

Effectiveness of visual prompts in changing food handling and/or handwashing behaviour

A Focused Practice Question

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Key Messages

- Multimodal or multicomponent hand hygiene improvement interventions, which may include visual prompts, can improve hand hygiene compliance, in food service and healthcare settings.
- The evidence on the effectiveness of single component hand hygiene interventions, such as visual prompts, to increase hand hygiene compliance in healthcare settings is inconsistent and very limited.

1 Issue & Context

In 2015, Peel Public Health’s inspectors conducted 10,900 compliance inspections at 5746 food premises. During inspections of food premises, inspectors provide food safety education to food handlers, and may distribute food safety visual prompts to operators to place in visible location(s) in the premise. These visual prompts, which may include signs, posters, magnets, or decals, serve to act as reminders for food safety behaviour such as handwashing, avoiding the temperature danger zone (between 4 and 60°C) when cooking, cooling, and/or storing potentially hazardous foods, ensuring proper cooking temperature of foods, and correct dishwashing procedures. Peel Public Health’s Environmental Health Team currently distributes an inventory of signs, magnets and stickers. However, the effectiveness of these is unknown. Thus, the purpose of this literature review is to determine the effectiveness of visual prompts in changing food handling and/or handwashing behaviour to determine whether to continue distributing visual prompts to food premise operators.

2 Literature Review Question

What is the effectiveness of visual prompts in changing food handling and/or handwashing behaviour?

Population	Employees in food service settings or healthcare settings (focus on food service settings)
Intervention	Visual prompts (visual reminders including signs, posters, stickers, and magnets, intended to prompt a change in behaviour)
Outcome	Food handling and/or handwashing behaviour

3 Literature Search

An initial search was conducted in academic databases (Medline, Environment Complete, Food Science database) and in the grey literature (including the TRIP database, environmental and/or health government organizations) specific to the food service setting in December 2015. However, due to the lack of research in this area, a broader search was conducted in February 2016 to include settings beyond food premises such as the healthcare setting. Searches were limited to synthesized research in the English language published since 2005. See Appendix A for details on search strategy.

4 Relevance Assessment

Search results were screened for relevance by two reviewers based on:

Inclusion criteria:

- Investigation of the effectiveness/efficacy of visual prompts, which are visual materials (e.g. signs, posters, stickers, magnets, etc.) that can be posted in a visible location, intended to prompt a change in food handling and/or handwashing behaviour (i.e. act as a reminder).
- Synthesized research (i.e. literature reviews, guidelines)

Exclusion criteria:

- Reviews where the effect of interventions including visual prompts were pooled together with other interventions without visual prompts in the analysis (except articles examining food safety interventions).
- Articles included in the analyses of newer articles.

5 Results of the Search

Seven articles were found to meet the relevance criteria and were assessed for quality. Two of these articles were hand hygiene guidelines for healthcare settings. One was from the World Health Organization (WHO) (1), and the second from the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA) (2). Five were reviews (two in the food service setting (3, 4) and three in the healthcare setting (5, 6, 7)). See Appendix B for the literature search results flowchart.

6 Critical Appraisal

Two reviewers independently appraised the two guidelines using the AGREE II tool, and the five reviews using the Health Evidence Quality Assessment Tool for review articles. Discrepancies were resolved through discussion. Additional details on methodology of the WHO (2009) guideline were retrieved from McGuckin et al. (8). Methodology of the SHEA/IDSA guideline (2014) was obtained from Yokoe et al. (9). Only articles rated at least moderate quality following quality assessment were selected for inclusion. Based on the quality assessment, the WHO (2009) guideline (1), and the reviews by Schweizer et al. (6), Luangasanatip et al. (5) and Soon et al. (3) were rated strong, and the SHEA and IDSA (2) guideline was rated moderate to strong. Two reviews (4, 7) were rated weak, and were excluded from review. However, after assessing for overlap/duplication between the articles, the review by Schweizer et al. (6) was excluded since it was included and analyzed by the SHEA/IDSA (2) guideline. Thus, two guidelines (1, 2) and two reviews (3, 5) were included in this review.

7 Description of Included Reviews/Guidelines

Two guidelines on hand hygiene in healthcare settings (1, 2), a meta-analysis of the efficacy of hand hygiene interventions in hospitals (5), and a meta-analysis of food safety interventions on hand hygiene (3) were analyzed in this review. See Appendix C: Data Extraction Tables for further details.

1. Meta-analysis of food safety training on hand hygiene knowledge and attitudes among food handlers (Soon et al., 2012) (3)

The objective of this meta-analysis, rated as strong quality, was to assess the extent to which food safety training and/or other intervention strategies increased food safety knowledge, attitudes and behaviour of food handlers in farm, food processing, wholesale and retail food service establishments. Nine studies in total were included in the meta-analyses. Nearly all the studies examined some form of food safety educational training. However, only three of these studies assessed interventions that included visual prompts on hand hygiene (10, 11, 12). Meta-analyses were conducted by intervention and outcome including the effect of food safety training or other interventions on hand hygiene knowledge, the effect of food safety training on hand hygiene attitudes and behaviour, and the effect of food safety training and cognitive-behavioural theory-based model interventions on hand hygiene attitudes and behaviour.

