Hand hygiene and professional practice: comparative studies exploring attitudes and practice among healthcare students and among healthcare professionals

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Structured PhD

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Dedications

I dedicate this thesis to my parents, Marian and Jack Kingston.

To my loving mother Marian, your commitment and determination to achieving your goals in life have inspired me to do likewise. From you I have learned a lot and I share this accomplishment with you.

To my late father, Jack, a wonderful man, who encouraged and supported me to begin this endeavour. His belief in me inspired me throughout the journey.
Executive Summary

Background

Hand hygiene is widely recognised as an effective measure in preventing the transmission of healthcare-associated infection (HCAI). HCAI is a public health challenge internationally and the emergence of antimicrobial resistance (AMR) and multi-drug resistant organism-associated infections add to the complexity and diversity of the challenge. Now, more than ever, the strategic and operational implementation of infection prevention and control policies, including hand hygiene improvement strategies, is a priority in managing the acute patient safety risk posed by the transmission of pathogenic organisms.

Despite this, evidence shows that hand hygiene compliance among healthcare workers (HCWs) internationally is low, while little is known about the hand hygiene practices of HCWs in Ireland. Heretofore, a comprehensive independent study of hand hygiene practice among HCWs in Ireland has not been published. This thesis presents an independent study of hand hygiene in Ireland and includes the following,

1. A published systematic review of hand hygiene compliance.
2. A published study examining hand hygiene practice among nursing students.
3. A comparative study (undergoing peer review) examining hand hygiene practice among medical students and nursing students.
**Systematic review**

Firstly, the thesis presents a published systematic review that summarises recent clinical research on the topic of hand hygiene compliance. Only studies of robust methodological design, in particular randomised controlled trials are included and thus, it provides a high level of evidence on the effectiveness of hand hygiene improvement interventions. Significant results include:

- Mean compliance before interventions 34%, (range 8% - 53%).
- Mean compliance after interventions 57% (range 33% - 91%).
- Mean net improvement in compliance after interventions 23%.

Among other findings, the systematic review also identified poor focus on hand hygiene compliance among healthcare students despite the significant contribution students make to patient care and healthcare delivery. This reported gap in knowledge provided a rationale for two subsequent studies conducted into hand hygiene practice among healthcare students.

**Hand hygiene: practice among nursing students**

Secondly, the thesis presents a published study that examines hand hygiene practice among students of a Bachelor of Science (BSc) Nursing degree programme. This is the first study of its kind in Ireland and provides previously unreported insights into hand hygiene practice among nursing students who make a vital contribution to healthcare delivery in the region. Significant results include:

- Largely positive attitudes towards hand hygiene and alcohol-based hand rub (ABHR) use.
• Good compliance with the World Health Organisation (WHO) ‘my five moments for hand hygiene’ model, with the exception of ‘hand hygiene after touching a patient’s surroundings’.

• Cross-tabulation revealed greater compliance among 1st year students compared to 4th year students.

• Optimal ABHR use in routine care delivery reported among 22% of students.

• Skin sensitivity featured as a barrier to ABHR use among 32% of students.

**Hand hygiene: comparing practice among medical students and nursing students**

The third study presented is a comparative study (undergoing peer review) of hand hygiene practice among students of a Graduate Entry Bachelor of Medicine and Surgery degree programme and students of a BSc Nursing degree programme. Significant results include:

• Positive attitudes in both disciplines towards ABHR use.

• Highest compliance ‘after body fluid exposure risk’ (mean compliance 95%).

• Lowest compliance ‘after touching a patient’s surroundings’ (mean compliance 59%).

• Knowledge deficits around contraindications to ABHR use among 45% of medical students compared to 16% of nursing students.

• Underutilisation of ABHR among both disciplines.

• Greater routine utilisation of ABHR among medical students (46%) than nursing students (22%).

The fourth study, also published, compares hand hygiene practice of registered nurses in a university hospital group in the region in 2007 to practice in 2015.

Significant results include:

- Attitudes towards hand hygiene predominately positive and nurses are motivated to use ABHR by prevention of cross-infection.
- ABHR is underutilised by registered nurses with a decline in optimal use from 55% in 2007 to 42% in 2015.
- New graduate nurses (45%) are more compliant with optimal ABHR use than experienced nurses (33%).
- Fewer nurses reported barriers to ABHR use in 2015 compared to 2007.

Hand hygiene: comparing practice among medical doctors in 2007 and 2015

The fifth and final study, also published, compares hand hygiene practice of medical doctors in 2007 and 2015 in a university hospital group in the region. Significant results include:

- Knowledge of international hand hygiene guidelines improved in 2015.
- More positive attitudes towards hand hygiene in 2015 compared to 2007.
- Improved compliance with hand hygiene e.g., 86% compliance ‘before touching a patient’ in 2015 compared to 58% in 2007.
• ABHR is underutilised by medical doctors, however, optimal compliance improved from 25% in 2007 to 39% in 2015.

**Conclusion**

Addressing hand hygiene education and training at the earliest available opportunity is essential in instilling positive attitudes and in encouraging best practice among doctors and nurses early in their career trajectories. Regular review of infection prevention and control curricula and of pedagogical approaches seems warranted in ensuring an evidence-based approach to hand hygiene. Channelling positive attitudes among nursing students and medical students and among nurses and doctors towards embedding a clinical culture of hand hygiene best practice is required, as we seek to tackle the current challenges experienced around HCAI and multi-drug resistant organism-associated infections. Nurses and doctors have a duty of care and a professional responsibility, as outlined by their regulatory authorities, to deliver competent and safe patient care and patients have a right to receive safe and competent care. Poor hand hygiene practice breeches those rights and responsibilities.
Declaration

I declare that this thesis, submitted to the University of Limerick for examination in consideration for the award of PhD, is my own personal effort and was completed under the guidance and advice of my supervisors Professor Colum Dunne and Professor Nuala O’Connell. Where any of the content presented is the result of collaborative research, this is duly acknowledged. I took reasonable care to ensure that the work is original and to the best of my knowledge does not breach copyright law. Furthermore, any material contained in the thesis that has been published is declared. In addition, any ideas, techniques, quotations, or any other material from the work of other people included in my thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices.

I declare that this is a true copy of my thesis, including any final revisions, as approved by the examination board and the Graduate School, and that this thesis has not been submitted for a higher degree to any other University or Institution.

Signed: [Signature]

Student number: 11067667

Date: November 30th 2017
Acknowledgements

I express my sincere appreciation to my supervisors, Professor Colum Dunne and Professor Nuala O’Connell, for their unwavering support throughout the duration of my studies, whose research expertise, positivity, encouragement, guidance, patience and belief in this research made it achievable and possible.

A sincere “thank you” to Ms Barbara Slevin, an early champion of infection prevention and control in the region, for her generosity in sharing her earlier work on the topic and for her willingness to support the research conducted in 2015. Her generous contribution is graciously acknowledged and appreciated.

In addition, a special word of thanks to the infection prevention and control team and staff of the nursing practice development unit at the University of Limerick Hospital Group, whose support, collegiality and practical assistance were invaluable.

I also wish to acknowledge the support of the Department of Nursing and Midwifery and the support of my colleagues there, who offered assistance, friendly advice and encouragement on many occasions.
I wish to acknowledge the students at the Faculty of Education and Health Sciences, University of Limerick and the staff at the University of Limerick Hospital Group who participated in this study, without whose contribution, this study would not have been possible.

A sincere “thank you” also to Mary O’Kelly at the Graduate Entry Medical School for her administrative support throughout.

I also acknowledge the Infection Prevention Society for the award of a research grant.

Finally, to my family, my husband Tom and my son Michael, “thank you for your support and encouragement throughout, delivered always with a good sense of humour that never failed to lift my spirits on the difficult days”.
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Appendix 3  Publications (including published chapters)

2016 - Hand hygiene-related clinical trials reported since 2010 a systematic review. *Journal of Hospital Infection*

2016 - Continuing Professional Development Questions. *Journal of Hospital Infection*

2016 - Continuing Professional Development Answers. *Journal of Hospital Infection*

2016 - Response letter to editor. *Journal of Hospital Infection*

2016 - Conference Abstract Published. *Journal of Infection Prevention*

2017 - Survey of attitudes and practices of Irish nursing students towards hand hygiene, including hand rubbing with alcohol-based hand rub. *Nurse Education Today*

2017 - Attitudes and practices of Irish hospital-based physicians towards hand hygiene and hand rubbing using alcohol-based hand rubs, a comparison between 2007 and 2015. *Journal of Hospital Infection*


2017 - Conference Abstract Published. *Journal of Infection Prevention*

Appendix 4  Conference Contributions

2017 - Invited guest speaker 4th International Conference on Prevention & Infection Control (ICPIC), Geneva, Switzerland
2017 - Poster presentation Infection Prevention Society UK Annual Conference, Manchester, UK

2017 - Poster presentation Health Research Symposium, Limerick, Ireland

2016 - Poster presentation Infection Prevention Society UK Annual Conference, Harrogate, UK

2016 - Poster presentation 3rd Annual Nursing & Midwifery Research & Innovation Conference, Limerick, Ireland

**Appendix 5** Honours and Achievements

Invited speaker - 4th International Conference on Prevention & Infection Control

Publication honour - Most downloaded articles in 2016 Journal of Hospital Infection - published Systematic Review

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**Appendix 7** Generic and Transferrable Skills Achieved

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<th>Abbreviation</th>
<th>Full Text</th>
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<tbody>
<tr>
<td>A</td>
<td>Alcohol-based hand rub</td>
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<tr>
<td>ABHR</td>
<td>Antimicrobial resistance</td>
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<tr>
<td>C</td>
<td>Centers for Disease Control and Prevention</td>
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<tr>
<td>AMR</td>
<td>Cumulative Index to Nursing and Allied Health Literature</td>
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<tr>
<td>CDC</td>
<td>Continuing Professional Development</td>
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<td>CRBI</td>
<td>Catheter-related bloodstream infection</td>
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<td>CINAHL</td>
<td>European Centre for Disease Prevention and Control</td>
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<td>CPD</td>
<td>European Union</td>
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<tr>
<td>ECDC</td>
<td>Health Information and Quality Authority</td>
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<td>CRBI</td>
<td>Health Protection Surveillance Centre</td>
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<tr>
<td>HCAI(s)</td>
<td>Health Service Executive</td>
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<td>HCO(s)</td>
<td>Hand hygiene opportunity</td>
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<td>HIQA</td>
<td>Health Service Executive</td>
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<td>HPSC</td>
<td>Health Service Executive</td>
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<td>HSE</td>
<td>Health Service Executive</td>
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<tr>
<td>ICU</td>
<td>Intensive care unit</td>
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<tr>
<td>INICC</td>
<td>Infection prevention and control</td>
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<td>LR</td>
<td>Long-term care facilities</td>
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<td>M</td>
<td>Multi-drug resistant organism(s)</td>
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<td>MDRO(s)</td>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
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<td>MRSA</td>
<td>Non-consultant hospital doctors</td>
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<tr>
<td>NCHDs</td>
<td>Neonatal intensive care unit</td>
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<tr>
<td>NICU</td>
<td>Nursing and Midwifery Board of Ireland</td>
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<tr>
<td>NMBI</td>
<td>Respiratory therapist</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>UL</td>
<td>University of Limerick</td>
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<tr>
<td>ULHG</td>
<td>United States/United States of America</td>
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<td>VAP</td>
<td>Ventilator-associated pneumonia</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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CHAPTER 1

Introduction

Background, rationale, thesis outline and personal reflection
Background

Healthcare-associated infection

The burden of healthcare-associated infection (HCAI) is a significant and enduring global problem and impacts patient safety. HCAI, also referred to as nosocomial infection or hospital-acquired infection, is described by the World Health Organization (WHO) as an infection occurring in a patient, in a hospital or other health care facility, which was not present or incubating at the time of admission. HCAI can also appear after discharge and include occupational infections among staff (WHO 2009).

Prevalence of HCAI

In the US, it is estimated that HCAI affects approximately 2 million patients annually, of whom approximately 90,000 patients die as a result (Stone 2009). In the European Union on any given day an estimated one in every 18 patients (5.7% of patients) in a European hospital has a HCAI (ECDC 2103a). Approximately 4.1 million patients in acute-care facilities acquire a HCAI annually, with the number of deaths estimated to be at least 37,000 (ECDC 2103a). A point-prevalence survey conducted in Ireland, the setting for this study, reported a national overall HCAI prevalence of 5.2% in acute-care facilities (Health Protection Surveillance Centre (HPSC) 2012). For infections acquired in long-term care, the national crude prevalence was 4.4% (HPSC 2017).

The emergence of multi-drug resistant organisms (MDROs) adds to the diversity and complexity of HCAIs and the setting for this report has experienced considerable HCAI challenges in recent years, in particular serious patient complications arising from MDROs (O’Connor et al. 2015a, O’Connor et al. 2015b, HPSC 2012, HPSC
2014). Antimicrobial resistance (AMR) in Europe continues to increase, especially in Gram-negative pathogens, for example, extended-spectrum beta-lactamase (ESBL)-producers and carbapenemase-producing Enterobacteriaceae (CPE), while the situation appears more stable for Gram-positive pathogens (ECDC 2013b). Monitoring of the incidence of outbreaks and individual cases have shown that, for instance, the prevalence of at least one HCAI, methicillin-resistant *Staphylococcus aureus* (MRSA) related HCAI, is stabilizing or decreasing in some European countries including Ireland; while other HCAIs are increasing (e.g., *Escherichia coli* and *Klebsiella pneumonia*) (HPSC 2017, ECDC 2013b).

**Burden of HCAI**

Patients attending for healthcare have an expectation and a right to receive that care in a safe and trusted healthcare environment (Health Service Executive (HSE) 2008). However, HCAI and especially those infections caused by MDROs pose a significant threat to patient safety and affect millions of patients worldwide (WHO 2009). HCAI negatively affects patient outcomes, leading to increased patient morbidity and mortality and places a significant psychological burden on patients and their families (Doronina *et al*. 2017). HCAI results in extended hospitalisation, consequently, reducing hospital capacity and directly impacting the efficiency of healthcare (WHO 2011, Allegranzi *et al*. 2011). The economic burden of HCAI is significant and impacts hospitals, patients and their insurers. The overall annual cost of HCAI in the US is estimated to range from US$ 9.8 billion to 45 billion (Zimlichman *et al*. 2013, Stone 2009).
**HCAI and hand hygiene**

There is extensive evidence that hand hygiene reduces the transmission of healthcare-associated pathogens and the incidence of HCAI, with many international guidelines supporting this (Centers for Disease Control and Prevention (CDC) 2002, WHO 2009, Loveday et al. 2014). Since the 1840’s when Semmelweis discovered the association between unwashed hands and post-partum mortality caused by hospital-acquired infection, numerous studies have demonstrated that improved adherence with hand hygiene practice reduces the transmission of pathogenic microorganisms and associated rates of HCAI (Rosenthal et al. 2005, Pessoa-Silva et al. 2007, Grayson et al. 2008, Pittet et al. 2000). However, despite this, hand hygiene compliance among healthcare workers (HCWs) remains poor in many hospital settings, with a baseline compliance rate of just 38.7% reported (Luangasanatip et al. 2015, WHO 2009). Achieving improved hand hygiene compliance among HCWs is an on-going infection prevention and control endeavour and one that requires a multimodal implementation strategy (WHO 2009).

**Defining hand hygiene**

Hand hygiene is a general term that refers to any action of hand cleansing including hand washing with soap and water, hand rubbing with an alcohol-based hand rub solution and surgical hand preparation (HSE 2005). Selection of the appropriate hand hygiene action by a healthcare worker is determined by the impending clinical encounter. Hand rubbing with alcohol-based hand rub (ABHR) is globally advocated as the optimum approach to hand hygiene in most clinical situations and should be used for routine hand hygiene, with exceptions (WHO 2009). Exceptions include when hands are visibly soiled or when caring for patients with Clostridium difficile.
infections, when ABHR is ineffective. The WHO defines hand rubbing as “applying
an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the
need for an exogenous source of water and requiring no rinsing or drying with towels
or other devices” (WHO 2009). ABHR is more efficacious than soap and water in
killing harmful microorganisms, takes less time, is better tolerated and improves
compliance (CDC 2003, Harbarth et al. 2002, Boyce et al. 2000, Voss and Widmer,
1997).

Rationale

Rationale for research

The rationale for this research arises from two issues. Firstly, the WHO recommends
the monitoring of perceptions, knowledge and practices of hand hygiene among HCWs
as part of a multi-modal hand hygiene implementation strategy (WHO 2009). However, despite commitment in Ireland to implementing the WHO strategy, a
literature search revealed just one recent Irish study that explored hand hygiene
practices among HCWs and one study preceding publication of the WHO strategy
(Higgins and Hannan 2013, Creedon et al. 2008). No study addressing hand hygiene
perceptions or knowledge was found. Further, no recent studies were found in Ireland
that explored hand hygiene among the healthcare student population, who account for
a sizable percentage of HCWs with direct patient contact (Bargellini et al. 2014). This
research seeks to address this gap in the literature by providing insight into current
hand hygiene attitudes and practices among healthcare students and healthcare
professionals in Ireland and in so doing, contributes to a broader understanding of the
topic.
The foundations of this research arise from considerable work in the field by Ms Barbara Slevin, an early champion of infection prevention and control in Ireland and in the region, whose valuable contributions have inspired many. Data from that work, albeit unpublished, were generously shared by the author and were influential in shaping the research design of this study. The research instrument used was originally devised by Larson (2004) and was adapted by Slevin (2007). In this research, following review for content validity, the tool adapted by Slevin (2007), with her agreement, was significantly modified and expanded to facilitate exploration of hand hygiene practice among healthcare students in 2015, taking it from a 42 item to a 62 item questionnaire. Modification of the tool facilitated the undertaking of two comparative studies of hand hygiene practice among healthcare professionals between 2007 and 2015.

The self-report design adopted for the study, with its inherent anonymity allows participants freedom to express attitudes and perceptions without fear of repercussions sometimes associated with the direct observational approach (Neo 2017, Bradley et al. 2017, Mahida 2016). Neo (2017) suggests that data on hand hygiene in self-report studies can be subsequently compared with data from direct observation and the triangulation of data sources may help to produce understanding.

The second issue is concerned with hand hygiene observational data. Direct observation data is readily available in Ireland through the HPSC website (HPSC 2016). In-line with WHO recommendations, the HPSC publishes results of biannual target-driven national direct observational hand hygiene audits. While the results of these audits are promising (e.g. 90% national compliance) and report ongoing progress in reaching targets, the high compliance rates reported are at odds with those reported internationally in independent studies, where randomised controlled trials have
reported much lower compliance rates (e.g. 30-50% compliance) (Ho et al. 2012, Huis et al. 2013, Martin-Madrazo et al. 2012). Publicly reported audit results are currently under scrutiny, with researchers in the UK and Australia suggesting that they may be artificially inflated and deny poor performance. A myriad of reasons for this are postulated, including poor research methods, the Hawthorne effect, poor levels of training and unstandardized inconsistent methodologies in collecting monitoring data (Azim et al. 2016, McLaws et al. 2015, Jeanes et al. 2015). Further, researchers suggest avoidance tactics, where the practitioner might avoid or defer activities until the audit is ended, may have significant implications for the validity of audit findings (Gould et al. 2017, Mahida 2016). In addition to the debate around the construct validity of direct observation, a debate is currently ongoing in relation to the unrealistic setting of high hand hygiene compliance targets rates (Jones et al. 2017, Oliver et al. 2017, Mahida et al. 2017, Mahida 2016, Bradley et al. 2017).

In summary, underpinning the need for this research is the dearth of independent research into hand hygiene practices in Ireland, coupled with the discrepancy between the publicly reported high hand hygiene compliance rates and the low rates found in independent international randomised controlled trials. These matters provide the rationale for this research that investigates patterns of behaviour relating to hand hygiene practices among healthcare students and healthcare professionals in Ireland. In so doing, this research provides an evidence base to inform education, practice and further research and finally, contributes to the broader international debate on the issue.
Thesis Outline

Article-based PhD thesis

This thesis is presented in the format of an article-based PhD thesis and follows the University of Limerick academic regulations, procedures and requirements around such. The thesis comprises a number of interrelated but independent research papers produced by the PhD candidate while registered as a research student. They are jointly written and the PhD candidate is the principal author. Excluding the introduction and conclusion chapters, the remainder of the thesis is presented in the format of individual manuscripts, each assigned as individual chapters. These five manuscripts represent a systematic review of the literature concerning the topic and four focused research studies conducted during the principal author’s time as a doctoral student. The manuscripts presented deal with the same set of research questions. Four are published in high impact peer-reviewed academic journals and the fifth is under peer review.

Chapter 1 of the thesis is an introduction to the topic and provides a background and overview of the significance of the research topic. Chapter 2 is a (published) systematic review of hand hygiene-related clinical trials published after 2010. Chapter 3 (published) examines hand hygiene attitudes and practices among students of a Bachelor of Science (BSc.) Nursing degree programme at the University of Limerick. Chapter 4 (under peer review) presents a comparative study of hand hygiene, including alcohol-based hand rub use, among students of a BSc. Nursing degree programme and of a Graduate Entry Bachelor of Medicine and Surgery degree programme at the University of Limerick. Chapter 5 (published) presents a comparative study examining attitudes and practices of Irish hospital-based physicians towards hand hygiene and towards hand rubbing using alcohol-based hand rub between 2007 and 2015. Chapter
6 (published) is also a comparative study and examines attitudes and practices of Irish registered nurses towards hand hygiene, between 2007 and 2015. Chapter 7 is an aggregate final discussion and conclusion. The published studies are presented in the appendices. As this Doctorate of Philosophy was undertaken as a Structured PhD programme, ten discipline specific modules were also undertaken, along with research skills courses and generic and transferrable skills courses, details of which are also presented in the appendices, along with other pertinent publications and relevant information.
Personal Reflection

My interest in undertaking this PhD degree arose from a personal commitment to continuous professional development and an aspiration to develop a repertoire of generic and transferrable research and writing skills to complement my existing skills and enhance my academic role. While always interested throughout my professional nursing career in the field of infection prevention and control, events of 2009, described here, led me to consider undertaking a PhD degree, focusing on one aspect of infection prevention and control i.e. hand hygiene.

In 2009, Ireland along with many countries internationally, experienced an outbreak of the H1N1 influenza virus, resulting in many hospitalised cases. A national and coordinated response followed and in order to monitor influenza activity in Ireland a number of surveillance systems were established. This public health crisis brought sharp focus on infection prevention and control measures. Public consciousness was awoken to the need for vigilant hand hygiene in preventing and controlling the spread of the virus and hand hygiene stations sprung up in shopping centres, office blocks and public spaces, while the media reporting on the pandemic was prolific and on-going.

In response to this pandemic, I successfully led a collaborative team, funded by the National Digital Learning Repository Awards for 2010, in the development of a suite of learning resources for undergraduate healthcare students, focused on infection prevention and control measures. We produced a video-based interactive online learning package with specific focus on standard precautions. It comprised evidence based, clinical work practices and measures which when implemented would serve to minimize, prevent and control the transmission of infectious agents in healthcare settings. Of these measures and practices I was particularly interested in hand hygiene.
and decided to pursue further study on the topic. Hence began my PhD degree trajectory.

Hand hygiene is a standard precaution, that, when employed by healthcare workers, can prevent the transmission of healthcare-associated infections. Surprisingly, while considerable research has been conducted internationally, a hand hygiene literature search yielded little research conducted in Ireland and there was a dearth of information relating to hand hygiene practices among healthcare workers. This was despite a recommendation from the World Health Organisation (2009) that, as part of a multi-modal hand hygiene implementation strategy, the monitoring of perceptions, knowledge and practices among healthcare workers was essential. Following extensive engagement with the literature I committed in earnest to this field of study for my doctoral studies.

My PhD journey began with the structured aspect of the programme. Two years of theoretical input was useful and relevant and enabled the development of strong foundational skills and the consideration of various methodological approaches to my field of interest. The early allocation of a supervisor, and later of a co-supervisor, enabled early, focused discussions on research questions, objectives, design, and methods. The evolution of the study during this time was fluid and a number of options were considered before finally settling on the approach taken.

The structured aspect was followed by four years conducting the research and writing the thesis. This was supported by a yearly review of progress vis-à-vis an annual progression review meeting with a review panel of experts. I successfully presented and defended my work at these meetings and progressed. While preparations were
time-consuming, the review meetings provided focus, structure and encouragement, at timely junctures.

Supervisory meetings were frequent and regular throughout the research trajectory. Regular email and phone contact with supervisors was also generously provided. The accessibility of my supervisors throughout the programme for consultation, advice and assistance was remarkable and enabled the development of a productive working relationship, focused on outputs and achievements, essential to the completion of an article-based PhD thesis.

While I was the primary author of the papers included in this thesis, the generous and focused input of my supervisors to these papers enhanced the manuscripts and undoubtedly contributed greatly to their final acceptance. The preparation of manuscripts for submission to editors and peer review was challenging at times. Timely advice and feedback from my supervisors ensured that targets were met and submission and re-submission deadlines were adhered to. The positive encouragement of my primary supervisor, whose expertise ensured that all stumbling blocks could be readily overcome, resulted in the publication of four research papers, three other publications and the ongoing development of my academic writing skills.
References


CHAPTER 2

Hand hygiene-related clinical trials reported since 2010: a systematic review.

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Title
Hand hygiene-related clinical trials reported since 2010: a systematic review.

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Abstract

Background

Considerable emphasis is presently being placed on reducing healthcare-associated infection through improving hand hygiene compliance amongst healthcare professionals. Concurrently, there is increasing discussion in the lay media of perceived poor hand hygiene compliance among healthcare staff.

Aim

The aim of this review is to report the outcomes of a systematic search for peer-reviewed, published studies, in particular clinical trials that focus on hand hygiene compliance among healthcare professionals.

Methods

Literature published between December 2009, after publication of the World Health Organisation (WHO) hand hygiene guidelines, and February 2014, which is indexed in PubMed and the Cumulative Index to Nursing and Allied Health Literature (Cinahl), on the topic of hand hygiene compliance, was searched and articles within the scope of this review were appraised. Search keywords used included: hand hygiene, hand washing and compliance. Limits to the search restricted the results to clinical trials only. Following review of titles and abstracts to identify publications relevant to the scope, 41 papers on hand hygiene compliance were retrieved in Pubmed and 16 papers in Cinahl. When inclusion and exclusion criteria were applied and duplicates were removed, the number was reduced to 24. After these papers were read in full, a further
8 were excluded due to methodological considerations; for example: study protocols, surveys and cost analysis studies did not meet the inclusion criteria. The final number of papers included in this review is 16.

**Findings**

A lack of homogeneity in research design made comparative analysis difficult to achieve. Nonetheless, findings emerged from analysis of the reported outcomes. The majority of studies were conducted in the US and Europe. The intensive care unit emerges as the pre-dominant focus of studies followed by care of the elderly facilities. The category of healthcare worker most often the focus of the research is the nurse, followed by the healthcare assistant and the doctor respectively. The unit of analysis reported for hand hygiene compliance was ‘hand hygiene opportunity’, in line with WHO guidelines, with large variation in respect of the number of opportunities recorded (WHO 2009).

**Conclusion**

Published clinical trials demonstrate that moderate improvements to hand hygiene compliance rates can be achieved when organisations adopt a multimodal approach, in line with recommended World Health Organisation guiding policy. Four studies adopted the ‘My Five Moments for Hand Hygiene’ framework, as set out in the WHO guidelines, while other papers focused on unique multimodal strategies of varying design (WHO 2009). The authors conclude that adopting a multimodal approach to hand hygiene improvement intervention strategies, whether guided by the WHO
framework or another tested multimodal framework results in moderate improvements in hand hygiene compliance. Recommendations for further research are made.
Key Words
Hand hygiene, compliance, multimodal approach, hand hygiene opportunity.
Introduction

Healthcare-associated infections (HCAI) also termed nosocomial infections are complications of healthcare that lead to increased patient morbidity and mortality (WHO 2009). HCAI lead to increased healthcare costs for patients, their insurers and hospitals, due to unanticipated duration of hospital stay and associated treatment. There is also a psychological burden placed on patients, their carers and their families, in addition to opportunity costs arising from patients and their carers’ inability to work, attend school, etc., while hospital capacity impacts the efficiency of healthcare (WHO 2011, Allegranzi et al. 2011).

In the US, it is estimated that HCAI affects approximately 2 million patients annually, of whom approximately 90,000 patients die and the overall annual cost of HCAI in the US has been estimated to range from US$ 28 billion to 45 billion (Stone 2009). Similarly, in the European Union, the European Centre for Disease Prevention and Control (ECDC) advise that approximately 4.1 million patients in acute-care facilities acquire a HCAI annually, with the number of deaths directly related to HCAI estimated to be at least 37,000 (ECDC 2013).

Monitoring of the incidence of outbreaks and individual cases have shown that, for instance, the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) is stabilizing and decreasing in some European countries; other HCAI are increasing (e.g., *Escherichia coli* and *Klebsiella pneumonia*) (ECDC 2013b). Such monitoring, including pan-European surveillance, has been expanded to encompass long-term care facilities (LTCF) in addition to hospitals (ECDC 2014). As a result, more comprehensive data is emerging across Europe and in Ireland, where a recent national median HCAI prevalence of 4.2% in long-term care facilities was reported (Health
Protection Surveillance Centre (HPSC) 2014). This is comparable with a national overall HCAI prevalence of 5.2% in acute-care facilities (HPSC 2012).

HCAI, however, are preventable and hand hygiene is widely regarded as the most effective preventative measure for healthcare workers (Cole 2009, Pittet et al. 2000). Naikoba and Hayward conducted a systematic literature review to establish the effectiveness of interventions aimed at improving hand hygiene compliance (Naikoba and Hayward 2001). On reviewing 21 studies, they concluded that a multifaceted approach to hand hygiene which includes education, reminders and feedback was most effective in increasing hand hygiene compliance and improving rates of hospital-acquired infections (Naikoba and Hayward 2001). In the intervening years, this multifaceted or multimodal approach to hand hygiene appears to have been adopted and advocated in the hand hygiene policies and campaigns of multiple countries; for example, by the US (Ellingson et al. 2014), Canada (Ontario Agency for Health Protection and Promotion 2014), the UK (Loveday et al. 2014) and Ireland (Royal College of Physicians Ireland and Health Service Executive 2015).

A number of subsequent reviews have superseded that of Naikoba and Hayward, which is limited to examining the literature between 1986 and 1999 (Naikoba and Hayward 2001). For example, Erasmus et al. (2010) systematically reviewed studies on compliance with hand hygiene guidelines in hospital care, assessing the prevalence and correlates of compliance and non-compliance. Those factors included occupation, knowledge, attitude, time of day, patient’s risk of infection, feedback and effects of varying hand hygiene solutions. This was the first review to make a distinction in its quantifications between compliance both before and after patient contact, but it is perhaps limited, due to the inclusion of studies published before the World Health Organisation guidelines on hand hygiene (WHO 2009).
Another notable review is a Cochrane Review by Gould *et al.* (2010) who evaluated 39 of the 96 studies reviewed by Erasmus *et al.* (2010) while focusing on interventions to improve hand hygiene compliance in patient care. The authors concluded that interventions should focus on the urgent need to offer solution-focused guidance in this field of practice.

Huis *et al.* (2012) conducted a systematic review of hand hygiene improvement strategies from a behaviourist approach. In order to provide conceptual clarity, they explored frequently used hand hygiene improvement strategies and related determinants of behaviour that included: knowledge; awareness; action control; facilitation; social influence; attitude; self-efficacy and intention (Huis *et al.* 2012). The authors found that those studies using a combination of various determinants of behavioural change (including social influence, self-efficacy, attitude and intention) may result in better outcomes (Huis *et al.* 2012).

A common discussion point in the publications by Naikoba and Hayward (2001), Erasmus *et al.* (2010), Gould *et al.* (2010) and Huis *et al.* (2012) relates to the methodological weaknesses in many of the studies reviewed. The publication of the WHO guidelines on hand hygiene has occurred since the last review was published (WHO 2009). Therefore, we believe that an updated collation of the literature is warranted, with a focus on clinical trials with robust methodological design published in the last five years.
Methods

Scope

Literature published between December 2009 and February 2014, which is indexed in PubMed and Cinahl, on the topic of hand hygiene compliance among healthcare professionals.

Systematic approach to finding appropriate literature

Searches were performed in PubMed and Cinahl in February 2014 for full articles published on the topic of hand hygiene compliance. The study methodology leading to publication within the scope of this review was clinical trials. Papers that were not published in English were excluded. Only full original research papers and reviews were included, that is: editorial opinions, letters to the editor and other “opinion” based publications were not included.

Search methodology

Title and abstract fields were searched for publications containing the words: hand hygiene, hand washing, compliance. Boolean operators were used to combine search components. For example, the PubMed search was: (hand hygiene) OR (hand washing) AND compliance (hand hygiene [Title/Abstract]) AND compliance [Title/Abstract]. The Cinahl search was: (hand hygiene) OR (hand washing) AND compliance. The combined yield was 57 articles (Figure 1). This number is relatively low but may be attributable to limiting the search to clinical trials only.
Critical appraisal and synthesis

Two reviewers (LK and CD) independently reviewed the search results, titles and abstracts. Consensus on eligibility for inclusion was agreed and where discrepancies arose these were resolved by discussion. These potentially eligible articles were retrieved and read resulting in the final selection of eligible studies. Those articles retrieved by the search but deemed ineligible for further analysis, as they did not report on hand hygiene compliance, can be found in table I.

Studies that met the following criteria were included: empirical studies conducted in study settings that included acute, non-acute, long-term care of the elderly and primary care; samples from countries with developed and developing economies; compliance with hand hygiene measured either by observation or electronic counters; results of hand hygiene compliance rates published; published in the English language. Studies set in domestic or school settings were excluded. One study where compliance was measured by self-reporting was excluded.

Of the 57 papers identified by the search 16 studies were deemed eligible. Data were extracted by examining study characteristics using the following headings; country of origin, study objectives, study setting, target population, study design, interventions and finally study outcomes. A lack of homogeneity of the studies selected was identified on extraction of study characteristics and so formal meta-analysis was not possible, however further analysis was achieved by manually collating data and compiling results in tables.
Results

Geographical location

Hand hygiene compliance research is of global interest and results of this review reflect the diversity of countries conducting research into this important patient safety agenda issue. Of the 16 reported studies, the majority were carried out in Europe and the US. Six of the studies were carried out in European Union Member States, of these two in the Netherlands (Huis et al. 2013, van den Hoogen et al. 2011), two in France (Chami et al. 2012, Hitoto et al. 2011), one in Spain (Martin-Madrazo et al. 2012), and one in the UK (Fuller et al. 2012). The five studies conducted in the US were across various States, in Washington (Henderson et al. 2012), Virginia (Bearman et al. 2012), New Hampshire (Koff et al. 2011), Ohio (Linam et al. 2011), and Texas (Bingham et al. 2010). Two studies were conducted in limited-resource countries, one in Brazil (Marra et al. 2010) and the other was across 19 limited-resource countries in Latin America, South America, Asia, the Middle East and Europe (Rosenthal et al. 2013). One Australian study was reviewed (Marshall et al. 2013), while both studies in Asia were conducted in Hong Kong (Ho et al. 2012, Yeung et al. 2011). Both studies in Hong Kong were conducted in long-term care of the elderly facilities.

Clinical setting

Studies were conducted in a variety of clinical settings, some across multiple clinical settings and indeed across multiple geographical locations, leading to a total of 299 individual clinical settings where studies were conducted (Table II). Intensive care unit (ICU) settings were most popular, accounting for the largest number of settings within
which studies were conducted (n=135). This included adult, step-down, paediatric and neonatal ICUs. Care of the elderly settings accounted for the second most popular clinical setting (n=93) and this included acute and long-term care of the elderly clinical settings. Ward settings (n=59) included medical, surgical, paediatric and burns wards. Eleven primary healthcare centres were included (n=11), and finally one study was performed across the whole organisation (n=1).

It is evident from table II that some studies were conducted across multiple clinical settings, for example Huis et al. (2013) studied the intensive care unit setting, medical, surgical and paediatric wards. Similarly, Fuller et al. (2012) studied the adult intensive care unit setting as well as acute care of the elderly wards. It is also evident that some studies were conducted across multiple geographical sites for example Martin-Madrazo et al. (2012) used 11 primary healthcare centres, while Chami et al. (2012) examined 47 long-term care of the elderly facilities. It is unknown exactly what clinical settings or how many clinical settings within the organisation were involved in the Henderson et al. (2012) study, as the focus is on the organisation as a whole.

The presentation of data in the reported studies relating to the categories of healthcare workers (HCW) participating in the studies lacks uniformity and so analysis is challenging. Added to this challenge is the lack of agreed global healthcare worker job titles and professional roles. Job titles like healthcare assistant, health worker, personal care assistant, auxiliary staff, ancillary staff and allied personnel undoubtedly have some degree of role similarity, but prove difficult to report in a uniform and consistent way. Another example of this challenge is the role of respiratory therapist (RT), which is common in the US, but not in Europe. Of the 16 studies reviewed just six quantified the total number of participating healthcare workers, with five of these six identifying the various different healthcare worker categories participating (Table III).
Nurses, doctors and healthcare assistants were the categories of healthcare workers most involved in hand hygiene compliance studies. The largest participant sample size (n=4,221) is attributed to Linam et al. (2011). This sample represents predominately nurses, doctors and healthcare assistants or care attendants, but also included were a broad range of other healthcare workers including respiratory therapists, physical therapists, occupational therapists, speech pathologists, dieticians, child life specialists, radiology technicians and chaplains. Huis et al. (2013) recruited 2,733 participants and all of these were nurses. The largest group in the Ho et al. (2012) study were healthcare assistants (health workers and personal-care assistants) (n=499) followed by nurses (n=130) and others namely physiotherapists and occupational therapists (n=39). No doctors participated in that study.

Although the sample size is smaller (n=198) in a study by Martin-Madrazo et al. (2012), a wide range of healthcare professionals took part including nurses (n=85) and doctors (n=91), of whom 22 were paediatricians and 69 were general practitioners, and others (n=22) including midwives, care assistants, dental hygienists and odontostomatologists. Category of healthcare worker is a variable not addressed by Bearman et al. (2012) although we know that 32 healthcare workers enrolled in the study and 25 completed the study. However, once again it is challenging to extract any further quantifiable information on the breakdown of participants by profession.

Other studies provided information on the hand hygiene opportunities observed based on the category of the healthcare worker. In those cases, the categorisation of healthcare worker is known but the numbers are not. More specifically, Rosenthal et al. (2013) recruited nurses, doctors and ancillary staff and although data are provided relating to the numbers of hand hygiene opportunities observed in each category of healthcare worker, no data are provided on actual numbers of participants. Despite
this, univariate analysis of variables associated with poor hand hygiene was performed and the independent variable ‘profession of HCW’ was analysed, thus indicating the importance of this variable to the study results (Rosenthal et al. 2013).

The primary outcomes of the study by Koff et al. (2011) were individual and group hourly electronically recorded and observed hand hygiene compliance rates. Nurses, doctors and respiratory therapists were recruited but exact numbers of each were not reported. Similarly, Marra et al. (2010) refer to providing positive deviance training to all healthcare workers in the step-down unit including nurses, doctors, physical therapists, speech pathologists and nutritionists, yet the numbers of participants is not provided. Positive deviance is defined as “the observation that in every community there are certain individuals or groups whose uncommon behaviours and strategies enable them to find better solutions to problems than their peers, while having access to the same resources and facing similar or worse challenges” (Marra et al. 2010). Hitoto et al. (2011) make little reference to categories of healthcare workers except in reference to opportunities for hand hygiene observed. Of the 1,326 HHO observed, 88% concerned nurses and nurse assistants. Elsewhere a reference is made to medical staff so it may be reasonable to assume that doctors were also involved.

**Hand hygiene opportunities**

In line with WHO guidelines, the unit of analysis reported was hand hygiene opportunity (WHO 2009). A hand hygiene opportunity (HHO) is a moment in time when hand hygiene should be carried out (WHO 2009). These opportunities were observed either by direct observation of participants or, in the case of two studies, by electronic recording devices (Koff et al. 2011, Marra et al. 2010). Ten of the sixteen studies provided quantified data on these opportunities and this data, alongside the
settings within which observations occurred, is provided in table IV. There was large variation in respect of the number of observations recorded in the various studies. In total, 719,876 HHOs were recorded, ranging from 1,173 HHOs in an adult ICU setting to 506,111 in two step-down ICU settings, the latter being recorded by electronic devices worn by the participants (Marra et al. 2010). The mean figure for HHO was 65,443. While most studies provide data on the HHO observed in each clinical setting, Huis et al. (2013) provided an overall number and did not provide a breakdown of HHO data by clinical site. One study provided an approximation of HHOs per month, enabling a calculation to be made based on the duration of the study (Henderson et al. 2012). Also five studies did not provide any HHO data (Fuller et al. 2012, Martin-Madrazo et al. 2012, Chami et al. 2012, Koff et al. 2011, Bingham et al. 2010).

**Hand hygiene compliance interventions**

The interventions reported in these studies were predominately multimodal focusing on more than one hand hygiene intervention, with the exception of three studies (Table V) (Bearman et al. 2012, Fuller et al. 2012, Bingham et al. 2010). Two of these studies focused on the same single intervention i.e. education (Bearman et al. 2012, Bingham et al. 2010), while the other focused on performance feedback (Fuller et al. 2012). In two studies, just two interventions are described, with both focusing on the same two interventions i.e. education and performance feedback (Marshall et al. 2013, Koff et al. 2011).

Bingham et al. (2010) implemented a single hand hygiene intervention, whereby hand hygiene education was implemented in a pre-test post-test design focused on reducing the probability of ventilator-associated pneumonia. Other interventions included oral care and head-of-bed elevation and are not relevant to this review (Bingham et al.
Bearman *et al.* (2012) also focused on hand hygiene education. They conducted a four month randomised blinded prospective crossover trail and provided hand hygiene education as part of this larger study to determine the effectiveness of antimicrobial scrubs on hand and clothing bacterial burden (Bearman *et al.* 2012). Both of the aforementioned studies included hand hygiene reporting as part of studies that predominantly focused on achieving other outcomes. The third study with a single intervention focused on personalised written feedback in the form of an action plan in attempting to achieve improved hand hygiene compliance (Fuller *et al.* 2012).

Marshall *et al.* (2013) and Koff *et al.* (2011) both described two interventions. Both combined education on hand hygiene and performance feedback as the foci of their interventions. The former introduced hand hygiene compliance as one of many measures taken to strengthen a study that focused on reducing MRSA acquisition and provided regular compliance monitoring feedback to participants (Marshall *et al.* 2013). While the latter designed a before and after study to evaluate the impact of a focused hand hygiene programme on the incidence of catheter related bloodstream infections (CRBI) and ventilator-associated pneumonias (VAP) (Koff *et al.* 2011). The programme involved education, performance feedback and the participants wore an electronic hand hygiene device to record compliance.

discussion, surveillance cultures feedback, education using video-based resources and reminders using posters and cartoons displayed prominently (van den Hoogen et al. 2011). In addition to focusing on hand hygiene education and the use of reminder materials, e.g. posters, others also addressed the issue of alcohol-based hand rub (ABHR) availability, supply and/or consumption (Martin-Madrazo et al. 2012, Chami et al. 2012, Yeung et al. 2011).

Four studies addressed the issue of leadership and the need for strong leadership in promoting a culture of compliance with evidence based hand hygiene practices (Huis et al. 2013, Rosenthal et al. 2013, Linam et al. 2011, Marra et al. 2010). Each describes different leadership strategies adopted in order to pursue the goal of improved compliance with hand hygiene practices. Rosenthal et al. (2013) address leadership by ensuring that hospital administrators of participating hospitals agreed and committed to the study, supported the need for additional resources and attended feedback meetings. Marra et al. (2010) adopted a positive deviance strategy for improving hand hygiene compliance, where the leadership was enhanced by healthcare worker peers (called positive deviants) who acted as role models for best practice. Both Linam et al. (2011) and Huis et al. (2013) address leadership in conjunction with a team approach.

Described as a quality improvement initiative, Linam et al. (2011) incorporated a leadership and team approach to developing and testing a multimodal intervention approach to improving hand hygiene compliance among healthcare workers. Leadership teams were established comprising of frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm (Linam et al. 2011). In a cluster randomised trial, Huis et al. (2013) also addressed social influence in groups by
adopting a team and leaders-directed strategy which was tested alongside an evidence-based strategy that excluded a team and leaders approach (Huis et al. 2013). Unlike Linam et al. (2011) who developed their own conceptual model, Huis et al. (2013) draw on existing theories of leadership (Ovretveit 2004), team effectiveness (Shortell et al. 2004, West 1990), social influence theory (Mittman et al. 1992) and social learning theory (Bandura 1986), and base the strategy on gaining the active commitment of ward management, settings targets within teams and role-modelling by leaders at ward level (Huis et al. 2013).

**Hand hygiene compliance outcomes**

Hand hygiene compliance was measured either by direct observation or by electronic recording. The observation was based on whether or not the HCW complied with best-practice relating to a hand hygiene opportunity (HHO). Most studies reported compliance as a percentage rate and identified a baseline before the study. Ten studies provide data on compliance, of which eight provide both baseline data and post-intervention data (Table VI). The baseline compliance rate varied considerably with some organisations starting from a very low baseline, e.g. 8.1% (Martin-Madrazo et al. 2012) and 20-23% (Huis et al. 2013).

Eight studies identified baseline compliance rates in either one or two intervention arms and in a control arm. This allows a mean baseline (before interventions) compliance rate respective to each study to be calculated. The mean baseline (before interventions) compliance rates varied considerably in the eight studies that provided baseline compliance rate data, ranging from the lowest at 8.1% (Martin-Madrazo et al. 2012) to the highest at 69.5% (Linam et al. 2011). The overall mean baseline
compliance rate before interventions, when all studies are combined, is calculated at 34.1%.

