

Understanding healthcare staff's hand hygiene adherence: A theory-driven approach

Thesis submitted in part fulfilment of the degree of
Doctorate in Clinical Psychology
(DClinPsy)
University of Leicester

By
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2016

'It always takes an awfully long time to understand unbelievably simple things'

Joe Chung

Declaration

All parts of this research are the original work of the author, except where otherwise stated with reference to the original author(s). This thesis has been submitted in part-fulfilment of the degree of Doctorate in Clinical Psychology (DClinPsy) at the University of Leicester. No part of the thesis has been submitted for any other degree or academic qualification.

Understanding healthcare staff's hand hygiene adherence: A theory-driven approach

Andy Brackett

Thesis Abstract

Literature Review

Healthcare staff's hand hygiene adherence has been associated with reduced healthcare-associated infection rates. Addressing poor adherence is therefore imperative. The use of psychological theory in hand hygiene research is lacking. A systematic review was conducted of the application and efficacy of the theory of planned behaviour to understanding healthcare staff's hand hygiene. Five databases were searched yielding nine relevant articles. The amount of variance accounted for across studies varied widely, explaining 35-70% of intention and 15-79% of actual behaviour. Current methodological limitations and heterogeneity of research aims limit the conclusions that can be drawn and inhibit an overall goodness-of-fit statistic being calculated. A revised model of the theory in relation to hand hygiene is proposed and salient issues discussed.

Research Report

Despite a wealth of research, our understanding of hand hygiene adherence and how to improve it remains poor. Reasons for this may lie in an overreliance on self-report methodologies and a lack of reference to psychological theory (Edwards *et al.* 2012). Therefore a theory-informed, mixed-methods investigation was undertaken to identify key factors influencing nursing staff's hand hygiene adherence within Critical Care. Three methodologies were triangulated and used concurrently: a) a quantitative questionnaire; b) a Delphi consensus approach; and c) ward observations. 'Memory, Attention and Decision Processes' were clearly highlighted as key to staff's hand hygiene across all three methodologies, whilst 'Environmental Context and Resources' were highlighted across the two self-report methodologies. Findings suggest that interventions should prioritise addressing factors related to 'Memory, Attention and Decision Processes'. 'Environmental Context and Resources' were also deemed important but appeared to reflect staff's perception of busyness and difficulties prioritising hand hygiene rather than externally visible factors. Limitations and implications are discussed.

Critical Appraisal

The researcher's account of the research process, reflections, learning points and critique are offered.

Acknowledgments

I would like to firstly extend my thanks to all those who gave their time and attention to participating in this study. I truly hope this paves the way for you to be better supported in the amazing work that you do.

Secondly, I'd like to thank the education and practice development sisters (RH and DP) within the participating Trust. Thank you for being such reliable points of contact, for making things happen and for putting up with my constant barrage of emails.

I must also thank my Mum and Dad, as well as all those at King's Church, Loughborough, for being a constant source of encouragement, prayer and support, and always having my back.

I'd like to express my sincere gratitude to my supervisor, Professor Mike Wang, for all his guidance and support over the past three years. Thank you for helping contain my unceasing research-related anxiety and never seeming phased by it.

I owe a **huge** thank you to my incredibly gracious and long-suffering wife, Sarah. Thanks for embarking upon this with me and for letting me tuck myself away day after day, week after week. Thanks for helping me set boundaries around the ever-present tide of research that would otherwise have consumed me, and for keeping me topped up with amazing food to fuel the endeavour.

My biggest thanks goes to Jesus – my source. Thank you for making a way.

Word Count

Thesis Abstract	309
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Literature Review

Abstract:	284
Full text (excluding tables):	6497
Total:	6781
References:	1544

Research Report

Abstract:	288
Full text (excluding tables):	11707
Total:	11995
References:	2027

Critical Appraisal

Full text:	4663
References:	206

Total word count for mandatory appendices:	1800
Total word count for non-mandatory appendices:	4651

Total word count for main text:	27525
Total word count for thesis main text: (excluding references, tables and mandatory appendices)	23748

Word count for thesis as a whole:	28399
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Part 1: Literature Review

Target journal: American Journal of Infection Control

The application and efficacy of the theory of planned behaviour in explaining healthcare workers' hand hygiene: A systematic review

Andy Brackett

Abstract

Context: Healthcare-associated infections cost the UK over £1 billion per year. Fortunately, improvements in healthcare workers' hand hygiene have been associated with reduced infection rates. However, hand hygiene amongst healthcare workers remains suboptimal and interventions to address this have had limited impact. The ineffectiveness of interventions could be the result of being designed with little or no reference to theoretical models, despite the growing awareness of the importance of theory-based interventions. The theory of planned behaviour (Ajzen, 1985) is a commonly used model to explain a variety of non-clinical behaviours. Less is known however, about its efficacy in explaining clinical behaviour such as hand hygiene. The current review systematically reviewed research on the application of the theory to healthcare workers' hand hygiene behaviour.

Methods: A systematic search of five databases (SCOPUS, PsycINFO, Medline, PubMed, and NHS Evidence) identified nine relevant articles. Articles were critically appraised using a standardised data extraction tool (Zaza *et al.* 2000) and critical appraisal checklist (Glynn, 2006), and the findings synthesised.

Results: The amount of variance accounted for across studies varied widely, explaining 35-70% of intention and 15-79% of actual behaviour.

Conclusions: Methodological limitations and heterogeneity of research aims limit firm conclusions being drawn and inhibit an overall goodness-of-fit statistic being calculated. Findings indicate that the theory's explanatory power could be improved through the splitting of existing normative components and the addition of new components (actual behavioural control, inherent and elective hand washing). A revised model is proposed. Salient issues to be addressed by future research are identified.

Keywords: *Theory of planned behaviour, hand hygiene, adherence, healthcare workers*

1 Introduction

1.1 Healthcare-associated infections and hand hygiene

Healthcare-associated infections (HCAIs; also known as nosocomial infections) are infections arising as a result of receiving healthcare, for example from the actions of a physician or institution. The most well-known are those caused by *methicillin-resistant Staphylococcus aureus* (MRSA) and *Clostridium difficile* (*C. diff*). The cost of HCAIs is substantial and includes not only financial costs but also lives and the confidence placed in healthcare providers. According to a report published by the National Audit Office in 2009, 9000 people were recorded as having died from infections caused by MRSA or *C. diff* within one year in the UK, with each HCAI being estimated to cost £4300 to treat. The cost of caring for those with a HCAI has been estimated at over £1 billion per year. Litigation costs alone between 2004 and 2008 cost the NHS £17 million. A report by the European Centre for Disease Prevention and Control, published in 2008, estimated that HCAIs resulted in 16 million extra days spent in hospital, a cost of €7 billion and contributed to 148,000 deaths annually in Europe. Thus it is safe to say that the issue of HCAIs needs addressing. Fortunately, improvements to hand hygiene (HH) by healthcare workers are linked to reduced rates of HCAIs (Grayson *et al.* 2008). In line with these findings, the World Health Organisation (WHO) has published guidelines to promote good HH amongst healthcare workers, the latest of which were published in 2009. Within these was a tool called the '5 Moments for Hand Hygiene' (5MHH) which gave instruction on when HH should be carried out (see Figure 1).

1.2 Factors affecting hand hygiene

Despite many attempts at improving adherence to HH guidelines, HH remains suboptimal. A systematic review of 96 empirical studies revealed that healthcare workers wash their hands considerably less often than would be expected if adhering to the WHO guidelines (Erasmus *et al.* 2010). Research into suboptimal HH amongst staff has been undertaken in attempts to both understand and improve adherence. Studies have identified a large number of factors influencing HH adherence at an individual, interpersonal and organisational level. At an individual level there are factors such as the irritating effects of HH on a person's skin (Zimakoff *et al.* 1992), and conflict between an individual's religious beliefs and what is

Figure 1 The 5 moments for hand hygiene (WHO, 2009)



expected of them in their clinical practice (Ahmed *et al.* 2006). At an interpersonal level there are factors such as the presence of role models and peer pressure to comply with HH guidelines (Smiddy *et al.* 2015), as well as the attribution of responsibility to others (Shah *et al.* 2015). Finally, at an organisational level there are factors such as the availability of resources/facilities, and high workloads (Squires *et al.* 2014). Thus, although HH practices are simple, one should not assume they are easily changed: '*...compliance with hand hygiene is about human behaviour and altering human behaviour is complex and constitutes an enormous challenge.*' (Jumaa, 2005, p.11.)

1.3 Hand hygiene interventions

Over the past two decades those responsible for the design and implementation of HH interventions have used this knowledge of what influences HH behaviour to devise a number of interventions aimed at improving adherence (Huis *et al.* 2012). The effectiveness of these interventions is unclear due to the methodological limitations of the research (Gould *et al.* 2010). However, it is reported that any improvements achieved are often difficult to sustain, and are reduced at follow-up (WHO, 2009). With HH adherence potentially influenced by so many factors, deciding which ones to address is difficult.

1.4 The importance of theory

Despite offering some insight into what influences and improves adherence, the current body of literature offers little in the way of understanding in regard to the processes or mechanisms by which adherence is influenced. This lack of understanding could result from research and interventions being carried out with little or no reference to theoretical models. Theory provides '*...a systematic framework for identification of antecedents to adherence*' (O'Boyle, Henly & Larson, 2001, p.353) and allows for a greater understanding of the interactions between factors. Theory is also important in organising and structuring the numerous interacting factors. Despite this, a systematic review reported that of 21 included studies '*...none explicitly incorporate[d] psychological theory*' in their HH interventions (Edwards *et al.* 2012; p.318). Others have voiced similar concerns, stating that: '*The mixed results and the limited practical value of much of this research [on changing professional practice] may be due to a limited theoretical basis for development of interventions.*' (Michie *et al.* 2005; p.26). A lack of theory-based research appears to be a growing concern (Godin *et al.* 2008).

The need for theory-driven research, upon which to base the subsequent design of interventions, is all the more pertinent in light of the current economic imperative within the NHS to improve quality whilst reducing costs. Both HCAs and ineffective interventions are a waste of valuable resources. The current state of HH research puts intervention designers at risk of being misled into thinking that the best way of addressing poor HH adherence is simply to address as many factors as possible. Theoretical models allow for a more systematic, comprehensive and robust understanding of the complexities of human thought and behaviour, which takes into account multiple and interacting factors. This in turn facilitates

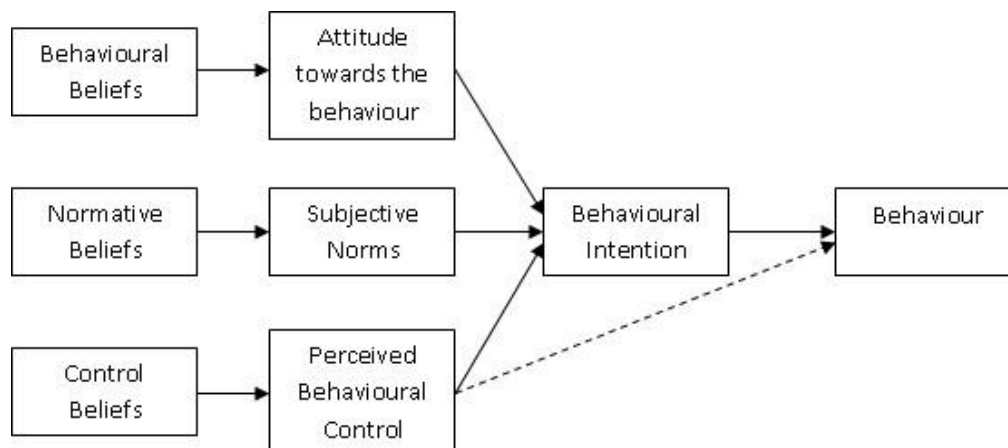
intervention designers to make informed choices about where to focus the limited resources for maximum gain.

1.5 The theory of planned behaviour

Outside of HH research, theoretical models have been used as frameworks for research and interventions across numerous settings and disciplines. Such models include: integrative models (Fishbein, 2000), self-efficacy models (Dallow & Aderson, 2003), behavioural learning theory, *the health belief model* (Becker, Radius & Rosensock, 1978), social cognitive theory, the *theory of reasoned action* (Fishbein & Azjen, 1977), and the *transtheoretical model* (Munro *et al.* 2007), which have all been well validated. In spite of this, theoretical models remain underused in explaining and improving *healthcare*-related behaviour (Edwards *et al.* 2012).

One commonly used model is the *theory of planned behaviour* (TPB; Azjen, 1985, see Figure 2). The theory proposes that behaviour is under volitional control and based upon well-thought out and rational thought processes. It also claims that the likelihood of a particular behaviour occurring can be predicted from knowledge of an individual's intention to carry out the behaviour. Thus if the level of intention is known, the likelihood of that intention being translated into action can be predicted. Intention itself can be predicted from knowledge of three enabling variables: an individual's attitudes towards the behaviour (attitude), their global perception of those around them in relation to that behaviour (subjective norms), and the amount of control they perceive themselves to have over the behaviour (perceived behavioural control). These three components can be predicted from a further three components; behavioural beliefs, normative beliefs and control beliefs. The model also claims that perceived behavioural control can influence behaviour directly, independent of intention (see dotted line in Figure 2). Since its formation the TPB has been used to explain a number of health-related behaviours such as condom use (Albarracín *et al.* 2001), healthy eating (Reibl *et al.* 2015), treatment adherence (Rich *et al.* 2015), helmet wearing (Ali *et al.* 2011), exercise (Nguyen, Potvin & Otis, 1997) and uptake of screening for cervical cancer (Hill, Gardner & Rassaby, 1985), with varying degrees of success.

Figure 2 The theory of planned behaviour (Ajzen, 1985)



1.6 Existing reviews

At the time of writing (November 2015), four published systematic reviews were found that quantified the overall predictive power of the TPB. Across these, the amount of variance in intention explained by the model ranged from 33-60%, and the amount of variance in actual behaviour ranged from 6-27% (McEachan *et al.* 2011; Rich *et al.* 2015; Reibl *et al.* 2015; Armitage & Conner, 2001). However none of these focused on *clinical* behaviour or intentions.

The only published reviews of the model's application to clinical behaviour were those of Godin *et al.* (2008) and Kretzer and Larson (1998). However Godin and colleagues calculated the predictive power of individual components of a number of social cognitive theories, rather than the TPB as a whole. As a result, no R-statistic relating to the amount of variance explained by the model was reported. Kretzer and Larson (1998) published the only review, to our knowledge, of the application of the TPB to HH. However, this was a narrative review and not conducted systematically.

It is also worth mentioning a recent systematic review by Srigley *et al.* (2015) which aimed to review both the effectiveness of theory-based HH interventions, and which theories had been utilised to date to predict HH adherence. Seven articles were included in the review, but only three of which focused on the predictive power of various theories, and only one of which focused on the TPB specifically. As a result, the review revealed little about the efficacy of the TPB in explaining and predicting HH behaviour.

1.7 Rationale and aims

Due to the lack of relevant systematic reviews and the current economic and ethical imperatives to reduce HCAs, the decision was made to conduct a systematic review into the application of the TPB to healthcare worker's HH behaviour. This aimed to answer the following questions:

1. To what extent, and how, has the TPB been applied to healthcare worker's hand hygiene?
2. To what extent is the TPB useful in explaining hand hygiene behaviour amongst healthcare workers?
3. What is the goodness-of-fit of the TPB to hand hygiene behaviour?
 - a. How well does the TPB predict healthcare worker's *intention* to carry out hand hygiene behaviour?
 - b. How well does the TPB predict healthcare worker's *actual* hand hygiene behaviour?

2 Methodology

2.1 Search strategy

2.1.1 Initial scoping search

An initial scoping exercise was carried out to obtain background knowledge and identify terminology relevant to HH and the TPB. Underpinning this scoping exercise were conversations with a consultant microbiologist/Infection Prevention Lead within a local NHS Trust who signposted to key articles. The scoping exercise utilised information from a variety of sources to identify existing reviews. These included the WHO, National Institute for Health and Care Excellence (NICE), the NHS, alongside the SCOPUS database. Seven reviews were found (as mentioned in '1.6. Existing reviews') however none were able to answer the current research questions. Key terminology was noted and synonyms identified using a thesaurus.

2.1.2 Comprehensive search

Search stems (Appendix A) were created to capture relevant aspects of the review's aims and were formed into appropriate search strings with which to search chosen databases (Appendix B). Search strings were entered into five online databases in attempts to cover all the relevant academic literature. The search was conducted in October 2015 and searched databases as far back as 1985¹. The following databases were searched:

- SCOPUS - to cover research from a broad number of disciplines
 - PsycINFO - to cover research related to psychology
 - Medline
 - PubMed
- } to cover biomedical literature
- NHS Evidence - to cover research related to healthcare

The search was carried out in three phases (see Figure 3):

- **Phase one** utilised the search limitation functions within databases to filter out irrelevant articles based upon inclusion/exclusion criteria (see Table 1). These criteria were determined by the scoping exercise.
- **Phase two** consisted of manually searching article titles to determine their relevance. Where it was unclear whether the article was relevant, the abstract was also reviewed.

¹ 1985 was the year that the theory of planned behaviour was first mentioned in the literature (Schifter & Azjen, 1985).

Articles deemed relevant by title were exported to citation management software; Refworks, and duplicates removed.

- **Phase three** entailed manually searching the abstracts of the remaining articles to determine their relevance against inclusion/exclusion criteria. The reference lists of all remaining articles were manually searched to ensure that no relevant articles were missed, but yielded no additional articles. The *cited by* function was also used to ensure up-to-date articles were not missed. This yielded one additional article.

2.2 Analysis

Full text versions of the remaining 13 relevant articles were obtained and read. Articles were further scrutinised against the aforementioned inclusion/exclusion criteria resulting in the exclusion of four more articles. Information was extracted using a data extraction pro forma (Appendix C) and scrutinised further using a critical appraisal checklist (Appendix D) to ensure standardised and thorough critical appraisal. The data extraction pro forma was created with reference to a data collection instrument by Zaza *et al.* (2000), to ensure its relevance to non-experimental research. The checklist used was taken from Glynn (2006) and was deemed to offer the most appropriate set of questions by which to interrogate the identified articles, which all utilised non-experimental, cross-sectional research designs². A pro forma and checklist were completed for each of the nine papers and relevant information tabulated (see Table 2) to allow easier comparison of studies.

² Many of the better known critical appraisal checklists (e.g. Critical Appraisal Skills Programme Checklist; NICE Quality Appraisal Checklist, 2012) appeared to be better suited to appraising health intervention research or comparison studies whereby participants are allocated to different groups/conditions.

Table 1 Inclusion and exclusion criteria

Inclusion criteria:

- Written in English.
- Carried out in *developed countries*³ (as categorised by the United Nations, 2015).
- Empirical in nature.
- Related specifically to HH rather than the broader area of infection prevention.
- Reference to the TPB in the title or abstract.
- Published in a peer-reviewed journal.
- Carried out on healthcare workers based in healthcare settings.
- Quantitative in nature⁴.
- Published during or later than 1985.

Exclusion criteria:

- Carried out in surgical settings (due to their specific and ritualised hand washing).
 - Carried out in dentistry, veterinary and catering settings.
 - Literature reviews (systematic or narrative), opinion letters and editorials.
 - Qualitative in nature.
 - Published prior to 1985.
-

³ It was decided to focus on developed countries to increase the likelihood of findings reflecting the behaviour of healthcare workers in the UK (a developed country), where the review hoped to impact practice.

⁴ This was due to wanting to calculate a goodness-of-fit statistic.

Figure 3 Shortlisting process

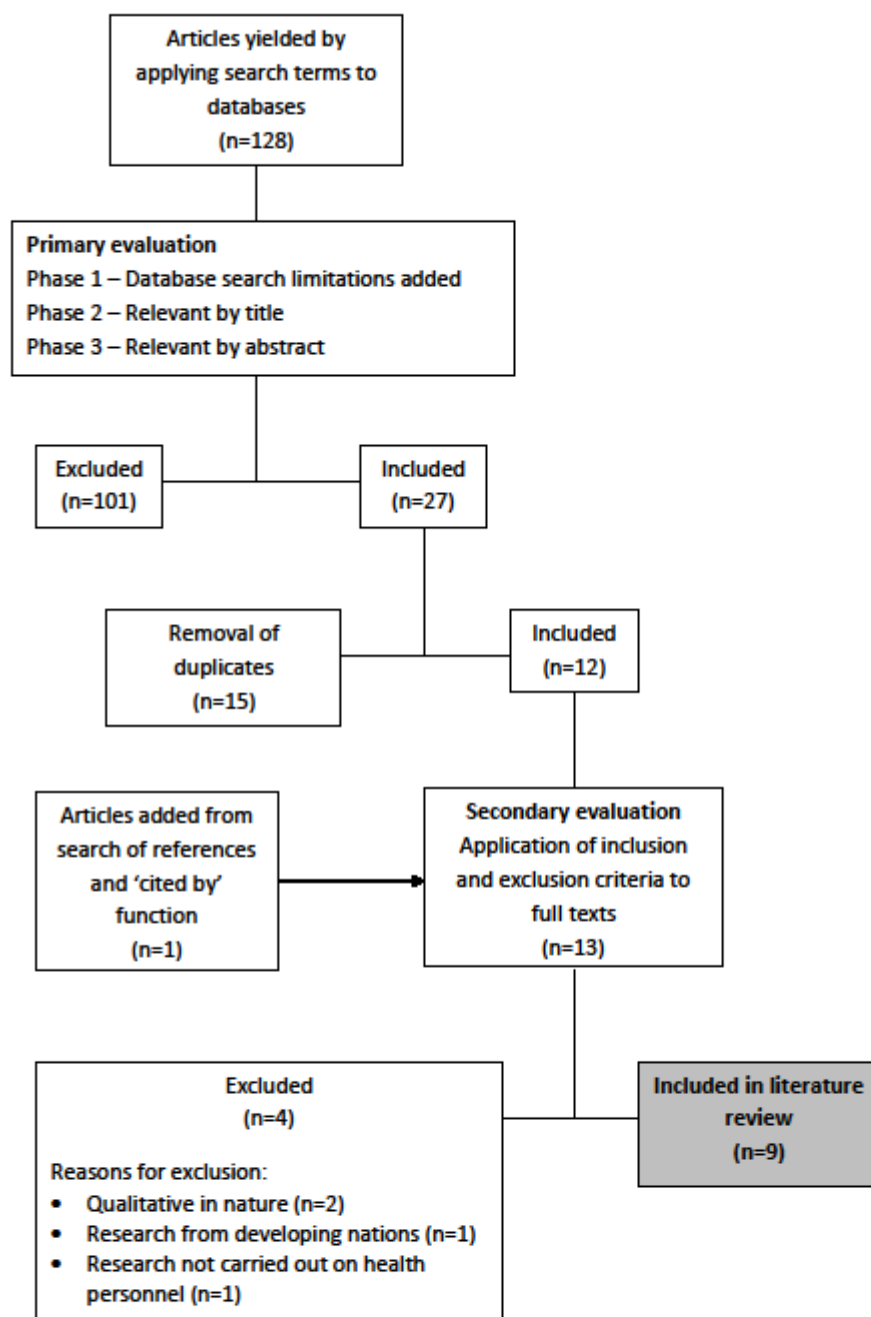


Table 2 Tabulated information from the final nine included studies

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB (‘+’ refers to positive application, ‘x’ refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
1.Roberto, Mearns & Silva (2012)	To test an extended version of the TPB - focusing on normative components - in predicting medical students’ intention to comply with HH guidelines.	Portugal	Cross-sectional. Quantitative.	Questionnaire. Measuring: - Demographics - TPB components: Attitudes (3), Subjective norms (3), Perceived behavioural control (3), Intention (3), Moral norms; professional (3) Personal commitment (3). Responses given on a 7-point Likert scale.	1 st and 6 th year medical students (N=175). Sampling method unclear.	Subjective norms were the most significant predictors of intention for both 1 st and 6 th year students. <u>For 1st years</u> - significant predictors of intention were: Subjective norms (relating to professors); Attitudes; and Moral norms (personal commitment) – explaining 35% of variance in intention ($R^2=0.35$). <u>For 6th years</u> - significant predictors of intention were: Subjective norms (relating to colleagues); Moral norms (professional commitment); Perceived behavioural control; and Attitudes – explaining 49% of variance in intention ($R^2=0.49$). Medical students appear to change their social referents and moral prerogatives as they proceed through medical training. Perceived behavioural control not significant for 1 st year students.	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + All TPB components measured. + Influence of each component explored. + Goodness-of-fit calculated ($R^2=0.35$ & $R^2=0.49$). + Findings related back to TPB (but only loosely). + TPB used to identify possible interventions. x Actual behaviour not investigated, only intention. x Perceived behavioural control did not appear relevant for 1 st year students. x TPB was modified: Normative components further divided - Subjective norms related to peers/superiors; Moral norms related to professional commitment to patient/personal commitment to hygiene.	42.11% Issues: - Unclear sampling and population - Questionnaire not included - Temporal change inferred from cross-sectional design

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
2.O'Boyle, Henly & Larson (2001)	To: a) Estimate adherence to HH guidelines; b) Describe relationships between motivational factors, rate of adherence and intensity of nursing activity; and c) Test a model of adherence based on TPB.	USA	Longitudinal. Quantitative.	Questionnaire (42 items) Measuring: - Self-reported adherence - TPB components: Intention (5), Perceived behavioural control (2), Control beliefs (5), Subjective norms (1), Normative beliefs (7), Attitudes (8), Beliefs about outcome (14). Responses given on a 7-point Likert scale. Observation – 2-16 weeks after completion of questionnaire, 120 minutes of observation carried out using the Handwashing Observation Instrument (HOI). Measuring: - HH compliance - Intensity of unit.	Nurses from 3 hospitals (N=120): Critical care nurses (n=70); Post-critical care nurses (n=50). Sample represented 21% of eligible nurses. Sampling method unclear (likely to have been a convenience sample)	Mean observed adherence = 70% (range = 61-74%). Mean self-reported adherence = 82% (range = 71-89%). Small, positive association between self-reported and observed adherence ($r=.22$, $p<.05$) TPB variables <u>did not</u> predict observed adherence, but <u>did</u> predict intention and self-reported adherence. Unit activity significantly and negatively associated with observed adherence ($r=-.33$, $p<.05$).	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + Predictive power of individual components was reported. + Findings related back to TPB. + TPB used to identify possible interventions. + All TPB components measured. x Overall goodness-of-fit of model not reported. x TPB was modified: addition of situational factor (unit activity), paths from control beliefs to attitude, and from control beliefs to intention. x TPB did not predict actual behaviour.	76.19%

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
3.Limper <i>et al.</i> (2013)	To quantify the intention of physician trainees to perform HH at various stages of medical training.	USA	Cross-sectional. Quantitative.	Online questionnaire (42 items) Measuring: - Demographics - TPB components: Attitudes, Subjective norms, Perceived behavioural control, Intention, Control beliefs. - Self-reported adherence. Responses given on a 3-point Likert scale.	Physician trainees (N=459) from a single medical centre. Consisting of Residents (R; n=197) and Medical Students (MS; n=262). Medical students made up of Pre-Clinical (PC; n=123) and Clinical (C; n=139) students. Response rate: 68% Volunteer sampling.	Cs and Rs had significantly lower belief in the ability of hand washing to prevent transmission of, and to protect them from, microorganisms, as well as significantly lower sense of satisfaction in protecting patients, compared to PCs. Cs and Rs reported significantly less peer pressure to adhere, compared to PCs. PCs and Cs reported significantly less control over their own HH performance, compared to Rs. There were significant differences in TPB components observed between trainees at different stages of their training.	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + Findings related back to TPB. + TPB used to identify possible interventions. + All TPB components measured. x Influence of each component on HH adherence not explored. x Overall goodness-of-fit of model not reported.	70.0% Issues: - Unclear whether informed consent was obtained. - Questionnaire not included. - Unclear whether questionnaire had been validated. - Questionable external validity. - Use of self-report to gather HH compliance data.

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
4.McLaughlin & Walsh (2012)	To discover internal and situational reasons why healthcare workers do and don't adhere to HH guidelines.	USA	Cross-sectional. Quantitative.	Online questionnaire. Measuring: - Reasons for washing hands. - Most frequent reason. - Cues for washing hands. Responses chosen from a set list.	'Healthcare workers' (N=71): made up of Nurses (n=25), Infection Preventionists (n=25) and Environmental Service Managers (n=21). (N.B. Environmental Service Managers are not clinical staff) Response rate: 46% Volunteer sampling.	Reasons given for adherence differed significantly based on where it was taking place. The most influential reasons given for adherence were internal factors, whereas reasons for non-adherence were more evenly split between internal and situational factors. Interventions should address both internal and situational factors and be tailored to where the hand washing is taking place.	+ TPB was made reference to briefly but the study does not appear to be built upon the theory. x Influence of each component not explored. x Overall goodness-of-fit of model not reported. x Outcome measures not mapped onto TPB components. x Findings not related back to TPB. x Study seems to be hinting at the need for the TPB to be modified to take situational factors into consideration.	71.43% Issues: - Unclear how representative sample was of wider population. - Unclear how bias-free sampling strategy was. - Questionnaire not included. - Unclear whether questionnaire had been validated.

