGENCY and NON-EMERGENCY conditions.

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>EMERGENCY</th>
<th>NON-EMERGENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talking on a mobile phone</td>
<td>Leave gloves on</td>
<td>Remove gloves</td>
</tr>
<tr>
<td>Talking on a radio handset</td>
<td>Leave gloves on</td>
<td>Remove gloves</td>
</tr>
<tr>
<td>Driving</td>
<td>Leave gloves on</td>
<td>Remove gloves</td>
</tr>
<tr>
<td>Filling out a patient care record or report form, either paper based or on a computer tablet</td>
<td>Leave gloves on</td>
<td>Remove gloves</td>
</tr>
</tbody>
</table>

**What factors influenced your answers to the above? (optional)**

[optional field]
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

17) Consider that you are wearing gloves during a case and that you have provided patient care. Before doing any of the following listed activities please indicate whether you would normally leave your gloves on, remove your gloves, or remove your gloves and perform hand hygiene. Please record responses for both EMERGENCY and NON-EMERGENCY conditions.

Talking on a mobile phone - EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Talking on a mobile phone - NON-EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Talking on a radio handset - EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Talking on a radio handset - NON-EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Driving - EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Driving - NON-EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Filling out a patient care record or report form, either paper based or on a computer tablet - EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

Filling out a patient care record or report form, either paper based or on a computer tablet - NON-EMERGENCY

- Leave gloves on
- Remove gloves
- Remove gloves and perform hand hygiene

What factors influenced your answers to the above? (optional)

[Blank space for text input]
Cleaning of ambulances can be thought of at two levels:

1. Routine which is the regular cleaning of frequently touched areas inside the ambulance.
2. Deep cleaning is a thorough clean and disinfection of all the internal compartments and equipment in an ambulance.

18) Is the routine cleaning of an ambulance part of your responsibilities as a paramedic? Routine cleaning is the regular cleaning of frequently touched areas inside the ambulance
   - Yes
   - No

19) Is there a standard operating procedure (SOP) in your employment setting that outlines when ambulances are to be cleaned?
   - Yes
   - No

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

Cleaning of ambulances can be thought of at two levels:

1. Routine which is the regular cleaning of frequently touched areas inside the ambulance.
2. Deep cleaning is a thorough clean and disinfection of all the internal compartments and equipment in an ambulance.

20) Is the deep cleaning of an ambulance part of your responsibilities as a paramedic? Deep cleaning is a thorough clean and disinfection of all the internal compartments and equipment in an ambulance
   - Yes
   - No. Please indicate who is responsible for the deep cleaning of an ambulance?

21) Is the deep cleaning of ambulances done at prescribed times?
   - Don't know
   - No
   - Yes
### The 2013 National Survey of Paramedics on Infection Control (SoPIC)

#### Your Self-Reported Practice

<table>
<thead>
<tr>
<th>22)</th>
<th>Is a record kept whenever an ambulance is cleaned?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

35% [back](#) [next](#)

Web design by [Charlotta Software](#)
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

In a few sentences, please describe how you clean the following types of medical equipment:

A non-invasive medical assessment item such as blood pressure cuff, oxygen saturation probe or ECG leads

A larger piece of equipment such as a spine board

The carry bags that contain medical items, such as a trauma bag or (TODO use photos of the gear)
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Your Self-Reported Practice

The next questions are concerned with the cleaning up of spills of blood or body substances. Spills can come in three sizes: drops, small spills up to 10cm in diameter, large spills greater than 10cm in diameter.

24) Have you ever had to clean up a large spill (greater than 10cm in diameter) in your ambulance?
   ○ No
   ○ Yes

25) Have you ever had to clean up a small spill (up to 10cm in diameter) in your ambulance?
   ○ No
   ○ Yes

26) Please indicate which statement identifies the correct order of the steps used to clean medical equipment. Please select the option that most closely reflects your normal practice.
   ○ Clean using a detergent, disinfect if required, allow to dry
   ○ Remove dirt or organic material if required, clean using a detergent, disinfect if required, and allow to dry
   ○ Clean with a disinfecting product, clean using a detergent, allow to dry
   ○ Clean with a disinfecting product, allow to dry
   ○ None of the statements match my normal practice
   ○ I am not sure
## Your Self-Reported Practice