Overall compliance rates improved as a result of the interventions with some studies showing greater and more sustained improvements than others. Yeung et al. (2011) reported only slight improvement, from 25.8% to 33.3%. Moderate to significant improvements were also reported. Martin-Madrazo et al. (2012) reported that the intervention group increased their compliance by 21.6% compared with an improvement of 3.6% in the control group at six months. Koff et al. (2011) reported significant improvements from a mean of 53% during the control period to a mean of 75% during the study period. Similarly, Rosenthal et al. (2013) reported that overall compliance increased from 48.4% to 71.4%. Van den Hoogen et al. (2011) described an improvement in compliance from 23% in the baseline assessment to 50% in the second assessment.

The calculated mean compliance rates in the intervention groups after intervention allow an overall mean improved compliance rate to be calculated in the intervention groups at 56.98%. This suggests an improvement of 22.88% from the calculated mean baseline compliance rate of 34.1%.
Discussion

This paper describes clinical trials conducted since 2010 that report hand hygiene compliance in the context of reducing healthcare associated infections. Previously, Naikoba and Hayward (2001), Erasmus et al. (2010), Gould et al. (2010) and Huis et al. (2012) remarked on the methodological weaknesses in many studies reviewed. This paper reviews an updated collation of the literature with a focus on clinical trials with robust methodological design published in the last five years.

For clarification purposes, it is noted that the hand hygiene data reported in many of the studies reviewed, is reported as part of a larger study. Examples of other outcomes examined include HCAI rates (Chami et al. 2012, Henderson et al. 2012, Koff et al. 2011, Bingham et al. 2010), the impact of screening (Hitoto et al. 2011) and the impact of active surveillance and contact precautions (Marshall et al. 2013).

Geographical location

Healthcare-associated infections are a global patient safety concern. The geographical location of the studies reported suggests that hand hygiene compliance research is conducted predominately in Europe and the United States. We identified only two studies from Asia, two from limited resource countries and one from Australia, suggesting that further studies are needed in these locations.

Clinical setting

The clinical setting in which hand hygiene compliance is monitored and reported is examined in this review and the results provide some interesting insight into the clinical settings selected. From the available data it emerges that the intensive care unit
is the predominant focus and when step-down, neonatal and paediatric ICUs are included, a total of 135 ICU settings were the foci of attention. Care of the elderly facilities account for 93 study settings, while the other settings combined include, medical, surgical, paediatric and burns wards account for 59 settings. Finally, one study examined 11 primary healthcare settings (Martin-Madrazo et al. 2012) and one study provided no information on the clinical settings within the organisation studied (Henderson et al. 2012).

Acute-care settings, in particular intensive care units, have been the focus of research studies for many years and justifiably so given the prevalence of HCAI in intensive care settings. The most recent ECDC point prevalence survey which examines the prevalence of HCAI in 1000 European hospitals in 30 counties is informative in this regard ECDC 2013a). The prevalence of HCAI was the highest among patients admitted to intensive care units, where 19.5% of patients had at least one HCAI. The ECDC estimates that approximately 5.7% of patients, or one in 18 patients, or 80,000 patients in European hospitals have a HCAI on any given day. The survey confirms that HCAI remain a major public health and patient safety issue across acute-care facilities in Europe (ECDC 2013a).

However, the expansion of the research in recent years to encompass care of the elderly facilities is welcome. The inclusion of acute-care of the elderly settings and long-term care of the elderly settings (Chami et al. 2012, Fuller et al. 2012, Ho et al. 2012, Yeung et al. 2011) reported in this review, reflect the aging population and recognise the importance of conducting robust research into hand hygiene behaviours in these settings. Data from the ECDC demonstrates the importance of surveillance in long-term care facilities (LTCF). The point prevalence survey of HCAI in European LTCF suggests that the crude prevalence of residents with at least one HCAI in 2013 was
3.4% (ECDC 2014). One thousand one hundred and eighty one long-term care facilities (LTCFs) from 17 European countries participated in the survey (ECDC 2014).

It is noteworthy that only one study included in this review was conducted in a primary health care setting despite the important of hand hygiene in this setting (Martin-Madrazo et al. 2012). Eleven healthcare settings in Madrid participated in the study. Data highlights that the overall baseline compliance with hand hygiene procedures was very low at 8.1%, further supporting the argument for conducting research in this setting. Hand hygiene is important in primary care settings. The move towards more complex and invasive procedures in primary care, the earlier discharge of patients from acute care settings and the advancements in home care, all suggest that hand hygiene compliance and further research is equally as important in primary care as in acute care settings (Martin-Madrazo et al. 2012). International and national guidelines published in more recent years reflect the increasing awareness of the need to be equally vigilant in primary care settings (WHO 2012, HPSC 2013). The work of Martin-Madrazo and colleagues demonstrates that significant improvements in practice can be achieved in primary care settings when multimodal hand hygiene improvement strategies are implemented.

**Healthcare worker category**

Compliance with hand hygiene is of equal importance among all healthcare workers in order to minimise the risk to patients of acquiring a HCAI. It is important to reflect the categories of healthcare workers when reporting studies as it adds significance to the results, allowing for greater impact among the professional groups. Some of the studies in this review may be criticised for not including reference to the category of
healthcare worker involved (Marshall et al. 2013, Bearman et al. 2012). Others provide categories but no sample sizes. It is noteworthy that in some cases hand hygiene is reported as part of a larger study where other determinants of outcomes are included.

As nurses, in most cases, form the largest group of health professionals, it is not surprising that the nursing profession is well represented in the studies reviewed and account for the large sample sizes (Wilson et al. 2012). Therefore, in the study with the largest number of study participants of 4,221 it is not unexpected that nurses formed the largest sample group (n=2,192), with healthcare assistants (n=971), doctors (n=597) and others (n=461) respectively (Linam et al. 2011). One study exclusively focused on the nursing profession (n=2,733) and there is no doubt that results, while informative to the nursing profession, might also be of relevance to other professional groups (Huis et al. 2013). Other studies, with smaller sample sizes than those referred to above, include more than one category of healthcare worker allowing the relevant results to be interpreted by each distinctive professional group (Bearman et al. 2012, Martin-Madrazo et al. 2012, Ho et al. 2012, Linam et al. 2011, Yeung et al. 2011).

**Hand hygiene opportunities**

Just two of the included studies report results relating to hand hygiene technique (Huis et al. 2013, van den Hoogen et al. 2011). However, these are limited to some, but not all, aspects of correct technique, for example, wearing jewellery or using an insufficient amount of alcohol-based hand rub (ABHR). The technique advocated by the WHO is complex and multifaceted. It is very likely that many of the aspects of the WHO promoted technique and their correct usage contributes to prevention of nosocomial infections. We considered this topic worthy of study in its own right and
too large an influencer of behaviour to be included as only one component of this review.

While the recognised unit of analysis is ‘hand hygiene opportunities’, as described previously, there were some deviations from this. Two studies recorded data using the latest cutting-edge technologies. Electronic hand hygiene counters, worn by participants in one study and placed at alcohol based hand rub stations in the other, appear to work by monitoring the dispensing of the ABHR from the device as opposed to monitoring the opportunity for hand hygiene (Koff et al. 2011, Marra et al. 2010). Currently ‘direct participant observation’ is considered the gold standard in measuring hand hygiene compliance (Sax et al. 2009). However, this can be time and resource intensive. Furthermore, when interpreting findings the Hawthorne effect and the potential for bias must be considered, when data is collected by direct observation (Allegranzi et al. 2009). Koff et al. (2011) report that while novel at the time of the study, the electronic device was a reliable system in monitoring hand hygiene compliance. They also credit the same device with contributing to the significant improvements in hand hygiene compliance reported, from a mean of 53% during the control period to a mean of 75% during the study period. There can be no doubt that the design of electronic devices will be developed further in the future and become more visible in this field of practice as the technology advances. Consequently, continued research is required to examine the effectiveness of electronic counters and their application to this field of research.

Whereas some studies explicitly report using the ‘my five moments for hand hygiene’ framework for measurement of HHOs, based on the WHO hand hygiene guidelines, not all studies report using this approach (Huis et al. 2013, Martin-Madrazo et al. 2012, Hitoto et al. 2011, Linam et al. 2011).
It is important to note, that while a number of studies do not explicitly address the WHO multimodal strategy incorporating the ‘my five moments for hand hygiene’ framework, many adopt a multimodal approach using various unique behavioural approaches. Fuller et al. (2012) adopted a ‘feedback intervention’ approach, while Rosenthal et al. (2013) implemented and evaluated the impact of a multidimensional hand hygiene approach designed by the International Nosocomial Infection Control Consortium (INICC). Marra et al. (2010) adopted a ‘positive deviance strategy’ as an alternative way to produce change, while Linam et al. (2011) approached their research design from a quality improvement stance. Van den Hoogen et al. (2011) also reported local hand hygiene protocols and procedures upon which the study design is framed.

In a number of studies it was not possible to definitively determine whether or not the ‘my five moments for hand hygiene’ framework was used, as explicit information was not provided on the approach adopted (Marshall et al. 2013, Henderson et al. 2012, Bearman et al. 2012, Bingham et al. 2010). This suggests that standardisation and conformity to hand hygiene practices and measures as outlined by the WHO guidelines has not been uniformly adopted at the time of this review. Clearly, the influence of the WHO guidelines on hand hygiene and interpretation of the impact of the guidelines is hampered by the low number of studies (n=4) explicitly reporting its adoption in research design.
Hand hygiene compliance interventions

Multimodal strategies have emerged as the best approach to hand hygiene practices, as advocated by the WHO (WHO 2009). Larson and colleagues explicitly referred to a multidimensional approach to hand hygiene in a study published in the US, and since then increasing evidence supports this approach (Larson et al. 1997). A multimodal approach involves using a variety of strategies aimed at addressing barriers to improving compliance with good hand hygiene practices and achieving behavioural change (Allegranzi et al. 2009). Although evidence supports the implementation of multimodal strategies and research substantiates the efficacy of the multimodal approaches, there are challenges associated with implementing this approach (Johnson et al. 2014, Pincock et al. 2012, Sax et al. 2009, Allegranzi et al. 2009). While the WHO advocate this approach the interpretation and implementation is varied across sites, leading to challenges of meta-analysis and comparative review. Results of this review demonstrate that researchers are focusing on multimodal approaches with ten of the 16 studies adopting this approach by using between three and six interventions. However, the variation of the approaches taken to, for example, one component of the multimodal approach i.e. education, are numerous. In implementing an education strategy that encompasses written materials a wide range of aids are used, varying from teaching and practical demonstrations to leaflets and knowledge quizzes to posters and cartoons, to video-based resources and websites (Huis et al. 2013, Rosenthal et al. 2013, Martin-Madrazo et al. 2012, Ho et al. 2012, van den Hoogen et al. 2011, Marra et al. 2010). With such variability of interventions establishing the link to improved outcomes can be challenging (Backman et al. 2008).
**Hand hygiene compliance outcomes**

Analysis of the outcomes of the eight studies that provide both baseline hand hygiene compliance data and post-intervention compliance data allow for calculation of an overall mean baseline compliance rate of 34.1% before intervention.

All eight studies showed improved compliance following intervention. Some showed slight improvement of 7.5% net effect, whereas others reported moderate to significant improvement of 22%, 23%, 27%, 28% and 30.6% (Huis et al. 2013, Rosenthal et al. 2013, Ho et al. 2012, Yeung et al. 2011, van den Hoogen et al. 2011, Koff et al. 2011, Linam et al. 2011). Calculation of an overall mean compliance rate after intervention suggests a mean post-intervention compliance rate of 56.98% in the intervention group. Based on these eight studies the net improvement calculated is 23%.

These reported improvements in outcomes are welcome. However, notable in this review was the duration of the studies. Not all studies provide details of the duration of the control and intervention period. Of those that did, most studies were of less than one year duration with the control or baseline period lasting 3 months and the intervention period lasting 3 months (Yeung et al. 2011, Marra et al. 2010). Koff et al. (2011) report a two-year before and after study design. Two longitudinal studies are reported (Fuller et al. 2012, Rosenthal et al. 2013). Rosenthal et al. (2013) conducted the study over a seven year period while Fuller et al. (2012) conducted their study over a three year period. In order to determine sustained improvement in hand hygiene practices among healthcare workers longitudinal studies provide an ideal research design to determine long term change in behaviour.
Conclusion

This review represents an updated collation of the literature with a focus on clinical trials with robust methodological design published in the last five years. Sixteen clinical trials are reviewed and some comparative analysis was possible. The paper found that of the 16 papers reviewed four research designs were explicitly guided by the ‘my five moments for hand hygiene’ framework, as set out in the WHO guidelines (WHO 2009). Others adopted locally designed multimodal approaches using various unique behavioural approaches and although there was a lack of uniformity in these approaches, positive outcome were achieved. This leads the authors to conclude that adopting a multimodal approach to hand hygiene improvement intervention strategies, whether guided by the WHO framework or another tested multimodal framework has been shown to achieve slight to moderate improvements in hand hygiene compliance.

Some especially pertinent areas for additional research might include knowledge, attitudes and awareness of future practitioners (e.g., medical and nursing students alongside allied health students and interns, healthcare facility managers, patients and their carers). Similarly, the adoption of technology-driven solutions for both delivery of ABHRs and monitoring of their use, and use of such data for analysis of patient and healthcare professional movements in the context of outbreaks may lead to enhanced compliance, or at least better understanding of the challenges involved.
References


Ontario Agency for Health Protection and Promotion (Public Health Ontario). (2014). *Provincial Infectious Diseases Advisory Committee. Best practices for hand*


Infection Control Consortium (INICC) multidimensional hand hygiene approach over 13 years in 51 cities of 19 limited-resource countries from Latin America, Asia, the Middle East, and Europe. *Infection Control & Hospital Epidemiology*, 34(4), 415-423.


Figure 1 Flowchart of selection methodology

Initial search

Pubmed search
Hand hygiene, hand washing, compliance
n=41

CINAHL search
Hand hygiene, hand washing, compliance
n=16

Scope

Following review of titles and abstracts to exclude those outside of the scope
n=21

Exclusions

Following exclusion of duplicates
n=24

Following review of full-text papers to exclude those outside of the scope
n=14

Following review of full-text papers to exclude those outside of the scope
n=2

Final publications

Final number of papers reviewed
n=16
Table I Summary of excluded studies

<table>
<thead>
<tr>
<th>Study Reference</th>
<th>Year</th>
<th>Study Focus</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeillo et al.</td>
<td>2012</td>
<td>Influenza in young adults</td>
<td>PubMed</td>
</tr>
<tr>
<td>Ashraf et al.</td>
<td>2010</td>
<td>Self-reporting hand hygiene compliance</td>
<td>PubMed</td>
</tr>
<tr>
<td>Bearman et al.</td>
<td>2010</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Birnbach et al.</td>
<td>2010</td>
<td>Hospital design</td>
<td>PubMed</td>
</tr>
<tr>
<td>Chittleborough et al.</td>
<td>2010</td>
<td>Primary school setting</td>
<td>Cinhahl</td>
</tr>
<tr>
<td>Chow et al.</td>
<td>2012</td>
<td>Comparing hand hygiene protocols</td>
<td>Cinhahl</td>
</tr>
<tr>
<td>Darawad et al.</td>
<td>2012</td>
<td>Hand hygiene survey</td>
<td>PubMed</td>
</tr>
<tr>
<td>Diaz-Agero et al.</td>
<td>2011</td>
<td>Pre-operative nosocomial infections</td>
<td>PubMed</td>
</tr>
<tr>
<td>Erasmus et al.</td>
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<td>Study protocol</td>
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<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Eveillard et al.</td>
<td>2012</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Fisher et al.</td>
<td>2013</td>
<td>Validating automated device</td>
<td>Cinhahl</td>
</tr>
<tr>
<td>Fuller et al.</td>
<td>2010</td>
<td>Assessment of blinding observers in RCT</td>
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<td>Fuller et al.</td>
<td>2011</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Harris et al.</td>
<td>2013</td>
<td>Glove and gown use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>2011</td>
<td>Study protocol</td>
<td>PubMed</td>
</tr>
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<td>Huis et al.</td>
<td>2013</td>
<td>Cost analysis</td>
<td>PubMed</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>2013</td>
<td>Process evaluation</td>
<td>PubMed</td>
</tr>
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<td>Kampf et al.</td>
<td>2010</td>
<td>Testing hand hygiene products</td>
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<td>Kutting et al.</td>
<td>2010</td>
<td>Skin protection</td>
<td>PubMed</td>
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<td>Larson et al.</td>
<td>2010</td>
<td>Domestic setting</td>
<td>PubMed</td>
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<tr>
<td>Nevo et al.</td>
<td>2010</td>
<td>Efficacy of hand hygiene triggers</td>
<td>PubMed</td>
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<td>Pandejpong et al.</td>
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<td>Pre-school setting</td>
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<td>Perez et al.</td>
<td>2012</td>
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<td>Reardon et al.</td>
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<td>Shaw et al.</td>
<td>2011</td>
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<td>Simmerman et al.</td>
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<td>Stebbins et al.</td>
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<td>Primary school setting</td>
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<td>Stuart et al.</td>
<td>2011</td>
<td>Prev. antimicrobial-resistant organisms</td>
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<td>Suchomel et al.</td>
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<td>Suess et al.</td>
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<td>PubMed</td>
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<tr>
<td>Williams et al.</td>
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<td>Skin irritation</td>
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<td>Yardley et al.</td>
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<td>Yawson and Hesse</td>
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<td>Hitoto <em>et al.</em></td>
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</tr>
<tr>
<td></td>
<td>2</td>
<td>Bingham <em>et al.</em></td>
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</tr>
<tr>
<td></td>
<td>1</td>
<td>Marshall <em>et al.</em></td>
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<td>Koff <em>et al.</em></td>
<td></td>
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<td>1</td>
<td>Bearman <em>et al.</em></td>
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<td>van den Hoogan <em>et al.</em></td>
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<td>Long term care of the elderly (n=71)</td>
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<td>Chami <em>et al.</em></td>
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<tr>
<td></td>
<td>18</td>
<td>Ho <em>et al.</em></td>
<td></td>
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<tr>
<td></td>
<td>6</td>
<td>Yeung <em>et al.</em></td>
<td></td>
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<tr>
<td></td>
<td>2</td>
<td>Linam <em>et al.</em></td>
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<td>Martin-Madrazo <em>et al.</em></td>
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<td>Whole Organisation (n=1)</td>
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<td><strong>Total</strong></td>
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Table III Healthcare Worker - Category and Sample Size

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<tr>
<th>Study Reference</th>
<th>Nurse (n=)</th>
<th>Physician (n=)</th>
<th>Healthcare Assistant (n=)</th>
<th>Other (n=)</th>
<th>Total Sample Size (n=)</th>
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<tr>
<td>Linam et al.</td>
<td>2,192</td>
<td>597</td>
<td>971</td>
<td>461</td>
<td>4,221</td>
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<td>Huis et al.</td>
<td>2,733</td>
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<td>0</td>
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<td>Ho et al. (missing data reported)</td>
<td>130</td>
<td>0</td>
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<td>810</td>
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<td>Martin-Madrazo et al.</td>
<td>85</td>
<td>91</td>
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<td>‘-’</td>
<td>‘-’</td>
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<td>Yes (n ‘-’)</td>
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<td>No</td>
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<td>‘-’</td>
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<td>Koff et al.</td>
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<td>Yes (n ‘-’)</td>
<td>No</td>
<td>Yes (n ‘-’)</td>
<td>‘-’</td>
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<tr>
<td>Hitoto et al.</td>
<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
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<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
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<tr>
<td>Chami et al.</td>
<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
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<td>No</td>
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<td>van den Hoogen et al.</td>
<td>Yes (n ‘-’)</td>
<td>Yes (n ‘-’)</td>
<td>No</td>
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Table IV Hand Hygiene Opportunities

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<th>Study Reference</th>
<th>Clinical Setting Type and Number (n=)</th>
<th>Number of Hand Hygiene Opportunities Observed or Recorded</th>
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<tbody>
<tr>
<td>Marra et al.</td>
<td>Step-down ICU (n=2)</td>
<td>506,111 * (ERD)</td>
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<tr>
<td>Rosenthal et al.</td>
<td>Adult ICU (n=80)</td>
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<td>Neonatal ICU (n=10)</td>
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<td>Paediatric ICU (n=9)</td>
<td></td>
</tr>
<tr>
<td>Henderson et al.</td>
<td>Academic Medical Centre (n=1)</td>
<td>*24,000</td>
</tr>
<tr>
<td>Ho et al.</td>
<td>Long-term Care Elderly (n=18)</td>
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<tr>
<td>Huis et al.</td>
<td>Medical/Surgical Wards (n=45)</td>
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<td>Adult ICU (n=13)</td>
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<td>Paediatric Wards (n=9)</td>
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<td>Paediatric Wards (n=2)</td>
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<td>Yeung et al.</td>
<td>Long-term Care Elderly (n=6)</td>
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<td>Neonatal ICU (n=1)</td>
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<td>Hitoto et al.</td>
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<td><strong>Mean</strong></td>
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Table V Hand Hygiene Compliance Interventions - Type and Number

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<tr>
<th>Study Reference</th>
<th>Education</th>
<th>Reminder Materials</th>
<th>Alcohol-based Hand Rub monitoring</th>
<th>Performance Feedback</th>
<th>Leadership and Management</th>
<th>Team Approach</th>
<th>Total Number of Interventions (n=)</th>
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<tbody>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Ho et al.</td>
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<tr>
<td>Marshall et al.</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
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<tr>
<td>Koff et al.</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
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<tr>
<td>Bingham et al.</td>
<td>Yes</td>
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<td>Bearman et al.</td>
<td>Yes</td>
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<td>Fuller et al.</td>
<td></td>
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</tbody>
</table>

No hand hygiene intervention reported by Hitoto et al.
Table VI Hand Hygiene Compliance Outcomes

<table>
<thead>
<tr>
<th>Study Reference</th>
<th>Reported Hand Hygiene Compliance Outcomes</th>
<th>Mean Compliance (%) Before Intervention</th>
<th>Mean Compliance (%) After Intervention (intervention group)</th>
<th>Net Effect on Intervention Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>van den Hoogen et al.</td>
<td>Increased significantly from 23% in the baseline assessment to 50% in second assessment</td>
<td>23%</td>
<td>50%</td>
<td>27%</td>
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<tr>
<td>Ho et al.</td>
<td>Increased from 27% to 60.6% and 22.2% to 48.6% in two intervention arms</td>
<td>24%</td>
<td>54.60%</td>
<td>30.60%</td>
</tr>
<tr>
<td>Yeung et al.</td>
<td>Increased slightly but significantly from 25.8% to 33.3% at 7 months post intervention</td>
<td>25.80%</td>
<td>33.30%</td>
<td>7.50%</td>
</tr>
<tr>
<td>Rosenthal et al.</td>
<td>Overall compliance increased from 48.4% to 71.4%</td>
<td>48.40%</td>
<td>71.40%</td>
<td>23%</td>
</tr>
<tr>
<td>Koff et al.</td>
<td>Significantly improved from 44-63% (mean 53%) during the control period to 67-90% (mean 75%) during the study period</td>
<td>53%</td>
<td>75%</td>
<td>22%</td>
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<tr>
<td>Linam et al.</td>
<td>Increased from 65%-91% and 74%-92% in the 2 units</td>
<td>69.50%</td>
<td>91.50%</td>
<td>22%</td>
</tr>
<tr>
<td>Martin-Madrazo et al.</td>
<td>Baseline compliance rate was 8.1%. HCW in the intervention group increased their compliance by 21.6% compared with control group</td>
<td>8.10%</td>
<td>30.56%</td>
<td>22.46%</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>Increased from baselines of 23% and 20% in the 2 intervention arms to 46% and 53% in the long run</td>
<td>21.5%</td>
<td>49.5%</td>
<td>28%</td>
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<td>Overall Mean Compliance Rates</td>
<td></td>
<td>34.1%</td>
<td>56.98%</td>
<td>22.88%</td>
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*(before interventions) (after interventions) (net improvement)*
CHAPTER 3

Survey of attitudes and practices of Irish nursing students towards hand hygiene, including hand rubbing with alcohol-based hand rub.

Published: Nurse Education Today (May 2017).

Title

Survey of attitudes and practices of Irish nursing students towards hand hygiene, including hand rubbing with alcohol-based hand rub.

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Abstract

Background

Hand hygiene is widely recognised as the most important measure a healthcare worker can take in preventing the spread of healthcare associated infections. As a member of the healthcare team, nursing students have direct patient contact during clinical practice; hence, good hand hygiene practice among nursing students is essential. Low to moderate levels of hand hygiene knowledge and poor attitudes and practices are reported among nursing students. However, less is known about their attitudes and practices of hand rubbing with ABHR, even though hand rubbing is the recommended optimum practice in most situations.

Aim

To explore attitudes and practices of hand hygiene, in particular hand rubbing with alcohol-based hand rub, among nursing students in Ireland.

Design

This survey employed a descriptive, self-report design using a questionnaire to gather data. It was administered electronically to all undergraduate nursing students (n=342) in the Department of Nursing and Midwifery at the University of Limerick, Ireland in March and April 2015.
Results

Response rate was 66%. Attitudes towards hand hygiene were generally positive. Compliance with hand hygiene after contact with body fluid was high (99.5%) and before a clean or aseptic procedure (98.5%). However, suboptimal practices emerged, before touching a patient (85%), after touching a patient (87%) and after touching patients’ surroundings (61%), with first year students more compliant than fourth year students. 16% of students were not aware of the clinical contraindications for using alcohol-based hand rub and 9% did not know when to use soap and water and when to use alcohol-based hand rub.

Conclusion

Educators and practitioners play an important role in ensuring that nursing students develop appropriate attitudes towards hand hygiene and engage in optimal hand rubbing practices. Raising awareness among nursing students of their responsibility in preventing the occurrence and in reducing the transmission of HCAI as an on-going endeavour is required, with the laudable aim of preventing complacency and ultimately improving patient outcomes.
Keywords
Nursing students, hand hygiene, alcohol-based hand rub, attitudes, self-report, behaviour, infection prevention and control, Ireland.

Highlights
- Nursing students are most compliant with hand hygiene after contact with body fluid.
- Nursing students are least compliant with hand hygiene after touching patients’ surroundings.
- One in six nursing students is not aware of the clinical contraindications for the use of alcohol-based hand rub.
- Barriers to using alcohol-based hand rub include, skin sensitivity, skin damage and time.
- Prevention of cross-infection, policy and personal protection all positively influence nursing students to use alcohol-based hand rub.

Funding
This study was supported by the Infection Prevention Society (IPS).
**Introduction**

Hundreds of millions of patients are affected by health care-associated infection (HCAI) worldwide each year (World Health Organization (WHO) 2013). HCAI represents a major public health concern, affecting up to 80,000 patients in European Hospitals on any given day (European Centre for Disease Control (ECDC) 2013). In Ireland, a national overall HCAI prevalence of 5.2% in acute care facilities is reported (Health Protection Surveillance Centre (HPSC) 2012) and patient complications arising from multi-drug resistant organisms (MDROs) are becoming more evident in the recent literature (O’Connor *et al.* 2015, WHO 2013). The ECDC (2013) estimates that 25,000 people die in the European Union annually from infections caused by MDROs with an associated cost of €1.5 billion. Hand hygiene is globally recognised as the most effective measure a healthcare worker can take to reduce the risk of cross-transmission of pathogens (HPSC 2012). It is simple, cost-effective and highly efficacious in controlling the spread of HCAI. Despite this, evidence suggests that compliance among healthcare workers is sub-optimal (Erasmus *et al.* 2010, Kingston *et al.* 2016).
Background

Hand hygiene is a general term that refers to any action of hand cleansing, of which there are many suited to various different clinical scenarios. However, one form of hand hygiene i.e. hand rubbing with alcohol-based hand rub (ABHR) is globally advocated as the optimum approach to hand hygiene in most situations. The WHO (2009) defines hand rubbing as “applying an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices” and this is the definition adopted by the University of Limerick and affiliated clinical practice sites where the study sample is practicing. Hand rubbing is the ‘gold standard’ technique or optimum approach to perform hand hygiene on all occasions, except those for which handwashing with soap and water is recommended, for example, when nursing patients with Clostridium difficile infections (WHO 2009) and both the university and affiliated clinical practice sites follow this recommendation. Hand rubbing is performed in isolation, as a standalone technique, and should not be combined with any other approach to hand hygiene.

Nursing students have direct patient contact during clinical placements and internships and, in fact, account for a sizable percentage of the healthcare personnel involved in patient care (Bargellini et al. 2014). Consequently, they are at risk of becoming mediators of pathogenic microorganisms or contracting a HCAI (Al-Khawaldeh et al. 2015). Yet, research on nursing students’ hand hygiene practices is limited, with less emphasis placed on investigating nursing students’ practices than those of nurses, due to their perceived position within the hospital hierarchy (Jeong and Kim 2016). Kingston et al. (2016) identified nurses and doctors as the categories of healthcare worker most often the focus of hand hygiene compliance studies. However, it is
important to explore and understand nursing students hand hygiene practices as they will become registered nurses in the future (Cruz and Bashtawi 2015).

Following a literature search, a reasonable number (n=14) of recent international research studies were identified concerning nursing students’ hand hygiene practices. Moderate hand hygiene knowledge among nursing students is reported in India (Nair et al. 2014), Sri Lanka (Ariyaratne et al. 2013), South Korea (Jeong and Kim 2016), Jordan (Al-Khawaldeh et al. 2015) and Namibia (Ojulong et al. 2013). However, poor knowledge of hand hygiene among nursing students is reported in some European countries, for example, Italy (D’Alessandro et al. 2014, van de Mortel et al. 2011) and Slovakia (Kelefkova et al. 2012). Nair et al. (2014) and Ariyaratne et al. (2014) report that attitudes towards hand hygiene and hand hygiene practices are poor, although Cruz and Bashtawi (2015) and Al-Khawaldeh et al. (2015) report moderate attitudes and practices among Saudi Arabian and Jordanian nursing students, respectively. In comparative studies better hand hygiene practices among nursing students than medical students are reported (van de Mortel et al. 2010, van de Mortel et al. 2011).

A small number of these recent studies report on hand rubbing using ABHR (n=9), providing limited data in some cases (Al-Khawaldeh et al. 2015, Hinkin and Cutter 2014, Bargellini et al. 2014, Ojulong et al. 2013, Gül et al. 2012, van de Mortel et al. 2011), while others provide more insight (Jeong and Kim 2016, Nair et al. 2014 and Ariyaratne et al. 2013). While the numbers of studies are relatively low, the data presented appear to suggest that ABHR knowledge among nursing students is poor, with correct responses to questions on hand rubbing technique as low as 11.5% (Gül et al. 2012), 14% (Ariyaratne et al. 2013) and 28.8% (Jeong and Kim 2016). Only, 28% of Indian students (Nair et al. 2014) and 25% of Sri Lankan students (Ariyaratne et al. 2013) knew the correct minimum time required for effective hand rubbing (WHO
2009), suggesting poor practice. In a Welsh study, less than half of the respondents (n=354) were unaware that ABHR usage is not recommended when nursing patients with *Clostridium difficile* infections (Hinkin and Cutter 2014). van de Mortel *et al.* (2011) also found knowledge deficits relating to ABHR among Italian nursing students. However, other more positive responses are reported with 81.7% of nursing students aware that hand rubbing using ABHR takes less time than using soap and water (Ariyaratne *et al.* 2013) and 75-85% of South Korean students knew when to perform hand rubbing using ABHR (Jeong and Kim 2016).
Conceptual Framework

Where a study has its roots in a conceptual model, the study framework is often called the conceptual framework (Polit and Beck 2013). The WHO Guidelines on Hand Hygiene in Health Care (WHO 2009) globally underpin best hand hygiene practice by providing an evidence-based conceptual framework for practitioners and educators alike, along with recommendations to improve practices and reduce HCAI transmission. This study has its roots in this conceptual framework, which presents an understanding of the phenomenon of interest and offers assembled concepts relevant to the study theme and design. The variables measured in this study are underpinned by the espoused practices and recommendations of the Guidelines.

According to the Guidelines hand rubbing with ABHR is recommended as the ‘gold standard’ technique in hand hygiene, with healthcare workers advised to routinely perform hand hygiene using ABHR for day-to-day decontamination of hands (WHO 2009). Therefore, it is important to understand nursing students’ attitude and practices of hand rubbing, as this is the optimum practice that students are expected to adhere to both in the university and clinical practice settings. Despite this, on searching the literature, we found a paucity of international research which comprehensively explores nursing students’ hand rubbing practices. There remains a need for further research to be conducted that explores the use of ABHR. Those studies that do report hand rubbing practices largely do so as part of a larger hand hygiene study, with little specific emphasis placed on hand rubbing practices. In summary, internationally there has not been focus on nursing attitudes and practices regarding ABHR and, more specifically, no Irish study has explored hand hygiene and hand rubbing practices among nursing students. Hence the objective of this study was to provide insight into
the current hand hygiene and in particular hand rubbing practices of nursing students in Ireland and, by doing so, contribute to the broader understanding of this topic.
Methods

Design

This study employed a descriptive, self-report design and aimed to explore nursing students’ hand hygiene attitudes and practices and in particular hand rubbing using ABHR. All undergraduate students of a Bachelor of Science Nursing honours degree programme (n=342), within the Faculty of Education and Health Sciences in the University of Limerick, were invited via student email addresses to participate, between March and April 2015. They were provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. The sample comprised students across the four cohorts of the four year programme. As part of the students’ curricula, hand hygiene education and training had been delivered to all cohorts, underpinned by the WHO Guidelines, consistently across both the university and the clinical practice sites. Students in each cohort were middle to near-end of the academic year and all had experience of delivering direct patient care during the clinical practice placement components of their programmes. Participation indicated consent and was voluntary and anonymous.

Data collection and analysis

Following a literature review a published study instrument was selected for data collection (Larson 2004). The validated questionnaire, originally developed at Colombia University, New York, was designed to assess barriers to adherence to the Centers for Disease Control and Prevention (CDC) hand hygiene guideline (CDC 2002). To reflect the current WHO Guidelines (WHO 2009), the survey was modified.
In addition, two experienced researchers reviewed the questionnaire for content validity and additional questions were added. To further address content validity, a pilot study was conducted (n=9) contributing to the reliability and validity of the questionnaire as well as checking completion time and allowing for minor redrafting of some questions for greater clarity.

The survey comprised 62 questions, with Likert scale, multiple choice and ‘yes or no’ questions. Almost all questions were closed questions and with pre-specified answer options. However, there were two open questions where respondents could choose the option “other” and respond in their own words. The questionnaire comprised three sections: a short demographics section with three questions, a hand hygiene practices section and a section specifically addressing hand rubbing using ABHR. Data were analysed using Survey Monkey (Gold Plan version). Descriptive statistics, including frequencies and percentages, were calculated. The relationship between variables was considered where there was a rationale to do so. Parametric testing was not carried out as data were ordinal and not normally distributed (Scott and Mazhindu 2014).

**Ethics**

The study, approved by the Faculty Research Ethics Committee of the University, was carried out in accordance with the code of ethics of the *World Medical Association Declaration of Helsinki* (2013). The study was conducted anonymously with no identifiable data reported.
Results

From the 342 invitations sent, 225 (66%) nursing students responded. 94% of respondents were female. Responses were received from across all four years of the programme, with 25%, 20%, 17% and 38% from year 1, 2, 3 and 4 of the programme, respectively.

Almost all students had received hand hygiene education and training as part of their degree programme (99%). The majority considered that hand hygiene teaching and learning resources were readily available in the university (92%) and in clinical practice sites (91%). Almost all (99%) reported familiarity with the recommended hand hygiene technique and 95% reported implementing hand hygiene recommendations in clinical practice. The majority (94%) agreed that hand hygiene improves patient outcomes and that it is likely that HCAI rates will decrease if recommended hand hygiene practices are followed (97%). This is in the context of 62% of respondents having observed adverse patient events associated with HCAI.

However, despite these positive attitudes, 19% (n=41) reported preferring to continue with personal hand hygiene routines and habits, rather than change to recommended hand hygiene practices. A minority reported that it is not practical to follow recommended hand hygiene practices (7%, n=15) and a similar number did not wish to change their hand hygiene practice regardless of research and policy recommendations (7%, n=15). Other negative attitudes emerged among a minority of respondents with 16% (n=34) reporting that hand hygiene practices are inconvenient in clinical practice and 13% (n=25) reporting that they do not have time to stay informed about new developments. This is despite more than one in five students (22%) reporting personal experience of HCAI.
Attitudes towards hand rubbing using ABHR were also explored and were largely positive, with 94% reporting that ABHR are practical to use. 98% reported that they are expected to use ABHR in clinical practice and they are readily available (91%). Fewer (80%) agreed that hand rubbing using ABHR helps to standardise care and assure that patients are treated in a consistent way. 89% considered it important to act as a role model for others when using ABHR. Despite the positive attitudes towards hand rubbing, a lack of clarity around best practice recommendations emerged, in particular when to use ABHR. While 93% (n=184) of students felt competent using ABHR in accordance with recommendations, 16% (n=34) were not aware of the clinical contraindications for using ABHR and 7% (n=15) had no opinion. In addition, 9% (n=19) of nursing students did not know when to use soap and water and when to use ABHR. When we compared data across the four years of the programme, only 2.3% of second years compared to 10.2%, 13.1% and 10.1% of first, third and fourth years respectively, did not know when to use soap and water versus ABHR. 34% (n=67) of respondents considered that ABHR were unpleasant to use and 37% (n=73) considered that hands do not feel clean following hand rubbing using ABHR. However, the majority (87%) disagreed that ABHR are cumbersome and inconvenient with only 5.5% agreeing.

In order to determine self-reported hand hygiene practices, the WHO concept called ‘my five moments for hand hygiene’ model was used, which centres around five opportunities or indications for hand hygiene that healthcare workers frequently encounter in their day-to-day routines. The majority (96%) of students were familiar with the ‘my five moments for hand hygiene’ model (WHO 2009) (see table 1). However, when asked about a fundamental concept necessary for understanding the model, i.e. the difference between the patient’s zone and environment or surroundings,
19% did not understand the difference. Respondents were most compliant with the indication to perform hand hygiene after contact with body fluid (99.5% n=208) and before a clean or aseptic procedure (98.5% n=206). Less compliance was reported for hand hygiene after touching a patient (87% n=182) and before touching a patient (85% n=177). Interestingly, 20% (n=41) of nursing students had observed a patient requesting a member of staff to perform hand hygiene, while only 6.4% had been asked by a patient to perform hand hygiene. A more varied response emerged in relation to hand hygiene after touching patients’ surroundings and respondents were least compliant with this indication (61% n=129). Of the 29% who reported non-compliance with this indication, we compared responses across the four years of the programme and found increasingly less compliance among students as the programme progressed, with 10.2% of first years compared to 41.7% of fourth years non-compliant. A similar pattern was also found for hand hygiene non-compliance both before and after touching a patient, with more fourth year students than first year students non-compliant.

To further determine if students were following best practice recommendations for hand rubbing practices they were asked to identify the percentage of time they use ABHR for hand hygiene (see table 2). It emerged that hand rubbing practices were suboptimal. Just over one fifth (22%) of students were hand rubbing almost all of the time as recommended (or approximately >90% of the time) and almost one third (32%) were hand rubbing less than 50% of the time. When we compared data across the four years of the programme, second years were most compliant (28.2%) and first years least compliant (16.6%).

Barriers to hand rubbing using ABHR were explored in depth. Students perceived ABHR as causing skin damage, with 52.8% agreeing that if they followed the
recommendations in relation to ABHR use, they would be likely to experience dermatology issues. This is in the context of 49% of students having experienced a dermatology issue arising from hand hygiene and 59% having observed a colleague with such a dermatology issue. When students were asked to identify the single most important barrier to adhering to ABHR use, over one fifth of students (21%) identified no barriers (see table 3). However, skin sensitivity (32.5%) and skin damage (19.6%) emerged as the two most frequently cited barriers. This was consistent across the data sets of the four cohorts. ‘Other’ barriers identified by a minority of students are found in table 4, and mainly relate to location and availability of ABHR in clinical practice. Factors that positively influence students’ adherence to hand rubbing were ‘prevention of cross infection’ (37.6%) and ‘infection prevention and control policy’ (26.8%), (see table 5), while personal protection emerged as the third highest positive influencer (17.5%).
Discussion

The ‘my five moments for hand hygiene’ model aims to increase self-efficacy among practitioners by giving unambiguous advice about when to incorporate hand hygiene into complex care tasks (WHO 2009). Despite this, almost one in five students lacked a clear understanding of the model. Furthermore, suboptimal compliance with three of the five indications for hand hygiene therein was reported. Almost full compliance with hand hygiene ‘before contact with body fluid’ (99.5%) and ‘before a clean or aseptic technique’ (98.5%) compared favourably to 92% and 77.2% respectively, reported by Jeong and Kim (2016). Given that ‘personal protection’ emerged as the single most important positive influencer of hand hygiene practice among 17.5% of respondents, the high compliance reported is perhaps unsurprising, as students strive to protect themselves from risk more traditionally associated with certain aspects of care, for example, contact with body fluid. Despite 37% of students identifying ‘prevention of cross infection’ as the single most important positive influencer of hand hygiene practice, 13% were non-compliant with hand hygiene ‘before touching a patient’ and 9% ‘after touching a patient’, suggesting that some students may perceive less risk associated with these indications and may not realise the potential for HCAI transmission associated with these patient encounters.

Previously, hand hygiene after touching a patient’s surrounding was the most commonly missed opportunity among healthcare workers (Fitzgerald et al. 2013, Randle et al. 2013), with suboptimal compliance rates as low as 36% reported (Randle et al. 2013). This is despite evidence that the hospital environment can contribute significantly to disease transmission (Chemaly et al. 2014). However, more recently, improved compliance rates are reported, varying from 72% (Jeong and Kim 2016) to 93% (Price et al. 2016). Our study differs and compares less favourably, with only...
61% (n=129) reporting compliance and a worrying 29% (n=61) reporting non-compliance. Given these findings of suboptimal compliance with hand hygiene best practice, it seems that a lot of work needs to be done to improve practice among nursing students.

We also revealed that fourth year students were less compliant than first years with the ‘my five moments for hand hygiene’ model. One possible explanation may be the impact of student socialisation on learning. Houghton et al. (2013) found that learning can be hindered by the anxiety caused by the reality of practice, in particular when students experience a gap between the teaching and learning of skills and their experience in the reality of practice. Negative socialisation may occur, whereby students implement less desirable practices to ‘fit in’, in favour of evidence-based practice (Houghton 2014). Therefore it is essential that socialisation issues are addressed within the nursing curriculum and educators and practitioners collaboratively explore opportunities to maximise on-going positive experiences of socialisation and associated learning.

While attitudes to hand rubbing using ABHR were predominately positive sub-optimal practices emerged. Despite clear and unambiguous recommendations in the WHO Guidelines regarding when to hand wash with soap and water and when to hand rub using ABHR confusion among nursing students persists. Previously, 44% of Welsh nursing students were unaware that ABHR was contraindicated when caring for patients with Clostridium difficile infection (Hinkin and Cutter 2014). Our study differs and compares more favourably with 16% of students not aware of the clinical contraindications for using ABHR. 9% did not know when to use soap and water and when to use ABHR. Given this lack of clarity among some students around usage, it is unsurprising therefore to find that only 22% of students were hand rubbing with
ABHR almost all of the time and that almost one third of students were hand rubbing less than 50% of the time. Despite this finding, 93% of students’ self-reported competence in using ABHR, in line with recommendations. However, this finding is interpreted taking into account that respondents may self-report a high rate of personal compliance (Cole 2009) and that hand hygiene beliefs, knowledge and practices do not always correlate (Jeong and Kim 2016, Creedon 2005).

An interesting and unexpected finding was that second year students had better hand rubbing attitudes and practices than other students. While this study did not align the timing of the distribution of the survey to any particular elements of the nursing curriculum, it is noteworthy that second years had recently completed a microbiology and infection prevention and control module. This may provide a possible explanation for the more positive attitudes and practices reported by second years.

Previously, McLaws et al. (2015), Smiddy et al. (2015), Nasirudeen et al. (2012) and Erasmus et al. (2010) found that workload and the lack of time to perform hand hygiene influenced compliance among healthcare professionals. Despite the evidence that ABHR significantly reduces the time taken for hand hygiene (McLaws et al. 2015, Voss and Widmer, 1997) 11% of students in this study identified time as a barrier and this may partially explain the suboptimal frequency of hand rubbing practice. In a seminal study, Voss and Widmer (1997) calculated that hand rubbing requires far less time (18 minutes in an eight-hour shift) than hand washing with soap and water (56 minutes), while Azim et al. (2016) more recently calculated even lower hand rubbing times (9-13.5 minutes per twelve-hour shift). It appears therefore, that the time burden for hand hygiene is not too onerous, and that full compliance among students ought to be achievable. Mindful that the focus for nursing students is on learning and becoming competent for professional life, we must strive to ensure that they are afforded
sufficient time to learn and develop appropriate hand hygiene attitudes and practices. It is important to be aware that negative attitudes and practices acquired during formative education years, may hold during professional careers and ultimately negatively impact patient outcomes.

Other identified barriers may also help to explain poor compliance. Previously, students incorrectly believed that ABHR causes more skin damage than soap and water (Jeong and Kim 2016, van de Mortel et al. 2011). This is despite the evidence that ABHR causes less skin damage than soap and water (Larson et al. 2000, Pittet et al. 2000). In this study the two most frequently cited barriers to the use of ABHR were skin sensitivity (32.5%) and skin damage (19.6%) and over half of students (53%) perceived correct adherence to ABHR recommendations to cause skin damage and dermatology issues. Students also perceived ABHR to be unpleasant to use and leaving the hands feeling unclean. Given that 49% of nursing students reported personal experience of a dermatology issue and given the barriers to hand rubbing identified in this study, it seems there may be scope to review current ABHR products, whilst continuously ensuring that WHO Guidelines are followed and that product selection is optimised.

Limitations

The transferability of the findings of our study may be limited as the work was performed in a single nursing department in a single University. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers (i.e. programme of study, gender, third-level education) within the Irish population. Furthermore, findings are validated by similar results reported elsewhere (Jeong and Kim 2016, Cruz and Bashtawi 2015, Hinkin and Cutter 2014,
Nasirudeen et al. 2012, van de Mortel et al. 2011) while also contributing to a new knowledge base.
Conclusion

This study provides new insight into hand hygiene practices among nursing students and to some degree addresses the scarcity of recent evidence on the topic. The findings suggest that nursing students’ attitudes towards hand hygiene are generally positive, with some room for improvement identified. Some poor hand hygiene practices are identified in particular relating to frequency of hand rubbing with ABHR and compliance with the ‘my five moments for hand hygiene’ WHO model. In addition, there is some confusion among students around when to use soap and water and when to use ABHR.

