Journal of Hospital Infection 101 (2019) 393–398

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin

Application of the Theoretical Domains Framework to identify factors that influence hand hygiene compliance in long-term care

J.D. Smith [a], K.M. Corace [b,c,d,*], T.K. MacDonald [e], L.R. Fabrigar [e], A. Saedi [a], A. Chaplin [a], S. MacFarlane [a], D. Valickis [a], G.E. Garber [a,b,d,f]

[a] *Infection Prevention and Control, Public Health Ontario, Toronto, ON, Canada*
[b] *Faculty of Medicine, University of Ottawa, Ottawa, ON, Canada*
[c] *University of Ottawa Institute of Mental Health Research, Ottawa, ON, Canada*
[d] *The Ottawa Hospital Research Institute, Ottawa, ON, Canada*
[e] *Department of Psychology, Queen's University, Kingston, ON, Canada*
[f] *Faculty of Medicine, University of Toronto, Toronto, ON, Canada*

ARTICLE INFO

Article history:
Received 18 October 2018
Accepted 20 December 2018
Available online 28 December 2018

Keywords:
Hand hygiene
Behaviour change theory
Compliance
Healthcare workers
Theoretical Domains Framework

SUMMARY

Background: Healthcare worker (HCW) hand hygiene compliance is key to patient safety; however, compliance is suboptimal. Nevertheless hand hygiene compliance is not well studied in the long-term care setting.
Aim: To apply a behaviour change framework, the Theoretical Domains Framework (TDF), to identify modifiable facilitators and barriers for HCW hand hygiene compliance in long-term care settings.
Methods: HCW hand hygiene compliance facilitators and barriers were examined using a questionnaire for HCWs from long-term care homes in Ontario, Canada. The questionnaire was informed by the TDF, which is based on a synthesis of constructs from a number of relevant psychological theories of behaviour change.
Findings: Barriers identified from the questionnaire aligned with the TDF domain environmental context and resources (time pressure, workload, and environmental controls). Facilitators identified from questionnaire results aligned with the TDF domains social/professional role and identity (it is what is expected of HCWs), and beliefs about consequences (risk of transmission of micro-organisms to self or others).
Conclusion: There are several barriers to hand hygiene compliance that persist in long-term care. A behaviour change theory-informed framework such as the TDF can be helpful to identify those barriers. This study identified several key behavioural constructs aligned with the TDF that can be targeted when developing novel hand hygiene interventions.

* Corresponding author. Address: University of Ottawa Institute of Mental Health Research, 1145 Carling Avenue, Ottawa, ON K1Z 7K4, Canada. Tel.: +1-613-722-6521.
E-mail address: kim.corace@theroyal.ca (K.M. Corace).

https://doi.org/10.1016/j.jhin.2018.12.014

Introduction

Despite the importance of hand hygiene in preventing healthcare-associated infections, healthcare worker (HCW) hand hygiene compliance rates fall below targeted expectations [1,2]. Hand hygiene is a complex behaviour, yet behaviour change theories are often ignored when trying to change HCW hand hygiene behaviour [3]. These theories offer promising tools to improve hand hygiene compliance rates [4].

Our recent systematic review identified a need for additional research assessing the use of psychological theories of behaviour change to inform interventions to improve HCW hand hygiene compliance [3]. Our findings indicated that behaviour change theories can predict hand hygiene behaviour and that interventions based on behaviour change theories resulted in improved hand hygiene compliance [5–8]. Several important issues in this literature were identified including that the studies relied on individual theoretical frameworks — a more integrative cross-theoretical approach may capture a wider array of important behavioural constructs, thereby increasing the likelihood of a successful intervention.

Herein, we describe the first step to confirm from published literature and identify unpublished barriers and facilitators related to hand hygiene compliance in long-term care homes — an understudied healthcare setting — and align them to domains of the Theoretical Domains Framework (TDF) [9].

Methods

A phase 1 survey (Appendix A) was conducted to assess the landscape of barriers and facilitators to hand hygiene compliance in long-term care homes. Phase 2 used data collected from the phase 1 survey and a review of published literature on barriers and facilitators to select questions to form the phase 2 questionnaire (Appendix B). The questionnaire development process included the use of a behaviour change theoretical framework to select items that addressed barriers and facilitators to hand hygiene compliance. Selection and recruitment were performed the same for both phases. Phase-specific methods are described below under the appropriate phase 1 survey and phase 2 questionnaire headings.