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
5.Pessoa-Silva <i>et al.</i> (2005)	To identify beliefs and perceptions associated with intention to comply with HH guidelines among neonatal healthcare workers.	Switzerland	Cross-sectional. Quantitative.	Questionnaire (74 items) Measuring: - Professional category - Duration of employment in neonatal - Year of qualification - Previous exposure to HH campaigns and training - Cognitive factors: Intention (12), Attitudes (15), Perceived behavioural control (11), Subjective norms (12), Behavioural norms (12), Perceived risk of transmission (1), Motivation to adhere (1). Responses to multi-item cognitive factor questions given on a 7-point Likert scale. Responses to single-item questions given on a visual analogue scale.	Healthcare workers (N=61): made up of Nurses (n=49) and Physicians (n=12). Response rate: 76% Volunteer sampling.	Mean intention score was 6.5 out of a possible score of 7. Having a strong sense of perceived control (OR, 3.1; CI ₉₅ , 1.1-8.7; p=.03) and a positive perception of superiors' values towards HH (OR, 2.9; CI ₉₅ , 1.1-7.8; p=.035) were significantly associated with intention to comply.	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + Predictive power of individual components was reported. + Findings related back to TPB. + TPB used to identify possible interventions. + All TPB components measured. x Overall goodness-of-fit of model not reported. x Actual behaviour not looked at, only intention. x Attitude was not found to be associated with intention to comply.	70.0% Issues: - Unclear whether informed consent was obtained. - Questionnaire not included. - Issues of face validity (in relation to survey items) leading to confounding variables being unaccounted for.

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
6. Whitby, McLaws & Ross (2006)	To explain behavioural determinants of intention to perform HH and their origins.	Australia	Cross-sectional. Mixed-methods: qualitative informing the design of a quantitative questionnaire	<p>Focus group - Facilitated by researcher using a semi-structured interview technique to discuss determinants.</p> <p style="text-align: center;">↓</p> <p>Questionnaire (64 items) - Developed from focus groups and HH literature.</p> <p>Measuring: -TPB components: Attitudes (56), Subjective norms (4), Perceived behavioural control (4). - Questions were related to either inherent (22) or elective (22) hand washing.</p> <p>Responses to elective/inherent questions given on 5-point Likert scale. Responses to TPB questions given on a 7-point Likert scale.</p>	<p>Focus Groups: children (n=64), mothers (n=64), nurses (n=64).</p> <p>Questionnaire: nurses (N=754) from 3 hospitals.</p> <p>Response rate: 61%</p> <p>Sampling method unclear.</p>	<p>64% of the variance in <u>elective</u>, in-hospital hand washing intention explained by model consisting of 6 components: Elective community behaviour, Attitudes, Perceived peer behaviour, Subjective norms relating to physicians, Subjective norms relating to administrators and Effort required ($R^2=0.64$, $p<0.001$).</p> <p>76% of the variance in <u>inherent</u>, in-hospital hand washing intention explained by model consisting of 3 components: Perceived peer behaviour, Attitudes and Elective community behaviour ($R^2=0.76$, $p<0.001$).</p> <p>Perceived pressure from nurses was not a significant predictor of intention. Only perceived pressure of superiors was significant.</p> <p>Inherent and elective hand washing are influenced by different components of TPB.</p>	<p>+ TPB used as underpinning framework.</p> <p>+ Outcome measures mapped onto TPB components.</p> <p>+ Predictive power of individual components and overall goodness-of-fit of model reported (between 64-76% of variance explained).</p> <p>+ Findings related back to TPB.</p> <p>+ TPB used to identify possible interventions.</p> <p>+ All TPB components measured.</p> <p>x Need for the TPB model of HH to distinguish between inherent and elective HH as separate target behaviours.</p>	<p>70.0%</p> <p>Issues:</p> <ul style="list-style-type: none"> - Unclear description of methodology including how participants were approached. - Sampling strategy unclear. - Unclear whether informed consent was obtained. - Only behavioural intention measured rather than actual behaviour. - Suggestions for future research not offered.

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
7.Sax <i>et al.</i> (2007)	To quantify the behavioural components of healthcare workers' motivation to comply with HH.	Switzerland	Cross-sectional. Quantitative	Questionnaire (26 items) Measuring: - Demographics (11) - TPB components: Behavioural beliefs (6), Normative beliefs (7), Control beliefs (1). -Self-reported adherence. Responses given by selecting items from a list or on a 7-point Likert scale.	Health care workers (N=1042): made up of Nurses (n=630), Physicians (n=271), Nursing Assistants (n=141). Response rate: 25.2% Stratified random sampling.	Behavioural beliefs: Perception that 'HCAIs are severe for patients' rated highly by 32.1% and that 'HH is effective' rated highly by 86% of respondents. <u>Normative beliefs</u> : Perception of pressure from patient rated highly by 73.7%, from superiors rated highly by 66.8%, from colleagues rated highly by 57.9%, and from the person deemed most influential to that individual rated highly by 68.8% of respondents. <u>Control</u> : Perception that 'HH is easy to perform' was rated highly by 65.1% of respondents. High self-reported adherence was associated with: being female, having received previous HH training, having participated in previous HH campaign, peer pressure, perceived good adherence by colleagues, perceived ease of behaviour. Strong control beliefs (OR=7.1, p=<0.001) and strong normative beliefs (OR=5.3, p=<0.001) were the most consistent explanations for good HH.	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + Findings related back to TPB and an in-depth discussion in relation to other TPB studies. + Predictive power of individual components was reported. x Overall goodness-of-fit of model not reported. x Intention not investigated.	88.89%

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
8. Jenner <i>et al.</i> (2002)	To: a) Develop a theoretical framework to identify psychological constructs predictive of healthcare workers' HH, and b) Determine ways of improving practice.	England	Cross-sectional. Quantitative	Questionnaire (15 items) Measuring: -TPB components: Attitudes (4), Subjective norms (2), Perceived behavioural control (2), Intention (4). -Self-reported adherence. -Personal responsibility (1) -Barriers to adherence (1) Responses given on a 7-point Likert scale.	Healthcare workers (N=104): made up of Nurses (n=76), Therapists (n=17), Healthcare Assistants (n=4), Doctors (n=3). Response rate: 34% Sampling method unclear (likely to have been a volunteer sample)	TPB variables accounted for 70% of variance in intention and 79% of variance in self-reported behaviour. Neither subjective norms nor perceived behaviour control significantly predicted intention. With the addition of personal responsibility and barriers (i.e. time and availability of sinks) model's predictive validity increased by 9% in intention and 8% in behaviour. The overall predictive validity of the new model was high: Intention: 79% ($X^2 = 57.95$, $df = 35$, $p < 0.01$) Behaviour: 87% ($X^2 = 80.22$, $df = 22$, $p < 0.001$)	+ TPB used as underpinning framework. + Outcome measures mapped onto TPB components. + Influence of each component was explored. + Goodness-of-fit calculated (intention: 70%, behaviour: 79%) + Findings related back to TPB. + All TPB components measured. + TPB used to identify possible interventions. x Subjective norms not found to be significant predictor of intention or behaviour. x TPB was modified: addition of personal responsibility and barriers.	71.43% Issues: - Unclear how representative sample was of wider population. - Unclear how bias-free sampling strategy was. - Unclear whether informed consent or ethical approval was obtained. - Unclear whether instrument had been validated. - Use of self-report to gather HH compliance data.

ID No, primary author & year of publication	Aims of study	Country of study	Study design	Methodology (number of items related to that component)	Sample	Key results of study	Application of TPB ('+' refers to positive application, 'x' refers to difficulties in application)	Overall validity calculation based on critical appraisal checklist ≥75% = High validity ≤75% = Questionable validity
9. White <i>et al.</i> (2015)	To identify key beliefs underlying nurses' HH compliance.	Australia	Longitudinal. Quantitative.	<p>Focus group - To elicit nurse beliefs about HH to inform subsequent questionnaire.</p> <p>↓</p> <p>Questionnaire - Measuring: Behavioural beliefs (9); Normative beliefs (9); Control beliefs (9).</p> <p>Responses given on a 7-point Likert scale.</p> <p>↓</p> <p>Follow up - Phone call/email to participants 2 weeks later to gather self-reported HH adherence over past 2 weeks.</p>	<p>Focus Groups: 5 groups of nurses (N=27)</p> <p>Questionnaire: Nurses (N=797) from 50 hospitals.</p> <p>Female: 86.2% Male: 11.0%</p> <p>Retention rate across questionnaire and phone call: 34%</p> <p>Sampling: 80 nurses randomly selected by individual matrons.</p>	<p>Average self-reported HH was moderate to high (5.81 out of 7.00).</p> <p>13 beliefs were significantly correlated with HH ($p<0.001$): Behavioural beliefs (4); Normative beliefs (1); Control beliefs (8).</p> <p>Further analysis found 3 significant beliefs explaining 15% of the variance in HH behaviour: 1) that HH reduces chance of infection for co-workers; 2) that nurses don't have enough time; 3) that nurses forget.</p> <p>Predictors accounted for limited variance (15%).</p> <p>Interventions should focus on: a) emphasising protecting co-workers; b) addressing time constraints; c) addressing forgetting.</p>	<p>+ TPB used as underpinning framework.</p> <p>+ Outcome measures mapped onto TPB components.</p> <p>+ Findings related back to TPB but little time given to discussion.</p> <p>x Influence of each component not reported – only those deemed to be key.</p> <p>x Goodness-of-fit not calculated but 15% of variance accounted for by 3 beliefs.</p> <p>x Intention not investigated.</p> <p>x Normative beliefs not found to be key to nurses' HH compliance.</p>	76.19%

3 Results

3.1 Overview of included studies

3.1.1 Methodologies

Nine studies (N=3802), conducted between 2001 and 2015, were included in the current review. All but two employed a cross-sectional design, with the others being longitudinal. Seven of the studies used solely quantitative methods, with the remaining two employing a mixed-methods approach. Three of the studies focused on healthcare worker's intention to follow guidelines, four focused solely on behaviour and the other two looked at intention and behaviour together. Studies relied predominantly on self-report questionnaires to gather data (n=9), however one study used behavioural observations alongside self-report, and two used focus groups to inform the design of questionnaires.

3.1.2 Samples

Samples were made up predominantly of healthcare workers (79.3%) and medical trainees (16.7%). Of those medical trainees, 80.6% were based in clinical settings and 19.4% were not (although all had received HH education). Healthcare workers (n=3015) consisted of nurses (67.5%), physicians (7.5%), healthcare assistants (3.8%), and therapists (0.4%). One study included environmental service managers (n=21) in their sample of 'healthcare workers' despite them having no direct patient contact. The rationale for this was that they had responsibility for HH resources.

3.1.3 Structure of the current review

For the purpose of the current review, studies were grouped into those focusing on intention and those focusing on behaviour. Studies including both intention and behaviour together were placed with the behaviour-focused studies⁵. The methodological characteristics and key findings of the intention-focused studies are summarised, followed by behaviour-focused studies. An overview of the application of the TPB and general methodological issues are reported later.

⁵ This was because although the TPB situates intention as a proxy measure of behaviour (i.e. behaviour can be predicted from knowledge of an individual's intention) changing behaviour, over intention, is what is of most interest to the review.

3.2 Intention to adhere to guidelines

Three studies (Roberto, Mearns & Silva, 2012; Pessoa-Silva *et al.* 2005; Whitby, McLaws & Ross, 2006) focused on predicting respondents' intentions to adhere to HH guidelines.

3.2.1 Methods

All three studies had cross-sectional designs and used quantitative questionnaires to gather information about determinants. However, Whitby, McLaws and Ross (2006) initially carried out focus groups to inform their questionnaire. All three studies reported their measures to have good internal consistency ($\alpha \geq 0.70$) and measured all components of the TPB, as well as additional items related to their specific aims. Whitby, McLaws and Ross (2006) for example, informed by their focus groups, added items to distinguish between inherent (washing when hands feel or are visibly dirty) and elective (washing despite hands being not obviously unclean) hand washing. Pessoa-Silva *et al.* (2005), in their study of healthcare workers based in a neonatal care setting, added two items related to perceived risk of transmission and motivation to adhere. Finally, Roberto, Mearns and Silva (2012) split the normative components of the TPB into further subcomponents (norms relating to professors and those relating to colleagues) to test their hypotheses.

3.2.2 Findings and critical appraisal

Using hierarchical multiple regression, Roberto, Mearns and Silva (2012) found, as predicted, that subjective norms were the most significant predictors of intention for both first and sixth year medical students. For first year students, attitudes, subjective norms (relating to perceived beliefs of professors), and moral norms (relating to *personal* commitment to HH) explained 35% of variance in intention. For sixth year students, attitudes, subjective norms (relating to perceived beliefs of colleagues), moral norms (relating to *professional* commitment to patient safety), and the addition of perceived behavioural control explained 49% of the variance in intention. They concluded that a change appears to occur in students' social referents and moral standpoint as they proceed through training and are exposed to clinical work. However, changes in beliefs cannot be established by cross-sectional research due to measurements only being taken once.

With the use of logistic regression, Pessoa-Silva *et al.* (2005) also found subjective norms to be significantly and positively associated with intention, along with perceived behavioural control.

However, there appear to be face validity issues with a number of the questionnaire items seeming not to measure what they claim, thus drawing into question the internal validity of the study.

Whitby, McLaws and Ross (2006) found that different factors were associated with inherent and elective hand washing respectively. In terms of HH in hospital settings, elective hand washing is the outcome arguably most interesting to researchers as much of the HH recommendations fall into this category. Backwards linear regression found subjective norms once again significantly and positively associated with intention in both types of hand washing. Better elective community handwashing; a more positive attitude towards HH; perceiving peers to be carrying out appropriate HH; perceiving superiors' expectations of good HH (subjective norms); and a reduction in effort required, were all significantly and positively associated with intention to carry out elective hospital-based hand washing. These factors explained 64% of the variance in intention.

3.3 Behavioural adherence to guidelines

Six studies (O'Boyle, Henly & Larson, 2001; Limper *et al.* 2013; McLaughlin & Walsh, 2012; Sax *et al.* 2007; Jenner *et al.* 2002; White *et al.* 2015) focused on explaining respondents' adherence to HH guidelines, rather than intention alone.

3.3.1 Methods

All but two studies had a cross-sectional design, with O'Boyle, Henly and Larson (2001) and White *et al.* (2015) using a longitudinal design. All six studies employed quantitative questionnaires. Only O'Boyle, Henly and Larson (2001) actually observed HH behaviour, alongside gathering self-reports, which increased the confidence that can be placed in their findings. O'Boyle, Henly and Larson (2001) attempted to test a modified version of the TPB which included, alongside traditional TPB components, the intensity of the environment that nurses worked in. This was the only study to take the intensity of the work environment into consideration. Limper *et al.* (2013) focused on quantifying the differences in determinants of intention and self-reported adherence amongst medical trainees at different stages of their training. McLaughlin and Walsh (2012) focused on differentiating between internal and situational determinants of healthcare worker's adherence. Sax *et al.* (2007) conducted a large scale survey (N=1042) of healthcare worker's beliefs and self-reported adherence, alongside

their exposure to HH campaigns, to identify relationships between determinants. Jenner *et al.* (2002) also attempted to test a modified version of the TPB on healthcare workers, with additional items related to personal responsibility and identified barriers. White *et al.* (2015) used a longitudinal design to capture nurses' HH beliefs and to look at relationships between these and their self-reported HH behaviour two weeks later. They used a focus group of nurses to inform their quantitative questionnaire which was then administered to 797 nurses.

3.3.2 Findings and critical appraisal

O'Boyle, Henly and Larson (2001) used structural equation modelling (SEM) to analyse their data. TPB components significantly explained the variance in healthcare worker's intention and self-reported adherence, but *not* their observed behaviour. The addition of a situational component did not improve the model's ability to predict either intention or self-reported behaviour. However this situational component was the only significant predictor of observed behaviour ($r=-0.32$, $p<.01$) apart from self-reported adherence ($r=0.22$, $p<.05$), although both showed only weak associations. The study's failure to report a power analysis, as well as the relatively small sample size increased the risk of significant associations going undetected. It is possible that the inability of TPB components to predict observed behaviour resulted from the length of time between self-reports and subsequent observations, which ranged from 2-16 weeks. This argument is supported by McEachan *et al.* (2011) who concluded that the components' predictive abilities lessen over time as experiences influence respondents' beliefs and attitudes.

Limper *et al.* (2013), similar to Roberto, Mearns and Silva (2012), focused on medical trainees and found that components of the TPB differed depending upon the respondents' stage of training. Unfortunately, Limper *et al.* (2013) failed to explore the influence of these components on adherence, choosing instead to simply describe differences between trainees with a chi-squared analysis.

McLaughlin and Walsh (2012) carried out a multivariate analysis of variance and found differences between what healthcare workers report as motivating and inhibiting factors. Although the study's write-up arguably lacks clarity, determinants were found to organise around the location in which the behaviour took place and whether the reason given for washing or not washing hands was attributed to internal or external factors. The motivating factors rated as most influential by respondents tended to be triggered internally, whereas

inhibiting factors rated most influential were more a mix of internal and external triggers. The likelihood of determinants being attributed to internal or external factors depended upon the location in which the behaviour took place. Despite conducting a power analysis, the validity of the study's findings should be questioned due to around a third of the sample consisting of non-clinical staff whose job role required no patient contact.

Sax *et al.* (2007) conducted a large (N=1042) questionnaire-based study of healthcare workers' beliefs, demographics and self-reported adherence. The number of respondents that rated highly on each belief was quantified to highlight where interventions may benefit from being aimed. Relationships between beliefs, demographics and adherence were further investigated using binary logistic regression. Control beliefs were the most influential predictor of adherence (OR=7.1, $p<0.001$) followed by normative beliefs (OR=5.3, $p<0.001$). The study employed a thorough approach to eliminate bias, including stratified-random sampling, a pilot study, explicit reporting of procedures and thorough discussion of the study's limitations, resulting in, what appears to be, a high quality study. However a power analysis and measure of internal consistency were missing from the study.

Jenner *et al.* (2002) used two hierarchical logistic regression analyses and found TPB variables accounted for 70% of the variance in intention and 79% of the variance in self-reported behaviour. However, with the addition of 'personal responsibility' and 'barriers' (barriers here referring to time and availability of sinks) the predictive validity of the model increased by 9% for intention and 8% for behaviour. The result was a modified TPB model with high overall predictive validity, with 79% of the variance in intention ($\chi^2 = 57.95$, $df = 35$, $p<0.01$) and 87% of the variance in behaviour ($\chi^2 = 80.22$, $df = 22$, $p<0.001$) accounted for. Caution should be used however when interpreting these findings as again self-reported behaviour was used as a proxy measure of observed behaviour. Also, the questionnaire item measuring adherence was arguably worded unhelpfully and may have led to respondents rating lower than was accurate due to the wording of the item. Both these limitations increased the likelihood that responses did not accurately reflect actual HH behaviour.

Finally, White *et al.* (2015) carried out Pearson's r correlations, followed by stepwise multiple regression analyses. Thirteen of the beliefs listed on the questionnaire were found to be significantly associated with nurses' self-reported HH ($p<0.001$) and three of these were identified as 'key' beliefs due to accounting for the most variance in HH ($R^2 = 0.15$, $p<0.001$).

These were beliefs that: good HH reduces the risk of infection for co-workers; there was not enough time for good HH; and that HH was easily forgotten. However, despite being found statistically significant these three factors still accounted for only a relatively small amount of the variance (15%). White *et al.* were the only researchers to highlight the protection of co-workers as a significant motivator.

3.4 Application of the theory of planned behaviour

Within the studies included in this review, the TPB was applied to a number of settings to achieve a variety of aims. Some focused on specific healthcare settings, for example Pessoa-Silva *et al.* (2005) with their neonatal unit staff, whereas others recruited participants indiscriminately from a variety of wards. Some of the studies have focused on specific staff groups, for example Roberto, Mearns and Silva (2012) looking at medical students at different stages of their training, whereas others have recruited healthcare staff more generally.

The TPB has been used to achieve a variety of aims including: identifying and exploring relationships between beliefs and *intention* to perform HH behaviour; identifying and exploring relationships between beliefs and *actual* HH behaviour; predicting intention to perform HH behaviour; and quantifying motivational factors.

Eight of the studies made explicit use of the TPB as an undergirding framework with questionnaire items mapped onto components of the TPB. Findings were related back to theory in seven of these studies in order to identify possible modifications. Three of the studies calculated an overall goodness-of-fit statistic (Whitby, McLaws & Ross, 2006; Roberto, Mearns & Silva, 2012; Jenner *et al.* 2002). The TPB was found to predict between 34-70% of the variance in intention and 79% of the variance in behaviour.

3.5 General methodological issues

Only three of the included studies (Sax *et al.* 2007; White *et al.* 2015; O'Boyle, Henly & Larson; 2001) achieved the status of 'good overall validity' as determined by the critical appraisal checklist. This meant that the remaining six studies contained considerable methodological issues undermining the confidence that can be placed in findings. There appeared to be numerous methodological issues shared between the studies that are worth addressing.

Firstly, the failure of all but one included studies (McLaughlin & Walsh, 2012) to conduct power analyses is a considerable methodological weakness. Researchers need to carry out power analysis to ensure an appropriate balance of alpha (type I) and beta (type II) error.

Secondly, four studies failed to report Cronbach's alpha as a measure of internal consistency (Sax *et al.* 2007; Limper *et al.* 2013; McLaughlin & Walsh, 2012; White *et al.* 2015). There was also a lack of transparency around the items making up each questionnaire. Explicit reporting of questionnaire items allows the reader to assess their face validity. For example, the items used by Pessoa-Silva *et al.* (2005) to capture motivation and intention arguably did not actually tap into intention and motivation but rather self-reported adherence and perceived behavioural control respectively. As less than half of the studies included their questionnaire in the final publication, the face validity of measures remained unclear. It is therefore difficult to say with confidence that components of the TPB are either significant predictors of HH behaviour or not, as findings could be the result of questionnaires lacking internal validity.

Thirdly, all of the studies, with the exception of O'Boyle, Henly and Larson (2001) made sole use of self-report measures of behaviour, rather than also observing behaviour. Despite being more cost-effective, self-report measures fail to reflect actual behaviour (Davis *et al.* 2006). Thus the reliance of HH research on such methods raises concerns.

Fourthly, all but two of the studies (Sax *et al.* 2007; White *et al.* 2015) were liable to sample bias, with the remaining seven studies either employing non-randomised sampling strategies or showing no evidence of considering the issue. It is plausible therefore that extraneous variables influenced who volunteered for participation.

Fifthly, despite all of the studies seeking to improve understanding of what influences HH adherence by applying the TPB, research aims lacked homogeneity. This manifested in differing: samples, outcomes of interest, definitions and grouping of components, and wording of questionnaire items. For example, studies varied in whether they classed perceived behavioural control as one component or two, and as previously mentioned, whether they measured only intention or included behaviour too. This issue was also apparent in the statistical analyses. Despite seven of the studies conducting regression analyses to determine variance in intention or behaviour, the way these were reported varied. Roberto, Mearns and Silva (2012) did not report standardised regression coefficients and data were not available to

allow analyses to be re-run, whereas Pessoa-Silva *et al.* (2002) and Whitby, McLaws and Ross (2006) did report them. The aforementioned differences made synthesising results, in order to offer a useful summary of the TPB's efficacy, difficult. This could be seen to indicate ambiguity amongst researchers around the structure of the TPB and what is most useful to measure. This heterogeneity of aims is also likely to explain the wide variation in the amount of variance explained by the model across studies. Despite the temptation to combine significant findings to offer a coherent statistical summary, the aforementioned methodological issues ensure that this would prove confusing and offer little clarity. However, the current review highlights useful ways forward.

4 Discussion

4.1 Summary of main findings

The TPB has been applied to a number of healthcare settings to achieve a variety of aims. This research has been conducted predominantly on nursing staff (n=93%) and has been quantitative in nature. Only three of the nine included studies calculated the overall predictive power of the TPB in relation to HH, with the explained variance in intention and actual behaviour varying widely (between 35-70% and 15-79% respectively). Findings showed that the addition of factors not included in the original model improved the predictive power of the model in relation to staff HH behaviour. Across studies of intention, normative beliefs were repeatedly found to be an important predictor, although the component's predictive power was often not reported. There was less consistency in findings amongst the studies attempting to predict behaviour. However, control beliefs were found to be the most influential predictor of adherence within the study scoring highest on the critical appraisal checklist (Sax *et al.* 2007).

4.2 Summary of the theory's efficacy in relation to HH behaviour

To determine the efficacy of the TPB in explaining HH adherence or intention to adhere, it would be necessary to know how often all TPB components had been found to significantly account for the variance in respondents' adherence (i.e. the model's overall 'goodness-of-fit'). It would also be useful to identify which of the components had been shown to be most influential in predicting HH adherence. However, identifying the most influential component would require two additional steps: firstly, investigating which component was found to be a

significant predictor most consistently across studies, and secondly, investigating the mean predictive strength of each component. Finding the most consistent significant component would entail calculating a ratio based upon the number of times a component was found to be a significant predictor divided by the number of times it was assessed, as done by Godin *et al.* (2008). This would allow for a percentage to be calculated and make it possible to say, for example, that 73% of the times it was assessed, perceived behavioural control was found to be a significant predictor of behaviour. Finding the mean predictive strength of each component would require calculating a pooled regression coefficient for each component made up of findings from different studies to provide an overall figure of how influential it was. These tasks were not possible within the current literature review due to the limited number of studies reporting relevant statistics and the studies' lack of homogeneity.

It was possible however to identify potential modifications to the TPB (see Figure 4) to improve the model's ability to predict HH adherence. These were as follows:

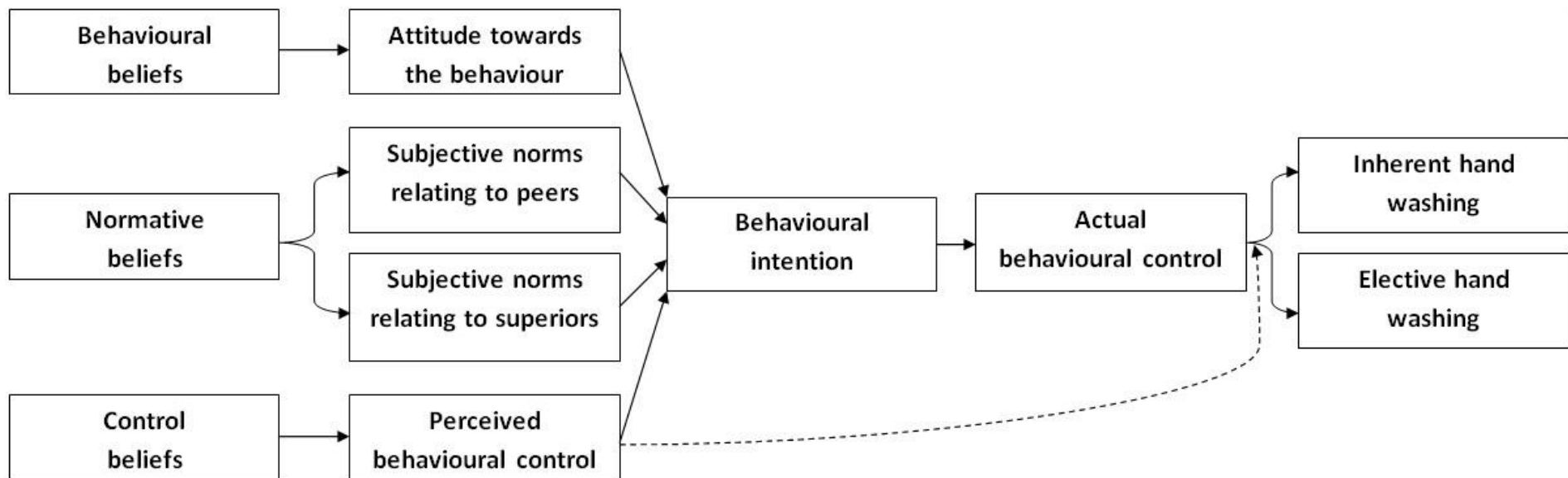
- The splitting of normative components into further subcomponents (i.e. those relating to different groups of people). This was supported by Roberto, Mearns and Silva (2012), Pessoa-Silva *et al.* (2005), and a meta-analysis by Armitage and Connor (2001).
- The inclusion of a component/s reflecting actual behavioural control rather than just perceived control. This was supported by O'Boyle, Henly and Larson (2001), Jenner *et al.* (2002), and McLaughlin and Walsh (2012). This idea is also supported, outside of the studies included in the current review, by Azjen (2011).
- The splitting of HH behaviour into inherent and elective hand washing. This was supported by Whitby, McLaws and Ross (2006).