The findings appear to suggest that there is scope to review current teaching and learning methodologies and perhaps review curricula so that greater clarity among nursing students can be achieved and practices improved. While university education has a strong influence on knowledge and practice, the influencing role of practitioners cannot be underestimated (Hinkin and Cutter 2014). Therefore, universities and their health service partners need to continue to work together synergistically to ensure that the influencing role of both, on students’ attitudes and practices, can be optimised. While long term behavioural changes are not guaranteed it is important to instil good habits during the early career stage of nursing students that may potentially have sustained long-term impact (Salmon et al. 2013). Raising awareness among nursing students of their responsibility in preventing the occurrence and reducing the transmission of HCAI as an on-going endeavour is required, with the laudable aim of preventing complacency and ultimately improving patient outcomes.
References


### Table 1 ‘My five moments for hand hygiene’ WHO (2009)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>No opinion</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the World Health Organization (WHO) ‘My 5 moments for hand hygiene’ recommendations.</td>
<td>78.47% (n=164)</td>
<td>17.7% (n=37)</td>
<td>0.48% (n=1)</td>
<td>3.35% (n=7)</td>
<td>0.00% (n=0)</td>
</tr>
<tr>
<td>I understand the difference between the patient zone and surroundings.</td>
<td>29.67% (n=62)</td>
<td>43.06% (n=90)</td>
<td>7.66% (n=16)</td>
<td>16.75% (n=35)</td>
<td>2.87% (n=6)</td>
</tr>
<tr>
<td>I always perform hand hygiene before each patient contact.</td>
<td>44.98% (n=94)</td>
<td>39.71% (n=83)</td>
<td>2.39% (n=5)</td>
<td>11.48% (n=24)</td>
<td>1.44% (n=3)</td>
</tr>
<tr>
<td>I always perform hand hygiene before performing a clean or aseptic technique.</td>
<td>85.17% (n=178)</td>
<td>13.40% (n=28)</td>
<td>0.48% (n=1)</td>
<td>0.48% (n=1)</td>
<td>0.48% (n=1)</td>
</tr>
<tr>
<td>I always perform hand hygiene after touching a patient</td>
<td>50.24% (n=105)</td>
<td>36.84% (n=77)</td>
<td>3.83% (n=8)</td>
<td>9.09% (n=19)</td>
<td>0.00% (n=0)</td>
</tr>
<tr>
<td>I always perform hand hygiene after contact with body fluids.</td>
<td>90.91% (n=190)</td>
<td>8.61% (n=18)</td>
<td>0.00% (n=0)</td>
<td>0.48% (n=1)</td>
<td>0.00% (n=0)</td>
</tr>
<tr>
<td>I always perform hand hygiene after touching a patient’s surrounding.</td>
<td>24.40% (n=51)</td>
<td>37.32% (n=78)</td>
<td>9.09% (n=19)</td>
<td>27.75% (n=58)</td>
<td>1.44% (n=3)</td>
</tr>
</tbody>
</table>
Table 2 Time spent using alcohol-based hand rub

<table>
<thead>
<tr>
<th>Answer options</th>
<th>Response % (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost always (&gt;90% of time)</td>
<td>22.2% (43)</td>
</tr>
<tr>
<td>Often (51-90% of time)</td>
<td>45.9% (89)</td>
</tr>
<tr>
<td>Sometimes (10-50% of time)</td>
<td>27.3% (53)</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>3.6% (7)</td>
</tr>
<tr>
<td>Never</td>
<td>1.0% (2)</td>
</tr>
</tbody>
</table>
Table 3 Rank order of barriers to alcohol-based hand rub use

<table>
<thead>
<tr>
<th>Rank order</th>
<th>Answer Options</th>
<th>Response % (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Skin sensitivity</td>
<td>32.5% (63)</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>No barriers</td>
<td>21.1% (41)</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Skin damage</td>
<td>19.6% (38)</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Time</td>
<td>10.8% (21)</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>No opinion</td>
<td>8.2% (16)</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Inconvenience</td>
<td>4.1% (8)</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Other (please specify)</td>
<td>3.6% (7)</td>
</tr>
</tbody>
</table>
Table 4 “Other” barriers to alcohol-based hand rub use

<table>
<thead>
<tr>
<th>No.</th>
<th>“Other” barriers identified to use of alcohol-based hand rub</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lack of alcohol-based hand rub within each patient's zone</td>
</tr>
<tr>
<td>2</td>
<td>Not located in the right areas</td>
</tr>
<tr>
<td>3</td>
<td>Not always available. Containers empty and not refilled</td>
</tr>
<tr>
<td>4</td>
<td>Prefer to wash hands with warm water and soap</td>
</tr>
<tr>
<td>5</td>
<td>Their location and availability</td>
</tr>
<tr>
<td>6</td>
<td>Availability at bedside</td>
</tr>
<tr>
<td>7</td>
<td>Psoriasis</td>
</tr>
</tbody>
</table>
Table 5 Rank order of influencers on adherence to alcohol-based hand rub use

<table>
<thead>
<tr>
<th>Rank order</th>
<th>Answer options</th>
<th>Response percent (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Prevention of cross infection</td>
<td>37.6% (73)</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Infection control policy</td>
<td>26.8% (52)</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Personal protection</td>
<td>17.5% (34)</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Patient outcomes</td>
<td>9.8% (19)</td>
</tr>
<tr>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Evidenced-based practice</td>
<td>4.6% (9)</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Convenience</td>
<td>2.1% (4)</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>No opinion</td>
<td>1.0% (2)</td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Patient/public expectations</td>
<td>0.5% (1)</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Role model influences</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Other (please specify)</td>
<td>0.0% (0)</td>
</tr>
</tbody>
</table>
CHAPTER 4

A comparative study of hand hygiene and alcohol-based hand rub use among Irish nursing and medical students.

Published: currently submitted and under peer review
Title
A comparative study of hand hygiene and alcohol-based hand rub use among Irish nursing and medical students.

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Abstract

Background

In Ireland, the setting for this study, the national prevalence rate of health care-associated infection (HCAI) in acute-care facilities is 5.2%. Hand hygiene and in particular hand rubbing using alcohol-based hand rub (ABHR) is highly efficacious in preventing HCAI transmission. Yet, compliance among healthcare professionals is sub-optimal. Less is known about the practices of nursing and medical students and no study comparing practices among these groups in Ireland was found. Hence the aim of this study was to provide insight into the current hand hygiene and hand rubbing practices of nursing and medical students in Ireland and, by doing so, contribute to the broader understanding of this topic.

Methods

This observational study employed a cross-sectional, self-reported design. An electronically administered questionnaire was sent to all nursing and medical students from one university.

Results

The response rate was 37% (323/872). Higher compliance with the World Health Organisation ‘my five moments for hand hygiene’ model was reported among nursing than medical students, with scope for improvement in both disciplines. Hand hygiene compliance was highest after body fluid exposure (99.5% nursing students, 91% medical students) and lowest after touching a patient’s surroundings (61.5% nursing
students, 57.5% medical students). Attitudes towards hand rubbing were largely positive in both disciplines. 16% of nursing students were not aware of the clinical contraindications to ABHR use, compared to 45% of medical students. 9% of nursing students did not know when to use soap and water and when to use ABHR, compared to 36% of medical students. In contrast, more medical (46%) than nursing students (22%) were routinely using alcohol-based hand rub for decontamination of hands as recommended.

**Conclusions**

Results suggest scope to review hand hygiene education programmes, provide more educational resources in academic and clinical settings and scope to address perceived barriers to ABHR use.
Keywords
Nursing students, medical students, hand hygiene, hand rubbing, alcohol-based hand rub, attitudes, self-report, practice, infection prevention and control, Ireland.

Highlights

- Nursing students reported greater compliance with the World Health Organisation, ‘my five moments for hand hygiene’ model than medical students.
- In both disciplines, greatest compliance with hand hygiene was reported, after body fluid exposure risk and least compliance, after touching a patient’s surroundings.
- Alcohol-based hand rub (ABHR) is underutilised by both nursing and medical students.
- Greater routine utilisation of ABHR among medical students compared to nursing students was reported.
- Similarities across disciplines in the reporting of barriers to ABHR use were reported.

Funding
This work was supported in part by the Infection Prevention Society Novice Investigator Grant 2015. The contents of this paper are solely the work of the individual authors and do not reflect the views of the funding body.
Introduction

The burden of health care-associated infection (HCAI) is well documented by the World Health Organization (WHO) and European Centre for Disease Control (ECDC) (WHO 2013, ECDC 2013). HCAI results in prolonged hospital stay, increased morbidity and mortality, high healthcare costs, financial burden and increased resistance of microorganisms to antimicrobials, leading to a sharp rise in multi-drug resistant organisms (MDROs) (WHO 2013, ECDC 2013). According to the WHO hundreds of millions of patients are affected by HCAI worldwide each year and the ECDC estimates that 25,000 people die in the European Union (EU) annually from infections caused by MDROs with an associated cost of €1.5 billion (WHO 2013, ECDC 2013). In Ireland, the setting for this study, the national prevalence rate of HCAI in acute-care facilities is 5.2% (Health Protection Surveillance Centre (HPSC) 2012). Hand hygiene is considered to be the most effective measure a healthcare professional can take to prevent the transmission of HCAI (HPSC 2013). Yet, even though hand hygiene is simple, cost-effective and highly efficacious in controlling the spread of HCAI, evidence suggests that compliance among healthcare professionals is sub-optimal (Kingston et al. 2016, Erasmus et al. 2010).
Background

Hand hygiene is a general term that refers to various actions of hand cleansing suited to different clinical situations, including the action of hand rubbing. Hand rubbing with alcohol-based hand rub (ABHR) is globally advocated as the ‘gold standard’ approach to hand hygiene in most routine patient encounters, except those for which handwashing with soap and water is recommended, for example, when nursing patients with *Clostridium difficile* infections (WHO 2009). Despite this, the literature seems to focus mainly on broader aspects of hand hygiene with less focus on exploring hand rubbing practices among healthcare professionals and healthcare students.

Poor to moderate hand hygiene knowledge is reported among nursing and medical students (collectively referred to as healthcare students), although nursing students appear to have better knowledge compared to medical students (D’Alessandro *et al*. 2014, Ariyarthne *et al*. 2013, van de Mortel *et al*. 2012, van de Mortel *et al*. 2010). Poor attitudes are also reported, as low as 12.9%, with better attitudes among nursing than medical students reported (Nair *et al*. 2014, van de Mortel *et al*. 2012, van de Mortel *et al*. 2010, Ariyarathne *et al*. 2013). Hand hygiene practices are also poor for example, Ariyarathne *et al*. (2013) found that 67% of healthcare students had poor self-reported practices, while Nair *et al*. (2014) found nursing students had better practices (62%) compared to medical students (19.6%).

It appears from limited studies, reporting limited data on hand rubbing specifically, that hand rubbing knowledge and practices are also poor among healthcare students, although nursing students are reported to have better knowledge and practices than medical students (Ojulong *et al*. 2013, Nair *et al*. 2014, Bargellini *et al*. 2014, van de Mortel *et al*. 2012, Ariyarthne *et al*. 2013). Interestingly, no recent studies addressing
this topic were found in the United States of America, Canada, Scandinavia or the United Kingdom and just one study from Ireland was found (Kingston et al. 2017). In Italy, substantial knowledge deficits relating to ABHR use among healthcare students is reported, based on just three questions which less than 50% of students answered correctly (van de Mortel et al. 2012). Significantly higher hand rubbing frequency in Italian nursing students (80%) compared to medical students (47%) was also found by Bargellini et al. (2014). In India and Sri Lanka knowledge of ABHR, based on five questions, was higher among medical students than nursing students, although several gaps in knowledge were identified in both groups (Nair et al. 2014, Ariyarathne et al. 2013). In Namibia, just 34% of nursing students and 20% of medical students correctly answered one knowledge question on the indications for the use of ABHR (Ojulong et al. 2013). No study was found that addressed attitudes towards hand rubbing using ABHR.

In summary, internationally there has not been recent substantial focus on comparing nursing and medical knowledge, attitudes and practices regarding hand rubbing using ABHR. More specifically, no Irish study has explored and compared hand hygiene and hand rubbing practices among nursing and medical students, with just one recent study exploring Irish nursing students’ hand hygiene practices found (Kingston et al. 2017). This is despite the prevalence of HCAI, especially MDRO-associated infections and comprehensive evidence that hand hygiene contributes significantly to reducing these (O’Connor et al. 2015). Hence, the objective of this study was to provide insight into the current hand hygiene and hand rubbing practices of nursing and medical students in Ireland and, by doing so, contribute to the broader understanding of this topic.
Methods

This observational study employed a cross-sectional, self-reported design and aimed to explore nursing students’ and medical students’ perceptions of their hand hygiene and hand rubbing practices. All students of a Bachelor of Science Nursing (Honours) degree programme (n=342) and of a Graduate Entry Bachelor of Medicine and Surgery degree programme (n=530) within the Faculty of Education and Health Sciences, University of Limerick, were invited via student email addresses to participate, between March and April 2015. They were provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. The sample comprised students across the four cohorts of both programmes. Hand hygiene education and training had been delivered to all cohorts as part of the students’ curricula. Participation indicated consent and was voluntary and anonymous.

Following a literature review, a validated questionnaire originally developed at Colombia University, New York and designed to assess barriers to adherence to US hand hygiene guidelines was selected as the study instrument (Larson 2004, CDC 2002). The survey was modified to reflect the WHO hand hygiene guidelines and additional questions were added (WHO 2009). Two experienced researchers (microbiologists) reviewed the questionnaire for content validity. A pilot study was conducted (n=9) contributing to the reliability and validity of the questionnaire as well as checking completion time and allowing for minor redrafting of some questions for greater clarity. The survey comprised 62 questions, with Likert scale, multiple choice and ‘yes or no’ questions. Data were analysed using Statistical Package for Social Sciences (SPSS), version 24 and Survey Monkey, gold plan version. Descriptive statistics, including frequencies and percentages, were calculated. The relationship between variables was considered where there was a rationale to do so. Parametric
testing was not carried out as data were ordinal and not normally distributed (Scott and Mazhindu 2014).

**Ethics**

The study, following approval by the Research Ethics Committee of the University of Limerick, was carried out in accordance with the code of ethics of the Declaration of Helsinki (World Medical Association 2013). It was conducted anonymously and no identifiable data was reported.
Results

A response rate of 37% (323/872) was achieved. Of the 323 respondents 70% (n=225) were nursing students and 30% (n=98) were medical students. 94% (n=212) of the nursing students were female and 58% (n=57) of the medical students were female.

Hand hygiene

Awareness of international hand hygiene guidelines was high with just 3% of nursing students and 16% of medical students reporting unfamiliarity with the WHO hand hygiene guidelines (WHO 2009). Awareness of national hand hygiene guidelines was lower with 34% of nursing students and 52% of medical students reporting unfamiliarity with these guidelines (Health Service Executive 2005). Even though 95% of nursing students and 74% of medical students were aware that the Irish Health Information and Quality Authority (HIQA) conducts inspections of adherence to national hand hygiene standards and 45% and 17% respectively had their practice inspected by HIQA inspectors, 18% of nursing students and 48% of medical students were unfamiliar with these national standards (HIQA 2009). The majority of healthcare students (92% nursing and 82% medical) agreed that relevant teaching and learning resources are readily accessible in the university. However, 91% (n=190) of nursing students considered that relevant teaching and learning resources are readily accessible in clinical practice, compared to 58% (n=49) of medical students.

A greater percentage of nursing students (96%) than medical students (78%) reported implementing hand hygiene recommendations and when self-reported hand hygiene practices were explored, using the WHO (2009) ‘my five moments for hand hygiene’ framework, nursing students self-reported higher compliance than medical students.
Greatest compliance with hand hygiene after body fluid exposure, moment 3, was reported among 99.5% of nursing students and 91% of medical students. Least compliance with hand hygiene after touching a patient’s surroundings, moment 5, was reported among 61.5% of nursing students and 57.5% of medical students. Nursing and medical students were equally compliant before touching a patient, moment 1, with a mean compliance of 85.5%. Compliance with hand hygiene before performing a clean or aseptic procedure, moment 2, was greater among nursing students (98.5%) than medical students (87%) and compliance with hand hygiene after touching a patient, moment 4, was also greater among nursing (87%) compared to medical students (80%).

Both positive and negative attitudes to hand hygiene were explored. The data indicate more positive attitudes among nursing than medical students, for example, 93% of nursing students compared to 72% of medical students considered hand hygiene practices relevant to their clinical practice, while 94% of nursing students and 84% of medical students agreed that hand hygiene improves patient outcomes. 7% (n=15) of nursing students and 11% (n=9) of medical students reported that it is not practical to follow recommended hand hygiene practices, while 13% (n=25) of nursing students compared to 21% (n=16) of medical students reported that they do not have time to stay informed about new developments in hand hygiene despite 22% of nursing students and 12.8% of medical students reporting personal experience of a HCAI.

**Hand rubbing**

Attitudes towards hand rubbing with ABHR were explored and were largely positive in both disciplines, with the majority reporting that ABHR is practical to use and convenient and that adherence to hand rubbing is expected in clinical practice. The
majority (94%) disagreed that they do not have time to use ABHR, while 80% of nursing and 71% of medical students agreed that hand rubbing helps to standardise care and ensure patients are treated in a consistent way. 91% of nursing students agreed that ABHR is readily available in clinical practice compared to 76% of medical students. Factors that positively influence ABHR use were explored (see table 2). The single most important factor identified among healthcare students was ‘prevention of cross infection’ (34.5%), followed by ‘infection control policy’ (22.5%). ‘Personal protection’ was identified by 17.6% of healthcare students and ‘patient outcomes’ by (14.2%).

Greater awareness of when to use ABHR was reported among nursing students compared to medical students. 9% (n=19) of nursing students compared to 36% (n=31) of medical students did not know when to use soap and water and when to use ABHR. In addition, 16% (n=34) of nursing students compared to 45% (n=38) of medical students were not aware of the clinical contraindications for using ABHR. Despite the knowledge deficit reported 93% (n=184) of nursing students and 91% (n=68) of medical students felt competent using ABHR in accordance with recommendations.

Greater ABHR use is reported among medical students compared to nursing students (see table 3). 22% of nursing students reported to use ABHR ‘almost always’ (>90% of the time), compared to 47% of medical students. 46% of nursing students and 45% of medical students reported using ABHR often (51%-90% of the time). 27% of nursing students compared to 7% of medical students reported using ABHR sometimes (10%-50% of the time), while 5% of nursing students compared to 1% of medical students reported to using ABHR rarely or never.
The reporting of barriers to hand rubbing using ABHR was similar across the disciplines. 37% (n=73) of nursing students and 39% (n=29) of medical students considered that hands do not feel clean following ABHR use. 34% (n=67) of nursing students and 24% (n=18) of medical students reported that ABHR was unpleasant to use. When identifying the single most important barrier to adhering to ABHR use, in both disciplines, skin sensitivity (32% nursing and 25% medical) and skin damage (20% nursing and 20% medical) emerged as the two most frequently cited barriers, with just 21% of nursing students and 23% of medical students reporting no barriers. Just over 50% of healthcare students agreed that if they followed the recommendations on hand rubbing using ABHR they would be likely to experience dermatology issues. Supporting this, 49% of nursing students and 35% of medical students reported having personally experienced a dermatology issue arising from hand hygiene and 59% of nursing students and 37% of medical students had observed a colleague with such a dermatology issue.
Discussion

Previous studies suggest that nurses are more compliant with hand hygiene than doctors (Randle et al. 2010, McLaws et al. 2009, Pittet 2000). However, fewer cross-disciplinary studies comparing hand hygiene behaviour among healthcare students are available (van de Mortel et al. 2010), despite direct patient contact during internships and clinical placements, which increases students’ risk of becoming mediators of HCAI or contracting a HCAI (Al-Khawaldeh et al. 2015, Bargellini et al. 2014, Ojulong et al. 2013). In this study, self-reported hand hygiene and hand rubbing attitudes and practices among nursing and medical students are explored to determine patterns of behaviour among these cohorts during formative education years. The study is important in contributing to a broader understanding of the topic, providing insight into current practices of future healthcare professionals and may be used to underpin curricular reform.

The WHO ‘my five moments for hand hygiene’ model aims to increase self-efficacy among healthcare workers by providing clear and explicit advice about when to integrate hand hygiene into multifaceted care tasks (WHO 2009). Adherence to this framework among healthcare students is of utmost importance. Despite this, we report less than optimal compliance with the framework and considerable variation in compliance across the five moments and across disciplines. This is in line with previous studies also reporting sub-optimal adherence to WHO hand hygiene recommendations among nursing and medical students (Nair et al. 2014, Herbert et al. 2013, Graf et al. 2011). In this study nursing students self-reported better compliance than medical students with the WHO framework. Both nursing students (99.5%) and medical students (91%) were most compliant with hand hygiene after body fluid exposure risk (moment 3). This, coupled with 17.5% of healthcare students identifying
‘self-protection’ as the primary influencer of their ABHR use, suggests that many healthcare students may be performing hand hygiene for protection against HCAI, as compliance is greatest after potential exposure to body fluid. Self-protection as a consistent motivator to performing hand hygiene is also reported among healthcare professionals and healthcare workers (Smiddy et al. 2015, Erasmus et al. 2009, Borg et al. 2009, Whitby et al. 2006).

Equal compliance (mean 85.5%) with hand hygiene before touching a patient (moment 1) was reported among nursing and medical students, with scope for improvement evident. However, 11.5% greater hand hygiene compliance among nursing students before a clean or aseptic procedure (moment 2) was also found. Least compliance with hand hygiene after touching a patient’s surroundings (moment 5), suggests that both nursing and medical students frequently miss this opportunity for hand hygiene, despite the evidence that the healthcare environment contributes significantly to HCAI transmission (Fitzgerald et al. 2013, Randle et al. 2013, Chemaly et al. 2014). Hand hygiene after touching a patient’s surrounding was previously reported as the most commonly missed opportunity among healthcare professionals and with rates as low as 36% reported, our results compares more favourably, with a mean compliance of 59.5% among healthcare students (Fitzgerald et al. 2013, Randle et al. 2013). However a recent study by Price et al. (2016) suggests that compliance with hand hygiene following moment five has improved with 93% of healthcare workers compliant.

Evidence-based hand hygiene guidelines are available to steer all healthcare workers towards achieving best practice and preventing HCAI (WHO 2009, Health Service Executive 2005). In this study almost a quarter of students identified “infection prevention and control policy” as positively influencing their hand hygiene practice.
However, while high awareness of international hand hygiene guidelines among both disciplines was reported, we also found significantly lower awareness, particularly among medical students, of both national hand hygiene guidelines and national infection prevention and control standards (HIQA 2009). Gaps in knowledge around when to use ABHR and when ABHR is contra-indicated were also reported, with 16% of nursing students and a disconcerting 45% of medical students not aware of the clinical contraindications for ABHR use. Given that ABHR is ineffective when caring for patients with *Clostridium difficile* infection, this finding is a cause for concern (WHO 2009). In addition, 9% of nursing students and 36% of medical students did not know when to use soap and water and when to use ABHR. Humphries and Richards (2011) and O’Brien *et al.* (2009) advise that in order to ensure safe practitioners, relevant and adequate knowledge that informs attitudes and leads to appropriate professional practice is essential. Kelcikova *et al.* (2012) found a direct correlation between insufficient levels of knowledge and significant deficits in hand hygiene education, and associated poor compliance by students. Our findings suggest continued scope to address identified knowledge deficits through tailored and focused education programmes delivered as part of a multi-modal hand hygiene improvement strategy, with the ultimate goal of delivering safe patient care and improving patient outcomes.

Huang *et al.* (2013) suggest that skill and performance is greatly influenced by learning resources. Adequate resources that facilitate knowledge acquisition and self-directed learning both in university and in clinical practice during formative education years are important. We found that despite an expectation of adherence to recommended hand hygiene guidelines in clinical practice, 91% of nursing students, compared to just 58% of medical students, considered teaching and learning resources accessible in
clinical practice, suggesting scope for improvement in resource provision. In 2009 O’Brien and colleagues in a survey of teaching and learning of HCAI in UK and Irish medical schools, found scope to introduce both more innovative teaching techniques and a shared pool of educational resources, that might include online resources. Others have discussed the value of quality assured health-related websites, relevant journals and textbooks and inter-professional teaching opportunities both in university and clinical practice settings (Kulkarni et al. 2013). Our findings suggest continued scope to improve the provision of shared educational resources accessible to both nursing and medical students in academic and clinical practice settings.

Given the gaps in knowledge identified around ABHR use, it is perhaps unsurprising that suboptimal hand rubbing practices emerged, with less than one third of healthcare students using ABHR for hand hygiene ‘almost always’ or greater than 90% of the time. In contrast to previous research by van de Mortel et al. (2012) which found higher hand rubbing frequency among nursing students compared to medical students we found nursing students were less complaint. Just over one in five were routinely using ABHR for hand hygiene, compared to 47% of medical students, even though just 3% of nursing students reported being unfamiliar with the WHO guidelines compared to 16% of medical students (WHO 2009). When compared to the routine utilisation of ABHR by doctors in Ireland (39%) routine ABHR use was greater among medical students in this study (Kingston et al. 2017b). The low compliance among both disciplines suggests that national and international guidelines are not being followed and in particular, the recommendation that routine day-to-day hand hygiene be performed using ABHR appears not to be reaching all students.

Barriers to hand rubbing using ABHR may inform reasons for suboptimal use among nursing and medical students. Barriers identified in this study include skin sensitivity
(30%) and skin damage (20%), with over half of students believing that if they follow the hand rubbing recommendations they will experience dermatology issues. This is despite evidence that hand rubbing with ABHR causes less skin damage than washing with soap and water (Graham et al. 2005, Pittet 2000, Larson et al. 2000). It is important that this perception among healthcare students is addressed, in order that greater compliance can be achieved. However, given that 49% of nursing students and 35% of medical students in this study reported personal experience of a dermatology issue, this suggests there is scope also to continue to review the selection of ABHR products, ensuring guidelines are followed and irritating products are identified and replaced. Addressing perceived barriers to ABHR use among healthcare students, through enhanced educational opportunities may also prove fruitful.

Limitations of this study include the potential for both a response bias and a social desirability bias. We attempted to offset these potential biases with non-judgemental sensitively worded questions, by counterbalancing positively and negatively worded questions and by ensuring confidentiality. The transferability of the study’s findings may be limited as the work was performed in a single Faculty in a single University. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers (i.e. programme of study, gender, third-level education) within the Irish population. Furthermore, findings are validated by similar results reported elsewhere (Jeong and Kim 2016, Bargellini et al. 2014, Herbert et al. 2013, van de Mortel et al. 2012, van de Mortel et al. 2010).
Conclusion

Despite reported improvements in patient safety education (Patey et al. 2011) results of this study suggest that a challenge persists. There remains scope to review hand hygiene education programmes, underpinned by recommendations of both national and international hand hygiene guidelines and to improve access to educational resources both in academic and clinical settings. Addressing perceived barriers to ABHR among healthcare students, through enhanced educational opportunities, is also recommended. Knowledge informs attitudes and leads to improved practice and these endeavours may encourage the adoption of correct attitudes and practices in the early stages of students’ careers, with the ultimate goal of avoiding complacency and improving patient safety outcomes. Our findings may prove useful to those developing nursing and medical education programmes and infection prevention and control curricula.
References


students at a tertiary health care centre in Raichur, India. *ISRN Preventive Medicine*, http://dx.doi.org/10.1155/2014/608927


World Health Organisation. (2013). *Evidence of hand hygiene to reduce transmission and infections by multidrug resistant organisms in health-care settings.* [online] available: [http://www.who.int/gpsc/5may/MDRO_literature-review.pdf](http://www.who.int/gpsc/5may/MDRO_literature-review.pdf) [accessed June 2016].


Table 1 Compliance with ‘my five moments for hand hygiene’ framework (WHO 2009) by discipline

<table>
<thead>
<tr>
<th>Moment</th>
<th>I always perform hand hygiene</th>
<th>% (n)</th>
<th>% (n)</th>
<th>% (n)</th>
<th>% (n)</th>
<th>% (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moment 1:</td>
<td>I always perform hand hygiene before touching a patient</td>
<td><strong>Nursing students</strong></td>
<td>Strongly agree</td>
<td>45% (94)</td>
<td>40% (83)</td>
<td>2.5% (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Medical students</strong></td>
<td></td>
<td>52% (44)</td>
<td>34% (29)</td>
<td>10.6% (9)</td>
</tr>
<tr>
<td>Moment 2:</td>
<td>I always perform hand hygiene before a clean/aseptic procedure</td>
<td><strong>Nursing students</strong></td>
<td></td>
<td>85% (178)</td>
<td>13.5% (28)</td>
<td>0.5% (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Medical students</strong></td>
<td></td>
<td>74% (63)</td>
<td>13% (11)</td>
<td>13% (11)</td>
</tr>
<tr>
<td>Moment 3:</td>
<td>I always perform hand hygiene after body fluid exposure risk</td>
<td><strong>Nursing students</strong></td>
<td></td>
<td>91% (190)</td>
<td>8.5% (18)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Medical students</strong></td>
<td></td>
<td>81% (69)</td>
<td>10% (8)</td>
<td>8% (7)</td>
</tr>
<tr>
<td>Moment 4:</td>
<td>I always perform hand hygiene after touching a patient</td>
<td><strong>Nursing students</strong></td>
<td></td>
<td>50% (105)</td>
<td>37% (77)</td>
<td>4% (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Medical students</strong></td>
<td></td>
<td>47% (40)</td>
<td>33% (28)</td>
<td>16.5% (14)</td>
</tr>
<tr>
<td>Moment 5:</td>
<td>I always perform hand hygiene after touching a patient’s surrounding</td>
<td><strong>Nursing students</strong></td>
<td></td>
<td>24.5% (51)</td>
<td>37% (78)</td>
<td>9% (19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Medical students</strong></td>
<td></td>
<td>21% (18)</td>
<td>36.5% (31)</td>
<td>21% (18)</td>
</tr>
</tbody>
</table>
Table 2 Factors influencing alcohol-based hand rub use

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Total % (n)</th>
<th>Nursing student (n)</th>
<th>Medical student (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention of cross infection</td>
<td>34.5% (92)</td>
<td>73</td>
<td>19</td>
</tr>
<tr>
<td>Infection control policy</td>
<td>22.5% (60)</td>
<td>52</td>
<td>8</td>
</tr>
<tr>
<td>Personal protection</td>
<td>17.6% (47)</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>Patient outcomes</td>
<td>14.2% (38)</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Evidenced-based practice</td>
<td>6.0% (16)</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Convenience</td>
<td>3.0% (8)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>No opinion</td>
<td>1.1% (3)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Patient/public expectations</td>
<td>0.7% (2)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Role model influences</td>
<td>0.4% (1)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>0.0% (0)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 3 Hand rubbing using alcohol-based hand rub by discipline and combined

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Combined % (n)</th>
<th>Nursing student % (n)</th>
<th>Medical student % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1% (3)</td>
<td>1% (2)</td>
<td>1% (1)</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>2% (7)</td>
<td>4% (7)</td>
<td>0% (0)</td>
</tr>
<tr>
<td>Sometimes (10-50% of time)</td>
<td>22% (58)</td>
<td>27% (53)</td>
<td>7% (5)</td>
</tr>
<tr>
<td>Often (51-90% of time)</td>
<td>46% (122)</td>
<td>46% (89)</td>
<td>45% (33)</td>
</tr>
<tr>
<td>Almost Always (&gt;90% of time)</td>
<td>29% (77)</td>
<td>22% (43)</td>
<td>47% (34)</td>
</tr>
</tbody>
</table>
CHAPTER 5

Attitudes and practices of Irish hospital-based physicians towards hand hygiene and hand rubbing using alcohol-based hand rubs, a comparison between 2007 and 2015.

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Title
Attitudes and practices of Irish hospital-based physicians towards hand hygiene and hand rubbing using alcohol-based hand rubs, a comparison between 2007 and 2015.

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Abstract

Background

Hand hygiene is the cornerstone of infection prevention and control practices and reduces healthcare-associated infections significantly. Yet, international evidence suggests that medical doctors demonstrate poor compliance.

Aim

To explore and compare practices and attitudes towards hand hygiene, in particular hand rubbing using alcohol-based hand rubs (ABHR), among hospital-based physicians in Ireland between 2007 and 2015.

Methods

In 2007, a random sample of doctors in a large teaching hospital was invited to complete a postal survey using a validated questionnaire. In 2015, the study was replicated among all doctors employed in a university hospital group, including the setting of the original study, using an online survey. Data were analysed using SPSS and Survey Monkey.

Findings

Predominately positive and improving attitudes and practices were found, with 86% of doctors compliant with hand hygiene before patient contact in 2015, compared to 58% in 2007. 91% were compliant after patient contact in 2015, compared to 76% in 2007. Just 39% of respondents in 2015 were using ABHR for hand hygiene almost
always. However, this represents 13.5% more than in 2007. Identified barriers to ABHR use included, dermatology issues and poor acceptance, tolerance and poor availability of ABHR products.

**Conclusion**

Greater awareness of hand hygiene guidelines and greater governance appear to have positively impacted practice. However, despite this, practice remains sub-optimal and there is scope for substantial improvement. Continued and sustained efforts are required in order to build on progress achieved since the publication in 2009 of the World Health Organisation hand hygiene guidelines.
Key Words

Hand hygiene, hand rubbing, alcohol-based hand rub, hospital-based physicians, medical doctors, attitudes, practices, patient safety.
**Introduction**

Patient safety is a healthcare priority and healthcare professionals globally have a responsibility to ensure that patients receive quality, safe healthcare. Infection prevention and control is a key component of patient safety programmes, yet, healthcare associated infections (HCAI) especially those caused by multi drug resistant organisms (MDROs) pose a significant threat to patient safety worldwide (WHO 2009). The impact of HCAI can be experienced by patients and their families, leading to increased patient morbidity and mortality and increased healthcare costs. A point-prevalence survey conducted in Ireland, the setting for this study, reported a national prevalence rate of HCAI in acute-care facilities of 5.2% and the setting for this report has experienced considerable HCAI challenges in recent years (Health Protection Surveillance Centre 2012, O’Connor et al. 2015a, O’Connor et al. 2015b).

Preventing HCAI is a healthcare priority and hand hygiene is recognised as a standard precautionary and effective measure in controlling their spread (Kirk et al. 2016, Pittet et al. 2000). In particular, hand rubbing is the preferred method of hand hygiene in most routine clinical situations and is defined as “applying an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices” (WHO 2009). Yet, despite this, compliance internationally among healthcare professionals with hand hygiene remains unacceptably low (Kingston et al. 2016, Allegranzi et al. 2014, Allegranzi and Pittet 2009). In particular, poor compliance among doctors is reported in many studies (Kirk et al. 2016, Squires et al. 2014, Randle et al. 2014, Randle et al. 2010, Pittet et al. 2004). While there has been much focus internationally on exploring doctors’ attitudes and practices regarding hand hygiene and hand rubbing, research from Ireland regarding this topic has been limited (Creedon 2005). Hence, the
significance of this study in addressing the deficit of research pertaining to doctors’ hand hygiene practices from an Irish perspective.

In 2007, as part of a larger study, a study of hand hygiene practices and ABHR use among doctors in a large teaching hospital was conducted (Slevin 2007). The study was replicated in 2015 and the setting was expanded to encompass additional sites, following the formation of a university hospital group anchored by the same large teaching hospital. In the interim, World Health Organisation (WHO) hand hygiene guidelines were published and widespread implementation of the guidelines was supported nationally by governmental agencies and locally by the hospital groups’ infection prevention and control team and management team. Hence, the aim of this paper is to compare and contrast results of the two studies, conducted 8 years apart, concerning hand hygiene and hand rubbing attitudes and practices of hospital-based medical doctors in Ireland. Our report further attempts to provide insight regarding the demonstrable influence of national and international guidelines in the intervening years.
Methods

Setting

In 2007, the study setting was a large regional teaching hospital providing major surgery, cancer treatment, emergency department services, critical care services and other medical, diagnostic and therapy services. In 2015, the expanded setting encompassed a university hospital group, comprising six hospitals functioning collectively as a single hospital system and included the site of the original study, the largest of the hospitals. The hospital group offers a range of inpatient, outpatient, accident and emergency and maternity care services, serves a population of approximately 400,000 people and provides approximately 750 acute hospital beds.

Design

Both studies employed a quantitative, survey approach, utilising a validated questionnaire comprising validated Likert-ordinal-attitudinal scales as the research instrument.

Between March and April 2007, a random sample of consultants and non-consultant hospital doctors employed in the aforementioned teaching hospital was invited to participate in a postal survey. A cover letter and the questionnaire were sent via the internal hospital postal system and participation indicated consent and was voluntary and anonymous.

Between November and December 2015, the setting was expanded to the aforementioned hospital group and all consultants and non-consultant hospital doctors were invited via staff email addresses to participate in the survey. They were provided
a link to the online study instrument and to a concise, unbiased explanation of the survey topic. Participation indicated consent and was voluntary and anonymous. On completion of the online data collection, in order to enhance the response rate hard copies of the survey were also distributed at education and training seminars, and the data were subsequently added manually to the online database.

**Study instrument and analysis**

In 2007, following a literature review, a study instrument was selected for data collection. The validated questionnaire was originally developed at Colombia University, New York and was designed to assess barriers to adherence to the Centers for Disease Control and Prevention (CDC) 2002 hand hygiene guidelines (Larson 2004, Centres for Disease Control 2002). The survey was modified and contextualised to the Irish setting. A microbiologist and a statistician further reviewed the questionnaire for content validity and a pilot test was carried out (n=20). This helped to identify administrative and analytical issues with the research tool and process.

In 2015, the same questionnaire was used although slightly modified to reflect the publication of international hand hygiene guidelines in the interim. Additional questions were added following review by two experienced researchers (microbiologists) for content validity. No questions were removed. A pilot study was conducted contributing to the reliability and validity of the questionnaire as well as checking completion time and allowing for minor redrafting of some questions for greater clarity (n=9).

The survey was composed of 42 and 57 questions in 2007 and 2015, respectively, with Likert scale, multiple choice and ‘yes or no’ questions. It comprised three sections with
focus on demographics, hand hygiene practices and hand rubbing practices. In 2007, data were analysed using the Statistical Package for Social Sciences (SPSS), version 14 and in 2015, using SPSS, version 24. Descriptive statistics, including frequencies and percentages, were calculated. The relationship between variables was considered where there was a rationale to do so. Parametric testing was not carried out as data were ordinal and not normally distributed (Scott and Mazhindu 2014). The Pearson Chi-square test of independence (non-parametric) allowed for testing of association between variables and was suited to the categorical, ordinal data e.g. Likert scale answers in this study. We used a significance criterion of 0.05 for our statistical tests. During data analysis, the ‘agree’ and ‘strongly agree’ response options were regarded as positive responses and the ‘disagree’ and ‘strongly disagree’ responses were regarded as negative responses. This is reflected in the presentation of results below. ‘No opinion’ was considered a neutral response and was not combined with any other response.

**Ethics**

Both studies were approved by the Research Ethics Committee of the hospital and hospital group, and performed in accordance with the code of ethics of the Declaration of Helsinki (World Medical Association 2013). Both studies were conducted anonymously with no identifiable data reported.
Results

In 2007, the response rate was 43% (n=65) and 15% (n=58) in 2015. 16.5% of respondents indicated medicine and 19% indicated surgery as their area of work in 2007, compared to 57% and 13.8% respectively in 2015.

Predominately positive attitudes towards hand hygiene were consistent, however, improved attitudes were found in 2015. In 2007, 76% of doctors agreed that hand hygiene improves patient outcomes, compared to 90% in 2015; while 76% in 2007 and 91% in 2015 agreed that if hand hygiene recommendations are followed it is likely that HCAI rates will decrease. 18% more doctors in 2015 believed that hand hygiene recommendations are based on sound scientific evidence. Significantly, 80% of respondents in 2015 considered that the person they report to expects adherence to hand hygiene policy, which is 24% more than in 2007 (p=0.029). 23% of doctors in 2007 preferred to continue personal hand washing routines rather than change to the recommended hand hygiene practices, compared to 14% in 2015. Despite these improved attitudes, some significant negative attitudes relating to convenience and practicality were more evident in 2015. Notably, 37% of respondents in 2015 considered hand hygiene to be inconvenient (10% > 2007) and 28% reported that it is not practical to follow hand hygiene recommendations, compared to 19% in 2007 (p=0.039).

In 2015, just 2% of respondents had been requested by a patient to perform hand hygiene, while 15% had observed a patient requesting another member of staff to carry out hand hygiene. When asked about their perceptions of patients’ wishes, 22% of doctors in 2007 compared to 14% in 2015 agreed that patients prefer to see doctors completing a traditional hand wash instead of using ABHR and over 50% of
respondents in both cohorts expressed no opinion on this. Further results of attitudes towards hand hygiene can be found in Table I.

Self-reported hand hygiene compliance improved from a low baseline in 2007. 82% of respondents in 2015 reported implementing hand hygiene recommendations, compared to 60% in 2007. Of significance, 86% of respondents in 2015 reported compliance with hand hygiene before patient contact, compared to 58% in 2007 (p=0.004), while 91% in 2015 reported compliance after patient contact, compared to 76% in 2007. A significant relationship was found between awareness of hand hygiene guidelines and when the study was conducted, with awareness of hand hygiene guidelines significantly improved in 2015 compared to 2007. 65% of respondents in 2015 were familiar with the WHO hand hygiene guidelines, compared to just 4.8% in 2007 (p=<0.001), when draft guidelines were available. Similarly, in 2015 awareness of Irish national hand hygiene guidelines was 56% compared to 16% in 2007 (p=<0.001). Further results of hand hygiene compliance can be found in Table II.

Attitudes towards hand rubbing using ABHR improved. Remarkably, 98% of respondents in 2015 reported feeling competent using ABHR products in accordance with recommendations, which is 22% more than in 2007. Also, in 2015, 87% reported that ABHR help to standardise care and ensure patients are treated in a consistent manner, compared to 74% in 2007. Notably, 93% of respondents in 2015 considered that it is important to act as a role model for others when using ABHR, compared to 81% in 2007. Further results of attitudes towards hand rubbing using ABHR can be found in Table III.

Hand rubbing practices using ABHR were explored by examining: factors that influence adherence (Table IV), the percentage of time respondents use ABHR for
hand hygiene (Table V) and the barriers to ABHR usage (Table VI). Overall, hand rubbing practices have improved from a low baseline. In 2007, ‘prevention of cross infection’ was identified as the single most important factor that influenced adherence to ABHR practices among 50% of respondents, and this is consistent in 2015 at 48% in 2015. In 2007 ‘infection control policy’ was identified by just 5.6% and this has doubled to 11.1% in 2015. 7.4% identified ‘personal protection’ in 2015, while this was not an answer option in 2007.

39% of respondents in 2015 reported using ABHR almost always (>90% of time), compared to 25% in 2007. Consequently, in 2015 15% fewer (37%) reported using ABHR often (51%-90% of the time). In 2015 7% reported using ABHR for hand hygiene rarely (<10% of the time) or never, compared to 12.7% in 2007.

20% of respondents in 2015 and 30% in 2007 identified ‘no barriers’ to adhering to ABHR and those barriers that were identified have remained consistent in the intervening years. For example, in 2015 it was evident that ‘skin sensitivity’ (20%) and ‘skin damage’ (18%) were significant barriers to ABHR usage, compared with levels of 23% and 22% respectively in 2007. Consistently, over half of the respondents (54% - 2015, 51% - 2007) agreed that skin condition would become drier and more damaged if hand hygiene recommendations were followed. 76% of respondents in 2015 disagreed that ABHR improve skin condition, compared to 66% in 2007. These results are in the context of 49% of doctors in 2015 reporting personal experience of a dermatology issues arising from hand hygiene.

Issues of user acceptability were also explored. One third of respondents in both 2007 and 2015 reported that hands do not feel clean following the use of ABHR. 39% in 2015 reported that ABHR were unpleasant to use, compared to 46% in 2007. Notably,
24% of respondents in 2015 disagreed that ABHR are readily available in the workplace, which is 11% more than in 2007. Further analysis revealed that 5.8% of consultants compared to 32.4% of non-consultant hospital doctors (NCHDs) reported this finding in 2015. 7% of respondents in 2015 considered that they do not have the time to use ABHR compared to 11% in 2007.
Discussion

This paper contributes to addressing the dearth of information pertaining to hand hygiene among hospital-based physicians in Ireland and allows for a greater understanding of their perspectives. This is the first study of its kind in Ireland and no comparable studies looking at constants and changes in hand hygiene attitudes and practices among hospital-based physicians over an eight year period were found elsewhere in the literature. Given the greater emphasis placed on hand hygiene in the intervening years, it is not unexpectedly that we report improving attitudes towards hand hygiene and in particular towards hand rubbing, with more doctors in 2015 compared to 2007 accepting the scientific evidence, the likely decreased HCAI rates and the improved patient outcomes achievable when hand hygiene recommendations are consistently followed. While the reported positive attitudes towards hand hygiene may be due to a response bias or a social desirability bias, this is somewhat offset by the inclusion of negatively worded questions and by negative attitudes also reported.

The widespread implementation of the WHO hand hygiene guidelines across the hospital group in which the study was set, coupled with the strong leadership provided by the management team and the infection prevention and control team, appears to have positively influenced attitudes and practices towards hand hygiene. More medical doctors in 2015 are aware of hand hygiene policies compared to 2007 and compared to previously reported (Pittet et al. 2000). Almost a quarter more doctors in 2015 reported that the person they report to expects adherence to hand hygiene policy, suggesting greater governance of hand hygiene practice in recent years, in line with WHO recommendations. However, the positive attitudes are somewhat tempered by the contrasting negative attitudes expressed, relating to the effort required to comply. For example, over a quarter of doctors in 2015 (9% > 2007) reported that it is not
practical to follow hand hygiene recommendations and over one third (10% > 2007) considered hand hygiene practice to be inconvenient. These findings suggest that doctors consider hand hygiene an onerous or burdensome task despite evidence that hand rubbing with ABHR significantly reduces the time taken for hand hygiene (McLaws et al. 2015, Voss and Widmer 1997). However, despite these negative perceptions reported, only 7% considered that they do not have time to use ABHR, differing from previous studies where workload and perceived lack of time to perform hand hygiene influenced compliance among healthcare professionals (Azim et al. 2016, McLaws et al. 2015, Smiddy et al. 2015, Erasmus et al. 2010).

