

**Hand Hygiene:**  
**A review of literature and programmes**

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Abbreviations

ABHR	Alcohol based handrub
ACSQHC	Australian Commission on Safety and Quality in Healthcare
AHS	Alberta Health Service
AI	Artificial intelligence
APIC	Association for Professionals in Infection Control and Epidemiology
CDC	Centers for Disease Control and Prevention
CEO	Chief Executive Officer
CI	Confidence interval
DHB	District Health Board
FTE	Full-time equivalent
GSA	Gold standard auditors
HAI	Healthcare associated infection
HA-SAB	Healthcare acquired staphylococcus aureus bacteraemia
HCW	Healthcare worker
HH	Hand hygiene
HHCApp	Hand hygiene compliance application
HHNZ	Hand Hygiene New Zealand
ICU	Intensive care unit
IPAC	Infection Prevention and Control Canada
IPC	Infection prevention and control
IQR	Inter-quartile range
IRR	Incidence rate ratio
MRSA	Methicillin resistant staphylococcus aureus
NHHI	Australian National Hand Hygiene Initiative
NICE	UK National Institute for Health and Care Excellence
NICU	Neonatal intensive care unit
NPSA	UK National Patient Safety Agency
OR	Odds ratio
POPS	Private Organizations for Patient Safety
RCT	Randomised controlled trial
RMO	Resident Medical Officer
TTT	Train the trainer
UK	United Kingdom
US	United States
VHA	US Veterans' Health Administration
WHO	World Health Organization

## Executive Summary

Health-care-associated infections (HAIs) risk patient safety and increase health-care costs. Improvement in hand hygiene (HH) compliance is the most effective measure to reduce HAIs. HH is a required practice for all health care workers (HCWs) and is recommended in all national and international infection prevention and control (IPC) guidelines.

In New Zealand, the Health Quality and Safety Commission implemented a HH programme (HHNZ) that uses the World Health Organization's (WHO) multimodal HH improvement strategy to drive culture change and establish best HH practice in New Zealand hospitals. The programme has been successful in increasing HH compliance from 62.1 to 86.7 percent.

Feedback from the sector and the 10-year milestone of the HHNZ programme has prompted an internal review of the programme. The review includes examination of current literature that may inform changes to the programme. The current report constitutes this literature scan.

Evidence indicates alcohol-based handrub is the preferred HH product for most situations. The optimal HH technique remains unknown. Evidence shows that a six step, 30-second technique is effective. However, some studies have found three-step approaches, or 15-second methods to be non-inferior. High-level reviews have called for continued promotion of the WHO's six-step approach, with ongoing research to establish if it can be simplified.

Multimodal HH improvement strategies are most effective for increasing HH compliance and reducing HAIs. Evidence supports bundle strategies that include education, reminders, feedback, administrative support, and access to alcohol-based handrub. Additional emphasis on leadership and teamwork elements appears to improve programme effectiveness. A WHO survey of HH at facilities around the world found organisational safety climate was the lowest scoring component of multimodal programmes.

Education on HH has been found to increase knowledge and adherence to HH. The literature favours mixed modal education, and multiple ongoing sessions are optimal. Train the trainer approaches are recommended for consistency. Education sessions should be mandatory for all staff working in clinical areas and be informed by audit and evaluation data.

The present review did not find evidence in favour of specific governance or leadership arrangements for HH programmes. However, the WHO recommends that HH be nationally coordinated. Several jurisdictions have a national standard regarding HH. NICE recommends that there be a facility Board member responsible for HH. CEOs of facilities should support a HH coordinator and multidisciplinary HH teams or committees and unit-level champions.

There remain many barriers to effective HH. These include understaffing, overcrowding, workload, product placement, discrepancies between healthcare professions, and the fact that using gloves gives a false sense of security.

Monitoring can increase HH compliance, and the mainstay is a combination of direct observation (including technique), with monitoring of product consumption, staff surveys, and tracking HAIs. Validation of data, and checks of reliability, should be ongoing. Data should be reported to the national programme, facility leadership, unit leadership, all HCWs, and the public. Reported data should be used to adjust and amend education and practice.

## Introduction and Aims

Health-care-associated infections (HAIs) risk patient safety and increase health-care costs. Improvement in hand hygiene (HH) compliance is the most effective measure to reduce HAIs (de Kraker et al 2022). Hand hygiene is a required practice for all health care providers and is recommended in all national and international infection prevention and control (IPC) guidelines. HH is a basic expectation of patients and their families (Public Health Ontario 2014), yet data continues to show that HH compliance is less than optimal and further progress is needed (Lotfinejad et al 2021). Covid-19 has had a huge effect on HH, with more awareness, research, and possibly more compliance. However, it has also impacted HH programmes resulting, for example, in resource re-direction and fewer audits.

In New Zealand, the Health Quality and Safety Commission (the Commission) has implemented a hand hygiene programme (HHNZ) that uses the World Health Organization's (WHO) multimodal hand hygiene improvement strategy to drive culture change and establish best HH practice in New Zealand hospitals. Staff training in the WHO's 'Five Moments for Hand Hygiene' along with regular auditing and reporting of hand hygiene compliance are key components of the HHNZ programme.

The HHNZ programme started as part of the Ministry of Health Quality Improvement Committee National Quality Improvement Programme in 2007. The programme was piloted in several DHBs. In 2010, with the formation of the Commission, the HHNZ programme was re-invigorated and by 2012 all 20 DHBs were participating. Participation now includes some private surgical hospitals and other private health facilities. The programme has been successful in increasing hand hygiene compliance from 62.1 percent to 86.7 percent.

Feedback from the sector and the 10-year milestone of the HHNZ programme has prompted an internal review of the programme by the Commission's IPC team. The review includes an examination of the current literature that may inform changes to the programme in the future. The 2022 transition to the Health New Zealand model for New Zealand healthcare provision may provide an opportunity to further consolidate the HHNZ programme and enhance facility-level leadership.

### **Aim and Scope**

The aim of the following focused and time-limited literature review was to identify academic literature, institutional guidance, and international, national, and subnational programmes on HH that might help inform the review of the HHNZ programme. Focus was on evidence published since 2005.

## Methods

The literature review consisted of a non-systematic, time-limited search. The search comprised two parts (1) a review of the academic literature since 2005, (2) a review of advice published by institutions around the world and examples of programmes at international, national, and facility level.

### Academic Literature Scan

Several databases were queried to source evidence relevant to the review. These included PubMed, Cochrane, Google Scholar, and MedRxiv. The JBI database was also consulted, and an artificial intelligence (AI) database search facility ‘Elicit’ was used to supplement the keyword/Boolean searches.

Targeted searches were undertaken in July 2022. In total 2,183 titles were identified in PubMed and screened, and 94 abstracts were obtained. Given the wealth of information the focus was on high-level evidence such as syntheses, reviews, meta-analyses, and cluster RCTs. Review of the Cochrane Database provided 18 results and one additional source was retained. Google Scholar returned 6 relevant results in the first ten pages that were not duplicates of sources already obtained. MedRxiv returned no additional relevant results.

A new semantic artificial intelligence (AI) search assistant called ‘Elicit’ was deployed.<sup>1</sup> Elicit identifies relevant literature using GPT-3 (an AI language model). Search queries are phrased in natural language rather than keywords. The search engine uses semantic structure to infer the papers of interest, results are refined by iteratively selecting results of interest and searching for ‘more like these’. Elicit was deployed using a range of queries including the search queries prompted by Elicit in response to user queries.

When limited to papers since 2005 and following ten iterations of selecting in-scope sources and instructing ‘more like these’, the Elicit search returned relevant 50 sources. Duplicates of earlier results were removed.

In total 67 full-text papers were obtained from the academic literature and categorized. Following screening of these papers 39 were retained and tabulated.

### Search for Institutional Guidance and Examples of Programmes

The grey literature was searched by scanning the websites of relevant organisations, searching for ‘hand hygiene’ or ‘handwashing’. Examples of organisations: National Institute for Health and Care Excellence, National Patient Safety Agency (UK), Hand Hygiene Australia, The Australian Commission on Safety and Quality in Health Care, Health Services Executive Ireland, Infection Prevention and Control Canada, Public Health Ontario, Alberta Health Services, the World Health Organisation, among others. After screening results, 16 reports were added to the retained materials (note some institutional HH programmes were described in the academic literature that was already obtained).

In total 55 papers, reports, and guidelines were included in the review and tabulated in the Excel spreadsheet. Incidental additional sources are mentioned in the report that follows.

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<sup>1</sup> <https://elicit.org/search>

## Part I: Academic Literature

A total of 28 sources from the academic literature (that did not pertain to specific programmes) were retained following full-text review. These were organised by study type and tabulated (see the first tab of the Supplementary Excel file). This Academic literature is presented as follows. First the high-level academic literature is described (syntheses of evidence, umbrella review, Cochrane reviews, other reviews, optimal HH bundles). Next come sections on Education and Training, Governance Structures, Monitoring Compliance, and Reporting. The content presented in these sections blends the academic literature (mostly reviews) with relevant statements and guidance found in the documentation for some of the programmes and case studies described in Part II. It is worth noting that a large proportion of the primary studies discussed in the academic reviews were conducted in the United States (US) and Europe, and most commonly (though certainly not exclusively) they study nurses and acute care settings such as ICU or acute care wards.

### *Syntheses of Evidence*

Several narrative reviews or review essays have attempted to synthesise the breadth of evidence on HH improvement. Four were included in the present review.

In a wide-ranging narrative review in the *Lancet*, Lotfinejad et al find that multimodal intervention strategies appear more effective than single interventions for improving HH. Alcohol-based handrub (ABHR) is the preferred product for HH and the authors suggest that organisations should supply at least two kinds of product to satisfy user preferences. Covid-19 has been a wakeup call and has highlighted issues of understaffing, overcrowding and workload, which are all major obstacles to HH. It is noted that HH concepts might be able to be simplified from the WHO's 'Five Moments' to a 'Four Moments' approach, as in Canadian guidance (see below). There remains variation in HH technique practiced. The WHO promotes a 'six-steps' approach, however, a '3-steps' technique is promising (or a six-steps but fingertips-first approach). These authors conclude that until further research is performed the WHO 'six-steps' should still be advised (Lotfinejad et al 2021).

Boyce reviews HH in a 2021 update, finding that HH reduces HAIs, and that automated monitoring is associated with fewer HAIs. This author suggests that automated monitoring should be combined with direct observation to overcome some limitations of the latter and it is also important to monitor technique (Boyce 2021).

Stadler et al argue that sustained increase of compliance and decrease of HAIs may be achieved by national, systematic, and rigorous education, and auditing programmes. These authors recommend ABHR solutions are the gold standard, but products should be modified in texture and composition to accommodate preferences of healthcare workers (HCWs). Periodically deployed self-operating HH surveillance systems coupled with personalized reminders are effective. Furthermore, a rub-time of 15 seconds appears sufficient (with good ABHR coverage) and simplifying the HH technique from the WHO's six steps to three has yielded encouraging results in terms of microbiological efficacy and higher compliance (Stadler and Tschudin-Sutter 2020).

The Society for Healthcare Epidemiology of America in conjunction with the Infectious Diseases Society of America published a detailed summary of practice recommendations

derived from WHO and CDC advice on HH (Ellingson et al 2014). The present report incorporates this assessment in various sections below.

#### *Umbrella review*

A 2018 systematic review of 19 systematic reviews (15 narrative syntheses, 3 meta-analyses, one network meta-analysis) found evidence to recommend interventions to improve HCW HH compliance including individual and multimodal approaches, except for monitoring technology (Price, MacDonald, et al 2018). The evidence, however, was not sufficient to make recommendations for which specific interventions are preferable (single, multimodal), or how to deliver the content. It did appear that efforts to target social influence, attitude, self-efficacy, and intention were associated with greater effectiveness. This umbrella review noted that only one study, the Cochrane review of Gould et al (2017), reported below, was at low risk of bias. Common components of multimodal programmes included ‘observation and feedback’, ‘training and education’, and ‘reminders.’ ‘Safety climate,’ was the least common of the WHO multimodal framework components to appear in the systematic reviews.

#### *Cochrane reviews*

The team of Gould et al undertook three Cochrane reviews on interventions to improve HH compliance. The most recent review included 26 studies in hospital, long-term care, and primary care settings (Gould, Moralejo, Drey, et al 2017). Outcome measures included product consumption, and measures of compliance. Fourteen studies reported multimodal programmes like that recommended by the WHO. Six focused on performance feedback with additional components. Two evaluated education, three evaluated cues such as signs or scent, one assessed positioning of handrub, and nine studies measured rates of infection or colonisation. The authors concluded that interventions may increase HH compliance, and may reduce healthcare acquired infection rates, but there was low certainty in the findings and studies examined were often of low quality.

#### *Commentary on the Cochrane reviews*

In a commentary on the Cochrane reviews Gould reflects that the evidence synthesis was very rigorous, that multimodal interventions, and their single components, probably can modestly increase compliance and infection and colonisation may slightly reduce. In this opinion Gould questioned the cultural generalisability of some interventions such as posters of eyes and scents (Gould, Moralejo, Drey, et al 2018). Importantly, the Cochrane reviews discarded over 500 studies because they did not meet a very strict methodological quality bar. Also, some large evaluations such as the eight-year evaluation of the Australian national programme (see below) were published after the Cochrane review.