Selection of long-term care homes

The phase 1 survey was delivered to 10 HCWs each in 10 long-term care homes in Ontario ($N = 100$). Selection of homes and participants within homes was first-come, first-served responses to an e-mail-based call for interest. The same approach was used to deliver the phase 2 questionnaire to 10 HCWs each in 70 long-term care homes ($N = 700$). Selection of homes included representation from all geographic regions of Ontario.

Recruitment of participants

Recruitment of participants from selected long-term care homes was non-probabilistic using convenience sampling. HCWs were notified by a staff member at the participating institution about the study and the site visit date. HCWs were either approached to determine interest to participate or had previously agreed to a time during the site visit to participate. HCWs who provide direct (hands-on) care to residents were the target participant group. Informed consent was obtained from participants through an information and consent letter provided prior to participation. Both phase 1 and phase 2 protocols were approved by the Ethics Review Board at Public Health Ontario (project ID: 2016–001.01, 2016–001.02, and 2016–029.01). A small honorarium was provided to participants who completed the survey (phase 1) and/or questionnaire (phase 2).

Hand hygiene compliance definition

For the purpose of the study and clarity for the study participants, hand hygiene was defined as using soap and water or alcohol-based hand rub (ABHR) at work when required to do so. The definition of compliance was limited to indications of when to do hand hygiene but not how to do hand hygiene. The four moments of hand hygiene as indicated in the Just Clean Your Hands programme were also described: before initial resident/resident environment contact, before aseptic procedures, after body fluid exposure risk, and after resident/resident environment contact [10].

Theoretical Domains Framework

The TDF was used to develop data collection tools, analyse data, and interpret results from the survey and questionnaire. The TDF was chosen because it integrates 33 behaviour change theories and has associated tools to support the implementation of behaviour change interventions [11–13]. This behaviour change framework has 14 domains (Appendix C) that may influence behaviour change [14]. To clarify, domains are simplified groupings of constructs from multiple theories, and constructs are the components of a theory used to explain behaviour.

Phase 1 survey

A cross-sectional mixed methods approach was used for the phase 1 paper-based survey.

Survey development

Questions were derived or modified from existing published surveys that target attitudes, barriers and facilitators to hand hygiene compliance [15–17]. Questions from these surveys were compiled and organized according to the 14 domains of the TDF. A subset of questions was selected from the domains pertaining to known barriers and facilitators reported in the literature and based on expert opinion. Three open-ended questions were also added to explore the possibility of unreported barriers and facilitators, and to solicit suggestions to increase hand hygiene compliance because little literature has been published based on research in long-term care homes.

Survey items

Thirty closed-ended Likert-type scale questions (referred to as closed-ended questions) asking about barriers and facilitators to hand hygiene compliance were included, based on barriers and facilitators identified from the literature. A five-point Likert-type scale was used with ratings of strongly disagree/agree, disagree/agree, and neither agree nor disagree (neutral). Three open-ended questions each asked for

participants to list up to six items related to reasons that motivate hand hygiene ('Tell us about the reasons that encourage you to do hand hygiene at work'), are barriers to hand hygiene ('Tell us about the reasons that make it difficult for you to do hand hygiene at work'), and would be facilitators for hand hygiene compliance ('Do you have any suggestions for what would help you and others to do hand hygiene?').

Additional measures

Demographics questions included gender, job title, employment status, years worked in healthcare, and whether the participant provided direct care to (contact with) residents.

Phase 1 statistical analysis

Content analysis (thematic analysis of qualitative questions)

Content analysis using a codebook was used to thematically analyse the open-ended responses from the phase 1 survey [18]. Themes were defined as broad concepts that capture the meaning or underlying content of the responses provided by participants. The themes in the codebook (Appendix C) were created in alignment with the domains of the TDF. Thus, the themes align with behaviour change theory constructs.