4.3 Limitations of the current review

The current review is not without limitations. Firstly, only published studies were included, introducing the risk of publication bias. Secondly, studies from undeveloped countries were excluded, further reducing the already limited number of included studies which may have otherwise yielded useful insights. Thirdly, as a result of the small number of studies meeting the inclusion/exclusion criteria, the methodological differences between studies were potentially not smoothed out or clarified by other studies, as would usually be the case with a larger number. Fourthly, the inclusion of only quantitative studies, despite being justified in terms of seeking quantifiable conclusions, may have led to insight being missed that could have informed future research. Fifthly, as mentioned previously, it would have been useful to

have a more homogenous group of studies to allow greater comparison. However, imposing tighter inclusion/exclusion criteria would also have further reduced the number of studies and potentially proved to be a limitation itself. Finally it is worth mentioning the critical appraisal checklist, which, although a useful set of criteria against which to judge the validity of each study, was not without limitations. The checklist required a *yes, no, unclear* or *N/A* response to each of the 26 questions. It proved difficult at times to answer in such dichotomous terms. For example when asked '*are data collection methods clearly described?*' one may decide to state *no* despite there being just one particular aspect of the method that was not reported. This may have served to lower the overall quality ratings of the included studies.

Figure 4 A revised model of the theory of planned behaviour indicating some of the additional complexities suggested by the current review



4.4 Clinical implications

As a result of the current state of HH research, those responsible for designing and delivering HH interventions are forced to rely on unclear and inconsistent findings in making decisions. More studies are needed that include both regression coefficients for individual components and overall goodness-of-fit statistics. Such studies allow more informed decisions to be made about where to allocate limited resources in the design of HH interventions. Despite the heterogeneity of findings and methodological limitations within the included studies, the normative beliefs component of the TPB emerged as a somewhat consistent and influential predictor. The existing HH literature would indicate that ensuring that addressing normative beliefs within any proposed intervention receives adequate resource would be advisable for decision makers. However decision makers are advised to bear in mind whether their target population are more influenced by the beliefs of peers or senior colleagues.

4.5 Research implications

The use of self-report measures is common due to their ease in gathering large amounts of data. However the continued use of methods that are widely regarded as inaccurate (Armitage & Conner, 2001; Godin *et al.* 2008) needs to be addressed. One of the studies included in the current review (O'Boyle, Henly & Larson, 2001) found only a small correlation between self-reported adherence and observed adherence ($r=0.22$) and concluded that self-report '*...should be abandoned...despite the incremental cost of the observation procedure.*' (p.359.) More accurate measures of behaviour, such as observations, are seemingly being overlooked whilst self-report is favoured. However the current review would argue that it is possible to overcome self-report limitations cheaply. The use of a subset of subjects upon whom to conduct observations, followed by a comparison against self-report data would enable an estimate of the amount of measurement error to be calculated. This error calculation could then be applied to a larger sample of self-report data to offer a more accurate estimation of adherence.

To move past the current state of the literature, with its disparity of measures and definitions, there is a need for measures and the reporting of findings to be standardised. In terms of standardising measures, attempts have already been made towards this, for example, the WHO's (2010) 'Hand Hygiene Self-Assessment Framework' and the Joint Commission's (2009) 'Measuring Hand Hygiene Adherence: Overcoming the Challenges' papers. However, how

these suggested measures map onto the TPB is unclear. Fortunately O'Boyle, Henly and Duckett (2001) have created and validated the Handwashing Assessment Inventory (HAI), as utilised by O'Boyle, Henly and Larson (2001). This self-report questionnaire measures the six components of the TPB alongside self-reported hand washing and could be a solution to the issue. The commitment of researchers to employ the HAI alongside the Handwashing Observation Instrument (HOI; O'Boyle, Henly & Larson, 2001) when investigating the application of the TPB to HH behaviour would be a step in the right direction. Alternatively, a more retrospective approach similar to that of Huis *et al.* (2012) may prove useful. This could entail the development of a taxonomy for researchers to identify which items of a pre-existing HH questionnaire map onto each TPB component. The inconsistencies in how statistical analyses were reported also proved difficult to overcome, with some studies reporting standardised coefficients whilst others did not. The body of research would benefit from researchers habitually reporting standardised statistics in order to permit easy and useful comparisons between studies. Researchers should strive to pay increasing attention not only to the quality of their own research but also to how it relates to the wider body of research.

4.6 Conclusions

Despite growing interest in the area, that only nine studies met the criteria for inclusion could be an indication that the application of the TPB to HH is a relatively recent addition to HH research and thus still in its infancy. It was hoped that the current review would offer more quantifiable conclusions than those of Kretzer and Larson (1998). Due both to the limited number of studies and their limitations, this review was unable to offer such conclusions. The current review found normative beliefs to be the most consistent predictor of HH intention, and thus promotes this as an obvious target for future interventions in the absence of more robust research findings. However, reviewing the literature whilst in its early stages is also useful in highlighting relevant issues to steer future research. The current review highlighted the need for: a) the identification and use of standardised measures that map comprehensively onto the TPB; b) the standardisation of statistical reporting; c) a revision of the original TPB model; d) clarification over whether certain of the TPB's components should be further divided; and e) an improvement in the quality of HH research, with innovation in balancing cost efficiency and rigour. These issues need addressing by future research in order to expand understanding of HH behaviour and more fully inform interventions.

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Part 2: Research Report

Target journal: American Journal of Infection Control

Identifying influential factors in healthcare workers' hand hygiene adherence: A theory-driven, mixed-methods approach

Andy Brackett

Abstract

Context: Hand hygiene is recognised as the single most successful and cost-effective means of preventing healthcare-associated infection (Pittet *et al.* 2004) and yet staff adherence to hand hygiene guidelines is suboptimal (WHO, 2009). Despite a wealth of research, our understanding of adherence and how to improve it remains poor. Reasons for this may lie in an overreliance on self-report methodologies and a lack of reference to psychological theory (Edwards *et al.* 2012). The current study used a theory-informed, mixed-methods approach to identify key factors influencing nursing staff's adherence within Critical Care.

Methods: Factors influencing hand hygiene were investigated by triangulating three methodologies: 1) a quantitative questionnaire (the Barriers and Levers to Hand Hygiene Instrument; Dyson *et al.* 2013), administered to all nursing staff; 2) a Delphi, run with 17 nursing staff; and 3) ward observations across three shifts. Methodologies were informed by the Theoretical Domains Framework (Michie *et al.* 2005) to ensure comprehensive coverage of influencing factors. The framework was also used to organise findings.

Results: 'Memory, Attention and Decision Processes' were clearly highlighted as key to staff's hand hygiene across all three methodologies, whilst 'Environmental Context and Resources' were highlighted across the two self-report methodologies.

Conclusions: Current findings suggest that interventions should prioritise addressing 'Memory, Attention and Decision Processes'. 'Environmental Context and Resources' seemed to reflect staff's perception of busyness and difficulties prioritising hand hygiene rather than externally visible factors. The current study demonstrates a more valid approach to hand hygiene research and the utility of mixed-methods research in accounting for the influence of bias. Considerations for clinical practice and future research are discussed.

Keywords: *Hand hygiene, adherence, theoretical domains framework*

1 Introduction

1.1 The 5 Moments for Hand Hygiene

Healthcare-associated infections (HCIs) are infections arising from receiving healthcare, for example from the actions of a physician or institution. Due to the widely-known detrimental effects of HCIs, and hand hygiene (HH) being recognised as the single most successful and cost-effective means of preventing them (Pittet *et al.* 2004), the World Health Organization (WHO) has published guidelines to promote good HH amongst healthcare workers (WHO, 2009). These guidelines include a tool called the '5 Moments for Hand Hygiene' (5MHH; see Figure 5), instructing staff on when HH should be carried out.

Figure 5 The 5 moments for hand hygiene (WHO, 2009)



1.2 Poor hand hygiene adherence

Despite a multitude of attempts at improving adherence to HH guidelines, HH is still suboptimal (WHO, 2009). A systematic review of 96 studies revealed that healthcare workers carry out HH considerably less often than would be expected if following guidelines, with an average compliance rate of 40% (Erasmus *et al.* 2010). This poor adherence rate has prompted

much research into identifying determinants of good HH in order to design and implement interventions to improve it. Studies have identified a large number of observed and self-reported factors influencing adherence at individual, interpersonal and organisational levels (WHO, 2009). It would be easy to assume that hand decontamination is a simple enough behaviour and easily changed. However it would appear that *'behaviour related to hand hygiene is a complex phenomenon that is not easily understood, explained or changed'* (O'Boyle, Henly & Larson, 2001, p.352). Some interventions have reportedly improved adherence although have tended to employ short follow-up periods and reveal only modest results (WHO, 2009), whilst others have proved ineffective (Davis *et al.* 2014). Concerns have been expressed that *'despite the large number of available implementation studies there is little evidence to suggest why any of the interventions are successful or otherwise'* (Dyson *et al.* 2011, p.17). Our understanding of HH adherence and how to improve it remains poor despite a wealth of research findings.

1.3 Utilising theory

A number of researchers (e.g. Fuller *et al.* 2014) have begun asking whether such difficulties in implementing guidelines are the result of theoretical understanding being neglected in the design of research and interventions. Michie and colleagues have emphasised the need to gain a thorough understanding of the target behaviour before starting to design an intervention. They state that, *'if the assessment is not thorough, the formulation of the problem is less likely to be accurate, and the intervention less likely to be effective'* (Michie, Atkins & West, 2014; p.29). However this essential stage of the research process is often done ineffectively or neglected altogether. Making use of theoretical understandings is essential to ensuring a systematic and thorough understanding of the behaviour hoping to be changed. Findings have shown that the use of a theoretical approach in investigating HH behaviour can lead to the reporting of important factors which fail to be reported with non-theoretical approaches (Dyson *et al.* 2011). Thus a theoretically-informed approach appears to prompt participants to think more widely about their behaviour and the context surrounding it.

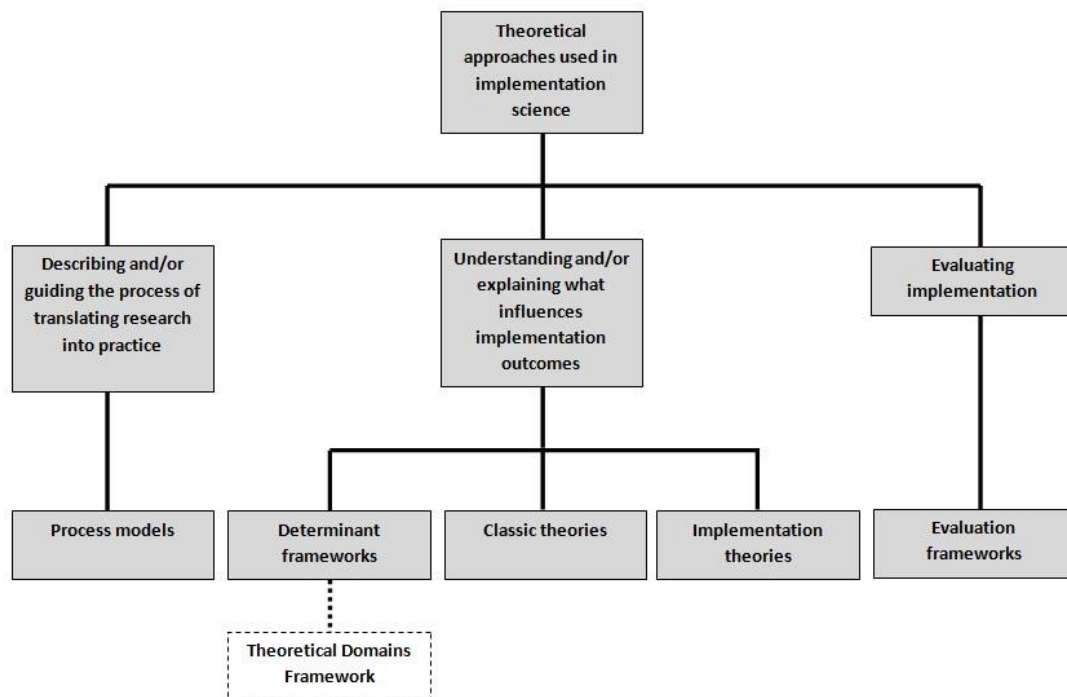
Until recently, costly interventions have been implemented with little understanding of the behaviour they seek to change and why the intervention might prove effective. Intervention decisions have instead tended to be made intuitively or with a *'scattergun approach'* (Robertson, Baker & Hearnshaw, 1996, p.54). A systematic review into HH determinants and

interventions reported that, of 14 included studies, '*none explicitly incorporate[d] psychological theory*' into their research (Edwards *et al.* 2012, p.318).

A number of recent studies have attempted to apply theory to understanding HH behaviour (e.g. von Lengerke *et al.* 2015). However, the use of theory is not straight forward. Researchers and intervention designers face difficult decisions around which theory to select due to the vast number available and the confusing overlap of constructs (Michie *et al.* 2005). A recent cross-disciplinary review identified 83 theories of behaviour change (Davis *et al.* 2014) which inevitably differ in which aspects and types of behaviour they focus on. Even if one or more theories are selected to base an investigation or intervention upon, it is unlikely that these will offer comprehensive coverage of all the factors at play, inevitably neglecting some. For example, the commonly used *theory of planned behaviour* (Ajzen, 1991) may be chosen as the guiding theory. However there is often little acknowledgment (and perhaps little awareness) that it is only applicable to volitional behaviour, thus neglecting more habitual behaviour. Such issues are likely to reduce the confidence that can be placed in existing findings and pose difficulties to researchers and intervention designers. A straight forward, systematic and comprehensive way of using theory to investigate and understand behaviour appears necessary.

In the last decade, implementation science has grown in its recognition of the importance of research being underpinned by sound theoretical understanding. This realisation has led to the development of a number of implementation theories, models and frameworks which can be organised into five categories: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks (Nilsen, 2015; see Figure 6).

Figure 6 The three aims of the use of theoretical approaches in implementation science and the five categories of theories, models and frameworks (adapted from Nilsen, 2015)



In regard to understanding what factors influence staff's HH, determinant frameworks are the most relevant. Examples of determinant frameworks include: the Consolidated Framework for Implementation Research (CFIR; Damschroder *et al.* 2009); the Promoting Action on Research Implementation in Health Services framework (PARiHS; Kitson *et al.* 2008); and the Understanding-User-Context Framework (Jacobson, Butterill & Goering, 2003). These frameworks are meta-theoretical in that they draw from a number of theories. These frameworks all aim to facilitate researchers to adopt a more systematic and theory-led approach to the design, implementation and evaluation of interventions.

1.3.1 The Theoretical Domains Framework

One particular framework, the Theoretical Domains Framework, has recently been applied to the area of HH (e.g. Fuller *et al.* 2014). The framework, first developed in 2005, is a well-validated, comprehensive, theoretical framework for understanding the implementation of evidence-based practice. It was developed by a group of psychologists, through the use of an expert consensus and validation approach (a Delphi) aimed at reaching consensus about what the key constructs are in relation to implementing evidence-based practice. The process

identified 128 constructs from 33 different theories and then grouped into 12 theoretical domains (Michie et al. 2005)⁷. These domains were as follows:

- Knowledge
- Skills
- Social/Professional Role and Identity
- Beliefs about Capabilities
- Beliefs about Consequences
- Motivation and Goals
- Memory, Attention and Decision Processes
- Environmental Context and Resources
- Social Influences
- Emotion
- Behavioural Regulation
- Nature of the Behaviour

1.4 The Theoretical Domains Framework and hand hygiene

There are currently six published studies⁸ applying the framework to the area of HH (Boscart *et al.* 2012; Squires *et al.* 2014; Dyson *et al.* 2011; Dyson *et al.* 2013; McAteer *et al.* 2014; Fuller *et al.* 2014), five of which explored determinants and one which focused on the development of a quantitative measure of determinants.

1.4.1 Methodological issues

Despite promising advances in the use of theory in HH research, there appear to be methodological issues within the current body of theory-informed HH research. There is an over-reliance on self-report methods (McAteer *et al.* 2014), with all of the aforementioned theory-based studies solely capturing self-reported factors. It is known that an '*overreliance on a single type of measure or method can seriously jeopardise accurate interpretation*' of findings (Jehn & Jonsen, 2010; p.316). Where observational methodologies have been used (e.g. Fuller *et al.* 2014), these have focused on auditing adherence rather than understanding it. Self-

⁷ The original model was later revised following further validation tests. The revised model (Cane, O'Connor & Michie, 2012) consisted of 14 domains rather than the original 12. In the current study the decision was made to stick with Michie *et al.*'s original model as the questionnaire used was based on this original model.

⁸ The latest search of the literature was conducted on 8th September 2015.

report methodologies are widely regarded to hold limited validity (Armitage & Conner, 2001) due to their vulnerability to bias. We know from psychological research that people: a) are not always aware of all the factors influencing their behaviour (Nisbett & Wilson, 1977); b) tend to claim simplistic reasons for their behaviour (Jones & Nisbett, 1971); c) rationalise unacceptable behaviour to enable it to sit more comfortably with their values and beliefs (Bibring, Dwyer, Huntington & Valenstein, 1961, p.64); d) present themselves in ways that will be viewed favourably by others ('social desirability bias'; Grimm, 2010); and e) attribute their behaviour, especially negative ones, to causes outside of themselves ('self-serving bias'; Miller & Ross, 1975). It would seem that *'what people say, what people do, and what they say they do are entirely different things'*.⁹

However, such phenomena are rarely mentioned in the HH literature, the implications being that the validity of identified determinants could be drawn into question. There appears to be a need to triangulate methodologies (Webb *et al.* 1966) to allow for the limitations of one to be compensated for by the strengths of another. To our knowledge the only existing HH study that has addressed this issue of validity by incorporating triangulation of methodologies as well as a theoretical framework, was carried out by Pittet *et al.* (2004). Physicians' adherence was observed before immediately asking the physician to complete a theory-informed questionnaire to capture cognitive factors. Despite their efforts to combine observational and self-report data, their questionnaire appeared to lack validity and social desirability bias was overlooked.

1.5 Trust hand hygiene audit

For 2015-2016 the agreed target for HH adherence, between the participating Trust and commissioners, was 98%. An audit of 1066 HH opportunities by 667 staff, spanning 85 wards/departments, was conducted in May 2015. This estimated Trust adherence at 55.3%. Despite regular audits, little is known about *why* the Trust's adherence is suboptimal. In light of this, the Clinical Psychology department were asked to assist in understanding and addressing staff HH.

⁹ Quote widely credited to cultural anthropologist, Margaret Mead.

1.6 Aims

In light of the aforementioned rationale, the current study aimed to triangulate three methodologies in order to adopt a more valid approach to identifying key factors influencing nursing staff's HH. The study intended to use the Theoretical Domains Framework as a guiding framework to both inform data collection and organise findings.

1.7 Research question

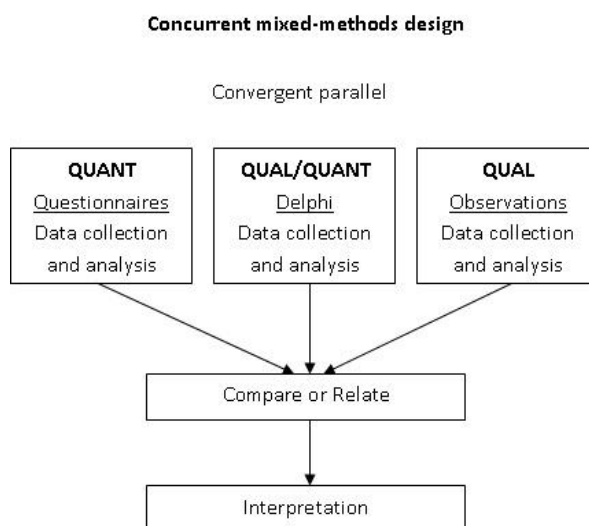
What are the key factors influencing Critical Care nursing staff's adherence to the 5MHH guidelines?

2 General methodology

2.1 Design

An exploratory, mixed-methods¹⁰, cross-sectional design (see Figure 7) was chosen as it was felt to offer an appropriate balance between scientific rigour and clinical feasibility in addressing the research question. A mixed-methods approach was favoured for several reasons: a) to minimise participant burden in light of pressures on clinician's time; b) to capture the views of a greater number of staff than qualitative methods alone would allow; and c) research highlighting the need for triangulation of methods. A cross-sectional approach was most appropriate to gain a 'snapshot' of influencing factors at a particular point in time. Three methodologies were used concurrently (see Figure 8): a questionnaire; a group process approach called the Delphi Technique; and ward observations (see Table 3). The researcher used Critical Realist (Bhaskar, 2008) and Pragmatist (Johnson & Onwuegbuzie, 2004) epistemological standpoints to frame the study (Appendix E).

Figure 7 The mixed-methods design used (adapted from Bishop, 2015)



¹⁰ Mixed-methods research can be defined as 'research in which the investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study' (Teddle & Tashakkori, 2006, p.15)

Figure 8 Timeline of data collection and analysis for each strand

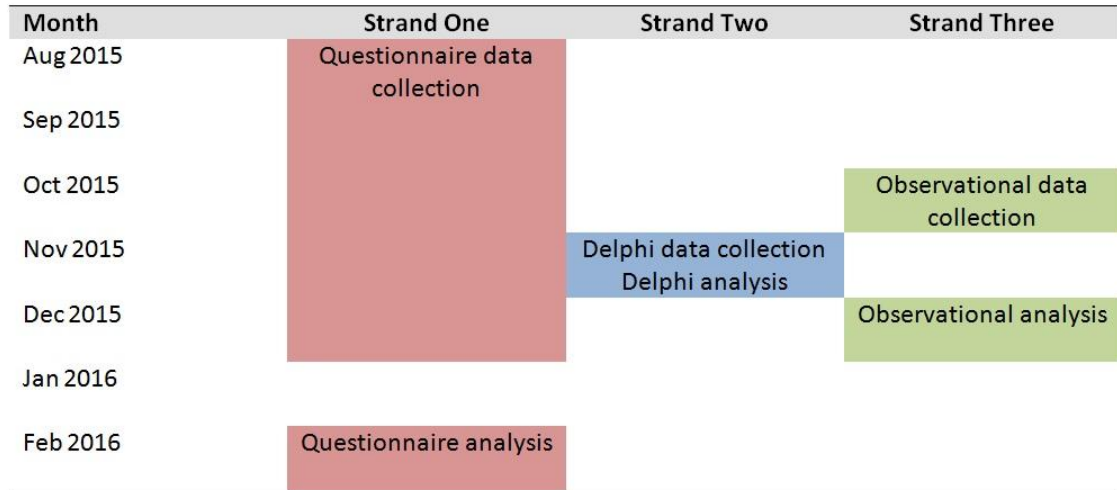


Figure footnote

Despite the concurrent mixed-methods design, note that data collection for the observational strand was conducted before analysis of other strands to minimise bias.

Table 3 Outline of the study's three strands

Method (Strand)	Type of information gathered	Sample	Aim	Analysis
Questionnaires (Strand One)	Quantitative	155 Critical Care nursing staff	To survey a large sample of nursing staff, in order to identify key factors influencing their HH.	Descriptive statistics: Item and domain averages.
Delphi (Strand Two)	Qualitative/ Quantitative	17 Critical Care nursing staff	To achieve consensus on what nursing staff perceive to be the key factors influencing their own, and colleague's, HH.	Descriptive statistics: Factor averages, SD, consensus and 'keyness' scores.
Observations (Strand Three)	Qualitative	All staff within one Critical Care Unit (across three shifts)	To gain a qualitative understanding of external factors (social and environmental) influencing staff's HH.	Inductive thematic analysis.

2.2 Setting

The study setting was the adult Critical Care¹¹ department of a large English NHS Trust. The Trust was chosen due to its links with the researcher's university. Critical Care was chosen as the setting for the study for three primary reasons: a) being widely recognised within the Trust and globally as having poor HH adherence (Pittet, Mourouga & Perneger, 1999); b) literature indicating that staff are presented with a greater number of HH opportunities per hour than non-Critical Care staff (Pittet, Mourouga & Perneger, 1999); and c) patients being more susceptible to infection due to their critical conditions (Osman & Askari, 2014).

2.3 Sample

Nursing staff working within adult Critical Care were chosen as the focus of the study. This was due to them making up the largest homogenous staff group within the Trust (N=395), having regular hands-on patient contact and thus being faced with a multitude of HH opportunities. Individual strands employed different sampling strategies. Upholding anonymity was deemed important to improve response validity. For this reason, and the project being classed as quality improvement, it was deemed unnecessary to obtain written consent from individual staff members. However, care was taken to ensure that clinical practice was not intruded upon and that where possible staff were well informed about the project's rationale and procedure.

2.4 Ethical approval

Prior to submission for ethical approval the project was reviewed by the researcher's university. Ethical approval was granted in March 2015 by the university. Trust approval was granted in June 2015 by the Trust's Clinical Audit, Standards and Effectiveness (CASE) Team¹² (Appendix F).

¹¹ Critical Care provides care to unstable or critically unwell patients. It is also sometimes referred to as Intensive Care Unit (ICU), Intensive Therapy Unit (ITU) and High Dependency Unit (HDU).

¹² The Trust's Research and Development team agreed that the project would be best positioned as quality improvement due to data collection lying within the remit of the infection prevention team, and thus final approval was granted by the CASE team.

3 Strand One - Questionnaires

3.1 Methodology

3.1.1 Strand aim

To quantitatively survey a large sample of nursing staff to identify key factors influencing their HH.

3.1.2 Sampling

Due to the questionnaire being analysed using descriptive statistics an *a priori* sample size was not deemed necessary. Sample size was instead based upon finding an appropriate balance between representativeness of the population and clinical feasibility. An arbitrary minimum figure of 100 participants was decided upon and a voluntary sampling approach used. All Critical Care nursing staff (N=387) were invited to take part via the Trust's email system as well as by education and practice development (EPD) sisters during training sessions. Participation was incentivised, with £100 being donated into the staff education fund upon completion of 100 questionnaires.

3.1.3 Measure

A questionnaire was used for its low participant burden and ease in gathering data from large samples. The Barriers and Levers for Hand Hygiene Instrument (BALHHI; Dyson *et al.* 2013; Appendix G) was chosen due to it currently being the only quantitative measure, based on the Theoretical Domains Framework, relating specifically to HH. The measure consists of 46 items, made up predominantly of seven-point Likert scales. The Likert scale items map onto 11 domains of the framework¹³. Barriers refer to factors inhibiting appropriate HH whereas levers refer to facilitating factors. A higher score for an item or domain indicates the presence of a barrier/absence of a lever, and a lower score indicates the presence of a lever/absence of a barrier. The measure is claimed to have good psychometric validity and reliability (Dyson *et al.* 2013), however closer inspection indicates considerable limitations (Appendix H).

¹³ Although the original model (Michie *et al.* 2005) identified 12 domains, the creators of the BALHHI found it appropriate to combine the domains 'Skills' and 'Knowledge'. Another domain, 'Nature of the Behaviour', was not included due to being deemed not to be '*...a determinant of behaviour but rather a set of characteristics that can be used to describe behaviour*' (Dyson *et al.* 2013, p.2). 'Behavioural Regulation' was replaced by the domain 'Action Planning' by later research. This change is not explicitly stated in the literature but a telephone conversation with one of the creators of the BALHHI revealed this to be the case.

3.1.4 Procedure

The questionnaire strand was the first to begin. This was to allow for a prolonged period of data collection in anticipation of a low initial response rate. A pilot was conducted but revealed no changes to be necessary. Paper surveys were disseminated within nurse training sessions. These were disseminated by EPD sisters and time allocated within the sessions to complete the questionnaires. A brief verbal explanation of the project was provided along with an information sheet (Appendix I). Participants were given opportunity to ask questions prior to deciding to take part. An email address was also included within participant information for any follow-up questions. Participants were informed that participation was voluntary.

An electronic version of the questionnaire was created using Survey Monkey (Appendix J) to capture the opinions of staff not attending training. This was disseminated to all Critical Care nursing staff via email (Appendix K). Participation was anonymous. The survey remained open for four months, with multiple reminder emails sent out to maximise response rate.

3.2 Analysis¹⁴

A total of 172 questionnaires were attempted. However only 155 were complete enough to be included for analysis (response rate: 40%). Respondents (n=155) consisted of 20 male (13%) and 130 female (84%) staff. Five staff (3%) did not state their sex. Respondents reported working within healthcare for between 1-40 years (mean=12, SD=9). The majority of respondents were qualified nurses (90.3%; see Table 4). The current sample was representative of the Trust's Critical Care nursing staff in regard to gender and qualification (see Table 5). Data were inputted into Microsoft Excel. Missing Likert values were substituted with the item median and domain medians¹⁵ calculated (see Table 6).

3.2.1.1 Excluded questionnaires

A total of 17 questionnaires were excluded from analysis: five had been completed by non-nursing staff, whilst 12 had over 50% of items missing. Excluded questionnaires were examined to determine any noticeable patterns to missing data, with none being found.

¹⁴ Data was not analysed until after the qualitative strand had been completed.

¹⁵ The median was used due to the ordinal nature of the data.