#### *Other reviews*

A comprehensive systematic review of 57 studies of HH trials around the world from 2014–2020 found that 36 studies evaluated some variation of the WHO’s multimodal framework for HH. Many studies recorded HH opportunities at each of the ‘Five Moments’ but recording of HH technique was not common. Nine studies involved all five WHO components (education and training, reminders, infrastructure improvement, performance feedback, and teamwork or leadership interventions). The review found that both single intervention and multimodal HH strategies can achieve modest-to-moderate improvements in HH compliance among HCWs. All except one study showed an increase in HH compliance post intervention, with the mean net effect being an increase of 26 percent. This was higher where baseline compliance was lower (Clancy, Delungahawatta and Dunne 2021).



An integrated review reported on 73 studies that included at least one HH intervention or programme. Five HH intervention types were found to be effective. These included improving awareness with education, facility design and planning, unit-level protocols and procedures, institution-wide programmes, or multimodal interventions. Additionally, the rate of effectiveness could be increased by systems and multimodal interventions, adaptation of the interventions to unit-level conditions and issues, and adaptations of novel approaches such as environmental psychology, behavioural economics, human factors and ergonomics, and financial rewards (Neo, Sagha-Zadeh, Vielemeyer and Franklin 2016).

#### *An optimal Hand Hygiene bundle*

A 2013 meta-analysis sought evidence for an optimal HH bundle (of multimodal intervention) (Schweizer et al 2013). This study included many ‘quasi experimental’ studies that were excluded by one of the Cochrane reviews in 2010. Six randomized controlled trials and 39 quasi-experimental studies met inclusion criteria. Only seven studies were ‘whole hospital’ and many were in ICUs, NICUs, or acute care only. Most studies (84%) measured compliance by direct observation, though some used electronic or video systems. Three studies evaluated the interventions education, reminders, feedback, administrative support, and access to alcohol-based handrub as a bundle. This was associated with improved HH compliance (pooled odds ratio [OR], 1.82; 95% confidence interval [CI], 1.69–1.97). Another bundle of education, reminders, and feedback evaluated in three studies was associated with improved compliance (OR, 1.47; 95% CI, 1.12–1.94). Studies were generally of low quality, with likely publication bias. However, only 8 of 45 studies did not find improvement in HH compliance.

A meta-analysis of 12 studies found that the most effective intervention (OR 18.4, 95% CI (13.6–24.8)) was a multilevel strategy that influenced the determinants of HH behaviour at individual, interpersonal, and organizational levels. The authors presented a theory-based logic model to guide planning, implementing, and evaluating an intervention at these three levels (Kaveh, Motamed-Jahromi and Hassanipour 2021). Table 2 in the paper provides the logic model which is based on a socioecological approach accounting for inputs, processes, and outcomes to improve HH compliance. An important finding in the study was the need to conduct situation analysis prior to implementing a HH improvement strategy to understand present activities in each target area.

Importantly, ABHR is the most effective HH product and should be modified for HCW preferences (Stadler and Tschudin-Sutter 2020). There is no one product that fits all needs, therefore facilities are recommended to provide at least two different ABHRs (Lotfinejad et al 2021).

## Education and Training

### *Overview of education and training*

Three reviews on the theme of education and training were included in the present report. Two were systematic reviews, one was an integrative review. Overall findings indicate that education can increase knowledge of HH and adherence to HH practices. A mixed educational approach is better than self-directed learning, and multiple, continuous education interventions are more effective than single sessions.

### *Reviews of education and training*

A systematic review of 30 studies on education on HH for HCWs considered the relationship between how the educational interventions were delivered and their effectiveness. Delivery of education was separated into six groups: (1) demonstration; (2) no demonstration; (3) self-study; (4) video; (5) demonstration and video, and (6) an online element. This review found that multiple, continuous interventions were better than single interventions in terms of eliciting and sustaining behaviour change. Data were not available to determine the time, nature, and type of booster sessions with feedback to produce permanent change in HH compliance. The review did not manage to identify individual features of educational interventions due to each study reporting multiple components (Cherry, Brown, Bethell, et al 2012).

Another systematic review of 17 studies examined education for nurses. All educational interventions increased adherence to HH (by 18-70%). In some cases, the increase in compliance decayed over time. Less experienced nurses tended to show greater compliance. A mixed intervention approach was better than self-directed training and strategies such as reminder sounds, practical simulations, videos, and audio-visual media improved handwashing compliance (Martos-Cabrera et al 2019). Note, however, that the umbrella review of Price et al (described above) found no clear link between how educational interventions were delivered and their effectiveness in improving HH, concluding that the evidence was insufficient to make specific recommendations regarding education content or how the content should be delivered. (Price, MacDonald, et al 2018).

An integrative review examined five studies on education for nurses. Training included multiple components, such as lectures on HH, training sessions on HH and HAIs, preparation of booklets or flyers, and posters about the topic in key locations. Adherence to HH was increased after training interventions but this review did not describe the interventions in any useful detail (Graveto, Rebola, Fernandes and Costa 2018).

### *Education frameworks*

#### *Five moments and six steps*

The WHO approach is to educate HCWs around the 'Five Moments' for HH. Several adaptations of the Five Moments apply in different settings, for example when the patient is sitting on a chair, is attending outpatient clinics, or in long-term care. The WHO recommends that HCWs learn a six-step technique for performing HH (World Health Organization 2009a).

The WHO Provides a set of tools for education, but these may need to be updated and modified for local use. The WHO further recommends ongoing education of HCWs, checking competence, training new trainers at a range of levels, basing education on feedback

and evaluation data, reviewing training materials annually, developing education innovations, and sharing success with other facilities (World Health Organization 2009a).

The WHO train the trainer (TTT) approach can be used to educate those who then facilitate education of observers and other HCWs. TTT education is structured around: key principles for best practices in HH, implementation of a multimodal promotion strategy, behavioural change, innovation, and recent scientific evidence. The Five Moments for HH are used to standardise monitoring of HH compliance and provide performance feedback to participants. The TTT course was evaluated in a multi-site study across six countries. Knowledge of HH increased 10-22% across all 7 sites ( $p < 0.05$ ) following the course. However, this study did not report compliance or clinical outcomes (Tartari et al 2019).

In its update on HH for outpatient settings the WHO states that educational supports and documents should include the following concepts: definition, impact and burden of HAI; major patterns of transmission of health care-associated pathogens with a particular focus on hand transmission; HH basic concepts including why, when, and how to perform HH according to the WHO Guidelines on HH in Health Care and accompanying tools (World Health Organization 2012).

In an analysis of resource considerations for HH programmes, the WHO identifies that primary and secondary care facilities will have different needs for implementing education (World Health Organization 2021):

- **Primary Care:** A trained IPC link person with dedicated (part-time) availability to deliver training, a funded programme to facilitate training to all HCWs at least annually, and programme and education materials.
- **Secondary Care:** A trained IPC professional team member for every 250 beds in charge of delivering training, a funded programme to facilitate training for at least 2 hours annually for all HCWs.

The WHO's frameworks and approach to education for HH (or those similar to them) have been incorporated by many HH programmes globally, including some of the earliest and most comprehensive programmes such as the Australian National Hand Hygiene Initiative (NHHI).

#### *Other frameworks*

Counter to the Five Moments approach, Infection Prevention and Control Canada, and Public Health Ontario, recommend a Four Moments framework for best practice (see section on 'Canada' below). In their guidance, education for health care providers should be ongoing and should cover the indications for HH (Four Moments), factors that influence HH, HH agents, HH techniques, hand care to promote skin integrity, as well as human factors in relation to the environment. Within the education framework there should also be encouragement of partnerships between clients/patients/residents, their families and health care providers to promote hand hygiene in health care (IPAC 2017, Public Health Ontario 2014).

Gould has criticised the 'My Five Moments' approach to HH (and by implication the Four Moments) and laid out 'five inconvenient truths': the Five Moments does not include the perspectives of stakeholders, it is not always possible to implement the Five Moments, the patient zone is not fixed, the Five Moments overlook barriers to HH compliance, and full adherence to the Five Moments cannot prevent all risk. There is also a risk of drift away from

the original concepts. Solutions might include rewriting guidelines and considering HCWs preferences and opinions, a national approach to placement of ABHR (including entrance to hospitals and wards), signage, and non-touch surfaces (eg doors), adding a ‘stochastic approach’ ie thorough hygiene at predetermined intervals, more focus on HH for visitors, and reducing the microbial burden of environment (Gould et al 2022).

#### *Hand hygiene technique*

Proper technique should be taught and adhered to, but the optimal technique is unclear. A systematic review identified seven studies that evaluated the WHO-recommended six-step technique. The WHO technique was found to reduce bacterial load on HCW hands. However, of three RCTs, one found no difference in the effectiveness of the WHO six-step compared to the CDC’s three-step technique ( $p=0.08$ ), another found the WHO six-steps more effective ( $p=0.02$ ) and one found a modified three-step technique more effective than the six-step technique ( $p=0.021$ ) (Price, Melone, et al 2018). A more recent cluster RCT also found a 3-step technique (with 3mL for 30sec) non-inferior to the six-step technique (Tschudin-Sutter et al 2019).<sup>2</sup>

The optimal duration of handrub is also unclear. Compliance with 30-second handrub is rare, and 30-seconds may disincentivize HH at all. There is laboratory evidence that 15-seconds may be non-inferior to 30-seconds (Stadler and Tschudin-Sutter 2020).

Another issue of technique is how much ABHR to use. A minimum of 1mL should be dispensed to allow a dry time of at least 15 seconds, and 3mL may provide better results (Boyce 2021, Lotfinejad et al 2021).

Given this evidence it may well be the case that a three-step technique, for at least 15-seconds, with 3 mL of ABHR could be non-inferior to the six-step 30-second approach. However, the HH overview in *Lancet* by Lotfinejad et al concludes, that because of the paucity of evidence for alternatives, the WHO six-step technique is still recommended, though a ‘fingertips first’ version might be optimal as it provides greater bacterial reduction (Lotfinejad et al 2021).

In addition to appropriate volume and technique, there have been suggestions that regular HH at predetermined times, in addition to the Five Moments, might provide ‘stochastic’ protection from HAI (Gould et al 2022). This remains untested and is an area for future research.

Taking what is probably a pragmatic approach the Public Health Ontario Best Practices for HH guide advocates the use of ‘one to two full pumps’ of the ABHR dispenser, and covering the hands, so that a minimum 15-seconds of rubbing should be required for drying (Public Health Ontario 2014).

#### *Frequency of hand hygiene training and refresher*

The UK National Institute for Health and Care Excellence (NICE) states that IPC competencies should be updated and checked at appropriate intervals (NICE 2011). Reviews of the academic literature indicate that ongoing HH training is more effective than one-time

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<sup>2</sup> The 3 steps consist of (1) covering all surfaces of the hands (based on own judgement), (2) rotationally rubbing the fingertips in the palm of the alternate hand, and (3) rotationally rubbing both thumbs.

training (Graveto et al 2018), although the exact optimal frequency is unknown (Cherry et al 2012).

#### *Annual training*

In practice, annual HH education and training is commonly recommended. An exception to this is in Ireland where guidelines for HH recommended education every two years (Royal College of Physicians Ireland 2015).

The Association for Professionals in Infection Control and Epidemiology (APIC) recommends that education and training should consist of annual mandatory completion of HH modules, with sign-offs of recertification. This can demonstrate that the organisation views HH as a priority and contributes to a culture of safety (APIC 2015).

The WHO also supports regular training ‘repeated at least annually’ (World Health Organization 2012), as well as regular updates and competence checks of existing and previously-trained staff (World Health Organization 2009a), as well as a process to confirm that all HCWs have received training (World Health Organization 2010). Although improvements from the TTT programme evaluation in seven countries were sustained over 5 months, 1 year, and 2 years follow-up periods, this was IPC staff only, and measured knowledge not behaviour (Tartari et al 2019).

Hand Hygiene Australia previously stated that online learning modules should be completed at least annually. Furthermore, high staff turnover means that regular updates should be planned, including orientation programmes, in-service lectures or special workshops (Hand Hygiene Australia 2019).

Additionally, general IPC training can be used as an opportunity to reinforce HH training on a regular basis. Day-to-day opportunities for education could especially target medical ward rounds. HH education can be included at intern and RMO orientations/education sessions. Reminders in the workplace can provide another layer of ongoing awareness and should bring attention to key educational messages. Such reminders can include: Posters on the Five Moments, how to handrub, and how to handwash; HH leaflets, screensavers, or other reminders.

#### *Mode of training*

HH training can be delivered online, in the classroom, self-directed, in-service, or through train-the-trainer approaches. Findings in reviews of the academic literature suggest that a mixed approach to education is better than self-directed learning alone.

HH education will likely have most benefit if it is interactive and engaging. Education should inform without being too cognitively demanding, and should fit into busy work schedules of HCWs (Neo et al 2016).