2. Strategies to prevent healthcare-associated infections through hand hygiene (Ellingson et al, 2014) (SHEA/IDSA) (2)

The purpose of this guideline, rated as moderate to strong quality, was to provide practical recommendations for hand hygiene in healthcare facilities based on the most current evidence. This expert guidance document was a collaborative effort led by the

Society for Healthcare Epidemiology of America (SHEA), Infectious Diseases Society of America (IDSA), the American Hospital Association (AHA), the Association for Professionals in Infection Control and Epidemiology (APIC), and The Joint Commission. Recommendations were based on a review of the literature including previously published guidelines, systematic reviews, meta-analyses and relevant literature published since 2008, and consensus among guideline development members. The quality of evidence supporting the recommendations was categorized into three levels (see Appendix C). The guideline also presented examples for implementation of multimodal hand hygiene improvement programs.

3. WHO guidelines on hand hygiene in health care (WHO, 2009) (1)

The purpose of this guideline, rated as strong quality, was to provide specific recommendations to healthcare workers, hospital administrators and health authorities to improve hand hygiene practices and reduce transmission of pathogens to patients and healthcare workers. Recommendations were based on a review of the literature, and contributions from over 100 international experts. Each recommendation was categorized into four levels based on the strength of evidence (see Appendix C).

These guidelines were intended to be implemented in any situation in which healthcare is delivered either to a patient or to a specific group in a population (e.g. home care by birth attendants). The WHO Multimodal Hand Hygiene Improvement Strategy and an Implementation Toolkit were developed to offer healthcare facilities a conceptual framework and practical tools for application of the recommendations.

The WHO Multimodal Hand Hygiene Strategy was pilot tested at eight different sites from seven countries representing six WHO regions. Evaluation of data and lessons learned from the testing sites were used to help inform guideline development.

4. Comparative efficacy of interventions to promote hand hygiene in hospital: systematic review and network meta-analysis. (Luangasanatip et al., 2015) (5)

This review, rated as strong quality, set out to evaluate the relative efficacy of the World Health Organization 2005 campaign (WHO-5) and other interventions to promote hand hygiene among healthcare workers in hospital settings. Interventions were classified into eight types based on the WHO guidelines (1) (see Appendix C). WHO-5 is a multimodal strategy including system change, training and education, observation and feedback, reminders in the hospital (e.g. printed material, verbal reminders, electronic communications or other methods to remind about the importance of hand hygiene and appropriate procedures), and a hospital safety climate. Twenty of 41 studies that were included in the review were included in quantitative analyses, which were conducted by study design. Two randomized controlled trials were included in a meta-analysis of the effect of WHO-5 in addition to goal setting on hand hygiene compliance. Eighteen interrupted time series studies that reported direct observation of hand hygiene compliance were re-analyzed to estimate the stepwise change in level of hand hygiene compliance associated with a hand hygiene intervention. These 18 studies included 22 pair-wise comparisons as some studies were conducted at multiple sites or had multiple intervention phases. Twelve of these pairwise comparisons were included in a network meta-analysis to compare four different hand hygiene strategies: WHO-5, WHO-5 with incentives, goal setting or accountability, single interventions, with no intervention.

8 Synthesis of Findings

1) Multimodal or multicomponent hand hygiene improvement interventions, which may include visual prompts, can improve hand hygiene compliance, in food service and healthcare settings.

- A combination of food safety training and social cognitive behavioural interventions resulted in greater effects on hand hygiene attitudes and behaviour compared with either food safety training or behavioural interventions alone. A meta-analysis of two studies (one of which included visual prompts (11)) produced a large summary effect size (standardized mean difference of 0.718; 95% CI: 0.523-0.912) (3).
- According to SHEA/IDSA practice recommendations (2), a multimodal strategy including enhanced access to alcohol-based hand rub, education, reminders (e.g. posters), feedback, and administrative support for improving hand hygiene adherence should be implemented to directly address a healthcare organization's most significant barriers. At a minimum, a bundled approach including education, reminders, and feedback should be used. This recommendation was supported by moderate quality evidence.
- Likewise, the WHO guideline (1) recommended that healthcare administrators implement a multidisciplinary, multifaceted and multimodal programme to improve adherence of healthcare workers to hand hygiene practices, which was strongly supported by well-designed experimental, clinical, or epidemiological studies. Most studies used multimodal strategies including healthcare worker education, audits of hand hygiene practices and performance feedback, reminders in the workplace,

improvement of water and soap availability, use of automated sinks, and/or introduction of an alcohol-based handrub, as well as improving institutional safety climate with participation at the institutional, healthcare worker and patient levels. As a result, the WHO Multimodal Hand Hygiene Improvement Strategy (WHO-5) was developed and pilot-tested, which consisted of five components to be implemented in parallel including:

- System change (i.e. availability of alcohol-based handrub at point of patient care and/or access to safe, continuous water supply and soap and towels)
 - Training and education of healthcare professionals
 - Monitoring of hand hygiene practices and performance feedback
 - Reminders in the workplace (tools available include WHO posters on how to handwash and “5 moments” (when to handwash))
 - Creation of a hand hygiene safety culture with the participation of both individual healthcare workers and senior hospital managers
- The WHO guideline made a recommendation to encourage partnerships between patients, their families, and healthcare workers to promote hand hygiene in healthcare settings, based on suggestive evidence, theoretical rationale or expert consensus (1). Programmes for patient and staff empowerment in hand hygiene improvement are part of a multimodal approach. These programmes may include education of patients, reminders and motivational messages (visual reminders), and role modelling in which healthcare worker hand hygiene behaviour is influenced by

peers or superiors. Visual reminders have included badges or stickers worn by patients, and posters to educate and empower healthcare workers and patients.