Despite widespread availability of ABHR dispensers throughout the hospital group poor availability of ABHR was reported among NCHDs. Perhaps, a contributing factor to this may be the regular turnover of NCHDs in the Irish healthcare system, leading to unfamiliarity with new surroundings and the location of product dispensers. However, this finding correlates with similar findings elsewhere in the US and Canada where location, inconvenience and empty product dispensers all served as potential barriers to compliance and where a working gel dispenser was found to be the most effective influencing strategy among doctors in Stanford University (Kirk et al. 2016, Barroso et al. 2016, Squires et al. 2014). Point of care availability of ABHR, conveniently located at the bedside, or the personal carriage of small containers of ABHR is essential. Sustained efforts are required to ensure supply, convenience and availability in order to avoid these potential pitfalls and support best practice among all healthcare professionals (Barroso et al. 2016, Allegranzi et al. 2014, WHO 2009, Health Service Executive 2005).

Self-reported hand hygiene practice has improved in the intervening eight years between the two studies, with 28% more doctors in 2015 reporting hand hygiene
compliance before patient contact (86%), and 15% more after patient contact (91%), compared to in 2007. While the reported improvements are promising, these results should be interpreted cautiously. In light of the publication of the WHO guidelines in the intervening years, the sustained campaign within the study setting to improve hand hygiene compliance including target setting and the introduction of evidence-based practice bundles, few doctors can remain unaware of the importance of vigilant hand hygiene practice. In addition, we acknowledge the potential for bias associated with the study design and that inflated or inaccurate results can be introduced when respondents self-report better practice than their actual practice (Cruz and Bashtawi 2015, Gould et al. 2011, Cole 2009). However, it is reasonable to suggest that these same drivers of hand hygiene compliance, combined with the greater awareness of policies and the perception of improved governance reported in this study, may have positively impacted practice and compliance.

Another driver of hand hygiene is the patient perspective. Squires et al. (2014) identified the patient as an important influence for physician hand hygiene compliance and Barroso et al. (2016) found that ‘patient request’ for hand hygiene was an effective strategy for influencing compliance among medical students and doctors. However, in our study only 2% of physicians had been requested by a patient to perform hand hygiene. Despite the WHO recommendation to use ABHR for routine decontamination of hands in most clinical situations and not the traditional hand wash approach using soap and water, 14% (2015) of physicians considered that patients prefer to see physicians doing a traditional hand wash instead of using ABHR. This may provide one possible explanation for the low uptake of ABHR by physicians in this study. This insight into Irish physicians’ perceptions of patients’ perspectives supports previous findings (Squires et al. 2014). It further suggests scope to enhance patient education
on the appropriate use of ABHR and the continuation of patient involvement in hand hygiene campaigns.

While previously, researchers contended that high self-evaluation of hand hygiene behaviour is not reflective of actual compliance and is likely inflated, our study differs, reporting low self-evaluation of ABHR usage and is comparable with others who report low compliance rates among doctors (Gould et al. 2011, Erasmus et al. 2010, Cole 2009). ABHR are ineffective in the removal and destruction of certain spore-forming organisms (e.g. *Clostridium difficile*). However, they are appropriate in most routine clinical situations and, therefore, high compliance rates among healthcare professionals are expected. The low percentage of doctors routinely using ABHR reported in this study raises concerns for the possible transmission of microorganisms and the potential for HCAI. While it is promising to note a 14% improvement in the use of ABHR, despite this, just 39% of doctors in 2015 were using ABHR for hand hygiene indications ‘almost always’. This echoes the findings of a systematic review by Kingston et al. (2016) reporting that despite the widespread implementation of multi-modal hand hygiene intervention strategies compliance rates remained poor.

We noted that the self-reported compliance rate of 39% in this study is considerably lower than results of a national observational hand hygiene audit. A national compliance rate of 74% is reported in Ireland for hand rubbing using ABHR as a percent of hand hygiene opportunities taken, with a set target of 80% (Health Protection Surveillance Centre 2015). Notwithstanding the bias potential associated with a self-report design, the disparity between the two results adds to the debate in the literature around the merits of observational hand hygiene audit, with researchers in the UK and Australia recently suggesting that observational audit hand hygiene results, may be artificially inflated and may deny poor performance, poor
methodology, poor training, the Hawthorne effect and avoidance tactics (Azim et al. 2016, Gould et al. 2016, McLaws et al. 2015, Jeanes et al. 2015). We concur that it may be timely to review the setting of unrealistically high targets and move towards progressively improving performance with reasonably achievable targets and more realistic expectations, with the ultimate goal of achieving improved practices and less infection transmission (Mahida 2016, Jeanes et al. 2015).

Enablers or influencers of hand hygiene previously identified among doctors include self-protection, availability of role-models and perceptions of risk (Smiddy et al. 2015, Erasmus et al. 2009, Pittet et al. 2004). In our study more doctors were influenced to adhere to hand rubbing with ABHR by ‘prevention of cross infection’ than any other factor. ‘Infection prevention and control policy’, ‘evidenced-based practice’ and ‘patient outcomes’ also featured as practice influencers and these results suggest that patient safety is a priority for more Irish doctors than ‘personal protection’ or ‘role model influence’ and differ from previous results (Smiddy et al. 2015, Erasmus et al. 2009, Whitby et al. 2006).

The barriers to hand hygiene identified in this study may provide some insight into reasons for poor compliance among doctors. One in five respondents in both cohorts identified skin sensitivity and skin damage as barriers to hand hygiene. Given that almost half of respondents in 2015 reported personal experience of a dermatology issues arising from hand hygiene, it is unsurprising that these barriers feature prominently. These barriers may constitute a deterrent to adherence to recommended practices and the widespread adoption of ABHR, and may partially account for the sub-optimal self-reported hand rubbing practices. Despite evidence to suggest that ABHR are well tolerated and kinder to the skin than soap and water (Graham et al. 2005, Larson et al. 2000, Pittet 2000), our findings differ, as the majority of doctors
disagreed that ABHR improve skin condition and over one third considered that their skin condition would become drier and more damaged if ABHR recommendations were followed. This is consistent with previous research where ‘products drying out hands’ (32%) is identified as a barrier to compliance among Canadian and American doctors and nurses (Kirk et al. 2016).

When conducting research, there are associated limitations and we acknowledge the limitations in conducting this research. The variation in methods between the two studies conducted and described earlier, for example, different study settings, different sample sizes and the move from postal to online survey may affect the comparability of data and are further discussed here.

Despite a larger sample (n=385) in 2015, compared to 2007 (n=151), the response rate in 2015 was lower. However, the numbers responding, although small, are comparable between both groups, 2007 (n=65) and 2015 (n=58) and are comparable to sample sizes, in similar studies on the topic (Hosseinialhashemi et al. 2015, Yawson and Hesse 2013, Creedon 2005). The move from postal survey in 2007 to online survey in 2015 may provide one possible explanation for the lower response rate in 2015, if medical doctors were not regularly using their employer-based email address. With response rates in mind, results need to be carefully interpreted and consideration given to the possible effect of a response bias, where those who responded were positively disposed to the topic. However, this is somewhat offset by the replication of the study and the consistent responses found in both cohorts. The transferability of the findings of our study may be limited, as the work was performed in one university hospital and one hospital group, in one region of Ireland. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers within the Irish population. Furthermore, findings are validated by similar results reported
elsewhere while also contributing to a new knowledge base (Kirk et al. 2016, Azim et al. 2016, McLaws et al. 2015).
Conclusions

This original study reports improved hand hygiene attitudes and practices among hospital-based physicians in a university hospital group in Ireland between 2007 and 2015. While attitudes towards hand rubbing using ABHR were predominantly positive and have also improved, there remains scope for substantial improvement in hand rubbing practices and scope also to address a number of perceived barriers among doctors. The adoption of international evidence-based hand hygiene guidelines and the widespread support for their implementation both by the government and by the hospital groups’ infection prevention and control team and management team appear to have positively influenced hand hygiene practices and raised awareness of this important patient safety issue among doctors in this study. Ongoing education and training, audits and feedback provided by the local infection prevention and control team, coupled with announced and unannounced audits conducted by governmental agencies appear to be contributing to greater compliance among medical doctors. The heightened emphasis placed on the importance of hand hygiene both in mainstream media and social media, and in society at large, and the resulting greater expectations of the public may have positively impacted doctors’ attitudes and practices. However, given the sustained focus on hand hygiene practices in the intervening years between the two studies, greater improvements were envisaged. Further improvements in hand hygiene practices are essential to addressing the challenges and complications that arise from HCAI, as recently experienced in the study setting (O’Connor et al. 2015a, O’Connor et al. 2015b). Our findings provide new insight into hand hygiene practices among doctors in Ireland and to some degree address the scarcity of recent evidence on the topic. Findings will be of particular interest to medical educators, those in the field of infection prevention and control and to clinicians working in this field.
References


That Hand Hygiene Prevents Cross-Infection. *Infection Control & Hospital Epidemiology*, 30(5), 415-419.


Table 1 Attitudes towards hand hygiene

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>No opinion</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007 % (n)</td>
<td>2015 % (n)</td>
<td>2007 % (n)</td>
<td>2015 % (n)</td>
<td>2007 % (n)</td>
</tr>
<tr>
<td>In this organisation, hand hygiene is important</td>
<td>0.0 (00)</td>
<td>7.0 (04)</td>
<td>1.5 (01)</td>
<td>1.7 (01)</td>
<td>0.0 (00)</td>
</tr>
<tr>
<td>I would prefer to continue my hand washing routines and habits rather</td>
<td>12.3 (08)</td>
<td>24.5 (14)</td>
<td>56.9 (37)</td>
<td>49.1 (28)</td>
<td>7.7 (05)</td>
</tr>
<tr>
<td>than change based on recommended hand hygiene practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommendations of the hospital hand hygiene policy are relevant to my work</td>
<td>0.0 (00)</td>
<td>1.7 (01)</td>
<td>1.5 (01)</td>
<td>3.5 (02)</td>
<td>3.1 (02)</td>
</tr>
<tr>
<td>Adherence to hand hygiene practice is inconvenient</td>
<td>23.4 (15)</td>
<td>14.0 (08)</td>
<td>43.8 (28)</td>
<td>42.0 (24)</td>
<td>6.3 (04)</td>
</tr>
<tr>
<td>The recommendations within the hospital regarding hand-hygiene are based</td>
<td>1.6 (01)</td>
<td>3.5 (02)</td>
<td>6.3 (04)</td>
<td>5.2 (03)</td>
<td>31.3 (20)</td>
</tr>
<tr>
<td>on sound scientific evidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is not really practical to follow the hand-hygiene recommendations</td>
<td>20.6 (13)</td>
<td>24.5 (14)</td>
<td>50.8 (32)</td>
<td>47.3 (27)</td>
<td>9.5 (06)</td>
</tr>
<tr>
<td>I do not wish to change my hand-hygiene practices, regardless of what the policy/research recommends</td>
<td>41.5 (27)</td>
<td>42.1 (24)</td>
<td>46.2 (30)</td>
<td>38.6 (22)</td>
<td>4.6 (03)</td>
</tr>
<tr>
<td>The person I report to expects me to adhere to the hand-hygiene policy</td>
<td>2.2 (02)</td>
<td>3.5 (02)</td>
<td>12.9 (08)</td>
<td>1.7 (01)</td>
<td>27.4 (17)</td>
</tr>
<tr>
<td>My patients prefer to see me do a traditional hand wash instead of using alcohol-based hand rubs</td>
<td>3.2 (02)</td>
<td>5.3 (03)</td>
<td>20.6 (13)</td>
<td>24.6 (14)</td>
<td>54 (34)</td>
</tr>
<tr>
<td>Hand hygiene improves patient outcomes</td>
<td>0.0 (00)</td>
<td>3.5 (02)</td>
<td>1.6 (01)</td>
<td>1.7 (01)</td>
<td>21.9 (14)</td>
</tr>
<tr>
<td>If we follow the recommendations of this policy in our practice setting, it is likely that HCAI/nosocomial infection rates will decrease</td>
<td>3.2 (02)</td>
<td>0.0 (00)</td>
<td>6.3 (04)</td>
<td>1.7 (01)</td>
<td>14.3 (09)</td>
</tr>
</tbody>
</table>
Table II Hand hygiene compliance

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the hospital’s hand hygiene policy</td>
<td>1.5</td>
<td>1.7</td>
<td>10.8</td>
<td>10.8</td>
<td>3.5</td>
<td>2.1</td>
<td>10.8</td>
<td>10.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>I have implemented recommendations made by the infection control team</td>
<td>1.6</td>
<td>0.0</td>
<td>15.9</td>
<td>15.9</td>
<td>8.7</td>
<td>8.7</td>
<td>22.2</td>
<td>22.2</td>
<td>8.7</td>
<td>8.7</td>
</tr>
<tr>
<td>The hospital hand hygiene policy is readily accessible if I want to refer</td>
<td>1.6</td>
<td>0.0</td>
<td>28.1</td>
<td>28.1</td>
<td>10.5</td>
<td>10.5</td>
<td>25.0</td>
<td>25.0</td>
<td>63.2</td>
<td>63.2</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene in front of patients</td>
<td>0.0</td>
<td>0.0</td>
<td>12.5</td>
<td>12.5</td>
<td>7.0</td>
<td>7.0</td>
<td>10.9</td>
<td>10.9</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>I am familiar with WHO Guidelines on Hand Hygiene in Health Care</td>
<td>4.8</td>
<td>4.8</td>
<td>65</td>
<td>65</td>
<td>95.2</td>
<td>95.2</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>I am familiar with the SARI National Guidelines for Hand Hygiene in Irish Health Care Settings (2005)</td>
<td>19.4</td>
<td>19.4</td>
<td>56.1</td>
<td>56.1</td>
<td>80.6</td>
<td>80.6</td>
<td>43.9</td>
<td>43.9</td>
<td>43.9</td>
<td>43.9</td>
</tr>
<tr>
<td>I am familiar with the Health Information Quality Authority Standards for the Prevention and Control of Healthcare Associated Infections (2009)</td>
<td>N/A</td>
<td>N/A</td>
<td>65</td>
<td>65</td>
<td>N/A</td>
<td>N/A</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>
Table III Attitudes to hand rubbing using alcohol-based hand rubs

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (n)</th>
<th>Disagree % (n)</th>
<th>No opinion % (n)</th>
<th>Agree % (n)</th>
<th>Strongly agree % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with alcohol-based hand rubs</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>1.85 (1)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Alcohol-based hand rubs are practical to use</td>
<td>3.2 (2)</td>
<td>3.7 (2)</td>
<td>3.2 (2)</td>
<td>9.26 (5)</td>
<td>3.2 (2)</td>
</tr>
<tr>
<td>Alcohol-based hand rubs help to standardise care and assure patient are treated in a consistent way</td>
<td>4.8 (3)</td>
<td>0.0 (0)</td>
<td>4.8 (3)</td>
<td>7.4 (4)</td>
<td>15.9 (10)</td>
</tr>
<tr>
<td>I feel competent using alcohol-based hand rubs in accordance with recommendation s</td>
<td>3.2 (2)</td>
<td>0.00 (0)</td>
<td>6.3 (4)</td>
<td>0.00 (0)</td>
<td>14.3 (9)</td>
</tr>
<tr>
<td>It is important to act as a role model for others, when using alcohol-based hand rubs</td>
<td>3.2 (2)</td>
<td>0.00 (0)</td>
<td>0.0 (0)</td>
<td>1.85 (1)</td>
<td>15.9 (10)</td>
</tr>
<tr>
<td>Generally, the costs of alcohol-based hand rubs outweigh the benefits</td>
<td>17.5 (11)</td>
<td>18.5 (10)</td>
<td>30.2 (19)</td>
<td>57.4 (31)</td>
<td>46.0 (29)</td>
</tr>
<tr>
<td>I am not really expected to use alcohol-based hand rubs in my practice setting</td>
<td>36.1 (22)</td>
<td>33.3 (18)</td>
<td>54.1 (33)</td>
<td>61.1 (33)</td>
<td>8.2 (5)</td>
</tr>
</tbody>
</table>

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Table IV Factors influencing adherence with alcohol-based hand rubs

The single most important factor that influences me to adhere to the use of alcohol-based hand rubs is:

<table>
<thead>
<tr>
<th>Answer options</th>
<th>Response % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>Prevention of cross infection</td>
<td>50 (27)</td>
</tr>
<tr>
<td>Infection control policy</td>
<td>5.6 (3)</td>
</tr>
<tr>
<td>Patient outcomes</td>
<td>11.1 (6)</td>
</tr>
<tr>
<td>Evidenced-based practice</td>
<td>13 (7)</td>
</tr>
<tr>
<td>Other</td>
<td>3.7 (2)</td>
</tr>
<tr>
<td>Personal protection</td>
<td>“ ”</td>
</tr>
<tr>
<td>Convenience</td>
<td>9.3 (5)</td>
</tr>
<tr>
<td>No opinion</td>
<td>3.7 (2)</td>
</tr>
<tr>
<td>Role model influences</td>
<td>1.9 (1)</td>
</tr>
<tr>
<td>Patient/public expectations</td>
<td>1.9 (1)</td>
</tr>
</tbody>
</table>
Table V Time spent hand rubbing using alcohol-based hand rubs

<table>
<thead>
<tr>
<th>Answer options</th>
<th>Response % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>Never</td>
<td>1.6 (1)</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>11.1 (7)</td>
</tr>
<tr>
<td>Sometimes (10-50% of time)</td>
<td>9.5 (6)</td>
</tr>
<tr>
<td>Often (51-90% of time)</td>
<td>52.4 (33)</td>
</tr>
<tr>
<td>Almost always (&gt;90% of time)</td>
<td>25.4 (16)</td>
</tr>
</tbody>
</table>
## Table VI Barriers to hand rubbing using ABHR

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (n)</th>
<th>Disagree % (n)</th>
<th>No opinion % (n)</th>
<th>Agree % (n)</th>
<th>Strongly agree % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have confidence that ABHR improve my skin’s condition</td>
<td>27.4 (17)</td>
<td>25.9 (14)</td>
<td>50 (27)</td>
<td>8.1 (5)</td>
<td>1.6 (1)</td>
</tr>
<tr>
<td>If I follow the hand hygiene policy recommendations, it is likely my hands will be in worse shape (drier, more skin damage)</td>
<td>7.9 (5)</td>
<td>7.4 (4)</td>
<td>30.2 (19)</td>
<td>27 (17)</td>
<td>23.8 (15)</td>
</tr>
<tr>
<td>My hands do not feel clean following the use of alcohol-based hand rub</td>
<td>14.3 (9)</td>
<td>7.4 (4)</td>
<td>42.9 (27)</td>
<td>11.1 (7)</td>
<td>14.8 (9)</td>
</tr>
<tr>
<td>I find alcohol-based hand rub unpleasant to use</td>
<td>20.6 (13)</td>
<td>7.4 (4)</td>
<td>44.4 (24)</td>
<td>11.1 (7)</td>
<td>14.8 (9)</td>
</tr>
<tr>
<td>Alcohol-based hand rubs are cumbersome and inconvenient</td>
<td>28.6 (18)</td>
<td>25.9 (14)</td>
<td>63 (34)</td>
<td>7.9 (5)</td>
<td>14.8 (8)</td>
</tr>
<tr>
<td>I don't have the time to use alcohol-based hand rub</td>
<td>32.3 (20)</td>
<td>26 (14)</td>
<td>61 (33)</td>
<td>1.6 (1)</td>
<td>1.8 (1)</td>
</tr>
<tr>
<td>In my area of work, I find alcohol-based hand rub readily available</td>
<td>1.6 (1)</td>
<td>1.8 (1)</td>
<td>22.2 (12)</td>
<td>0.00 (0)</td>
<td>31.5 (17)</td>
</tr>
<tr>
<td>My religious/cultural beliefs prevent me from using ABHR in my healthcare setting</td>
<td>66.7 (42)</td>
<td>57.4 (31)</td>
<td>35.2 (19)</td>
<td>7.4 (4)</td>
<td>0.0 (0)</td>
</tr>
</tbody>
</table>
CHAPTER 6

Hand hygiene: attitudes and practices of nurses, a comparison between 2007 and 2015.

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Title
Hand hygiene: attitudes and practices of nurses, a comparison between 2007 and 2015.

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Abstract

Background

Hand hygiene reduces healthcare-associated infections significantly. Yet, international evidence suggests that practices are suboptimal.

Aim

To compare and contrast hand hygiene attitudes and practices and alcohol-based hand rub (ABHR) use, among nurses between 2007 and 2015.

Methods

In 2007, a random sample of nurses in a large teaching hospital was invited to complete a postal survey using a validated questionnaire. In 2015, the study was replicated among all nurses employed in a university hospital group, including the setting of the original study. Data were analysed using SPSS and Survey Monkey.

Findings

Attitudes to hand hygiene were positive and >90% of respondents’ self-reported compliance before and after patient contact. However, 13% fewer in 2015 (42%) reported using ABHR >90% of the time compared to in 2007 (55%). 90% of nurses with <2yrs experience reported using ABHR >50% of the time compared to 73% of nurses with 2-5yrs experience. Barriers to ABHR improved, but remain high, skin sensitivity (23% 2007, 17% 2015), skin damage (18% 2007, 13% 2015), poor user acceptability and tolerance (25% 2007 and 2015).
Conclusion

Use of positive role models, the adoption of a positive social and cultural norm within the organisation and the provision of continuing professional development opportunities may prove useful strategies in harnessing good practice among graduate nurses and in preventing negative socialisation from occurring.
Key Words

Hand hygiene, hand rubbing, alcohol-based hand rub, nurses, attitudes, practices.

Highlights

- Self-reported use of alcohol-based hand rub is sub-optimal
- New graduate nurses self-reported greater compliance with hand rubbing than more experienced nurses
- Barriers to using alcohol-based hand rub have improved in the intervening eight years between the two studies
- Barriers reported include, skin sensitivity, skin damage, tolerance issues and time.
Introduction

Infection prevention and control is a cornerstone of patient safety programmes worldwide; yet, healthcare associated infections (HCAI) pose a significant threat to patient safety (WHO 2009). A point-prevalence survey conducted in Ireland, the setting for this study, reported a national prevalence rate of HCAI in acute-care facilities of 5.2% (HPSC 2012) and the setting for this report has experienced considerable HCAI challenges in recent years, especially from those infections caused by multi drug resistant organisms (MDROs) (O’Connor et al. 2015, O’Connor et al. 2015). The impact of HCAI can be considerable resulting in poor patient outcomes and increased financial burden on healthcare organisations, patients and their families.

Hand hygiene is widely recognised as an effective measure in controlling the spread of HCAI (Kirk et al. 2016, Pittet 2000). Yet, despite this, compliance internationally among healthcare professionals with hand hygiene remains unacceptably low (Kingston et al. 2016, Allegranzi et al. 2014, Allegranzi and Pittet 2009). The preferred method of hand hygiene in most routine clinical situations is hand rubbing (WHO 2009). It is defined as “applying an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices” (WHO 2009).

While there has been some focus internationally on exploring nurses’ attitudes and practices regarding hand hygiene, research from Ireland regarding this topic has been limited (Creedon 2005). In 2007, as part of a larger study, a study of hand hygiene practices and ABHR use among nurses was conducted in a large teaching hospital (Slevin 2007). The study was replicated in 2015 and the setting was expanded to encompass additional sites, following the formation of a university hospital group.
anchored by the same large teaching hospital. In the interim, World Health Organisation (WHO) hand hygiene guidelines were published (WHO 2009). Widespread implementation of the guidelines was supported nationally by governmental agencies and locally by the infection prevention and control team and by the hospital group management team. Hence, the aim of this paper similar to that of a previous study regarding physicians (Kingston et al. 2017) is to compare and contrast results of the two studies, conducted 8 years apart, concerning hand hygiene and hand rubbing attitudes and practices of nurses in Ireland. Our report further attempts to provide insight regarding the demonstrable influence of national and international guidelines in the intervening years.
Methods

**Setting**

In 2007, the study setting was a large regional teaching hospital providing major surgery, cancer treatment, emergency department services, critical care services and other medical, diagnostic and therapy services. In 2015, the expanded setting encompassed a university hospital group, comprising six hospitals functioning collectively as a single hospital system and included the site of the original study, the largest of the hospitals. The hospital group offers a range of inpatient, outpatient, accident and emergency and maternity care services, serves a population of approximately 400,000 people and provides approximately 750 acute hospital beds.

**Design**

Both studies employed a quantitative, survey approach, utilising a validated questionnaire comprising validated Likert-ordinal-attitudinal scale, as the research instrument.

Between March and April 2007, a random sample of nurses employed in the aforementioned teaching hospital was invited to participate in a postal survey. Random sampling was achieved by sourcing a list of all registered nurses in the hospital from the nursing administration department. Each nurse was allocated a number (n=934). Sample size was accurately calculated (n=272) using online software, with a confidence level of 95% and a confidence interval of 5. Using the number allocated to each nurse a random bias-free sample was generated using online software, resulting in 272 numbers. The paper-based survey was distributed by sending participants a
cover letter, the questionnaire and a self-addressed envelope via the internal hospital postal system and requesting return of completed questionnaires by mail. Participation indicated consent and was voluntary and anonymous.

Between November and December 2015, the setting was expanded to the aforementioned hospital group and all nurses (n=1,500) were invited to participate in the survey. The questionnaire was administered by the human resource department of the hospital group and sent to participants via internal staff email addresses. Participants were electronically provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. Participation indicated consent and was voluntary and anonymous. A neutral research assistant, who was unknown to participants, acted as a gatekeeper and managed online survey responses. On completion of the online data collection process, in order to enhance the response rate, hard copies of the survey were also distributed at education and training seminars and the data were subsequently added manually by the research assistant to the online database.

**Study instrument**

In 2007, following a literature review, a study instrument was selected for data collection. The validated questionnaire was originally developed at Columbia University, New York and was designed to assess barriers to adherence to the Centers for Disease Control and Prevention (CDC) 2002 hand hygiene guidelines (Larson 2004, CDC 2002). The survey was modified and contextualised to the Irish setting. A microbiologist and a statistician further reviewed the questionnaire for content validity and a pilot test was carried out (n=20). This helped to identify administrative and analytical issues with the research tool and process.
In 2015, the same questionnaire was used although slightly modified to reflect the publication of international hand hygiene guidelines in the interim. Additional questions were added following review by two experienced researchers (microbiologists) for content validity. No questions were removed. A pilot study was conducted (n=9) contributing to the reliability and validity of the questionnaire as well as checking completion time and allowing for minor redrafting of some questions for greater clarity.

The survey was composed of 42 and 57 questions in 2007 and 2015, respectively with Likert scale, multiple choice and ‘yes or no’ questions. It comprised three sections with focus on demographics, hand hygiene practices and hand rubbing practices.

**Statistical analysis**

In 2007, data were analysed using the Statistical Package for Social Sciences (SPSS) (IBM-SPSS Inc, Armonk, NY, USA) version 14 and in 2015 using SPSS version 24 and Survey Monkey gold plan version. Standard descriptive statistics, including frequencies and percentages, were calculated to characterise the distribution of variables. Parametric testing was not performed as data were ordinal and not normally distributed (Scott and Mazhindu 2014). The relationship between variables was considered where there was a rationale to do so. The Pearson Chi-square test of independence (non-parametric) allowed for testing of association between variables and was suited to the categorical, ordinal data (e.g., Likert scale answers) in this study. We used a significance criterion of \( p<.05 \) for our statistical tests. During analysis ‘agree’ and ‘strongly agree’ responses were combined and likewise, ‘disagree’ and ‘strongly disagree’ responses were combined. This is reflected in the tables presented.
where the original five answer options have been reduced to three categories of responses.

*Ethics*

Both studies were approved by the Research Ethics Committee of the hospital and hospital group, and performed in accordance with the code of ethics of the Declaration of Helsinki (2013). Both studies were conducted anonymously with no identifiable data reported.
Results

In 2007, based on the numbers targeted (n=272) the response rate was 63% (n=171) and in 2015 the response rate was 19% (n=287) based on 1,500 nurses targeted. In 2007, 19% of respondents worked in medical wards compared to 30% in 2015 and 17.5% in surgical wards, compared to 26% in 2015. In 2015, 28% of respondents had worked in clinical practice for between 10 and 20 years and 47% for greater than 20 years. As this question was added in 2015, there are no data for 2007.

Awareness of WHO hand hygiene guidelines among respondents increased significantly (p=<0.001) by 54%, from 31% in 2007 (when draft guidelines were available) to 85% in 2015 (when published WHO guidelines were available). Awareness of Irish national hand hygiene guidelines (HSE 2005) also significantly increased (p=<0.001) in the intervening years from 60% to 79%. Self-reported hand hygiene compliance was consistently high in both cohorts. 93% of respondents in 2007 and 2015 reported implementing hand hygiene recommendations. The majority of respondents in 2007 (95%) and in 2015 (96%) reported compliance with hand hygiene before patient contact, while reported compliance after patient contact improved marginally but not significantly (p=0.109) from 90% in 2007 to 94.5% in 2015. Further results of hand hygiene compliance can be found in Table I.

Hand rubbing practices were explored by examining the percentage of time respondents use ABHR for hand hygiene (Table II), factors that influence adherence (Table III), and the barriers to ABHR usage (Table IV). In 2015, even though 77% of respondents had observed patients affected by HCAI, there was a downward trend in ABHR usage compared to in 2007. 13% fewer nurses in 2015 (42%) reported using ABHR ‘almost always’ (>90% of time), compared to in 2007 (55%). In addition, when
responses were combined it was evident that 10% more nurses in 2015 (21%) compared to in 2007 (11%) reported using ABHR ‘sometimes, rarely or never’. Further analysis and cross tabulation of 2015 data revealed that newly qualified nurses were the most compliant group overall. 45% of respondents working <2yrs in practice reported compliance with hand rubbing using ABHR almost always, whereas just 33% of respondents working 2-5 years in practice reported similarly. In addition, when responses were combined, 90% of respondents working <2yrs in practice reported compliance ‘often’ or ‘always’ (i.e.>50% of time), compared to 73% of those working 2-5 years and 74% of those working 10-20 years in practice.

In 2015, even though 17% of respondents reported personal experience of HCAI, only 5% identified ‘personal protection’ as the single most important factor that influenced their adherence to ABHR practices. Further analysis and cross tabulation revealed that of the 5% who identified ‘personal protection’, 0% worked in surgical wards, 44% worked in medical wards, while 56% worked in other areas. Comparative data is not available here as these two questions were added in 2015. In contrast to the very low percentage of respondents identifying ‘personal protection’, 66% of respondents in 2007 and 47% in 2015 identified ‘prevention of cross infection’ as the single most important factor that influenced adherence to hand rubbing practices. In addition, ‘infection control policy’ also featured strongly in both cohorts (16%-2007 and 17%-2015).

The percentage of respondents reporting no barriers to ABHR increased from 34% in 2007 to 38% in 2015 and respondents’ perceptions of dermatology related barriers also improved. Of significance (p=0.05), 10% fewer respondents in 2015 (33%) agreed that skin condition would become drier and more damaged if hand hygiene recommendations were followed, compared to in 2007 (43.7%), while 8% fewer in
2015 (59%) compared to 2007 (67%) disagreed that ABHR improves skin condition. When asked to identify the single most important barrier to adhering to the use of ABHR, 23% in 2007 and 17% in 2015 identified ‘skin sensitivity’, while 18% in 2007 and 13% in 2015 identified ‘skin damage’. Further analysis of 2015 data revealed that ‘skin damage’ was identified by 30% of respondents with <2 years experience compared to 8% of respondents with >20 years of experience. With regard to user acceptability, over a quarter of respondents in both cohorts considered that hands do not feel clean following the use of ABHR, while 26% of respondents in 2007 and 20% in 2015 reported that ABHR was unpleasant to use. Time was identified as the single most important barrier to ABHR usage among 9.5% and 10.9% of respondents in 2007 and 2015 respectively. In 2015, ‘time’ was identified by 15% of respondents with <2 years experience compared to 6% of respondents with 10 to 20 years of experience.

Even though a downward trend in hand rubbing using ABHR is reported between 2007 and 2015, attitudes towards hand hygiene and hand rubbing were consistently positive overall, with little change evident in the intervening years. Over 95% of respondents in both cohorts reported that hand hygiene policy was relevant to their work, while over 90% considered that the person they report to expected adherence to hand hygiene policy. The vast majority in both cohorts considered that hand hygiene improves patient outcomes, that hand hygiene recommendations are based on sound scientific evidence and that if these recommendations are followed it is likely that HCAI rates will decrease. The majority reported that ABHR help to standardise care and ensure patients are treated in a consistent manner. The majority also reported that ABHR is practical to use and that they felt competent using ABHR products in accordance with recommendations. Over 95% in both cohorts considered that it is important to act as a
role model for others when using ABHR. Further results of attitudes towards hand rubbing can be found in Table V.

Marginal but not statistically significant changes in negative attitudes towards hand hygiene were reported among a minority in both cohorts, for example, 4.7% of respondents in 2007 did not wish to change personal hand hygiene practice, regardless of what the policy recommends, compared to 2.2% in 2015. In contrast, 8% in 2007 compared to 13% in 2015 reported that it is not practical to follow hand hygiene recommendations, while just over 10% in both cohorts considered hand hygiene to be inconvenient. Further results of attitudes towards hand hygiene can be found in Table VI.
Discussion

No comparable studies looking at constants and changes in hand hygiene attitudes and practices among nurses over an eight year period were found elsewhere in the international literature; hence, this paper makes a novel and valuable contribution in its field. In addition, this is the first study of its kind in Ireland and addresses the scarcity of information available on hand hygiene practices among nurses in Ireland. Only one other study conducted into hand hygiene practices among registered nurses in Ireland was found, with data collection dating back to 2001 (Creedon 2005) and one study examining hand hygiene practices among nursing students was also found (Kingston et al. 2017). Given that Ireland has historically been a net exporter of nurses to such countries as the United States, Canada, Australia and the United Kingdom (Humphries et al. 2008), with estimates suggesting that foreign-educated nurses represent 5–10 percent of such countries’ nurse workforce (Kingma 2007), the potential impact of Irish nurses on infection prevention and control and patient safety issues internationally is considerable. Hence, within a global nursing context and cognisant that hand hygiene is a globally transferrable clinical skill this study makes a significant contribution to the international body of literature.

Caution was exercised in interpreting results due to the bias potential associated with the self-report study design as respondents may self-report better practices than their actual practice, leading to artificially high results (Gould et al. 2011, Cole 2009, Larson 2004). Others have suggested that self-report survey design predicts intention to comply rather than actual performance (O’Boyle et al. 2001, Borg et al. 2009). Hence, it is probably reasonable to assume that our data offer a reasonably accurate picture of nurses’ perceptions and intentions.
Awareness of international and national hand hygiene guidelines among respondents significantly improved in the intervening years between the two studies, coinciding with the widespread adoption of the WHO hand hygiene guidelines in the study setting. This, along with a positive attitude among respondents towards the relevance of hand hygiene policy to their work and the perception that managers expect adherence to hand hygiene policy suggests that hand hygiene guidelines may be positively influencing practice. The predominately positive attitudes among nurses towards hand hygiene reported in our study is also reflected in the literature (McLaws et al. 2015, Hosseinialhashemi et al. 2015, Creedon 2005), although, Shinde and Mohite (2014) report negative attitudes among nurses in a teaching hospital in India.

We know that nurses have high levels of direct patient contact due to the nature of their work and consequently, they experience a high burden of hand hygiene, resulting in up to 15 opportunities to use ABHR per hour (Boyce et al. 2017, Doronina et al. 2017, Azim et al. 2016). Accordingly, this places a high onus of responsibility on nurses to comply with best practice in the interest of patient safety. Nurses have a moral, ethical and professional responsibility to engage in optimal usage of ABHR in the daily routine delivery of care. However, disappointingly, in this study a continuing trend of suboptimal usage of ABHR was found and fewer nurses self-reported compliance with hand rubbing best practice in 2015 than in 2007, despite greater knowledge of policy recommendations in 2015. This raises concerns for the possible transmission of multi-drug resistant organisms and the potential for HCAI. It also suggests that knowledge does not always result in improved practices and that despite positive attitudes, good intention does not always result in good practice.

An associated risk factor for poor hand rubbing practice that is rarely reported is the clinical experience of healthcare workers (WHO 2009). We found that nurses working
less than two years in practice were more complaint with optimum hand rubbing practice compared to more experienced nurses, a finding echoed by Darawad et al. (2012). This finding is significant when examined under a professional socialisation lens. The behaviour of junior healthcare professionals is influenced by the example shown by their more senior colleagues and if senior colleagues display poor practices, negative socialisation may occur (Erasmus et al. 2009, Huis et al. 2012, Huis et al. 2013). Newly qualified nurses, in an effort to ‘fit in’ may compromise their own practice in order to achieve a sense of belonging (Houghton 2014). In order to prevent negative socialisation from occurring and to encourage the continuation of good practice it is important that a strong cultural or social norm of excellence in hand hygiene compliance exists (Erasmus et al. 2009). Additionally, positive role models make a significant contribution to positively influencing the behaviour and practice of others and are associated with improvements in hand hygiene compliance and reduced HCAI rates (Huis et al. 2013, Marra et al. 2010), along with preventing the onset of hand hygiene fatigue among staff (Seto et al. 2013).

Internationally and in Ireland nurses are required by their regulatory body to continuously develop their knowledge and skills through Continuing Professional Development (CPD) and post-graduate programmes (NMBI 2017). CDP may prove useful in positively influencing compliance. In this study and consistent with previous studies, we found that even though the majority of respondents had availed of CPD in the form of hand hygiene education and training and were familiar with policies, suboptimal practices were evident (Korniewicz and El-Masri 2010, Hosseinalhashemi et al. 2015). Notwithstanding that education is but one component of the recommended multi-modal hand hygiene strategy (WHO 2009), our findings suggest scope among nurses for increased engagement with post-graduate infection prevention and control
programmes that may increase their sensitivity to the importance of hand hygiene as a patient safety measure and their awareness of their moral, ethical and professional responsibilities in this regard (Belela-Anacleto et al. 2017, Korniewicz and El-Masri 2010).

ABHR are kinder to the skin than hand washing with soap and water (Pittet 2000). Despite this, our findings suggest that over half of respondents may be routinely using soap and water for hand hygiene and reflects previous international findings reporting a preference for soap and water (Kirk et al. 2016, Ataei et al. 2013, Anargh et al. 2013, Borg et al. 2009). Furthermore, our finding supports the contention that the use of soap and water is an established behaviour that is difficult to change and the possibility that respondents may find the use of soap and water subconsciously more gratifying for perceived self-efficacy (Fitzpatrick et al. 2011, Borg et al. 2009). Perhaps coincidental, but nonetheless of concern, we also report that almost half of all respondents had experienced a dermatology issue arising from hand hygiene and three quarters of respondents had observed a colleague with similar.

Similar to findings reported among healthcare workers in the US, our data from both cohorts reveal greater percentages of nurses were influenced to adhere to hand rubbing by ‘prevention of cross infection’ than any other factor (McLaughlin and Walsh 2012). Results contrast with previous work in the field where self-protection was identified as a major driver of hand hygiene among healthcare workers and personal protection was identified as more influential to hand hygiene compliance than patient safety (Smiddy et al. 2015, Korniewicz and El-Masri 2010, Darawad et al. 2012, Borg et al. 2009, Erasmus et al. 2009, Whitby et al. 2006).
Regardless of study designs, results suggest that compliance rates among nurses before and after patient contact can vary greatly, from 42-62% compliance before patient contact to 72-87% after patient contact in direct observation design studies (O’Boyle et al. 2001, Korniewicz and El-Masri 2010). Similarly, compliance rates varied from 31% to 74% in studies adopting a survey design, (Hosseinialhashemi et al. 2015, Darawad et al. 2012). In this study, self-reported compliance with recommended hand hygiene practices was over 90%, both before and after patient contact and in both cohorts. While others have reported significantly higher compliance rates after patient contact than before patient contact, suggesting self-protection as a driving force, in our study there was no significant difference found in rates before and after patient contact, in either cohort (Yawson and Hesse 2013, Borg et al. 2009).

Comparative data reveal a downward trend in perceptions of barriers between 2007 and 2015 and findings compare more favourably to other similar international studies (Kirk et al. 2012, McLaws et al. 2015). Despite the downward trend, skin sensitivity and skin damage featured prominently as barriers to ABHR particularly among graduate nurses, despite evidence that ABHR is well tolerated (Larson 2000, Pittet 2000, Graham et al. 2005). In contrast, others have reported user intolerance and acceptability issues and these barriers also featured in our study (Kirk et al. 2016, Darawad et al. 2012). Despite evidence that hand rubbing with ABHR significantly reduces the time required for hand hygiene compared to hand washing (Voss and Widmer 1997, McLaws et al. 2015), time also featured as a barrier among one in ten respondents, a finding reflected in other international studies (Sadule-Rios and Aguilera 2017, Voss and Widmer 1997, Pittet et al. 1999). The barriers identified in this study may constitute deterrents to adherence to recommended practices and may partially account for the sub-optimal self-reported hand rubbing practices. A recent
research study assessing a simplified three step hand rubbing technique and another assessing the impact of the duration of hand rubbing on bacterial count report promising results with further research recommended (Tschudin-Sutter et al. 2017, Pires et al. 2017).

Limitations

As mentioned earlier, despite a larger sample (n=287) in 2015, compared to 2007 (n=171), the response rate in 2015 was lower. However, sample sizes and the response rates are comparable to similar studies on the topic (Kirk et al. 2016, Darawad et al. 2012, Hosseinialhashemi et al. 2015). The move from postal survey in 2007 to online survey in 2015 may provide one possible explanation for the lower response rate in 2015 if nurses were not regularly using their employer-based email address.

Consideration must be given to the possible effect of a social desirability bias, where prevailing social views may have influenced respondents. In addition, the impact of a response bias, where respondents may have been positively disposed to the topic cannot be ruled out (Polit and Beck 2010). We attempted to address these potential biases by counterbalancing positively and negatively worded questions, ensuring sensitively worded non-judgemental questions and guaranteeing confidentiality. The potential for biased results is also somewhat offset by the consistent responses found in both cohorts.

The transferability of the findings of our study may be limited, as the work was performed in one university hospital group, in one region of Ireland. However, it is reasonable to speculate that opinions expressed in this study may be representative, in
general, of their peers. Furthermore, findings are validated by similar results reported elsewhere (Kirk et al. 2016, Azim et al. 2016, McLaws et al. 2015).
Conclusions

It is encouraging to report predominately positive attitudes towards hand hygiene and strong motivation among nurses to prevent cross-infection in both hand hygiene studies, conducted in 2007 and 2015. The demonstrable influence of international and national guidelines in the intervening years is reflected in the findings and discussion. While it is disappointing to report a trend of sub-optimal compliance with the routine utilisation of ABHR in most clinical situations, we report greater compliance among graduate nurses. We caution that negative socialisation must be prevented so that positive practices among graduate nurses can be maintained. There is considerable scope to improve the routine utilisation of ABHR over soap and water, in line with recommendations (WHO 2009, HSE 2005). Our findings provide new insight into hand hygiene practices among nurses in Ireland. Mindful of the mobility of Irish nurses and their contributions to healthcare systems globally, these findings will be of particular interest internationally to nurse educators, managers, infection prevention teams and to clinicians working in the field.
References


available: [https://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf](https://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf) [accessed November 2016].