The APIC recommends that multimedia presentations can be used, including: mandatory online multimedia learning modules; presentations; group discussions, classes, lectures, and grand rounds; role modelling and mentoring including start of shift team huddles; and posters, pocket cards, and brochures. Education sessions are an opportunity for a brief message from senior leadership to express the importance of HH culture change. Effective education and training programmes will tie individual knowledge to organisation policies, compliance expectations, and HH culture (APIC 2015).

The WHO recommends standardised approaches, such as the WHO TTT approach. Facilitators should be IPC practitioners trained and validated in HH by IPC/WHO Collaborating Centre faculty members, and local IPC focal points in respective countries. The TTT course consists of didactic lectures, simulation-based training, and experiential participatory activities (role plays, clinical scenarios, presentations about real-world challenges) (Tartari et al 2019). A key aim of the TTT approach is to facilitate reliable and reproducible auditing and consistent compliance data. The WHO recommends that various WHO HH materials including the technical manual, guideline summary, brochure, and glove use information booklet should be readily available to HCWs.

In settings where time or resources for educational sessions are limited, adequate HH education supports should be provided. Sophisticated e-learning modules can be a good option. However, other methods include focus and discussion groups, problem-solving approaches, experiential and interactive learning, flip charts, videos, and buddy systems (World Health Organization 2012).

The Australian NHHI includes online learning modules that consist of educational slides, followed by questions. Immediate feedback is provided after each section is answered and correct answers are required before progressing. High profile promotional activities are recommended, for example leveraging World HH Day (5 May) or International Infection Prevention Week in October. Additional recommended promotional activities are: posters, awards, screen savers, newsletters, pay slip notices, rewarding individual compliance (stickers, chocolate), competitions or community involvement (Hand Hygiene Australia 2019).

Neo et al list other educational interventions including: hands-on or online training; problem-based education; gaming technology, conferences, newsletters, brochures, videos, posters, visual cues, simple visual illustrations to families and visitors; verbal reminders; voice messages; electronic alerts and displays; e-mail; screen savers; signs; prominent visual cues; and getting patients to remind HCWs on HH; monitoring HH using cameras; electronic monitoring; evaluation using performance feedback; and use of fluorescent gel to evaluate HH technique; and engaging student mentors in monitoring students' HH (Neo et al 2016).

Public Health Ontario recommends the use of educational materials including (Public Health Ontario 2008):

- Education presentations
- HH education modules
- Training presentations and materials
- Your 4 Moments for HH pocket card
- On-the-spot feedback tool
- Certificate of training completion

The Society for Healthcare Epidemiology of America paper on CDC and WHO advice states that organisations should educate providers on recommended indications and techniques for HH, using tools that clearly define HH indications and teach the logic of each (eg the Five Moments for HH). Interactive methods, education targeting specific groups or major misconceptions can be considered, and competency assessed (Ellingson et al 2014).

### *Categories of HCWs who receive the training*

The WHO states that ‘all HCWs’ should receive HH education and training, with specific sessions for trainers and for observers, including new starts, and repeat training periodically to include new staff and to update knowledge (World Health Organization 2009a).

The target audience for the WHO’s TTT programme is personnel from departments that supervise IPC activities at the participating healthcare facilities, including IPC, infectious diseases, hospital quality assurance department and hospital epidemiology departments. The programme evaluation noted that hospital managers, ward nurse managers and other health professionals were also welcomed (Tartari et al 2019).

In the UK, NICE advises that ‘staff working in clinical areas’ should complete IPC training within one week of starting (NICE 2011).

The APIC recommends that all service providers, volunteers, and staff, as well as patients, families, and visitors, must receive education on the importance of proper HH, as well as training on how and when to perform it (APIC 2015).

The Australian Hand Hygiene Initiative recommends that HH education be compulsory for all staff, including all HCWs, medical staff, students, and non-clinical staff. The Australian NHHI provides modules for all HCWs: Allied health, dental, medical, non-clinical staff, nursing/midwifery, renal/dialysis, surgeons, student health practitioner, and a ‘standard theory module’ for everyone else (Hand Hygiene Australia 2019). The NHHI further states that training for HH general auditors must be provided by ‘endorsed gold standard auditors’ and training for gold standard auditors must be provided by endorsed gold standard auditor training providers (Hand Hygiene Australia 2019). The training for gold standard auditors should include evaluation of interrater reliability and annual validation.

The Alberta Health Service ‘Interactive HH Module’ is recommended for all employees, members of the medical and midwifery staffs, students, volunteers and other persons acting on behalf of AHS (including contracted service providers) (Alberta Health Services 2021).

Data demonstrate lower HH compliance among laboratory staff and pharmacy staff, and also lower compliance among staff with lower levels of qualification (Clancy et al 2021). This finding may suggest that all staff ought to get HH training.

### *Regulatory requirements for hand hygiene education*

The WHO recommends that HH programmes would ideally implement a system for checking the competence of all HCWs who have received HH training (World Health Organization 2012). For example, in Canada HH reviews and HH education are Required Organizational Practices (ROPs) set by Accreditation Canada (Alberta Health Services 2021). The Australian NHHI recommends a HH learning module be included among mandatory training competencies for all HCWs. This training should take place on commencement (including student placements) and be written into employment contracts (Hand Hygiene Australia 2019).



## Governance Structures

The WHO intended that their 2009 HH multimodal programme implementation guide would be useful for: WHO country office staff, Ministry of Health leads for patient safety and infection control, infection prevention and control practitioners, senior managers/leaders, other individuals or teams responsible for HH or infection control programmes at a health-care facility, and patient organizations (World Health Organization 2009a). This gestures towards the wide range of individuals and entities that will be part of leadership and governance arrangements for HH.

### *Responsibility for the programme*

#### *National monitoring and feedback*

The WHO has made a strong HH recommendation in their guidance on the core components of IPC programmes. As well as ensuring that materials and equipment to perform appropriate HH are readily available at the point of care, HH monitoring and feedback should be a key performance indicator at the national level (World Health Organization 2020).

In Australia, for example, participation in the Australian NHHI is a national Quality Health Service Standard (Hand Hygiene Australia 2019).

#### *Health Boards & policy*

NICE has published guidance on healthcare associated infections in 2011 addressing Board Members in secondary care. The aim was to offer advice on management or organisational actions to reduce HAIs in secondary care settings. NICE recommended that Boards should assess current practice, identify areas for quality improvement, monitor progress, and provide leadership and support. There should be a Board member who leads on IPC. This will include HH and audit of hand-hygiene practices and feedback given to relevant staff (NICE 2011).

The Australian NHHI emphasizes that the hospital executive can demonstrate commitment and support for the HH programme through interest, participation and regular reporting on the HH programme at executive meetings, and to the hospital board (Hand Hygiene Australia 2019). The HH programme reported by one Australian private hospital was overseen by a team consisting of the Chief Executive Officer (CEO), Director of Clinical Services, Assistant Director of Clinical Services, Finance Manager, Risk Manager, and the Business Development Manager (Brocket & Shaban 2015).

Public Health Ontario emphasizes the need for policies, and states that each health care setting must have written HH policies and procedures (Public Health Ontario, 2014).

### *Leadership of the programme*

The WHO's 'Self-Assessment Framework' indicates that at a facility level the CEO, Medical Director, and Director of Nursing should make clear commitment to support HH improvement (World Health Organization 2010).

#### *Facility hand hygiene coordinator*

The WHO recommends that a HH coordinator leads education for HH trainers, with Senior Managers' awareness and support. The HH Coordinator should be a professional who understands HH and infection control issues (and possibly has experience in quality and



safety). The HH coordinator should have access to high-level management (World Health Organization 2009a).

*Hand hygiene committee*

The WHO also recommends a HH team/committee. This is a group of key internal stakeholders including influential leaders (head nurses, chief doctors, leads from other disciplines, senior managers) along with those involved in IPC (World Health Organization 2009a).

*Multidisciplinary team*

The APIC's high-level review of HH programmes states that effective HH bundles can contribute to hospital-wide cultures of safety. However, support from the most senior administrators is necessary. A quality improvement HH bundle should be a regular topic at departmental meetings and be promoted as an organisational priority outside and internal to the organisation by senior executives. Implementation of a quality improvement bundle for HH requires leadership from a multidisciplinary team. The programme can be coordinated by an infection prevention specialist, and include administrative, purchasing, clinical, and front-line staff, and quality improvement personnel. Such a team would guide the strategy, evaluation, and any adjustments to interventions, objectives, and timelines. Stakeholders and decision-makers should be included during development. Education staff can assist in developing high-quality education programmes (APIC 2015).

NICE also states that there should be evidence of local arrangements to ensure consultant medical staff across specialities champion IPC (including HH). These staff should have protected time to achieve defined objectives (NICE 2011).

The Australian NHHI promotes the use of local steering committees that include a HH coordinator, medical champion, IPC team, and quality and safety team. The HH coordinator should be a Gold HH Auditor. Critically, an executive sponsor should be identified who becomes a member of the steering committee (Hand Hygiene Australia 2019). Staff from the departments of infection prevention and control, infectious diseases, microbiology, and pharmacy (where available) should have an active role in the programme implementation. Wards could have HH Programme liaison officers. An organisation administrator could collate information on who has completed training.

Public Health Ontario's Best Practices guide suggests that the following is a minimum composition of a multidisciplinary HH team (Public Health Ontario 2014):

- Senior management representative
- Middle management representative(s)
- Physician representative(s)
- Infection prevention and control representative(s)
- Occupational health representative(s)
- Environmental services/housekeeping representative
- Plant services/maintenance representative
- Hand hygiene program champions
- Product purchasing representative
- Public relations/communications representative

The Society for Healthcare Epidemiology of America in their review of HH guidance describe an engagement process that includes developing a multidisciplinary team that includes representatives from administrative leadership as well as local (unit-level) champions, as well as ensuring that institutional leadership is aware and supportive of HH improvement strategies and supports these efforts with adequate resources. Qualitative studies suggest that role models, especially physician role models, are important ‘yet underappreciated’ (Ellingson et al 2014). The Society’s publication presents a table of ‘fundamental elements of accountability’ for IPC programmes, elements directly relevant to HH include (emphasis added):

- Senior management is *responsible* for ensuring that the healthcare system supports an infection prevention and control (IPC) programme.
- Senior management is *accountable* for ensuring that an adequate number of trained personnel are assigned to the IPC programme.
- Senior management is *accountable* for ensuring that healthcare personnel, including licensed and non-licensed personnel, are adequately trained and competent to perform their job responsibilities.
- Direct healthcare providers (such as physicians, nurses, aides, and therapists) and ancillary personnel are *responsible* for ensuring that appropriate IPC practices are used at all times (including hand hygiene).
- Senior and unit leaders are *responsible* for holding personnel *accountable* for their actions, including development of progressive discipline for habitual nonadherence to HAI prevention strategies.
- Senior and unit leaders are *accountable* for ensuring that appropriate training and educational programmes to prevent HAIs are developed and provided to personnel, patients, and families.
- Personnel from the IPC programme, the laboratory, and information technology departments are *responsible* for ensuring that systems are in place to support the surveillance programme.

#### **Australian National Hand Hygiene Initiative**

Grayson et al’s eight-year evaluation of the Australian NHHI concluded that, ‘Key contributors to NHHI success include leadership from the ACSQHC, a standardised national approach with collaboration and engagement between federal and jurisdictional authorities, adoption of WHO methodology, participation in the NHHI as mandatory for hospital accreditation, public reporting of hospital HH compliance data, and considerable efforts from frontline infection control practitioners.’

Additionally, Grayson et al note: ‘the central coordinating and supporting role of HH Australia was also important, focusing on assisting local jurisdictional ownership, ensuring national standardisation and messaging, validation, data integrity, and auditing efficiency via free provision of tools such as the central database, HCCApp mobile, mobile data entry, and educational materials’ (Grayson et al 2018) (p.1275). However, all these functions have more recently been taken over by the ACSQHC.

## Monitoring Compliance

There are several reasons for non-compliance of HCWs with HH guidelines (Clancy et al 2021, Ellingson et al 2014). These include:

- Tolerability of ABHR by staff and the aversion to skin irritation
- Perceptions about HH such as low prioritization of HH, staff rejection of HH as an effective measure, or lack of knowledge about HH
- Religious beliefs about ABHR (noted among a largely Muslim staff cohort)
- Cultural issues including a lack of role models
- Inconvenient location of ABHR/sinks
- Understaffing/busy workload

Factors for overcoming barriers include:

- Becoming habituated to HH
- Heightened awareness of microbial transmission during a pandemic
- Convenience of accessing HH material
- Quality feedback (sense of competition)
- Avoiding disappointing HH leaders/role models
- Staff workload

Importantly, research findings support monitoring as a driver for better HH compliance (Stadler and Tschudin-Sutter 2020).

### *High-level recommendations*

HH is intended to prevent infection as an outcome. Therefore, ultimately the rate of HAIs should be monitored. Compliance with HH is the process measure leading to this outcome (APIC 2015).