**27)** Do you undertake any of the following during patient care activities?

<table>
<thead>
<tr>
<th>Use your mouth to hold or uncap medical items?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use a bluey or kidney dish to ensure a clean surface to place medical items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Swab Intravenous medication ports (IV bung etc) prior to giving medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remove Oropharyngeal (OP) airways from the original packaging to store in your kit, ready for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remove Laryngeal Mask Airways (LMAs) from the original packaging to store in your kit, ready for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remove Endotracheal Tubes (ETTs) from the original packaging to store in your kit, ready for use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Touch a site selected to insert an intravenous needle after you have swabbed the site and prior to insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wear multiple layers of gloves to enable quick removal of the top pair if they become contaminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>
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Your Self-Reported Practice

Indicate how you have dealt with the situation when your partner has not used an aseptic technique during the insertion of an IV.

Tick all that apply.

☐ Not applicable, I have not encountered this scenario
☐ I did not report it to anyone
☐ I spoke directly to my partner about it
☐ I spoke to my supervisor/training officer
☐ I filed an incident report form
☐ I told staff at the receiving facility
☐ Documented in the patient care record
☐ Other

Indicate how you have dealt with the situation when you have found blood contamination on equipment or supplies in the ambulance at the start of your shift.

Tick all that apply.

☐ Not applicable, I have not encountered this scenario
☐ I did not report it to anyone
☐ I spoke directly to my partner about it
☐ I spoke to my supervisor/training officer
☐ I filed an incident report form
☐ Other
### Your Self-Reported Practice

**Please indicate which vaccines you have received**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Yes</th>
<th>No</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diphtheria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tetanus</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pertussis (whooping cough)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poliomyelitis (polio)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Measles (rubeola)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rubella (German Measles)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mumps</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Haemophilus influenzae type b infections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Seasonal influenza</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hepatitis B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pneumococcal infections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Self-Reported Practice

30) Please indicate the statement which best describes your uptake of the seasonal influenza immunisation:

- I have the influenza vaccine every year
- I have the influenza vaccine every couple of years
- I have had the influenza vaccine, but not for a few years
- I have not received the influenza vaccine, but I am not opposed to it
- I have not received the influenza vaccine as I am opposed to it
- I am unable to have the influenza vaccine for medical reasons

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Your Opinions

This next section focuses on what you think is important in relation to infection control.

31) What do you believe contributes most to the transmission of Healthcare Acquired Infections (HAI) in the paramedic work environment? HAI are those infections that are not present or incubating at the time of admission to a healthcare program or facility, but develop within a healthcare organisation or are produced by microorganisms acquired during admission.
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

32) Please indicate whether you think that hand hygiene is important at the following times during a case.

<table>
<thead>
<tr>
<th>Event</th>
<th>Important</th>
<th>Not Important</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before entering an unknown scene</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before touching a patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before inserting an intravenous cannula</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After touching a patient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After touching patient's surroundings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After the removal of gloves or PPE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At the completion of a case</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Perceptions hand wear, governance

The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

33) Are there difficulties with performing hand hygiene in the field while working as a paramedic?

- No
- Yes, please comment briefly

[Please indicate your level of agreement or disagreement with the following statements.]

- Infection control guidelines are relevant to my clinical practice.
- My employer’s infection control guidelines are readily accessible if I want to refer to them.
- The wearing of disposable gloves replaces the need for hand hygiene during patient care.
- The cleanliness of the ambulance does not add significant risk to my patients developing a healthcare acquired infection.
- ECG leads should be cleaned between patients.
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## Your Opinions

Please indicate your level of agreement or disagreement with the following statements.

### P2 masks should be worn if a patient is coughing or sneezing.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### I should clean my hands before filling in a patient care record, whether paper based or electronic.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Paramedics should not go to work if they have a communicable illness such as a cold.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Supervisors (e.g. station officer/team manager) should ask paramedics to go home if they come to work with a communicable disease such as a cold.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ambulance services fail to provide the necessary supplies to practice good infection control.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

Please indicate your level of agreement or disagreement with the following statements.