Table I Hand hygiene compliance among nurses

<table>
<thead>
<tr>
<th>Questions</th>
<th>Disagree or Strongly Disagree % (n)</th>
<th>No Opinion % (n)</th>
<th>Agree or Strongly Agree % (n)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the hospital’s hand hygiene policy</td>
<td>1.2 (2) 2.9 (8)</td>
<td>0.6 (1) 1.8 (5)</td>
<td>98.2 (168) 95.2 (260)</td>
<td>.495</td>
</tr>
<tr>
<td>I have implemented the recommendations made by the infection control team regarding hand hygiene</td>
<td>3.0 (5) 4.7 (13)</td>
<td>3.6 (6) 2.2 (6)</td>
<td>93.5 (157) 93.1 (254)</td>
<td>.358</td>
</tr>
<tr>
<td>The hospital hand hygiene policy is readily accessible if I want to refer to it</td>
<td>3.5 (6) 5.1 (14)</td>
<td>1.2 (2) 3.7 (10)</td>
<td>95.3 (162) 91.2 (249)</td>
<td>.157</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene before each patient contact</td>
<td>5.3 (9) 1.8 (5)</td>
<td>4.7 (8) 2.2 (6)</td>
<td>90.0 (154) 96.0 (262)</td>
<td>.003</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene after each patient contact</td>
<td>4.2 (7) 2.9 (8)</td>
<td>5.9 (10) 2.6 (7)</td>
<td>89.9 (152) 94.5 (258)</td>
<td>.109</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2007</th>
<th>2015</th>
<th>2007</th>
<th>2015</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>I am familiar with the WHO Guidelines on Hand Hygiene in Health Care (2009)</td>
<td>*31.6 (54)</td>
<td>85.7 (234)</td>
<td>*68.4 (117)</td>
<td>14.3 (39)</td>
</tr>
<tr>
<td>I am familiar with the National SARI Guidelines for Hand Hygiene in Irish Health Care Settings (2005)</td>
<td>60.3 (103)</td>
<td>79.1 (216)</td>
<td>39.8 (68)</td>
<td>20.9 (57)</td>
</tr>
<tr>
<td>I am familiar with the Health Information Quality Authority (HIQA) National Standards for Prevention and Control of Healthcare Associated Infections (2009)</td>
<td>N/A</td>
<td>90.1 (246)</td>
<td>N/A</td>
<td>9.9 (27)</td>
</tr>
</tbody>
</table>

*In 2007 Draft WHO Guidelines on Hand Hygiene in Health Care were available*
Table II Time spent hand rubbing using alcohol-based hand rub among nurses

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response</th>
<th>2007</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1.8 (3)</td>
<td>0.37 (1)</td>
<td></td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>0.6 (1)</td>
<td>3.37 (9)</td>
<td></td>
</tr>
<tr>
<td>Sometimes (10-50% of time)</td>
<td>8.5 (14)</td>
<td>17.6 (47)</td>
<td></td>
</tr>
<tr>
<td>Often (51-90% of time)</td>
<td>33.9 (56)</td>
<td>36.7 (98)</td>
<td></td>
</tr>
<tr>
<td>Almost always (&gt;90% of time)</td>
<td>55.2 (91)</td>
<td>41.95 (112)</td>
<td></td>
</tr>
</tbody>
</table>
Table III Factors influencing adherence with alcohol-based hand rub

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>Response % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>Prevention of cross infection</td>
<td>66 (70)</td>
</tr>
<tr>
<td>Infection control policy</td>
<td>16 (17)</td>
</tr>
<tr>
<td>Patient outcomes</td>
<td>9.4 (10)</td>
</tr>
<tr>
<td>Evidenced-based practice</td>
<td>6.6 (7)</td>
</tr>
<tr>
<td>Other</td>
<td>0.9 (1)</td>
</tr>
<tr>
<td>Personal protection</td>
<td>*No data</td>
</tr>
<tr>
<td>Convenience</td>
<td>0.9 (1)</td>
</tr>
<tr>
<td>No opinion</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Role model influences</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Patient/public expectations</td>
<td>0.0 (0)</td>
</tr>
</tbody>
</table>

*Answer option added to 2015 survey
Table IV Barriers to hand rubbing using alcohol-based hand rub among nurses

<table>
<thead>
<tr>
<th>Questions</th>
<th>Disagree or Strongly Disagree % (n)</th>
<th>No Opinion % (n)</th>
<th>Agree or Strongly Agree % (n)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have confidence that alcohol-based hand rub improves my skin’s condition</td>
<td>66.9 (111)</td>
<td>59.2 (158)</td>
<td>20.5 (34)</td>
<td>27.3 (73)</td>
</tr>
<tr>
<td>If I follow the hand hygiene policy recommendations it is likely my hands will be in worse shape (drier, more skin damage)</td>
<td>47.3 (79)</td>
<td>51.6 (138)</td>
<td>9.0 (15)</td>
<td>15.0 (40)</td>
</tr>
<tr>
<td>My hands do not feel clean following use of alcohol-based hand rub</td>
<td>65.4 (110)</td>
<td>67.7 (181)</td>
<td>7.1 (12)</td>
<td>6.7 (18)</td>
</tr>
<tr>
<td>I find alcohol-based hand rub unpleasant to use</td>
<td>68.5 (115)</td>
<td>69.0 (184)</td>
<td>5.4 (9)</td>
<td>10.5 (28)</td>
</tr>
<tr>
<td>Alcohol-based hand rubs is cumbersome and inconvenient</td>
<td>93.4 (157)</td>
<td>91.0 (243)</td>
<td>4.2 (7)</td>
<td>4.9 (13)</td>
</tr>
<tr>
<td>I don't have the time to use alcohol-based hand rub</td>
<td>94.0 (158)</td>
<td>95.1 (254)</td>
<td>0.6 (1)</td>
<td>1.9 (5)</td>
</tr>
<tr>
<td>In my area of work, I find alcohol-based hand rub readily available</td>
<td>4.2 (7)</td>
<td>6.76 (18)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>My religious/cultural beliefs prevent me from using alcohol-based hand rub in my healthcare setting</td>
<td>92.8 (155)</td>
<td>94.7 (253)</td>
<td>6.6 (11)</td>
<td>4.5 (12)</td>
</tr>
</tbody>
</table>
Table V Attitudes to hand rubbing using alcohol-based hand rub among nurses

<table>
<thead>
<tr>
<th>Questions</th>
<th>2007 Disagree or Strongly Disagree % (n)</th>
<th>2007 No Opinion % (n)</th>
<th>2007 Agree or Strongly Agree % (n)</th>
<th>2015 Disagree or Strongly Disagree % (n)</th>
<th>2015 No Opinion % (n)</th>
<th>2015 Agree or Strongly Agree % (n)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with alcohol-based hand rub</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>100 (167)</td>
<td>1.5 (4)</td>
<td>0.37 (1)</td>
<td>98.1 (262)</td>
<td>.000</td>
</tr>
<tr>
<td>Alcohol-based hand rub is practical to use</td>
<td>3.0 (5)</td>
<td>1.2 (2)</td>
<td>95.8 (158)</td>
<td>2.6 (7)</td>
<td>1.1 (3)</td>
<td>96.2 (257)</td>
<td>.094</td>
</tr>
<tr>
<td>Alcohol-based hand rub helps to standardise care and assure patients are treated in a consistent way</td>
<td>2.4 (4)</td>
<td>5.4 (9)</td>
<td>92.2 (154)</td>
<td>2.2 (6)</td>
<td>10.5 (28)</td>
<td>87.3 (233)</td>
<td>.290</td>
</tr>
<tr>
<td>I feel competent using alcohol-based hand rub products in accordance with recommendations</td>
<td>1.8 (3)</td>
<td>1.8 (3)</td>
<td>96.4 (162)</td>
<td>0.74 (2)</td>
<td>1.1 (3)</td>
<td>98.1 (262)</td>
<td>.094</td>
</tr>
<tr>
<td>It is important to act as a role model for others, when using alcohol-based hand rub</td>
<td>1.8 (3)</td>
<td>1.2 (2)</td>
<td>97.0 (163)</td>
<td>3.74 (10)</td>
<td>0.75 (2)</td>
<td>95.5 (254)</td>
<td>.390</td>
</tr>
<tr>
<td>Generally, the costs of alcohol-based hand rub outweigh the benefits</td>
<td>49.4 (81)</td>
<td>28.0 (46)</td>
<td>22.6 (37)</td>
<td>55.8 (149)</td>
<td>24.7 (66)</td>
<td>19.5 (52)</td>
<td>.339</td>
</tr>
<tr>
<td>I am not really expected to use alcohol-based hand rub in my practice setting</td>
<td>94.6 (159)</td>
<td>1.2 (2)</td>
<td>4.2 (7)</td>
<td>94.4 (252)</td>
<td>1.1 (3)</td>
<td>4.4 (12)</td>
<td>.446</td>
</tr>
</tbody>
</table>
### Table VI: Attitudes towards hand hygiene among nurses

<table>
<thead>
<tr>
<th>Questions</th>
<th>Disagree or Strongly Disagree % (n)</th>
<th>No Opinion % (n)</th>
<th>Agree or Strongly Agree % (n)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this organisation, hand hygiene is important</td>
<td>1.8 (3) 4.5 (12) 0.6 (1) 1.4 (4)</td>
<td>97.6 (167)</td>
<td>94.0 (257)</td>
<td>.046</td>
</tr>
<tr>
<td>Generally, I would prefer to continue my hand washing routines and habits rather than to change based on recommended hand hygiene practices</td>
<td>81.3 (139) 80.9 (221) 2.3 (4) 4.0 (11)</td>
<td>16.4 (28)</td>
<td>15.0 (41)</td>
<td>.884</td>
</tr>
<tr>
<td>The recommendations of the hospital hand hygiene policy are relevant to my work</td>
<td>1.2 (2) 4.0 (11) 0.0 (0) 0.7 (2)</td>
<td>98.8 (168)</td>
<td>95.2 (260)</td>
<td>.309</td>
</tr>
<tr>
<td>Adherence to hand hygiene practice is inconvenient</td>
<td>87.3 (145) 86.7 (237) 1.8 (3) 2.5 (7)</td>
<td>10.8 (18)</td>
<td>10.6 (29)</td>
<td>.890</td>
</tr>
<tr>
<td>The recommendations within the hospital regarding hand hygiene are based on sound scientific evidence</td>
<td>1.8 (3) 2.6 (7) 8.8 (15) 8.0 (22)</td>
<td>89.5 (153)</td>
<td>89.4 (244)</td>
<td>.332</td>
</tr>
<tr>
<td>It is not really practical to follow the hand hygiene recommendations</td>
<td>91.3 (156) 83.8 (229) 0.6 (1) 2.9 (8)</td>
<td>8.2 (14)</td>
<td>13.1 (36)</td>
<td>.026</td>
</tr>
<tr>
<td>Statement</td>
<td>Percentage</td>
<td>Confidence Interval</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------------</td>
<td>---------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>I don’t have the time to stay informed about new developments in hand hygiene</td>
<td>83.8% (140)</td>
<td></td>
<td>.027</td>
<td></td>
</tr>
<tr>
<td>I do not wish to change my hand hygiene practices, regardless of what the policy/research recommends</td>
<td>94.2% (161)</td>
<td></td>
<td>.65</td>
<td></td>
</tr>
<tr>
<td>The person I report to expects me to adhere to the hand hygiene policy</td>
<td>4.7% (8)</td>
<td></td>
<td>.147</td>
<td></td>
</tr>
<tr>
<td>My patients prefer to see me do a traditional hand wash instead of using alcohol based hand rub</td>
<td>30.0% (51)</td>
<td></td>
<td>.544</td>
<td></td>
</tr>
<tr>
<td>Patients are generally aware of hand hygiene recommendations including the use of alcohol based hand rub</td>
<td>32.5% (54)</td>
<td></td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Hand hygiene improves patient outcomes</td>
<td>1.8% (3)</td>
<td></td>
<td>.063</td>
<td></td>
</tr>
<tr>
<td>If we all follow the recommendations of this policy in our practice setting, it is likely that HCAI/nosocomial infection rates will decrease</td>
<td>3.0% (5)</td>
<td></td>
<td>.284</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 7

Discussion and conclusion
Introduction

We currently live in a challenging era of global AMR and MDRO-associated infections and the setting for this research, the mid-West region of Ireland, has in recent times experienced well-documented HCAI challenges (O’Connor 2016). Hand hygiene is widely recognised and promoted as an effective strategy to counter occurrences of HCAI (WHO 2009, CDC 2002). However, internationally hand hygiene compliance remains low (Huis et al. 2013, Ho et al. 2012) although improvements are reported (Randle et al. 2014). In Ireland, to date, there has been a dearth of independent research conducted into hand hygiene compliance among healthcare workers, with few recent studies providing baseline data or a frame of reference from which changes can be monitored. Given the HCAI challenges faced nationally and in particular in the mid-West region of Ireland, it was timely to explore hand hygiene and, in so doing, provide insight into the current practices among healthcare workers that may in-part inform policies to deal with the current HCAI challenges the region is experiencing.
Methodology

This research was conducted using a cross-sectional, self-report survey design, using a questionnaire as the data collection instrument. Taking account of a possible social desirability bias and a possible response bias, anonymity and confidentiality were ensured, non-judgemental language was used and negatively and positively worded questions were counterbalanced. Additionally, the surveys were administered by persons not acquainted with the respondents and respondents had time to reflect on the survey questions, thereby enabling valuable insights to be achieved (Neo 2017).

Some suggest that self-report design predicts intention to comply rather than actual performance (O’Boyle et al. 2001, Borg et al. 2009) and that respondents may report better practices than their actual practices, leading to artificially high results (Gould et al. 2011, Larson et al. 2004). Therefore, a cautious approach to interpreting results was adopted. Neo (2017) suggests that data from self-reports can subsequently be compared with data from direct observation. For example, this research reports low compliance with hand hygiene after touching a patient’s surroundings (overall mean compliance 59%) and compares similarly with findings by Randle et al. (2014) and Fitzgerald et al. (2013), where direct observation was used for data collection. In addition, some results from national target driven audits and from unannounced audits conducted by the government watchdog, the Health Information and Quality Authority (HIQA) are also comparable, and thereby strengthen results of this research and partially address validity.
Systematic Review

The systematic review presented in this thesis provides high level evidence that hand hygiene compliance rates remain low to moderate despite international efforts to improve compliance among HCWs. The studies reviewed were conducted primarily in acute care and older person settings, focusing predominantly on compliance among nurses, doctors and healthcare assistants across the US and Europe. No studies from Ireland were retrieved. Hand hygiene intervention strategies focused strongly on ‘education’ and ‘performance feedback’, and of the 16 studies reviewed just four featured ‘leadership support’ and only two adopted a ‘team approach’. Compliance rates before interventions were low (mean 34%) and after interventions, moderate improvements were found (mean 57%).

Implications for research

The systematic review identified poor focus internationally on hand hygiene compliance among healthcare students, who through their significant contribution to healthcare delivery are at risk of becoming mediators of pathogenic organisms or of contracting a HCAI (Al-Khawaldeh et al. 2015, Bargellini et al. 2014). Given the significant contribution students make to healthcare delivery and patient care, future hand hygiene research ought to include this cohort.

The review identified a lack of focus to date on robust independent hand hygiene research in Ireland. Given the significant HCAI and AMR challenges Ireland is currently experiencing and the important contribution effective hand hygiene practice makes to infection prevention and control, future focus on hand hygiene research is warranted.
Hand hygiene attitudes and practices among healthcare students and workers in the mid-West of Ireland.

This thesis reports four studies of hand hygiene attitudes and practices among nursing and medical students, and among qualified nurses and doctors, in the mid-West region of Ireland. All of the studies were based on inviting participants to complete a study instrument that included self-reporting of compliance with hand hygiene.

**Biases of the study and interpretation of the results**

The limitations associated with self-reporting are discussed earlier in the chapter under the methodology section. Here, the impact of these limitations is analyzed further in respect of the interpretation of the results. A number of potential biases associated with a voluntary survey that may have implications for the interpretation of study results are discussed and these include, a) response bias, b) social desirability bias, c) recall bias, d) extreme response bias and e) acquiescence response bias (Polit and Beck 2013, The Joint Commission 2009). Also discussed are the limitations arising from the samples and response rates.

a) When conducting a survey consideration should be given to a response bias, where those who respond to a survey may be positively disposed to the survey topic. Therefore, in interpreting the predominantly positive attitudes reported in this study a possible response bias was considered.

b) A social desirability bias where respondents may misrepresent their attitudes or practices in line with prevailing social views was also considered. The adoption of the recommendations of the WHO Guidelines in the study settings, along with the sustained focus of the infection prevention and control team on
hand hygiene compliance may have led some healthcare workers to know what answers were expected in the survey. Hence, some responses may be more indicative of intention to comply as opposed to actual compliance (Borg et al. 2009). The survey results may have reflected healthcare workers’ exposure and absorption of what they should be saying rather than what they actually did.

c) A recall bias was also considered as respondents were asked to recall past events and practices. Recall bias occurs because memories are imperfect and vary based on perception. In this study respondents were asked to recall many aspects of their hand hygiene practices and so this was also considered as a potential bias.

d) An extreme response bias, where respondents may display a tendency to consistently select extreme positive or negative answer options, was also considered given the nature of the Likert scale answer options used in the surveys.

e) Another bias considered was the acquiescence response bias, where respondents display a tendency to agree with responses regardless of content.

To offset these potential biases anonymity and confidentiality were guaranteed, non-judgmental sensitively worded questions were used and questions were counterbalanced with positively and negatively worded questions. The inclusion of a neutral response option also allowed respondents to opt out of a response and thereby avoiding inaccurate answers. In addition, conducting the survey online automatically reduced the potential for biases somewhat because the questions were self-administered thus facilitating honesty among respondents.
Although the numbers of respondents were high there were very large differences in response rates between staff groups participating in the same survey, and this limitation has implications for the interpretation and the generalizability of the results. One possible explanation for the varying response rates may be the variation in the methods between the different periods which may affect the comparability. The initial 2007 surveys were undertaken in a large teaching hospital and the subsequent 2015 surveys in an expanded setting of six hospitals including the original site. The 2007 surveys used a postal questionnaire and the 2015 used an online questionnaire. The number of questions also changed from 42 to 57. In 2007 a random sampling strategy was adopted, while in 2015 a total accessible population sampling strategy was adopted in an effort to reduce the risk of missing potential insights from nurses and doctors not included. The non-response bias evident in the 2015 surveys limits the generalisability of the results to a broader population (Polit and Beck 2013).
Hand hygiene and healthcare students

This thesis reports hand hygiene attitudes and practices among undergraduate nursing students and graduate-entry medical students in a university in the mid-West region of Ireland. While overall attitudes towards hand hygiene among the majority of nursing and medical students were positive, similar to previous reports (Nair et al. 2014, van de Mortel et al. 2012) the data indicate more positive attitudes among nursing than medical students. Reported knowledge of international hand hygiene guidelines was high. However, similar to findings reported elsewhere (D’Alessandro et al. 2014, van de Mortel et al. 2012, van de Mortel et al. 2010) nursing students appear to have better knowledge than medical students, in particular, knowledge of the clinical contraindications for ABHR use and around when to use soap and water and when to use ABHR.

However, the more positive attitudes and the better knowledge reported among nursing students did not translate to better practices when compared to medical students. According to results, just 22% of nursing students compared to 47% of medical students routinely use ABHR for hand hygiene >90% of the time. This compares poorly with practice among healthcare students in Italy and contrasts with significantly higher hand rubbing frequency reported among Italian nursing students compared to medical students (Bargellini et al. 2014). Given the low rates of engagement with optimum hand rubbing practice the perceived dermatology-related barriers to ABHR use reported among Irish healthcare students may, in fact, be attributable to the apparent over use of soap and water for routine hand decontamination, despite the evidence in favour of ABHR use (Graham et al. 2005, Pittet et al. 2000, Larson et al. 2000).
The recent improvements in hand hygiene practice among healthcare professionals after touching a patient’s surrounding (Price et al. 2016) are not echoed here among healthcare students, with up to 40% of students missing this opportunity for hand hygiene. While there is scope for improvement in all ‘five moments for hand hygiene’ (WHO 2009), particular focus on this indication for hand hygiene is needed and infection prevention and control curricula should reflect this.

A new contribution to this field of study is the comparative data reported across the four years of the nursing degree programme. Better hand hygiene practice among 1st and 2nd year nursing students compared to 3rd and 4th year students emerged when cross-tabulations were carried out relating to the ‘five moments for hand hygiene’ (WHO 2009). Also, 2nd year students reported better compliance with optimal ABHR use compared to students in other years. One possible explanation for this may be the frontloading of infection prevention and control content in the nursing curriculum during the early years of the degree programme, particularly in 2nd year and less theoretical input in subsequent years. A possible further explanation may be the impact of negative socialisation in clinical practice, where students implement less desirable practice to ‘fit in’ in favour of evidence-based practice (Houghton 2014).

Implications for education

Channelling the reported positive attitudes towards ABHR use among healthcare students to achieve improvements in hand hygiene practice is required and reviewing infection prevention and control curricula and pedagogical approaches seems warranted. Underpinning nursing and medical curricula with national and international evidence-based hand hygiene guidelines (WHO 2009, HSE 2005, HSE 2015) may prove useful in addressing knowledge deficits and improving professional practice.
(Kelcikova et al. 2012). Particular focus on the indications for hand hygiene as outlined in the WHO (2009) ‘my five moments for hand hygiene’ framework is required. Paying greater attention to routine ABHR utilisation and the perceived barriers to its use is also warranted. Consideration of a stepwise or spiral approach to the infection prevention and control curricula might also prove useful by incrementally delivering content throughout the four years of the degree programmes, in order to prevent the adoption of suboptimal practice among students as they progress and to improve the overall quality of patient care. Scheithauer et al. (2012) found a steady increase in hand hygiene compliance among German medical students who received repeated hand hygiene training throughout their programme.

**Implications for clinical practice**

Nursing and medical students make a valuable contribution to healthcare delivery on their journey to becoming competent, safe and effective healthcare professionals upon graduation. Health service providers, while concomitantly ensuring patient safety, have a responsibility to assist students in their endeavour to learn by providing a supportive clinical learning environment. Providing strong and supportive leadership, while also involving students in a team approach to improving hand hygiene compliance, is recommended. Huis et al. (2013) reported an improvement in hand hygiene compliance of 28% when a team and leaders-directed strategy was implemented in the Netherlands.

To prevent negative socialisation the use of positive role models is recommended. Erasmus et al. (2009) found that lack of positive role models among senior colleagues hindered compliance, particularly among medical students. Students in the mid-West region of Ireland also valued the importance of good role models. In order to ensure
the continuation of best practice as students progress through their career trajectories, the use of positive role models is recommended. HCWs are influenced by the actions of their peers and by their senior colleagues according to Smiddy et al. (2015) and the use of positive peer role models among nursing and medical students can positively impact hand hygiene practice.

Finally, an organisational culture that is open and supportive both motivates and empowers students, and although difficult to measure, it is linked to improved hand hygiene compliance (Smiddy et al. 2015). Creating a strong social norm and a culture of hand hygiene compliance among all staff will serve to positively influence students’ hand hygiene practice and may positively impact the current HCAI challenges in the region.
**Hand hygiene and healthcare professionals**

This thesis presents two further studies establishing insight into current hand hygiene practice among healthcare professionals, namely nurses and doctors, by comparing data from 2007 and 2015. Previously, independent unpublished research was carried out in the mid-West region of Ireland by a colleague Ms Barbara Slevin into hand hygiene practice among nurses and doctors in a large teaching hospital and these data were available from which comparisons could be drawn (Slevin 2007). Subsequent to this body of work undertaken in 2007, the WHO (2009) hand hygiene guidelines were published and widespread implementation and adoption of the recommendations followed, both nationally and in the region. The implementation of the hand hygiene guidelines in the years between the two studies allows for consideration of the effects of this intervention, by comparing data from 2007 with 2015. No comparable Irish or international studies looking at constants and changes in hand hygiene attitudes and practices among healthcare professionals over an eight-year period were found in the literature, highlighting the novel and valuable contribution of this research to the field.

Awareness of international hand hygiene guidelines (WHO 2009) improved considerably from 2007 to 2015 with statistically significant changes found (p=<0.001) in both disciplines. Undoubtedly, the impact of the implementation of the guidelines’ recommendations has been positive, with more positive hand hygiene attitudes reported, particularly among doctors. This heightened awareness of the guidelines and recommended practices is reflected also in improved self-reported practice, for example, self-reporting of hand hygiene compliance both before and after patient contact improved significantly in the intervening years, particularly among doctors.
However, scope for substantial improvements in other hand hygiene practices was found, for example, the routine utilisation of ABHR for hand hygiene. While an improvement in optimal AHBR use is reported among doctors, far greater improvements in the intervening years were envisaged and the reported decline in optimal use among nurses was unexpected. Cross tabulation revealed that newly qualified nurses or graduate nurses were more compliant with optimal hand rubbing practice than more experienced nurses. The underutilisation of ABHR among both groups of healthcare professionals suggests that approximately 60% of doctors and nurses may continue to routinely use soap and water and echoes similar findings in international studies (Kirk et al. 2016, Borg et al. 2009) and mirrors the underutilisation reported among healthcare students above. Furthermore, this finding supports the contention that the use of soap and water is an established behaviour that is difficult to change and the possibility that respondents may find the use of soap and water subconsciously more gratifying for perceived self-efficacy (Fitzpatrick et al. 2011, Borg et al. 2009). Given that ABHR is more efficacious than soap and water in reducing the bacterial load on the hands (Harbarth et al. 2002, Boyce et al. 2000) this finding raises concern for potential HCAI transmission in the region.

Both doctors and nurses reported skin sensitivity and skin damage as perceived barriers to ABHR use. However, given the underutilisation of ABHR reported and the knowledge that ABHR is kinder to the skin than soap and water, this suggests that the perception that ABHR is causing dermatology issues, may be ill-founded. Another notable barrier reported among almost 25% of doctors, was the perceived poor availability of ABHR, a finding echoed elsewhere in the literature (Barroso et al. 2016, Kirk et al. 2016, Squires et al. 2014).
Implications for clinical practice

Nurses and doctors have ethical and professional responsibilities as outlined by their regulatory authorities to deliver competent and safe patient care (Nursing and Midwifery Board of Ireland (NMBI) 2014, Medical Council 2009) and poor hand hygiene practices breach those responsibilities. Moreover, patients have a right to safe and effective healthcare, delivered by trusted professionals and the National Healthcare Charter that seeks to reassure patients regarding processes in place to ensure safe healthcare delivery specifically addresses the prevention of HCAI and the importance of hand hygiene in this endeavour (HSE 2008).

While reported attitudes to hand hygiene among healthcare professionals were predominantly positive there is considerable scope for improved practice. Directing the positive attitudes reported among both nurses and doctors towards improving practice is a worthwhile endeavour and one that may in-part address current infection prevention and control challenges, leading ultimately to improved patient outcomes. Harnessing the good practices of graduate professionals in embedding a positive culture of hand hygiene within the region is recommended. The establishment of hand hygiene champions and positive role models may positively influence the practice of others (Erasmus et al. 2009).

Sustained efforts are needed to ensure convenience and availability of ABHR, including point of care availability and personal carriage of ABRH, in order to avoid potential barriers to the widespread adoption of ABHR among all healthcare professionals (Barroso et al. 2016, Allegranzi et al. 2014).

Results suggest that while progress has been achieved, challenges remain and there is scope to achieve further improvements in hand hygiene practices. Achieving further
progress may contribute in-part to reducing the burden of HCAI as recently experienced in the study setting (O’Connor 2016) and in addressing the widespread challenges and complications that arise from HCAI.

Implications for education

Internationally and in Ireland continuing professional development (CPD) is a requirement for both doctors and nurses to ensure that knowledge, skills and competence are maintained at an acceptable level (NMBI 2017, Medical Council 2017). The hand hygiene practices reported in this research suggest that further engagement with infection prevention and control CPD opportunities among doctors and nurses in the region is required. Findings have been useful and impactful in informing the curriculum development of a level nine infection prevention and control module offered by the university in the region. The module, open to applications from doctors, nurses and other healthcare professionals provides an opportunity for CDP in evidence-based infection prevention and control knowledge and skills. Engagement with this type of CPD opportunity is recommended, particularly among more experienced healthcare professionals in order that current, evidence-based infection prevention and control knowledge will inform practice and ultimately positively impact patient care.
Conclusion

In conclusion, ensuring that a culture of hand hygiene best practice is embedded by all levels of healthcare students and professionals is the ultimate goal in ensuring patient safety. This research identifies that attitudes towards hand hygiene are predominantly positive and that healthcare workers are motivated to prevent cross infection. Despite this, it identifies specific shortcomings in hand hygiene practice, in particular less than optimum compliance with the WHO ‘my five moments for hand hygiene’ model. In addition, the research identifies that ABHR is underutilised in the mid-West region by both students and staff alike and perceived barriers to ABHR use among healthcare workers are also identified.

As previously discussed, the region is experiencing significant HCAI issues, complicated by the emerging challenges associated with Gram-negative organisms. Hand hygiene is signalled as the most effective measure a healthcare worker can take in preventing HCAI occurrence and transmission. Yet, the results of this research suggest a degree of complacency among healthcare workers towards hand hygiene. Therefore, as we strive to reduce the burden of HCAI occurrences in the region and nationally, a renewed effort is required that will serve to motivate and encourage staff and students alike to re-examine their practices and to take the appropriate steps to rectify poor practice.

In this endeavour to achieve improvements in hand hygiene practices we are guided by the WHO (2009) hand hygiene guidelines that recommend the adoption of a multi-modal intervention strategy including; system change, an institutional safety climate, education and training, evaluation and feedback, and workplace reminders. In addition, results of this independent research conducted in the region can inform a
renewed approach to hand hygiene education and practice based on the WHO recommendations. It is envisaged that arising from the collaborative nature of this research, the research outcomes and a shared desire to deliver safer patient care, that the higher education institutions and the health service providers in the region will collectively lead and drive the delivery of safer healthcare, underpinned by evidence based infection prevention and control practices. Working together in supporting and promoting a culture within the university and the hospitals of hand hygiene best practice may ultimately influence the delivery of safe patient care and improve patient outcomes.
References


Nursing and Midwifery Board of Ireland. (2014). Code of Professional Conduct and Ethics for Registered Nurses and Registered Midwives. Dublin: Nursing and Midwifery Board of Ireland.


23rd February 2015

Dear Colum, Liz and Nuala

Thank you for your Research Ethics application which was recently reviewed by the Education and Health Sciences Research Ethics Committee. The recommendation of the Committee is outlined below:

**Project Title:** 2014_12_04_EHS A comparative study exploring the awareness and attitudes of nursing students, midwifery students, medical students and physiotherapy students towards hand hygiene and alcohol-based hand rubs.
**Principal Investigator:** Colum Dunne
**Other Investigators:** Liz Kingston, Nuala O’Connell
**Recommendation:** Approved until November 2015.

Yours Sincerely

Dr. Barry Coughlan
Assistant Director
Doctoral Programme in Clinical Psychology
Faculty of Education & Health Sciences.
Chair, Education & Health Sciences
Research Ethics Committee
Faculty of Education & Health Sciences
University Of Limerick
Ireland.
Tel: 00-353-61-234345
Mobile: 086-0493367
Email: Barry.Coughlan@ul.ie
22nd November, 2014.

Prof. Colum Dunne,
Chair & Director of Research,
Graduate Entry Medical School,
University of Limerick,
Castletroy,
Limerick.

Re: Protocol Title
A comparative study exploring awareness and attitudes of nurses, midwives and doctors towards hand hygiene and alcohol-based hand rubs.

Dear Prof. Dunne,

The Research Ethics Committee at the University Hospital Limerick has received a submission for ethical approval for the above study.

The following documents were reviewed and approved by the Research Ethics Committee:

- Application to the Research Ethics Committee
- Survey
- Information Leaflet for Participants
- Reminder Leaflet for Participants
- Letter to Director of Nursing
- Letter to Chief Clinical Director

Approved

From an insurance perspective, please note that cover does not extend to those parties not employed by the Health Service Executive (HSE), or non-HSE Institutions.

Yours sincerely,

Joanne O’Connor,
Staff Officer, Quality & Patient Safety Department,
(For and on behalf of the Research Ethics Committee & the QPS Department).
Liz Kingston
Lecturer, Department of Nursing and Midwifery
University of Limerick
Limerick
Ireland

9th December 2015

Dear Liz

Infection Prevention Society – Annual Research Grants 2015

I am writing to inform you that your application for the IPS Novice Investigator Grant has been successful. The comments of the review panel are summarised below:

The reviewers felt that the study uses a theoretical basis and reasonable approach to the research question. They felt this was a reasonable and achievable piece of work for a novice researchers. The reviewers felt that the applicant should note that hand hygiene has moved on considerably with improvement science, human factors and patient safety. It was also felt that while an online questionnaires would enable the measurement of attitudes and behaviours, it is unlikely an exploration of issues will be achievable without using qualitative methods. The applicant needs to consider likely response rates and bias.

Please review the attached terms and conditions of the award, in particular I would draw your attention to the point made under (6) Intellectual Property.

A payment of £1,000.00 will be made via BACS transfer upon confirmation from you that the project has commenced. The funding for subsequent years will be dependent on the receipt of your six monthly project reports (form attached) to the IPS Research and Development Committee. It would be helpful if you could provide bank account details for payment on the enclosed form and return to pa@ips.uk.net as soon as possible.

Congratulations on your award, I look forward to seeing the progress of your studies.

Yours sincerely,

Dr Emma Burnett
IPS Research & Development Coordinator

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Company Registration No. 6273843, Charity Registration No. 1120063,  VAT No. 925 4238 25
TERMS AND CONDITIONS OF THE GRANT

The applicant(s) agree to the following conditions on acceptance of the grant:

1) The grant is awarded on the condition that you and any co-applicants complete the project as stated on your application form and in accordance with the terms and conditions of the grant. In the event that you do not proceed with the project or fail to complete it, you must notify Fitwise immediately. Applicants must submit accurate accounts and evidence of spending to date. Unspent funding must be returned to the Society.

2) Produce a final report of the results of the research for the IPS Research and Development Committee within 1 month of the completion of the project.

3) Submit six monthly project reports to the IPS Research and Development Committee. This will include a record of expenditure. The funding for subsequent years will be dependent on the production of this report.

4) Acknowledge the financial support of the IPS in all papers and presentations arising from this research project.

5) Develop a research report for the Journal of Infection Prevention within 6 months of the completion of the project and/or present the findings of this research at the IPS Annual Conference.

6) In the event of intellectual property being developed through this research project a written agreement must be made between the applicant’s host organisation (and any other funders) and the IPS before the patent is applied for.
Review

Hand hygiene-related clinical trials reported since 2010: a systematic review

L. Kingston a,*, N.H. O’Connell b,c, C.P. Dunne c

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SUMMARY

Considerable emphasis is currently placed on reducing healthcare-associated infection through improving hand hygiene compliance among healthcare professionals. There is also increasing discussion in the lay media of perceived poor hand hygiene compliance among healthcare staff. Our aim was to report the outcomes of a systematic search for peer-reviewed, published studies — especially clinical trials — that focused on hand hygiene compliance among healthcare professionals. Literature published between December 2009, after publication of the World Health Organization (WHO) hand hygiene guidelines, and February 2014, which was indexed in PubMed and CINAHL on the topic of hand hygiene compliance, was searched. Following examination of relevance and methodology of the 57 publications initially retrieved, 16 clinical trials were finally included in the review. The majority of studies were conducted in the USA and Europe. The intensive care unit emerged as the predominant focus of studies followed by facilities for care of the elderly. The category of healthcare worker most often the focus of the research was the nurse, followed by the healthcare assistant and the doctor. The unit of analysis reported for hand hygiene compliance was ‘hand hygiene opportunity’; four studies adopted the ‘my five moments for hand hygiene’ framework, as set out in the WHO guidelines, whereas other papers focused on unique multimodal strategies of varying design. We concluded that adopting a multimodal approach to hand hygiene improvement intervention strategies, whether guided by the WHO framework or by another tested multimodal framework, results in moderate improvements in hand hygiene compliance.

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Introduction

Healthcare-associated infections (HCAIs), also termed nosocomial infections, are complications of healthcare that lead to increased patient morbidity and mortality.1 HCAIs lead to increased healthcare costs for patients, their insurers and hospitals, due to unanticipated duration of hospital stay and associated treatment. There is also a psychological burden placed on patients, their carers, and their families, in addition to opportunity costs arising from patients and their carers’ inability to work, attend school, etc., while hospital capacity impacts the efficiency of healthcare.2,3

In the USA, it is estimated that HCAI affects about two million patients annually, of whom ~90,000 die.4 The overall annual cost of HCAI in the USA has been estimated to range...
from US$28 to 45 billion. Similarly, in the EU, the European Centre for Disease Prevention and Control (ECDC) advises that ~4.1 million patients in acute care facilities acquire an HCAI annually, with the number of deaths directly related to HCAI estimated to be at least 37,000.

Whereas the prevalence of at least one HCAI, meticillin-resistant Staphylococcus aureus (MRSA) related HCAIs, is stabilizing or decreasing in some European countries, other HCAIs are increasing (e.g. Escherichia coli and Klebsiella pneumonia). Monitoring of HCAI, including pan-European surveillance, has been expanded to encompass long-term care facilities (LTCFs) in addition to hospitals. Consequently, more comprehensive data are emerging across Europe and in Ireland, where a recent national median HCAI prevalence of 4.2% in LTCFs was reported. This is comparable with a national overall HCAI prevalence of 5.2% in acute care facilities.

HCAIs, however, are preventable and hand hygiene is widely regarded as the most effective preventive measure for healthcare workers (HCWs). Naikoba and Hayward conducted a systematic literature review to establish the effectiveness of interventions aimed at improving hand hygiene compliance. On reviewing 21 studies, they concluded that a multifaceted approach to hand hygiene which includes education, reminders and feedback was most effective in increasing hand hygiene compliance and improving rates of hospital-acquired infections. In the intervening years, this multifaceted or multimodal approach to hand hygiene appears to have been adopted and advocated in the hand hygiene policies and campaigns of multiple countries; for example, by the USA, Canada, the UK, and Ireland.

Several reviews have superseded that of Naikoba and Hayward, which is limited to examining the literature between 1986 and 1999. For example, Erasmus et al. systematically reviewed studies on compliance with hand hygiene guidelines in hospital care, assessing the prevalence and correlates of compliance and non-compliance. Factors included occupation, knowledge, attitude, time of day, patient’s risk of infection, feedback, and effects of varying hand hygiene solutions. This was the first review to distinguish between compliance both before and after patient contact, but it is perhaps constrained by the inclusion of studies published before the World Health Organization (WHO) guidelines on hand hygiene.

In a Cochrane review, Gould et al. evaluated 39 of the 96 studies reviewed by Erasmus et al., while focusing on interventions to improve hand hygiene compliance in patient care. The authors concluded that interventions should focus on the urgent need to offer solution-focused guidance in this field of practice.

Huis et al. conducted a systematic review of hand hygiene improvement strategies from a behaviourist approach. In order to provide conceptual clarity, Huis et al. explored frequently used hand hygiene improvement strategies and related determinants of behaviour that included: knowledge; awareness; action control; facilitation; social influence; attitude; self-efficacy and intention. The authors found that those studies using a combination of various determinants of behavioural change (including social influence, self-efficacy, attitude and intention) may result in better outcomes.

A frequent discussion point in the above publications relates to methodological weaknesses in many of the studies reviewed. WHO has subsequently published guidelines for improving the quality of future reviews.

## Methods

### Scope

The scope included literature published between December 2009 and February 2014, which is indexed in PubMed and CINAHL, on the topic of hand hygiene compliance among healthcare professionals.

### Systematic approach to finding appropriate literature

Searches were performed in PubMed and CINAHL in February 2014 for full articles published on the topic of hand hygiene compliance. The study methodology leading to publication within the scope of this review was clinical trials. Papers that were not published in English were excluded. Only full original research papers and reviews were included, that is: editorial opinions, letters to the editor, and other ‘opinion’-based publications were not included.

### Search methodology

Title and abstract fields were searched for publications containing the words: hand hygiene, handwashing, compliance. Boolean operators were used to combine search components. For example, the PubMed search was: (hand hygiene) OR (hand washing) AND compliance. The CINAHL search was: (hand hygiene) OR (hand washing) AND compliance (hand hygiene [Title/Abstract]) AND compliance [Title/Abstract]. The combined yield was 57 articles (Figure 1). This number is relatively low but may be attributable to limiting the search to clinical trials only.

### Critical appraisal and synthesis

Two reviewers (L.K. and C.D.) independently reviewed the search results, titles, and abstracts. Consensus on eligibility for inclusion was agreed and where discrepancies arose these were resolved by discussion. These potentially eligible articles were retrieved and read, resulting in the final selection of eligible studies. Those articles retrieved by the search but deemed ineligible for further analysis, as they did not report on hand hygiene compliance, are listed in Table 1.

Studies that met the following criteria were included: empirical studies conducted in study settings that included acute, non-acute, long-term care of the elderly and primary care; samples from countries with developed and developing economies; compliance with hand hygiene measured either by observation or electronic counters; results of hand hygiene compliance rates published; published in the English language. Studies set in domestic or school settings were excluded. One study where compliance was measured by self-reporting was excluded.

Of the 57 papers identified by the search, 16 studies were deemed eligible. Data were extracted by examining study characteristics using the following headings: country of origin,
study objectives, study setting, target population, study design, interventions and finally study outcomes. A lack of homogeneity of the studies selected was identified on extraction of study characteristics and so formal meta-analysis was not possible; however, further analysis was achieved by manually collating data and compiling results in tables.

Results

Geographical location

Hand hygiene compliance research is of global interest and results of this review reflect the diversity of countries conducting research on this topic. Of the 16 reported studies, the majority of the studies were carried out in Europe and the USA. Six of the studies were carried out in EU Member States; two in The Netherlands, two in France, one in Spain, and one in the UK. The five studies conducted in the USA were across various States, in Washington, Virginia, New Hampshire, Ohio, and Texas.\textsuperscript{56–66} Two studies were conducted in resource-limited countries, one in Brazil, and the other was across 19 resource-limited countries in Latin America, South America, Asia, the Middle East and Europe.\textsuperscript{67,68} One Australian study was reviewed, and two studies were conducted in Hong Kong.\textsuperscript{69–71}

Clinical setting

Studies were conducted in a variety of clinical settings, some across multiple clinical settings and indeed across multiple geographical locations, leading to a total of 299 individual clinical settings where studies were conducted (Table II). Intensive care unit (ICU) settings were most popular, accounting for the largest number of settings within which studies were conducted ($N = 135$). This included adult, step-down, paediatric, and neonatal ICUs. Care-of-the-elderly settings accounted for the second most popular clinical setting ($N = 93$) and this included acute and long-term care-of-the-elderly clinical settings. Ward settings ($N = 59$) included medical, surgical, paediatric, and burns wards.
Eleven primary healthcare centres were included \((N = 11)\), and finally one study was performed across the whole organization \((N = 1)\). Some studies were conducted across multiple clinical settings, for example Huis et al. studied the ICU setting, medical, surgical, and paediatric wards (Table II).\(^{56}\) Similarly, Fuller et al. studied the adult ICU setting as well as acute care-of-the-elderly wards.\(^{61}\) Some studies were conducted across multiple geographical sites, for example Martin-Madrazo et al. used 11 primary healthcare centres, and Chami et al. examined 47 long-term care-of-the-elderly facilities.\(^{59,60}\) It is unknown exactly what clinical settings or how many clinical settings within the organization were involved in the Henderson et al. study, as the focus was on the organization as a whole.\(^{62}\)

**Healthcare worker category**

The presentation of data in the reported studies relating to the categories of HCWs participating in the studies lacks uniformity, and so analysis is challenging. Moreover the lack of agreed global HCW job titles and professional roles makes it difficult to compare studies in a consistent way. Of the 16 studies reviewed, only six quantified the total number of participating HCWs, with five of these six identifying the various HCW categories participating (Table III).

Nurses, doctors, and healthcare assistants were the categories of HCWs most involved in hand hygiene compliance studies. The largest participant sample size \((N = 4221)\) was attributed to Linam et al.\(^{65}\) This sample represented predominantly nurses, doctors and healthcare assistants or care attendants, but also included were a broad range of other HCWs including respiratory therapists, physical therapists, occupational therapists, speech pathologists, dieticians, child life specialists, radiology technicians, and chaplains. Huis et al. recruited 2733 participants and all were nurses. \(^{56}\) The largest group in the Ho et al. study were healthcare assistants (health workers and personal-care assistants) \((N = 499)\) followed by nurses \((N = 130)\) and others, namely physiotherapists and

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Study focus</th>
<th>Study source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeillo et al.</td>
<td>2012</td>
<td>Influenza in young adults</td>
<td>PubMed</td>
</tr>
<tr>
<td>Ashraf et al.</td>
<td>2010</td>
<td>Self-reporting hand hygiene compliance</td>
<td>PubMed</td>
</tr>
<tr>
<td>Bearman et al.</td>
<td>2010</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Birnbach et al.</td>
<td>2010</td>
<td>Hospital design</td>
<td>PubMed</td>
</tr>
<tr>
<td>Chittleborough et al.</td>
<td>2010</td>
<td>Primary school setting</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Chow et al.</td>
<td>2012</td>
<td>Comparing hand hygiene protocols</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Daraad et al.</td>
<td>2012</td>
<td>Hand hygiene survey</td>
<td>PubMed</td>
</tr>
<tr>
<td>Diaz-Agero et al.</td>
<td>2011</td>
<td>Preoperative nosocomial infections</td>
<td>PubMed</td>
</tr>
<tr>
<td>Erasmus et al.</td>
<td>2011</td>
<td>Study protocol</td>
<td>PubMed</td>
</tr>
<tr>
<td>Eveillard et al.</td>
<td>2011</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Eveillard et al.</td>
<td>2012</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Fisher et al.</td>
<td>2013</td>
<td>Validating automated device</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Fuller et al.</td>
<td>2010</td>
<td>Assessment of blinding observers in an RCT</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Fuller et al.</td>
<td>2011</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Harris et al.</td>
<td>2013</td>
<td>Glove and gown use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>2011</td>
<td>Study protocol</td>
<td>PubMed</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>2013</td>
<td>Cost analysis</td>
<td>PubMed</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>2013</td>
<td>Process evaluation</td>
<td>PubMed</td>
</tr>
<tr>
<td>Kampf et al.</td>
<td>2010</td>
<td>Testing hand hygiene products</td>
<td>PubMed</td>
</tr>
<tr>
<td>Kutting et al.</td>
<td>2010</td>
<td>Skin protection</td>
<td>PubMed</td>
</tr>
<tr>
<td>Larson et al.</td>
<td>2010</td>
<td>Domestic setting</td>
<td>PubMed</td>
</tr>
<tr>
<td>Nevo et al.</td>
<td>2010</td>
<td>Efficacy of hand hygiene triggers</td>
<td>PubMed</td>
</tr>
<tr>
<td>Pandejpong et al.</td>
<td>2012</td>
<td>Pre-school setting</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Perez et al.</td>
<td>2012</td>
<td>University setting</td>
<td>PubMed</td>
</tr>
<tr>
<td>Reardon et al.</td>
<td>2013</td>
<td>Glove use</td>
<td>PubMed</td>
</tr>
<tr>
<td>Rello et al.</td>
<td>2013</td>
<td>Prevention of VAP</td>
<td>PubMed</td>
</tr>
<tr>
<td>Rock et al.</td>
<td>2013</td>
<td>Hand hygiene before glove use</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Shaw et al.</td>
<td>2011</td>
<td>Trial on botulinum</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Simmerman et al.</td>
<td>2011</td>
<td>Domestic setting</td>
<td>PubMed</td>
</tr>
<tr>
<td>Stebbins et al.</td>
<td>2010</td>
<td>Primary school setting</td>
<td>PubMed</td>
</tr>
<tr>
<td>Stuart et al.</td>
<td>2011</td>
<td>Prevalence of antimicrobial-resistant organisms</td>
<td>PubMed</td>
</tr>
<tr>
<td>Suchomel et al.</td>
<td>2012</td>
<td>Testing hand hygiene products</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Suess et al.</td>
<td>2012</td>
<td>Domestic setting</td>
<td>PubMed</td>
</tr>
<tr>
<td>Williams et al.</td>
<td>2011</td>
<td>Skin irritation</td>
<td>PubMed</td>
</tr>
<tr>
<td>Yardley et al.</td>
<td>2011</td>
<td>Domestic setting</td>
<td>CINAHL</td>
</tr>
<tr>
<td>Yawson and Hesse</td>
<td>2013</td>
<td>Hand hygiene survey</td>
<td>PubMed</td>
</tr>
</tbody>
</table>

RCT, randomized controlled trial; VAP, ventilator-associated pneumonia.
Martin-Madrazo took part including nurses (that study. Of participants by profession. extract any further quantifiable information on the breakdown completed the study.63 However, once again it is challenging to although we know that 32 HCWs enrolled in the study and 25
et al. of HCW was a variable not addressed by Bearman et al.