The WHO advises that evaluation and repeated monitoring is a vital component of HH programmes. The WHO multimodal HH improvement strategy recommends monitoring and evaluation of the following indicators (World Health Organization 2009a):

- HH compliance through direct observation as the ‘gold standard’ (note the WHO does not favour unobtrusive or covert observation due to issues of trust)
- Audit of ward infrastructure for HH (at least annually)
- HCW knowledge on HAI and HH indications and technique (at least annually)
- HCW perception of HAI and HH
- soap and alcohol-based handrub consumption (at least every 3 months)

The Joint Commission in the United States recommends a combination of three methods for assessing HH compliance. These are (1) direct observation, (2) measuring product use, and (3) conducting surveys (Tejada and Bearman 2015).

### *Academic literature*

Following review of the academic literature on monitoring of compliance with HH, ten papers were retained. These included nine additional reviews and the report of a stepped-wedge cluster RCT.

A systematic review including 71 studies of hospital based HCWs, aimed to determine the validity of HH compliance monitoring by observation. Results revealed that there were

multiple sources of bias in all studies where HH compliance was monitored by direct observation.<sup>3</sup> These biases included selection bias and lack of interrater reliability. This reduces the validity of findings and challenges the assumption that direct observation is the ‘gold standard’ monitoring technique. Standardised methodology would allow comparison of HH compliance between clinical settings and organisations. It is clearly important to have experienced, trained and educated observers (Jeanes, Coen, Gould and Drey 2019).

However, a review of the ‘state of the science’ in 2017 concluded that direct observation will remain an important tool for measuring HH performance. This is because direct observation can monitor all HH moments, as well as technique, and provides the opportunity for real time feedback. The author noted that data provided by electronic monitoring methods may help target potential problem areas (Boyce 2017).

An opinion by Gould supported these conclusions, noting that a Hawthorne effect and other behaviour modifying responses are problems for audit that just uses direct observation. Gould notes that monitoring product consumption can help and has the advantage of 24 hour monitoring. Electronic devices could overcome these issues but are costly and not widely used (Gould, Creedon, et al 2017).

The Hawthorne effect was quantified in a systematic review and meta-analyses of nine studies. With respect to HH compliance by observation, the Hawthorne effect ranged from minus 6.9% to +65.3%. There was variation across units, the effect was +4.2% in one study conducted in intensive care and +16.4% in transplant units. The authors concluded that occasional covert audit could give a better estimation of true HH adherence but its acceptability and feasibility to health workers need to be explored (Pursell, Drey, Chudleigh et al, 2020).

To these analyses Masroor et al adds the conclusion that although several methods of monitoring exist, it will often be that financial and human resources dictate the most feasible approach. Taking a multimodal approach to monitoring may increase the success of HH programmes. Also Masroor et al concur that high quality direct observation remains an essential element (Masroor, Doll, Stevens and Bearman 2017).

A systematic review of 73 studies summarized systems used in electronic monitoring for HH compliance. These systems included application-assisted direct observation (5), camera-assisted observation (10), sensor-assisted observation (29), and real-time locating systems (32). Twenty-one studies evaluated HH quality, consisting of compliance with the World Health Organization 6-step HH techniques (14) and surface coverage. These authors identify a number of limitations of electronic HH monitoring (Wang et al 2021).

Additionally, a 2021 review of commercial products for monitoring HH identified 29 commercial electronic HH monitoring systems. Only six of these had evidence supporting their use. However, most evaluation designs were quasi-experimental with only one study using a high-quality stepped-wedge cluster RCT design. In that study the electronic system was part of a wider HH multimodal improvement strategy, so it is hard to draw conclusions about its effectiveness in improving HH compliance (Cawthorne and Cooke 2021).

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<sup>3</sup> Criticism of HH compliance data includes observer bias, observer training, limited reliability, absence of corroborative methods of data collection, and sampling bias arising because data collection has taken place primarily during the day and on critical care units.

The stepped-wedge RCT involved five Canadian hospitals (including medicine, surgery, mixed and chronic care wards) with baseline HH compliance 83 percent by direct observation. Daily HH compliance was measured by a wireless electronic device connecting dispenser activations to an electronic hub. Daily HH adherence was calculated using estimates of the number of daily HH opportunities per patient bed multiplied by the hourly census of patients on the unit. This method has been previously validated. The study found that HH adherence increased from 29% to 37% within one month, followed by consecutive incremental increases up to 53% by ten months ( $P < 0.0001$ ). There was a trend toward reduced healthcare-associated transmission of MRSA (IRR, 0.74 [95% CI, .53–1.04];  $P = 0.08$ ) (Leis et al 2020).

It appears there is no one optimal method for monitoring HH compliance. Indeed Tejada et al conclude that several methods for measuring HH compliance exist and each method has its inherent advantages and limitations (Tejada and Bearman 2015). Table 1 below compiles the advantages and disadvantages of several methods by combining tables found in three other reviews (Boyce 2021, Ellingson et al 2014, Tejada and Bearman 2015).

**Table 1:** Methods for monitoring hand hygiene compliance

Method	Advantages	Disadvantages
Direct observation	Can estimate all Five Moments Identify barriers to HH Evaluation of technique Applicable in all facilities Immediate feedback Low cost	Observers need training Lack of standardisation (selection and observer bias) Periodic validation lacking Small sample sizes Hawthorne effect Hard to observe all indications Time consuming Concerns over accuracy
Product consumption (purchases, litres used, electronic meters)	Low resource Unobtrusive Avoids Hawthorne effect 24/7 coverage	Poor correlation with direct observation Cannot distinguish among users Cannot assess technique Cannot assess indications Standard dose not established Potential for tampering Ongoing maintenance
Electronic surveillance	Real-time assessment Wearables could provide feedback/reminders Individual-level monitoring More reliable over longer periods May capture 95–100% of HH events (eg entering/leaving patient zone)	Often only surrogates for Moments 1, 4, and 5. May not capture Moments 2 and 3 Relies on technology/batteries Potentially higher cost Specific infrastructure needed HCW privacy concerns Little real-world validation
Video surveillance	Some opportunity for real-time feedback Increases compliance Can provide assessment of all or most HH opportunities	Requires auditors Potentially high cost Requires infrastructure Time consuming (though less than direct observation) Possible Hawthorne effect Privacy issues Limited opportunity for immediate feedback

Self-report	Raise individual's awareness	Potentially unreliable
Bacterial load on HCW hands, organizational culture, and psychological variables		Seldom assessed

A key issue is deciding whether to monitor 'Moments' or 'entry/exit HH'. Entry/exit monitoring (or 'in-and-out' monitoring) means recording whether the HCW performs HH upon entering and upon leaving a patient's room. This method has the advantages of the HCW being less likely to be aware of being observed, the observer not needing to enter the patient's room, and requires less training. However, the entry/exit approach is not able to observe for all indications for HH, nor does entry and exit mean that patient contact has occurred. The 'Moments' approach is when the observer notes all actual HH indications and whether HH occurred. The moments may be based on the WHO's framework, or the CDC's indications, or another framework such as the Canadian 'Four Moments' approach. This approach has the advantage of allowing for real-time feedback including on technique. This is important because not all auditing methods are able to evaluate HH technique, and monitoring of technique is seldom reported. Furthermore, there are reports of high adherence to the indications for HH accompanied by poor HH technique (Boyce 2021). A disadvantage of direct observation of the Five Moments is that more training is required to correctly identify the moments. Both approaches are susceptible to bias due to the schedule of observations (APIC 2015).

#### *Hawthorne effect*

One issue when relying solely on direct observation is the Hawthorne effect where those being observed perform to a higher standard during the observation period. This effect varies with the type of observer, the presence of nearby HCWs not involved in performing observations, and the duration of the observation sessions. Adherence is higher with unit-based observers than by non-unit-based observers (Boyce 2021). Evidence suggests that HH may be performed up to three times as often in the presence of observers compared to in their absence (Gould, Creedon et al 2017). Longer periods of observation may be able to diminish this effect. However, other complex behavioural adaptation in the face of being observed can occur. These might take the form of waiting until auditors have gone to perform duties or moving to a different clinical area. Possible avoidance and deferral tactics in the presence of observers have implications for the validity of audit and research findings and also for normal workflow (Gould, Creedon et al 2017).

#### *Electronic hand hygiene monitoring systems*

Methods for electronic recording of HH compliance include video camera monitoring, radio frequency feedback linked to a HH station alone, or a HH station in combination with an employee badge, a HH station in combination with wearable technology other than badges, or an electronic medical record that provided HH reminders (Clancy et al 2021). Various systems look at different moments, eg WHO Five Moments, or entry/exit HH, or just one moment. However, electronic HH monitoring systems face issues of accuracy, data integration, privacy and confidentiality, usability, associated costs, and the need for infrastructure improvements. Standardised evaluation tools for these systems are lacking, and often evaluation is in the context of wider HH improvement strategies, making the role of electronic systems unclear. Interviews with IPC leaders revealed a reluctance to support

financial investment into this type of technology until its cost-effectiveness was better established (Cawthorne and Cooke 2021). However, electronic monitoring and reminders could be implemented in phases to evaluate and ensure cost-effectiveness (Neo et al 2016).

### **Monitoring and Evaluation Case Study**

Brocket et al described a successful HH programme at a 323-bed acute facility in Australia. An initial infrastructure survey identified that the facility lacked adequate resources and equipment that would enable staff to practice HH. Following upgrades, product use was monitored and ABHR consumption increased measurably after programme roll-out.

Ongoing evaluation and feedback entailed regular auditing of HH compliance by direct observation and monitoring of infrastructure changes. Auditing took place three times per year across 8-week periods in line with the requirements of the Australian NHHI. ABHR and liquid soap consumption data was tabled at infection control committee meetings and presented at meetings of department heads. Ongoing monitoring included the assessment of staff perceptions as well as their practices and behaviours using the WHO perception surveys for staff and for senior managers (Brocket and Shaban 2015).

Although high-risk outpatient settings such as dialysis units or ambulatory surgical clinics should aim to monitor compliance with all five HH Moments, other settings such as primary care might focus more narrowly on one or two indications by including only one or two moments in the observation form, while using product consumption monitoring to help overcome resources and expertise constraints. The denominator for product consumption calculation should be the number of patient consultations per day (World Health Organization 2012). Other auditing appropriate for non-acute, primary care, or mental health settings includes staff HH knowledge surveys, HH technique audits, product placement/availability audits, and reports of online-learning programme completion by staff (Hand Hygiene Australia 2019).

#### *Frequency of audits/monitoring*

Continuous real-time auditing is the ideal. However, it is not always practical. Only a limited number of observations are possible with direct observation. For example, in the US VHA Most facilities (81.2%) only spent between one and four hours on observations at a single site of care in a month (Reisinger et al 2013). On the other hand, 24/7 monitoring may be possible with some electronic systems and product use approaches.

Recent recommendations from the WHO on resources for HH programmes recommend monitoring of HH process and structure in secondary care settings ‘at least annually’ (World Health Organization 2021).

The Australian NHHI promotes three direct observation audit periods per year. The number of observations is dictated by the number of inpatient beds, and a standardised HH compliance audit form (using the Five Moments) or mobile data HHCApp is used. Eight-week periods of audit are followed by eight-week implementation cycles. Some high-risk facilities are required to report monthly audits (Hand Hygiene Australia 2019).

Public Health Ontario recommends ‘routinely’ monitoring HH compliance with timely feedback using a reliable, validated observer audit tool and training process. Monitoring by direct observation should assess compliance with each of the ‘Four Moments’. It should be undertaken by trained observers, using a standardised observation tool, with quality control checks of data entry, and periodic inter-rater reliability testing. This approach should help provide reliability and a focus for education. Product usage should also be monitored. The results of HH monitoring should be reviewed as part of the ongoing safety agenda (eg Joint Health and Safety, Infection Prevention and Control, Medical Advisory Committee and Senior Management) (Public Health Ontario 2014).

For some kinds of electronic monitoring an intermittent-use strategy has been found effective in terms of maintaining staff participation with systems and long-term HH compliance. However, the problem of decreasing compliance in non-surveillance periods remains. There may be negative feelings towards electronic systems which might be able to be reduced by the introduction of ‘respite’ periods (Stadler and Tschudin-Sutter 2020).

As long as compliance is continuously high, then product use could be monitored with reintroduction of electronic methods when dispenser counts fall below some predetermined threshold (Stadler and Tschudin-Sutter 2020).

#### *Caregivers/families*

There should be patient engagement on HH (IPAC 2017). Future work could seek to understand caregiver-patient-family/whānau HH interactions (Neo et al 2016). Monitoring processes might be redesigned considering the role of patients and whānau.

#### *Resources for auditing*

A baseline evaluation will help indicate the proportion of resources for HH that should be allocated to each of the elements of a multimodal programme. This will vary from facility to facility depending on needs. The WHO Self-Assessment Framework can help to target audit resources to where gaps are, for example auditing the location of ABHR dispensers.

The WHO has provided guidance on resource considerations for HH programmes that include consideration of resources for *monitoring/auditing* (World Health Organization 2021) – note that similar information was presented above for *education/training*.

- **In primary care:** there should be a trained IPC officer at the next administrative level to assist primary care facilities to monitor HH structural and process indicators.
- **In secondary care:** there should be a trained IPC team member (or equivalent FTE) for every 250 beds in charge of periodic or continuous monitoring (at least once per year) of HH process and structure with feedback as part of their role.