Message units from responses to open-ended questions were sorted according to the themes in the codebook. A message unit was the whole or part of a participant's response that contained an identifiable theme defined by the codebook; that is, a single response could contain one or more message units. Themes with the highest proportion of message units coded were considered important themes to inform question selection for the phase 2 questionnaire.

The codebook was piloted on a subset of the message units to ensure the coders' (J.S., A.S.) coding was in agreement. Disagreements in coding were resolved through consensus discussion. If required, arbitration by a third coder (K.C.) was used. Inter-rater reliability was measured using Cohen's kappa coefficient.

Exploratory factor analysis (quantitative analysis)

Closed-ended questions were analysed using factor analysis [19]. Factor analysis puts the closed-ended questions into groups according to how well the responses to the questions in those groups correlate. These groupings of questions (termed factors) were assessed for a theme (termed common factor) that aligned with one of the 14 domains of the TDF. Themes that resulted from factor analysis were considered important themes to inform question selection for the phase 2 questionnaire.

Factor analysis was conducted in Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 24; IBM Corp., Armonk, NY, USA). A factor model contains one or more themes (common factors). The number of themes being assessed by the closed-ended questions is determined by which factor model is the most appropriate. Factor models containing one to eight themes (common factors) were tested for appropriateness using the root mean square error of approximation as an index of model fit (computed using FITMOD; Michael Browne, 1992), parallel analysis, and the scree test [19]. From these analyses, the most appropriate factor model was selected and the themes of the common factors were aligned with the domains of the TDF.

Phase 2 questionnaire

A cross-sectional quantitative methods approach was used for the phase 2 questionnaire. The phase 2 questionnaire was completed electronically using Inquisit 5; Millisecond Software, Seattle, OR, USA).

Questionnaire development

By reviewing the important themes identified from the analysis of the phase 1 survey and using the 30 existing questions from the survey that were informed by barriers and facilitators from published literature as a starting point, the questionnaire was created by: (i) rewording of closed-ended questions for clarity; (ii) addition of closed-ended questions based on important themes identified by open-ended questions that were not already present in the closed-ended questions; or, (iii) removal of questions based on the addition or modification of other questions. All open-ended questions were removed and the resulting set of closed-ended questions constituted the phase 2 questionnaire.

Questionnaire items

The phase 2 questionnaire contained 47 questions using the same five-point Likert-type scale used in the phase 1 survey to assess barriers and facilitators to hand hygiene compliance.

Additional measures

Demographics questions included gender, job title, employment status, years worked in healthcare, and whether the participant provides direct care to (contact with) residents.

Phase 2 statistical analysis

Exploratory factor analysis (quantitative analysis)

Exploratory factor analysis was used to analyse the closed-ended questions from the phase 2 questionnaire in the same manner described for the phase 1 survey. Whether a theme was a barrier or facilitator was determined by reviewing the cumulative scores of the closed-ended questions (adjusted for negative wording). Low scores identified a theme as a barrier, moderate scores as a potential barrier, and high scores as not a barrier and facilitates compliance.

Results

Phase 1 survey

One-hundred HCWs were recruited and completed the phase 1 survey. Nine participants indicated that they did not provide direct patient care, and six participants opted to not disclose direct care information. Data analysis was conducted on the subset of participants who indicated that they provided direct care ($N = 85$) (Table I). For the phase 1 survey, the ratio of female to male participants was 63:4, which would be expected given the population being sampled. Personal support workers ($N = 54$; 63.5%) and registered practical nurses ($N = 15$; 17.6%) were the most common job titles of participants, which reflects the distribution of HCWs in long-term care homes.

Table I
Phase 1 survey and phase 2 questionnaire demographics[a]

Variable	Phase 1 survey ($N = 85$), direct care	Phase 2 questionnaire ($N = 342$), direct care
Gender		
Female	63 (74.1%)	308 (90.1%)
Male	4 (4.7%)	32 (9.4%)
Employment status		
Full-time	61 (71.8%)	234 (68.4%)
Part-time	22 (25.9%)	93 (27.2%)
Casual	2 (2.4%)	14 (4.1%)
Years worked ($N = 82$)		
Median	15	10
Range	0–41	0–42
Job title		
Nurse practitioner	1 (1.2%)	1 (0.3%)
Personal support worker	54 (63.5%)	147 (43.0%)
Recreational staff	4 (4.7%)	21 (6.1%)
Registered nurse	3 (3.5%)	40 (11.7%)
Registered practical nurse	15 (17.6%)	97 (28.4%)
Therapy staff (OT/physio)	6 (7.1%)	13 (3.8%)
Other	2 (2.4%)	20 (5.8%)

OT, occupational therapy.
[a] Values may not add to 100% due to participants opting to not disclose demographic data.