Reporting any blood or body substance contamination found in the ambulance helps to protect patients from developing HAI.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Supervisors would normally speak to paramedics who do not follow infection control guidelines.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Peers would normally speak to their fellow paramedics who do not follow infection control guidelines.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Recertification of a paramedic should be conditional on their compliance with infection control procedures.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

It is the responsibility of every paramedic to ensure infection control procedures are followed in the workplace.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

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Your Opinions

Please indicate your level of agreement or disagreement with the following statements.

A paramedic should stop another paramedic who is about to insert an intravenous cannula using a poor aseptic technique.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

It should be mandatory for all paramedics to be immunised against vaccine preventable diseases.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Paramedics should be allowed to wear jewellery on their hands and wrists.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

The wearing of nail polish by paramedics should be allowed.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Medical items only require cleaning when they are visibly soiled.

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

Please indicate your level of agreement or disagreement with the following statements.

Stretcher mattresses should be cleaned between patients.
- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Stretcher linen should be changed between patients.
- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

A disinfectant should be used before a detergent when cleaning.
- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

The next section asks you about issues with governance of infection control practices.

50) Please indicate below if your employer has Standard Operating Procedures (SOPs) or policies which explain each of the following.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to clean an ambulance station</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How to clean non-critical medical equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How to clean the interior of an ambulance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How to clean a computer / tablet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criteria for when an ambulance should be cleaned</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How to clean different types of medical equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Your Opinions

60) Please indicate if you have encountered any of the following difficulties when trying to conduct routine cleaning of an ambulance between patients. (Indicate all that apply)

- Operational pressure between cases
- Being directed to respond to another case rather than clean the ambulance
- Lack of cleaning equipment at the receiving facility or transport destination.
- Lack of cleaning equipment at your work site.
- Other, please specify

61) Have you ever been informed that a patient you were about to transfer was colonised with a multidrug resistant organism (for example VRE or MRSA)?

- No
- Yes
### Your Opinions

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>62) Does your employer maintain immunisation records on your behalf?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>I don't know</td>
</tr>
<tr>
<td>63) Is it mandatory in your workplace for paramedics to be immunised against all the immunisations included in the NH&amp;MRC adult Standard Vaccination Schedule for adults for your employment as a paramedic?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>I don't know</td>
</tr>
<tr>
<td>64) Does your employer provide the vaccinations included in the NH&amp;MRC adult Standard Vaccination Schedule?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>I don't know</td>
</tr>
</tbody>
</table>
### The 2013 National Survey of Paramedics on Infection Control (SoPIC)

#### Your Opinions

65) Please indicate in which of the following areas you have received training that was assessed or a competency based outcome recorded (select all that apply)

- [ ] Infection control guidelines
- [ ] Standard precautions
- [ ] How to clean an ambulance
- [ ] How to clean medical equipment
- [ ] How to clean an ambulance station or branch
- [ ] How to use an aseptic non-touch technique

66) Where do you access your employer's infection control guidelines (indicate all that are applicable)

- [ ] I don't know how to access them
- [ ] Employer website
- [ ] Hard copy in my workplace.
- [ ] Personal copy supplied by your employer
- [ ] Reference material in the ambulance
- [ ] Application on a smart phone or tablet

67) Please list what you would like to see included in infection control guidelines.

[Insert text]

---

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[opinion14]
Finally, we would like to ask some questions about you. This information will be kept confidential and de-identified to maintain your privacy.

68) **Please state your gender.**
- Male
- Female

69) **Please indicate your age bracket.**
- Less than 18 years of age
- 18-24 years of age
- 25-34 years of age
- 35-44 years of age
- 45-54 years of age
- 55-64 years of age
- 65 and over

70) **Please indicate your ethnicity or background.**
- Aboriginal Australian
- Torres Strait Islander
- Aboriginal and Torres Strait Islander
- White or Caucasian
- African
- African American
- Asian
- Pacific Islander
- Other, please describe
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Participant Attributes

71) Which best describes the highest clinical level of practice you have obtained?