Table II
Clinical settings

<table>
<thead>
<tr>
<th>Type of clinical setting</th>
<th>No. of clinical settings</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult ICU (N = 113)</td>
<td>80</td>
<td>Rosenthal et al.68</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Fuller et al.61</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Huis et al.56</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Hitoto et al.58</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Bingham et al.56</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Marshall et al.59</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Koff et al.64</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Bearman et al.53</td>
</tr>
<tr>
<td>Step-down ICU (N = 2)</td>
<td>2</td>
<td>Marra et al.67</td>
</tr>
<tr>
<td>Neonatal ICU (N = 11)</td>
<td>10</td>
<td>Rosenthal et al.68</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>van den Hoogan et al.57</td>
</tr>
<tr>
<td>Paediatric ICU (N = 9)</td>
<td>9</td>
<td>Rosenthal et al.68</td>
</tr>
<tr>
<td>Sub-total: ICU settings</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td>Long term care of the elderly (N = 71)</td>
<td>47</td>
<td>Chami et al.59</td>
</tr>
<tr>
<td>Acute care-of-the-elderly wards (N = 22)</td>
<td>22</td>
<td>Fuller et al.61</td>
</tr>
<tr>
<td>Sub-total: care of elderly settings</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>Medical and/or surgical ward (N = 47)</td>
<td>45</td>
<td>Huis et al.56</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Bingham et al.56</td>
</tr>
<tr>
<td>Paediatric ward (N = 11)</td>
<td>9</td>
<td>Huis et al.56</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Linam et al.65</td>
</tr>
<tr>
<td>Burns unit (N = 1)</td>
<td>1</td>
<td>Bingham et al.56</td>
</tr>
<tr>
<td>Sub-total: ward settings</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Primary healthcare centre (N = 11)</td>
<td>11</td>
<td>Martin-Madra zo et al.50</td>
</tr>
<tr>
<td>Whole organization (N = 1)</td>
<td>1</td>
<td>Henderson et al.52</td>
</tr>
<tr>
<td>Total</td>
<td>299</td>
<td></td>
</tr>
</tbody>
</table>

ICU, intensive care unit.

occupational therapists (N = 39).70 No doctors participated in that study.

Although the sample size was smaller (N = 198) in a study by Martin-Madra zo et al., a wide range of healthcare professionals took part including nurses (N = 85) and doctors (N = 91), of whom 22 were paediatricians and 69 were general practitioners, and others (N = 22) including midwives, care assistants, dental hygienists and odontostomatologists.60 Category of HCW was a variable not addressed by Bearman et al., although we know that 32 HCWs enrolled in the study and 25 completed the study.63 However, once again it is challenging to extract any further quantifiable information on the breakdown of participants by profession.

Other studies provided information on hand hygiene opportunities (HHOs) observed based on the category of HCW. In those cases, the categorization of HCW is known but the numbers are not. Rosenthal et al. recruited nurses, doctors, and ancillary staff, and although data are provided relating to the numbers of HHOs observed in each category of HCW, no data are provided on actual numbers of participants.68 Despite this, univariate analysis of variables associated with poor hand hygiene was performed and the independent variable ‘profession of HCW’ was analysed, thus indicating the importance of this variable to the study results.68

The primary outcomes of the study by Koff et al. were individual and group hourly electronically recorded and observed hand hygiene compliance rates.64 Nurses, doctors and respiratory therapists were recruited but exact numbers of each were not reported. Similarly, Marra et al. investigated positive deviance training to all HCWs in a step-down unit, including nurses, doctors, physical therapists, speech pathologists and nutritionists, but they did not record numbers of participants.65 Positive deviance is defined as ‘the observation that in every community there are certain individuals or groups whose uncommon behaviours and strategies enable them to find better solutions to problems than their peers, while having access to the same resources and facing similar or worse challenges’.72 Hitoto et al. make little reference to categories of HCWs except in reference to opportunities for hand hygiene observed.70 Of the 1326 HHOs observed, 88% concerned nurses and nurse assistants. Elsewhere a reference is made to medical staff, so it may be reasonable to assume that doctors were also involved.

Hand hygiene opportunities

In line with WHO guidelines, the unit of analysis reported was the HHO. An HHO is a moment in time when hand hygiene should be carried out.71 These opportunities were observed either by direct observation of participants or, in the case of two studies, by electronic recording devices.64,67 Ten of the 16 studies provided quantified data on these opportunities and these data, alongside the settings within which observations occurred, are provided in Table IV. There was large variation in respect of the number of observations recorded in the various studies. In total, 719,876 HHOs were recorded, ranging from 1173 HHOs in an adult ICU setting to 506,111 in two step-down ICU settings, the latter being recorded by electronic devices worn by the participants.62 The mean number for HHOs was 65,443. Whereas most studies provide data on the HHOs observed in each clinical setting, Huis et al. provided an overall number and did not provide a breakdown of HHO data by clinical site.56 One study provided an approximation of HHOs per month, enabling a calculation to be made based on the duration of the study.62 Also five studies did not provide any HHO data.59–61,64,66

Hand hygiene compliance interventions

The interventions reported in these studies were predominately multimodal, focusing on more than one hand hygiene intervention, with the exception of three studies (Table V).61,63,66 Two of these studies focused on the same single intervention, i.e. education, while the other focused on performance feedback.61,63,66 In two studies, just two
Ten other studies addressed multimodal interventions ranging from three to six interventions. 56-60 The former introduced hand hygiene compliance as one of the outcomes. Koff et al. 61,62,63 introduced two intervention groups, i.e. education and performance feedback, education using video-based resources, and reminders using posters and cartoons displayed prominently. 64 In addition to focusing on hand hygiene education and the use of reminder materials, e.g. posters, others also addressed the issue of alcohol-based hand rub (ABHR) availability, supply and/or consumption. 59-63

**Table III**

<table>
<thead>
<tr>
<th>Study</th>
<th>Nurse</th>
<th>Physician</th>
<th>Healthcare assistant</th>
<th>Other</th>
<th>Total sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linam et al. 55</td>
<td>2192</td>
<td>597</td>
<td>971</td>
<td>461</td>
<td>4221</td>
</tr>
<tr>
<td>Huis et al. 56</td>
<td>2733</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2733</td>
</tr>
<tr>
<td>Ho et al. 65 (missing data reported)</td>
<td>130</td>
<td>0</td>
<td>499</td>
<td>39</td>
<td>810</td>
</tr>
<tr>
<td>Martin-Madrazo et al. 60</td>
<td>85</td>
<td>91</td>
<td>0</td>
<td>22</td>
<td>198</td>
</tr>
<tr>
<td>Yeung et al. 66</td>
<td>26</td>
<td>0</td>
<td>150</td>
<td>4</td>
<td>180</td>
</tr>
<tr>
<td>Bearman et al. 63</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td>Marshall et al. 69</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Henderson et al. 62</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bingham et al. 66</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rosenthal et al. 68</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>-</td>
</tr>
<tr>
<td>Marra et al. 67</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>No</td>
<td>Yes (-)</td>
<td>-</td>
</tr>
<tr>
<td>Koff et al. 64</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>No</td>
<td>Yes (-)</td>
<td>-</td>
</tr>
<tr>
<td>Hitoto et al. 58</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>No</td>
<td>-</td>
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<tr>
<td>Fuller et al. 61</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>-</td>
</tr>
<tr>
<td>Chami et al. 59</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>No</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>van den Hoogen et al. 57</td>
<td>Yes (-)</td>
<td>Yes (-)</td>
<td>No</td>
<td>Yes (-)</td>
<td>-</td>
</tr>
</tbody>
</table>

"Yes (-)": sample included this category of healthcare worker but the sample size was not reported.

Interventions are described, with both focusing on the same two interventions, i.e. education and performance feedback. 64,69

Bingham et al. implemented a single hand-hygiene intervention, whereby hand hygiene education was implemented in a pre-test/post-test design focused on reducing the probability of ventilator-associated pneumonia. 66 Other interventions included oral care and head-of-bed elevation and are not relevant to this review. 66 Bearman et al. also focused on hand hygiene education. 63 They conducted a four-month randomized blinded prospective crossover trial and provided hand hygiene education as part of this larger study to determine the effectiveness of antimicrobial scrubs on hand and clothing bacterial burden. 63 Both of the aforementioned studies included hand hygiene reporting as part of studies that predominantly focused on achieving other outcomes. 63-66 The third study with a single intervention focused on personalized written feedback in the form of an action plan in attempting to achieve improved hand hygiene compliance. 61,62,63

Marshall et al. and Koff et al. both described two interventions. 64,69 Both combined education on hand hygiene and performance feedback as the foci of their interventions. The former introduced hand hygiene compliance as one of many measures taken to strengthen a study that focused on reducing MRSA acquisition and provided regular compliance-monitoring feedback to participants. 65 The latter designed a before—after study to evaluate the impact of a focused hand hygiene programme on the incidence of catheter-related bloodstream infections and ventilator-associated pneumonias. 66 The programme involved education and performance feedback, and the participants wore an electronic hand hygiene device to record compliance. 64

Ten other studies addressed multimodal interventions ranging from three to six interventions. 56,57,59,60,62,65,67,68,70,71 Van den Hoogen et al. evaluated the effect of a multimodal hand hygiene intervention programme in a neonatal intensive care unit. 57 The programme comprised observation of hand hygiene practices, a knowledge questionnaire followed by immediate feedback and discussion, surveillance cultures feedback, education using video-based resources, and reminders using posters and cartoons displayed prominently. 57 In addition to focusing on hand hygiene education and the use of reminder materials, e.g. posters, others also addressed the issue of alcohol-based hand rub (ABHR) availability, supply and/or consumption. 59-63

**Table IV**

<table>
<thead>
<tr>
<th>Study</th>
<th>Clinical setting type (no.)</th>
<th>No. of HHOs observed or recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marra et al. 67</td>
<td>Step-down ICU (2)</td>
<td>506,111 (ERD)</td>
</tr>
<tr>
<td>Rosenthal et al. 68</td>
<td>Adult ICU (80)</td>
<td>149,727</td>
</tr>
<tr>
<td>Henderson et al. 62</td>
<td>Academic medical centre (1)</td>
<td>24,000</td>
</tr>
<tr>
<td>Ho et al. 70</td>
<td>Long-term care elderly (18)</td>
<td>11,669</td>
</tr>
<tr>
<td>Huis et al. 56</td>
<td>Medical/surgical wards (45)</td>
<td>10,785</td>
</tr>
<tr>
<td>Marshall et al. 59</td>
<td>Adult ICU (13)</td>
<td>6179</td>
</tr>
<tr>
<td>Linam et al. 65</td>
<td>Paediatric wards (9)</td>
<td>4029</td>
</tr>
<tr>
<td>Yeung et al. 71</td>
<td>Long-term care elderly (6)</td>
<td>3300</td>
</tr>
<tr>
<td>van den Hoogen et al. 57</td>
<td>Neonatal ICU (1)</td>
<td>1577</td>
</tr>
</tbody>
</table>

HHO, hand hygiene opportunity; ICU, intensive care unit; ERD, electronic recording device.
Four studies addressed the issue of leadership and the need for strong leadership in promoting a culture of compliance with evidence-based hand hygiene practices. Each described different leadership strategies adopted in order to pursue the goal of improved compliance with hand hygiene practices. Rosenthal et al. addressed leadership by ensuring that hospital administrators of participating hospitals agreed and committed to the study, supported the need for additional resources and attended feedback meetings. Marra et al. addressed leadership by ensuring that hospital administrators of participating hospitals agreed and committed to the study, supported the need for additional resources and attended feedback meetings. Ho et al. addressed leadership by ensuring that hospital administrators of participating hospitals agreed and committed to the study, supported the need for additional resources and attended feedback meetings. Henderson et al. addressed leadership by ensuring that hospital administrators of participating hospitals agreed and committed to the study, supported the need for additional resources and attended feedback meetings.

Described as a quality improvement initiative, Linam et al. incorporated a leadership and team approach to developing and testing a multimodal intervention approach to improving hand hygiene compliance among HCWs. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm. Linam et al. address leadership in conjunction with a team approach. Both Linam et al. and Huis et al. address leadership in conjunction with a team approach. Described as a quality improvement initiative, Linam et al. incorporated a leadership and team approach to developing and testing a multimodal intervention approach to improving hand hygiene compliance among HCWs. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm.

Described as a quality improvement initiative, Linam et al. incorporated a leadership and team approach to developing and testing a multimodal intervention approach to improving hand hygiene compliance among HCWs. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm. Leadership teams were established comprising frontline staff and infection control staff whose role was to provide committed unit leadership and to serve as role models and educators. They sought to influence the culture of the units in order that hand hygiene compliance would become the social norm. Linam et al. address leadership in conjunction with a team approach.

Hand hygiene compliance outcomes

Hand hygiene compliance was measured either by direct observation or by electronic recording. The observation was based on whether or not the HCW complied with best-practice relating to an HHO. Most studies reported compliance as a percentage rate and identified a baseline before the study. Ten studies have supplied data on compliance, of which eight provide both baseline data and post-intervention data (Table VI). The baseline compliance rate varied considerably, with some organizations starting from a very low baseline, e.g. 8.1% and 20–23%. Eight studies identified baseline compliance rates in either one or two intervention arms and in a control arm. This allows a mean baseline (before interventions) compliance rate respective to each study to be calculated. The mean baseline (before interventions) compliance rates varied considerably in the eight studies that provided such data, ranging from 8.1% to 69.5%. The overall mean baseline compliance rate before interventions, when all studies were combined, was 34.1%.

Overall compliance rates improved as a result of the interventions, with some studies showing greater and more sustained improvements than others. Yeung et al. reported only slight improvement, from 25.8% to 33.3%. Moderate to significant improvements were also reported. Martin-Madrazo et al. reported that the intervention group increased their compliance by 21.6% compared with an improvement of 3.6% in the control group at six months. Significant improvements were also reported. Martin-Madrazo et al. reported that the intervention group increased their compliance by 21.6% compared with an improvement of 3.6% in the control group at six months. Koff et al. reported significant improvements from a mean of 23% in the baseline assessment to 50% in the second assessment.
The calculated mean compliance rate after intervention allows an overall mean improvement of 22.88% from the calculated mean baseline compliance rate of 34.1%. This suggests that hand hygiene compliance research has expanded beyond acute care facilities in Europe, including care-of-the-elderly facilities. The expansion of research in recent years to encompass care-of-the-elderly facilities is welcome. However, the expansion of research in recent years to encompass care-of-the-elderly facilities is welcome. The inclusion of acute care-of-the-elderly facilities in this review reflects the expansion of research in recent years to include acute care-of-the-elderly settings.

The clinical setting in which hand hygiene compliance is monitored and reported is examined in this review and the results provide some interesting insight into the clinical setting selected. The prevalence studies for many years and justifiably so given the high prevalence of HCAI in intensive care settings. The most recent point prevalence study examining the prevalence of HCAI in 100 European hospitals is informative in this regard. The prevalence of HCAI was the highest among ICUs, with 8.1% of patients having at least one HCAI. The EDCC estimates that in 2014, 32% of patients had a HCAI in European hospitals with more than 50% of patients in ICUs. The recent large-scale study examining the prevalence of HCAI in 100 European hospitals is informative in this regard. The prevalence of HCAI was the highest among ICUs, with 8.1% of patients having at least one HCAI. The EDCC estimates that in 2014, 32% of patients had a HCAI in European hospitals with more than 50% of patients in ICUs. The recent large-scale study examining the prevalence of HCAI in 100 European hospitals is informative in this regard.

The geographical location of the studies reviewed is examined in this review and the results provide some interesting insight into the clinical setting selected. The included studies are mainly from Europe and the USA, with a few studies from Asia. The geographical location of the studies reviewed is examined in this review and the results provide some interesting insight into the clinical setting selected. The included studies are mainly from Europe and the USA, with a few studies from Asia.

<table>
<thead>
<tr>
<th>Study</th>
<th>Reported hand hygiene compliance outcomes</th>
<th>Mean compliance (%) before intervention</th>
<th>Mean compliance (%) after intervention (intervention group)</th>
<th>Net effect on intervention group</th>
</tr>
</thead>
<tbody>
<tr>
<td>van den Hoogen et al.</td>
<td>Increased significantly from 23% in the baseline assessment to 50% in the second assessment</td>
<td>23%</td>
<td>50%</td>
<td>27%</td>
</tr>
<tr>
<td>Ho et al.</td>
<td>Increased from 27% to 60.6% and 22.2% to 48.6% in two intervention arms</td>
<td>24%</td>
<td>54.60%</td>
<td>30.60%</td>
</tr>
<tr>
<td>Yeung et al.</td>
<td>Increased slightly but significantly from 25.8% to 33.3% at 7 months post intervention</td>
<td>25.80%</td>
<td>33.30%</td>
<td>7.50%</td>
</tr>
<tr>
<td>Rosenthal et al.</td>
<td>Overall compliance increased from 48.4% to 71.4%</td>
<td>48.40%</td>
<td>71.40%</td>
<td>23%</td>
</tr>
<tr>
<td>Koff et al.</td>
<td>Significantly improved from 44% to 63% (mean 53%) during the control period to 67–90% (mean 75%) during the study period</td>
<td>53%</td>
<td>75%</td>
<td>22%</td>
</tr>
<tr>
<td>Linam et al.</td>
<td>Increased from 65% to 91% and from 74% to 92% in the two units</td>
<td>69.50%</td>
<td>91.50%</td>
<td>22%</td>
</tr>
<tr>
<td>Martin-Madrazo et al.</td>
<td>Baseline compliance rate was 8.1%. HCWs in the intervention group increased their compliance by 21.6% compared with control group</td>
<td>8.10%</td>
<td>30.56%</td>
<td>22.46%</td>
</tr>
<tr>
<td>Huis et al.</td>
<td>Increased from baselines of 23% and 20% in the two intervention arms to 46% and 53% in the long run</td>
<td>21.5%</td>
<td>49.5%</td>
<td>28%</td>
</tr>
<tr>
<td>Overall mean compliance rates</td>
<td></td>
<td>34.1% (before interventions)</td>
<td>56.98% (after interventions)</td>
<td>22.88% (net improvement)</td>
</tr>
</tbody>
</table>

HCW, healthcare worker.

Discussion

This review describes clinical trials conducted since 2010 that have reported hand hygiene compliance in the context of reducing healthcare-associated infections. The methodology weaknesses in many previous studies have been discussed.12,17 For clarification purposes, it is noted that the hand hygiene data in many of the studies reviewed is reported as part of a larger study. Examples of other outcomes examined include HCAI rates, the impact of screening, and the impact of active surveillance and contact precautions.58,59,62,64,66,69

Geographical location

Healthcare-associated infections are a global patient safety concern. The geographical location of the studies reviewed is examined in this review and the results provide some interesting insight into the clinical settings selected. From the available data it emerges that the ICU is the predominant focus; when step-down, neonatal and paediatric ICUs are included, a total of 135 ICU settings were the focus of attention. Care-of-the-elderly facilities accounted for 93 study settings, whereas the other settings combined accounted for 59 settings. Finally, one study examined 11 primary healthcare settings and one study provided no information on the clinical settings within the organization studied.60,62

Acute care settings, especially ICUs, have been the focus of research studies for many years and justifiably so given the prevalence of HCAI in intensive care settings. The most recent ECDC point prevalence survey examining the prevalence of HCAI in 100 European hospitals in 30 counties is informative in this regard. The prevalence of HCAI was the highest among patients admitted to ICUs, where 19.5% of patients had at least one HCAI. The ECDC estimates that in 2014, 32% of patients had a HCAI in European hospitals with more than 50% of patients in ICUs. The recent large-scale study examining the prevalence of HCAI in 100 European hospitals is informative in this regard. The prevalence of HCAI was the highest among patients admitted to ICUs, where 19.5% of patients had at least one HCAI. The ECDC estimates that in 2014, 32% of patients had a HCAI in European hospitals with more than 50% of patients in ICUs.

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the ageing population and recognizes the importance of conducting robust research into hand hygiene behaviours in these settings.\(^5\) Data from the ECDC demonstrate the importance of surveillance in LTCFs. The point prevalence survey of HCAI in European LTCFs suggests that the crude prevalence of residents with at least one HCAI in 2013 was 3.4\%.\(^7\) From 17 European countries 1181 LTCFs participated in the survey.\(^7\)

It is noteworthy that only one study included in this review was conducted in a primary healthcare setting despite the importance of hand hygiene in this setting.\(^6\) Eleven healthcare settings in Madrid participated in the study. Overall baseline compliance with hand hygiene procedures was very low at 8.1\%, further supporting the argument for conducting research in this setting. Hand hygiene is important in primary care settings. The move towards more complex and invasive procedures in primary care, the earlier discharge of patients from acute care settings, and the advancements in home care all suggest that hand hygiene compliance and further research is equally as important in primary care as in acute care settings.\(^6\)

International and national guidelines published in more recent years reflect the increasing awareness of the need to be equally vigilant in primary care settings.\(^7\)\(^8\) The work of Martin-Madrazo and colleagues demonstrates that significant improvements in practice can be achieved in primary care settings when multimodal hand hygiene improvement strategies are implemented.

**Healthcare worker category**

Compliance with hand hygiene is of equal importance among all HCWs in order to minimize the risk to patients of acquiring an HCAI. It is important to reflect the categories of HCWs when reporting studies, as it adds significance to the results, allowing for greater impact among the professional groups. Some of the studies in this review may be criticized for not including reference to the category of HCW involved.\(^6\)\(^3\)\(^6\)\(^9\)

Other studies define categories, but do not give sample sizes. It is noteworthy that in some cases hand hygiene is reported as part of a larger study where other determinants of outcomes are included.

As nurses, in most cases, form the largest group of health professionals, it is not surprising that the nursing profession is well represented in the studies reviewed and accounts for the large sample sizes.\(^6\) Therefore, in the study with the largest number of study participants of 4221 it is not unexpected that nurses formed the largest sample group (\(N = 2192\)), followed by healthcare assistants (\(N = 971\)), doctors (\(N = 597\)) and others (\(N = 461\)).\(^6\)\(^5\) One study exclusively focused on the nursing profession (\(N = 2733\)) and there is no doubt that the results, while informative to the nursing profession, might also be of relevance to other professional groups.\(^5\)\(^6\) Other studies, with smaller sample sizes than those referred to above, included more than one category of HCW, allowing the relevant results to be interpreted by each distinctive professional group.\(^6\)\(^3\)\(^6\)\(^5\)\(^7\)\(^1\)

**Hand hygiene opportunities**

Just two of the included studies reported results relating to hand hygiene technique.\(^5\)\(^6\)\(^7\) However, these are limited to some, but not all, aspects of correct technique — for example, wearing jewellery or using an insufficient amount of ABHR. The technique advocated by WHO is complex and multifaceted. It is very likely that many of the aspects of the WHO-promoted technique, and their correct use, contribute to prevention of nosocomial infections. We considered this topic worthy of study in its own right and too large an influencer of behaviour to be included as only one component of this review.

Whereas the recognized unit of analysis is HHO, there were some deviations from this. Two studies recorded data using the latest cutting-edge technologies. Electronic hand hygiene counters, worn by participants in one study and placed at ABHR stations in the other, appear to work by monitoring the dispensing of the ABHR from the device as opposed to monitoring the opportunity for hand hygiene.\(^6\)\(^4\)\(^6\)\(^7\) Currently ‘direct participant observation’ is considered the gold standard in measuring hand hygiene compliance.\(^8\) However, this can be time and resource intensive. Furthermore, when interpreting findings, the Hawthorne effect and the potential for bias must be considered, when data are collected by direct observation.\(^8\)\(^2\) Koff et al. report that the electronic device, while novel at the time of the study, was a reliable system in monitoring hand hygiene compliance. They also credit the same device with contributing to the significant improvements in hand hygiene compliance reported, from a mean of 53\% during the control period to a mean of 75\% during the study period. There can be no doubt that the design of electronic devices will be developed further in the future and become more visible in this field of practice as the technology advances. Consequently, continued research is required to examine the effectiveness of electronic counters and their application to this field of research.

Whereas some studies explicitly report using the ‘my five moments for hand hygiene’ framework for measurement of HHOs, based on the WHO hand hygiene guidelines, not all studies report using this approach.\(^5\)\(^6\)\(^8\)\(^6\)\(^3\)\(^6\)

It is important to note that whereas a number of studies do not explicitly address the WHO multimodal strategy incorporating the ‘my five moments for hand hygiene’ framework, many adopt a multimodal approach using various unique behavioural approaches. Fuller et al. adopted a ‘feedback intervention’ approach, while Rosenthal et al. implemented and evaluated the impact of a multidimensional hand hygiene approach developed by the International Nosocomial Infection Control Consortium (INICC).\(^6\)\(^1\)\(^6\)\(^8\) Marra et al. adopted a ‘positive deviance strategy’ as an alternative way to produce change, while Linam et al. approached their research design from a quality improvement stance.\(^6\)\(^5\)\(^6\)\(^7\) Van den Hoogan et al. also reported local hand hygiene protocols and procedures upon which the study design is framed.\(^5\)

In a number of studies it was not possible to definitively determine whether or not the ‘my five moments for hand hygiene’ framework was used, as explicit information was not provided on the approach adopted.\(^6\)\(^2\)\(^6\)\(^6\)\(^6\)\(^7\) This suggests that standardization and conformity to hand hygiene practices and measures as outlined by the WHO guidelines has not been uniformly adopted at the time of this review. Clearly, the influence of the WHO guidelines on hand hygiene and interpretation of the impact of the guidelines is hampered by the low number of studies (\(N = 4\)) explicitly reporting its adoption in research design.
Hand hygiene compliance interventions

Multimodal strategies have emerged as the best approach to hand hygiene practices, as advocated by WHO. Larson and colleagues explicitly referred to a multidimensional approach to hand hygiene in a study published in the USA, and, since then, increasing evidence has supported this approach. A multimodal approach involves using a variety of strategies aimed at addressing barriers to improving compliance with good hand hygiene practices and achieving behavioural change. Although evidence supports the implementation of multimodal strategies and research substantiates the efficacy of the multimodal approaches, there are challenges associated with implementing this approach. Whereas WHO advocates this approach the interpretation and implementation are varied across sites, leading to challenges of meta-analysis and comparative review. Results of this review demonstrate that researchers are focusing on multimodal approaches, with 10 of the 16 studies adopting this approach by using from three to six interventions. However, various approaches are taken to single components of the multimodal approach, for example, education. In implementing an education strategy that encompasses written materials a wide range of aids is used, from teaching and practical demonstrations to leaflets and knowledge quizzes to posters and cartoons, to video-based resources, and websites. With such variability of interventions, establishing the link to improved outcomes can be challenging.

Hand hygiene compliance outcomes

Analysis of the outcomes of the eight studies that provide both baseline hand hygiene compliance data and post-intervention compliance data allow for calculation of an overall mean baseline compliance rate of 34.1% before intervention. All eight studies showed improved compliance following intervention. Some showed slight improvement of 7.5% net effect, whereas others reported moderate to significant improvement of 22%, 23%, 27%, 28%, and 30.6%. Calculation of an overall mean compliance rate after intervention suggests a mean post-intervention compliance rate of 56.98% in the intervention group. Based on these eight studies the net improvement calculated is 23%.

These reported improvements in outcomes are welcome. However, notable in this review was the duration of the studies. Not all studies supplied details of the duration of the control and intervention period. Of those that did, most studies were of less than one year’s duration with the control or baseline period lasting three months and the intervention period lasting three months. Koff et al. reported a two-year period—a study design. Two longitudinal studies were reported. Rosenthal et al. conducted the study over a seven-year period whereas Fuller et al. conducted their study over a three-year period. In order to determine sustained improvement in hand hygiene practices among HCWs, longitudinal studies provide an ideal research design to determine long-term change in behaviour.

Conclusion

Of the 16 papers reviewed, four research designs were explicitly guided by the ‘my five moments for hand hygiene’ framework, as set out in the WHO guidelines. Others adopted locally designed multimodal approaches using various unique behavioural approaches and although there was a lack of uniformity in these approaches, positive outcomes were achieved. This leads us to conclude that adopting a multimodal approach to hand hygiene improvement intervention strategies, whether guided by the WHO framework or another tested multimodal framework, has been shown to achieve slight to moderate improvements in hand hygiene compliance.

Some especially pertinent areas for additional research might include knowledge, attitudes and awareness of future practitioners (e.g. medical and nursing students alongside allied health students and interns, healthcare facility managers, patients and their carers). Similarly, the adoption of technology-driven solutions for both delivery of ABHRs and monitoring of their use, and use of such data for analysis of patient and healthcare professional movements in the context of outbreaks, may lead to enhanced compliance, or at least to better understanding of the challenges involved.

Conflict of interest statement
None declared.

Funding sources
None.

References


Continuing Professional Development and the *Journal of Hospital Infection*

**Questions linked to Kingston L, O’Connell NH, Dunne CP. Hand hygiene-related clinical trials reported since 2010: a systematic review. *J Hosp Infect* 92;201:309–320**

Available online 29 June 2016

1. Hand hygiene compliance studies have been conducted across various clinical settings. What is the most frequent clinical setting within which such studies were completed?

(a) Care of the elderly setting.
(b) Intensive care unit.
(c) Primary healthcare centre.
(d) Medical ward.

2. Multi-modal hand hygiene compliance intervention strategies are advocated. A number of such interventions were identified in this review, including education, reminder materials, alcohol-based hand-rub (supply and consumption monitoring), performance feedback, leadership and management support, and a team approach. How many reported studies engaged all six interventions?

(a) Fourteen.
(b) Three.
(c) One.
(d) Seven.

3. Which category of healthcare worker accounted for the largest sample size participating in hand hygiene compliance studies?

(a) Doctor.
(b) Nurse.
(c) Healthcare assistant.
(d) Physiotherapist.

4. Hand hygiene compliance outcomes improved following intervention in studies where before-and-after intervention hand hygiene compliance rates were reported. The net improvement calculated was which of the following?

(a) 78.23%.
(b) 53.60%.
(c) 35.13%.
(d) 22.88%.

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**Summarizing the instructions from the Royal College of Pathologists:**

(1) One CPD point is allowed for each question and answer set (up to five questions and answers).

(2) Answers must be recorded referenced back to the questions and recorded in the CPD portfolio.

(3) It is essential that participants include the completed response form showing both questions and answers in their portfolio as these may be subject to audit by RCPath.

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0195-6701/ © 2016 The Healthcare Infection Society. Published by Elsevier Ltd. All rights reserved.
Answers linked to Kingston L, O’Connell NH, Dunne CP. Hand hygiene-related clinical trials reported since 2010: a systematic review. *J Hosp Infect* 2016;92:309–320

Available online 28 June 2016

1. Hand hygiene compliance studies have been conducted across various clinical settings. What is the most frequent clinical setting within which such studies were completed?

   (a) Care of the elderly setting.
   (b) Intensive care unit.
   (c) Primary healthcare centre.
   (d) Medical ward.

   Answer: (b). Our study identified the intensive care unit (ICU) as the type of clinical setting in which the most hand hygiene compliance studies were performed. ICU settings accounted for 135 of the 299 clinical settings identified in published studies, comprising 113 adult ICUs, 11 neonatal ICUs, nine paediatric ICUs, and two step-down ICUs.

2. Multi-modal hand hygiene compliance intervention strategies are advocated. A number of such interventions were identified in this review, including education, reminder materials, alcohol-based hand-rub (supply and consumption monitoring), performance feedback, leadership and management support, and a team approach. How many reported studies engaged all six interventions?

   (a) Fourteen.
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   (d) Seven.


3. Which category of healthcare worker accounted for the largest sample size participating in hand hygiene compliance studies?

   (a) Doctor.
   (b) Nurse.
   (c) Healthcare assistant.
   (d) Physiotherapist.

   Answer: (b). Our review identified two studies in which more than 2000 nurses participated in hand hygiene compliance studies:


4. Hand hygiene compliance outcomes improved following intervention in studies where before-and-after intervention hand hygiene compliance rates were reported. The net improvement calculated was which of the following?

(a) 78.23%.
(b) 53.60%.
(c) 35.13%.
(d) 22.88%.

Answer: (d). Our review calculated a mean hand hygiene compliance rate of 34.1% before interventions rising to 56.98% following interventions, yielding a mean net improvement of 22.88%.
Response to letter from Chudleigh et al.: Systematic reviews of hand hygiene in patient care post 2010

Sir,

In response to the letter from Chudleigh et al., we respect the input of those authors who have previously published a Cochrane review on this topic in 2010 and who are preparing to publish their update later this year.1–3 We especially welcome their comment that ‘another angle on this perennially important issue is always welcome’. Whereas Cochrane reviews and the recommendations from the Cochrane Collaboration regarding review processes are considered the ‘gold standard’ of such review, there remains a place in the literature for less process-driven reviews. We believe this to be especially the case in areas where developments occur rapidly and, hence, in the absence of a major review of hand hygiene improvement/compliance studies between 2012 and our submission our objective was to provide a synthesis of recent studies for the benefit of interested researchers, practitioners, and patients.3

We stated our search parameters clearly, limiting the databases to those we determined subjectively to be most relevant to the topic. This is similar to the choices made by others when, for example, they focused in 2015 in limiting the focus of their review to qualitative studies of hand hygiene compliance when, for example, they focused in 2015 in limiting the focus of their review to qualitative studies of hand hygiene compliance among healthcare workers.4

Of course, we accept that our design has limitations. However, our stated conclusions were derived from the data we garnered within our search parameters and are robust. We very much look forward to the more comprehensive Cochrane review update by Chudleigh et al., but in the meanwhile we believe and hope that our review is useful to those working on this important topic.

Conflict of interest statement
None declared.

Funding sources
None.

References


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The first 15 minutes of each observation were discarded to reduce limitations (e.g. Hawthorne Effect/Observer Bias).

Clinical activities (e.g. empyting catheter) and associated HH behaviour was recorded.

A random number generator selected one inherent and elective activity from each participant for analysis.

HH was expected to be more likely for inherent activities. As regular exposure to blood may reduce inherent HH through desensitisation, less difference was predicted within the RH.

Semi-structured interviews with 13 staff across both settings explored the meaningfulness of the current measurement and preference for future feedback mechanisms.

Results and discussion
Data was collected over 9 days between 3rd and 24th December 2015. Of the 369 observations conducted, 40 were randomly selected for analysis. The effect of inherent and elective activities on likelihood of HH occurring was determined using a McNemar test of difference.

Both settings showed statistically significant differences between inherent vs. elective HH activities. Higher likelihood for HH was observed for inherent activities and was weaker within RH as predicted (RH: p=0.045; CT: p=0.003).

The interviews revealed that staff knowledge of HH referred to training scores rather than their specific ward HH performance data. Participants felt that measurement and reporting of HH performance based on inherent and elective activities may enhance meaning for staff. This is currently being explored in Phase 2 of this research programme.

Declaration of interest
I do not have any conflict of interests to declare.

Abstract ID: 4637

Hand hygiene compliance: A systematic review of the evidence
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Introduction
Reducing healthcare-associated infections through improving hand hygiene compliance amongst healthcare professionals remains topical. However, research evidence suggests that hand hygiene compliance remains sub-optimal across various geographical locations and healthcare settings. The aim of this poster is to report the outcomes of a recently published systematic review of peer-reviewed published studies, notably clinical trials, which focus on hand hygiene compliance among healthcare professionals.

Methods
Literature published between December 2009 and February 2014, which is indexed in PubMed and Cinahl, on the topic of hand hygiene compliance, was searched. Following examination of the 57 publications initially reviewed, the final number of papers appraised is 16.

Results
A lack of homogeneity in research design made meta-analysis difficult to achieve; however, comparative analysis was possible. The majority of studies were conducted in the USA and Europe, in intensive care units and care of the elderly facilities. The nurse, the healthcare assistant and the doctor are the three categories of healthcare worker most often the focus of the research. Published studies demonstrate that moderate improvements to hand hygiene compliance rates were achieved when organisations adopted a multimodal approach, incorporating up to six strategies for change. The multimodal approaches used were either guided by the World Health Organization (WHO) hand hygiene framework or by an independently tested multimodal framework.

Discussion
Hand hygiene compliance remains an important patient safety issue, as we strive to reduce healthcare-associated infection rates across the globe. The WHO multimodal hand hygiene framework is transferrable to a variety of healthcare and education settings globally, and international research evidence suggests that moderate improvements in hand hygiene compliance rates can be achieved when it is adopted.

Declaration of interest
I do not have any conflict of interests to declare.
Survey of attitudes and practices of Irish nursing students towards hand hygiene, including handrubbing with alcohol-based hand rub

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ABSTRACT

Background: Hand hygiene is widely recognised as the most important measure a healthcare worker can take in preventing the spread of healthcare associated infections. As a member of the healthcare team, nursing students have direct patient contact during clinical practice; hence, good hand hygiene practice among nursing students is essential. Low to moderate levels of hand hygiene knowledge and poor attitudes and practices are reported among nursing students. However, less is known about their attitudes and practices of handrubbing with ABHR, even though handrubbing is the recommended optimum practice in most situations.

Aim: The aim of this study was to explore attitudes and practices of hand hygiene, in particular handrubbing with alcohol-based hand rub, among nursing students in Ireland.

Design: This survey employed a descriptive, self-report design using a questionnaire to gather data. It was administered electronically to all undergraduate nursing students (n = 342) in the Department of Nursing and Midwifery at the University of Limerick, Ireland in March and April 2015.

Results: Response rate was 66%. Attitudes towards hand hygiene were generally positive. Compliance with hand hygiene after contact with body fluid was high (99.5%) and before a clean or aseptic procedure (98.5%). However, suboptimal practices emerged, before touching a patient (85%), after touching a patient (87%) and after touching patients’ surroundings (61%), with first year students more compliant than fourth year students. 16% of students were not aware of the clinical contraindications for using alcohol-based hand rub and 9% did not know when to use soap and water and when to use alcohol-based hand rub.

Conclusion: Educators and practitioners play an important role in ensuring that nursing students develop appropriate attitudes towards hand hygiene and engage in optimal handrubbing practices. Raising awareness among nursing students of their responsibility in preventing the occurrence and reducing the transmission of HCAI as an ongoing endeavour is required, with the laudable aim of preventing complacency and ultimately improving patient outcomes.

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1. Introduction

Hundreds of millions of patients are affected by healthcare-associated infection (HCAI) worldwide each year (World Health Organization (WHO), 2013). HCAI represents a major public health concern, affecting up to 80,000 patients in European Hospitals on any given day (European Centre for Disease Control (ECDC), 2013). In Ireland, a national overall HCAI prevalence of 5.2% in acute care facilities is reported (Health Protection Surveillance Centre (HPSC), 2012) and patient complications arising from multi-drug resistant organisms (MDROs) are becoming more evident in the recent literature (O’Connor et al., 2015; WHO, 2013). The ECDC (2013) estimates that 25,000 people die in the European Union annually from infections caused by MDROs with an associated cost of €1.5 billion. Hand hygiene is globally recognised as the most effective measure a healthcare worker can take to reduce the risk of cross-transmission of pathogens (HPSC, 2012). It is simple, cost-effective and highly efficacious in controlling the spread of HCAI. Despite this, evidence suggests that compliance among healthcare workers is sub-optimal (Erasmus et al., 2010, Kingston et al., 2016).

2. Background

Hand hygiene is a general term that refers to any action of hand cleansing, of which there are many suited to various different clinical scenarios. However, one form of hand hygiene i.e. handrubbing with alcohol-based hand rub (ABHR) is globally advocated as the optimum approach to hand hygiene in most situations. The WHO (2009) defines...
handrubbing as “applying an antiseptic handrub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices” and this is the definition adopted by the University of Limerick and affiliated clinical practice sites where the study sample is practicing. Handrubbing is the ‘gold standard’ technique or optimum approach to perform hand hygiene on all occasions, except those for which handwashing with soap and water is recommended, for example, when nursing patients with Clostridium difficile infections (WHO, 2009) and both the university and affiliated clinical practice sites follow this recommendation. Handrubbing is performed in isolation, as a standalone technique, and should not be combined with any other approach to hand hygiene.

Nursing students have direct patient contact during clinical placements and internships and, in fact, account for a sizable percentage of the healthcare personnel involved in patient care (Bargellini et al., 2014). Consequently, they are at risk of becoming mediators of pathogenic microorganisms or contracting a HCAI (Al-Khawaldeh et al., 2015). Yet, research on nursing students’ hand hygiene practices is limited, with less emphasis placed on investigating nursing students’ practices than those of nurses, due to their perceived position within the hospital hierarchy (Jeong and Kim, 2016). Kingston et al. (2016) identified nurses and doctors as the categories of healthcare worker most often the focus of hand hygiene compliance studies. However, it is important to explore and understand nursing students hand hygiene practices as they will become registered nurses in the future (Cruz and Bashitawi, 2015).

Following a literature search, a reasonable number (n = 14) of recent international research studies were identified concerning nursing students’ hand hygiene practices. Moderate hand hygiene knowledge among nursing students is reported in India (Nair et al., 2014), Sri Lanka (Ariyarathne et al., 2013), South Korea (Jeong and Kim, 2016), Jordan (Al-Khawaldeh et al., 2015) and Namibia (Ojulong et al., 2013). However, poor knowledge of hand hygiene among nursing students is reported in some European countries, for example, Italy (D’Alessandro et al., 2014, van de Mortel et al., 2011) and Slovakia (Kelcikova et al., 2012), Nair et al. (2014) and Ariyarathne et al. (2013) report that attitudes towards hand hygiene and hand hygiene practices are poor, although Cruz and Bashitawi (2015) and Al-Khawaldeh et al. (2015) report moderate attitudes and practices among Saudi Arabian and Jordanian nursing students, respectively. In comparative studies better hand hygiene practices among nursing students than medical students is reported (van de Mortel et al., 2010, van de Mortel et al., 2011).

A small number of these recent studies report on handrubbing using ABHR (n = 9), providing limited data in some cases (Al-Khawaldeh et al., 2015, Hinkin and Cutter, 2014, Bargellini et al., 2014, Ojulong et al., 2013, Gül et al., 2012, van de Mortel et al., 2011), while others provide more insight (Jeong and Kim, 2016, Nair et al. 2014 and Ariyarathne et al., 2013). While the numbers of studies are relatively low, the data presented appear to suggest that ABHR knowledge among nursing students is poor, with correct responses to questions on handrubbing technique as low as 11.5% (Gül et al., 2012), 14% (Ariyarathne et al., 2013) and 28.8% (Jeong and Kim, 2016). Only, 28% of Indian students (Nair et al., 2014) and 25% of Sri Lankan students (Ariyarathne et al., 2013) knew the correct minimum time required for effective handrubbing (WHO, 2009), suggesting poor practice. In a Welsh study, less than half of the respondents (n = 354) were unaware that ABHR usage is not recommended when nursing patients with Clostridium difficile infections (Hinkin and Cutter, 2014). van de Mortel et al. (2011) also found knowledge deficits relating to ABHR among Italian nursing students. However, other more positive responses are reported with 81.7% of nursing students aware that handrubbing using ABHR takes less time than using soap and water (Ariyarathne et al., 2013) and 75–85% of South Korean students knew when to perform handrubbing using ABHR (Jeong and Kim, 2016).

2.1. Conceptual Framework

Where a study has its roots in a conceptual model, the study framework is often called the conceptual framework (Polit and Beck, 2013). The WHO Guidelines on Hand Hygiene in Health Care (WHO, 2009) globally underpin best hand hygiene practice by providing an evidence-based conceptual framework for practitioners and educators alike, along with recommendations to improve practices and reduce HCAI transmission. This study has its roots in this conceptual framework, which presents an understanding of the phenomenon of interest and offers assembled concepts relevant to the study theme and design. The variables measured in this study are underpinned by the espoused practices and recommendations of the Guidelines.

According to the Guidelines handrubbing with ABHR is recommended as the ‘gold standard’ technique in hand hygiene, with healthcare workers advised to routinely perform hand hygiene using ABHR for day-to-day decontamination of hands (WHO, 2009). Therefore, it is important to understand nursing students’ attitude and practices of handrubbing, as this is the optimum practice that students are expected to adhere to both in the university and clinical practice settings. Despite this, on searching the literature, we found a paucity of international research which comprehensively explores nursing students’ handrubbing practices. There remains a need for further research to be conducted that explores the use of ABHR. Those studies that do report handrubbing practices largely do so as part of a larger hand hygiene study, with little specific emphasis placed on handrubbing practices. In summary, internationally there has not been focus on nursing attitudes and practices regarding ABHR and, more specifically, no Irish study has explored hand hygiene and handrubbing practices among nursing students. Hence the objective of this study was to provide insight into the current hand hygiene and in particular handrubbing practices of nursing students in Ireland and, by doing so, contribute to the broader understanding of this topic.

3. Methods

3.1. Design

This study employed a descriptive, self-report design and aimed to explore nursing students’ hand hygiene attitudes and practices and in particular handrubbing using ABHR. All undergraduate students of a Bachelor of Science Nursing honours degree programme (n = 342), within the Faculty of Education and Health Sciences in the University of Limerick, were invited via student email addresses to participate, between March and April 2015. They were provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. The sample comprised students across the four cohorts of the four year programme. As part of the students’ curricula, hand hygiene education and training had been delivered to all cohorts, underpinned by the WHO Guidelines, consistently across both the university and the clinical practice sites. Students in each cohort were middle to near-end of the academic year and all had experience of delivering direct patient care during the clinical practice placement components of their programmes. Participation indicated consent and was voluntary and anonymous.

3.2. Data Collection and Analysis

Following a literature review a published study instrument was selected for data collection (Larson, 2004). The validated questionnaire, originally developed at Colombia University, New York, was designed to assess barriers to adherence to the Centers for Disease Control and Prevention (CDC) hand hygiene guideline (CDC, 2002). To reflect the current WHO Guidelines (WHO, 2009), the survey was modified. In addition, two experienced researchers reviewed the questionnaire for content validity and additional questions were added. To further address
content validity, a pilot study was conducted \((n = 9)\) contributing to the reliability and validity of the questionnaire as well as checking completion time and allowing for minor redrafting of some questions for greater clarity.