Qualitative analysis

The top three facilitators, barriers, and suggestions by thematic analysis of qualitative data are presented in Table II (see Appendix D for a complete summary of qualitative data). The inter-rater reliability was good for the application of the codebook to each open-ended question for qualitative analysis (Cohen's kappa coefficient: 0.79, 0.84, 0.76, respectively for facilitators, barriers, and suggestions).

Key facilitators included (i) beliefs about consequences to self, family, or residents, (ii) beliefs about social–professional role as HCW, (iii) HCW confidence in ability to perform hand hygiene, (iv) social influences and norms, (v) environmental cues, and (vi) habitual behaviour.

Key barriers included (i) resources (time pressure, work load), (ii) environmental resources (lack of supplies), (iii) attention, memory, and decisional processes (forgetfulness, prioritizing competing demands), and (iv) beliefs about negative consequences to self (skin irritation). Almost half of responses from the attention, memory, and decisional processes theme were related to emergency situations. The remaining half was attributed to distractions and forgetfulness. Distractions were also related to the resource barrier of too much workload. Damage to skin was the predominant concern of participants that acted as a barrier to hand hygiene as coded to the theme of beliefs about negative consequences to self.

Key suggestions from HCWs to support hand hygiene compliance included (i) environmental resources (hand care products, supplies to perform hand hygiene, facilities to perform hand hygiene in convenient locations), (ii) knowledge/training (facts related to disease transmission), and (iii) attention, memory and decisional processes (cues for hand hygiene). Although lack of hand moisturizer was not identified in the barrier-related open-ended question, it was a frequent suggestion. Respondents also suggested additional staff, time, supplies, and functional hand hygiene stations.

Quantitative analysis

The most appropriate model from factor analysis contained three themes. The three themes aligned to the TDF were (i) social/professional role and identity, (ii) resource barriers related to time pressure and workload, and (iii) beliefs about consequences to self and others.

Phase 2 questionnaire

In all, 420 HCWs accessed the phase 2 questionnaire. Data analysis was conducted on the subset of participants who indicated that they provide direct care ($N = 342$) (Table I). For the phase 2 questionnaire, the ratio of female to male participants was 308:32 as seen in phase 1 and was expected as this reflects the population of HCWs in long-term care homes. Personal support workers ($N = 147$; 43.0%) and registered practical nurses ($N = 97$; 28.4%) were the most common job titles of participants.

Quantitative analysis

The most appropriate model from factor analysis contained four themes. The four themes aligned to the TDF were (i) social/professional role and identity, (ii) resource barriers related to time pressure and workload, (iii) beliefs about consequences to self and others, and (iv) resource barriers related to environmental controls. The latter theme was not present in the quantitative analysis of the phase 1 survey.

Table II
Phase 1 survey: qualitative data summary

Domain	Top 3 themes aligned to TDF (% of total message units)
Facilitators of hand hygiene (message units, $N = 510$)	Beliefs about consequences (62.2%) Social/professional role and identity (8.0%) Knowledge (7.8%)
Barriers to hand hygiene (message units, $N = 298$)	Resources (63.1%) Attention, memory, cues, cognitive affect, and decision-making (17.8%) Beliefs about consequences (10.4%)
Suggestions to facilitate hand hygiene (message units, $N = 65$)	Resources (47.7%) Attention, memory, cues, cognitive affect, and decision-making (12.3%) Knowledge (10.8%)

Discussion

According to the phase 1 survey and phase 2 questionnaire results, the barriers we identified in long-term care homes were consistent with those seen in acute care settings; the TDF domain of environmental context and resources (time/workload and supplies) was the dominant barrier. Facilitators were aligned to beliefs about consequences (spread of organisms to patients/residents or to themselves) and their social/professional role as HCW (it is their duty to wash their hands and it is part of what is normal to do). Despite the similarity of barriers and facilitators seen from published literature in acute care settings, interventions likely need to be tailored to select healthcare setting-specific hand hygiene improvement strategies which are also theory-informed.