It may matter greatly who is resourced to do the observing. In US Veterans Health Administration facilities, for example, nursing staff conducted most audit observations along with some ICPs and HAI coordinators. However, a statistically significant difference in optimal HH rate has been described when comparing unit-based observers and infection control nurse observers. Infection control observers identified a far lower rate of HH compliance (42.4% vs 86.3%,  $p < 0.01$ ) (Baek et al 2020). This begs the question whether unit-based observers require more appropriate training, or whether interpersonal dynamics might be at play.



Electronic systems will require an initial investment outlay. For example, the cost of electronic motion sensor-triggered audible reminders in one study was US\$500 (per installation) and the installation took half a day (Tejada and Bearman 2015).

#### *Monitoring compliance: summary*

Combining electronic monitoring with observational methods may provide the best information as part of a multimodal strategy to improve and sustain HH compliance rates (Boyce 2017). Direct observation should seek to identify all Five Moments and ideally technique as well. That said, the Canadian national HH campaign has collapsed moments 4 and 5 into a single ‘after patient care’ moment. In practice, observations are often simplified to actual observation of entry and exit points. This may be a reasonable proxy for HH during patient care and respects privacy (Ellingson et al 2014). Facilities should start auditing in departments with risk of high infection rates (eg, intensive care units, transplantation units, haematology–oncology units, and emergency departments) (Grayson et al 2018). Monitoring/auditing programmes can be piloted first to ensure any issues are addressed (eg availability of product, staff motivation). Product consumption methods could serve as a continuous baseline, with observational and electronic methods deployed intermittently when baseline use drops. Facilities could consider additionally auditing: the duration of HH action, the quantity of product used per HH event, HH technique, the donning/doffing of gloves, type of gloves used, length of fingernails, or presence of jewellery. It is critical that dedicated auditors are available, with staff having audit time included in their role descriptions.

#### *Feedback mechanisms to staff*

Monitoring is only effective if there are mechanisms for reporting and feedback so that improvements can be made. Feedback to the HCWs being monitored is essential. Direct timely feedback at the point of care is one advantage of observational audits (Boyce 2017). However, other kinds of monitoring require data to be fed-back.

A systematic review and meta-analysis to determine the optimal HH bundle, described feedback mechanisms in the studies evaluated. Among 27 studies that assessed feedback, three solely provided feedback in person in a one-on-one setting, six solely provided feedback in person in a group setting, eight provided written feedback, nine used more than one type of feedback. When feedback was provided, various studies provided feedback at the individual-level, facility level, unit level, provider level (eg, physician, nurse), and eight studies did a combination of these types (Schweizer et al 2013). Feedback is an important component of an optimal bundle however it is unclear exactly what form this feedback should take.

In Australia, overall rates of HH compliance are reported nationally three times per year. However, reports for organisations can be produced at any time from the HHCApp and used for feedback (Hand Hygiene Australia 2019). The WHO recommends that results can be disseminated in written reports or other means of internal communication or shown during educational and data feedback sessions. Each facility should decide whether these, or other methods are most appropriate for communicating the data (World Health Organization 2009a). As well as regular discussion of data at staff meetings, there can be monthly/quarterly postings of compliance data on hospital units and on hospital websites (APIC 2015).

The Alberta HH Toolkit suggests that HH data can be shared through various means including, but not limited to: newsletters, quality improvement boards, discussions during

educational sessions, during team meetings, at ‘Quality Councils’, or at just-in-time feedback huddles (Alberta Health Services 2021).

The Society for Healthcare Epidemiology of America suggests the following for providing feedback (Ellingson et al 2014):

- Feedback may be most effective when provided more than once, when both verbal and written feedback are provided, and when a superior or colleague is responsible for the audit and feedback
- Providing overall HH adherence rates for a facility may not be as effective as unit-based or role-based reports
- HH data may be displayed on dashboards providing recent or cumulative HH adherence rates compared with a target rate
- Statistical process control charts can be used to show data trends over time and whether changes in rates are due to specific interventions or normal variation
- Automated monitoring systems may have the ability to give real-time displays of unit HH adherence, providing incentive for shift-by-shift improvement
- Feedback may engage HCWs in identifying problems and use data to tailor ongoing interventions
- Private feedback if individually identified HH adherence rates are used

Feedback should be provided in the context of clear targets with an action plan in place for improving adherence. Associations between HH and HAI reductions may not be evident in individual unit or facility data because of confounding factors (eg, environmental cleanliness and small sample sizes) (Ellingson et al 2014).

## Reporting

The WHO's 'Self-Assessment Framework' suggests that immediate feedback should be given to HCWs at the end of each hand hygiene compliance observation session, and that regular (at least 6 monthly) feedback of HH data and trends should be reported to HCWs and facility leadership (World Health Organization 2010).

In the US it is not clear what the standard performance measures for HH reporting should be (Ellingson et al 2014). The WHO sees direct observation and the resulting proportion of instances of HH over the total HH indications (Five Moments) as a key metric of compliance. Several other possibilities are described in the section on 'Monitoring Compliance' above (including product consumption per bed day, electronic monitoring, and HAI rates).

In Canada HH Compliance is one of the Alberta Health Service's performance measures reported by organisations to Alberta Health and to the public (Alberta Health Services 2021). There is a performance measures dashboard.<sup>4</sup> In Ontario, staff HH rates have been reportable annually as a mandatory patient safety indicator since 2009 and Ontario requires a program to monitor, evaluate and improve HH compliance, with feedback to individual employees, managers, chiefs of service and the Medical Advisory Committee/Professional Advisory Committee (Public Health Ontario 2014).

In Australia participation in a national public reporting system is mandatory for acute public and private hospitals. In 2017, the national benchmark was increased to 80% (compliance), and reporting is stratified by the Five HH Moments and by HCW occupational group (Grayson et al 2018).

At Australian organisations the HH Lead (HHCApp Administrator) must first validate the data against the NHHI HHCApp validation rules. Audit data should be submitted to the national database. Reports of HH compliance data as a regular infection control or quality report go to the CEO and health facility board. There is reporting back to all wards (including compliance and SAB rates) (Hand Hygiene Australia 2019).

At a 323-bed acute care facility in Australia, compliance data, and alcohol-based handrub and liquid soap consumption data, is tabled at infection control committee meetings and presented at meetings of department heads. The department heads feed these results back to staff within their departments via departmental meetings. HH audit results are a key performance indicator for department heads (Brocket and Shaban 2015).

Staff ownership of HH programmes is encouraged, therefore, reporting should include timely feedback (see above), recognizing achievements, appointing champions (including medical champions) and accountable individuals (Hand Hygiene Australia 2019).

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<sup>4</sup> <https://www.albertahealthservices.ca/about/performance.aspx>

## Part II: International Programmes and Case Studies

The review of the academic and grey literature identified a wide range of relevant publications describing HH programmes. Twenty-seven reports were retained and tabulated (see the second tab of the Supplementary Excel file). These included two overviews of international guidelines and programmes, a series of publications describing the WHO HH programme, and descriptions of national or regional programmes in Australia, Canada, and Ireland, as well as evaluations of programmes in Australia, the United Kingdom, the Netherlands, and the United States.

### Overviews of Guidelines and Programmes

#### *The APIC Guide*

The Association for Professionals in Infection Control and Epidemiology published a *Guide to HH Programmes for Infection Control* (APIC 2015). The 70-page guide provides an overview of HH programmes and their key components including evidence-based strategies for implementing HH programmes. Programmes that informed the *Guide* included the CDC's Guidelines for HH in Healthcare Settings, the WHO's Improving HH Programme, and statements by the Association of Professionals in Infection Control and Epidemiology, Infection Prevention and Control Canada, and the Society for Healthcare Epidemiology of America, as well as a host of other national and international agencies (a number of these feature below in the present report).

The *Guide* includes an overview, information on guidelines, regulatory oversight, and public reporting, HH products, HH monitoring, implementing HH programmes, strategies for behaviour change, and HH within organisational culture. The *Guide* notes that some federal and regional governmental authorities provide guidance for HH programmes; that accrediting organizations may develop specific standards to review healthcare organisations; and that reporting of HH compliance is required in certain US states and in Canadian provinces. The *Guide* further notes that the WHO, CDC, and Public Health Agency of Canada have each developed recommendations on HH technique, products, timing, methods, and programme implementation, but their recommendations for the timing, or indication, for HH differ slightly from each other. For example, the WHO recommends HH before handling medication, whereas the CDC does not. The Joint Commission, an accrediting organization in the United States, requires that facilities follow either the CDC or WHO guideline to meet the specific patient safety goal.

Regarding HH Monitoring the *Guide* emphasizes the need for a standardised process, the necessity of consistency, regular observation periods, the use of validated instruments, and feedback to staff, managers, and leaders as part of a multimodal HH programme. Furthermore, observers must have dedicated work time to focus on HH observation and should undergo training prior to participating in the monitoring process and should be intermittently assessed or their work validated. The *Guide* notes that various guidelines recommend that HH compliance can be monitored at specific time points during the course of patient care (eg Five Moments, or the CDCs indications for HH) or upon room entry and room exit. Monitoring can also include direct observation, product usage, and emerging electronic monitoring strategies, HH dispenser-associated monitoring systems, real-time locating systems to track employees and HH activity, and video surveillance of HH (as discussed in the 'Monitoring' section above).

On implementing HH Programmes, the *Guide* notes that multimodal strategies are considered the best improvement programmes. Comprehensive programmes include plans of action that are integrated and coordinated and include the following components: (1) HH culture change, (2) programme support from organizational leaders, (3) education and training, (4) compliance monitoring, (5) multidisciplinary teams, (6) accessible HH products, (7) reminders in the workplace, and (8) outcome monitoring.

## World Health Organization

In 2009 the WHO finalised its Guidelines for HH (World Health Organization 2009c), and published an Implementation Guide for the recommended multimodal improvement programme (World Health Organization 2009a). The Guidelines advocate HH at the Five Moments and a six step HH technique. Indications for routine HH are mostly the same between the CDC and WHO guidelines, although they provide different details in implementation sections (Lotfinejad et al 2021).

The WHO Implementation Guide supports the deployment of a multimodal framework that includes the following five synergistic elements, which should all be in place to some degree:

1. Creating an Environment for Success
2. Training and Education
3. Evaluation and Feedback
4. Reminders in the Workplace
5. Building a Supportive Culture

The multimodal improvement strategy is grounded in behavioural science and incorporates elements of multiple behavioural models, such as the Health Belief Model and the Theory of Planned Behaviour. Both the Guidelines and the Implementation Guide are part of the longer term SAVE LIVES Clean Your Hands initiative.

The Implementation Guide provides advice on how to prepare an Action Plan for HH improvement (see Figure 1); perform a baseline analysis, identify any system changes needed (eg infrastructure for ABHR); select and access ABHRs; provide education and reminders to HCWs; ensure an institutional safety climate; undertake evaluation and feedback (with a focus on direct observation); and maintain momentum and motivation.

Leadership and governance should include a HH coordinator at each site, the awareness and support of senior managers, and a HH team/committee.

The education approach recommended by the WHO focuses on the WHO's 'My Five Moments for hand hygiene' framework, and the WHO recommended procedures for handrubbing and handwashing (six steps).<sup>5</sup> The WHO recommends that all HCWs, including those in outpatient settings, particularly those with direct patient contact, require continuous training. This training should include the importance of HH, the 'My Five Moments for HH' approach, and the correct techniques for hand washing and handrubbing. Additionally, health authorities and institutions should demonstrate open commitment to education, provide budget and time, and identify feasible methods.

Monitoring and audit include evaluation of practices (observation), infrastructure (audit), perceptions, and knowledge (surveys). There should be performance and results feedback to staff. The WHO provides tools to help facilitate these evaluations.

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<sup>5</sup> The six steps are: palm to palm, palm over dorsum with interlaced fingers, palm to palm with interlaced fingers, backs of fingers to opposing palms, rotate thumbs, fingertips in palms.