The survey comprised 62 questions, with Likert scale, multiple choice and 'yes or no' questions. Almost all questions were closed questions and with pre-specified answer options. However, there were two open questions where respondents could choose the option 'other' and respond in their own words. The questionnaire comprised three sections: a short demographics section with three questions, a hand hygiene practices section and a section specifically addressing handrubbing using ABHR. Data were analysed using Survey Monkey (Gold Plan version). Descriptive statistics, including frequencies and percentages, were calculated. The relationship between variables was considered where there was a rationale to do so. Parametric testing was not carried out as data were ordinal and not normally distributed (Scott and Mazhindu, 2014).

### 3.3. Ethics

The study, approved by the Faculty Research Ethics Committee of the University, was carried out in accordance with the code of ethics of the World Medical Association Declaration of Helsinki (2013). The study was conducted anonymously with no identifiable data reported.

### 4. Results

From the 342 invitations sent, 225 \((66\%)\) nursing students responded. 94% of respondents were female. Responses were received from across all four years of the programme, with 25%, 20%, 17% and 38% from years 1, 2, 3 and 4 of the programme, respectively.

Almost all \((99\%)\) students had received hand hygiene education and training as part of their degree programme \((99\%)\). The majority considered that hand hygiene teaching and learning resources were readily available in the university \((92\%)\) and in clinical practice sites \((91\%)\). Almost all \((99\%)\) reported familiarity with the recommended hand hygiene technique and 95% reported implementing hand hygiene recommendations in clinical practice. The majority \((94\%)\) agreed that hand hygiene improves patient outcomes and that it is likely that HCAI rates will decrease if recommended hand hygiene practices are followed \((97\%)\). This is in the context of 62% of respondents having observed adverse patient events associated with HCAI.

However, despite these positive attitudes, 19% \((n = 41)\) reported preferring to continue with personal hand hygiene routines and habits, rather than change to recommended hand hygiene practices. A minority reported that it is not practical to follow recommended hand hygiene practices \((7\%, n = 15)\) and a similar number did not wish to change their hand hygiene practice regardless of research and policy recommendations \((7\%, n = 15)\). Other negative attitudes emerged among a minority of respondents with 16% \((n = 34)\) reporting that hand hygiene practices are inconvenient in clinical practice and 13% \((n = 25)\) reporting that they do not have time to stay informed about new developments. This is despite more than one in five students \((22\%)\) reporting personal experience of HCAI.

Attitudes towards handrubbing using ABHR were also explored and were largely positive, with 94% reporting that ABHR are practical to use. 98% reported that they are expected to use ABHR in clinical practice and they are readily available \((91\%)\). Fewer \((80\%)\) agreed that handrubbing using ABHR helps to standardise care and assure that patients are treated in a consistent way. 89% considered it important to act as a role model for others when using ABHR. Despite the positive attitudes towards handrubbing, a lack of clarity around best practice recommendations emerged, in particular when to use ABHR. While 93% \((n = 184)\) of students felt competent using ABHR in accordance with recommendations, 16% \((n = 34)\) were not aware of the clinical contraindications for using ABHR and 7% \((n = 15)\) had no opinion. In addition, 9% \((n = 19)\) of nursing students did not know when to use soap and water and when to use ABHR. When we compared data across the four years of the programme, only 2.3% of second years compared to 10.2%, 13.1% and 10.1% of first, third and fourth years respectively, did not know when to use soap and water versus ABHR. 34% \((n = 67)\) of respondents considered that ABHR were unpleasant to use and 37% \((n = 73)\) considered that hands do not feel clean following handrubbing using ABHR. However, the majority \((87\%)\) disagreed that ABHR are cumbersome and inconvenient with only 5.5% agreeing.

In order to determine self-reported hand hygiene practices, the WHO concept called 'my five moments for hand hygiene' model was used, which centres around five opportunities or indications for hand hygiene that healthcare workers frequently encounter in their day-to-day routines. The majority \((96\%)\) of students were familiar with the 'my five moments for hand hygiene' model (WHO, 2009) (see Table 1). However, when asked about a fundamental concept necessary for understanding the model, i.e. the difference between the patient’s zone and environment or surroundings, 19% did not understand the difference. Respondents were most compliant with the indication to perform hand hygiene after contact with body fluid \((99.5\% n = 208)\) and before a clean or aseptic procedure \((98.5\% n = 206)\). Less compliance was reported for hand hygiene after touching a patient \((87\% n = 182)\) and before touching a patient \((85\% n = 177)\). Interestingly, 20% \((n = 41)\) of nursing students had observed a patient requesting a member of staff to perform hand hygiene, while only 6.4% had been asked by a patient to perform hand hygiene. A more varied response emerged in relation to hand hygiene after touching patients’ surroundings and respondents were least compliant with this indication \((61\% n = 129)\). Of the 29% who reported non-compliance with this indication, we compared responses across the four years of the programme and found increasingly less compliance among students as the programme progressed, with 10.2% of first years compared to 41.7% of fourth years non-compliant. A similar pattern was also found for hand hygiene non-compliance both before and after touching a patient, with more fourth year students than first year students non-compliant.

To further determine if students were following best practice recommendations for handrubbing practices they were asked to identify the percentage of time they use ABHR for hand hygiene (see Table 2). It emerged that handrubbing practices were suboptimal. Just over one fifth \((22\%)\) of students were handrubbing almost all of the time as recommended \((or approximately >90\% of the time)\) and almost one third \((32\%)\) were handrubbing <50% of the time. When we compared data across the four years of the programme, second years were most compliant \((28.2\%)\) and first years least compliant \((16.6\%)\).

Barriers to handrubbing using ABHR were explored in depth. Students perceived ABHR as causing skin damage, with 52.8% agreeing that if they followed the recommendations in relation to ABHR use, they would be likely to experience dermatology issues. This is in the context of 49% of students having experienced a dermatology issue arising from hand hygiene and 59% having observed a colleague with such a dermatology issue. However, despite these positive attitudes, 19% \((n = 41)\) reported practicing a different handrubbing routine when to use soap and water versus ABHR. 34% \((n = 67)\) of respondents considered that hands do not feel clean following handrubbing using ABHR and 10.1% of students felt no need to perform hand hygiene after touching patients’ surroundings and respondents were least compliant with this indication \((61\% n = 129)\). Of the 29% who reported non-compliance with this indication, we compared responses across the four years of the programme, second years were most compliant \((28.2\%)\) and first years least compliant \((16.6\%)\).

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### 5. Discussion

The ‘my five moments for hand hygiene’ model aims to increase self-efficacy among practitioners by giving unambiguous advice about...
when to incorporate hand hygiene into complex care tasks (WHO, 2009). Despite this, almost one in five students lacked a clear understanding of the model. Furthermore, suboptimal compliance with three of the five indications for hand hygiene therein was reported. Almost full compliance with hand hygiene ‘before contact with body fluid’ (99.5%) and ‘before a clean or aseptic technique’ (98.5%) compared favourably to 92% and 77.2% respectively, reported by Jeong and Kim (2016). Given that ‘personal protection’ emerged as the single most important positive influencer of hand hygiene practice among 17.5% of respondents, the high compliance reported is perhaps unsurprising, as students strive to protect themselves from risk more traditionally associated with certain aspects of care, for example, contact with body fluid. Despite 37% of students identifying ‘prevention of cross infection’ as the single most important positive influencer of hand hygiene practice, 13% were non-compliant with hand hygiene ‘before touching a patient’ and 9% ‘after touching a patient’, suggesting that some students may perceive less risk associated with these indications and may not realise the potential for HCAI transmission associated with these patient encounters.

Previously, hand hygiene after touching a patient’s surrounding was the most commonly missed opportunity among healthcare workers (Fitzgerald et al., 2013, Randle et al., 2013), with suboptimal compliance rates as low as 36% reported (Randle et al., 2013). This is despite evidence that the hospital environment can contribute significantly to disease transmission (Chemaly et al., 2014). However, more recently, improved compliance rates are reported, varying from 72% (Jeong and Kim, 2016) to 93% (Price et al., 2016). Our study differs and compares less favourably, with only 61% (n = 129) reporting compliance and a worrying 29% (n = 61) reporting non-compliance.

We also revealed that fourth year students were less compliant than first years with the ‘my five moments for hand hygiene’ model. One possible explanation may be the impact of student socialisation on learning. Houghton et al. (2013) found that learning can be hindered by the anxiety caused by the reality of practice, in particular when students experience a gap between the teaching and learning of skills and their experience in the reality of practice. Negative socialisation may occur, whereby students implement less desirable practices to ‘fit in’, in favour of evidence-based practice (Houghton, 2014). Therefore it is essential that socialisation issues are addressed within the nursing curriculum and educators and practitioners collaboratively explore opportunities to maximise on-going positive experiences of socialisation and associated learning.

While attitudes to hand rubbing using ABHR were predominately positive sub-optimal practices emerged. Despite clear and unambiguous recommendations in the WHO Guidelines regarding when to handwash with soap and water and when to handrub using ABHR confusion among nursing students persists. Previously, 44% of Welsh nursing students were unaware that ABHR was contraindicated when caring for patients with Clostridium difficile infection (Hinkin and Cutter, 2014). Our study differs and compares more favourably with 16% of students not aware of the clinical contraindications for using ABHR. 9% did not know when to use soap and water and when to use ABHR. Given this lack of clarity among some students around usage, it is unsurprising therefore to find that only 22% of students were handrubbing with ABHR almost all of the time and that almost one third of students

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>No opinion</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am familiar with the World Health Organization (WHO) ‘My 5 moments for hand hygiene’ recommendations.</td>
<td>78.47% (n = 164)</td>
<td>17.7% (n = 37)</td>
<td>0.48% (n = 1)</td>
<td>3.35% (n = 7)</td>
<td>0.00% (n = 0)</td>
</tr>
<tr>
<td>2. I understand the difference between the patient zone and surroundings.</td>
<td>29.67% (n = 62)</td>
<td>43.06% (n = 90)</td>
<td>7.66% (n = 16)</td>
<td>16.75% (n = 35)</td>
<td>2.87% (n = 6)</td>
</tr>
<tr>
<td>3. I always perform hand hygiene before each patient contact.</td>
<td>44.98% (n = 94)</td>
<td>39.71% (n = 83)</td>
<td>2.35% (n = 5)</td>
<td>11.48% (n = 24)</td>
<td>1.44% (n = 3)</td>
</tr>
<tr>
<td>4. I always perform hand hygiene before performing a clean or aseptic technique.</td>
<td>85.17% (n = 178)</td>
<td>13.40% (n = 28)</td>
<td>0.48% (n = 1)</td>
<td>0.48% (n = 1)</td>
<td>0.00% (n = 1)</td>
</tr>
<tr>
<td>5. I always perform hand hygiene after touching a patient</td>
<td>50.24% (n = 105)</td>
<td>36.84% (n = 77)</td>
<td>3.83% (n = 8)</td>
<td>9.09% (n = 19)</td>
<td>0.00% (n = 0)</td>
</tr>
<tr>
<td>6. I always perform hand hygiene after contact with body fluids.</td>
<td>90.91% (n = 190)</td>
<td>8.61% (n = 18)</td>
<td>0.00% (n = 0)</td>
<td>0.48% (n = 1)</td>
<td>0.00% (n = 0)</td>
</tr>
<tr>
<td>7. I always perform hand hygiene after touching a patient’s surrounding.</td>
<td>24.40% (n = 51)</td>
<td>37.32% (n = 78)</td>
<td>9.09% (n = 19)</td>
<td>27.75% (n = 58)</td>
<td>1.44% (n = 3)</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Time spent using alcohol-based hand rub.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer options</td>
</tr>
<tr>
<td>Almost always (90% of time)</td>
</tr>
<tr>
<td>Often (51–90% of time)</td>
</tr>
<tr>
<td>Sometimes (10–50% of time)</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
</tr>
<tr>
<td>Never</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Rank order</th>
<th>Answer options</th>
<th>Response percent (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Skin sensitivity</td>
<td>32.5% (63)</td>
</tr>
<tr>
<td>2nd</td>
<td>No barriers</td>
<td>21.1% (41)</td>
</tr>
<tr>
<td>3rd</td>
<td>Skin damage</td>
<td>19.6% (38)</td>
</tr>
<tr>
<td>4th</td>
<td>Time</td>
<td>10.8% (21)</td>
</tr>
<tr>
<td>5th</td>
<td>No opinion</td>
<td>8.2% (16)</td>
</tr>
<tr>
<td>6th</td>
<td>Inconvenience</td>
<td>4.1% (8)</td>
</tr>
<tr>
<td>7th</td>
<td>Other (please specify)</td>
<td>3.6% (7)</td>
</tr>
</tbody>
</table>

Table 4

<table>
<thead>
<tr>
<th>No.</th>
<th>‘Other’ barriers identified to use of alcohol-based hand rub</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lack of alcohol-based hand rub within each patient’s zone</td>
</tr>
<tr>
<td>2</td>
<td>Not located in the right areas</td>
</tr>
<tr>
<td>3</td>
<td>Not always available. Containers empty and not refilled</td>
</tr>
<tr>
<td>4</td>
<td>Prefer to wash hands with warm water and soap</td>
</tr>
<tr>
<td>5</td>
<td>Their location and availability</td>
</tr>
<tr>
<td>6</td>
<td>Availability at bedside</td>
</tr>
<tr>
<td>7</td>
<td>Psoriasis</td>
</tr>
</tbody>
</table>
were handrubbing <50% of the time. Despite this finding, 93% of students' self-reported competence in using ABHR, in line with recommendations. However, this finding is interpreted taking into account that respondents may self-report a high rate of personal compliance (Cole, by second years. It is noteworthy that second years had recently completed a microbiology and infection prevention and control module. This may provide a possible explanation for the more positive attitudes and practices reported by second years.

Previously, McLaws et al. (2015), Smidt et al. (2015), Nasirudeen et al. (2012) and Erasmus et al. (2010) found that workload and the lack of time to perform hand hygiene influenced compliance among healthcare professionals. Despite the evidence that ABHR significantly reduces the time taken for hand hygiene (McLaws et al., 2015, Voss and Widmer, 1997) 11% of students in this study identified time as a barrier and this may partially explain the suboptimal frequency of handrubbing. In a seminal study, Voss and Widmer (1997) calculated that handrubbing requires far less time (18 min in an 8 h shift) than hand washing with soap and water (56 min), while Azim et al. (2016) more recently calculated even lower handrubbing times (9–13.5 min per twelve hour shift). It appears therefore, that the time burden for hand hygiene is not too onerous, and that product selection is optimised.

Personalised, the single most important factor that influences me to adhere to the use of alcohol-based hand rub is:

<table>
<thead>
<tr>
<th>Rank order</th>
<th>Answer options</th>
<th>Response percent (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Prevention of cross infection</td>
<td>37.6% (73)</td>
</tr>
<tr>
<td>2nd</td>
<td>Infection control policy</td>
<td>26.8% (52)</td>
</tr>
<tr>
<td>3rd</td>
<td>Personal protection</td>
<td>17.5% (34)</td>
</tr>
<tr>
<td>4th</td>
<td>Patient outcomes</td>
<td>9.8% (19)</td>
</tr>
<tr>
<td>5th</td>
<td>Evidenced-based practice</td>
<td>4.8% (9)</td>
</tr>
<tr>
<td>6th</td>
<td>Convenience</td>
<td>2.1% (4)</td>
</tr>
<tr>
<td>7th</td>
<td>No opinion</td>
<td>1.0% (2)</td>
</tr>
<tr>
<td>8th</td>
<td>Patient/public expectations</td>
<td>0.5% (1)</td>
</tr>
<tr>
<td>9th</td>
<td>Role model influences</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>10th</td>
<td>Other (please specify)</td>
<td>0.0% (0)</td>
</tr>
</tbody>
</table>

5.1. Limitations

The transferability of the findings of our study may be limited as the work was performed in a single nursing department in a single University. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers (i.e. programme of study, gender, third-level education) within the Irish population. Furthermore, findings are validated by similar results reported elsewhere (Jeong and Kim, 2016, Cruz and Bashtawi, 2015, Hinkin and Cutter, 2014, Nasirudeen et al., 2012, van de Mortel et al., 2011) while also contributing to a new knowledge base.

6. Conclusion

This study provides new insight into hand hygiene practices among nursing students and to some degree addresses the scarcity of recent evidence on the topic. The findings suggest that nursing students’ attitudes towards hand hygiene are generally positive, with some room for improvement identified. Some poor hand hygiene practices are identified in particular relating to frequency of handrubbing with ABHR and compliance with the ‘my five moments for hand hygiene’ WHO model. In addition, there is some confusion among students around when to use soap and water and when to use ABHR.

The findings appear to suggest that there is scope to review current teaching and learning methodologies and perhaps review curricula so that greater clarity among nursing students can be achieved and practices improved. While university education has a strong influence on knowledge and practice, the influencing role of practitioners cannot be underestimated (Hinkin and Cutter, 2014). Therefore, universities and their health service partners need to continue to work together synergistically to ensure that the influencing role of both, on students’ attitudes and practices, can be optimised. While long term behavioural changes are not guaranteed it is important to instil good habits during the early career stage of nursing students that may potentially have sustained long-term impact (Salmon et al., 2013). Raising awareness among nursing students of their responsibility in preventing the occurrence and reducing the transmission of HCAI as an on-going endeavour is required, with the laudable aim of preventing complacency and ultimately improving patient outcomes.

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References


Attitudes and practices of Irish hospital-based physicians towards hand hygiene and hand rubbing using alcohol-based hand rub: a comparison between 2007 and 2015

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SUMMARY

Background: Hand hygiene is the cornerstone of infection prevention and control practices, and reduces healthcare-associated infections significantly. However, international evidence suggests that medical doctors demonstrate poor compliance.

Aim: To explore and compare practices and attitudes towards hand hygiene, particularly hand rubbing using alcohol-based hand rub (ABHR), among hospital-based physicians in Ireland between 2007 and 2015.

Methods: In 2007, a random sample of doctors in a large teaching hospital was invited to complete a postal survey using a validated questionnaire. In 2015, the study was replicated among all doctors employed in a university hospital group, including the setting of the original study, using an online survey. Data were analysed using SPSS and Survey Monkey.

Findings: Predominately positive and improving attitudes and practices were found, with 86% of doctors compliant with hand hygiene before patient contact in 2015, compared with 58% in 2007. Ninety-one percent of doctors were compliant after patient contact in 2015, compared with 76% in 2007. In 2015, only 39% of respondents reported that they ‘almost always’ used ABHR for hand hygiene. However, this represents 13.5% more than in 2007. Stated barriers to use of ABHR included dermatological issues, poor acceptance, tolerance and poor availability of ABHR products.

Conclusion: Greater awareness of hand hygiene guidelines and greater governance appear to have had a positive impact on practice. However, despite this, practice remains sub-optimal and there is scope for substantial improvement. Continued and sustained efforts are required in order to build on progress achieved since the World Health Organization hand hygiene guidelines were published in 2009.

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Introduction

Patient safety is a healthcare priority and healthcare professionals globally have a responsibility to ensure that patients receive quality, safe health care. Infection prevention and control is a key component of patient safety programmes, with healthcare-associated infections (HCAI), especially those caused by multi-drug-resistant organisms, posing a significant threat to patient safety worldwide [1]. The impact of HCAI can be experienced by patients and their families, leading to increased patient morbidity and mortality, and increased healthcare costs. A point-prevalence survey conducted in Ireland, the setting for this report, studied a national prevalence rate of HCAI in acute care facilities of 5.2%, and the setting for this report has experienced considerable HCAI challenges in recent years [2–4].

The prevention of HCAI is a healthcare priority, and hand hygiene is recognized as a standard precautionary and effective measure in controlling the spread of these infections [5,6]. Hand rubbing is the preferred method of hand hygiene in most routine clinical situations, and is defined as ‘applying an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices’ [1]. However, hand hygiene compliance among healthcare professionals remains unacceptably low internationally [7–9]. In particular, poor compliance among doctors has been reported in many studies [5,10–13]. While there has been much focus internationally on exploring doctors’ attitudes and practices regarding hand hygiene and hand rubbing, research from Ireland regarding this topic has been limited [14]. As such, this study addresses the deficit of research pertaining to doctors’ hand hygiene practices from an Irish perspective.

In 2007, a study of hand hygiene practices and ABHR use among doctors in a large teaching hospital was conducted, as part of a larger study. The study was replicated in 2015 and the setting was expanded to encompass additional sites, following the formation of a university hospital group anchored by the original large teaching hospital. In the interim, World Health Organization (WHO) hand hygiene guidelines were published, and widespread implementation of the guidelines was supported nationally by governmental agencies and locally by the hospital groups’ infection prevention and control team and management team. This article will compare and contrast the results of the two studies, conducted eight years apart, concerning the attitudes and practices of hospital-based medical doctors in Ireland towards hand hygiene and hand rubbing. This article will also attempt to provide insight into the demonstrable influence of national and international guidelines in the intervening years.

Methods

Setting

In 2007, the study setting was a large regional teaching hospital providing major surgery, cancer treatment, emergency department services, critical care services and other medical, diagnostic and therapy services. In 2015, the expanded setting encompassed a university hospital group, comprising six hospitals functioning collectively as a single hospital system, and included the site of the original study, the largest of the hospitals. The hospital group offers a range of inpatient, outpatient, accident and emergency, and maternity care services, serves a population of approximately 400,000 people, and provides approximately 750 acute hospital beds.

Design

Both studies employed a quantitative, survey approach, using a validated questionnaire comprising validated Likert-ordinal-attitudinal scales as the research instrument.

Between March and April 2007, a random sample of consultants and non-consultant hospital doctors employed in the aforementioned teaching hospital was invited to participate in a postal survey. A cover letter and the questionnaire were sent via the internal hospital postal system, and participation indicated consent and was voluntary and anonymous.

Between November and December 2015, the setting was expanded to the aforementioned hospital group, and all consultants and non-consultant hospital doctors were invited to participate in the survey via staff email. They were provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. Participation indicated consent and was voluntary and anonymous. On completion of the online data collection, hard copies of the survey were also distributed at education and training seminars in order to enhance the response rate; these data were subsequently added manually to the online database.

Study instrument and analysis

In 2007, following a literature review, a study instrument was selected for data collection. The validated questionnaire was originally developed at Columbia University, New York and was designed to assess barriers to adherence to the Centers for Disease Control and Prevention 2002 hand hygiene guidelines [15,16]. The survey was modified and contextualized to the Irish setting. A microbiologist and a statistician further reviewed the questionnaire for content validity, and a pilot test was performed (N = 20). This helped to identify administrative and analytical issues with the research tool and process.

In 2015, the same questionnaire was used, although it was modified slightly to reflect the publication of international hand hygiene guidelines in the interim. Additional questions were added following review by two experienced researchers (microbiologists) for content validity. No questions were removed. A pilot study was conducted to improve the reliability and validity of the questionnaire, and to check completion time and allow for minor redrafting of some questions for greater clarity (N = 9).

The survey was composed of 42 and 57 questions in 2007 and 2015, respectively, with Likert scale, multiple choice and ‘yes or no’ questions. It comprised three sections that focused on demographics, hand hygiene practices and handrubbing practices. Data were analysed using Statistical Package for Social Sciences (SPSS) Version 14 (IBM Corp., Armonk, NY, USA) in 2007, and SPSS Version 24 was used in 2015. Descriptive statistics, including frequencies and percentages, were calculated. The relationship between variables was considered where there was a rationale to do so. Parametric testing was not performed as data were ordinal and not normally distributed [17]. The Pearson Chi-squared test of independence (non-
parametric) allowed for testing of association between variables and was suited to the categorical, ordinal data (e.g. Likert scale answers in this study). A significance criterion of 0.05 was used for statistical tests.

During data analysis, the 'agree' and 'strongly agree' response options were regarded as positive responses, and the 'disagree' and 'strongly disagree' responses were regarded as negative responses. This is reflected in the presentation of results below. 'No opinion' was considered a neutral response and was not combined with any other response.

Ethics

Both studies were approved by the Research Ethics Committee of the hospital and hospital group, and were performed in accordance with the code of ethics of the Declaration of Helsinki [18]. Both studies were conducted anonymously with no identifiable data reported.

Results

Response rates were 43% (N = 65) in 2007 and 15% (N = 58) in 2015. In 2007, 16.5% and 19% of respondents indicated medicine and surgery as their area of work, respectively. These figures were 57% and 13.8%, respectively, in 2015.

Predominately positive attitudes towards hand hygiene were consistent; however, improved attitudes were found in 2015. In 2007, 76% of doctors agreed that hand hygiene improves patient outcomes, compared with 90% in 2015. In 2007, 76% of doctors agreed that it is likely that HCAI rates will decrease if hand hygiene recommendations are followed, compared with 91% in 2015. In 2015, 18% more doctors believed that hand hygiene recommendations are based on sound scientific evidence, compared with 2007. Significantly, 80% of respondents in 2015 considered that the person they report to expects adherence to hand hygiene policy, which is 24% more than in 2007 (P = 0.029). In 2007, 23% of doctors preferred to continue personal handwashing routines rather than change to the recommended hand hygiene practices, compared with 14% in 2015. Despite these improved attitudes, some significant negative attitudes relating to convenience and practicality were more evident in 2015. Notably, 37% of respondents in 2015 considered hand hygiene to be inconvenient (10% more than in 2007), and 28% reported that it is not practical to follow hand hygiene recommendations, compared with 19% in 2007 (P = 0.039).

In 2015, just 2% of respondents had been asked to perform hand hygiene by a patient, while 15% had observed a patient asking another member of staff to carry out hand hygiene. When asked about their perceptions of patients’ wishes, 22% of doctors in 2007 compared with 14% in 2015 agreed that patients prefer to see doctors completing a traditional hand wash instead of using ABHR, and over 50% of respondents in both cohorts expressed no opinion on this. Further results of attitudes towards hand hygiene can be found in Table I.

Self-reported hand hygiene compliance improved from a low baseline in 2007. Eighty-two percent of respondents in 2015 reported implementing hand hygiene recommendations, compared with 60% in 2007. Of significance, 86% of respondents in 2015 reported compliance with hand hygiene before patient contact, compared with 58% in 2007 (P = 0.004), while 91% in 2015 reported compliance after patient contact, compared with 76% in 2007. A significant relationship was found between awareness of hand hygiene guidelines and when the study was conducted, with awareness of hand hygiene guidelines significantly improved in 2015 compared with 2007. Sixty-five percent of respondents in 2015 were familiar with the WHO hand hygiene guidelines, compared with just 4.8% in 2007 (P < 0.001) when draft guidelines were available. Similarly, in 2015, awareness of Irish national hand hygiene guidelines was 56%, compared with 16% in 2007 (P < 0.001). Further results of hand hygiene compliance can be found in Table II.

Attitudes towards hand rubbing using ABHR improved between 2007 and 2015. Remarkably, 98% of respondents in 2015 reported feeling competent using ABHR products in accordance with recommendations, which is 22% more than in 2007. Also, in 2015, 87% of respondents reported that ABHR helps to standardize care and ensure that patients are treated in a consistent manner, compared with 74% in 2007. Notably, 93% of respondents in 2015 considered that it is important to act as a role model for others when using ABHR, compared with 81% in 2007. Further results of attitudes towards hand rubbing using ABHR can be found in Table III.

Handrubbing practices using ABHR were explored by examining: factors that influence adherence (Table IV); the percentage of time that respondents use ABHR for hand hygiene (Table V); and the barriers to ABHR usage (Table VI). Overall, handrubbing practices have improved from a low baseline. In 2007, ‘prevention of cross-infection’ was identified as the single most important factor that influenced adherence to ABHR practices among 50% of respondents, and this was consistent in 2015 (48%). In 2007, ‘infection control policy’ was identified by just 5.6%, and this doubled to 11.1% in 2015. In 2015, 7.4% identified ‘personal protection’, but this was not an answer option in 2007.

Thirty-nine percent of respondents in 2015 reported that they ‘almost always’ (>90% of the time) used ABHR, compared with 25% in 2007. Consequently, in 2015, 15% fewer (37%) respondents reported that they ‘often’ (51–90% of the time) used ABHR. In 2015, 7% of respondents reported that they ‘rarely’ (<10% of the time) or never used ABHR for hand hygiene, compared with 12.7% in 2007.

While 20% of respondents in 2015 and 30% of respondents in 2007 identified ‘no barriers’ to adhering to ABHR, those barriers that were identified remained consistent in the intervening years. For example, in 2015, it was evident that ‘skin sensitivity’ (20%) and ‘skin damage’ (18%) were significant barriers to ABHR usage, compared with levels of 23% and 22%, respectively, in 2007. Consistently, over half of the respondents (54% in 2015, 51% in 2007) agreed that their skin would become drier and more damaged if hand hygiene recommendations were followed. Seventy-six percent of respondents in 2015 disagreed that ABHR improved skin condition, compared with 66% in 2007. These results are in the context of 49% of doctors in 2015 reporting personal experience of dermatological issues arising from hand hygiene.

Issues of user acceptability were also explored. One-third of respondents in both 2007 and 2015 reported that their hands did not feel clean following the use of ABHR. In 2015, 39% of respondents reported that ABHR was unpleasant to use, compared with 46% in 2007. Notably, 24% of respondents in 2015 disagreed that ABHR is readily available in the workplace, which is 11% more than in 2007. Further analysis revealed that
<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (N) 2007</th>
<th>Disagree % (N) 2007</th>
<th>No opinion % (N) 2007</th>
<th>Agree % (N) 2007</th>
<th>Strongly agree % (N) 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this organization, hand hygiene is important</td>
<td>0.0 (0)</td>
<td>7.0 (4)</td>
<td>1.7 (1)</td>
<td>12.3 (8)</td>
<td>86.2 (56)</td>
</tr>
<tr>
<td>I would prefer to continue my handwashing routines and habits rather</td>
<td>12.3 (8)</td>
<td>24.5 (14)</td>
<td>56.9 (37)</td>
<td>49.1 (28)</td>
<td>63.1 (36)</td>
</tr>
<tr>
<td>than change based on recommended hand hygiene practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The recommendations of the hospital hand hygiene policy are relevant</td>
<td>0.0 (0)</td>
<td>1.7 (1)</td>
<td>1.5 (1)</td>
<td>0.0 (0)</td>
<td>52.3 (34)</td>
</tr>
<tr>
<td>to my work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43.1 (28)</td>
</tr>
<tr>
<td>Adherence to hand hygiene practice is inconvenient</td>
<td>23.4 (15)</td>
<td>14.0 (8)</td>
<td>43.8 (28)</td>
<td>42.0 (24)</td>
<td>31.3 (20)</td>
</tr>
<tr>
<td>The recommendations within the hospital regarding hand hygiene are</td>
<td>1.6 (1)</td>
<td>3.5 (2)</td>
<td>6.3 (4)</td>
<td>5.2 (3)</td>
<td>46.9 (30)</td>
</tr>
<tr>
<td>based on sound scientific evidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.1 (9)</td>
</tr>
<tr>
<td>It is not really practical to follow the hand hygiene recommendations</td>
<td>20.6 (13)</td>
<td>24.5 (14)</td>
<td>50.8 (32)</td>
<td>47.3 (27)</td>
<td>12.7 (8)</td>
</tr>
<tr>
<td>I do not wish to change my hand hygiene practices, regardless of what</td>
<td>41.5 (27)</td>
<td>42.1 (24)</td>
<td>46.2 (30)</td>
<td>38.6 (22)</td>
<td>1.5 (1)</td>
</tr>
<tr>
<td>the policy/research recommends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.0 (4)</td>
</tr>
<tr>
<td>The person I report to expects me to adhere to the hand hygiene policy</td>
<td>2.2 (2)</td>
<td>3.5 (2)</td>
<td>12.9 (8)</td>
<td>1.7 (1)</td>
<td>38.7 (24)</td>
</tr>
<tr>
<td>My patients prefer to see me do a traditional hand wash instead of</td>
<td>3.2 (2)</td>
<td>5.3 (3)</td>
<td>20.6 (13)</td>
<td>24.6 (14)</td>
<td>14.3 (9)</td>
</tr>
<tr>
<td>using alcohol-based hand rub</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.5 (6)</td>
</tr>
<tr>
<td>Hand hygiene improves patient outcomes</td>
<td>0.0 (0)</td>
<td>3.5 (2)</td>
<td>1.6 (1)</td>
<td>1.7 (1)</td>
<td>42.2 (27)</td>
</tr>
<tr>
<td>If we all follow the recommendations of this policy in our practice</td>
<td>3.2 (2)</td>
<td>0.0 (0)</td>
<td>6.3 (4)</td>
<td>1.7 (1)</td>
<td>39.7 (25)</td>
</tr>
<tr>
<td>setting, it is likely that healthcare-associated infection/nosocomial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>36.5 (23)</td>
</tr>
<tr>
<td>infection rates will decrease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45.6 (26)</td>
</tr>
</tbody>
</table>
5.8% of consultants compared with 32.4% of non-consultant hospital doctors reported this finding in 2015. Seven percent of respondents in 2015 reported that they did not have the time to use ABHR, compared with 11% in 2007.

Discussion

This paper contributes to addressing the dearth of information pertaining to hand hygiene among hospital-based physicians in Ireland, and allows for a greater understanding of their perspectives. This is the first study of its kind in Ireland, and no comparable studies looking at constants and changes in hand hygiene attitudes and practices among hospital-based physicians over an eight-year period were found elsewhere in the literature. Given the greater emphasis placed on hand hygiene in the intervening years, it is not surprising that improved attitudes towards hand hygiene, particularly towards hand rubbing, were found, with more doctors in 2015 compared with 2007 accepting the scientific evidence, the likely decreased HCAI rates, and the improved patient outcomes achievable when hand hygiene recommendations are followed consistently. While the reported positive attitudes towards hand hygiene may be due to response bias or social desirability bias, this is somewhat offset by the inclusion of negatively worded questions and by negative attitudes.

The widespread implementation of the WHO hand hygiene guidelines across the hospital group in which the study was set, coupled with the strong leadership provided by the management team and the infection prevention and control team, appears to have had a positive influence on attitudes and practices towards hand hygiene. In 2015, more medical doctors were aware of hand hygiene policies compared with 2007, and compared with previous reports [6]. In 2015, almost one-quarter more doctors reported that the person they reported to expected adherence to hand hygiene policy, suggesting greater governance of hand hygiene practice in recent years, in line with WHO recommendations. However, the positive attitudes are somewhat tempered by the contrasting negative attitudes expressed, relating to the effort required to comply. For example, over one-quarter of doctors in 2015 (9% more than in 2007) reported that it is not practical to follow hand hygiene

Table II
Hand hygiene compliance

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (N)</th>
<th>Disagree % (N)</th>
<th>No opinion % (N)</th>
<th>Agree % (N)</th>
<th>Strongly agree % (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the hospital’s hand hygiene policy</td>
<td>1.5 (1)</td>
<td>10.8 (7)</td>
<td>0.0 (0)</td>
<td>46.6 (30)</td>
<td>30.8 (20)</td>
</tr>
<tr>
<td>I have implemented the recommendations made by the infection control team regarding hand hygiene</td>
<td>1.6 (1)</td>
<td>15.9 (10)</td>
<td>22.2 (14)</td>
<td>47.6 (30)</td>
<td>12.7 (8)</td>
</tr>
<tr>
<td>The hospital hand hygiene policy is readily accessible if I want to refer to it</td>
<td>1.6 (1)</td>
<td>28.1 (18)</td>
<td>25 (16)</td>
<td>32.8 (21)</td>
<td>12.5 (8)</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene in front of patients before each patient contact</td>
<td>1.6 (1)</td>
<td>26.6 (17)</td>
<td>14.1 (9)</td>
<td>45.3 (29)</td>
<td>33.3 (19)</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene in front of patients after each patient contact</td>
<td>0.0 (0)</td>
<td>12.5 (8)</td>
<td>10.9 (7)</td>
<td>45.3 (29)</td>
<td>42.1 (24)</td>
</tr>
<tr>
<td>I am familiar with the World Health Organization Guidelines on Hand Hygiene in Health Care (2009) (draft version for 2007 study)</td>
<td>4.8 (3)</td>
<td>65 (37)</td>
<td>95.2 (60)</td>
<td>35 (20)</td>
<td></td>
</tr>
<tr>
<td>I am familiar with the SARI National Guidelines for Hand Hygiene in Irish Health Care Settings (2005)</td>
<td>19.4 (12)</td>
<td>56.1 (32)</td>
<td>80.6 (50)</td>
<td>43.9 (25)</td>
<td></td>
</tr>
<tr>
<td>I am familiar with the Health Information Quality Authority National Standards for the Prevention and Control of Healthcare Associated Infections (2009)</td>
<td>N/A</td>
<td>65 (37)</td>
<td>N/A</td>
<td>35 (20)</td>
<td></td>
</tr>
</tbody>
</table>
recommendations, and over one-third (10% more than in 2007) considered hand hygiene practice to be inconvenient. These findings suggest that doctors consider hand hygiene to be an onerous or burdensome task despite evidence that hand rubbing with ABHR significantly reduces the time taken for hand hygiene [19,20]. However, despite these negative perceptions reported, only 7% of respondents considered that they do not have time to use ABHR, differing from previous studies where workload and perceived lack of time to perform hand hygiene influenced compliance among healthcare professionals [19,21-23].

Despite widespread availability of ABHR dispensers throughout the hospital group, poor availability of ABHR was reported among non-consultant hospital doctors. A contributing factor to this could be the regular turnover of non-consultant hospital doctors in the Irish healthcare system, leading to unfamiliarity with new surroundings and the location of product dispensers. However, this finding correlates with similar findings in the USA and Canada, where location, inconvenience and empty product dispensers all served as potential barriers to compliance, and where a working gel dispenser was found to be the most effective influencing strategy among doctors in Stanford University [5,13,24]. Point of care availability of ABHR, located conveniently at the bedside, or personal carriage of small containers of ABHR is essential. Sustained efforts are required to ensure supply, convenience and availability in order to avoid these potential pitfalls and support best practice among all healthcare professionals [1,8,24,25].

Self-reported hand hygiene practice has improved in the eight years between the two studies, with 28% more doctors reporting hand hygiene compliance before patient contact (86%), and 15% more doctors reporting hand hygiene compliance after patient contact (91%) in 2015 compared with 2007. While the reported improvements are promising, these results should be interpreted with caution. In light of publication of the WHO guidelines in the intervening years, the sustained

### Table III
Atitudes to hand rubbing using alcohol-based hand rub (ABHR)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (N) 2007</th>
<th>Disagree % (N) 2007</th>
<th>No opinion % (N) 2007</th>
<th>Agree % (N) 2007</th>
<th>Strongly agree % (N) 2007</th>
<th>Strongly disagree % (N) 2015</th>
<th>Disagree % (N) 2015</th>
<th>No opinion % (N) 2015</th>
<th>Agree % (N) 2015</th>
<th>Strongly agree % (N) 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with ABHR</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>1.85 (1)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
<td>47.6 (30)</td>
<td>38.8 (21)</td>
<td>52.4 (33)</td>
<td>59.2 (32)</td>
</tr>
<tr>
<td>ABHR is practical to use</td>
<td>3.2 (2)</td>
<td>3.7 (2)</td>
<td>3.2 (2)</td>
<td>9.26 (5)</td>
<td>3.2 (2)</td>
<td>1.85 (1)</td>
<td>44.4 (28)</td>
<td>46.3 (25)</td>
<td>46 (29)</td>
<td>38.9 (21)</td>
</tr>
<tr>
<td>ABHR helps to standardize care and ensure that patients are treated in a</td>
<td>4.8 (3)</td>
<td>0.0 (0)</td>
<td>4.8 (3)</td>
<td>7.4 (4)</td>
<td>15.9 (10)</td>
<td>5.5 (3)</td>
<td>52.4 (33)</td>
<td>57.4 (31)</td>
<td>22.2 (14)</td>
<td>29.6 (16)</td>
</tr>
<tr>
<td>consistent way</td>
<td>I feel competent using ABHR in accordance with recommendations</td>
<td>3.2 (2)</td>
<td>0.00 (0)</td>
<td>6.3 (4)</td>
<td>0.00 (0)</td>
<td>14.3 (9)</td>
<td>1.85 (1)</td>
<td>52.4 (33)</td>
<td>63 (34)</td>
<td>23.8 (15)</td>
</tr>
<tr>
<td>It is important to act as a role model for others when using ABHR</td>
<td>3.2 (2)</td>
<td>0.00 (0)</td>
<td>0.0 (0)</td>
<td>1.85 (1)</td>
<td>15.9 (10)</td>
<td>5.56 (3)</td>
<td>47.6 (30)</td>
<td>50.0 (27)</td>
<td>33.3 (21)</td>
<td>42.6 (23)</td>
</tr>
<tr>
<td>Generally, the costs of ABHR outweigh the benefits</td>
<td>17.5 (11)</td>
<td>18.5 (10)</td>
<td>30.2 (19)</td>
<td>57.4 (31)</td>
<td>46.0 (29)</td>
<td>14.8 (8)</td>
<td>4.8 (3)</td>
<td>7.4 (4)</td>
<td>1.6 (1)</td>
<td>1.85 (1)</td>
</tr>
<tr>
<td>I am not really expected to use ABHR in my practice setting</td>
<td>36.1 (22)</td>
<td>33.3 (18)</td>
<td>54.1 (33)</td>
<td>61.1 (33)</td>
<td>8.2 (5)</td>
<td>1.8 (1)</td>
<td>1.6 (1)</td>
<td>1.8 (1)</td>
<td>0.0 (0)</td>
<td>1.8 (1)</td>
</tr>
</tbody>
</table>

### Table IV
Factors influencing adherence to use of alcohol-based hand rub

The single most important factor that influences me to adhere to the use of alcohol-based hand rub is:

<table>
<thead>
<tr>
<th>Answer options</th>
<th>Response % (N) 2007</th>
<th>Response % (N) 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention of cross-infection</td>
<td>50 (27)</td>
<td>48.1 (26)</td>
</tr>
<tr>
<td>Infection control policy</td>
<td>5.6 (3)</td>
<td>11.1 (6)</td>
</tr>
<tr>
<td>Patient outcomes</td>
<td>11.1 (6)</td>
<td>9.3 (5)</td>
</tr>
<tr>
<td>Evidence-based practice</td>
<td>13 (7)</td>
<td>5.6 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>3.7 (2)</td>
<td>7.4 (4)</td>
</tr>
<tr>
<td>Personal protection</td>
<td></td>
<td>7.4 (4)</td>
</tr>
<tr>
<td>Convenience</td>
<td>9.3 (5)</td>
<td>5.6 (3)</td>
</tr>
<tr>
<td>No opinion</td>
<td>3.7 (2)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Role model influences</td>
<td>1.9 (1)</td>
<td>3.7 (2)</td>
</tr>
<tr>
<td>Patient/public expectations</td>
<td>1.9 (1)</td>
<td>1.9 (1)</td>
</tr>
</tbody>
</table>

### Table V
Time spent hand rubbing using alcohol-based hand rub

In clinical practice, the percentage of the time I use alcohol-based hand rub for hand hygiene is:

<table>
<thead>
<tr>
<th>Answer options</th>
<th>Response % (N) 2007</th>
<th>Response % (N) 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1.6 (1)</td>
<td>1.85 (1)</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>11.1 (7)</td>
<td>5.56 (3)</td>
</tr>
<tr>
<td>Sometimes (10–50% of time)</td>
<td>9.5 (6)</td>
<td>16.67 (9)</td>
</tr>
<tr>
<td>Often (51–90% of time)</td>
<td>52.4 (33)</td>
<td>37.04 (20)</td>
</tr>
<tr>
<td>Almost always (&gt;90% of time)</td>
<td>25.4 (16)</td>
<td>38.89 (21)</td>
</tr>
</tbody>
</table>
campaign within the study setting to improve hand hygiene compliance, including target setting and the introduction of evidence-based practice bundles, few doctors can remain unaware of the importance of vigilant hand hygiene practice. In addition, it is acknowledged that there is potential for bias associated with the study design, and that inflated or inaccurate results can be introduced when respondents self-report better practice than their actual practice [26–28]. However, it is reasonable to suggest that these same drivers of hand hygiene compliance, combined with the greater awareness of policies and the perception of improved governance reported in this study, may have had a positive impact on practice and compliance.

Another driver of hand hygiene is the patient perspective. Squires et al. identified the patient as an important influence for physician hand hygiene compliance, and Barroso et al. found that ‘patient request’ for hand hygiene was an effective strategy for influencing compliance among medical students and doctors [13,24]. However, in the present study, only 2% of physicians had been asked to perform hand hygiene by a patient. Despite the WHO recommendation to use ABHR for routine decontamination of hands in most clinical situations, rather than the traditional handwash approach using soap and water, 14% (2015) of physicians considered that patients prefer ABHR rather than the traditional handwash approach using soap and water, 14% (2015) of physicians considered that patients prefer ABHR rather than the traditional handwash approach using soap and water.