Table 4 Number of respondents broken down by job role

Job role		Number of Respondents (percentage of sample)
Unqualified	Including: <ul style="list-style-type: none"> Healthcare Assistants (Band 2/Band 3) Assistant Practitioners/Associate Practitioners (Band 3/Band 4) 	15 (9.7%)
Qualified	Including: <ul style="list-style-type: none"> Registered Nurses, Staff Nurses, Critical Care Nurses (usually Band 5) ECMO¹⁶ Nurses, Sisters, Deputy Sisters, Deputy Charge Nurses, Clinical Skills Supervisors, Clinical Placement Facilitators, Education and Practice Development Sisters, Senior Sisters, Specialist Nurses (Band 6/Band 7) 	140 (90.3%)

Table footnotes

¹⁰ExtraCorporeal Membrane Oxygenation (ECMO)

Table 5 Table to show the representativeness of the current sample against wider Critical Care staff

	Number of respondents as a percentage of current sample (n=155)	Number of staff as a percentage of overall staff within Critical Care (N=387)
Male	12.9%	12.7%
Female	83.9%	87.3%
Qualified staff	90.3%	87.9%
Unqualified staff	9.7%	12.1%

3.3 Findings

Calculation of the domain medians revealed no particular domains to stand out as obvious barriers to HH. Only one domain, 'Social Influences' (median=5), had an average score greater than the mid-way point on the Likert scale, highlighting this as a potential barrier. Two other domains, 'Memory, Attention and Decision Processes' and 'Environmental Context and Resources' had averages falling at the mid-way point of the Likert scale (median=4). The other seven domains had averages falling below the mid-way point (≤ 4), making these likely to be acting as levers.

3.3.1 Barriers

The domain 'Social Influences' was highlighted as the most likely to be hindering HH. One item in particular captured a strong feeling amongst staff (median=6) that they are not praised for good HH. The domain averages for both 'Environmental Context and Resources' and 'Memory, Attention and Decision Processes' fell at the mid-way point of the Likert scale (median=4). However the profiles of item averages were different for the two domains, with staff on the whole not responding strongly to items related to 'Environmental Context and Resources' whilst responding more strongly to those related to 'Memory, Attention and Decision Processes'. On one item related to 'Memory, Attention and Decision Processes', staff strongly agreed (median=6) that they often omit HH due simply to forgetting. With both of these domains having medians of 4, it seems that neither are considerably hindering or facilitating HH. However with both having room for improvement (i.e. potential for movement towards becoming a lever), it may prove useful to treat them as barriers and target them for intervention.

3.3.2 Levers

Domains identified as levers were: 1) 'Social/Professional Role and Identity'; 2) 'Motivation and Goals'; 3) 'Beliefs about Consequences'; 4) 'Knowledge and Skills'; 5) 'Emotion'; 6) 'Action Planning'; and 7) 'Beliefs about Capabilities' (Appendix L). Low scores on these domains indicate the presence of levers in relation to these seven domains that are already encouraging and facilitating HH. Therefore targeting intervention at these domains is unlikely to offer much improvement.

3.3.2.1 Test of knowledge questions

The BALHHI contains questions that directly test HH knowledge rather than simply gathering staff perceptions of their knowledge. On the whole, respondents displayed a good level of HH knowledge. What constitutes 'good' HH knowledge is open to debate. However, over 80% of respondents demonstrated an understanding of when it was appropriate to conduct HH, which procedure to follow when, and the idea that bacteria are spread most readily by hand contamination. These are arguably the key aspects of HH-related knowledge that staff need to be aware of in order to uphold good HH.

Table 6 BALHHI item and domain averages

Domain	Items related to domain (‘R’ indicates item has been reverse scored)	Item medians	Domain medians
Social Influences	<i>*14. When staff engage in HH they are praised</i>	6	5
	<i>22. I engage in HH because I do not want to let the team down</i>	2	
	<i>37. Supervision from senior staff means that carrying out HH is easier for me</i>	4	
	<i>39. My HH is encouraged by others</i>	3	
Environmental Context & Resources	<i>9. It is difficult for me to attend HH courses due to time pressure (R)</i>	4	4
	<i>20. Some government targets make HH more difficult (such as high bed occupancy) (R)</i>	4	
	<i>33. My environment is cluttered (R)</i>	4	
	<i>36. My area of work has poor staffing levels (R)</i>	4	
Memory, Attention & Decision Processes	<i>*11. Sometimes I miss out HH simply because I forget it (R)</i>	6	4
	<i>12. HH is not second nature to me (R)</i>	2	
	<i>15. I am more likely to forget HH if I am tired (R)</i>	4	
Beliefs about Capabilities	<i>17. There are some practical barriers to HH because of my particular job/role (R)</i>	2.5	3.25
	<i>24. I am reluctant to ask others to engage in HH (R)</i>	4	
	<i>25. The frequency of HH makes it difficult for me to carry it out as often as necessary (R)</i>	4	
	<i>27. I am confident in my ability to carry out HH</i>	1	
Action Planning	<i>7. Government targets have led to improvements in my HH</i>	3	3
	<i>28. Hospital targets relating to infection or HH have led to improvements in my HH</i>	2	
	<i>38. Some strategies designed to improve HH influence my practice</i>	3	
Emotion	<i>13. I feel angry if HH is not carried out by others</i>	2	2
	<i>29. I feel frustrated when others omit HH</i>	2	
	<i>34. I feel guilty if I omit HH</i>	2	
	<i>35. I feel ashamed if I omit HH</i>	2	
Knowledge & Skills	<i>16. HH training is available to me</i>	2	2
	<i>23. There are adverts or newsletters about HH in my workplace</i>	2	
	<i>31. HH guidelines are easily accessible</i>	1	

Domain	Items related to domain (‘R’ indicates item has been reverse scored)	Item medians	Domain medians
Beliefs about Consequences	18. <i>If I do not engage in HH I may catch an infection</i>	2	2
	21. <i>If I omitted HH I would blame myself for infections</i>	2	
	30. <i>If I engage in HH it improves patients’ confidence</i>	1	
	40. <i>If I miss out HH I will be subject to disciplinary action</i>	4	
Motivation & Goals	10. <i>I feel complacent about HH (R)</i>	2	2
	19. <i>I cannot be bothered with HH (R)</i>	1	
	26. <i>I disagree with some part of the HH guidelines (R)</i>	2	
Social/Professional Role & Identity	6. <i>I engage in HH out of respect for my patients</i>	1	1
	8. <i>HH is a non-negotiable part of my role</i>	1	
	32. <i>HH is part of my professional culture</i>	1	

Table footnotes

1. Higher average scores indicate the potential presence of a barrier; lower average scores indicate the potential presence of a lever
2. Displayed in order from highest to lowest domain average
- * Items scored as biggest barriers

Table 7 List of domains acting as barriers and levers

Barriers	Levers
Social Influences	Beliefs about Capabilities
Environmental Context & Resources	Action Planning
Memory, Attention & Decision Processes	Emotion
	Knowledge & Skills
	Beliefs about Consequences
	Motivation & Goals
	Social/Professional Role & Identity

3.4 Discussion

Three domains a) 'Social Influences'; b) 'Environmental Context and Resources'; and c) 'Memory, Attention and Decision Processes' were highlighted as potential barriers (see Table 7). Despite the presence of a large and representative sample, anonymity and protected time to complete the questionnaire, which increase the confidence that can be placed in these findings, considerable psychometric limitations reduce the validity of findings.

The following limitations are acknowledged. Firstly, there are considerable issues with the validity and reliability of the BALHHI which are evident when looking more generally at the BALHHI's face validity as well as when taking a more objective look at the measure's psychometrics (appendix H). One obvious concern, evident without reference to the psychometric data, was that the BALHHI measured respondent's agreement with items rather than how important they felt them to be. Although a tenuous argument could be made, based on Dyson *et al.*'s rigorous approach to generating the initial pool of questionnaire items, that the presence or absence of a factor is enough to infer its importance, this is not one that sits particularly comfortably. For some of the items this argument appears to hold whilst for others it appears more of a stretch. Another concern lies in the potential for debate around whether certain items are mapped onto the most appropriate domain. Some of the items are grouped under domains that do not appear to best capture what the item is measuring. For example, the item 'when staff engage in hand hygiene they are praised' was grouped under 'social influences' rather than the arguably more appropriate 'beliefs about consequences'. This is likely to prove problematic for the current study due to 'social influences' being identified as a key barrier, based largely on the high average score for this item relating to praise. Such issues are likely to be symptoms of the poor underlying psychometric properties of the questionnaire which are elaborated on in Appendix H. Further validation research is required and researchers are advised against using the BALHHI without triangulating it with other methods. Secondly, Dyson *et al.* (2013) neglected to provide prompts during the qualitative phase of the BALHHI's development. As such it is possible that the list of factors identified by staff was not comprehensive and important factors could have been overlooked during the BALHHI's development. Thirdly, it is not possible to know whether respondents completing the survey electronically answered the test of knowledge questions using their existing knowledge or by researching the answers whilst on the computer. It is therefore possible that staff knowledge was overestimated. Fourthly, as already mentioned, self-report methodologies are vulnerable to bias. However, it was hoped that the other strands of the project would compensate for

this. Finally, analysis involved some subjectivity, such as the decision about whether average domain scores indicated a domain to be important or not. However this subjectivity has been acknowledged as an inherent part of the process (French *et al.* 2012) and the rationale for decisions has been made explicit.

Although use of the BALHHI was justified by it currently being the only available HH-specific questionnaire based on the Theoretical Domains Framework, current findings must be carefully interpreted in light of considerable limitations.

4 Strand Two - Delphi

4.1 Methodology

4.1.1 Strand aim

To achieve consensus on what staff perceive as the key factors influencing their own and colleague's HH, whilst compensating for some of the limitations of questionnaire methodologies.

4.1.2 Sampling

Sample size was limited to 20 nurses due to the logistics of conducting a real-time Delphi, and Delphi's typically consisting of 15 to 30 participants (de Villiers *et al.* 2005). An opportunity sampling approach was used, with one of the Trust's EPD sisters approaching matrons to release a number of staff for training. Staff (n=17) were then invited to attend an infection prevention education session based on shift patterns on the day of the Delphi and staff training needs.

4.1.3 Method

The Delphi method is a group process aimed at helping a group of 'experts' reach consensus about a topic. It is based on the idea that 'pooled intelligence' offers a more valuable insight than individual judgement (Linstone & Turoff, 1975) and thus a group is consulted for their opinions. An expert is defined as '*...someone who possesses the relevant knowledge and experience, and whose opinions are respected by fellow workers in the field*' (de Villiers *et al.* 2005; p.640). Nursing staff were selected as experts on the basis of their everyday experiences of HH and their training in infection prevention. Unlike other group methodologies, for example focus groups, the Delphi upholds the anonymity of participants and thus minimises social desirability bias (Krumpal, 2013). A major strength of the technique is its iterative approach (Sourani & Sohail, 2015) in which participants are given opportunities to reconsider their initial responses in light of group feedback. This allows for a more balanced and well-thought out account than those obtained through single-round approaches.

'[The controlled interaction] appears to be more conducive to independent thought on the part of the experts and to aid them in the gradual formation of a considered opinion. Direct confrontation, on the other hand, all too often induces the hasty formulation of preconceived notions, an inclination to close one's mind to novel ideas, a tendency to defend a stand once taken, or, alternatively and sometimes alternately, a predisposition to be swayed by persuasively stated opinions of others.'

(Dalkey and Helmer, 1963; p.459)

4.1.4 Procedure and initial analysis

A real-time Delphi (de Villiers *et al.* 2005) was used due to concerns of participant attrition with a traditional email-based Delphi. Although a less commonly cited approach, it is possible to condense the traditional Delphi process to fit within a meeting by using mechanisms to immediately summarise responses. A pilot of the first round was carried out with the researcher's university peers. The Delphi was modified to fit within a four-hour session whilst retaining the Delphi's essential features. This allowed for data to be collected within one session rather than over several weeks or months. An education session was therefore organised within which the Delphi was embedded. The session was structured to allow the Delphi rounds to be interspersed with educational slots whilst rounds were analysed (Appendix M). Selected staff were expected to attend the session as part of their training requirements. A three-round Delphi was chosen to minimise respondent fatigue (Hallowell & Gambatese, 2010).

4.1.5 Round One

An outline of the session and wider quality improvement project was given verbally to staff. Staff were then asked the following question:

'What factors do you feel influence whether Critical Care nursing staff, where you work, follow the '5 moments for hand hygiene' guidelines in their daily clinical work?'

Staff were given 10 minutes to write their responses independently and anonymously (Appendix N). Participants were asked to comment on staff group behaviour rather than solely their own behaviour to reduce the influence of social desirability bias. Five minutes into the round, the group were presented with a list of possible influencing factors taken from the HH literature (Appendix O). Prompts were presented to compensate for limitations of self-report methodologies whereby people are not always aware of, or able to recall, all the factors

influencing their behaviour (Nisbett & Wilson, 1977). At the end of the 10 minutes, participants' responses were collected. Over the following 65 minutes, whilst teaching was delivered, the researcher and project supervisors set about summarising responses. The round was summarised using a simple thematic analysis, following steps recommended by Sourani and Sohail (2015). This involved the researcher reading each response and identifying preliminary factors. Face validity was then checked by project supervisors against the original data, before consolidating them into groups of related factors¹⁷. These related factors were then given an overarching name that encapsulated the related responses¹⁸. These names were inputted into Powerpoint to be fed back to the group at the beginning of Round Two.

4.1.6 Round Two

At the beginning of Round Two, participants were shown the table of factors identified by the group. Participants were then asked to independently and anonymously rate on Likert scales (Appendix P) how important they deemed each factor to be. The scales were anchored at opposing ends with the labels '*not at all important*' and '*extremely important*'. Participants were also invited to offer written comments on their choices as a way of influencing the group. Fifteen minutes were given for this round. At the end of the round participants' responses were collected. Over the following 35 minutes, whilst teaching was delivered, the mode was calculated for each factor. These were then inputted, along with legible participant comments lifted directly from response sheets, into the Powerpoint presentation to be fed back at the beginning of Round Three.

4.1.7 Round Three

Participants were again presented with anonymous group feedback - this time related to how important the group found each factor to be alongside comments about why the factor was rated so (Appendix Q). Participants were again asked to rate how important they now felt each factor to be. This provided the opportunity for participants to reconsider their initial responses in light of group feedback. Ten minutes were given for this round. Response sheets were collected for later analysis to determine the level of consensus for each factor.

¹⁷ One participant's responses were excluded due to making little sense. As it had been noted that one participant had arrived late it was assumed that these nonsensical responses had arisen from this participant not understanding what was being asked. All three researchers agreed to discard the responses.

¹⁸ Due to the time constraints posed by doing a real-time Delphi, factor names were not reworded following each iteration which is commonly done in traditional Delphis to ensure factor names accurately reflect participant's comments.

4.2 Analysis

4.2.1 Post-event analysis

After the session was complete, data were inputted into Excel for further analysis.

4.2.1.1 Consensus

Consensus can be determined using a measure of dispersion (Brody *et al.* 2014). The current project set both consensus and ‘keyness’ criteria *a priori*, as recommended by Diamond *et al.* (2014). The population standard deviation (SD) was calculated for importance ratings of each factor. The SD was chosen, over the interquartile range, due to its robustness. Consensus was said to have been reached if the SD for a particular item was calculated at ≤ 1 .

4.2.1.2 Determining key factors (‘keyness’)

As well as reaching consensus, the strand’s aim was to identify key factors influencing staff HH. A factor was deemed to be a key factor if $\geq 82\%$ ¹⁹ of participants rated a factor (that had already reached consensus) as a ‘6’ or ‘7’ (‘7’ being labelled ‘extremely important’).

¹⁹ This 82% threshold was a relatively arbitrary figure. Previous studies have used figures between 55% and 100% (Kilner, 2004, p.376), and due to wanting to inform a subsequent intervention the current study opted for a relatively high definition of consensus. An 82% threshold was used rather than the rounder figure of 80% due to needing to round up to the nearest whole person.

Table 8 Table showing all 20 identified factors and justification for selection of 'key' factors

Factor Number	Factor Name	Round 2 Mode	Round 2 Standard Deviation	Round 3 Mode	Round 3 Standard Deviation (* = consensus reached)	Number of participants rating factor as '6' or '7' (* = 82% 'keyness' threshold reached)	Key factor?
1	Busyness/workload	7	1.1	7	0.8*	16*	Yes
2	Other tasks/emergencies taking priority	7	0.8	7	0.4*	17*	Yes
3	Lack of HH resources	7	1.1	7	0.7*	15*	Yes
4	Peer behaviour	4	1.4	5	1.3	7	No
5	Challenging poor HH	5	1.1	7	1.1	11	No
6	Accessibility of HH resources	6	0.8	7	0.7*	15*	Yes
7	ITU layout/design	7	1.6	7	1.6	10	No
8	Motivation	6	1.5	7	1.2	11	No
9	Skin irritation	6	1.7	6	0.7*	14*	Yes
10	Lack of immediately obvious consequences	6	1.9	7	0.8*	13	No
11	Audit feedback	7	1.7	7	1.0*	12	No
12	Challenging the rationale for 5MHH	6	1.5	6	0.8*	12	No
13	Awareness of touching	7	1.4	7	0.8*	14*	Yes
14	Training/education	7	1.0	7	0.7*	15*	Yes
15	Obviousness of need for HH	7	1.5	7	0.7*	14*	Yes
16	Ease of HH	6	0.8	7	0.8*	14*	Yes
17	Understanding the appropriateness of different HH methods	7	1.3	7	0.9*	12	No
18	Knowledge of contamination	7	0.7	7	0.8*	13	No
19	HH becoming a habit	7	0.7	7	0.7*	15*	Yes
20	Understanding risk	7	0.8	7	0.7*	15*	Yes

4.3 Findings

Responses from Round One's open-ended question were organised around 20 factors and fed back to the group. Through the Delphi process, 11 of these factors were deemed 'key' factors (i.e. they reached both the consensus *and* $\geq 82\%$ importance threshold) (see Table 8). Descriptions of the factors were taken from responses given by participants. These 11 key factors were then mapped onto the Theoretical Domains Framework (see Table 9) by referring back to Cane, O'Conner and Michie (2012).

4.3.1 Environmental Context and Resources

Five of the 11 factors identified as 'key' fell under the domain of 'Environmental Context and Resources'. These five factors: 1) Busyness/workload; 2) Other tasks/emergencies taking priority; 3) Lack of HH resources; 4) Accessibility of HH resources; and 5) Ease of HH, appeared to capture a general feeling from staff that they are unable to uphold good HH because of factors outside their control. The comments underpinning these factors firmly attributed HH difficulties externally to the environment, facilities or situations in which they worked.

4.3.2 Memory, Attention and Decision Processes

Three of the 11 factors identified as 'key' fell under the domain of 'Memory, Attention and Decision Processes'. These three factors were: 1) Awareness of touching; 2) Obviousness of touching; and 3) HH becoming a habit. These factors appeared to capture staff perceptions of aspects of the 5MHH not being particularly intuitive or habitual and thus being easily forgotten. Again staff appeared to be attributing responsibility for their HH difficulties externally, to something inherently difficult about the act of carrying out HH. However, the factor 'awareness of touching' appeared to attribute responsibility internally to a lack of staff awareness.

4.3.3 Emotion

Only one of the 11 factors identified as 'key' fell under the domain of 'Emotion'. This factor captured reports of skin irritation which understandably deterred them from upholding high standards of HH. Such an experience is likely to serve to punish HH due to the associated negative sensations of pain, irritation and soreness.

4.3.4 Knowledge and Skills

Two of the 11 factors identified as 'key' fell under the domains of 'Knowledge and Skills'²⁰. These were 'Training/education' and 'Understanding of risk'.

²⁰ Despite being two distinct domains, Knowledge and Skills were combined here due to the two factors falling under these domains sharing considerable overlap.

Table 9 Factors identified as key (i.e. those reaching consensus and ‘keyness’ thresholds), related framework domains and factor descriptions

Key Factor <i>Related domain</i>	Factor description (compiled from participant responses during the Delphi)
1. Busyness/workload <i>Environmental Context & Resources</i>	This factor captured reports of: there being too little time, too few staff and too many tasks to juggle; staff experiencing a sense of time pressure; the 5MHH taking too long to follow rigorously; busyness making people forget; actual workload not being reflected by the number of patients; and HH being missed as staff rush to complete tasks.
2. Other tasks/emergencies taking priority <i>Environmental Context & Resources</i>	This factor captured reports of: appropriate HH being made difficult by urgent needs arising at very short notice, for example, providing CPR or a vomit bowl; staff having to act decisively and quickly and risk assess what is most important in that moment, for example keeping confused patients from harming themselves; and there subsequently not being enough time to wash hands.
3. Lack of HH resources <i>Environmental Context & Resources</i>	This factor captured reports of: there not being enough sinks; gels dispensers running out and not being replaced quickly enough; feeling unable to leave patients to obtain resources; there generally not being enough gel dispensers around unit; and the lack of resources making staff feel HH isn’t important.
4. Accessibility of HH resources <i>Environmental Context & Resources</i>	This factor captured reports of: the importance of resources and facilities being located close to beds so that staff don’t have to leave the patient area to carry out HH (as evidenced by staff reporting HH to be easier in side rooms where sinks are closer to beds); gels being easier to use than sinks due to gels being at the end of each bed; existing sinks not being fit for purpose, for example the water pressure being too high, the water too hot, presence of <i>Pseudomonas</i> bacteria, and soap and paper towels not always being present; and the importance of having quick and easy access to PPE and spare supplies.
5. Skin irritation <i>Emotion</i>	This factor captured reports of: staff’s hands becoming sore from carrying out HH; some staff having issues with their skin which makes them reluctant to carry out HH; staff disliking the sting of alcohol products on sore skin; and the need for alternative products for staff with sensitive skin.
6. Awareness of touching <i>Memory, Attention & Decision Processes</i>	This factor captured reports of: staff not always being aware of what they have touched or are about to touch, for example touching curtains and then the patient without realising the need for HH.

7. Training/education <i>Knowledge/Skills</i>	This factor captured reports of: not all staff having a good understanding of the 5MHH and their rationale; some staff questioning the rationale for some of the moments deemed impractical and unnecessary; e-learning and group discussion being helpful in improving knowledge of HH; the need for demonstration of appropriate HH, in particular ward-based demonstrations; the need for education/training to be frequent; and staff feeling that training puts HH at the front of their thinking.
8. Obviousness of need for HH <i>Memory, Attention & Decision Processes</i>	This factor captured reports of: some of the 5MHH being easier to identify in practice than others and thus being carried out more (e.g. inter-patient rather than intra-patient moments, and before an invasive procedure); and some of the 5MHH not necessarily being intuitive, for example why staff are expected to carry out HH after wearing gloves.
9. Ease of HH <i>Environmental Context & Resources</i>	This factor captured reports of: the importance of reducing the amount of time it takes to carry out HH in order to facilitate staff (e.g. gels being much easier to use due to there being less steps involved in the process, whilst having to 'hunt' for soap and paper towels makes HH inconvenient and less likely to be done).
10. HH becoming a habit <i>Memory, Attention & Decision Processes</i>	This factor captured reports of: the need for the 5MHH to become habitual to help staff in remembering.
11. Understanding risk <i>Knowledge/Skills</i>	This factor captured reports of: staff needing to have a greater understanding of the importance of HH and its protective function to both staff and patients; and there being uncertainty around what to prioritise in an emergency.

4.4 Discussion

Using the Delphi process, 11 of the initial 20 factors were found to be 'key' factors. These 11 factors fell within five of the framework's domains: 1) 'Environmental Context and Resources'; 2) 'Memory, Attention and Decision Processes'; 3) 'Emotion'; 4) 'Knowledge'; and 5) 'Skills', highlighting these domains as potential targets for intervention. Given the iterative approach and group feedback inherent in the Delphi process, findings reported here arguably hold more validity than a traditional single-round survey approach (Keeney, Hasson & McKenna, 2001).

The following limitations are acknowledged. Firstly, the consensus threshold used, although justifiable, was '*fundamentally an arbitrary cut-off*' (Diamond *et al.* 2014, p.405), as was the 82% 'keyness' cut-off. Some factors narrowly missed out on qualifying as key factors due to these cut-offs. Therefore one cannot confidently conclude that other factors are not also worthy of intervention. However, in light of limited NHS resources available to address HH, setting a relatively high cut-off point is arguably useful. Secondly, the decision to run only three rounds may have hindered more factors reaching consensus cut-offs. The decision was a deliberate one to reduce participant burden, work within time constraints, and as research shows that most change takes place in the first two rounds with little occurring after that (Gunhan & Ardit, 2005). It is likely therefore that with more rounds responses would have plateaued as participants disengaged. Thirdly, there is an implicit assumption made by consensus approaches that consensus is paramount and disagreement less useful. Just because there was not agreement on a particular factor does not necessarily mean it is of little importance. Finally, a reasonable short space of time was allocated to conduct the thematic analysis (65 minutes). Although no apologies are made for this, it is worth considering that given more time, a more thorough exploration of the data may have taken place. However certain validity checks were put in place, for example, having all three researchers involved in determining factors and the Delphi itself offering its own informal checks against researcher bias - as staff are able to disregard any factor as unimportant and hinder any irrelevant factor from becoming a key factor. In spite of these limitations the subjective nature of qualitative analysis is acknowledged and embraced as both a considerable strength and potential weakness of qualitative research.

5 Strand Three – Ward Observations

5.1 Methodology

5.1.1 Strand aim

Few Theoretical Domains Framework studies have utilised observational methods, settling instead for the limited, yet less burdensome, self-report option. This strand therefore aims to gain a qualitative understanding of external factors influencing staff HH, free from the constraints of self-report methodologies, and to apply the Theoretical Domains Framework *post hoc* to findings.

5.1.2 Sampling

An opportunity sampling approach was used. A matron was chosen at random from a list provided by the Trust's Human Resources department and contacted via email. The project was explained and informed consent for the observations obtained. An arbitrary decision was made to conduct the observations on the unit that the matron was overseeing at the time of the meeting. Although other strands had focused solely on nursing staff, this strand was more interested in the general ward environment and context meaning that the researcher would not be solely observing nursing staff. It was decided²¹ that three observation periods across three different shifts would provide a good impression of what external factors were influential.

5.1.3 Method

An inductive and qualitative observational approach was used to compensate for self-report bias. Inspiration for the approach came from ethnographic studies of healthcare settings (e.g. Dixon-Woods *et al.* 2012; Goodson & Vassar, 2011) which promote an open, flexible and curious approach to observational research. Although drawing on ideas from ethnographic studies, due to time constraints an ethnographic approach was not used. A qualitative approach was favoured over a more quantitative one (e.g. a time-sample behavioural checklist or functional behavioural analysis) to minimise observer effects and free the observer to be

²¹ These decisions were relatively arbitrary based on striking a balance between validity issues and feasibility of the project within time constraints.

curious about what was being observed. The use of a more checklist-type approach would risk being perceived as an audit and potentially increase observer effects.

5.1.4 Procedure

Three hours of ward observation were conducted, broken into three, one-hour periods (see Table 10). Observations took place on a 23-bedded Critical Care Unit during a weekday.

Table 10 Times and shifts covered by ward observations

Observation period	Time	Shift fallen within
1	09.30 - 10.30	'Early' (07.30 – 15.30)
2	16.00 – 17.00	'Late' (15.30 – 20.00)
3	21.00 – 22.00	'Night' (19.30 – 08.00)

The researcher moved freely around the ward (Appendix R) to minimise observer effects whilst ensuring a clear view of the unit. The researcher took care not to disturb clinical tasks. The researcher attempted to adopt a passive observer role, engaging only in minimal conversation when necessary. The researcher was not known on the ward prior to the observations.

Only the matron was aware of the true scope of the project. It was emphasised that it would be necessary that other staff not be told specifically what was being observed. If staff asked, a stock response was given that the researcher was *'interested in understanding the Critical Care culture and what it was like for staff to attempt to follow guidelines in such an environment'*. If further questions were asked, the researcher would politely explain that giving further details could invalidate the research and offer reassurance that they were not being audited and no identifying information was being collected.

The researcher made jotting notes in a pocket-sized notebook when appropriate. These shorthand reminders served to jog the researcher's memory during the write-up of expanded fieldnotes. The researcher aimed to balance making enough notes to ensure recollection at write-up, with causing as little disruption as possible to staff behaviour. Both jotting and fieldnotes aimed to describe predominantly what was visible on the ward. However the researcher also noted their impressions of, and responses to, what was seen. At the end of each observation period the researcher exited the unit to a nearby private room to write up

fieldnotes. The researcher took neither a purely salience-driven nor time-driven approach to making fieldnotes, aiming instead for a balance between the two. This meant that the researcher jotted down observations that appeared salient but also jotted things down regularly, even when little appeared to be happening.

5.2 Analysis²²

An inductive thematic analysis based on Braun and Clarke's (2006) guidelines was used to analyse fieldnotes (Appendix S and T).