**Figure 1:** The WHO hand hygiene multimodal improvement programme ‘template action plan’

WHO Guidelines on Hand Hygiene in Health Care				
Guide to Implementation of the WHO Multimodal Hand Hygiene Improvement Strategy				
Template Action Plan				
Tools for System Change	Tools for Training / Education	Tools for Evaluation and Feedback	Tools for Reminders in the Workplace	Tools for Institutional Safety Climate
Ward Infrastructure Survey	Slides for the Hand Hygiene Co-ordinator	Hand Hygiene Technical Reference Manual	Your 5 Moments for Hand Hygiene Poster	Template Letter to Advocate Hand Hygiene to Managers
Alcohol-based Handrub Planning and Costing Tool	Slides for Education Sessions for Trainers, Observers and Health-Care Workers	Observation Tools: Observation Form and Compliance Calculation Form	How to Handrub Poster	Template Letter to Communicate Hand Hygiene Initiatives to Managers
Guide to Local Production: WHO-recommended Handrub Formulations	Hand Hygiene Training Films	Ward Infrastructure Survey	How to Handwash Poster	Guidance on Engaging Patients and Patient Organizations in Hand Hygiene Initiatives
Soap / Handrub Consumption Survey	Slides Accompanying the Training Films	Soap / Handrub Consumption Survey	Hand Hygiene: When and How Leaflet	Sustaining Improvement – Additional Activities for Consideration by Health-Care Facilities
Protocol for Evaluation of Tolerability and Acceptability of Alcohol-based Handrub in Use or Planned to be Introduced: Method 1	Hand Hygiene Technical Reference Manual	Perception Survey for Health-Care Workers	<b>SAVE LIVES: Clean Your Hands</b> Screensaver	<b>SAVE LIVES: Clean Your Hands</b> Promotional DVD
Protocol for Evaluation and Comparison of Tolerability and Acceptability of Different Alcohol-based Handrubs: Method 2	Observation Form	Perception Survey for Senior Managers		
	Hand Hygiene Why, How and When Brochure	Hand Hygiene Knowledge Questionnaire for Health-Care Workers		
	Glove Use Information Leaflet	Protocol for Evaluation of Tolerability and Acceptability of Alcohol-based Handrub in Use or Planned to be Introduced: Method 1		
	Your 5 Moments for Hand Hygiene Poster	Protocol for Evaluation and Comparison of Tolerability and Acceptability of Different Alcohol-based Handrubs: Method 2		
	Frequently Asked Questions	Data Entry Analysis Tool		
	Key Scientific Publications	Instructions for Data Entry and Analysis		
	Sustaining Improvement – Additional Activities for Consideration by Health-Care Facilities	Data Summary Report Framework		

The WHO also provides a technical manual explaining the Five Moments, along with details on observation and reporting methods (World Health Organization 2009b). The WHO recommends reporting compliance with HH as the ratio of the number of performed actions to the number of opportunities.

In addition to the materials released in 2009 the WHO subsequently provided a HH Self-Assessment Framework for organisations (World Health Organization 2010), and in 2012 a guide for Outpatient and Home-based Care and Long-term Care Facilities (World Health Organization 2012). The Outpatient guide adapts the Five Moments and patient zone to the



outpatient or long-term care setting. In 2016 the University of Geneva Hospitals launched the first HH train-the-trainers course (Tartari et al 2019).

### **Evaluation of the WHO Hand Hygiene Programme**

The WHO HH Programme was evaluated at 43 hospitals around the world including in Costa Rica, Italy, Mali, Pakistan, and Saudi Arabia. Following implementation of the multimodal strategy compliance increased from 51 percent (95% CI 45.1–56.9) to 67 percent (61.8–72.2). Implementation had a major effect after adjustment for main confounders (OR 2.15, 1.99–2.32). HCWs' knowledge improved at all sites from 18.7 (95% CI 17.8–19.7) to 24.7 (23.7–25.6). Two years after the intervention, all sites reported ongoing HH activities with sustained or further improvement (Allegranzi et al 2013).

In 2012 the WHO initiated the Private Organizations for Patient Safety (POPS) programme to leverage the support of private industry to promote HH and the WHO guidelines. A wide range of organisations have contributed, for example at conferences and on World HH Day (May 5). However, there is no POPS report on the WHO website since 2016-17 and no meeting report for any meetings since the 13<sup>th</sup> POPS for HH meeting in 2016.<sup>6</sup>

#### *WHO Global Self-Assessment Survey*

The WHO has conducted a series of global surveys in which facilities provided HH information using the WHO HH Self-Assessment Framework, a self-administered questionnaire designed to obtain a systematic situation analysis of HH structures, resources, promotion, and practices within a health-care facility. The framework has been validated to measure HH implementation level. The framework scores the five areas of WHO's multimodal intervention approach out of 100, giving a total out of 500.

The survey results represent a snapshot of the current position of global HH improvement efforts. Median scores across time were 302.5 (2011), 392.5 (2015), 350 (2019) (de Kraker et al 2022, Kilpatrick et al 2018). Most healthcare facilities globally had an 'intermediate level' of HH implementation or higher.

Results of the 2019 survey incorporated data from 3206 health-care facilities in 46% of all WHO Member States worldwide (de Kraker et al 2022). 1083 facilities from high-income countries responded. Weighted median scores for high income countries were as follows:

- System Change 100 (IQR 85–100). Most health-care facilities in high-income countries had budget available for continuous procurement of HH supplies (90.6%).
- Training and Education 85 (65–95). However, across the entire sample (all income levels) less than half of facilities had budget for education.
- Evaluation and Feedback 75 (55–90). HH compliance was evaluated by direct observation at least every 3 months at 44.9% of health-care facilities (all income levels). High income country facilities provided systematic feedback to staff (72%) and leadership (76%). Only 36% of high-income facilities reported the recommended ABHR consumption of 20L per 1000 patient days.

<sup>6</sup> <https://www.who.int/initiatives/private-organizations-for-patient-safety/pops-for-hand-hygiene>



- Reminders in the Workplace scored a median of 75 (60–95) in high-income countries.
- Institutional Safety Climate had the lowest weighted median score of 65 (45–85) in high-income countries. A formalised programme of patient engagement existed in only 33.5% of 1038 facilities in high-income countries, only 41.5% supported HH role models and 47.1% HH champions.

The overall survey paints a picture of stagnation globally (considering scores across the 2011–2019 period). However, the 190 facilities that completed the survey in both 2015 and in 2019, and who were already high performing, managed to improve the Safety Climate scores (the lowest scoring dimension).

### The Australian National HH Initiative (NHHI)

The NHHI appears to be the largest, most comprehensive, and effective, national HH programme. It was established in 2008 by The Australian Commission on Safety and Quality in Health Care (ACSQHC) in partnership with HH Australia. Participation is mandatory for all public and private hospitals to maintain accreditation. Other services such as day treatment, mental health, and dental services participate as appropriate. The NHHI is a national Quality Health Service Standard. Since 2019, the ACSQHC has coordinated and supported all aspects of NHHI (Hand Hygiene Australia 2019). The programme is also supported by the Council of Presidents of Medical Colleges Joint Statement.<sup>7</sup>

The NHHI is based on the WHO Multimodal HH Improvement Strategy modified for the Australian setting (Grayson et al 2018). The focus is on system change, HCW education, and audit and feedback. The ‘My Five Moments for HH’ framework provides the basis for evidence-based education and auditing approaches. Key elements of the programme include:

- Ensuring the availability of ABHR
- Monitoring HH compliance
- Education regarding HH and ABHR
- Measuring infection rates

Standardised educational, promotional, and scientific materials are hosted on a national HH website. This includes multiple credential packages and educational resources aimed at specific HCW occupational groups (eg, nurses, surgeons, physicians, allied health, non-clinical, and students). Annual completion of credential packages by all HCWs is required for hospital accreditation.

Auditor training focuses on the use of the HH compliance auditing tool (based on WHO’s My Five Moments for HH approach). A train-the-trainer model employs a two-day auditor workshop. Participants that complete workshops and an assessment become gold-standard auditors (GSA). GSAs can lead the HH programme and train general auditors at their organisations. Since 2012, a new auditing web application (HHCApp mobile) enables auditing by direct data entry. Participation in public reporting is mandatory for public and private acute hospitals.

Audit data is validated for consistency and errors using a validation process. Data storage was initially managed centrally by HH Australia using an external commercial provider. More recently, however, the ACSQHC has taken over management of the database. Validated HH compliance data have been uploaded into the federal government’s Enterprise Data Warehouse to allow high-level correlations with other national health-care data. HH is a national key performance indicator, and the national benchmark is 80% compliance. Reporting is stratified by the Five Moments and by HCW occupational group. Representative samples of hospitals were visited by HH Australia to ensure auditing accuracy, assist with improvements, and share lessons from well performing sites.

The NHHI Manual identifies success and sustainability factors. These factors include hospital-wide rollout and HCW acceptance and ownership.

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<sup>7</sup> <https://www.safetyandquality.gov.au/publications-and-resources/resource-library/joint-statement-council-presidents-medical-colleges-cpmc-and-acsqhc-hand-hygiene-compliance-and-medical-practitioners>

### **Evaluation of the Australian NHHI**

Evaluation of the NHHI across 8 years demonstrated increased compliance and reduced incidence of HAIs. Compliance increased for each Moment type and for each HCW occupational group, including for medical staff (50.5% of Moments [95% CI 49.4–51.5] in 2009 compared with 71.7% of Moments [71.4– 72.0];  $p < 0.0001$ ). Over the same period improved HH compliance in 132 of Australia's major public hospitals was associated with declines in the incidence of HA-SAB (incidence rate ratio 0.85; 95% CI 0.79–0.93;  $p \leq 0.0001$ ): for every 10% increase in HH compliance, the incidence of HA-SAB decreased by 15% (Grayson et al 2018).

In cost-effectiveness analysis, probabilistic sensitivity analysis revealed a 100% chance the initiative was cost effective in the Australian Capital Territory and Queensland, with incremental cost effectiveness ratios of \$1,030 and \$8,988 per quality adjusted life year respectively. Cost-effectiveness appeared less in other jurisdictions was not as high, with an 81% chance it was cost effective in New South Wales with an ICER of \$33,353, a 26% chance for South Australia with an ICER of \$64,729 and a 1% chance for Tasmania and Western Australia (Graves et al 2016).

**Facility Case Study: John Flynn Hospital (Australia)**

John Flynn Hospital (323-bed, private, acute) implemented a successful NHHI Australia HH Culture Change Programme. This multi-interventional culture-change programme incorporated the WHO ‘Five Moments for HH’. It also integrated the WHO Guidelines on HH in Health Care and Improvement Strategy by:

- (i) Providing necessary infrastructure
- (ii) Regular training and education on the Five Moments
- (iii) Audit of compliance (three times per year), infrastructure audits, staff perception survey, and measuring consumption of handrub and handsoap
- (iv) Reminders in the workplace (visual aids)
- (v) Promoting an institutional safety climate that accepts HH improvement and culture change is a priority

*Governance:* Implementation was approved as a quality improvement project by the CEO and Risk Management Committee. Essential support for the programme was obtained from the hospital executive management team, including: CEO, Director of Clinical Services, Assistant Director of Clinical Services, Finance Manager, Risk Manager, and Business Development Manager.

*Implementation:* The Infection Control Coordinator attended the two-day HH Australia training. A baseline audit was conducted and roll-out followed the NHHI manual. Staff surveys identified an ABHR product tolerated by all. Sufficient point-of-care ABHR facilities were installed. HH champions (heroes) were selected from each department and wore bright green T-shirts. The hospital hosted a Launch Day, including barbecue, quizzes, and prizes. Multiple large auditorium education sessions were held over a 3-month period. Education was mandatory and emphasized by the CEO to department heads. Staff also had access to the HH Australia online materials. Five Moments posters as well as ‘How to Handwash’ and ‘How to Handrub’ posters were displayed.

*Outcomes:* HH compliance improved from 22% to 71%, ABHR use increased from 32L to 90L per 10,000 bed days. There was a decrease in bed days associated with surgical site infections, and with SAB (Brocket et al 2015).

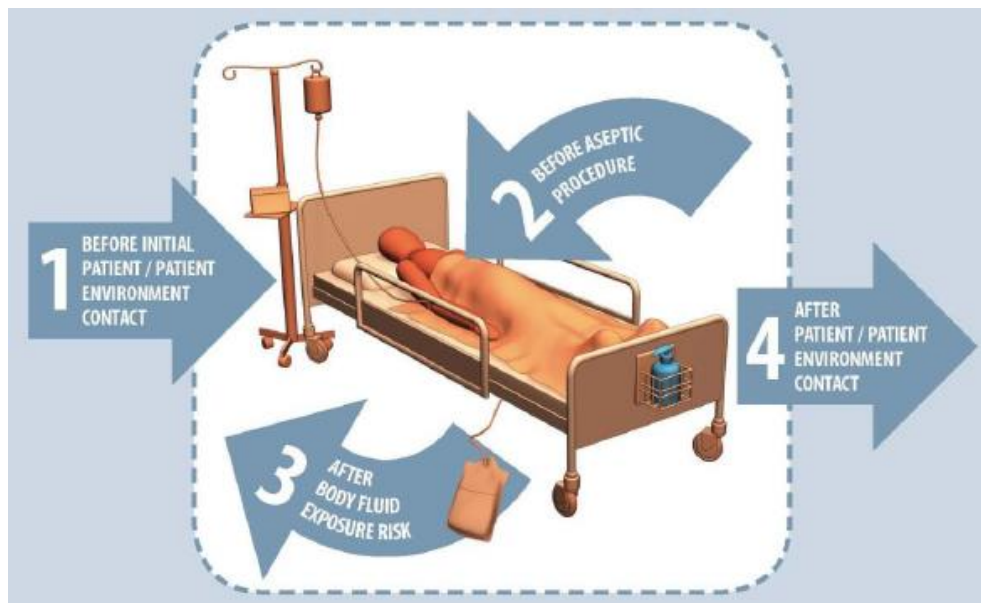
## Canada

Nationally, in 2006, Canada pledged commitment to the Global Patient Safety Challenge and a reduction of HAIs. The national approach borrowed components from the UK ‘Cleanyourhands’ campaign (see below) and from the WHO’s ‘Clean Care is Safer Care’ approach. In 2017 Infection Prevention and Control Canada published a set of Practice Recommendations for Hand Hygiene in Healthcare Settings (IPAC 2017). A multifaceted, multidisciplinary HH programme was to be implemented in all health care settings. These programmes were to include ongoing education about HH indications, agents, techniques, skin care, and human factors. There was also to be audit of adherence with feedback to HCWs.