Table VI
Barriers to hand rubbing using alcohol-based hand rub (ABHR)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly disagree % (N)</th>
<th>Disagree % (N)</th>
<th>No opinion % (N)</th>
<th>Agree % (N)</th>
<th>Strongly agree % (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have confidence that ABHR improves my skin’s condition</td>
<td>27.4 (17)</td>
<td>25.9 (14)</td>
<td>38.7 (24)</td>
<td>50 (27)</td>
<td>24.2 (15)</td>
</tr>
<tr>
<td>If I follow the hand hygiene policy recommendations, it is likely my hands will be in worse shape (drier, more skin damage)</td>
<td>7.9 (5)</td>
<td>7.4 (4)</td>
<td>30.2 (19)</td>
<td>22.2 (12)</td>
<td>11.1 (7)</td>
</tr>
<tr>
<td>My hands do not feel clean following the use of ABHR</td>
<td>14.3 (9)</td>
<td>7.4 (4)</td>
<td>42.9 (27)</td>
<td>53.7 (29)</td>
<td>9.5 (6)</td>
</tr>
<tr>
<td>I find ABHR unpleasant to use ABHR</td>
<td>20.6 (13)</td>
<td>7.4 (4)</td>
<td>22.2 (14)</td>
<td>44.4 (24)</td>
<td>11.1 (7)</td>
</tr>
<tr>
<td>ABHR is cumbersome and inconvenient</td>
<td>28.6 (18)</td>
<td>25.9 (14)</td>
<td>54 (34)</td>
<td>63 (34)</td>
<td>7.9 (5)</td>
</tr>
<tr>
<td>I don’t have the time to use ABHR</td>
<td>32.3 (20)</td>
<td>26 (14)</td>
<td>54.8 (34)</td>
<td>61 (33)</td>
<td>1.6 (1)</td>
</tr>
<tr>
<td>In my area of work, I find ABHR readily available</td>
<td>1.6 (1)</td>
<td>1.8 (1)</td>
<td>11.3 (7)</td>
<td>22.2 (12)</td>
<td>6.5 (4)</td>
</tr>
<tr>
<td>My religious/cultural beliefs prevent me from using ABHR in my healthcare setting</td>
<td>66.7 (42)</td>
<td>57.4 (31)</td>
<td>25.4 (16)</td>
<td>35.2 (19)</td>
<td>6.6 (11)</td>
</tr>
</tbody>
</table>

usage and is comparable with other studies that reported low compliance rates among doctors [22,26,27]. ABHR is ineffective in the removal and destruction of certain spore-forming organisms (e.g. Clostridium difficile). However, ABHR is appropriate in most routine clinical situations and, therefore, high compliance rates among healthcare professionals are expected. The low percentage of doctors who reported routine use of ABHR in this study raises concerns for the possible transmission of micro-organisms and the potential for HCAI. While it is promising to note a 14% improvement in the use of ABHR since 2007, only 39% of doctors in 2015 were ‘almost always’ using ABHR for hand hygiene indications. This echoes the findings of a systematic review by Kingston et al., which reported that compliance rates remained poor despite widespread implementation of multi-modal hand hygiene intervention strategies [7].

The self-reported compliance rate of 39% in this study is considerably lower than the results of a national observational hand hygiene audit. A national compliance rate of 74% is reported in Ireland for hand rubbing using ABHR as a percentage of hand hygiene opportunities taken, with a set target of 80% [29]. Notwithstanding the bias potential associated with a self-report design, the disparity between the two results adds to the debate in the literature around the merits of observational hand hygiene audit, with researchers in the UK and Australia recently suggesting that observational audit hand hygiene results may be artificially inflated and may deny poor performance, poor methodology, poor training, the Hawthorne effect and avoidance tactics [19,23,30,31]. It may be timely to review the setting of unrealistically high targets and move towards progressively improving performance with reasonably achievable targets and more realistic expectations, with the ultimate goal of achieving improved practices and less transmission of infection [30,32].

Self-protection, availability of role models and perceptions of risk have been identified previously as enablers or
influencers of hand hygiene among doctors [10,21,33]. In the present study, more doctors were influenced to adhere to hand rubbing with ABHR by ‘prevention of cross-infection’ than any other factor. ‘Infection prevention and control policy’, ‘evidenced-based practice’ and ‘patient outcomes’ also featured as practice influencers, and these results suggest that patient safety is a priority for more Irish doctors than ‘personal protection’ or ‘role model influence’, and differ from previous results [21,33,34].

The barriers to hand hygiene identified in this study may provide some insight into reasons for poor compliance among doctors. One in five respondents in both cohorts identified skin sensitivity and skin damage as barriers to hand hygiene. Given that almost half of the respondents in 2015 reported personal experience of dermatological issues arising from hand hygiene, it is unsurprising that these barriers feature prominently. These barriers may constitute a deterrent to adherence to recommended practices and the widespread adoption of ABHR, and may account, in part, for the suboptimal self-reported handrubbing practices. Despite evidence to suggest that ABHR is well tolerated and kinder to the skin than soap and water [39–37], the present findings differ as the majority of doctors disagreed that ABHR improved skin condition, and over one-third considered that their skin condition would become drier and more damaged if ABHR recommendations were followed. This is consistent with previous research where ‘products drying out hands’ (32%) is identified as a barrier to compliance among Canadian and American doctors and nurses [5].

It is acknowledged that this study had some limitations. The variation in methods between the two studies conducted and described earlier (e.g. different study settings, different sample sizes and the move from postal to online survey) may have affected the comparability of data. Despite a larger sample size (N = 385) in 2015 compared with 2007 (N = 151), the response rate in 2015 was lower. However, the numbers of respondents, although small, were comparable between the two groups (N = 65 in 2007 and N = 58 in 2015), and were comparable to sample sizes in similar studies on the topic [14,38,39]. The move from a postal survey in 2007 to an online survey in 2015 may provide one possible explanation for the lower response rate in 2015, if medical doctors were not using their employer-based email address regularly. With response rates in mind, results need to be interpreted carefully and consideration given to the possible effect of response bias, where those who responded were positively disposed to the topic. However, this is somewhat offset by the replication of the study and the consistent responses found in both cohorts. The transferability of the findings of this study may be limited, as the work was performed in one university hospital and one hospital group in one region of Ireland. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers within the Irish population. Furthermore, findings are validated by similar results reported elsewhere while also contributing to a new knowledge base [5,19,23].

This original study reports improved hand hygiene attitudes and practices among hospital-based physicians in a university hospital group in Ireland between 2007 and 2015. While attitudes towards hand rubbing using ABHR were predominantly positive and have improved, there remains scope for substantial improvement in handrubbing practices, and scope to address a number of perceived barriers among doctors. The adoption of international evidence-based hand hygiene guidelines, and widespread support for their implementation by the government and the hospital group’s infection prevention and control team and management team appear to have had a positive influence on hand hygiene practices, and raised awareness of this important patient safety issue among doctors in this study. Ongoing education and training, audits and feedback provided by the local infection prevention and control team, coupled with announced and unannounced audits conducted by governmental agencies appear to be contributing to greater compliance among medical doctors. The heightened emphasis on the importance of hand hygiene both in mainstream media, social media and society at large, and the resulting greater expectations of the public may have had a positive effect on doctors’ attitudes and practices. However, given the sustained focus on hand hygiene practices in the years between the two studies, greater improvements were envisaged. Further improvements in hand hygiene practices are essential to address the challenges and complications that arise from HCAI, as experienced recently in the study setting [3,4]. These findings provide new insight into hand hygiene practices among doctors in Ireland, and, to some degree, address the scarcity of recent evidence on the topic. Findings will be of particular interest to medical educators, those in the field of infection prevention and control, and clinicians working in this field.

Conflict of interest
None declared.

Funding sources
None.

References


Hand hygiene: Attitudes and practices of nurses, a comparison between 2007 and 2015

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Key Words: Hand hygiene Handrubbing Alcohol-based handrub Nurses Attitudes Practices

Background: Hand hygiene reduces health care–associated infections significantly. However, international evidence suggests that practices are suboptimal. The objective of this study was to compare and contrast hand hygiene attitudes and practices and alcohol-based handrub (ABHR) use among nurses between 2007 and 2015.

Methods: In 2007, a random sample of nurses in a large teaching hospital was invited to complete a postal survey using a validated questionnaire. In 2015, the study was replicated among all nurses employed in a university hospital group, including the setting of the original study. Data were analyzed quantitatively and qualitatively using appropriate software.

Results: Attitudes to hand hygiene were positive and >90% of respondents' self-reported compliance before and after patient contact. However, 13% fewer in 2015 (42%) reported using ABHR >90% of the time compared with in 2007 (55%). Of nurses with <2 years' experience, 90% reported using ABHR >50% of the time compared with 73% of nurses with 2-5 years' experience. Barriers to ABHR improved, but remained high (skin sensitivity: 2007: 23%; 2015: 17%; skin damage: 2007: 18%; 2015: 13%; poor user acceptability and tolerance: 2007 and 2015: 25%).

Conclusions: Use of positive role models, the adoption of a positive social and cultural norm within the organization, and the provision of continuing professional development opportunities may prove useful strategies in harnessing good practice among graduate nurses and in preventing negative socialization from occurring.

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Infection prevention and control is a cornerstone of patient safety programs worldwide; however, health care–associated infections (HCAs) pose a significant threat to patient safety. The impact of HCAs can be considerable, resulting in poor patient outcomes and increased financial burden on health care organizations, patients, and their families. A point-prevalence survey conducted in Ireland, the setting for this study, reported a national prevalence rate of HCAs in acute care facilities of 5.2%, and the setting for this report has experienced considerable HCAI challenges in recent years, especially from those infections caused by multidrug-resistant organisms.

Hand hygiene is widely recognized as an effective measure in controlling the spread of HCAs. However, despite this, compliance internationally among health care professionals with hand hygiene remains unacceptably low. The preferred method of hand hygiene in most routine clinical situations is handrubbing. It is defined as "applying an antiseptic hand rub to reduce or inhibit the growth of microorganisms without the need for an exogenous source of water and requiring no rinsing or drying with towels or other devices."

Although there has been some focus internationally on exploring nurses’ attitudes and practice regarding hand hygiene, research from Ireland regarding this topic has been limited. In 2007, as part of a larger study, we conducted a study of hand hygiene practices and alcohol-based handrub (ABHR) use among nurses in a large teaching hospital. The study was replicated in 2015, and the setting was expanded to encompass additional sites, following the formation of a university hospital group anchored by the same large
teaching hospital. In the interim, World Health Organization (WHO) hand hygiene guidelines were published. Widespread implementation of the guidelines was supported nationally by governmental agencies and locally by the infection prevention and control team and by the hospital group management team. Hence, the aim of this article, similar to that of a previous study regarding physicians, is to compare and contrast results of the 2 studies, conducted 8 years apart, concerning hand hygiene and handrubbing attitudes and practices of nurses in Ireland. Our report further attempts to provide insight regarding the demonstrable influence of national and international guidelines in the intervening years.

METHODS

Setting

In 2007, the study setting was a large regional teaching hospital providing major surgery, cancer treatment, emergency department services, critical care services, and other medical, diagnostic, and therapy services. In 2015, the expanded setting encompassed a university hospital group, comprising 6 hospitals functioning collectively as a single hospital system, and included the site of the original study, the largest of the hospitals. The hospital group offers a range of inpatient, outpatient, accident and emergency, and maternity care services; serves a population of approximately 400,000 people; and provides approximately 750 acute hospital beds.

Design

Both studies used a quantitative, survey approach, using a validated questionnaire comprising a validated Likert-ordinal-attitudinal scale, as the research instrument.

Between March and April 2007, a random sample of nurses employed in the aforementioned teaching hospital were invited to participate in a postal survey. Random sampling was achieved by sourcing a list of all registered nurses in the hospital from the nursing administration department. Each nurse was allocated a number (n = 934). Sample size was accurately calculated (n = 272) using online software, with a confidence level of 95% and a confidence interval of 5. Using the number allocated to each nurse, a random bias-free sample was generated using online software, resulting in 272 numbers. The paper-based survey was distributed by sending participants a cover letter, the questionnaire, and a self-addressed envelope via the internal hospital postal system and requesting return of completed questionnaires by mail. Participation indicated consent and was voluntary and anonymous.

Between November and December 2015, the setting was expanded to the aforementioned hospital group, and all nurses (n = 1,500) were invited to participate in the survey. The questionnaire was administered by the human resource department of the hospital group and sent to participants via internal staff e-mail addresses. Participants were electronically provided a link to the online study instrument and to a concise, unbiased explanation of the survey topic. Participation indicated consent and was voluntary and anonymous. A neutral research assistant, who was unknown to participants, acted as a gatekeeper and managed online survey responses. On completion of the online data collection process, to enhance the response rate, hard copies of the survey were also distributed at education and training seminars, and the data were subsequently added manually by the research assistant to the online database.

Study instrument

In 2007, after a literature review, a study instrument was selected for data collection. The validated questionnaire was originally developed at Columbia University, in New York, and was designed to assess barriers to adherence to the Centers for Disease Control and Prevention 2002 hand hygiene guidelines. The survey was modified and contextualized to the Irish setting. A microbiologist and a statistician further reviewed the questionnaire for content validity, and a pilot test was carried out (n = 20). This helped to identify administrative and analytical issues with the research tool and process.

In 2015, the same questionnaire was used although slightly modified to reflect the publication of international hand hygiene guidelines in the interim. Additional questions were added after review by 2 experienced researchers (microbiologists) for content validity. No questions were removed. A pilot study was conducted (n = 9) contributing to the reliability and validity of the questionnaire and checking completion time and allowing for minor redrafting of some questions for greater clarity. The survey was composed of 42 and 57 questions in 2007 and 2015, respectively, with a Likert scale, with multiple choice and yes or no questions. It comprised 3 sections with a focus on demographics, hand hygiene practices, and handrubbing practices.

Statistical analysis

In 2007, data were analyzed using SPSS version 14 (IBM-SPSS, Armonk, NY) and in 2015 using SPSS version 24 (IBM-SPSS) and Survey Monkey (SurveyMonkey, San Mateo, CA) gold plan version. Standard descriptive statistics, including frequencies and percentages, were calculated to characterize the distribution of variables. Parametric testing was not performed because data were ordinal and not normally distributed. The relationship between variables was considered where there was a rationale to do so. The Pearson χ² test of independence (nonparametric) allowed for testing of association between variables and was suited to the categorical, ordinal data (eg, Likert scale answers) in this study. We used a significance criterion of P < .05 for our statistical tests. During analysis, agree and strongly agree responses were combined, and likewise, disagree and strongly disagree responses were combined. This is reflected in Tables 1, 4, 5, and 6 where the original 5 answer options have been reduced to 3 categories of responses.

Ethics

Both studies were approved by the research ethics committee of the hospital and hospital group and performed in accordance with the code of ethics of the Declaration of Helsinki. Both studies were conducted anonymously with no identifiable data reported.

RESULTS

In 2007, based on the numbers targeted (n = 272), the response rate was 63% (n = 171), and in 2015 the response rate was 19% (n = 287) based on 1,500 nurses targeted. In 2007, 19% of respondents worked in medical wards, compared with 30% in 2015 and 17.5% in surgical wards, compared with 26% in 2015. In 2015, 28% of respondents had worked in clinical practice between 10 and 20 years and 47% for >20 years. Because this question was added in 2015, there are no data for 2007.

Awareness of WHO hand hygiene guidelines among respondents increased significantly (P < .001) by 54%, from 31% in 2007 (when draft guidelines were available) to 85% in 2015 (when published WHO guidelines were available). Awareness of Irish national
Hand hygiene compliance among nurses

Table 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the hospital’s hand hygiene policy</td>
<td>1.2/2</td>
<td>2.9/8</td>
<td>0.6/1</td>
<td>1.8/5</td>
<td>98.2/168</td>
<td>95.2/260</td>
<td>.495</td>
</tr>
<tr>
<td>I have implemented the recommendations made by the infection control team regarding hand hygiene</td>
<td>3.0/5</td>
<td>4.7/13</td>
<td>3.6/6</td>
<td>2.2/6</td>
<td>93.5/157</td>
<td>93.1/254</td>
<td>.358</td>
</tr>
<tr>
<td>The hospital hand hygiene policy is readily accessible if I want to refer to it</td>
<td>3.5/6</td>
<td>5.1/14</td>
<td>1.2/2</td>
<td>3.7/10</td>
<td>95.3/162</td>
<td>91.2/249</td>
<td>.517</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene in front of patients before each patient contact</td>
<td>5.3/9</td>
<td>1.8/5</td>
<td>4.7/8</td>
<td>2.2/6</td>
<td>90.0/154</td>
<td>96.0/262</td>
<td>.003</td>
</tr>
<tr>
<td>I make a conscious effort to carry out hand hygiene in front of patients after each patient contact</td>
<td>4.2/7</td>
<td>2.9/8</td>
<td>5.9/10</td>
<td>2.6/7</td>
<td>89.9/152</td>
<td>94.5/258</td>
<td>.109</td>
</tr>
</tbody>
</table>

Table 2

Time spent handrubbing using alcohol-based handrub among nurses

<table>
<thead>
<tr>
<th>In clinical practice, the percentage of the time I use alcohol-based handrub for hand hygiene is</th>
<th>2007</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1.8</td>
<td>0.37</td>
</tr>
<tr>
<td>Rarely (&lt;10% of time)</td>
<td>0.6</td>
<td>3.37</td>
</tr>
<tr>
<td>Sometimes (10%-50% of time)</td>
<td>8.5</td>
<td>17.6</td>
</tr>
<tr>
<td>Often (51%-90% of time)</td>
<td>33.9</td>
<td>36.7</td>
</tr>
<tr>
<td>Almost always (&gt;90% of time)</td>
<td>55.2</td>
<td>41.95</td>
</tr>
</tbody>
</table>

Hand hygiene guidelines also significantly increased (P ≤ .001) in the intervening years from 60% to 79%. Self-reported hand hygiene compliance was consistently high in both cohorts. Of respondents in 2007 and 2015, 93% reported implementing hand hygiene recommendations. Most respondents in 2007 (95%) and in 2015 (96%) reported compliance with hand hygiene before patient contact, whereas reported compliance after patient contact improved marginally but not significantly (P = .109), from 90% in 2007 to 94.5% in 2015. Further results of hand hygiene compliance can be found in Table 1.

Handrubbing practices were explored by examining the percentage of time respondents use ABHR for hand hygiene (Table 2), factors that influence adherence (Table 3), and barriers to ABHR usage (Table 4). In 2015, even though 77% of respondents had observed patients affected by HCAI, there was a downward trend in ABHR usage compared with 2007. There were 13% fewer nurses in 2015 (42%) who reported using ABHR almost always (>90% of time), compared with in 2007 (55%). In addition, when responses were combined, it was evident that 10% more nurses in 2015 (21%) compared with 2007 (11%) reported using ABHR sometimes, rarely, or never. Further analysis and cross tabulation of 2015 data revealed that newly qualified nurses were the most compliant group overall. Of respondents working <2 years in practice, 45% reported compliance with handrubbing using ABHR almost always, whereas just 33% of respondents working 2-5 years in practice reported similarly. In addition, when responses were combined, 90% of respondents working <2 years in practice reported compliance often or always (ie, >50% of time), compared with 73% of those working 2-5 years and 74% of those working 10-20 years in practice.

In 2015, even though 17% of respondents reported personal experience of HCAI, only 5% identified personal protection as the single most important factor that influenced their adherence to ABHR practices. Further analysis and cross tabulation revealed that of the 5% who identified personal protection, 0% worked in surgical wards, 44% worked in medical wards, whereas 56% worked in other areas. Comparative data are not available here because these 2 questions were added in 2015. In contrast with the very low percentage of respondents identifying personal protection, 66% of respondents in 2007 and 47% in 2015 identified prevention of cross-infection as the single most important factor that influenced adherence to handrubbing practices. In addition, infection control policy also featured strongly in both cohorts (2007: 16% and 2015: 17%) (Fig 1).

The percentage of respondents reporting no barriers to ABHR increased from 34% in 2007 to 38% in 2015, and respondents’ perceptions of dermatology-related barriers have also improved. Of significance (P = .05), 10% fewer respondents in 2015 (33%) agreed that skin condition would become drier and more damaged if hand hygiene recommendations were followed, compared with in 2007 (43.7%), whereas 8% fewer in 2015 (59%) compared with 2007 (67%) disagreed that ABHR improves skin condition. When asked to identify the single most important barrier to adhering to the use of ABHR, 23% in 2007 and 17% in 2015 identified skin sensitivity, whereas

NOTE. Values are % (n) or as otherwise indicated.
N/A, not applicable; SARI, Strategy for the control of Antimicrobial Resistance in Ireland; WHO, World Health Organization.

*In 2007 Draft WHO Guidelines on Hand Hygiene in Health Care were available.

In 2015, even though 17% of respondents reported personal experience of HCAI, only 5% identified personal protection as the single most important factor that influenced their adherence to ABHR practices. Further analysis and cross tabulation revealed that of the 5% who identified personal protection, 0% worked in surgical wards, 44% worked in medical wards, whereas 56% worked in other areas. Comparative data are not available here because these 2 questions were added in 2015. In contrast with the very low percentage of respondents identifying personal protection, 66% of respondents in 2007 and 47% in 2015 identified prevention of cross-infection as the single most important factor that influenced adherence to handrubbing practices. In addition, infection control policy also featured strongly in both cohorts (2007: 16% and 2015: 17%) (Fig 1).

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18% in 2007 and 13% in 2015 identified skin damage. Further analysis of 2015 data revealed that skin damage was identified by 30% of respondents with <2 years' experience compared with 8% of respondents with >20 years' experience. Regarding user acceptability, over a quarter of respondents in both cohorts considered that hands do not feel clean after the use of ABHR, whereas 26% of respondents in 2007 and 20% in 2015 reported that ABHR was unpleasant to use. Time was identified as the single most important barrier to ABHR usage among 9.5% and 10.9% of respondents in 2007 and 2015, respectively. In 2015, time was identified by 15% of respondents with <2 years' experience compared with 6% of respondents with 10-20 years' experience.

Even though a downward trend in handrubbing using ABHR is reported between 2007 and 2015, attitudes toward hand hygiene and handrubbing were consistently positive overall, with little change evident in the intervening years. Over 95% of respondents in both cohorts reported that hand hygiene policy was relevant to their work, whereas >90% considered that the person they report to expected adherence to hand hygiene policy. The vast majority in both cohorts considered that hand hygiene improves patient outcomes, that hand hygiene recommendations are based on sound scientific evidence, and that if these recommendations are followed it is likely that HCAI rates will decrease. Most reported that ABHR helps to standardize care and ensures patients are treated in a consistent manner. Most
also reported that ABHR is practical to use and that they felt competent using ABHR products in accordance with recommendations. Over 95% in both cohorts considered that it is important to act as a role model for others when using alcohol-based handrub.

Marginal but not statistically significant changes in negative attitudes toward hand hygiene were reported among a minority in both cohorts, for example 4.7% of respondents in 2007 did not wish to change personal hand hygiene practice, regardless of what the policy and research recommends. The recommendations of the hospital hand hygiene policy are relevant to my work, 87.3% in 2007 compared with 86.7% in 2015 reported that it is not practicable to follow hand hygiene recommendations, whereas just over 10% in both cohorts considered hand hygiene to be inconvenient. Further results of attitudes toward hand hygiene can be found in Table 5.

### DISCUSSION

No comparable studies looking at constants and changes in hand hygiene attitudes and practices among nurses over an 8-year period were found elsewhere in the international literature; hence, this article makes a novel and valuable contribution in its field. In addition, to our knowledge, this is the first study of its kind in Ireland and addresses the scarcity of information available on hand hygiene practices among nurses in Ireland. Only one other study conducted on hand hygiene practices among registered nurses in Ireland was found, with data collection dating back to 2001, and one study examining hand hygiene practices among nursing students was also found.

Given that Ireland has historically been a net exporter of nurses to such countries as the United States, Canada, Australia, and the United Kingdom, with estimates suggesting that foreign-educated nurses represent 5%-10% of such countries’ nurse workforce, the potential impact of Irish nurses on infection prevention and control and patient safety issues internationally is considerable. Hence, within a global nursing context and cognizant that hand hygiene is a globally transferrable clinical skill, this study makes a significant contribution to the international body of literature.
leading to artificially high results. Others have suggested that self-report survey design predicts intention to comply rather than actual performance. Hence, it is probably reasonable to assume that our data offer a reasonably accurate picture of nurses’ perceptions and intentions.

Awareness of international and national hand hygiene guidelines among respondents significantly improved in the intervening years between the 2 studies, coinciding with the widespread adoption of the WHO hand hygiene guidelines in the study setting. This, along with a positive attitude among respondents toward the relevance of hand hygiene policy to their work and the perception that managers expect adherence to hand hygiene policy, suggests that hand hygiene guidelines may be positively influencing practice. The predominately positive attitudes among nurses toward hand hygiene reported in our study is also reflected in the literature; however, one study reports negative attitudes among nurses in a teaching hospital in India.

We know that nurses have high levels of direct patient contact because of the nature of their work; consequently, they experience a high burden of hand hygiene, resulting in up to 15 opportunities to use ABHR per hour. Accordingly, this places a high onus of responsibility on nurses to comply with best practice in the interest of patient safety. Nurses have a moral, ethical, and professional responsibility to engage in optimal usage of ABHR in the daily routine delivery of care. However, disappointingly, in this study a continuing trend of suboptimal usage of ABHR was found, and fewer nurses self-reported compliance with handrubbing best practice in 2015 than in 2007, despite greater knowledge of policy recommendations in 2015. This raises concerns for the possible transmission of multidrug-resistant organisms and the potential for HCAL. It also suggests that knowledge does not always result in improved practices and that despite positive attitudes, good intention does not always result in good practice.

An associated risk factor for poor handrubbing practice that is rarely reported is the clinical experience of health care workers. We found that nurses working >2 years in practice were more compliant with optimum handrubbing practice compared with more experienced nurses, a finding echoed by Darawad et al. This finding is significant when examined under a professional socialization lens. The behavior of junior health care professionals is influenced by the example shown by their more senior colleagues, and if senior colleagues display poor practices, negative socialization may occur.

Newly qualified nurses, in an effort to fit in, may compromise their own practice to achieve a sense of belonging. To prevent negative socialization from occurring and to encourage the continuation of good practice, it is important that a strong cultural or social norm of excellence in hand hygiene compliance exists. Additionally, positive role models make a significant contribution to positively influencing the behavior and practice of others and are associated with improvements in hand hygiene compliance and reduced HCAL rates, along with preventing the onset of hand hygiene fatigue among staff.

Internationally, and in Ireland, nurses are required by their regulatory body to continuously develop their knowledge and skills through Continuing Professional Development (CPD) and postgraduate programs. CPD may prove useful in positively influencing compliance. In this study, and consistent with previous studies, we found that even though most respondents had availed of CPD in the form of hand hygiene education and training and were familiar with policies, suboptimal practices were evident. Notwithstanding that education is but one component of the recommended multimodal hand hygiene strategy, our findings suggest scope among nurses for increased engagement with postgraduate infection prevention and control programs that may increase their sensitivity to the importance of hand hygiene as a patient safety measure and their awareness of their moral, ethical, and professional responsibilities in this regard.

ABHR is kinder to the skin than handwashing with soap and water. Despite this, our findings suggest that over half of respondents may be routinely using soap and water for hand hygiene and reflects previous international findings reporting a preference for soap and water. Furthermore, our finding supports the contention that the use of soap and water is an established behavior that is difficult to change and the possibility that respondents may find the use of soap and water subconsciously more gratifying for perceived self-efficacy. Perhaps coincidental, but nonetheless of concern, we also report that almost half of all respondents had experienced a dermatology issue arising from hand hygiene and three-quarters of respondents had observed a colleague with similar.

Similar to findings reported among health care workers in the United States, our data from both cohorts reveal greater percentages of nurses were influenced to adhere to handrubbing by prevention of cross-infection than any other factor. Results contrast with previous work in the field where self-protection was identified as a major driver of hand hygiene among health care workers and personal protection was identified as more influential to hand hygiene compliance than patient safety.

Regardless of study designs, results suggest that compliance rates among nurses before and after patient contact can vary greatly, from 42%-62% compliance before patient contact to 72%-87% after patient contact in direct observation design studies. Similarly, compliance rates varied from 31%-74% in studies adopting a survey design. In this study, self-reported compliance with recommended hand hygiene practices was >90%, both before and after patient contact and in both cohorts. Although others have reported significantly higher compliance rates after patient contact than before patient contact, suggesting self-protection as a driving force, in our study there was no significant difference found in rates before and after patient contact, in either cohort.

Comparative data reveal a downward trend in perceptions of barriers between 2007 and 2015, and findings compare more favorably with other similar international studies. Despite the downward trend, skin sensitivity and skin damage featured prominently as barriers to ABHR particularly among graduate nurses, despite evidence that ABHR is well tolerated. Among 1 in 10 respondents, a finding reflected in other international studies. Comparativedatarevealadownwardtrendinperceptionsofbarriersbetween2007and2015,andfindingscomparemorefavorablywithothersimilarinternationalstudies. Despite the downward trend, skin sensitivity and skin damage featured prominently as barriers to ABHR particularly among graduate nurses, despite evidence that ABHR is well tolerated. Among 1 in 10 respondents, a finding reflected in other international studies.

As previously mentioned, despite a larger sample (n = 287) in 2015, compared with 2007 (n = 171), the response rate in 2015 was lower. However, sample sizes and the response rates are comparable with similar studies on the topic. The move from postal survey in 2007 to online survey in 2015 may provide one possible explanation for the lower response rate in 2015 if nurses were not regularly using their employer-based e-mail address.

Consideration must be given to the possible effect of a social desirability bias, where prevailing social views may have influenced respondents. In addition, the impact of a response bias, where
respondents may have been positively disposed to the topic cannot be ruled out. We attempted to address these potential biases by counterbalancing positively and negatively worded questions, ensuring sensitively worded nonjudgmental questions and guaranteeing confidentiality. The potential for biased results is also somewhat offset by the consistent responses found in both cohorts.

The transferability of the findings of our study may be limited because the work was performed in one university hospital group, in one region of Ireland. However, it is reasonable to speculate that opinions expressed in this study may be representative, in general, of their peers. Furthermore, findings are validated by similar results reported elsewhere."

**CONCLUSIONS**

It is encouraging to report predominately positive attitudes toward hand hygiene and strong motivation among nurses to prevent cross-infection in both hand hygiene studies, conducted in 2007 and 2015. The demonstrable influence of international and national guidelines in the intervening years is reflected in the findings and discussion. Although it is disappointing to report a trend of suboptimal compliance with the routine utilization of ABHR in most clinical situations, we report greater compliance among graduate nurses. We caution that negative socialization must be prevented so that positive practices among graduate nurses can be maintained. There is considerable scope to improve the routine utilization of ABHR over soap and water, in line with recommendations. Our findings provide new insight into hand hygiene practices among nurses in Ireland. Mindful of the mobility of Irish nurses and their contributions to health care systems globally, these findings will be of particular interest internationally to nurse educators, managers, infection prevention teams, and clinicians working in the field.

**References**


Standard precautions including hand hygiene

Abstract ID: 37

Hand hygiene: Attitudes towards alcohol-based hand rubs and handrubbing practices among nursing students in Ireland

Liz Kingston, Nuala O’Connell, Colum Dunne
1University of Limerick, 2University of Limerick Hospital Group, 3Graduate Entry Medical School and Centre for Interventions in Infection, Inflammation & Immunity (4i), University of Limerick
Background
As members of the healthcare team, nursing students have direct patient contact during clinical practice; hence, good hand hygiene practice among nursing students is essential. While low to moderate levels of hand hygiene knowledge and poor attitudes and practices are reported among nursing students internationally, less is known about their attitudes and practices of handrubbing with alcohol-based hand rubs (ABHR), even though handrubbing is the recommended optimum practice in most clinical situations. The aim of the poster is to present the results of a recently published study, exploring hand hygiene and handrubbing practices and attitudes towards ABHR among nursing students in Ireland.

Methods
Following ethical approval, a questionnaire was electronically administered to all BSc Nursing Programme students (n = 342) at an Irish University in 2015.

Results
Response rate 66%. Attitudes towards hand hygiene were generally positive. Self-reported compliance was high after contact with body fluid (99.5%) and before a clean or aseptic procedure (98.5%) and lower before (85%) and after (87%) touching a patient and lowest after touching patients’ surroundings (61%). A trend towards greater self-reported compliance among first year students compared to fourth year was evident. Just 22% of students were handrubbing with ABHR >90% of the time and 32% were handrubbing <50% of the time. 16% were not aware of the clinical contraindications for using ABHR and 9% did not know when to use soap and water and when to use ABHR.

Conclusion
Continuing hand hygiene education throughout undergraduate nursing degree programmes is recommended, in order to develop and maintain appropriate attitudes towards hand hygiene and to ensure engagement in optimal handrubbing practices among nursing students. Instilling good practice during the early career stage of nursing students may potentially have sustained long-term impact.

Funding
Study was supported by the IPS Novice Investigator Grant.
Hand hygiene: a systematic review

Presenter: Liz Kingston
21/06/2017
Hand Hygiene: attitudes towards alcohol-based hand rubs and hand rubbing practices among nursing students in Ireland

Ms L Kingston1, Prof N O’Connell2,3, Prof C Dunne3

1Department of Education and Professional Studies & Department of Nursing and Midwifery, University of Limerick, Ireland
2Department of Clinical Microbiology, University Hospital Limerick, Limerick, Ireland
3Graduate Entry Medical School & Centre for Interventions in Infection, Inflammation & Immunity (4i), University of Limerick, Ireland

1. Background

Hand rubbing with alcohol-based hand rub (ABHR) is widely recommended as the optimum approach to hand hygiene in most clinical situations. Nursing students have direct patient contact during clinical placements and internships; hence, the importance of good hand hygiene practice among nursing students. The aim of the poster is to present the results of a published study, exploring attitudes towards alcohol-based hand rub and hand rubbing practice among nursing students in Ireland.

2. Methods

Ethical approval was gained. A cross-sectional, descriptive, self-report design was used. Following a pilot study, a validated questionnaire was electronically administered to all Bachelor of Science Nursing programme students (n = 342) at an Irish University. Data were analysed using SPSS and Survey Monkey.

3. Results

The response rate was 66%. Attitudes towards hand hygiene and towards ABHR use were predominantly positive, although a minority expressed negative attitudes. While some very positive practices were reported, overall compliance with hand rubbing was sub-optimal with underutilisation of ABHR and barriers to ABHR use featuring significantly.

4. Discussion

Cross-tabulations revealed a trend towards greater compliance among 1st and 2nd year students, compared to 3rd and 4th year students. Possible explanations might include; the front loading of infection prevention and control curricular content in the 1st and 2nd year of the programme and this may have positively influenced compliance, a more complacent approach towards hand hygiene compliance among 3rd and 4th year students, or perhaps 3rd and 4th year students were less influenced by a social desirability response than 1st and 2nd year students.

Results suggest scope to review hand hygiene curricula, in particular the content and the timing of delivery, with renewed focus on the recommendations of national and international hand hygiene guidelines, placing particular emphasis on ABHR use. This may ultimately positively influence attitudes and lead to improved practice.


Acknowledgement: This study was supported by a grant from the Infection Prevention Society (IPS)

Contact: liz.kingston@ul.ie
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Acknowledgements:
Ms Barbara Slevin, University of Limerick Hospital Group.
The Infection Prevention Society for the award of a research grant.
Introduction
Considerable emphasis is currently placed on reducing healthcare-associated infection through improving hand hygiene compliance. Concurrently, there is increasing discussion in the media of perceived poor hand hygiene compliance among healthcare professionals. Research evidence suggests that hand hygiene compliance is sub-optimal across geographical locations and various healthcare settings.

Aim
The aim of the poster is to report the outcomes of a systematic review (Kingston et al 2015) of peer-reviewed published studies, notably clinical trials, which focus on hand hygiene compliance among healthcare professionals.

Methods
Literature published between December 2009 and February 2014, which is indexed in PubMed and Cinahl, on the topic of hand hygiene compliance, was searched. Following examination of 57 publications initially reviewed the final number of papers appraised is 16.

Results
The majority of the reviewed studies were conducted in the EU (n=6) and the USA (n=5). Intensive care units and care of the elderly settings emerged as the predominant clinical settings. The unit of analysis reported for hand hygiene compliance was ‘hand hygiene opportunity’. The category of healthcare worker most often the focus of the research was the nurse, followed by the healthcare assistant and the doctor. Four studies adopted the ‘my five moments for hand hygiene’ framework, as set out in the World Health Organisation (WHO) hand hygiene guidelines, whereas other studies adopted multimodal strategies of varying design. Hand hygiene compliance interventions included a) education, b) reminder materials, c) alcohol-based hand rub - supply and consumption monitoring, d) performance feedback, e) leadership and management support, f) team approach.

Hand Hygiene Compliance Outcomes

<table>
<thead>
<tr>
<th>Study Reference</th>
<th>Reported Hand Hygiene Compliance Outcomes</th>
<th>Mean Compliance (%) Before Intervention</th>
<th>Mean Compliance (%) After Intervention (in intervention group)</th>
<th>Net Effect on Intervention Group</th>
</tr>
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<tbody>
<tr>
<td>van den Hoogen et al. (2011)</td>
<td>Increased significantly from 23% in the baseline assessment to 50% in the second assessment</td>
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<td>Ho et al. (2012)</td>
<td>Increased from 27% to 60.6% and 22.2% to 48.6% in two intervention arms</td>
<td>24%</td>
<td>54.60%</td>
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<td>Yeung et al. (2011)</td>
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<td>Rosenthal et al. (2013)</td>
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<td>71.40%</td>
<td>23%</td>
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<td>Koff et al. (2011)</td>
<td>Improved from 44-63% (mean 53%) in control period to 67-90% (mean 75%) in study period</td>
<td>53%</td>
<td>75%</td>
<td>22%</td>
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<tr>
<td>Linam et al. (2011)</td>
<td>Increased from 65%-91% and 74%-92% in the 2 units</td>
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<td>91.50%</td>
<td>22%</td>
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<td>22.88% (net improvement)</td>
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Conclusion
The published clinical trials demonstrate that moderate improvements to hand hygiene compliance rates can be achieved when organisations adopt a multimodal approach, in line with recommended WHO guiding policy, or another tested multimodal framework.


Contact: liz.kingston@ul.ie
Systematic Review of Hand Hygiene-related Clinical Trials

Ms L Kingston1, Dr N O’Connell1,2, Prof C Dunne3

1Department of Education and Professional Studies & Department of Nursing and Midwifery, University of Limerick, Limerick, Ireland
2Department of Clinical Microbiology, University Hospital Limerick, Limerick, Ireland
3Graduate Entry Medical School & Centre for Interventions in Infection, Inflammation & Immunity (4i), University of Limerick, Limerick, Ireland

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<table>
<thead>
<tr>
<th>Clinical Setting</th>
<th>No. of clinical settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Intensive Care Unit</td>
<td>113</td>
</tr>
<tr>
<td>Step-down Intensive Care Unit</td>
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</tr>
<tr>
<td>Neonatal Intensive Care Unit</td>
<td>11</td>
</tr>
<tr>
<td>Paediatric Intensive Care Unit</td>
<td>9</td>
</tr>
<tr>
<td><strong>Subtotal - Intensive Care Unit Settings</strong></td>
<td><strong>135</strong></td>
</tr>
<tr>
<td>Long term care of the elderly</td>
<td>71</td>
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<tr>
<td>Acute care of the elderly wards</td>
<td>22</td>
</tr>
<tr>
<td><strong>Subtotal - Care of Elderly Settings</strong></td>
<td><strong>93</strong></td>
</tr>
<tr>
<td>Medical/Surgical Wards</td>
<td>47</td>
</tr>
<tr>
<td>Paediatric Ward</td>
<td>11</td>
</tr>
<tr>
<td>Burns Unit</td>
<td>1</td>
</tr>
<tr>
<td><strong>Subtotal - Ward Settings</strong></td>
<td><strong>59</strong></td>
</tr>
<tr>
<td>Primary Healthcare Centre</td>
<td>11</td>
</tr>
<tr>
<td>Whole Organisation</td>
<td>1</td>
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<tr>
<td><strong>Total</strong></td>
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Contact: liz.kingston@ul.ie
Dear Dr Liz Kingston,

On behalf of the Programme Committee of the 4th International Conference on Prevention and Infection Control (ICPIC), it is our great pleasure to invite you to actively participate as speaker to this fourth edition and deliver the following lecture:

<table>
<thead>
<tr>
<th>Session title:</th>
<th>Saraya Integrated Symposium: Current Challenges in Hand Hygiene Research and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session type:</td>
<td>90 minutes session</td>
</tr>
<tr>
<td>Proposed lecture title:</td>
<td>Hand hygiene clinical trials</td>
</tr>
<tr>
<td>Length of presentation:</td>
<td>20 mins excluding Q&amp;A</td>
</tr>
</tbody>
</table>

Please kindly confirm your acceptance of this invitation by 15 February 2017 at the latest, by email to coralie.deleage@mci-group.com

**IMPORTANT INFORMATION TO READ**

1. If you accept this mission, please indicate any modifications regarding the title of your lecture. If no indication is given, it will appear as given above.

2. All relevant details such as exact date & time, room will be communicated to you at a later stage. If you have restrictions on your attendance on specific days of the conference, please let us know.

3. You are kindly requested to submit a short biography, which will be published on the ICPIC 2017 website. Please submit it via this link. You should also include two different pictures of yourself.

4. Please indicate your preferred title and academic position on the online form as you would like these to appear in the programme announcements. If no indication is given, it will appear as per this letter.

5. Once your participation is confirmed, you will receive all information regarding the logistics (travel, accommodation, registration) and the final session details from our partner MCI who is in charge of the organization of the conference.

We also invite you to consult regularly the ICPIC website: [www.icpic2017.com](http://www.icpic2017.com) for updates and additional information on the conference.

The success of the Scientific Programme of the conference depends greatly on the contribution of leaders in the field such as yourself, and we look forward to your acceptance of our invitation and to welcoming you to Geneva.
Yours sincerely,

Prof. Didier Pittet
ICPIC Chair

Prof. Andreas Voss
Co-chair & Programme director

Prof. Stephan Harbarth
Co-chair

Secretariat contact:
Coralie DELEAGE
Project Assistant

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- **epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England**
- **Hand hygiene-related clinical trials reported since 2010: a systematic review**
- **Impact of non-rinse skin cleansing with chlorhexidine gluconate on prevention of healthcare-associated infections and colonization with multi-resistant organisms: a systematic review**
- **Computerized image analysis of full-hand touch plates: a method for quantification of surface bacteria on hands and the effect of antimicrobial agents**

With best regards,

Fiona Macnab
Publisher
On behalf of the editorial & publishing team of Journal of Hospital Infection

*full length and review articles downloaded on ScienceDirect between 1 January and 31 December 2016

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## Appendix 6

### Year 1 and Year 2 Modules

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<tr>
<th>No.</th>
<th>Year</th>
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<th>Module Title</th>
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<tr>
<td>1</td>
<td>Year 1</td>
<td>EN7011</td>
<td>Foundations of Social Scientific and Education, Research and Practice: Epistemology and Ontology 1</td>
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<td>2</td>
<td>Year 1</td>
<td>EN7021</td>
<td>Advanced Research Methods 1: Research Design</td>
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<td>3</td>
<td>Year 1</td>
<td>EN7003</td>
<td>Professional Portfolio and Professional Practice with Placement Component</td>
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<td>4</td>
<td>Year 1</td>
<td>EN7012</td>
<td>Advanced Research Methods 2: Collecting and Analysing Text and Oral Data in Educational Settings</td>
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<td>Foundations of Social Scientific and Educational Research and Practice: Epistemology and Ontology 2</td>
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<td>6</td>
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<td>Responding to Cultural Diversity in Educational Contexts</td>
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<td>7</td>
<td>Year 2</td>
<td>EN7031</td>
<td>Policy Studies</td>
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<td>8</td>
<td>Year 2</td>
<td>EN7041</td>
<td>Advanced Research Methods 3: Collecting and Analysing Cross Sectional and Statistical Data in Educational Settings</td>
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<td>9</td>
<td>Year 2</td>
<td>EN7022</td>
<td>Contemporary Issues in Teaching, Learning and Assessment: International Winter School</td>
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<td>10</td>
<td>Year 2</td>
<td>EN7062</td>
<td>Leadership and Professional Practice</td>
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## Generic and Transferrable Skills

### Research Training
- Questionnaire Design - Statistical Consulting Unit
- Basic Statistics for Researchers - Statistical Consulting Unit
- Introductory SPSS - Statistical Consulting Unit
- Introductory NVIVO - Statistical Consulting Unit
- Analysing Data with NVIVO - Statistical Consulting Unit
- Critical Appraisal and Systematic Review – Statistical Consulting Unit
- Statistics for Research – The Graduate School
- Statistical Inference with SPSS - The Graduate School
- Writers’ Retreat – Centre for Teaching and Learning

### Research Skills Workshops
- Working with Long Documents - Glucksman Library
- End Note Tutorial - Glucksman Library
- Finding Research Information and Keeping Up-To-Date - Glucksman Library
- Getting Published and Maximising your Research Impact - Glucksman Library
- Altmetrics Workshop - Glucksman Library
- Turbocharge your Writing – The Graduate School
- How to plan your PhD – The Graduate School
# Appendix 8

## Conferences Attended

<table>
<thead>
<tr>
<th>Year</th>
<th>Conference Title</th>
<th>Location</th>
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<tbody>
<tr>
<td>2017</td>
<td>4th International Conference on Prevention and Infection Control</td>
<td>Geneva</td>
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<td>2017</td>
<td>Health Research Symposium</td>
<td>Limerick</td>
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<td>2017</td>
<td>Infection Prevention Society UK Annual Conference</td>
<td>Manchester</td>
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<td>2016</td>
<td>Infection Prevention Society UK Annual Conference</td>
<td>Harrowgate</td>
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<td>2016</td>
<td>Royal College of Surgeons, Expert Lecture Dr. Michael Gardam</td>
<td>Dublin</td>
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<td>2016</td>
<td>Royal College of Surgeons, 34th International Nursing Conference</td>
<td>Dublin</td>
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<td>2015</td>
<td>Royal College of Surgeons Ireland, Hand Hygiene Workshop</td>
<td>Dublin</td>
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<td>2015</td>
<td>Infection Prevention Society Annual Conference</td>
<td>Croke Park, Dublin</td>
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<td>2015</td>
<td>Health Protection Surveillance Centre, Hand Hygiene Auditor Training</td>
<td>Dublin</td>
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<tr>
<td>2014</td>
<td>Infection Prevention Society Annual Conference</td>
<td>Portlaoise</td>
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<tr>
<td>2014</td>
<td>Health Service Executive Patient Safety First Training Day</td>
<td>Dublin</td>
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## Seminars, Colloquia, Summer & Winter Schools Attended

<table>
<thead>
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<th>Seminar Title</th>
<th>Institution</th>
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<tbody>
<tr>
<td>2016</td>
<td>Towards PhD Completion Seminar</td>
<td>School of Education</td>
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<td>2016</td>
<td>International Winter School</td>
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<tr>
<td>2015</td>
<td>International Summer School</td>
<td>School of Education</td>
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<td>2014</td>
<td>Writing for Academia Seminar</td>
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<td>2014</td>
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<td>2013</td>
<td>Health and Education Colloquium</td>
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<td>2012</td>
<td>Ethical Approval Seminar</td>
<td>School of Education</td>
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