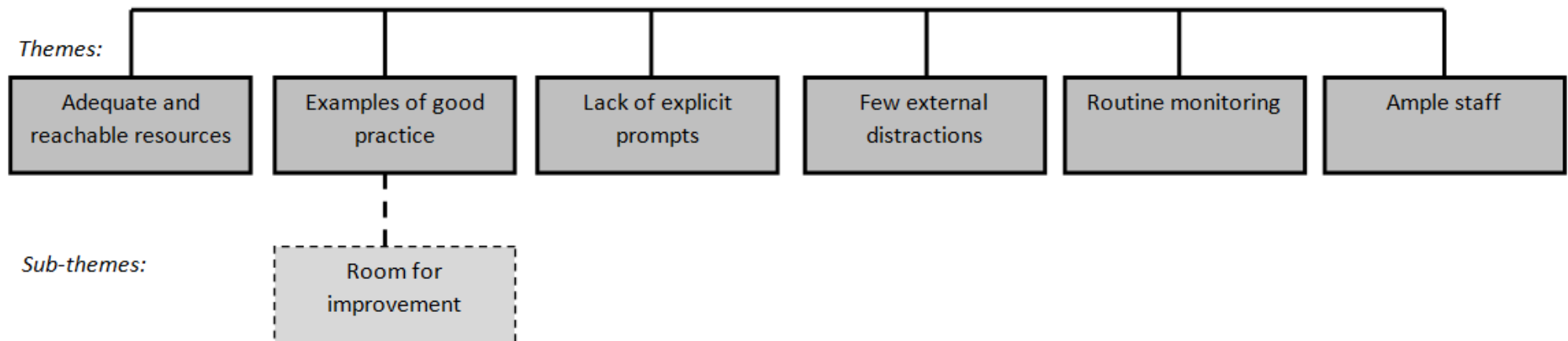
Template analysis not used due to this being better suited to larger data sets (Waring & Wainwright, 2008) whereby a wealth of data can ensure the creation and revision of a meaningful template. It was also hoped that taking a more open approach, rather than imposing a top-down template onto the data, would allow for a more exploratory investigation of staff behaviour (in line with the study's aims and overarching design), before the later *post hoc* application of the Theoretical Domains Framework. The decision was made against using the constant comparative method of thematic analysis (an iterative approach, commonly used in ethnographic healthcare studies, whereby existing data is reanalysed in light of new data) again due a small data set and all observational data being gathered in one day. The constant comparative method (Glaser & Strauss, 1967) lends itself more to traditional ethnography where the researcher spends much longer, for example several weeks or months, immersed in a particular setting.

Analysis of observational data took place before the other two strands to ensure an inductive approach to analysis. A standard thematic analysis was chosen over other qualitative approaches due to its flexibility, the focus of the study as well as the researcher's familiarity with the approach. Findings were displayed in a thematic map (see Figure 9).

²² Analysis should be seen as beginning during the observations themselves as observation is not a value-free activity.

5.3 Findings

Figure 9 Thematic map of themes and sub-themes



5.3.1 Theme #1: Ample staff

This theme reflected the seemingly ample number of staff present on the ward during the observation periods. Staffing levels appeared adequate, as evidenced by the researcher's subjective impression as well as more objective sources. These sources included: observation of a staff member being given the option of taking annual leave due to a surplus of staff, comments from clerical staff about the surplus of staff on that day, and reference to the staff-to-patient ratio, as found on the ward wipe board. During each observation there was at least one member of staff to each patient. The researcher also observed two staff tending to one patient on numerous occasions indicating there being enough staff to allow for this. It was also noted that staff were not always engaged in work-related tasks, for example, one staff member was observed using her mobile phone, staff were observed taking breaks in the staff room and several staff members were seen engaging in a relaxed conversation about non-work related topics.

5.3.2 Theme #2: Routine monitoring

This theme captured codes relating to the lack of stimulation and excitement on the ward. The researcher noted a surprising quiet and calmness on the ward across the three shifts. The researcher noted that the ward *'had quite a peaceful feel to it'*²³ (period 2) with the *'routine, rhythmic beeps of monitoring machinery'* (period 1). During the three hours, two occasions were noted where staff attention was drawn to a pressing need, once for a sounding machine alarm and another time in response to staff being informed that a patient had been incontinent. The researcher did not get the general impression that staff were having to repeatedly respond to changing demands and being interrupted by new and pressing tasks. Several codes referred to the routine nature of the tasks being carried out, with the majority of visible tasks seemingly related to monitoring patients and recording information.

5.3.3 Theme #3: Few external distractions

This theme referred to a lack of external distractions (i.e. interpersonal and environmental factors) on the ward. As mentioned previously, the general ward atmosphere appeared surprisingly calm and lacking in drama. However the researcher did note *some* external distractions, for example, a machine alarm, a staff member talking loudly on the phone, the presence of visitors and the occasional change in priority arising from expressed patient needs.

²³ More supporting extracts can be found in Appendix V.

Despite this, the researcher's general impression was that the majority of external noise was routine and that external distractions were likely to be having little, if any, impact on hand hygiene.

5.3.4 Theme #4: Lack of explicit prompts

This theme reflected codes focusing on a lack of verbal and visual HH-cues. The exception seemed to be the presence of a small sticker above some of the wall-based sanitiser dispensers with the phrase '*1 – before patient contact*' written on it. The prompt was obviously intended to remind staff of the 5MHH, although the researcher observed no stickers prompting sanitizer use in relation to the other four moments for HH, despite intentionally looking for them. The researcher also did not see any examples of posters or notices relating to HH, nor any episodes of staff prompting each other to carry out HH. It is possible however that these happened behind bedside curtains, out of sight of the researcher.

5.3.5 Theme #5: Examples of good practice

Sub-theme: Room for improvement

This theme reflected codes related to good and/or cautious HH, whilst acknowledging room for improvement. The researcher witnessed numerous episodes of good HH. There were examples of staff not only carrying out HH at times where it could be deemed more obviously required (i.e. before and after patient contact and aseptic procedures), but also at arguably less obvious times. For example, staff were seen carrying out appropriate HH in between care tasks on the same patient, carrying out appropriate HH after only having touched patient notes, and staff seemingly being aware that the use of personal protective equipment (PPE) does not negate the need for HH. There was also an example of staff seemingly being aware that equipment may harbour bacteria. The researcher coded several extracts of fieldnotes for 'over cautious HH' and 'unclear donning of PPE' where it was unclear why these acts had been done. However this is undoubtedly preferable to the alternative scenario of not doing so when clearly required. There were also examples of missed HH opportunities, as captured by the sub-theme 'room for improvement'.

5.3.6 Theme #6 Adequate and reachable resources

A number of codes reflected the presence of adequate HH resources and their reasonable proximity to where care tasks were carried out. The researcher noted two sinks on each side of the ward, positioned at each end, as well as one in each of the side rooms. The researcher

estimated that when delivering patient care, staff were unlikely to be any further than six metres from a sink. Sinks appeared well stocked, with soaps, sanitising gel and moisturiser above each one, as well as automatic taps. The researcher noted several wall mounted sanitiser dispensers that could be easily accessed, and each bed having its own dispenser positioned at the end of it. Staff were observed wearing gloves at various points, with some staff using numerous pairs within a short space of time. There appeared to be no lack of HH resources, facilities or gloves.

5.3.7 Framework domains represented

There appeared to be more themes/sub-themes capturing factors associated with levers to HH (e.g. 'ample staff', 'few external distractions', 'examples of good practice', 'adequate and reachable resources', 'routine monitoring') than barriers (e.g. 'room for improvement', 'lack of explicit prompts'). Themes were mapped onto the Theoretical Domains Framework, by referring to Cane, O'Connor and Michie's (2012). The only theme observed as a potential barrier to good HH: 'lack of explicit prompts'²⁴, fell under 'memory, attention and decision processes' domain, indicating this as an important domain for potential interventions

²⁴ 'Room for improvement' here is not viewed as a specific barrier but rather a theme capturing a general sense of improvement still being needed in spite of existing good HH.

5.4 Discussion

Six themes and one sub-theme were felt to best organise the 85 codes arising from the observations (see Table 11).

Table 11 List of themes and sub-themes arising from thematic analysis

Themes	Sub-themes
Ample staff	Room for improvement
Routine monitoring*	
Few external distractions*	
Lack of explicit prompts*	
Examples of good practice	
Adequate and reachable resources	

Table footnote

*Themes/sub-themes relating to the domain 'Memory, Attention & Decision Processes'.

The current findings are felt to capture a more accurate portrayal of influencing factors than self-report methodologies due to bypassing the influence of self-report biases. The impartiality of the observer, observations spanning three different shifts, the inclusion of a validity check of the codes against the original data, and the partially disguised rationale for observations, increase confidence that can be placed in the findings.

The following limitations are acknowledged. Firstly, the non-random approach to deciding which ward to observe could have introduced bias, with the matron potentially selecting a ward with better HH. However with the researcher making sure to emphasise ward anonymity and the focus on understanding rather than auditing, it is perhaps unlikely that the matron felt this necessary. Secondly, only three hours of observation was conducted and all three observations took place on the same ward within the same day, thus limiting generalisability. Thirdly, observational methods only allow the investigation of observable (i.e. external) factors and as such the themes and sub-theme identified should not be viewed as an exhaustive list. This also means that internal factors identified by the first two strands are not necessarily verifiable by the observational strand. Fourthly, the researcher's view was obstructed on numerous occasions by curtains being drawn around bays. This was presumably for privacy but meant that few invasive procedures were observed, making it unclear what factors were

impacting on staff at these times. Finally, there is the possibility of observer effects leading staff to behave differently than normal.

It is up for debate whether the researcher's 'outsider' status (i.e. not being a member of Trust staff) was a weakness or strength of the observational strand. Being unfamiliar with the environment and culture of the ward allowed the researcher to be curious about what was or was not occurring on the ward, noticing things perhaps taken for granted by those familiar with the setting (i.e. having a 'fresh pair of eyes'). Alternatively it could be argued that such an 'outsider' is naive to what is going on and risks interpreting things out of context. Future research may benefit from observations being conducted by two researchers; one 'insider' (a member of the Trust) and one 'outsider' to allow discussion and clarification about what was observed.

Some may argue that the subjective nature of qualitative research is itself a considerable limitation. However qualitative research, underpinned by a Relativist ontological position, embraces the individual and subjective nature of all perception and subsequently all research. In spite of this, qualitative research should still attempt to achieve high standards of rigor and take a reflexive approach to highlight potential sources of bias (Drummond, 2010). The researcher was aware of carrying certain assumptions into the observations, such as expecting the ward to be understaffed and the environment to be chaotic. Taking a reflexive approach allowed the researcher to notice his surprise at the seeming abundance of staff and calm ward environment. That these two assumptions appeared to hold little validity, with their opposites being captured by two themes, indicated that the researcher was taking an open-minded approach.

Table 12 Key points, main findings and limitations of each strand

	Strand One – Questionnaires	Strand Two – Delphi	Strand Three – Ward Observations
Main findings	<p>155 questionnaires completed (RR=40%). Analysis: descriptive statistics. No domains stood out clearly as barriers. Two items were highlighted as specific item-level barriers: a) Forgetting to carry out HH and b) a lack of praise for good HH. Seven domains appeared to be acting as levers to HH.</p> <p>Three domains were highlighted as potential barriers to staff HH: 1. Social Influences 2. Environmental Context & Resources 3. Memory, Attention & Decision Processes</p>	<p>17 participants. Analysis: thematic analysis and descriptive statistics. Consensus and ‘keyness’ criteria were reached for 11 factors, highlighting them as key factors:</p> <ul style="list-style-type: none"> • Busyness/workload • Other tasks/emergencies taking priority • Lack of HH resources • Accessibility of HH resources • Skin irritation • Awareness of touching • Training/education • Obviousness of need for HH • Ease of HH • HH becoming a habit • Understanding risk <p>Factors fell under five domains, highlighting these domains as potential targets for intervention:</p> <ul style="list-style-type: none"> • Environmental Context & Resources • Memory, Attention & Decision Processes • Emotion • Knowledge • Skills 	<p>Three hours of observations completed. Analysis: fieldnotes and thematic analysis. Six themes and one sub-theme were deemed to best organise the data:</p> <ul style="list-style-type: none"> • Ample staff • Routine monitoring • Few external distractions • Lack of explicit prompts Examples of good practice (sub-theme: Room for improvement) • Adequate and reachable resources <p>Themes relating to barriers to HH fell under one domain, highlighting ‘Memory, Attention and Decision Processes’ as an important domain to target with interventions.</p>
Limitations	<p>Arbitrary cut-offs for determining barriers. Measuring agreement rather than importance. BALHHI may not cover a comprehensive range of factors due to the lack of prompts used by Dyson <i>et al.</i> (2013) during their Delphi. Considerable psychometric limitations. Potential for cheating on knowledge testing questions which may have led to an overestimation of staff HH knowledge. Vulnerability to self-report bias.</p>	<p>Arbitrary consensus cut-off point. Only three rounds used. Implicit assumption around value of consensus. Short time given to Round One analysis due to time constraints. Limited generalisability of findings.</p>	<p>Non-random sampling approach. Limited periods of observation. Restricted view of invasive procedures. Only able to capture external factors. Possible observer effects. Limited generalisability of findings.</p>

6 General Discussion

6.1 Summary of main findings

The current study aimed to use a theory-informed, mixed-methods approach to answer the question ‘what are the key factors influencing Critical Care nursing staff’s adherence to the 5MHH guidelines?’ Findings identified a variety of influential factors (see Table 12) which were then organised post hoc around the Theoretical Domains Framework to clarify key domains for intervention. All three strands highlighted the domain of ‘Memory, Attention and Decision Processes’ as key. The ‘Environmental Context and Resources’ domain was highlighted only by self-report strands. Other domains were also highlighted but not corroborated across strands.

6.2 Discrepancies between strands

There were some clear discrepancies across the three strands. Firstly, despite ‘Social Influences’ being highlighted by the questionnaire, it was not by the other two strands. A closer examination of questionnaire items provided explanation. One of the domain items (*‘when staff engage in hand hygiene they are praised’*) seemed to be exerting a considerable influence on the domain’s overall average score. Removing this item, which is arguably more about consequences than social influences anyway, lowered the domain average to a score falling below that which would be regarded a barrier. We can therefore conclude that ‘Social Influences’ were highlighted due to validity issues with the questionnaire.

Secondly, ‘Knowledge and Skills’ were only highlighted by the Delphi. Closer inspection of the questionnaire revealed that items making up this domain focused solely on whether information and training were available and accessible. Delphi responses however seemed to capture a desire amongst staff for training and education that: acknowledged clinical dilemmas; facilitated a better understanding of, and gave space to discuss, the rationale for some of the less intuitive of the 5MHH; and provided practical demonstrations of appropriate HH in different clinical situations. It is this kind of *applied* knowledge that staff appeared to want, and that was not detectable by our questionnaire. This finding is supported by Kaur *et al.* (2015) who found practical exercises to be considered the most useful and desired teaching approach amongst medical school educators. Although the test of knowledge questions included in the BALHHI indicated a good level of HH-related knowledge, such questions fail to capture the complexity of clinical work where competing demands can be present. Current

findings may overestimate staff's HH-related knowledge and underestimate difficulties in applying this knowledge to practice.

Thirdly, 'Emotion' was also only highlighted by the Delphi. This domain contained only one factor, skin irritation caused by HH. This was supported by de Wandel *et al.* (2010) who also found staff to report skin irritation as a barrier to HH. That 'Emotion' was not highlighted by the questionnaire or observational strands was perhaps unsurprising in light of the BALHHI containing no items related to skin irritation, and skin irritation being unobservable.

6.3 'Memory, Attention and Decision Processes'

'Memory, Attention and Decision Processes' were reported as influential across all three strands. This domain has been defined as *'the ability [of staff] to retain information, focus selectively on aspects of the environment and choose between two or more alternatives'* (Cane, O'Conner & Michie, 2014, p.14) and consists of the constructs: memory, attention, attention control, decision making and cognitive overload/tiredness.

Despite a large number of influencing factors being reported by staff (Pittet, 2001), forgetting doesn't appear too frequently in the HH literature.²⁵ What seems to appear more often is staff busyness and patient needs taking priority. Although not necessarily directly related to 'Memory, Attention and Decision Processes' these factors may influence staff towards implicit decisions of how to ration their limited cognitive resources and time (as previously noted by Schubert *et al.* 2013) and decisions to adopt suboptimal practice in attempts to balance risk with available resources (Shah *et al.* 2015). Questionable support for the impact of 'Memory, Attention and Decision Processes' can be found in Fuller *et al.* (2014). They found that the majority (42%) of reasons given by staff for their non-adherence, when organised using the Theoretical Domains Framework fell under 'Memory, Attention and Decision Processes'. 'Environmental Context and Resources' was highlighted as the third most relevant domain (after 'Knowledge' and 'Memory, Attention and Decision Processes') with 9% of reasons falling into this domain. However the methods employed involved observing HH behaviour before immediately following up episodes of non-adherence by questioning the staff member. With no attempts made to control for social desirability bias and the researchers being senior

²⁵ Although the WHO (2009) report numerous studies having found 'not thinking about it/forgetting' as reasons given for non-compliance, reference to the original studies revealed only one of these contained original data supporting forgetting as an issue.

members of staff, there is reason to doubt the findings. More robust support for the influence of 'Memory, Attention and Decision Processes' was found by Khatib *et al.* (1999) with HH significantly improving over four weeks as a result of visual prompts being placed on machinery.

It is somewhat difficult and unhelpful to draw meaningful comparisons between the current study and existing findings due to so much of the existing literature neglecting to account for self-report bias. However in light of methods being employed across the three strands of the current study to reduce bias (e.g. observation; participant anonymity; asking participants to comment on collective behaviour during the Delphi rather than simply their own; and exposing participants to a list of possible influences on their behaviour during the Delphi), staff highlighting this domain as a barrier, and observations revealing a lack of prompts and reminders on the ward, it appears a logical choice for intervention.

6.4 'Environmental Context and Resources'

'Environmental Context and Resources' were reported as influential within the Delphi and questionnaire strands. This domain has been defined as *'any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour'* (Cane, O'Conner & Michie, 2014, p.14) and consists of the constructs: environmental stressors, resources/material resources, organisational culture/climate, salient events/critical incidents, person and environment interaction, barriers and facilitators.

This finding is supported by a number of existing observational and self-report findings that indicate an inverse relationship between adherence and environmental constraints, in particular high staff workload, unit activity and high patient-to-staff ratio (O'Boyle, Campbell & Henry *et al.* 1994; Shah *et al.* 2015; Pittet *et al.* 2004; Arenas *et al.* 2005; Pittet, Mourouga & Perneger, 1999; O'Boyle, Henly & Larson, 2001). However one cannot conclude that these factors were an issue within the participating Trust due to resources and constraints varying between Trusts and between departments within Trusts.

Despite our Delphi showing strong support for this domain our observational data did not, and questionnaire data were not hugely convincing. Although questionnaire data highlighted the domain as key, staff did not appear to feel particularly strongly about the domain, with the

average score across related items falling at the mid-point of the Likert scale. This reduces the confidence that can be placed in this as a key domain.

There are a number of possible explanations for this discrepancy between our self-report and observational findings. Firstly, our observations may not have been representative of the ward environment at other times. This was eluded to by clerical staff during the first observational period who described fluctuations in staffing levels resulting from emergencies. Pittet *et al.* (2003) also described workload increasing rapidly when several patients are admitted simultaneously. However clerical staff did not seem to be strongly emphasising that what was observed was unrepresentative and in regard to the questionnaire, staff did not tend to rate items relating to the domain particularly highly. This may indicate that our observations were reasonably representative.

Secondly, even if the observations were representative and the unit atmosphere was generally calm, self-report data could have been detecting the salience of situations where staff felt overwhelmed by demands or restricted by a lack of resources. Even if these events are uncommon they may have had a significant enough impact on staff to ensure their recollection.

Thirdly, the discrepancy could be explained in terms of self-report biases. Existing observational research has revealed the patient-to-staff ratio to have no significant effect on adherence (Buffet-Bataillon *et al.* 2010). However, in light of the aforementioned attempts to control for bias and that staff reported both internal and external factors as influencing behaviour (rather than simply placing responsibility externally), we can perhaps conclude that self-serving bias was not a confounding factor in the current study.

Fourthly, it is possible that staff's experience of working within Critical Care simply differs from the researcher's perspective, despite the researcher attempting to immerse himself in the setting. The experience of working within a setting, with the responsibility and demands it brings, is likely to differ considerably from that of an external observer. Therefore it is potentially unsurprising that staff could perceive environmental constraints that the researcher did not. The theory of planned behaviour (Ajzen, 1991) would perhaps frame this discrepancy in terms of *perceived* behavioural control and *actual* behavioural control. In the current study it is possible that staff perceived themselves to lack behavioural control due to

perceived environmental constraints, whilst actually, more objectively, having quite a lot of behavioural control. Despite the inherent difficulty in bringing together subjective and more objective perspectives, both are necessary and need to be heard, to more fully understand behaviour.

6.5 Links between the two domains

It is possible that the two domains highlighted in the current study were in fact linked. Perceived busyness and lack of time, related to having to carry out a large number of tasks, could underpin reported difficulties with memory, attention and decision making. This link was supported by the Delphi, with reports of busyness making staff forget, HH being missed as staff rush to complete tasks, and actual workload not necessarily being reflected by the number of patients.

Previous studies have indicated a link between the two domains. Ashraf *et al.* (2010) found that a considerable proportion of their sample of 1143 care home staff, reported 'sometimes to always' forgetting to carry out HH because they felt too busy. Picheansathian *et al.* (2008) found perceived lack of time, forgetfulness and having too many concurrent functions to be commonly reported reasons for non-adherence. However, this link is perhaps more confusing within the current study due to observational data not highlighting environmental constraints.

It is plausible that the issue is more to do with an internal busyness (i.e. having too many things to think about concurrently) arising from the nature of the job, rather than an externally visible busyness. Caring for critically ill patients, where mistakes or forgetting something could have serious consequences, is likely to add to the cognitive load staff report. In light of this possible internal busyness it would follow that HH is seen as another task to add to an already lengthy list. The lack of observed environmental constraints and the suggested interplay between both domains, indicate the importance of addressing 'Memory, Attention and Decision Processes'. Doing so could have knock-on effects for perceived environmental constraints. If staff could uphold good HH with minimal cognitive effort, the time pressure they report experiencing would perhaps lessen.

Within the Delphi, staff also identified some HH opportunities as being more intuitive than others and thus more easily remembered. This idea has been eluded to by Whitby, McLaws and Ross (2006) who conceptualised HH as being composed of 'two distinct behavioural

practices' (p.484): 'inherent' and 'elective' HH. Inherent HH refers to that carried out when hands are visibly dirty, feel sticky or have been somewhere deemed to be unclean, whereas elective HH refers to all other potential HH opportunities. Several comments during the Delphi highlighted staff's perception that HH was '*always* remembered' before a clean/aseptic procedure and after exposure to bodily fluid but not necessarily before touching a patient or after touching patient surroundings. Although on face value this appears to fit with the inherent/elective distinction that HH is carried out more readily when obviously required, hands would not necessarily be visibly dirty or sticky before conducting a clean/aseptic procedure and yet staff reported intuitively remembering to conduct HH at this point. It is therefore possible that HH is driven less by whether hands are felt to be unclean but more by staff's perceptions of a stronger or more intuitive rationale for performing HH, for example, when performing invasive care tasks and the risk of bacterial transmission is more obvious. Intuition does not necessarily refer to an innate sense of 'clean' and 'dirty' but a sense learnt through experience. Therefore whether particular aspects of HH are perceived as intuitive or not is potentially open to change.

6.6 Strengths and limitations

6.6.1 A theory-driven approach

The current study adds to the HH literature by taking a theory-informed approach to understanding HH behaviour. Much of the existing literature has neglected psychological theory despite its known usefulness. The current study has been informed by theory at multiple stages. Firstly, understanding of psychological theory underpinned our critique of self-report methodologies. Secondly, the use of a theory-informed questionnaire (albeit a flawed one) and the presentation of theory-informed prompts during the Delphi, promoted comprehensive coverage of possible factors. Finally, a theoretical framework was applied to findings during analysis to organise them and highlight domains for intervention. Despite claims that the Theoretical Domains Framework makes theory more useable for researchers, the existing inconsistencies around how many domains make up the framework, although understandable in light of the framework's infancy, do not facilitate its use. Another issue was the apparent overlap between domains, with it not always being clear which domain certain factors fell within. This added an element of subjectivity to the process. The above criticisms have been previously reported by Phillips *et al.* (2015).

6.6.2 A mixed-methods approach

The current research also adds to the HH literature by using a mixed-methods approach to investigate HH behaviour, integrating both self-report and observational perspectives. Single-method approaches can be misleading whilst viewing a phenomenon from multiple angles allows for a fuller understanding. We argue that the triangulation of methods is essential in clarifying understanding. In the current study, different strands were able to corroborate findings, for example to ascertain that the two key domains were unlikely to have resulted from self-report bias.

When attempting to off-set limitations using mixed-methods, one is faced with the question of ‘when is enough, enough?’. There is the risk of spreading a study too thinly across multiple strands and ending up with a selection of weak findings. The key issue is whether ‘...*the end product is more than the sum of the individual quantitative and qualitative parts*’ (Bryman, 2007, p.8). We believe the current findings to be, and feel that our approach has allowed for the integration and greater exploration of findings. However, our observational strand arguably lacked robustness and was perhaps stretched too thinly. Although justifiable in light of researcher time constraints, the validity of the current findings would undoubtedly have been strengthened by carrying out more observations. At what point a mixed-methods approach is deemed to have stretched itself too thinly is subjective, but should be carefully considered prior to data collection.

The potentially more time-consuming nature of mixed-methods research needs acknowledging. However it could be argued that there is little benefit in saving time only to produce weak findings. Also it is not possible for all factors to be corroborated by observation as some factors are not observable.

6.7 Clinical implications

Ideally, intervention designers should conduct their own behavioural analysis within their own particular context, as hospitals are known to have different ‘safety climates’ and resources (Jimmieson *et al.* 2016), and are thus likely to be influenced by different factors. However if this is not feasible, designers should ensure that they draw upon good quality, mixed-methods, theory-informed research to make decisions.

Current findings suggest that interventions should prioritise addressing 'Memory, Attention and Decision Processes', and include elements aimed at facilitating staff to: a) remember to carry out HH; b) remain attentive to what they are touching; and c) make well-informed choices about what to prioritise in the midst of multiple demands. Finding ways of reducing staff's perceived busyness also appears important. Facilitating HH to become more intuitive and habitual may reduce the cognitive load that HH, and other care-related tasks, place upon staff, and subsequently reduce staff's sense of busyness.

Michie, Atkins and West (2014) recommend the *APEASE* criteria for deciding upon interventions. These are: 1) Affordability, 2) Practicability, 3) Effectiveness and cost-effectiveness, 4) Acceptability, 5) Side-effects/Safety, and 6) Equity. Despite not being highlighted across all three strands, the fit of two individual factors - skin irritation and a lack of applied knowledge - with these criteria arguably make them worthwhile addressing as a matter of routine. In the words of Dixon-Woods *et al.* (2013), '*not all innovations need to be grand and over-arching: fixing (apparently) small problems may result in major gains*' (p.9).

Raising awareness of what actually causes skin irritation and the availability of products for sensitive skin, as well as facilitating discussion around clinical dilemmas and the rationale of the 5MHH, could all be done within pre-existing training and thus prove easy and cost-effective to implement. There also seems to be a need for experiential, multiple-demand exercises within HH training which mimic the clinical setting and prepare staff for the realities of upholding good HH amidst competing demands.

Due to its use of a multi-method, theory-driven approach, the current study is arguably in a better position to offer recommendations for intervention than many of the existing single-method, theory-free studies. Despite clear methodological limitations, the current study goes beyond the simplistic claims that sometimes surround HH that staff simply need more education, feedback and motivation in order to become more compliant. The multi-method approach has allowed for a balance to be found between breadth and depth of investigation and some of the more subtle nuances of HH behaviour to be highlighted. As a result the current recommendations are likely to allow intervention designers to move beyond using a 'scattergun approach' (p.43) towards addressing only relevant factors.

For interventions to be effective they must be aimed across all levels (individual, interpersonal and organisational) of the hospital system (Larson & Kretzer, 1995). For example, teaching mnemonics to aid memory, developing team cultures where peer-prompting is welcomed, and ensuring organisational commitment to releasing staff to attend reflective discussion groups around challenges to good HH. Responsibility for upholding good HH cannot fall solely on individuals.

6.8 Research implications

The current study serves as a far-from-perfect example of what a more valid approach to HH research could look like, and has demonstrated the utility of mixed-methods to account for bias. It is hoped that future research will follow suit to begin to clarify the body of HH literature.

6.8.1 Recommendations for future research

Future research would benefit from: a) utilising qualitative forms of observation alongside self-report and quantitative observation; b) ensuring that observations are representative of the typical ward environment; c) developing innovative ways of observing practice behind bay curtains; d) further validating the BALHHI questionnaire or creating a more robust measure; e) conducting mixed-methods research using the theory of planned behaviour to investigate the relationship between staff's perceptions of busyness and more objective perspectives; and f) developing interventions to address 'Memory, Attention and Decision Processes', as existing interventions have focused predominantly on improving education, feedback and resources (Gould *et al.* 2010).

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Part 3: Critical Appraisal

1 Introduction

This section presents my reflections on the process of designing and conducting the research, considers limitations of the project and highlights key learning points. Reflection was facilitated by a research diary kept throughout the course of the research process²⁶.