In a review of methods to design interventions intended to change HCW behaviour, four components were salient: the need to identify barriers, tailor interventions to these barriers, use theory, and have stakeholder engagement [20]. In our study we used pre-existing questions aligned to the TDF and open-ended questions designed to assess the barriers and facilitators to hand hygiene compliance. We applied theory in the analysis of data and used stakeholders to inform questionnaire development and gather data. Further development of the questionnaire and its applications would necessitate tailoring interventions to address the identified barriers. In addition to tailoring interventions, the questionnaire could be used to evaluate intervention impacts based on changes to closed-ended question scores before and after an intervention, but this has not been assessed.

The importance of using a theory-based approach should not be overlooked. A theoretical approach may identify barriers that are not immediately associated with HCWs' hand hygiene compliance such as work stress (i.e. the emotion domain of the TDF) [21].

So far, even for those studies that have been conducted using a theoretical approach, there have been many limitations discussed including the limitations in applying one behaviour change theory [3]. Using the TDF overcomes this major limitation. Fuller and colleagues evaluated explanations for non-compliance to hand hygiene best practices in real-time using a codebook based on the TDF [22]. Forty-four percent of explanations for non-compliance to hand hygiene mapped to attention, memory, cues, cognitive affect, and decision-making. This domain was the most common barrier for our study after the resources domain. Contrary to our findings, knowledge was the second most important barrier reported by Fuller and colleagues (26% of explanations), whereas for our study it represented 0.3%. Resources domain, our most common barrier, was the third most common explanation reported by Fuller and colleagues. Differences in the results may be attributed to the study setting (long-term care settings versus acute and intensive care units), different type of hand hygiene programme and years of exposure to a hand hygiene programme, and differences in applicable biases affecting the methods of data collection (real-time versus based on recall discussed below).

There are limitations to the approach used in this study that must be acknowledged. We asked participants to describe reasons for when they do or do not comply with hand hygiene practices, which could be affected by recall bias. Asking these types of questions in real-time (e.g. when hand hygiene auditing is taking place) may elicit different types of responses, which should be considered in future studies [22]. This approach could be affected by different biases (e.g. attribution bias). Whereas this questionnaire was capable of measuring explicitly reported barriers, there is still value in exploring measures of automatic behaviour which may not be measured by explicit responses of the questionnaire. The questionnaire may have regionally restricted applicability because the domains assessed were informed by an assessment of barriers and facilitators from the phase 1 survey and a literature review. Some participating facilities did not provide completed questionnaires. However, data were obtained from at least one facility in the 14 regions of Ontario covered by Public Health Ontario's regional sites. No regions of the province of Ontario were unrepresented, but the lack of responses from some facilities may diminish generalizability of findings to those regions with lower response rates as well as those regions outside of Ontario.

Aligning responses to the TDF provides a practical way to approach interventions because domains (e.g. knowledge) can be targeted within an intervention (e.g. education) and implementation plans (e.g. access to education) surrounding those domains are thus theory-informed (i.e. identified using the TDF). Moreover, resources are available to support a stepped approach to select strategies to address those barriers and facilitators identified [11]. In conclusion, this study developed a questionnaire that assesses selected domains of the TDF that might be important to target for future interventions. The questionnaire may be applied at any institution to determine the institution-specific barriers and facilitators to inform a tailored intervention specific to that institution's needs. The questionnaire would be the first tool developed to systematically assess modifiable attitudes and behaviours grounded in psychological theories of behaviour change with the goal to create tailored interventions to improve hand hygiene compliance.

Conflict of interest statement
None declared.

Funding sources
None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2018.12.014.