- Hand hygiene interventions (such as WHO-5, goal setting, incentives) resulted in improved hand hygiene compliance among healthcare workers in hospital settings.
 - Implementation of WHO-5, in addition to goal setting, was associated with a 35% increase in hand hygiene compliance (pooled OR=1.35, 95% CI: 1.04-1.76), based on a meta-analysis of two randomized controlled trials (5).
 - Hand hygiene interventions (including WHO-5 or different combinations of interventions including system change, education, feedback, reminders, incentives, goal setting, institutional safety climate, or accountability) was associated with stepwise and mean increases in hand hygiene compliance, based on a re-analysis of interrupted time series studies (5).
 - There was considerable uncertainty in the relative effectiveness of hand hygiene interventions, based on a network meta-analysis (5). The implementation of WHO-5 was associated with a 6.51 times higher odds of hand hygiene compliance compared with no intervention (mean OR=6.51; 95% CI: 1.58-31.91). Furthermore, the addition of interventions including goal setting, reward incentives, and accountability further improved the odds of compliance to 11.83 times (mean OR=11.83; 95% CI: 2.67-53.79) (5).

2) The evidence on the effectiveness of single component hand hygiene interventions, such as visual prompts, to increase hand hygiene compliance in healthcare settings is inconsistent and very limited.

- The recommendation to use posters to promote hand hygiene messaging in healthcare settings was supported by low graded evidence according to SHEA/IDSA recommendations (2).
- Single component hand hygiene interventions in healthcare settings, which included education, system change or a reminder (i.e. computer screen saver), was associated with hand hygiene compliance, based on a network meta-analysis, but the effect was not statistically significant (mean OR=4.30; 95% CI: 0.43-46.57) (5).

9 Limitations and Gaps

There are a number of limitations which should be considered when interpreting the evidence.

- Research on visual prompts is very sparse, particularly in the food service setting, to improve food handling and/or handwashing behaviour. More research is needed on the effect of visual prompts on food handling practice. Only three studies included in the Soon et al. (3) review investigated visual prompts as a food safety intervention or component of an intervention, and these studies were not synthesized in a meta-analysis. One examined a multi-component intervention including prompts for street food vendors in India, a study population and setting which may be very different and not very applicable to the Canadian setting (12). In addition, the only relevant meta-analysis included only two studies, one of which included visual prompts (11). The outcome also combined handwashing attitudes and practices, and did not draw conclusions on the effectiveness of visual prompts to improve food safety practices.

- Most of the research literature examined the effect of multi-component interventions, which included visual prompts, so the effect of visual prompts alone could not be singled out. Thus, the outcomes could not be easily attributed to the effectiveness of visual prompts alone.
- In all of the included articles on hand hygiene in healthcare settings, the definition of reminders may not be limited to visual prompts. Reminders also included audio or audiovisual prompts and electronic reminders such as screen savers (5, 6).
- Interventions including visual prompts in the healthcare setting may have reduced applicability to food service settings (e.g. different populations, different intervention components, hand sanitizer use is a component of hand hygiene in healthcare settings).

10 Relevance to Practice/Recommendations

- There is limited research on visual prompts in the food service setting compared to the healthcare setting.
- Although research findings in healthcare settings may not be totally transferrable, they were still consistent with the findings in food service settings.
- Multimodal or multifaceted strategies, which may include visual prompts should be used to improve food handling behavior and/or handwashing among staff in food premises.

- Other interventions to consider include gaining management support/buy-in for encouraging food safety, and the development of a hand hygiene/food safety culture among staff/management in food premises.

References

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Appendices

Appendix A: Search Strategy

Appendix B: Literature Search Flowchart

Appendix C: Data Extraction Tables

Appendix A: Search Strategy

Medline Search Strategy #1 (focus on food service settings)

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to December 2015>, Global Health <1973 to 2015 Week 50>, Ovid Healthstar <1966 to November 2015>, Ovid MEDLINE(R) <1946 to November Week 3 2015>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <December 18, 2015>

Search Strategy:

-
- 1 "food*".ti,ab. (738293)
 - 2 exp Food Handling/ (65064)
 - 3 "food safety".ti,ab. (25664)
 - 4 exp Foodborne Diseases/ (40657)
 - 5 exp "Hazard Analysis and Critical Control Points"/ (1844)
 - 6 "HACCP".ti,ab. (3279)
 - 7 exp Hand Hygiene/ (10932)
 - 8 "hand hygiene".ti,ab. (7074)
 - 9 exp Hand Disinfection/ (10052)
 - 10 "handwash*".ti,ab. (3796)
 - 11 "dishwash*".ti,ab. (613)
 - 12 exp "Cooking and Eating Utensils"/ (2194)
 - 13 exp Cooking/ (19471)
 - 14 "cook*".ti,ab. (54953)
 - 15 ("storing" or "storage").ti,ab. (233239)
 - 16 "critical control point*".ti,ab. (3293)
 - 17 exp Cross Infection/ (107237)
 - 18 exp Consumer Product Safety/ (27269)
 - 19 Infection Control/mt [Methods] (19737)
 - 20 exp Health Behavior/ (246466)
 - 21 "health behav*".ti,ab. (33796)
 - 22 "behav*".ti,ab. (1491951)
 - 23 exp Health Education/ (292245)
 - 24 exp Health Knowledge, Attitudes, Practice/ (167502)
 - 25 "behav* chang*".ti,ab. (43824)
 - 26 "intervention*".ti,ab. (1297557)
 - 27 "cue*".ti,ab. (99077)
 - 28 "prompt*".ti,ab. (171238)
 - 29 "reminder*".ti,ab. (16446)
 - 30 ("review*" or "meta analys*" or "synthes*").ti. (979756)
 - 31 1 or 2 or 3 or 4 (796456)
 - 32 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 (450105)