2 Choosing a research topic

I had given little thought to potential research topics prior to commencing the DClinPsy. My undergraduate experience of research had not been a particularly enjoyable one and I think I came to my postgraduate research somewhat jaded by the experience. The combination of clashing with my supervisor and my study not reaching power had left my recollection of conducting research shrouded by frustration and disappointment, and as a result I was not keen to embark upon another research project. I realised early on in the research process that I was not particularly adept at tolerating the abstract nature and uncertainty involved in generating research ideas. I remember wanting someone to tell me what to do, to point me in the right direction so that I could get to work; the sea of potential research ideas felt vast. These factors most likely influenced my decision to look for a 'pre-packaged' research idea (i.e. an idea that someone else had identified as worthwhile) and to prioritise the supervisory relationship above my inherent interest in the topic.

A research fair, hosted by the university, provided my opportunity and I responded to a proposal from a local consultant microbiologist asking for help in '*identifying and understanding psychological and behavioural factors influencing staff hand hygiene compliance*'. Although I must admit that the topic of hand hygiene did not particularly excite me, seeking to understand staff behaviour held more appeal. Through his own extensive clinical experience and review of the literature, the consultant explained that hand hygiene adherence was suboptimal, both nationally and locally, and requested help to understand why. My own scoping review of the literature confirmed this to be the case and revealed that much of the existing research relied heavily on single-method approaches, in particular self-report methods - known to hold questionable validity (Armitage & Conner, 2001) - and made little reference to guiding theory (Edwards *et al.* 2012).

²⁶ For a table of research chronology see Appendix X.

Further conversations with supervisors and the infection prevention team, shadowing a nurse who was conducting hand hygiene audits, and continued reviewing of the literature helped focus my research question. The decision was made to focus on nursing staff as they represented the largest homogenous staff group working within healthcare settings and research indicated that professional groups differ in their adherence to HH guidelines (WHO, 2009). Therefore focusing on one profession would likely enhance internal validity. The decision to focus on Critical Care was made as a result of hand hygiene being known to be particularly poor in such settings.

I found this stage of the research process arguably the most challenging. Firstly, learning to take more of a lead to research meetings in light of my growing expertise in the literature, rather than passively agreeing, felt initially uncomfortable and unnatural. As the project developed, so too did my confidence in voicing my opinions and challenging ideas. Secondly, I remember my reluctance to delve too deeply into the literature for fear of getting lost or 'drowning' in it all. Linked to this was the strong urge to identify a clear research question and pin down the project as soon as possible. Identifying a clear research question felt like an unsettling and disorientating process. A good friend of mine, Dr Paul Warwick, sent me a message around this time which seemed to shed light on the difficulties I was experiencing:

'The process of writing a research proposal is like asking you to map out the terrain, with an air of confident certainty, of a landscape you are yet to visit. So whilst a useful stepping stone, to a perfectionist or just someone who is conscientious and wants to do a great job, it is agony, frustratingly illusive and dissatisfying in some ways. What ends up as your learning flight will be informed by your proposal but be steered and lifted by many discoveries and changes along the way.'

I was encouraged by my academic supervisor to take my time in exploring the literature, noticing what I discovered along the way. Thirdly, I recall initially desiring to do something hugely worthwhile and meaningful with my research - something that really made a difference. My initial ideas were vast and expansive, as I considered conducting a detailed mixed-methods assessment of staff behaviour, whilst validating a theoretical framework as well as designing and implementing an intervention to address the issues raised. Fourthly, I recall feeling caught between different agendas that I sensed to exist between those involved. Trying to find a way of satisfying all parties felt difficult at times but I am grateful for the support of my academic supervisor for his help in navigating this. Finally, I recall having to

repeatedly remind others (and myself) that I was not doing a traditional, purely research-based PhD and thus had less time to complete the research than often expected.

The process taught me: a) to be patient in exploring the literature and forming ideas (the phrase '*tolerate the uncertainty*' became my constant companion, written above my desk); b) a greater awareness of myself, especially in regard to how I handle uncertainty and anxiety; c) helpful strategies for 'staying afloat' in the ocean of academic literature; and d) to be more confident in voicing my opinions.

3 Choosing a methodology

My own critical review of the literature on the use of theory in understanding staff hand hygiene highlighted numerous articles challenging the validity of single-theory approaches (i.e. those drawing from just one theoretical model) and approaches relying solely on self-report methods. My own observations of hand hygiene audits also left me feeling that the current approach to monitoring and improving hand hygiene was naive and lacking in psychological understanding. It seemed clear that my project would need to reach beyond the limits of self-report methodologies and individual theories. Thus a mixed-methods design was felt appropriate. I found myself aligned with many of the ideas of mixed-methods researchers and their more pragmatic approach to research. It felt refreshing to be given permission to step outside of the futile quantitative/qualitative debate and to be able to find the most helpful ways of addressing the research question.

I was introduced to the work of Susan Michie and her colleagues following my field supervisor's attendance at a conference Michie had recently presented at. The Theoretical Domains Framework (Michie, Atkins & West, 2014) appeared as a promising meta-theoretical approach, still in its infancy, to understanding and addressing staff hand hygiene.

I had decided early on in the research process that it would be useful to have a quantitative element to the project to allow for the gathering of large amounts of data. This was based on my understanding that the participating Trust were hoping to base a hand hygiene intervention upon my findings and that it would therefore be best to gather data from a larger pool of staff than qualitative means would allow. It was also based on my assumption that quantitative research was often seen to carry more credibility than qualitative research, which

is arguably seen by some as too subjective. Surveying the thoughts of a large proportion of staff would likely be regarded as stronger evidence upon which to base an intervention²⁷.

My literature review led me to read a lot around different methodologies used in understanding behaviour, in search of ways to overcome the limitations of self-report methods. The Delphi technique (Linstone & Turoff, 1975) and functional behavioural analysis (Gable, Park & Scott, 2014) stood out as two promising methodologies that would complement a questionnaire nicely. I had not previously encountered the Delphi technique but found myself intrigued by the approach. It appeared to offer a richer account than questionnaires and one less vulnerable to self-report bias, whilst still lending itself to a more quantitative analysis. Functional behavioural analysis too seemed to provide a more quantitative method, this time completely free from self-report limitations.

The issue of feasibility felt like the main challenge of this phase of the research. It felt like a steep learning curve in the importance of balancing what the literature indicates is needed with what is feasible within the current constraints. My perfectionist traits made it difficult for me to accept there being inevitable limitations to any piece of research and I found it hard to let go of my desire to conduct the perfect piece of research. Unsurprisingly, reviewers of my proposal raised concerns around the feasibility of conducting three strands. This felt like a real dilemma as the literature seemed to indicate that a mixed-methods approach was necessary and using just two of the strands felt like something would be lacking. This dilemma prompted changes to be made to allow all three strands to go ahead. These involved conducting a real-time Delphi (de Villiers *et al.* 2005) rather than the more traditional email-based one, and switching from functional behavioural analysis to a more ethnographic observation approach. The total amount of time spent observing staff was also scaled down from 18 hours to three.

The process has taught me that all research has inevitable limitations regardless of how well it is designed and implemented, and that these need to be considered and reflected upon. I now have a greater appreciation of just how much time and effort goes into producing high quality research.

²⁷ This is not to claim that quantitative research is actually stronger evidence than qualitative, merely that this is likely to be the perception of those designing interventions.

4 Ethical and Trust approval

Ongoing confusion and contradictory messages around whether or not Trust R&D approval was required meant that gaining approval for the project became a frustrating and drawn-out process (spanning eight months). The issue centred around whether the project could be classed as quality improvement within the participating Trust rather than research per se. This seemed appropriate due to the data collection procedures falling within the usual remit of the infection prevention team. I was advised by both supervisors that R&D approval would not be necessary, but neither were able to obtain actual confirmation. I decided to proceed with the IRAS application regardless, for fear of being left behind. The application was a daunting and confusing process to navigate, with so much of what was being asked for not seemingly relevant to my project. Seven months later it was confirmed that the project could be approved as audit and thus did not require IRAS submission. The process left me frustrated and wondering how many budding researchers are put off doing research by the bureaucracy involved in obtaining approval. The process doesn't seem to encourage and empower busy clinicians to follow up research ideas arising from clinical practice. Despite the potential for my IRAS experience to be written off as a waste of time, I prefer to positively reframe it as a 'valuable learning experience' (if for no other reason than my own sanity). The process exposed me to what is involved in obtaining research approval and forced me to think more carefully about the intricacies of my project. However, greater clarity around the process could have considerably reduced the stress involved.

5 Data collection

During my data collection I was incredibly grateful to have several contacts within the Trust come on board with the project. Having a senior medical consultant supervising the project opened doors into the Trust and gave the project more face credibility. A meeting with the Critical Care Head of Service led to him agreeing to be part of the wider project team and publicly endorse the project. I was subsequently introduced to an education and development sister who was responsible for organising nurse training and who, alongside her colleagues, proved incredibly helpful. Having contacts within the Trust who were onboard with the project proved essential in identifying ways to engage staff without encroaching on their clinical practice, and helped to promote the idea that the project wasn't being done to staff by external forces but a genuine collaboration to improve practice. Having access to inside knowledge of how the Trust worked and how best to get things done felt invaluable in

navigating the system, as well as helping me to tailor the project to the setting. However I was left wondering how much the project's fate hinged upon these key contacts being onboard, and how achievable it would have been without having two senior consultants backing the project. Reflecting on this makes me thankful for my decision to take on a research idea arising from within a local clinical setting. The process gave me insight into how important it is to prioritise face-to-face contact with key people to ensure that the project moves beyond being simply a good idea.

The data collection process raised considerable anxiety for me, which appeared to centre around certain aspects of the project being out of my control. For example, data collection for the questionnaire strand was carried out by education and development sisters within pre-existing training sessions. High on my priority list was ensuring that the sisters were 100% clear on the research procedure and how to frame the questionnaire to staff. However, I felt like I was walking a tightrope – needing to be thorough and assertive enough to ensure rigor and keep the project high on people's agenda, whilst maintaining rapport and not putting people off the project. Having to work within other people's timeframes with their own sets of priorities felt uncomfortable at times, especially with it seeming like I had so much to juggle and with time ticking away. It is difficult to say whether I found an appropriate balance between rigor and rapport but relationships remained intact and all data were collected by the deadlines set. I was pleased with our questionnaire response rate of 40% which I attribute to the hard work of the sisters.

Setting up the Delphi strand took a lot of work. Trying to match my availability with that of my supervisors (who were needed for the in-session analysis), that of the Trust's training roster and the availability of rooms was difficult and required a great deal of thought. A lot of thought was also required to organise the structure of the four-hour Delphi session to ensure an appropriate balance between scientific rigor and keeping participants engaged. Despite the general consensus from staff feedback forms being that the Delphi was a useful approach within which staff felt heard, one of its notable limitations was that the analysis of qualitative responses had to take place within a short window of time (65 minutes for Round One, and 35 minutes for Round Two). It was unclear what effect this had on the data (outside the obvious increase in researcher stress). Indeed, it would be interesting for future research to compare results from a real-time Delphi with those of a traditional email-based one to see how different the end findings are. The day itself felt quite stressful as a result of having so much to

remember, attempting to fit a lot in to a reasonably short space of time and so much effort having gone into its organisation. I remember feeling acutely anxious that something would go wrong, that the data would be ruined and ultimately that I wouldn't have time to reorganise my data collection. Although I still stick by the Delphi process as being a useful one, its iterative approach has the potential to cause participant's attention to wane, especially if they perceive that they are being asked to do the same thing repeatedly. This is likely to be less of a problem for traditional Delphi's with weeks separating each round.

In regard to the observational strand, adopting a passive observer role felt somewhat uncomfortable, especially attempting not to make eye contact. This conflicted with my natural tendency to want to build rapport.

The data collection process has taught me: a) the importance of developing good working relationships with contacts in the setting; b) that having inside contacts is very helpful in engaging people with the project; c) more about how I handle situations falling beyond my control; and d) how to communicate complex ideas quickly and in understandable terms.

6 Analysis

I was struck by the marked reduction in my anxiety upon completing my data collection. Not because I suddenly felt like the light was at the end of the tunnel, as it definitely still felt very far away. I think the change was more to do with feeling that things were back within my control. I think I reasoned to myself that no matter how much still lay ahead of me, that I could face it on my own time frame which seemed a whole lot less stressful. Up until this point, the project had felt like a rather fragile 'house of cards', just waiting for some unforeseen difficulty to bring the whole thing tumbling down. Following data collection, the project felt a whole lot more achievable.

Inputting my questionnaire data into Excel I remember feeling somewhat overwhelmed by the pages of numbers facing me. Analysis highlighted how quickly numerical data can lose its meaning when extracted from the questionnaire and reduced simply to numbers. I recall feeling unnerved by it seeming so easy to make a mistake and not notice it. I now have a much greater appreciation of the importance of taking time during data entry and to check over data several times. On numerous occasions upon checking through my spreadsheet, I noticed errors. For example, I noticed that for one item I had not reverse scored the responses which

had a considerable impact on early attempts at interpreting the data. I felt a weight of responsibility for ensuring that the data were handled and interpreted correctly, due to the potential for findings to inform subsequent intervention. I feared getting it wrong and false conclusions being drawn.

During the analysis of my questionnaire I was faced with an unexpected obstacle. Questionnaire items did not appear to map onto the underlying theoretical domains that they claimed to, thus bringing into the question the construct and structural validity of the questionnaire. I was advised by my academic supervisor that an exploratory factor analysis may help clarify the questionnaire's true underlying structure. The task filled me with dread due to my lack of confidence with numbers but I set about the task with vigour, determined to understand it. For two confusing and anxiety-filled weeks I immersed myself in the world of factor analysis only to realise that the validity issues were the result of having removed one of the demographic items prior to data collection due to its irrelevance to the project. This deletion had shifted all the remaining items up one place meaning that the items did not match up with the questionnaire scoring instructions. I felt embarrassed but a whole lot more relieved that the confusion was over and I could return to the world of words. My understanding of factor analysis is far greater than when I started the project but I must admit that the process made me appreciate only needing to carry out basic descriptive statistics. However I am aware that my confidence with statistics is a personal area for development. Another issue discovered during analysis was around the questionnaire not measuring importance of factors per se but rather staff's agreement with the statements. This ideally would have been noticed prior to its use. The process gave me a greater appreciation of the need to carefully consider measures and precisely what data they will yield, prior to using them. Despite a questionnaire pilot being carried out prior to data collection, a lengthier pilot, including an attempt at data analysis, would have been more likely to highlight these issues earlier.

I found the analysis of the observational strand an enjoyable experience. On reflection I wonder whether this was the result of the implicit acknowledgement within qualitative research that it is impossible to look objectively at things and as such individual interpretations are valued and reflected upon. This felt like a liberating experience, in contrast to the more daunting experience of quantitative analysis where one could easily 'get it wrong'. I was aware going into the observations, of my alignment with staff and my prejudices formed working

within healthcare settings. I acknowledged feeling some sense that the problem lay within the organisational culture rather than within staff. However my analysis did not appear to reflect this assumption, highlighting 'Memory, Attention and Decision Processes' – arguably factors residing more within an individual – as being the key issue. Perhaps reflexive skills, honed through clinical training, well position clinical psychologists for conducting qualitative research, allowing us to look inward and reflect upon the impact of our thoughts and feelings.

7 Using a theory-informed, mixed-methods approach

Many of the critiques of mixed-methods research centre around claims that it is neither possible nor appropriate to bridge the ontological divide between realism and relativism (Bryman, 2007). However these arguments need not take centre stage in critiques of mixed-methods research when such research is framed within a pragmatism orientation (Bryman, 2007). Although the discussion segment of the current project did require careful consideration around how to integrate the different types of information and which findings to give most weight to, this did not feel like an impossible or inappropriate task. This was done by sensibly exploring any discrepancies between strands in light of their known limitations, to try and arrive at a balanced and well-thought out understanding. Mixed-methods research is perhaps more likely than single-method approaches to highlight discrepancies between accounts of phenomena. However this should perhaps be framed as a considerable strength due to it forcing the researcher to more deeply consider possible relationships between, and explanations for, such discrepancies. Another thing worth considering with mixed-methods approaches is the danger of spreading resources too thinly across multiple strands, resulting in weakened findings. Within the current project the observational strand did feel somewhat weaker than the other two due to only consisting of three hours of observation. In hindsight I would stick with the original plan of observing for longer across multiple days and units, to allow for firmer conclusions to be drawn. However making decisions retrospectively about feasibility is a lot less abstract and risky. Whilst I acknowledge challenges to using a mixed-methods approach, I still firmly believe that the benefits far outweigh the costs. I feel passionate about seeing research move beyond the arguably unhelpful quantitative/qualitative divide which often lacks external validity. So much of our everyday experience relies on us integrating both quantitative *and* qualitative information, and surely research should acknowledge and reflect this.

The process of using the Theoretical Domains Framework involved more subjective decisions than initially anticipated which were not always easy to make in light of a lack of clearly operationalised domain definitions. I think I had anticipated that the approach would be a panacea and do a lot of the decision making for me. However this was (perhaps unsurprisingly) not the case. As Michie and her colleagues explain:

'Just like any science, the science underlying behaviour change can only take you so far with complex real-world problems. Most intervention strategies will require judgement on the basis of the best available evidence.'

(Michie, Atkins & West, 2014, p.21)

By the end of my project I think I have come to a healthy acceptance of the Theoretical Domains Framework as a useful but not flawless approach. However I am a firm believer in the cause of Michie and colleagues in ensuring that theoretical understandings are useable by for those actually making the decisions and hope that issues with the framework can be addressed. I know that any future research I embark upon will benefit from what I've learnt through using the framework.

8 Write up

I found the actual write up of the thesis challenging for several reasons. The perception of time pressure and strict marking criteria did not feel conducive to inspiration and creativity. I noticed my tendency to overthink what I was writing and thus struggle to convey my thoughts. I found myself at the mercy of inspiration whenever and wherever it chose to arise, which often seemed to be at the most random of times. I would quickly jot down thoughts in my phone for fear of them being lost forever. It was somewhat of an annoyance not being able to control when this inspiration would appear and many times when I sat down to write I was greeted by a complete absence of inspiration and creative thought. The project, and in particular the write up, felt like a lonely experience. The effort involved in explaining the area of research to people, which was likely underpinned by feeling I had too much to juggle, kept this feeling like a solo expedition. That said, I am truly grateful to my academic supervisor for all of his support and guidance; research meetings were a frequent source of inspiration and reassurance. I also came to hugely value my reflective practice group at the university which met monthly. The group allowed research experiences to be shared with others in a similar position and coping strategies to be shared. The group came to be one of the key sources of emotional support during my research and helped to offset, if only briefly, the predominant

feelings of loneliness. Whilst the individual effort involved in the process has arguably helped foster a confidence in my ability and judgement, I wonder if I may prefer working as part of a research team where there is opportunity for more creative discussion.

I felt that prior to embarking upon this research that I had already developed reasonable time management skills and I feel these served me well in getting the project completed on time. With the help of my academic supervisor I have been able to set deadlines for myself throughout the research journey to maintain momentum and ensure steady progress. These deadlines have had to allow some degree of flexibility and change along the way but have served as a useful guide throughout. Although I feel I have generally managed my time well, I have found it difficult sharing my time between research, placement and family life as well as attempting to look after my own well-being. The support of my wife in establishing and maintaining appropriate boundaries around research has been invaluable and I am eternally grateful for her input. Over the course of my research I also noticed that attempting to make progress felt like opening a 'can of worms'. I would only want to attempt a research-related task if I perceived myself to have sufficient time to tackle it and to get the worms back in the can and thus my anxiety under control. This potentially led to my time not being used as efficiently as it could have been as large chunks of time were not always available. However this was perhaps a useful coping strategy in light of the anxiety tied up in the research endeavour. I feel I have gained insight into the challenges facing clinical psychologists in trying to manage research alongside their normal clinical work.

9 Intentions for dissemination

I hope to submit both my literature review and research project to the *American Journal of Infection Control* for publication (Appendix Y). I feel I have been granted the luxury of time to study the area in depth - time which few clinicians are afforded. I'd love for some of this newfound knowledge and understanding to be passed onto the Trust's infection prevention team to inform their practice. I plan to meet with them to present and discuss my findings. I hope that my findings will serve as firm foundations upon which the Trust can build a relevant and effective intervention to support staff hand hygiene.

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APPENDICES

APPENDIX A: Search stems

Stem 1 - was used to focus the search on hand hygiene:

*Hand hygiene, hand wash*²⁸, hand-wash* handwash*, hand rub, hand decontamination, hand sanitation, hand disinfect*, hand cleaning, hand cleansing, hand antiseptis.*

Stem 2 - was used to focus the search on the behaviour of health care staff:

Healthcare staff, health care staff, health-care staff, nurse, doctor, health personnel, healthcare worker, health care worker, health-care worker, clinician and staff.

Stem 3 - was used to focus the search on the theoretical model of interest:

The theory of planned behavior*

²⁸ * refers to the use of a wildcard character within the search to allow variations of the word to also be found.

APPENDIX B: Database search results

Database: PubMed		
Search terms	Results	Relevant by title
("hand hygiene" OR "hand wash*" OR "hand-wash" OR "handwash*" OR "hand rub" OR "hand decontamination" OR "hand sanitation" OR "hand disinfect*" OR "hand cleaning" OR "hand cleansing" OR "hand antisepsis") AND ("healthcare staff" OR "health care staff" OR "health-care staff" OR "nurse" OR "doctor" OR "health personnel" OR "health* worker" OR "clinician" OR "staff") AND ("Theory of Planned Behavior"))	12	8

Database: NHS Evidence (AMED, BNI, CINAHL, EMBASE, Health Business Elite, HMCIC)		
Search terms	Results	Relevant by title
("hand hygiene" OR "hand wash*" OR "hand-wash" OR "handwash*" OR "hand rub" OR "hand decontamination" OR "hand sanitation" OR "hand disinfect*" OR "hand cleaning" OR "hand cleansing" OR "hand antisepsis") AND ("healthcare staff" OR "health care staff" OR "health-care staff" OR "nurse" OR "doctor" OR "health personnel" OR "health* worker" OR "clinician" OR "staff") AND ("Theory of Planned Behavior"))	6	2

Database: PsycINFO		
Search terms	Results	Relevant by title
("hand hygiene" OR "hand wash*" OR "hand-wash" OR "handwash*" OR "hand rub" OR "hand decontamination" OR "hand sanitation" OR "hand disinfect*" OR "hand cleaning" OR "hand cleansing" OR "hand antisepsis") AND ("healthcare staff" OR "health care staff" OR "health-care staff" OR "nurse" OR "doctor" OR "health personnel" OR "health* worker" OR "clinician" OR "staff") AND ("Theory of Planned Behavior"))	4	3

Database: Medline		
Search terms	Results	Relevant by title
("hand hygiene" OR "hand wash*" OR "hand-wash" OR "handwash*" OR "hand rub" OR "hand decontamination" OR "hand sanitation" OR "hand disinfect*" OR "hand cleaning" OR "hand cleansing" OR "hand antisepsis") AND ("healthcare staff" OR "health care staff" OR "health-care staff" OR "nurse" OR "doctor" OR "health personnel" OR "health* worker" OR "clinician" OR "staff") AND ("Theory of Planned Behavior"))	86	10

Database: SCOPUS		
Search terms	Results	Relevant by title
TITLE-ABS-KEY(("hand hygiene" OR "hand wash*" OR "hand-wash" OR "handwash*" OR "hand rub" OR "hand decontamination" OR "hand sanitation" OR "hand disinfect*" OR "hand cleaning" OR "hand cleansing" OR "hand antisepsis") AND ("healthcare staff" OR "health care staff" OR "health-care staff" OR "nurse" OR "doctor" OR "health personnel" OR "health* worker" OR "clinician" OR "staff") AND ("Theory of Planned Behavior"))	20	11

APPENDIX C: Data extraction pro forma

Article Number:		
Title:		
Author (1 st only):		
Publication Date:		Place of publication:
Journal:		
Volume:	Number:	Pages:
Aims:		
Sampling/Participants: <i>(N? Age range, who was studied, sampling strategy, response rate?)</i>		
Study Type/Design: <i>(Quant/Qual?)</i>		
Outcomes: <i>(Outcomes being measured? What measures are used? Validated? Time frame? Self-report or clinician-rated? Hand washing operationalised?)</i>		
Analysis: <i>(methods, power analysis, effect size, clear reporting?)</i>		
Findings:		
Quality of paper: <i>(clarity of reporting, bias accounted for, completeness of data, funding sources made explicit?)</i>		
Application of TPB: <i>(Measures mapped on items? Explicit theoretical framework? Referring findings back to theory? Goodness-of-fit? Influence of individual components calculated?)</i>		
Conclusions: <i>(What do the findings mean? Generalisability? Implications & Recommendations?)</i>		
Missing information:		

APPENDIX D: Critical appraisal checklist (Glynn, 2006)

EBL CRITICAL APPRAISAL CHECKLIST		Yes	No	Unclear	N/A
Section A: population Is the study population representative of all users, actual and eligible, who might be included in the study? Are inclusion and exclusion criteria definitively outlined? Is the sample size large enough for sufficiently precise estimates? Is the response rate large enough for sufficiently precise estimates? Is the choice of population bias-free? If a comparative study: -Were participants randomized into groups? -Were the groups comparable at baseline? -If groups were not comparable at baseline, was incomparability addressed by the authors in the analysis? Was informed consent obtained?					
Section B: data collection Are data collection methods clearly described? If a face-to-face survey, were inter-observer and intra-observer bias reduced? Is the data collection instrument validated? If based on regularly collected statistics, are the statistics free from subjectivity? Does the study measure the outcome at a time appropriate for capturing the intervention's effect? Is the instrument included in the publication? Are questions posed clearly enough to be able to elicit precise answers? Were those involved in data collection not involved in delivering a service to the target population?					
Section C: study design Is the study type/methodology utilized appropriate/ Is there face validity? Is the research methodology clearly stated at a level of detail that would allow its replication? Was ethics approval obtained? Are the outcomes clearly stated and discussed in relation to the data collection?					
Section D: results Are all the results clearly outlined? Are confounding variables accounted for? Do the conclusions accurately reflect the analysis? Is subset analysis a minor, rather than a major, focus of the article? Are suggestions provided for further areas to research? Is there external validity?					
Calculation for section validity: (Y + N + U = T) If Y/T < 75% or if N + U/T > 25% then you can safely conclude that the section identifies significant omissions and that the study's validity is questionable. It is important to look at the overall validity as well as section validity.		Calculation for overall validity: (Y + N + U = T) If Y/T ≥ 75% or if N + U/T ≤ 25% then you can safely conclude that the study is valid.			
Section A validity calculation: Section B validity calculation: Section C validity calculation: Section D validity calculation:		Overall validity calculation:			

APPENDIX E: Statement of epistemological position

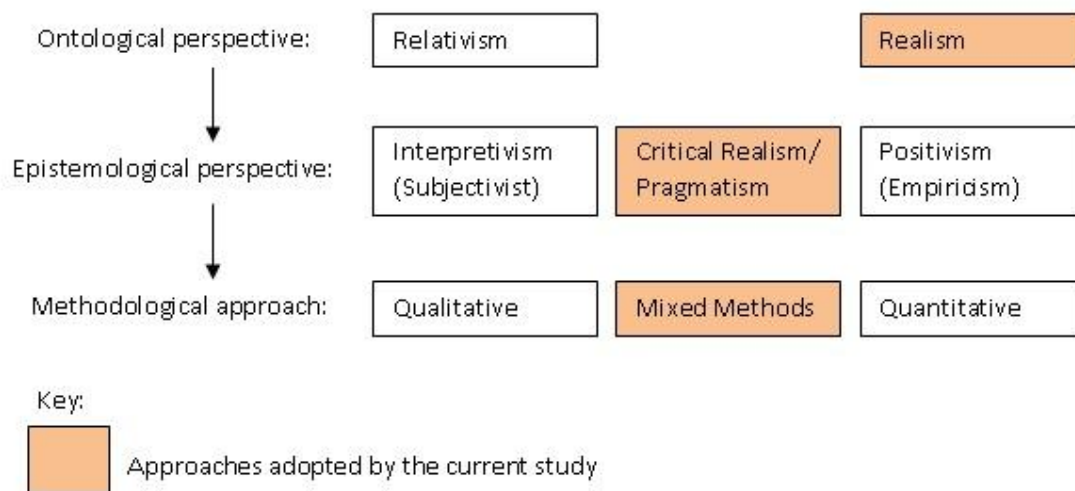
In terms of ontology, the researcher identified holding to a Realist world view. That is that an objective truth exists independent of one's ability to perceive it, and in the case of the current study that an objective truth exists around what key factors are influencing HH adherence. However the researcher also acknowledges that there is no truly objective means of accessing this truth.

As a result, whilst conducting the project the researcher held to an epistemological position characterised by ideas of Critical Realism (Bhaskar, 2008) and Pragmatism (Johnson & Onwuegbuzie). Critical Realists hold to the existence of a single reality whilst acknowledging multiple interpretations of this reality. Pragmatism rejects the idea of rigid dualisms by basing the selection of an epistemological stance and methodology upon a needs-based approach, with choices being made as a result of how well they work in answering the research question being posed (Johnson & Onwuegbuzie, 2004). In the context of the current research project, the inclusion of a quantitative questionnaire was based on the pragmatic needs for the Trust to be able to justify any future intervention with more than a handful of qualitative perspectives, as well as minimise researcher and clinician burden. Pragmatism holds that combining insights and procedures from both quantitative and qualitative approaches can lead to better quality research.