*Ontario, Canada*

In 2014 Public Health Ontario published an extensive *Best Practices* guide for HH (Public Health Ontario 2014). The *Best Practices* described are applicable to all healthcare settings and specific variations across settings are noted. Key guidance includes using a simplified Four Moments framework to identify indications for HH and for training purposes (see figure 2 below). ABHR is recommended with a six-step approach and a rub time of 15-seconds until dry, necessitating ‘one to two’ good pumps of the dispenser. Public Health Ontario states that A multifaceted, multidisciplinary HH program must be implemented in all health care settings. There is a focus on developing champions, role models, and a multidisciplinary group. It is noted that staff compliance is significantly influenced by the behaviour of other health care providers and that HH champions and role models (separate from compliance auditor roles) will impact positively on the motivation of staff.

**Figure 2:** The Four Moments for Hand Hygiene (Public Health Ontario, 2014)



The *Best Practices* are summarised in a table of Recommendations with 49 statements in 11 categories, which include the key areas of policy, education, and monitoring and feedback (as noted in relevant sections above). The *Best Practices* guide refers users to Public Health Ontario’s ‘Just Clean Your Hands’ programme and implementation guide.

‘Just Clean Your Hands’ is a multimodal HH programme developed by the Ontario Ministry of Health and Long-Term Care (Public Health Ontario 2008). The programme implementation guide identifies the need for management support, education, environmental changes, monitoring, observation and feedback, opinion leaders/champions, and patient engagement. The programme is like the WHO’s approach and involves a multimodal set of actions starting from facility preparedness, and progressing through baseline evaluation, implementation, follow-up evaluation, an ongoing action plan, and then review cycle.

A set of initial implementation tools was provided including the Implementation Guide for Hospital Implementation Coordinator (Public Health Ontario 2008), and a separate guide for long-term care facilities (Public Health Ontario 2009). Available materials included education tools, promotional tools, and evaluation tools.<sup>8</sup>

Facilities were encouraged to develop a communication plan, deploy accessible HH products, a handcare programme, and collect information on programme costs and the costs of HAIs. Facilities should have an observational auditing plan and training for observers and trainers.

Senior management must agree the scope and extent of the HH programme and identify an implementation coordinator. This coordinator will have the support of the CEO, and senior and middle managers. Facilities were to set up a working group or committee to champion the programme. This could take the form of an IPC committee, or patient safety committee. At least one influential healthcare provider on each unit should be involved.

Education materials include an education presentation, HH education module, training presentations and materials, a ‘Your 4 Moments for Hand Hygiene’ pocket card, an ‘On-the-spot feedback tool’, and there is a certificate of training completion.

Monitoring and evaluation consist of the following (Public Health Ontario 2008):

- Use of a baseline facility level assessment tool
- An implementation checklist (for each of the five implementation phases)
- Senior and middle managers perception survey
- Health care provider perception survey
- Unit structure survey
- Monitoring soap/handrub consumption
- HH direct observations (HH observation tool)
- Health care provider knowledge survey
- HH Assessment Tool for Health Care Provider Hands
- HAI rates

Reporting should be to hospital boards, senior managers, and healthcare providers.

At a follow-up evaluation, facilities should see:

- Increase in HH compliance
- Improvement in environmental supports
- Increase in usage of HH products
- Improved perception of HH

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<sup>8</sup> <https://www.publichealthontario.ca/en/health-topics/infection-prevention-control/hand-hygiene/jcyh-ltch>

- Improved knowledge of HH.

The use of the WHO Self-Assessment Tool for Programme Evaluation is encouraged.

A guide for long-term care facilities describes adaptations to the programme for this context. There is also a resident and family engagement video. HCWs should abide by the Four Moments in a resident's room and perform HH before and after common area activities. Audit should take place in resident rooms because most care occurs there. There is a checklist for implementation in long-term care (senior management support and commitment, environmental changes, education for staff, patient and family engagement, HH champions, ongoing monitoring and observation, and follow-up).

#### *Alberta, Canada*

The Alberta Health Service HH programme is based on the WHO multimodal framework and AHS provides a HH Programme toolkit (Alberta Health Services 2021). AHS notes that strong leadership and accountability are important in influencing HH practices. HH Compliance is one of AHS's performance measures to be reported to Alberta Health and the public.

As with Ontario's programme, a notable difference between the WHO guidance and Canadian programmes is that the 'Five Moments' are collapsed into 'Four Moments' with 'after touch patient' and 'after environment contact' becoming a single moment.

Implementation involves ensuring appropriate availability of ABHR and AHS provides a dispenser placement algorithm.<sup>9</sup> Site Infection Control Professionals and Facilities Maintenance & Engineering staff should help add or remove dispensers.

Staff training and education materials are provided on the AHS HH Webpage. Materials include videos, information, newsletters, and users can request department and programme-specific materials.<sup>10</sup> Facilities are encouraged to develop HH champions, raise HH at team meetings, on QI boards, and in monthly emails.

Ongoing monitoring and audit are undertaken through team based HH reviews completed by trained reviewers observing the 'Four Moments'. Reviewers upload data to the Clean Hands System. The Clean Hands System iPad Application and Clean Hands Paper Tool are used to collect data. The Clean Hands Portal is the database where the data is stored as well as where reports can be generated.<sup>11</sup> Unit HH Feedback Reports can be generated as soon as the review is completed to provide real-time feedback. An 'on the spot' feedback card system is used to recognise good practice. Compliance data is displayed in high traffic areas and shared in team huddles.

Additional programme components include reminders in the workplace, encouraging the use of 'codes', which are brief signals staff can use to remind and signal to each other. Also, a set of Just Culture Guiding Principles can be used. AHS provides a comprehensive checklist for the HH initiative.

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<sup>9</sup> <https://www.albertahealthservices.ca/assets/healthinfo/ipc/if-hp-ipc-abhr-placement-algorithm.pdf>

<sup>10</sup> <https://www.albertahealthservices.ca/ipc/Page14955.aspx>

<sup>11</sup> <https://www.albertahealthservices.ca/ipc/Page14935.aspx>

## United Kingdom

NICE guidance on HCAs provides advice on management or organisational actions to reduce HCAs in secondary care settings (NICE 2011). Facilities should identify areas for quality improvement, monitor progress, and provide leadership and support. NICE recommends Board leadership, a responsible Board Member, and Medical Specialist Leaders. Initiatives will include HH and audit of HH practices with feedback given to relevant staff. Each of NICE's 11 HAI Guidance Statements is associated with a list of 'evidence of achievement', although most statements are not specific to HH. Education for HCWs is recommended within one week of starting work in a clinical area, updated at appropriate intervals.

*CleanYourHands*

The 'Cleanyourhands' programme was a UK National Patient Safety Agency (NPSA) campaign from 2004-2010 (ie was started prior to WHO's 2009 guidelines). The programme used marketing techniques to educate, prompt and enable healthcare staff to practice HH at the right time, every time, during patient care (National Patient Safety Agency 2010).

Key themes of the programme included a focus on 'are your hands safe?' and later extended to 'how to clean your hands'. The aim was to maximise the convenience of HH, for example with ABHR provided at point of care and the campaign leveraged habit-forming theory (the model that it takes 21 days to form a habit). In 2008, the programme was extended to primary care and the WHO Five Moments were incorporated.

The support of CEOs was required before facilities could enrol. Resources were provided to support local implementation and staff engagement, and the programme included:

- A 3-month preparation period (*Ready Steady Go! Guide*)
- Lead campaign coordinator (main point of contact for NPSA)
- HH coordinators
- Guidance video
- Templates
- CleanYourHands Champions (role models)

The multimodal approach included education, prompts, and structures to enable healthcare staff to clean their hands at the right time, every time. Posters were deployed (though it was later determined they needed to be more 'striking' to stand out among visual pollution), and patients were encouraged through an 'its ok to ask' approach.

**Evaluation of the UK Cleanyourhands campaign**

Evaluation was through interviews with NHS staff, visual audits of hospitals, and a survey of over 300 HCWs in England and Wales. Outcomes included evidence of sustained changes in HH behaviour and declines in MRSA bacteraemia rates. There was a tripling of product procurement (this peaked at 30mL/patient/bed day), and a one millilitre per patient per bed day increase in ABHR use was associated with a 1 percent decrease in MRSA infection (there was no correlation with soap use, and no correlation with *C. difficile* infections – this is as expected) (National Patient Safety Agency 2010).



### The Netherlands: Case study

The WHO's own evaluation of its HH programme in 43 hospitals around the world suggests that the multimodal approach can work. However, there is the question as to whether it is the optimal approach. A cluster RCT evaluation of HH strategy in the Netherlands aimed to evaluate whether the WHO programme could be improved upon (Huis, Schoonhoven et al 2013). Outcomes of the RCT were also subject to a process evaluation (Huis, Holleman et al 2013).

The study involved 67 nursing wards of three hospitals, with the inpatient nursing ward being the unit of randomisation. All affiliated qualified nurses and nurse students participated in the study.

Two programmes were evaluated. The first ('state of the art' intervention) included HH education, reminders, feedback and installation of adequate products and facilities. The programme was based on existing literature and included the WHO 2009 guidance. There was:

- Education to improve HH knowledge and skills
- Reminders to support HH performance
- Feedback to provide insight and reinforce improved behaviour.
- Targeted factors related to structural organisational context
- Screening and providing for adequate products and facilities.

The second ('team and leaders' intervention) involved the same elements as above but was also supplemented with social influence and leadership elements, comprising specific team and leaders-directed activities:

- Gaining active commitment and initiative of ward management
- Modelling by informal leaders at the ward
- Setting norms and targets within the team
- All team sessions were guided by the team manager as well as an external coach
- Participating managers in the team-directed strategy received four-hours of training in accompanying and motivating the nurses.

Strategies were carried out with good adherence (Huis, Holleman et al 2013).

- HH compliance in the 'state of the art' group increased from 23% to 42%, and to 46% longer term.
- HH compliance in the 'team and leaders' group improved from 20% to 53% in the short term and remained 53%.
- The 'team and leaders' approach was associated with better HH adherence (odds ratio 1.64; 95% CI 1.33–2.02).

Results of this RCT support the added value of social influence and enhanced leadership in HH improvement strategies. Ward managers also saw the value of the approach for other improvement strategies.

The process evaluation (Huis, Holleman et al 2013), determined that contextual factors were associated with changes in HH compliance. These included changes in nurses' HH compliance being positively correlated with experienced feedback about their HH performance ( $p < 0.05$ ), as well as several items of 'social influence' (i.e., addressing each

other on undesirable hand hygiene behaviour  $p < 0.01$ ), and ‘leadership’ (i.e., ward managers holding team members accountable for hand hygiene performance  $p < 0.01$ ) which correlated positively with changes in nurses’ HH compliance.

This study appears to demonstrate the case for staff addressing each other in case of undesirable behaviour (and fostering a culture of speaking up via education sessions), supporting colleagues, accountability, goal setting, and the active commitment of the ward manager.

The authors of the process evaluation further concluded that the effectiveness of the ‘team and leaders’ strategy may have even been underestimated due to an intention-to-treat rather than as-received analysis.

## United States

The US does not appear to have a coordinated national HH programme. However, expert and in-depth guidance has been produced through collaboration by the Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America, the American Hospital Association, the Association for Professionals in Infection Control and Epidemiology, and The Joint Commission (Ellingson et al 2014).

This detailed guidance provides a rationale for HH and statements of concern, as well as background on strategies to measure HH adherence, preventing HAI through HH, and recommended HH improvement strategies. The guidance explains the various performance measures and examples of implementation strategies. This guidance is referred to in several places throughout the present report (see above).

### *Veterans' Health Administration survey*

The VHA conducted a HH survey covering three major areas (Reisinger et al 2013):

- (1) Methods of measuring HH compliance
- (2) Interventions to improve HH compliance
- (3) Site-specific targets for HH compliance

One hundred and forty-one (100%) VHA centres responded:

- 88.5% conducted mandatory education programmes for clinical staff
- 98.6% conducted direct observations to measure HH compliance rates (the main behaviours considered as HH opportunities were room entry (69.1%) and exit (71.9%))
- 22.7% monitored product usage
- 2.8% used automated monitoring systems

Nursing staff conducted most audit observations along with some ICPs and HAI coordinators. However, only 45.3% of organisations validated the observer process at the beginning, and only 39.6% continued to validate observers. Approximately three-quarters of organisations attempted to blind observed staff to HH observations (ie covert observations).

Quality improvement interventions included posters (97.2%), feedback (eg, 98.6% to leadership), and improved access to HH products (eg, 90.6% provided individual hand sanitizers to staff), and most VHA centres (77%) set HH compliance targets of 90% or more.

Overall, the survey of VHA organisations identified a lack of standardisation in practice, particularly for training observers, defining HH opportunities, and establishing compliance goals.