- 33 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (3290335)
- 34 30 and 31 and 32 and 33 (158)
- 35 remove duplicates from 34 (85)
- 36 limit 35 to english language [Limit not valid in CDSR; records were retained] (84)
- 37 limit 36 to yr="2005 -Current" (71)

Medline Search Strategy #2 (broader search beyond food service settings)

Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to February 03, 2016>, Global Health <1973 to 2016 Week 04>, Ovid Healthstar <1966 to November 2015>, Ovid MEDLINE(R) <1946 to January Week 4 2016>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <February 08, 2016>, PsycINFO <2002 to February Week 1 2016>

Search Strategy:

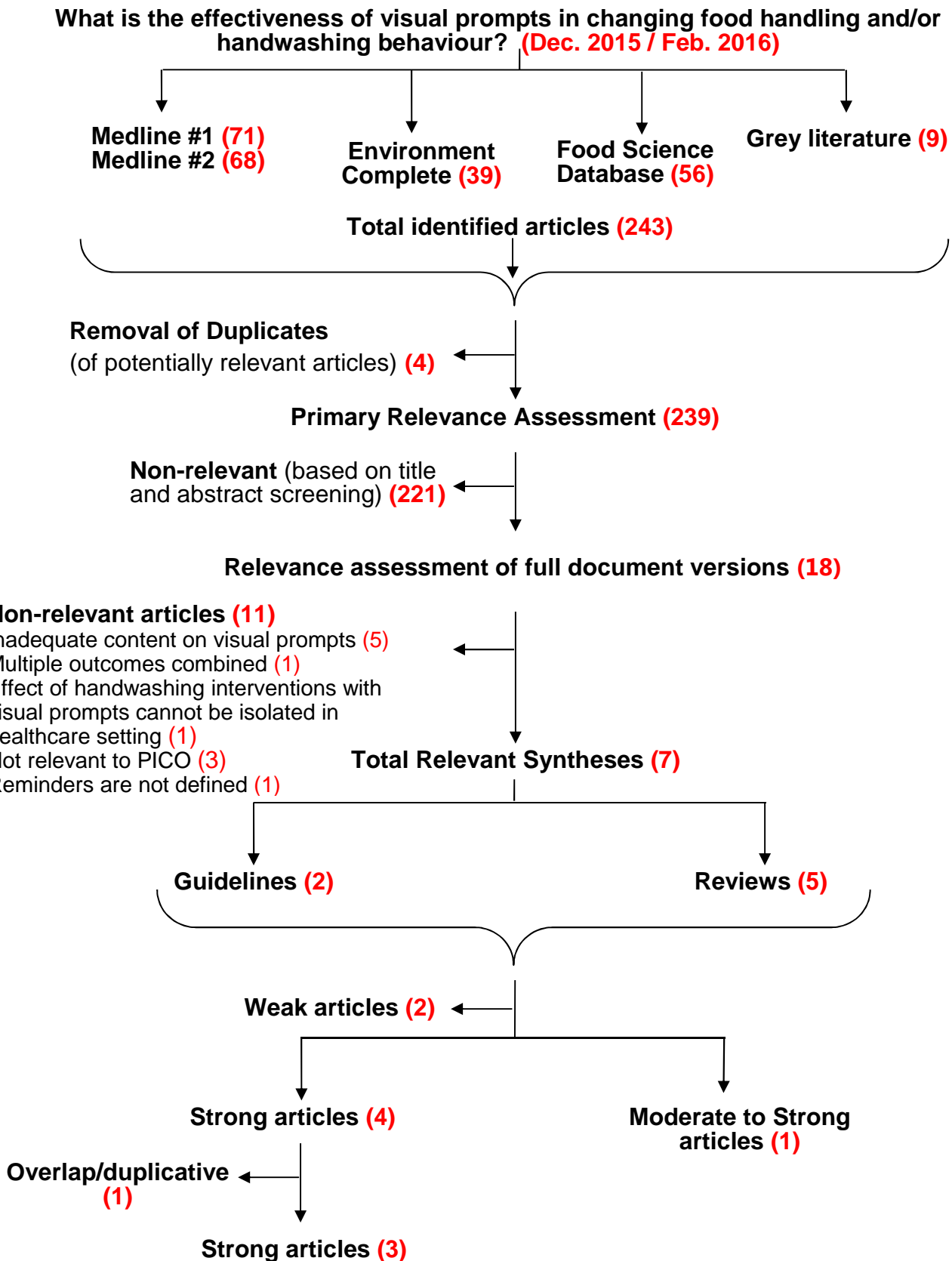
-
- 1 exp "Hazard Analysis and Critical Control Points"/ (1860)
 - 2 "HACCP".ti,ab. (3313)
 - 3 exp Hand Hygiene/ (10685)
 - 4 "hand hygiene".ti,ab. (7012)
 - 5 exp Hand Disinfection/ (9813)
 - 6 "handwash*".ti,ab. (3780)
 - 7 "dishwash*".ti,ab. (657)
 - 8 "critical control point*".ti,ab. (3328)
 - 9 exp Cross Infection/ (103996)
 - 10 Infection Control/mt [Methods] (18951)
 - 11 exp Health Behavior/ (263491)
 - 12 "behav*".ti,ab. (1900618)
 - 13 exp Health Education/ (299409)
 - 14 exp Health Knowledge, Attitudes, Practice/ (165799)
 - 15 "behav* chang*".ti,ab. (55164)
 - 16 "cue*".ti,ab. (135457)
 - 17 "prompt*".ti,ab. (182730)
 - 18 "promotion*".ti. (35291)
 - 19 "reminder*".ti,ab. (19923)
 - 20 ("review*" or "meta analys*" or "synthes*).ti. (1074588)
 - 21 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (130333)
 - 22 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 (2732166)
 - 23 20 and 21 and 22 (190)
 - 24 limit 23 to english language [Limit not valid in CDSR; records were retained] (184)
 - 25 limit 24 to yr="2005 -Current" (145)
 - 26 remove duplicates from 25 (68)

Note: A search of the Environment Complete and Food Science databases was also conducted by adapting the Medline search strategy #1 search terms.