References

[1] Erasmus V, Daha TJ, Brug H, Richardus JH, Behrendt MD, Vos MC, et al. Systematic review of studies on compliance with hand hygiene guidelines in hospital care. Infect Control Hosp Epidemiol 2010;31:283–94.
[2] World Health Organization. WHO guidelines on hand hygiene in healthcare. Geneva: WHO; 2009.
[3] Srigley JA, Corace K, Hargadon DP, Yu D, MacDonald T, Fabrigar L, et al. Applying psychological frameworks of behaviour change to improve healthcare worker hand hygiene: a systematic review. J Hosp Infect 2015;91:202–10.

[4] Huis A, van Achterberg T, de Bruin M, Grol R, Schoonhoven L, Hulscher M. A systematic review of hand hygiene improvement strategies: a behavioural approach. Implement Sci 2012;7:92.
[5] Fuller C, Michie S, Savage J, McAteer J, Besser S, Charlett A, et al. The Feedback Intervention Trial (FIT)—improving hand-hygiene compliance in UK healthcare workers: a stepped wedge cluster randomised controlled trial. PLoS One 2012;7:e41617.
[6] Harne-Britner S, Allen M, Fowler KA. Improving hand hygiene adherence among nursing staff. J Nurs Care Qual 2011;26:39–48.
[7] Mayer J, Mooney B, Gundlapalli A, Harbarth S, Stoddard GJ, Rubin MA, et al. Dissemination and sustainability of a hospital-wide hand hygiene program emphasizing positive reinforcement. Infect Control Hosp Epidemiol 2011;32:59–66.
[8] Pontivivo G, Rivas K, Gallard J, Yu N, Perry L. A new approach to improving hand hygiene practice in an inner city acute hospital in Australia. Healthcare Infect 2012;17:57–63.
[9] Chatfield SL, DeBois K, Nolan R, Crawford H, Hallam JS. Hand hygiene among healthcare workers: a qualitative meta summary using the GRADE-CERQual process. J Infect Prev 2017;18:104–20.
[10] Public Health Ontario. Just Clean Your Hands. 2018. Available at: http://www.publichealthontario.ca/en/BrowseByTopic/InfectiousDiseases/JustCleanYourHands/Pages/Just-Clean-Your-Hands.aspx [last accessed October 2018].
[11] Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. Implement Sci 2017;12:77.
[12] Huijg JM, Gebhardt WA, Dusseldorp E, Verheijden MW, van der Zouwe N, Middelkoop BJ, et al. Measuring determinants of implementation behavior: psychometric properties of a questionnaire based on the theoretical domains framework. Implement Sci 2014;9:33.
[13] Smiddy MP, O'Connell R, Creedon SA. Systematic qualitative literature review of healthcare workers' compliance with hand hygiene guidelines. Am J Infect Control 2015;43:269–74.
[14] Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci 2012;7:37.
[15] Dyson J, Lawton R, Jackson C, Cheater F. Development of a theory-based instrument to identify barriers and levers to best hand hygiene practice among healthcare practitioners. Implement Sci 2013;8:111.
[16] World Health Organization. Clean care is safer care: tools for evaluation and feedback. 2018. Available at: http://www.who.int/gpsc/5may/tools/evaluation_feedback/en/ [last accessed October 2018].
[17] Zimakoff J, Kjelsberg AB, Larsen SO, Holstein B. A multicenter questionnaire investigation of attitudes toward hand hygiene, assessed by the staff in fifteen hospitals in Denmark and Norway. Am J Infect Control 1992;20:58–64.
[18] Neuendorf KA. The content analysis guidebook. 1st ed. Los Angeles: SAGE; 2002.
[19] Fabrigar LR, Wegener DT. Exploratory factor analysis. New York: Oxford University Press; 2012.
[20] Colquhoun HL, Squires JE, Kolehmainen N, Fraser C, Grimshaw JM. Methods for designing interventions to change healthcare professionals' behaviour: a systematic review. Implement Sci 2017;12:30.
[21] Dyson J, Lawton R, Jackson C, Cheater F. Does the use of a theoretical approach tell us more about hand hygiene behaviour? The barriers and levers to hand hygiene. J Infect Prev 2011;12:17–24.
[22] Fuller C, Besser S, Savage J, McAteer J, Stone S, Michie S. Application of a theoretical framework for behavior change to hospital workers' real-time explanations for noncompliance with hand hygiene guidelines. Am J Infect Control 2014;42:106–10.