- First Responder
  - Ambulance Responder, Combat First Aider (Australian Army), Community Responder, Primary Care, Defence First Aider & Combat Life Saver (New Zealand Defence Force)

- Patient Transport Attendant
  - Patient Transport Officer, Ambulance Officer - an individual who has completed accredited training in advanced first aid, patient transport and management and who provides quality care and transport for medium acuity, stabilised patients between health facilities and/or home.

- Basic Life Support Medic
  - Ambulance Officer, Paramedic 1, Ambulance Volunteer, Ambulance Community Officer, Emergency Medical Technician (BLS) - an individual who has undertaken accredited training in emergency patient care

- Student Paramedic

- Paramedic
  - Ambulance Paramedic, Paramedic 3, Advanced Care Paramedic, Intermediate Life Support (ILS) Paramedic, Australian Defence Force (ADF) - Medic or Advanced Medical Technician, Combat Paramedic (Australian Army), New Zealand Defence Force (NZDF) - Medic (Intermediate Life Support Level)

- Intensive Care Paramedic
  - Mobile Intensive Care Ambulance (MICA) Paramedic, Clinical Manager (Royal Australian Navy), Intensive Care Paramedic (ALS), Level 5 Paramedic

- Retrieval Paramedic
  - Flight Paramedic, Air Ambulance Paramedic, MICA Flight Paramedic, Critical Care Paramedic, Flight ICP, Aero Medical Evacuation Medic (Australian Defence Force)

- General Care Paramedic
  - an advanced clinical practitioner in Paramedicine who specialises in facilitating a comprehensive medical history/assessment, appropriate referral for low and medium acuity patients in a variety of community and clinical settings with an emphasis on managing a patient in their own environment/context.

- Other, please specify

72) Mostly I work as:

- A single officer
- A member of a two person crew
- Other, please explain

We are done...
### Participant Attributes

#### 73) What is the highest level of formal education you have completed?
- [ ] Certificate
- [ ] Diploma
- [ ] Bachelor degree
- [ ] Post graduate certificate or diploma
- [ ] Masters by course work
- [ ] Postgraduate research degree
- [ ] Other, please specify:

#### 74) When you obtained your first paramedic qualification, was it through
- [ ] A pre-employment training programme (you paid to do your study)
- [ ] A post-employment training programme (you were paid to do your study)

#### 75) In which year did you first obtain your original certification/qualification as a paramedic or ambulance officer?

2013

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Participant Attributes

77) Have you ever been registered in any of the following health professions?

- Medicine
- Nursing (any type)
- Physician's Assistant
- I have not been registered in any other health professions
- Other (specify)

78) I work for (indicate for your main employer only)

- A government based emergency ambulance service
- A quasi autonomous non-government organisation such as St John Ambulance
- A private company
- Australian Defence Force
- New Zealand Defence Force
- Other, please specify
### Participant Attributes

#### Q79) In which state or territory do you work as a paramedic? (Indicate the state or territory of your main employer only)

- ACT
- NSW
- NT
- QLD
- SA
- TAS
- VIC
- WA
- Overseas

#### Q82) Please indicate if you suffer skin irritation due to using the following products (tick all that apply):

- Plain soap and water
- Antiseptic soap and water
- Alcohol based hand hygiene products
- Nitrile gloves
- Latex gloves
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Raffle

As a thank you for the time taken to complete the survey we will be drawing a raffle for a Samsung galaxy tablet and 5 double gold pass movie tickets. If you would like to be entered into this draw please provide an email address below.

This email contact will not be linked to your responses and will only be accessed by the research team. When the survey is concluded, participants will be chosen randomly and contacted on the email address provided.

If you wish to enter the drawing, please enter your email address here.

[Email field]
The 2013 National Survey of Paramedics on Infection Control (SoPIC)

Thank You

The survey team would sincerely like to thank you for your participation. Paramedics Australasia and the ambulance services across Australia and New Zealand will be notified when the results are published.

Any additional comments you would like to make can be provided in the space below.

Please click next to submit your completed questionnaire.

END OF QUESTIONNAIRE

Thank you very much for your time.

Now that you have reached the end of the questionnaire.