Grey Literature Databases/Websites

TRIP database, Public Health Agency of Canada (PHAC), National Institute for Health and Care Excellence (NICE), Centers for Disease Control (CDC), World Health Organization (WHO), National Collaborating Centre for Environmental Health (NCCEH), Canadian Institute for Public Health Inspectors (CIPHI), Public Health Ontario (PHO), Health Canada, Health-Evidence.org

Appendix B: Literature Search Flowchart



Appendix C: Data Extraction Tables

Items reviewed	Review #1 of 2: Meta-analysis of food safety training on hand hygiene knowledge and attitudes among food handlers			
General Information & Quality Rating				
Author(s), Date	Soon et al., 2012			
Quality rating	Strong (score of 8/10 using Health Evidence tool by two independent reviewers)			
Objective(s) of review	To assess the extent to which food safety training or intervention strategies increased knowledge and attitudes about hand hygiene. Note: The remainder of this table is focused on the impact of interventions including visual prompts on handwashing behaviour.			
Details on methodology				
Number of included primary studies	<ul style="list-style-type: none"> • 9 studies included in meta-analysis of effect of food safety training/intervention strategies on hand hygiene knowledge (one study, Chapman et al. (2010), included visual prompts) • 5 studies included in meta-analysis of effect of food safety training on hand hygiene attitudes and behaviours (one study, Choudhury et al. (2011), included visual prompts) • 2 studies included in meta-analysis of effect of food safety training and cognitive-behavioural theory-based intervention strategies on hand hygiene attitudes and behaviours (one study, York et al. (2009), included visual prompts) 			
Relevant included studies	Study author (year)	Study design	Study population (sample size, n)	Relevant findings
	Chapman et al. (2010)	Pre- and post-intervention	Food service workers in Ontario, Canada (n=47)	Introduction of food safety information sheets (one-page fact sheets highlighting a recent foodborne disease outbreak and methods to prevent it that can be posted) was significantly associated with increased attempted and correct handwashing events (by 6.7 and 68.9%, respectively).
	York et al. (2009)	Controlled trial 4 groups: -Food safety training -Behavioural intervention	Restaurant workers in U.S. (n=368)	The combination of both food safety training and the behavioural intervention (including food safety signs, incentive program, provision of thermometers) was significantly associated with improved food safety behaviour compared with training alone or no training or intervention.

		-Training and behavioural intervention -No training or intervention		
	Choudhury et al. (2011)	Pre- and post-intervention	Street vendors in India (n=80)	A significant change in food safety practices after food handlers were provided with a training program (including charts, posters, motivational videos, role playing, demonstrations, puppet shows and handouts) was found.
Types of studies	Pre- and post-training evaluations, cohort study designs, controlled trials			
Study settings	Food service setting (farm, food processing, wholesale and retail food service establishments)			
Search period	1990-2011			
Search sources	<ul style="list-style-type: none"> • Pubmed, Web of Science, Cochrane Library • Key journals, reference lists, abstracts from food safety/science conferences 			
Inclusion/exclusion criteria	<p>Inclusion: Food safety training and hand hygiene interventions including information sheets, posters, role playing, training manuals, videos and demonstration of microbial plate counts; evaluation of hand hygiene knowledge, attitudes and behavioral changes after food safety education/training or hand hygiene interventions; pre- and post-training evaluations, cohort study design; English language articles</p> <p>Exclusion: No hand hygiene evaluations carried out in training programs</p>			
Study population	Food handlers dealing with ready-to-eat food			
Interventions	Educational training covering food safety, hygiene and handwashing procedures; interventions including on-site training, videos, booklets, demonstrations, slides, and behavioural interventions (e.g. management support, incentive programs, reminders/posters)			
Outcomes	Hand hygiene knowledge, attitudes and behaviour			
Review methods	<p>Meta-analyses of studies (using random effects model) conducted by intervention and outcome:</p> <ul style="list-style-type: none"> • Effect of food safety training/other interventions on hand hygiene knowledge • Effect of food safety training on hand hygiene attitudes and behaviour • Effect of food safety training and cognitive-behavioural theory-based model interventions on hand hygiene attitudes and behaviour 			
Results & Limitations				
Relevant results of review	A combination of food safety training and social cognitive behavioural interventions resulted in the greater effects on hand hygiene attitudes and behaviour compared with either food safety training or behavioural interventions alone. Meta-analysis of two studies that examined this produced a summary effect size (Hedges' g) of 0.718 (95% CI: 0.523-0.912).			
Comments/limitations	<ul style="list-style-type: none"> • Possible publication bias (biased towards "positive" result) for effects of food safety training or interventions on hand hygiene knowledge. • Meta-analyses combined outcomes of both hand hygiene attitudes and practices. • Meta-analysis of effect of food safety training and cognitive behavioural interventions only based on two studies. 			