With the researcher holding to the aforementioned ontological and epistemological viewpoints, it was felt most useful to investigate the phenomenon of HH from a variety of perspectives in order to get the closest possible estimation of reality. Therefore, the study utilised a variety of methodologies to explore HH from both a phenomenological perspective and more quantitative perspective. Due to the researcher wanting to access more than just observable behaviour, whilst also going beyond simply relying on self-report methodologies, Critical Realism and Pragmatism appeared to offer the most useful epistemological frameworks for the current study. Whereas a strictly Realist/quantitative approach fails in capturing the complexity and meaning of phenomenon by allowing reductionism to run rampant, and a strictly Relativist/qualitative approach embraces individual complexity with such open arms that it risks getting lost in the depths of individual experience, the current approach appears to allow for a more balanced middle ground that brings together 'fact' and meaning (Longhofer & Floersch, 2012). The current approach's compatibility with a wide range of methods, including both qualitative and quantitative (Sayer, 1992) lends itself to a mixed-

methods approach within a healthcare setting where traditional science and exploration of personal experience are both required.

Figure 10 Diagram to show the current study's underlying ontological, epistemological and methodological perspectives



It is worth mentioning here some of the personal factors that have shaped the researcher's world view and subsequently his approach to the current study. The researcher recalls experiences during his undergraduate studies of a 'Research Design and Analysis' module lectured by two very passionate lecturers; one with a strong quantitative leaning, the other with a strong qualitative leaning. The module was structured in such a way so as to allow students to be exposed to both sides of the argument, understand their philosophical underpinnings, and experience the practical application of both approaches. At the end of the term students were told to adopt an epistemological position, present their case to the class and defend their position against questions from the class. The researcher recollects the explicit and persistent message from the lecturers not to 'sit on the fence' but to 'choose a camp'. In spite of the insistence of the lecturers to adopt either a quantitative (Positivist) or a qualitative (Interpretivist) position, the researcher resisted and did indeed opt to 'sit on the fence'. The researcher recalls feeling disappointed, confused and somewhat irritated by only being presented with two opposing options with there being seemingly little in the way of a middle ground. The researcher remembers feeling that surely quantitative and qualitative approaches both had their place and were invaluable for answering different research


questions. At the time, another option was not offered, and although mixed-methods research was mentioned, little was said in the way of philosophical underpinnings to such an approach.

Following completion of the module, the researcher gave little thought to wrestling with the ontological/epistemological debate for several years due to a lack of research opportunities. It is perhaps worth mentioning at this point the researcher's faith orientation, which arguably serves as a prominent lens through which he views the world. The researcher claims to hold to the Christian faith²⁹. Out of this faith position, the researcher holds to a belief in objective truth, that is, there being an objective reality that exists independent of one's perception of it. Saying this, the researcher also acknowledges that this objective reality can only be ever truly known by Jesus/God himself because of his unique ability to stand outside of humanity's perceptual biases whilst simultaneously viewing and holding in mind all of the vast number of factors making up that truth. The human inability to stand apart from their incomplete individual viewpoint makes it impossible for them to ever obtain this objective truth. For example, in the case of the current project attempting to identify key factors influencing HH, the researcher held the position that there *are* objective factors at play that influence whether someone washes their hands or not, but that people will have different interpretations of these factors. A complete picture of what is going on can never be truly and objectively known by someone regardless of the methods used. All that can be hoped for is instead the closest possible estimation of 'reality' attained through triangulating flawed measurement tools.

On embarking upon the Doctorate in Clinical Psychology, the researcher was faced with another opportunity to conduct research and the once dormant ontological/epistemological debate again reared its ugly head. This time however the researcher was presented with an alternative to the polarised stances of Positivism and Interpretivism; this time there was Critical Realism. The researcher was first introduced to the idea of Critical Realism through a fellow trainee, and the epistemological position appeared to offer a way of holding both of the traditional stances together in tension. Further reading around the area clarified the picture for the researcher whilst also highlighting Pragmatism as a similarly useful middle ground.

²⁹ That is placing one's trust in Jesus Christ as the creator and rescuer of humanity, and attempting to follow his example and guiding.

APPENDIX F: Email confirmation of Ethics and Trust approval

University of Leicester Ethics Review Sign Off Document		
To:	Andy Brckett	
Subject:	Ethical Application Ref: ab748-1a19 <i>(Please quote this ref on all correspondence)</i>	
<hr/>		
31/03/2015 10:58:07		
Psychology		
Project Title: Understanding influential factors in the implementation of the '5 Moments for Hand Hygiene'™ guidelines amongst health care staff: a theory-driven and triangulated approach		
Thank you for submitting your application which has been considered.		
This study has been given ethical approval, subject to any conditions quoted in the attached notes.		
Any significant departure from the programme of research as outlined in the application for research ethics approval (such as changes in methodological approach, large delays in commencement of research, additional forms of data collection or major expansions in sample size) must be reported to your Departmental Research Ethics Officer.		
Approval is given on the understanding that the University Research Ethics Code of Practice and other research ethics guidelines and protocols will be complied with		
<ul style="list-style-type: none">• http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice• http://www.le.ac.uk/safety/		
The following is a record of correspondence notes from your application ab748-1a19. Please ensure that any proviso notes have been adhered to:-		

RE: [redacted] 11407 - Google Chrome

<https://email.le.ac.uk/owa/?ae=Item&a=Open&t=IPM.Note&id=RgAAAAD4XEs5K8PuRZaUwwVdbKqNBwBACm3h%2f3nrQJnHbrPgrhLCAAAMS19FA>

Reply Reply All Forward [icons]

RE: [redacted] 11407

[redacted] - [redacted] Clinical Audit Manager [redacted]

To: Brackett, Andrew

- You replied on 19/06/2015 08:48.

From: [redacted] - [redacted] Clinical Audit Manager [redacted]
Sent: 19 June 2015 08:41
To: [redacted] Research Support Officer; Wang, Michael (Prof.); Jenkins David - Consultant; Brackett, Andrew
Cc: [redacted] - Clinical Audit Facilitator; [redacted] - Senior Nurse
Subject: RE: [redacted] 11407


Thanks – I have registered the study on the trust database – ref 7662e

Please send us a copy of the final report when the project is completed for our records


Sue - FYI

Many thanks

[redacted] Clinical Audit Manager

 Intranet site: [http://\[redacted\].nhs.uk/homepage/clinical/audit-and-effectiveness](http://[redacted].nhs.uk/homepage/clinical/audit-and-effectiveness)

[redacted]

 @ [redacted]

The information in this email and in any attachments is confidential and may be privileged. If you are not the intended recipient, please destroy this message, delete any copies held sender immediately. You should not retain, copy or use this email for any purpose, nor disclose all or any part of its content to any other person.

Barriers and Levers to Hand Hygiene Instrument (BALHHI) Information and Instructions

- This questionnaire has been developed because research tells us that hand hygiene will vary from hospital to hospital, between different wards and departments and also according to the role of different practitioners. We are trying to identify the factors that influence hand hygiene.
- The information you give will enable the creation of improvement strategies that will be most effective in supporting you to uphold good hand hygiene.
- Simply consider each statement in the light of your own hand hygiene and circle the number that demonstrates to what extent you agree or disagree with the statements given.
- It is anticipated that this will take about 10 minutes.

1. What is your job title? (e.g. staff nurse)

2. How long have you worked in health care? (in full years)

3. What area of the hospital do you work in?

(e.g. elderly Care)

4. Are you male or female? M F
(please circle)

5. To what extent do you consider you usually comply with good practice guidelines for hand hygiene? (Times you clean your hands compared with opportunities to do so – 0 to 100%) _____%

6. To what extent do you consider your colleagues in your department comply with good practice guidelines for hand hygiene? (Times you clean your hands compared with opportunities to do so – 0 to 100%) _____%

P.T.O.

Please consider your own hand hygiene. Then circle the number between 1 and 7 that best reflects your opinion at present.

	Strongly Agree						Strongly Disagree
7. I engage in hand hygiene out of respect for my patients	1	2	3	4	5	6	7
8. Government targets have led to improvements in my hand hygiene	1	2	3	4	5	6	7
9. Hand hygiene is a non-negotiable part of my role	1	2	3	4	5	6	7
10. It is difficult for me to attend hand hygiene courses due to time pressure	1	2	3	4	5	6	7
11. I feel complacent about hand hygiene	1	2	3	4	5	6	7
12. Sometimes I miss out hand hygiene simply because I forget it	1	2	3	4	5	6	7
13. Hand hygiene is not second nature for me	1	2	3	4	5	6	7
14. I feel angry if hand hygiene is not carried out by others	1	2	3	4	5	6	7
15. When staff engage in hand hygiene they are praised	1	2	3	4	5	6	7
16. I am more likely to forget hand hygiene if I am tired	1	2	3	4	5	6	7
17. Hand hygiene training is available to me	1	2	3	4	5	6	7
18. There are some practical barriers to hand hygiene because of my particular job/role	1	2	3	4	5	6	7
19. If I do not engage in hand hygiene I may catch an infection	1	2	3	4	5	6	7
20. I cannot be bothered with hand hygiene	1	2	3	4	5	6	7
21. Some government targets make hand hygiene more difficult (such as high bed occupancy)	1	2	3	4	5	6	7
22. If I omitted hand hygiene I would blame myself for infections	1	2	3	4	5	6	7
23. I engage in hand hygiene because I do not want to let the team down	1	2	3	4	5	6	7
24. There are adverts or newsletters about hand hygiene in my workplace	1	2	3	4	5	6	7
25. I am reluctant to ask others to engage in hand hygiene	1	2	3	4	5	6	7
26. The frequency of hand hygiene required makes it difficult for me to carry it out as often as necessary	1	2	3	4	5	6	7
27. I disagree with some parts of the hand hygiene guidelines	1	2	3	4	5	6	7
28. I am confident in my ability to carry out hand hygiene	1	2	3	4	5	6	7

P.T.O.

	Strongly Agree					Strongly Disagree	
29. Hospital targets relating to infection or hand hygiene have led to improvements in my hand hygiene	1	2	3	4	5	6	7
30. I feel frustrated when others omit hand hygiene	1	2	3	4	5	6	7
31. If I engage in hand hygiene it improve patients' confidence	1	2	3	4	5	6	7
32. Hand hygiene guidelines are easily accessible	1	2	3	4	5	6	7
33. Hand hygiene is part of my professional culture	1	2	3	4	5	6	7
34. My environment is cluttered	1	2	3	4	5	6	7
35. I feel guilty if I omit hand hygiene	1	2	3	4	5	6	7
36. I feel ashamed if I omit hand hygiene	1	2	3	4	5	6	7
37. My area of work has poor staffing levels	1	2	3	4	5	6	7
38. Supervision from senior staff means that carrying out hand hygiene is easier for me	1	2	3	4	5	6	7
39. Some strategies designed to improve hand hygiene influence my practice	1	2	3	4	5	6	7
40. My hand hygiene is encouraged by others	1	2	3	4	5	6	7
41. If I miss out hand hygiene I will be subject to disciplinary action	1	2	3	4	5	6	7

P.T.O.

- 42. In which of the following situations should hand hygiene be performed** (circle as many letters as apply)
- a. Before having direct contact with a patient
 - b. Before inserting an invasive device (e.g. catheter)
 - c. When moving from a contaminated body site to a clean body site during an episode of patient care
 - d. After having direct contact with a patient or with items in the immediate vicinity of the patient
 - e. After removing gloves
- 43. If your hands are not visibly soiled or visibly contaminated with blood or other material which is most effective for reducing the number of disease causing bacteria?** (circle one letter corresponding to the single best answer)
- a. Washing hand with plain soap and water
 - b. Washing hands with an antimicrobial soap and water
 - c. Applying 1.5 to 3ml of alcohol-based hand rub to the hands and rubbing hands together until they feel dry
- 44. How are antibiotic-resistant bacteria most frequently spread from one patient to another in health care settings?** (circle one letter corresponding to the single best answer)
- a. Airborne spread resulting from patients coughing or sneezing
 - b. Patients coming in contact with contaminated equipment
 - c. From one patient to another via the contaminated hands of clinical staff
 - d. Poor environmental maintenance
- 45. Which of the following infections can be potentially transmitted from patients to clinical staff if appropriate glove use and hand hygiene are not performed?** (circle as many letters as apply)
- a. Herpes simplex virus infection
 - b. Colonisation or infection with MRSA (methicillin-resistant Staphylococcus aureus)
 - c. RSV (Respiratory syncytial virus infection)
 - d. Hepatitis B virus infection
- 46. Clostridium difficile (the cause of antibiotic-associated diarrhoea) is readily killed by alcohol based hand hygiene products** (circle one letter corresponding to the single best answer)
- a. True
 - b. False

Thank you for participating – your help is massively appreciated

Questionnaire developed by Judith Dyson (j.dyson@hull.ac.uk), Francine Cheater,

Cath Jackson and Rebecca Lawton

APPENDIX H: Reliability and validity statistics for the BALHHI

Validity and reliability statistics reported by Dyson *et al.* (2013)

All the domains covered by the questionnaire achieved a Cronbach's alpha of close to 0.7, except for 'beliefs about capabilities' ($\alpha=0.49$). The overall Cronbach's alpha was calculated as 0.84, showing a high level of internal consistency between items (Anderson & Gerbing, 1982). Construct validity was calculated using three measures of fit: Chi square to degrees of freedom ratio (χ^2/df); Root Mean Square Error of Approximation (RMSEA); and Confirmatory Factor Analysis (CFA). For the fit to be deemed 'good' the χ^2/df should be less than 2 (Byrne, 2008); the RMSEA should be less than 0.06 (Brown, 2006); and the CFA 'close to' 0.95 (Brown, 2006). The fit was therefore deemed good with: $\chi^2/df=1.9$; RMSEA=0.05; and CFA=0.84. In regard to test-retest reliability, all items had a Pearson's coefficient of 0.3 or above, with all but two of the items falling within the 'strong correlation' range (Cohen, 1988) of 0.5 or above. Pearson's coefficient for the theoretical domains was also found to fall within the 'strong correlation' range.

Critique of the reported BALHHI psychometrics

Despite Dyson *et al.* (2013) claiming that the BALHHI showed 'good levels of validity and reliability' (p.8), this claim deserves questioning. Whilst one must give credit to Dyson *et al.* for their rigorous approach to generating the initial item pool using the Delphi process, their approach to developing these items into a valid and reliable questionnaire appears to have been more influenced by attempts to adhere to their theoretical framework and uphold the findings of the Delphi rather than what the psychometrics indicated. This can be seen in their use of confirmatory factor analysis rather than exploratory factor analysis. By conducting a confirmatory analysis one decides how many factors are relevant *a priori* and then forces the analysis to organise items around that number of factors rather than exploring how many factors actually underpin the questionnaire. Such an approach runs the risk of creating a questionnaire where although items may claim to be measuring different domains they actually just measure the same underlying factor.

Another cause for concern is that a number of statistics one would hope to see reported were not present. For example, there was a distinct lack of individual factor loadings with just one overall figure reported. Dyson *et al.* therefore provide no evidence for the utility of proceeding with 10 factors. It would likely have been more useful to first run an exploratory factor analysis in order to identify the number of underlying factors.

Yet another concern are Dyson *et al.*'s claims that the BALHHI holds good test-retest reliability based on the incorrect use of Cohen's (1988) criteria for effect size. Cohen's criteria are of use only when looking at validity rather than reliability statistics. Reliability coefficients falling below the minimum cut-off of 0.7 are concerning and not be deemed to hold good test-retest reliability (George & Mallery, 2003). Dyson *et al.* fail to provide evidence of how many of the BALHHI items reached this cut-off thus reducing the confidence that can be placed in the measure.

APPENDIX I: Participant information sheet for questionnaire strand

[Logo of participating Trust]



Staff Information Sheet

Project title: *Understanding what influences whether healthcare staff adhere to hand hygiene guidelines: a theory-driven and triangulated approach.*

Part Two - A Questionnaire Approach

Explanation: Purpose, background and invitation

You are invited to take part in a Quality Improvement Project (QIP) being conducted by [Trust Name] and the University of Leicester into the hand hygiene of Critical Care nursing staff. The project is made up of three parts and this invitation is for the questionnaire arm of the project. The project aims to gain a better understanding of the factors that both help and hinder staff's ability to carry out appropriate hand hygiene procedures. You have been selected to take part due to your day to day experience of hand hygiene procedures.

Your participation is **completely voluntary** and you are not obliged to take part. However, before making your decision please read this sheet to enable you to make an informed choice. The project is **not** concerned with auditing whether staff are or are not carrying out appropriate hand hygiene but *is* interested in **understanding** what influences whether staff do or do not.

What is involved?

Participation involves filling in a 45-item questionnaire (The Barriers and Levers to Hand Hygiene Instrument) here and now. Responses are given by circling a number between 1 and 7 that best represents your views. You will not be asked for any identifiable information.



The questionnaire is estimated to take **approximately 10 minutes** to complete.

What will the results be used for?

The end result of the project will be a set of factors, with attached importance ratings, that reveal what influences whether staff follow the guidelines. The information you give will enable the creation of improvement strategies that will be most effective in supporting you to uphold good hand hygiene.

P.T.O

If you have any immediate questions please ask the Education and Development Sister delivering this training or for further information please contact any of the following members of the project team:

Andy Brackett
(Trainee Clinical Psychologist/Project Lead)
Email:

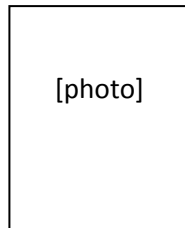


Dr
(Consultant Microbiologist/Trust Infection Prevention Lead/Project Supervisor)
Email:

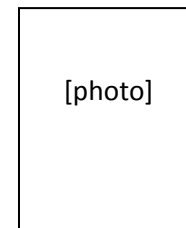


Wider project team:

Dr
(Consultant Anaesthetist/
Critical Care Head of Service)



Prof
(Emeritus Professor of Clinical Psychology,
University of Leicester)



Please keep this information sheet for future reference

APPENDIX J: Part of the electronic version of the BALHHI

Critical Care Hand Hygiene Project - Questionnaire Strand							
<p>* 6. Please consider your own hand hygiene and tick a number between 1 (Strongly Agree) and 7 (Strongly Disagree) that best reflects your opinion at present.</p>							
	1	2	3	4	5	6	7
I engage in hand hygiene out of respect for my patients	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Government targets have led to improvements in my hand hygiene	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hand hygiene is a non-negotiable part of my role	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is difficult for me to attend hand hygiene courses due to time pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel complacent about hand hygiene	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sometimes I miss out hand hygiene simply because I forget it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

APPENDIX K: Email invitation sent to all Critical Care nursing staff about taking part in the electronic version of the BALHHI

ATTENTION ALL CRITICAL CARE NURSING STAFF
We need your help!

There is some confusion around what makes good hand hygiene at work tricky for staff, with Trust audits showing that hand hygiene is not at the standard we need it to be. To get a better understanding the Trust is collaborating with the University of Leicester to conduct a quality improvement project within Critical Care.

The project is aimed at better understanding what it is like for staff on the ground to uphold good hand hygiene, rather than it simply being audited. The project hopes to discover what will help promote and sustain the best possible hand hygiene within the Trust. The information you give will guide the creation of relevant and effective improvement strategies.

You are invited to take part in the questionnaire strand of the project. The project focuses on nursing staff within Critical Care due to them being the largest staff group and delivering the majority of hands-on patient care. You will not be asked for any identifiable information.

Some of you may have already completed a paper version. If so, thank you – please feel free to disregard this email. If not, please could you spare **10 minutes** to complete the following questionnaire:

https://www.surveymonkey.com/Understanding_Hand_Hygiene

As a small gesture of appreciation, £100 will be donated to the staff education fund upon completion of 100 questionnaires (paper copies included). The questionnaire will close on Friday 11th December.

Many thanks.

Andy Brackett

Project Lead/Trainee Clinical Psychologist working on an honorary contract with the Trust
Under the supervision of Dr (Consultant Microbiologist/Trust Infection Prevention Lead)

APPENDIX L: Information relating to BALHHI levers

Low scores on these domains (identified as levers) revealed that, on average staff:

- Strongly agreed that HH is a core part of their professional role and identity, and reported being motivated to carry out HH;
- Perceived there to be negative consequences to omitting HH and positive ones for complying;
- Reported there to be negative emotions associated with omitting HH;
- Perceived themselves to have access to HH-related information and training, and knowledge-testing questions revealed that, on the whole, staff had good HH knowledge;
- Felt reasonably capable of carrying out HH as required, and that various targets and strategies had facilitated their HH.

APPENDIX M: Delphi schedule

Time	Task	Allocated time (minutes)
09.00	Refreshments and registration	30
09.30	Introduction to the session and wider project	10
09.40	Introduction to the Delphi (inc. rationale)	10
09.50	Run Round One	15
10.05	Data analysis/Infection Prevention session #1	50
10.55	COFFEE BREAK	15
11.10	Feedback Round One	5
11.15	Intro Round Two	5
11.20	Run Round Two	15
11.35	Data analysis/Infection Prevention session #2	20
11.55	COFFEE BREAK	15
12.10	Feedback Round Two (averages and comments)	15
12.25	Intro Round Three	5
12.30	Run Round Three	10
12.40	BALHHI questionnaire	15
12.55	What happens next?	5
13.00	Finish	-

APPENDIX N: Delphi response sheet for Round One

Delphi - Round One

What factors do you feel influence whether Critical Care nursing staff, where you work, follow the '5 moments for hand hygiene' guidelines in their daily clinical work?

Instructions:

Please work **individually**. Please list, in the space below, factors that you feel are important - feel free to bullet point these but please make it clear what you mean for each factor. You will be given **10 minutes** for this round – the facilitator will indicate when the time is up.

N.B. The aim is not to simply list all possible factors but to list those you feel are influential in your work place.

APPENDIX O: Round One prompts

Possible influential factors

Please do not feel bound to these – put down whatever you feel is relevant

Knowledge of what is required, education, policies, understanding rationale
Skills to do what is required, training, ease/difficulty of task
Confidence in ability to follow the guidelines
Memory, prompts, reminders
Environmental factors, resources, finances, staffing, time, constraints, priorities
Beliefs about hand hygiene, does it make a difference, team beliefs, individual beliefs
Other people's behaviour, peer pressure, role models
Consequences, rewards, sanctions, self-protection
Systems to monitor hand hygiene, feedback
How people talk about hand hygiene
How people feel about doing/not doing hand hygiene
Job role, responsibility, obligation, expectations, unit culture
Motivation, habit, tiredness, emotions, how it feels

APPENDIX P: Delphi response sheet for Round Two
(enough sheets were provided for all 20 identified factors)

Delphi – Round Two

Instructions:

- Each scale below represents one of the factors identified in the previous round (as shown on the Powerpoint). Please circle a number on each scale that represents how important you feel that particular factor to be in influencing nursing staff hand hygiene behaviour.
- **REMEMBER** to write the factor at the top of each box.
- Please provide a brief comment on why you have given each rating. This is to help others understand where you are coming from.

<p>Factor #1</p> <div style="text-align: center; margin-top: 20px;"> </div>	<p>Comments:</p>
<p>Factor #2</p> <div style="text-align: center; margin-top: 20px;"> </div>	<p>Comments:</p>
<p>Factor #3</p> <div style="text-align: center; margin-top: 20px;"> </div>	<p>Comments:</p>
<p>Factor #4</p> <div style="text-align: center; margin-top: 20px;"> </div>	<p>Comments:</p>

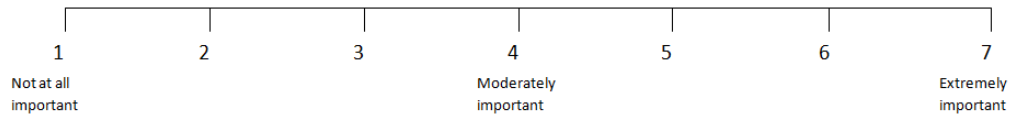
APPENDIX Q: Delphi response sheet for Round Three
(enough sheets were provided for all 20 identified factors)

Delphi – Round Three
Stick or Twist?

Instructions:

- Now you have seen what others in the group think, please circle a number on each scale that represents how important you *now* feel that particular factor to be.
- **REMEMBER** to write the factor at the top of each box.
- You can stick with what you put last round or change your mind.