### **Facility Case Study: Johns Hopkins Hospital (US)**

Johns Hopkins Hospital (a tertiary care academic centre) implemented a HH programme based on a framework of Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE). This framework is based on multiple theories of behaviour change, departing from singular approaches to interventions by addressing both environmental and individual factors, such as knowledge, attitudes, and beliefs. The programme emphasised promotion of two target behaviours, which were cleaning hands in accordance with guidelines and reminding other colleagues to clean their hands. The programme was evaluated in 2007–8 (prior to the WHO's formal adoption of the 'Five Moments' campaign, but subsequent to the CDC's guidelines on HH) (Aboumatar et al 2012).

Programme components included:

- **Communication campaign:** Multimedia, multidisciplinary, posters, banners, stickers, screen savers
- **Education:** an online course on HAI (mandatory for all HCWs), discipline-specific question-and-answer sets, fact sheets
- **Environment optimization:** Hand sanitizer placement recommendations (2,500 dispensers were installed outside rooms and between beds)
- **Leadership engagement:** inclusion in communications campaign messages, leader guide to HH promotion, HH toolkit, tailored data reports, institutional leadership support letters
- **Performance measurement:** HH monitoring system (undercover observers), monthly consumption of handrub
- **Feedback:** online reporting tool and dashboard with data at unit and HCW level, with goal setting

There was also public recognition and rewards for top-performing teams and attention was given to low-performing teams through leadership letters and/or calls. There was recognition for HH superstars.

HH compliance increased two-fold after full programme implementation ( $P < 0.001$ ), and this change was sustained over a 20-month follow-up period ( $P < 0.001$ ).

## Ireland

In Ireland one objective of the National HAI Antimicrobial Resistance Clinical Programme and Clinical Advisory Group is to introduce initiatives including improvements in HH. Guidance comes from the WHO 2009 Multimodal HH Strategy and the 'My Five Moments of HH' model, with ABHR to be made available at all points of care. Standard 6 of the 2009 Health Information and Quality Authority Standards for Infection Prevention and Control is wholly dedicated to hand hygiene.

By June 2011 Irish public acute hospitals were undertaking national HH observational audits twice a year. Results were published documenting HH compliance within the Irish acute hospital sector. In 2012 the WHO 'Clean Hands Saves Lives' campaign was introduced (Health Service Executive Ireland, nd).

Irish National HH guidelines have been developed and were updated in 2015 (Royal College of Physicians Ireland 2015). The Irish Guidelines are based on the WHO guidelines, with input from recently updated guidelines from NICE (2012), epic3 (2013), Public Health Ontario (2014), and the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America (2014).

The Irish National HH Guidelines recommend the following pertaining to improvement, education, audit, and governance:

### *Multimodal improvement strategy*

- A multimodal HH improvement strategy, such as that developed by WHO, should be used in all healthcare services

### *Education*

- HCWs should undertake mandatory HH education at induction and at least every two years thereafter
- HH education should be a mandatory component of all clinical course curricula
- Adherence to appropriate HH should be assessed in final clinical/professional examinations
- Content and learning outcomes should include the importance of HH, the evidence base for HH, the indications for HH (including the WHO Five Moments for HH), the choice of HH product, preparation for HH, technique for hand washing and use of alcohol handrub, practical demonstration, and prevention of skin damage
- The content and duration of HH education should be tailored to the particular healthcare setting and to the degree of clinical contact
- Education can be delivered face-to-face, by an e-learning programme or by a combination of both

### *Audit*

- Regular audits of HH (locally determined) with feedback in all healthcare settings, linked to an improvement programme
- HH audits should form part of a broader programme of surveillance and audit
- Audits should be performed in a standardised manner
- Results should be reported to senior management, clinicians and the infection prevention and control committee (where present)

Suggested evaluation and audit measures:

- Compliance of healthcare workers with hand hygiene opportunities and/or technique
- Barriers to effective hand hygiene technique
- Proportion of healthcare workers that have completed hand hygiene education
- Healthcare worker knowledge questionnaire
- Evaluation of healthcare worker hand hygiene technique
- Alcohol handrub consumption
- Soap consumption
- Hand hygiene facilities
- Availability of alcohol handrub at point of care
- Location of hand hygiene posters
- Patient questionnaire

Suggested outcome measures:

- Facility/unit acquired *Clostridium difficile* infection
- Facility/unit acquired multidrug resistant organisms (e.g., MRSA)
- Facility/unit acquired catheter related bloodstream infections

*Governance/Responsibility*

- The *CEO/General Manager* of each healthcare facility/service has overall responsibility for implementation, including the provision of the necessary resources
- Each HCW is responsible for performing appropriate HH during all aspects of patient care
- Each HCW is responsible for ensuring that they complete mandatory HH education

## Summary and Discussion

The evidence presented above draws largely on academic reviews, institutional guidance, and examples of HH programmes around the world.

Evidence indicates ABHR is the preferred HH product for most situations. The choice of ABHR should be made in consultation with users, and alternative products can be offered for those with skin issues, along with a hand care programme.

The optimal HH technique remains unknown. Evidence shows that a six step, 30-second technique works to reduce microbial load on the hands. However, other studies have found three-step approaches, or 15-second methods to be non-inferior. At least 1 mL of ABHR is needed to cover the hands, but 2-3mL, or ‘one to two good pumps’, may make full coverage more likely in practice. A stochastic approach where HH is performed at pre-determined regular intervals could be added to supplement standard indications for HH. Considering the emerging evidence, high-level reviews have called for continued promotion of the WHO’s six-step approach, but ongoing research to establish if it can be simplified.

High-level evidence in the form of Cochrane reviews has indicated that multimodal HH improvement strategies can be effective in increasing HH compliance and reducing HAIs. However, it is not clear exactly which components of such strategies are essential or most effective. Various versions of the WHO’s multimodal strategy are effective, and this approach combines provision of ABHR, education and training, observation and feedback, reminders in the workplace, and developing the institutional safety climate. One meta-analysis found a strategy of education, reminders, feedback, administrative support, and access to alcohol-based handrub as a bundle was likely more effective than education, reminders, and feedback alone. However, there is evidence that adding additional emphasis on leadership and teamwork elements can improve on the WHO’s strategy and this has been demonstrated in a cluster RCT in the Netherlands. Targeting self-efficacy and intention may also improve the effectiveness of programmes.

In a WHO survey of HH at facilities around the world ‘Safety Climate’ was found to be the lowest scoring component of the multimodal framework, but somewhat promisingly it was also the only domain to improve significantly at facilities that completed both the 2015 and 2019 survey. There is some evidence that Safety Climate is also the least studied of the multimodal components and lack of understanding of its role might underlie lower self-assessment scores.

Education on HH has been found to increase knowledge and adherence to HH. The literature favours mixed modal education, and multiple continuous sessions are optimal. Train the trainer approaches are recommended for consistency. Education frameworks include the WHO’s Five Moments (Four Moments in Canada) and should teach about HAI and transmission, HH agents, appropriate technique, the multimodal HH improvement approach, factors influencing HH, human factors, and hand care. Education sessions should be informed by audit and evaluation data. It is recommended that there be a process to check competence, and to check all HCWs have completed education. Mandatory training is commonly recommended, this could be enforced using employment contracts and facility accreditation. The optimal frequency of education is unknown, but annual updates are common. Education sessions are an opportunity for senior leadership to make brief comments about institutional commitment and the importance of HH. Various organisations recommend training for the

following categories: TTT for all hand hygiene auditors (and sustain a pool of trainers), HH education for all HCWs, staff working in clinical areas, volunteers, visitors, patients, students, laboratory staff, and pharmacy staff. There should be a budget and time allocated for HH education and training.

The present review did not find evidence in favour of specific governance or leadership arrangements for HH programmes. However, the WHO recommends that HH be nationally coordinated. Several jurisdictions have a national standard regarding HH. NICE recommends that there be a facility Board member responsible for HH. CEOs of facilities should be supportive of HH improvement and ensure there are written policies and procedures in place. The WHO recommends a facility HH coordinator who operates with support and resourcing from senior management. A multidisciplinary HH team or committee is recommended, along with unit champions, especially physician role models.

Monitoring HH compliance as well as facility audits are important aspects of HH improvement strategies. Evidence indicates that monitoring can improve HH compliance. The WHO recommends direct observation of the Five Moments as the 'gold standard' for monitoring. Facility audits and knowledge and perception surveys are also recommended. However, direct observation is prone to certain biases. These include selection bias, the Hawthorne effect, other behavioural modifications, and issues of validation and reliability. Some evidence has indicated that non-unit-based observers noted lower HH compliance than unit-based observers. This raises the issue of whether observers should be IPC staff. However, taking this approach might risk deflecting responsibility for HH away from HCWs and on to IPC teams. At a minimum, regular unit-based observer validation exercises are needed. Despite these issues, direct observation is still needed to observe the Five Moments, and to evaluate technique, which is a neglected area of monitoring and reporting. Covert observation has the potential to overcome some of the problems of direct observation, but it needs to be accepted by HCWs.

Other monitoring techniques can help compensate for the weaknesses of direct observation. Product consumption can monitor 24/7 HH activity and uses fewer resources. It may also be appropriate for settings where HH moments are too infrequent to make direct observation worthwhile. Electronic monitoring might help overcome some of the gaps and problems of observation, however most electronic systems are yet to be fully validated or proven, and those for which evidence exists were often part of wider improvement programmes. Their potential is noted in high-level reviews, but effectiveness and cost-effectiveness remain unclear. Audit of staff knowledge, and perceptions, including those of management, as well as learning completions, can supplement compliance monitoring. The WHO Facility Self-Assessment Framework can help facilities track progress.

The optimal frequency of audit and monitoring is unknown. Continuous audit might be ideal, however, with some kinds of electronic monitoring it has been proposed that intermittent monitoring might be more acceptable. Regardless of methods, there should be quality control processes in place for data validation. Feedback of monitoring data is important. This should be done to staff, to management, and should be linked to a quality improvement programme.

Compliance (including technique), product consumption, and HAI data should be reported to a national programme, to facility leadership (including the CEO and Board), to unit leadership, to staff and publicly. Performance measures are tracked on dashboards in some jurisdictions, and reporting is often mandatory. Six-monthly or annual reporting is common.



There are many HH programmes around the world. These exist at international, national, and local level. One of the more comprehensive approaches is that of the Australian NHHI, which has also been comprehensively evaluated with an evidence-base demonstrating its effectiveness in improving compliance and reducing HAIs. Programmes differ in their recommendations. However, this is consistent with findings in the academic literature that HH programmes are probably effective, but the exact form an optimal programme should take is not known with certainty.

It is possible that some programmes might be able to be simplified and remain effective. Programmes using the Five Moments approach might consider switching to a Four Moments framework. Those encouraging a six step HH technique or 30-seconds ABHR approach might consider switching to a three-step or 15-seconds approach with more emphasis on monitoring technique. However, it must be emphasized that although there is some evidence suggesting these approaches are non-inferior, academic reviews are still cautious in tone, and suggest change should only come on the back of ongoing evidence. Piloting new approaches in stepwise fashion with robust evaluation might confirm improved strategies. Such strategies could potentially include adding the ‘stochastic’ approach advocated by Gould (see above) to current methods, and a concerted effort to monitor and report technique.

Arguably when HH compliance is consistently high, product consumption could be monitored as a proxy and direct observation, or electronic methods, used if usage drops (eg below the 20L per 1000 bed days recommended by the WHO).

There remain many barriers to effective HH. These include understaffing, overcrowding, workload, product placement, discrepancies between healthcare professions, and the fact that using gloves gives a false sense of security. It may be that a any post-Covid-19 period is an opportunity to address overuse of gloves. These and other issues should be addressed in ongoing fashion. Additionally, patients and visitors can transmit HAIs in their own hands, through touching the shared environment and interaction with other patients and visitors. Patient/family engagement is another area for ongoing attention.

Finally, it is worth noting that much is yet unknown with respect to HH and this is illustrated starkly by a 2021 list of 55 open research questions (Lotfinejad et al 2021).

## Conclusion

This study sought to identify evidence and examples of effective HH practice and programmes. The academic literature supports the use of multimodal HH improvement strategies and currently successful programmes might be able to be made even more effective by increasing focus on teamwork and leadership engagement and more attention to a climate of safety. It is possible that simplified approaches to teaching the indications for HH (eg a Four Moments framework) or for HH technique (three-steps, 15-seconds) might be appropriate, however sensible implementation of these innovations could be as pilot programmes with careful evaluation. National HH programmes are recommended by the WHO, and governance at facility Board and CEO level with engagement of multidisciplinary teams and committees, and unit leadership with champions and role models are widely recommended. All staff, students, volunteers, and patients should receive ongoing education about HH, and for HCWs this should be mandatory with competence assessed. Monitoring increases HH compliance and the mainstay is a combination of direct observation, as well as monitoring product consumption, staff surveys, and tracking HAIs. Validation of data, and checks of reliability, need to be ongoing. Reporting of data should be to the national programme, facility leadership, unit leadership, all HCWs, and the public. Reported data should be used to adjust and amend education and practice.

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