Items reviewed	Review #2 of 2: Comparative efficacy of interventions to promote hand hygiene in hospital: systematic review and network meta-analysis
General Information & Quality Rating	
Author(s), Date	Luangasanatip et al., 2015
Quality rating	Strong (score of 8/10 using Health Evidence tool by two independent reviewers)
Objective(s) of review	<ul style="list-style-type: none"> To evaluate the relative efficacy of the World Health Organization 2005 campaign (WHO-5) and other interventions to promote hand hygiene among healthcare workers in hospital settings. To summarize information on changes in clinical and microbiological outcomes associated with these interventions and their use of resources. <p>Note: The rest of the table below will be focused on the relevant objective (i.e. efficacy of hand hygiene interventions particularly those including visual prompts).</p>
Details on methodology	
Number of included primary studies	<p>41 studies (6 randomised controlled trials, 1 non-randomised trial, 32 interrupted time series studies, 2 controlled before and after trials)</p> <p>Of the 41 studies, only 20 studies were included in meta-analyses:</p> <ul style="list-style-type: none"> 2 randomised controlled trials (both included reminders) 18 interrupted time series studies (11 included reminders). As some studies were conducted at multiple sites or had multiple intervention phases, 22 pairwise comparisons from these 18 studies were available for re-analysis. 18 of these comparisons were further analyzed since they had clear details about interventions and similar indications for hand hygiene compliance. <ul style="list-style-type: none"> 12 pairwise comparisons were included in the network meta-analysis.
Types of studies	Randomised controlled trials, non-randomised trials, interrupted time series studies, controlled before and after trials
Study settings	Hospital setting
Search period	<p>Two stage search strategy:</p> <ul style="list-style-type: none"> All studies considered in two previous reviews (covering period up to November 2009) Literature search conducted for studies from December 2009 to February 2014
Search sources	<ul style="list-style-type: none"> Databases including Medline, EMBASE, CINAHL, DARE, National Health Service Economic Evaluation Database (NHS-EED), National Health Service Centre for Reviews and Dissemination (NHS-CRD) and British Nursing Index (BNI), Cochrane Library, ClinicalTrial.gov, Current Clinical Control Trial, Cochrane Effective Practice and Organisation of Care Group (EPOC) register American College of Physicians Journal, reference lists of two earlier reviews
Inclusion/exclusion criteria	<p>Inclusion:</p> <p>Evaluated one or more interventions intended to improve hand hygiene compliance among healthcare workers in hospital setting; measured compliance with hand hygiene using opportunities with prespecified indications or using proxies linked to compliance (e.g. consumption of soap and alcohol hand rub); randomised controlled trials or non-randomised trials (with at least two intervention and two control sites), controlled before-after studies (with outcome measures before and after intervention from at least two intervention and two comparable control sites), or used interrupted time series design (clearly defined point in time for intervention and outcome measures from at least three time points in both baseline and intervention periods).</p>

	<p><u>Exclusion:</u> Not reported in peer-reviewed publications; not written in English; studies that failed to meet minimal quality criteria specified by EPOC.</p>
Study population	Healthcare workers
Interventions	<p>WHO-5 is a multimodal strategy consisting of five components:</p> <ol style="list-style-type: none"> 1. System change 2. Training and education 3. Observation and feedback 4. Reminders in the hospital 5. Hospital safety climate <p>Interventions to improve hand hygiene were classified based on the WHO guidelines (2009) into the following categories:</p> <p>System change- Ensuring necessary infrastructure is available including access to water, soap and towels and alcohol based handrub at point of care.</p> <p>Education and training- Providing training or educational programme on importance of hand hygiene and correct procedures for hand hygiene for healthcare workers.</p> <p>Feedback- Monitoring hand hygiene practices among healthcare workers while providing compliance feedback to staff.</p> <p>Reminders at workplace- Prompting healthcare workers either through printed material, verbal reminders, electronic communications or other methods, to remind them about importance of hand hygiene and appropriate indications and procedures.</p> <p>Institutional safety climate- Active participation at institutional level, creating environment allowing prioritisation of hand hygiene.</p> <p>Goal setting- Setting of specific goals aimed at improving compliance with hand hygiene, which can both apply at individual and group level and can include healthcare associated infection rates.</p> <p>Reward incentives- Interventions providing any reward incentive for participants completing a particular task or reaching a certain level of compliance (including non-financial and financial rewards).</p> <p>Accountability- Interventions involved with improving healthcare workers' accountability both at individual and unit level.</p>
Primary outcome	Hand hygiene compliance