Factor #1



Factor #2



Factor #3

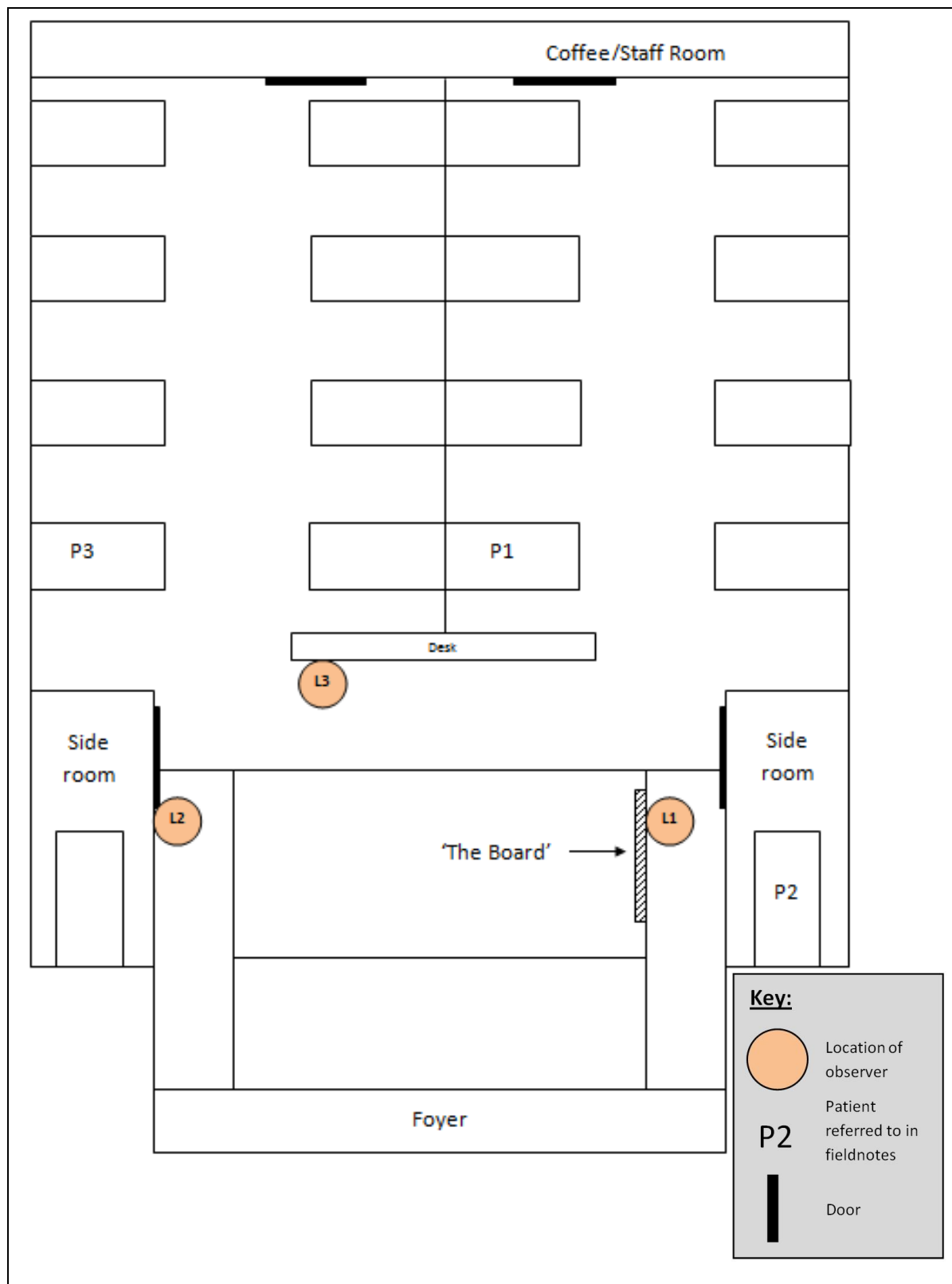


Factor #4

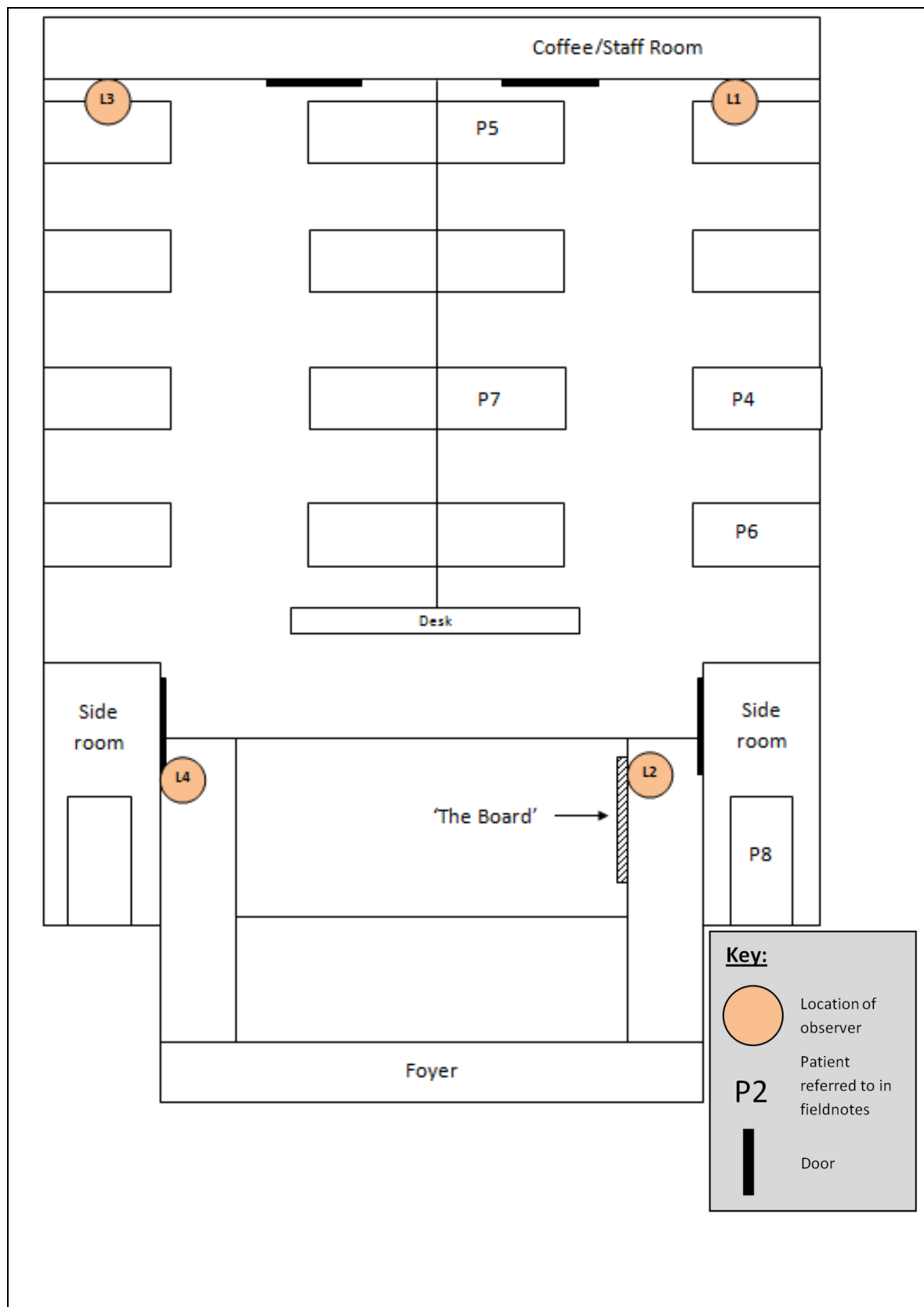


APPENDIX R: Researcher position during observations

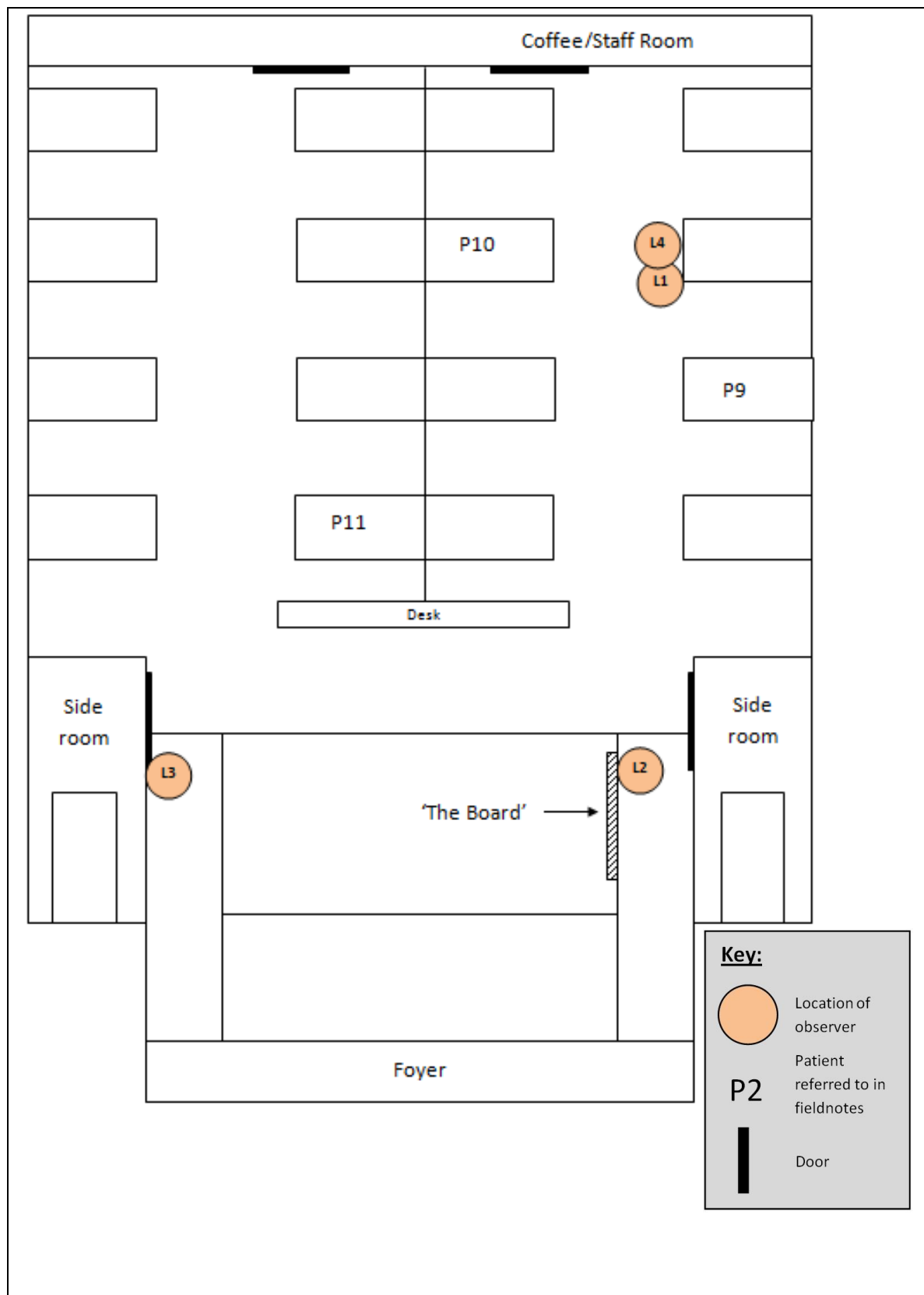
Observational Period One



Observational Period Two



Observational Period Three



APPENDIX S: Example of coded fieldnotes

Date: Tuesday 13th October 2015

Staff:	Early	Late	Night
	16	16	16

At least 1 to 1 staff

Observation Period 1

Time: 09.25-10.30

Field notes written: 10.45-11.45

Patients:	Level 3	Level 2	No. of patients	Total Dependency Level
	10	5	15	12.5

At least 1 to 1 staff

Time	Observations
09.20	<p>Upon entering the ward I was greeted by two female clerical staff members sat at a desk in the entrance foyer. The older of the two ladies introduced me to the admin manager, who, despite having been informed of my visit by the ward matron, appeared surprised at my arrival. I explained the reason for my visit - to see what it was like to work on an ICU and to look at the influence of the ward environment on staffs' ability to follow good practice guidelines. Both the admin manager and older clerical staff member appeared satisfied by my explanation and offered to assist me in any way I required. I explained that I had already been shown around by the ward matron on a previous visit and that if it was still ok that I would just move around the ward observing normal practice. I emphasised that I would not interfere with any clinical tasks being carried out. I asked the older clerical lady if she would be happy to explain the different uniforms worn by different staff members to help me in identifying staff roles during my observations. She began to explain as I took notes in my small pocket notepad.</p> <p>The clerical staff were sat at a desk behind a counter situated on the left-hand side of the foyer. Anyone wanting to enter the heart of the ward, where the majority of activity occurred, were required to walk past the admin staff. The ward seemed very quiet from where I was stood in the foyer (I was struck by how quiet it seemed, which had not been what I was expecting). For some reason, the lights were off in the corridor leading away from the foyer toward the heart of the ward, which further added to the sense of quietness.</p>
09.25	<p>Upon thanking the clerical staff for the explanation of the uniforms I moved from the foyer, down the corridor and positioned myself at the end of it just before it opened out onto the main ward (location 1). I stood leaning against the left-hand wall to allow people enough space to move past me, up and down the corridor. From where I was positioned I could see into the side room to my right (bay 15) and onto the right-hand side of the ward. The ward was split into two sides, separated by a wall but joined at the end closest to the entrance which was where I was positioned. Joining the two sides of the ward was a long desk with several computers and monitor screens on it displaying vital information relating to each bed (e.g. heart rate, blood pressure etc).</p> <p>I initially observed a doctor talking to an awake patient (Patient #1) and touching the side rails of the patient's bed. I noted that the Doctor did not meet the hand hygiene</p>

Forgetting

Welcoming

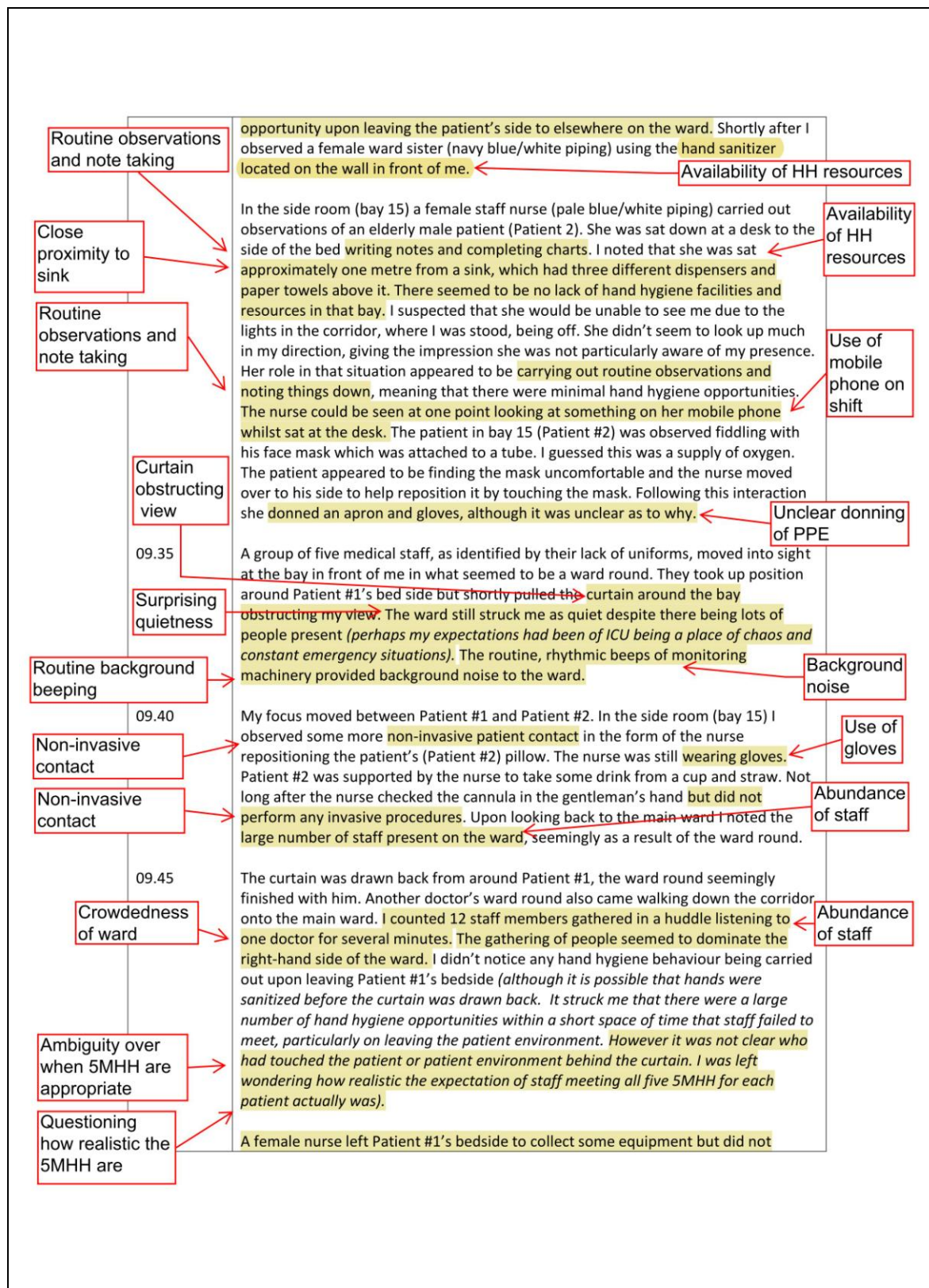
Surprising quietness

Helpfulness

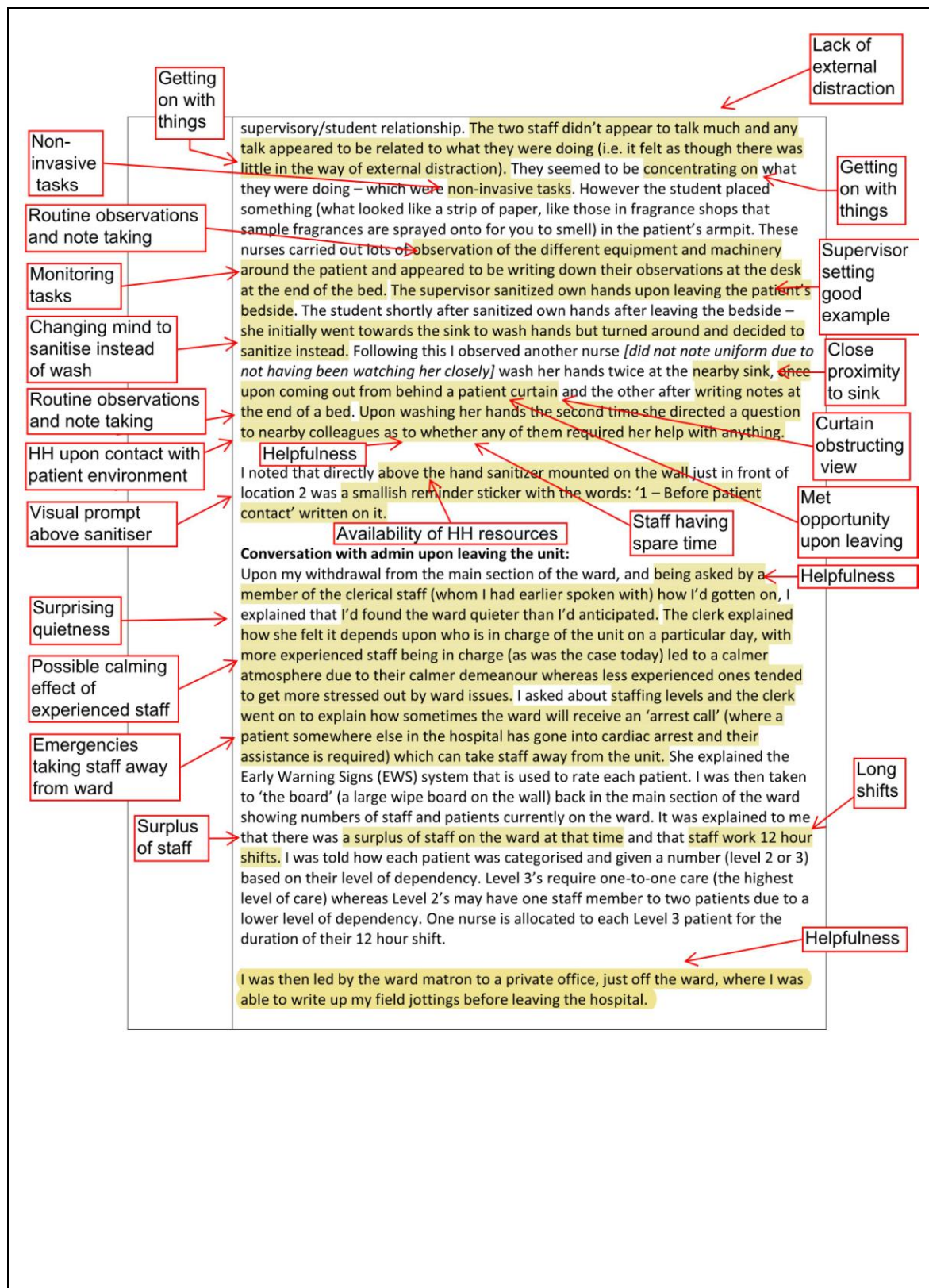
Dim lighting

Surprising quietness

Missed opportunity after environmental contact



Ambiguity over when 5MHH are appropriate	conduct any hand hygiene as she left, although she had no contact with other patients in between.
Potential influence of consultants	I noted that there appeared to be a clear differentiation between staff roles and bandings that was being made visible by the different colours of uniform worn by staff. Different members of non-medical staff wore different shades of blue uniform with different coloured piping around the arms and collar. It was noticeable that doctors did not have to wear uniforms, although some were wearing blue surgical scrubs. <i>(I noticed myself wondering whether it would make any difference if doctors did wear uniform. I felt as though there appeared to be a clear staff hierarchy with consultants at the very top holding a kind of celebrity status within the unit, being followed around by other staff wherever they moved. I wonder how much this perception of hierarchy has been influenced by my preconceptions and experience of the medical profession?)</i>
Rigmarole of tasks	Patient #1 requested a drink. Two nurses were currently seeing to him (one staff nurse; the other a respiratory nurse). It took about 10 minutes for the patient to receive his drink due to the nurse: a) having to remove the patient's oxygen mask and check some information by the bedside, b) getting sidetracked by another nearby colleague talking to her (about work), and c) actually having to go into another area of the ward to get the drink. <i>(It felt to me like quite a lot of work simply to get a drink and made me appreciate being able to get myself one without support).</i> I noted that the staff nurse administering the drink (pale blue/white piping) did not conduct hand hygiene after giving the patient the drink, however she did take off the gloves she had been using.
Availability of HH resources	I noted the hand hygiene facilities around Patient #1. There was a hand gel dispenser at the end of his bed and attached to the wall a few metres from his bed, as well as a sink a couple of metres away from the bed. There appeared to be no lack of hand hygiene facilities nearby.
Close proximity to sink	<i>(I attempted to position myself as a passive observer on the unit and thus did not initiate conversation, other than to ask at several points if someone needed the chair that I was sat in).</i> Only two people asked me what I was doing on the ward, with the others seeming to notice me but not ask who I was or what I was doing. <i>(This struck me as odd but I put this down to people feeling awkward to ask. Perhaps they perceived me as a medic due to the clothes I was wearing (i.e. non-uniform: shirt and chino trousers)).</i> I noticed several people attempted to subtly look at my name badge whilst nearby <i>(I wondered whether they perceived me to be auditing as on several occasions it felt as though people conducted hand hygiene after looking at me. I wonder whether it would have been more useful and reassuring to them if I had made it explicit somehow what I was doing?)</i>
Close proximity of HH facilities	Location 2 – left-hand side corridor – sat on a chair by a trolley – able to see into a different side room, although less inconspicuously, and the left hand, opposing side of the unit. I moved between here and location 3 – a chair at the long desk at the head of the ward, a few metres in front of location 2. Location 3 gave a closer view of Patient #3.
Keeping distance from observer	Patient #3 – awake female – two female nurses carrying out nursing duties. It became clear from uniforms, comments and behaviour that this was a
Awareness of observer	
Curiosity towards observer	
10.00	



APPENDIX T: Steps involved in the thematic analysis of observational data

The thematic analysis was conducted as follows:

1. Fieldnotes were word processed within two weeks of observation.
2. Fieldnotes were transferred into NVivo Version 10 to facilitate organisation of data and subsequent analysis.
3. Fieldnotes were read, without noting any codes, to allow familiarisation with the material.
4. Responses were re-read and initial codes generated.
5. Responses were re-read and re-coded without reference to initial codes generated in step four to avoid simply reproducing the same codes. Total codes generated numbered 174.
6. Codes were reviewed for overlap and merged or deleted accordingly. Code names were edited to ensure they accurately represented the data. Codes remaining numbered 85.
7. Codes were then listed in Word to allow for easier refinement and organisation.
8. Codes were analysed to find ways of organising the data around overarching themes (Appendix U).
9. Once preliminary themes were decided upon, these were checked against fieldnotes to ensure: a) they reflected the data; b) that support was present across the dataset and/or; c) that the theme appeared to capture something salient about the ward environment or research question³⁰. If a lack of support was found, the theme was re-analysed and refined. If no better way to organise the codes was found and the code could not be incorporated into another theme, the code was discarded.
10. Six themes and four sub-themes were decided upon.
11. The project's academic supervisor reviewed a portion of coded fieldnotes as a validity check of the coding. Coding was deemed appropriate.
12. Themes and sub-themes were displayed in a thematic map (see Figure 9).

³⁰ According to Braun and Clarke (2006): *'a theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set'* and thus *'the 'keyness' of a theme is not necessarily dependent on quantifiable measures – but rather on whether it captures something important in relation to the overall research questions'* (p.82).

APPENDIX U: Organisation of codes around themes

Codes (grouped together based on relatedness)	Possible theme names (final name labelled in bold)
<i>2 staff to 1 patient</i> <i>Abundance of staff</i> <i>At least 1 to 1 staff</i> <i>Crowdedness of ward</i> <i>Staff having spare time</i> <i>Surplus of staff</i> <i>Ward not at capacity</i>	Surplus of staff/No lack of staff/ Ample staff
<i>Adequate HH facilities and resources</i> <i>Automatic taps</i> <i>Availability of HH resources</i> <i>Availability of sink</i> <i>Close proximity of HH facilities</i> <i>Close proximity to sink</i> <i>Sanitiser at end of bed</i> <i>Use of gloves</i>	Adequate resources/Proximity of resources/No lack of resources/ Adequate and reachable resources
<i>Alarm attracting staff attention</i> <i>Presence of visitors</i> <i>Responding to changing priorities</i> <i>Emergencies taking staff away from ward</i> <i>Distraction from care task</i> <i>Juggling multiple demands</i>	Some external distractions
<i>Lack of external distraction</i> <i>Calmness</i> <i>Background noise</i> <i>Quietness</i> <i>Routine background beeping</i> <i>Surprising quietness</i>	Few external distractions /Large Internal vs Little External distractions/Potentially many internal distractions
<i>Adequate HH facilities and resources</i> <i>Availability of HH resources</i> <i>Availability of sink</i> <i>Influence of being observed</i> <i>Presence of student nurse</i> <i>Sanitiser at end of bed</i> <i>Visual prompt above sanitiser</i> <i>Supervisor setting good example</i> <i>Lack of peer prompting</i> <i>Lack of visual prompts</i> <i>Potential influence of consultants</i>	Limited presence of explicit prompts/Potential for prompt-based improvements/Presence of implicit prompts/Visual & verbal prompts/ Lack of explicit prompts /Some implicit prompts

<i>Annex as undesirable to staff</i> <i>Background noise</i> <i>Calmness</i> <i>Fresh faced work ethic</i> <i>Lack of ward activity</i> <i>Lack of external distraction</i> <i>Long shifts</i> <i>Monitoring tasks</i> <i>Monotony of job</i> <i>Quietness</i> <i>Routine background beeping</i> <i>Routine observations and note taking</i> <i>Staff having spare time</i> <i>Surprising quietness</i> <i>Silent night</i> <i>Surplus of staff</i> <i>Use of mobile phone on shift</i>	Diminishing stimulation/Lack of stimulation/Boredom/Lack of motivation/Monotony/Just going through the motions/Just keeping things ticking over/Repetitive tasks/ Routine monitoring
<i>Appropriate HH</i> <i>Appropriate use of PPE</i> <i>HH after environmental contact</i> <i>HH upon leaving patient environment</i> <i>HH upon reading notes</i> <i>Intra-patient hand hygiene</i> <i>Met opportunity upon leaving</i> <i>Met opportunity upon transition</i> <i>Over cautious HH</i> <i>Remembering equipment hygiene</i> <i>Supervisor setting good example</i> <i>Unclear donning of PPE</i> <i>Changing mind to sanitise instead of wash</i> <i>Use of gloves</i> <i>Missed opportunity after environmental contact</i> <i>Missed opportunity upon leaving patient</i> <i>Questioning how realistic the 5MHH are</i> <i>Ambiguity over when 5MHH are appropriate</i>	Good hand hygiene/Appropriate hand hygiene/Examples of good hand hygiene Examples of bad hand hygiene Appropriateness of 5MHH/ Examples of good practice Missed opportunities/ Room for improvement

APPENDIX V: Supporting extracts from fieldnotes

Theme #3: Few external distractions

'The routine, rhythmic beeps of monitoring machinery provided the background noise to the ward.'

(Observation period 1)

'I noted that several of the patient bays where patients had lay this morning were now empty. The ward seemed calm and relaxed with staff having informal conversations about Christmas leave.'

(Observation period 2)

'It took about 10 minutes for the patient to receive his drink due to the nurse: a) having to remove the patient's oxygen mask and check some information by the bedside, b) getting sidetracked by another nearby colleague talking to her (about work), and c) actually having to go into another area of the ward to get the drink. (It felt to me like quite a lot of work simply to get a drink and made me appreciate being able to get myself one without support).'

(Observation period 1)

Theme #4: Lack of explicit prompts

'Upon my leaving the ward I decided to look in the staff room to see if there were hand hygiene posters or notices displayed in there. There were lots of papers attached to the numerous notices boards and placed on the coffee tables. However I found none to be related to hand hygiene. The only one that came close was a research project advertising for participants with eczema for their project on staff skin irritation. (I was surprised by this. There felt to be a distinct lack of hand hygiene reminders on the ward despite ICUs being recognised as having poor hand hygiene).'

(Observation period 3)

Theme #5: Examples of good practice
Sub-theme: Room for improvement

'The nurse further down from her (nurse #2; pale blue/white piping) also seemed conscientious in regard to hand hygiene, regularly changing her gloves whilst working with the same patient and sanitizing her hand after removing each pair of gloves. This hadn't been my experience during previous observations (I wondered whether this was something to do with the freshness of the new staff, although some of the staff during my previous observations had been pretty fresh to the shift too. Or perhaps something to do with a different work ethic or less banter on the night shift).'

(Observation period 3)

'The staff nurse nearest to me (nurse #1; pale blue/white piping) was stationed at bay 13 and seemed to uphold good hand hygiene. She repeatedly donned gloves, performed a task, took gloves off and sanitised before donning another pair. I observed her wiping down a stethoscope with an alcohol wipe before and after using it.'

(Observation period 3)

'It felt like staff were just concentrating on their jobs.'

(Observation period 3)

'There seemed to be a freshness to them with them appearing to just get on with their work with an air of enthusiasm. There was little talk amongst the staff as they simply got on with their allocated care tasks, seemingly concentrating on what they had to do.'

(Observation period 3)

APPENDIX X: Chronology of research process

Date	Stage of research
Oct 2013	Research fair - research opportunity presented. Initial meeting with field supervisor.
Mar 2014	Critical literature review (the theory of planned behaviour's application to HH) Conversations with supervisors around thesis ideas. Introduction to Susan Michie's work.
Apr 2014	Shadowing Infection Prevention Nurse on ward audits. Decision made to focus project on determinants rather than intervention.
Jun 2014	Feedback from university panel review – concerns raised around feasibility.
Aug 2014	Initial meeting with wider Infection Prevention Team. Decision made to focus on Critical Care setting.
Oct 2014	Research question about validation of BALHHI questionnaire dropped.
Nov 2014	Contact with R&D department - informed by R&D and a local contact that IRAS would be needed. Advised by supervisors not to proceed with IRAS application due to project falling under quality improvement. IRAS process started.
Dec 2014	Feedback from university peer review process – feasibility issues again raised. Decision to do real-time Delphi and ethnographic observations.
Feb 2015	University ethics submission. Honorary contract obtained.
Mar 2015	Meeting with Critical Care Head of Service – project approval granted. Introduced to Trust Education and Practice Development Sister. University ethics approval granted. IRAS submission.
May 2015	Contact with Director of R&D for clarification (re. Trust approval)
Jun 2015	Delphi pilot conducted. Trust approval granted (project classed as quality improvement rather than research). Questionnaire pilot conducted.
Jul 2015	Delphi data collection delayed due to staff availability.
Aug 2015	Liaison with Critical Care Head of Service. Creation of electronic survey. Electronic survey opened. Draft of introduction written.
Oct 2015	Ward observations conducted. Observational strand transcribed. Draft of literature review completed.
Nov 2015	Journals identified for publication.
Dec 2015	Delphi data collection and analysis. Observational data analysis/Thematic analysis. Electronic survey closed.
Jan 2016	Questionnaire data inputted.
Feb 2016	Questionnaire data analysis.
Mar 2016	Results sections and discussion written.
Apr 2016	Critical appraisal written (based on reflective diary) Thesis formatted. Thesis submitted.

APPENDIX Y: Author guidelines for target journal



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