<p>Characteristics of studies</p>	<p>Intervention (number of studies):</p> <ul style="list-style-type: none"> • Hospital-wide (17) vs. hospital ward (21) vs. specific healthcare workers (3) • Low-/middle-income countries (5) vs. high-income countries (36) • Single faceted intervention: <ul style="list-style-type: none"> ○ Education (4) ○ System change or reminders (2) • WHO-5 or equivalent interventions (17) • WHO-5 supplemented with additional interventions including goal setting, incentives and accountability (6) <p>Study period:</p> <ul style="list-style-type: none"> • < 1 year (11) • 1-3 years (17) • > 3 years (13) <p>Outcome measurement:</p> <ul style="list-style-type: none"> • Used direct observation to measure hand hygiene compliance (30) • Used proxy measures to measure hand hygiene compliance (19)
<p>Relevant review methods</p>	<p>Only studies that used direct observation to measure hand hygiene compliance were included in quantitative analyses. Analyses conducted by study design:</p> <p><i>Randomised controlled trials, non-randomised trials, and controlled before-after studies</i></p> <ul style="list-style-type: none"> • Meta-analysis conducted using random effects models to pool odds ratios. <p><i>Interrupted time series</i></p> <ul style="list-style-type: none"> • Generalised linear segmented regression analysis used to estimate stepwise change in level and change in trend associated with intervention. Two summary measures were estimated that combine both stepwise and trend changes. • Network meta-analysis conducted by combining all evidence (indirect and direct) to estimate comparative relative effectiveness of four different groups: <ul style="list-style-type: none"> ○ No hand hygiene promotion ○ Single component interventions (system change or education) ○ WHO-5 ○ WHO-5 plus other interventions (incentives, goal setting or accountability) • A sensitivity analysis was also conducted by excluding studies that implemented multi-component strategies in a stepwise manner without sufficient data to evaluate individual components.
<p>Results & Limitations</p>	
<p>Relevant results of review</p>	<p><i>Meta-analysis of randomised controlled trials</i></p> <ul style="list-style-type: none"> • WHO-5 intervention in addition to goal setting was associated with improved hand hygiene compliance (pooled OR=1.35, 95% CI: 1.04-1.76).

	<p><i>Analysis of interrupted time series studies</i></p> <ul style="list-style-type: none"> • 18 of the 22 pairwise comparisons of hand hygiene interventions showed both stepwise increases in hand hygiene compliance associated with the intervention, and increases in mean compliance after the intervention compared with absence of the intervention. Note that 13 of the 18 pairwise comparisons included reminders as part of a multi-component intervention. The four pairwise comparisons that did not show stepwise increases in compliance either did not include reminders or did not compare different interventions. <p><i>Network meta-analysis</i></p> <ul style="list-style-type: none"> • Although there is large uncertainty in the effect sizes of hand hygiene interventions, there is evidence that all intervention strategies are associated with improved hand hygiene compliance compared with no intervention. <ul style="list-style-type: none"> ○ Single component interventions (education or system change/reminders) were associated with improving hand hygiene compliance compared with no intervention (mean OR=4.30; 95% CI: 0.43-46.57). However, this finding was not statistically significant. ○ WHO-5 (mean OR=6.51; 95% CI: 1.58-31.91) was significantly associated with improving hand hygiene compliance compared with no intervention. ○ WHO-5 in conjunction with additional interventions including goal setting, reward incentives, and accountability were significantly associated with improving hand hygiene in comparison to no intervention (mean OR=11.83; 95% CI: 2.67-53.79). • After excluding three studies with multiple stepwise interventions in the sensitivity analysis, there was a decrease in the effect size of all intervention strategies. Notably, both single component interventions and WHO-5 alone were not significantly associated with improved hand hygiene compliance. WHO-5 in conjunction with goal setting, reward incentives, and accountability remained significantly associated with hand hygiene compliance.
Comments/limitations	<ul style="list-style-type: none"> • Uncertainty in effect sizes of interventions based on network meta-analysis • Consistency in implementation of the same interventions (and each component) may differ across studies.

Items reviewed	Guideline #1 of 2: Strategies to prevent healthcare-associated infections through hand hygiene
General Information & Quality Rating	
Author(s), Date	Ellingson et al, 2014 (Society for Healthcare Epidemiology of America; SHEA, and Infectious Disease Society of America; IDSA guideline)
Quality rating	Moderate to strong (using AGREE II tool by two independent reviewers)
Focus & Objectives	<ul style="list-style-type: none"> To highlight practical recommendations for hand hygiene in healthcare facilities based on the most current evidence. To elucidate topics that warrant clarification or more robust research. To assist healthcare facilities in implementing hand hygiene adherence improvement programs, including efforts to optimize hand hygiene product use, monitor and report back hand hygiene adherence data, and promote behavior change. <p>Note: This guideline is one part of a series of guidelines “A compendium of strategies to prevent healthcare-associated infections in acute care hospitals” developed to provide practical, relatively concise expert guidance in prioritizing and implementing healthcare-associated infection prevention efforts. The rest of the table below will be focused on relevant aspects of this guideline (i.e. the effectiveness of hand hygiene interventions to improve hand hygiene compliance).</p>
Target audience	Acute care hospitals (e.g. administrators, clinical/institutional leaders)
Target population	Acute care hospital healthcare staff (e.g. physicians, nurses)
Interventions	Hand hygiene improvement strategies including access to hand hygiene equipment and products, education of healthcare workers, reminders (e.g. posters), feedback to healthcare workers on hand hygiene performance, administrative support (i.e. institutional leadership and champions).
Primary outcome	Hand hygiene compliance
Evidence ranking system	<ul style="list-style-type: none"> Category I (High): Highly confident that the true effect lies close to that of the estimated size and direction of the effect. Evidence is rated as high quality when there is a wide range of studies with no major limitations, there is little variation between studies, and the summary estimate has a narrow confidence interval. Category II (Moderate): The true effect is likely to be close to the estimated size and direction of the effect, but there is a possibility that it is substantially different. Evidence is rated as moderate quality when there are only a few studies, or the confidence interval of the summary estimate is wide. Category III (Low): The true effect may be substantially different from the estimated size and direction of the effect. Evidence is rated as low quality when supporting studies have major flaws, there is important variation between studies, the confidence interval of the summary estimate is very wide, or there are no rigorous studies, only expert consensus.
Relevant recommendations	<ul style="list-style-type: none"> Implement a multimodal strategy (or “bundle”) for improving hand hygiene adherence to directly address the organization’s most significant barriers (recommendation classified as category II). <ul style="list-style-type: none"> Use a bundled approach including enhanced access to alcohol-based hand rubs, education, reminders, feedback, and administrative support. At a minimum, use a bundled approach including education, reminders, and feedback. Educate, motivate and ensure competency of healthcare practitioners about proper hand hygiene (recommendation classified as category III). <ul style="list-style-type: none"> Motivate healthcare practitioners to perform hand hygiene using positive message framing for hand hygiene messaging and posters.
Details on methodology of literature review	
Types of evidence used to	<ul style="list-style-type: none"> Results of literature review

inform guideline	<ul style="list-style-type: none"> • Expert panel consensus • Feedback from peer-review process and stakeholder organizations
Number of included primary studies/reviews	Although the total number of studies included in the literature review was not reported, the number of studies was accounted for in the evidence ranking system.
Search period	Up to 2008
Literature search sources	Not known
Inclusion/exclusion criteria	Previously published guidelines, systematic reviews, and meta-analyses as well as relevant literature.
Geographical settings of primary studies/reviews	Varies
Comments/limitations	<ul style="list-style-type: none"> • Lack of information on methodology of literature review (e.g. search sources, inclusion/exclusion criteria, synthesis, etc.). • Reminders (and other hand hygiene intervention components) were not explicitly defined in the guideline, although references were made to findings of a systematic review (Schweizer et al., 2014), and the WHO implementation guide (2009), which considered posters as an example.

Items reviewed	Guideline #2 of 2: WHO Guidelines on hand hygiene in healthcare
General Information & Quality Rating	
Author(s), Date	The World Health Organization (WHO), 2009
Quality rating	Strong (using AGREE II tool by two independent reviewers)
Focus & Objectives	<ul style="list-style-type: none"> To thoroughly review the evidence on hand hygiene in healthcare. To provide specific recommendations to improve practices and reduce transmission of pathogenic micro-organisms to patients and healthcare workers. <p>Note: The remainder of the table focuses on hand hygiene interventions including use of reminders.</p>
Target audience	Policy makers, managers and healthcare workers in different settings and geographical areas.
Target population	Healthcare workers, hospital administrators and health authorities who deliver healthcare to patients or a specific group in a population.
Interventions	Hand hygiene interventions including training/education of healthcare workers, institutional safety climate (e.g. institutional leadership, patient/healthcare worker empowerment), performance feedback, access to hand hygiene supplies and equipment (e.g. soap/water, sinks, alcohol-based handrubs), reminders in the workplace (i.e. posters)
Primary outcome	Hand hygiene compliance
Evidence ranking system	<ul style="list-style-type: none"> Category IA: strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiological studies Category IB: strongly recommended for implementation and supported by some experimental, clinical, or epidemiological studies and a strong theoretical rationale Category IC: required for implementation, as mandated by federal and/or state regulation or standard Category II: suggested for implementation and supported by suggestive clinical or epidemiological studies or a theoretical rationale or a consensus by a panel of experts
Relevant recommendations	<ul style="list-style-type: none"> For healthcare administrators, implement a multidisciplinary, multifaceted and multimodal programme designed to improve adherence of healthcare workers to recommended hand hygiene practices (recommendation categorized as category IB). <ul style="list-style-type: none"> According to the guideline, most studies used multimodal strategies including healthcare worker education, audits of hand hygiene practices and performance feedback, reminders in the workplace, improvement of water and soap availability, use of automated sinks, and/or introduction of an alcohol-based handrub as well as improving institutional safety climate with participation at the institutional, healthcare worker and patient levels. Encourage partnerships between patients, their families, and healthcare workers to promote hand hygiene in healthcare settings (recommendation categorized as category II). <ul style="list-style-type: none"> According to the guideline, programmes for patient and staff empowerment in hand hygiene improvement are part of a multimodal approach. Empowerment strategies may include patient education, motivational messages (i.e. visual reminders including badges/stickers worn by patients, posters), and role modelling (by peers/superiors).
Implementation strategy	<p>The WHO Multimodal Hand Hygiene Improvement Strategy was created to facilitate implementation of the guideline, which consists of five components to be implemented in parallel including:</p> <ol style="list-style-type: none"> System change (i.e. availability of alcohol-based handrub at point of patient care and/or access to safe, continuous water supply and soap and towels)

	<ol style="list-style-type: none"> 2. Training and education of healthcare professionals 3. Monitoring of hand hygiene practices and performance feedback 4. Reminders in the workplace (tools available include WHO posters on how to handwash and “5 moments” (when to handwash)) 5. Creation of a hand hygiene safety culture with the participation of both individual healthcare workers and senior hospital managers <p>Additional actions can be added depending on local resources and culture, particularly patient involvement.</p>
Details on methodology	
Types of evidence used	<ul style="list-style-type: none"> • Results of literature review • Expert panel consensus • Internal and external peer review feedback • Results of pilot testing of WHO Multimodal Hand Hygiene Improvement Strategy at eight healthcare sites.
Number of included primary studies/reviews	Although the total number of studies included in the literature review was not reported, the number of studies was accounted for in the evidence ranking system.
Geographical settings of primary studies/reviews	Mostly developed countries
Search period	1997-2008
Literature search sources	<ul style="list-style-type: none"> • Pubmed, Medline, EMBASE, Cochrane Library • Reference lists, international and national infection control guidelines and textbooks
Inclusion/exclusion criteria	<u>Inclusion:</u> English language
Comments/limitations	<ul style="list-style-type: none"> • Lack of detailed information on literature review methods (i.e. inclusion/exclusion criteria).