JNTP Journal of Nursing Theory and Practice

journal homepage: https://pops.uclan.ac.uk/index.php/jtnp

Literature Review

Effective methods of promoting hand hygiene to reduce hospital acquired infections: A literature review

Sean Yates [1a], Paul Regan [b]

[a] Royal Preston Hospital, Lancashire Teaching Hospitals NHS Foundation Trust; [b] Senior Lecturer in Adult Nursing, School of Nursing and Midwifery, University of Central Lancashire.

Key Words: *Hospital-acquired infection; hand hygiene; healthcare-associated infection; hand washing; hand sanitising; nosocomial infection; reduce infection*

Abstract

Aim: A literature review aimed to explore the most effective methods of promoting hand hygiene in nursing to reduce the prevalence of hospital acquired infections (HAIs). **Methodology:** A literature search was conducted using AMED, British Education Index, CINAHL Ultimate, ERIC, and MEDLINE with the search terms "hand hygiene, hospital acquired infection, reduction, and promotion" between 2014 and 2024. A PICO framework helped to create a search hypothesis and a PRISMA flowchart used. The search was later repeated between 2017 and 2024 to be relevant post Covid 19 pandemic. **Results:** n=33 research studies were retrieved, reduced to n=10 and finally reduced to n-=6. The research studies were critically appraised to identify themes and relevant discussion. **Findings:** Three key themes were; first, education and knowledge; second, direct observation, and third, reminders/ prompts. All research studies demonstrated a correlation between promoting hand hygiene and a reduction in hospital acquired infections. **Discussion:** The cost of HAIs was an issue in terms of a negative effect on hospital resources (beds, staffing costs, equipment) and positive patient outcomes. Despite WHO (2020) and organisational guidelines of best practice, education and training, hand hygiene frequency had improved at the beginning of the Covid 19 pandemic, with healthcare staff being key to reduce HAIs but hand hygiene later became less observed due to high staff workload and burnout. The research findings reinforce WHO guidelines, and indicate a need for regular training, reminders, and updates in clinical practice to promote hand hygiene to reduce the incidence of HAIs. **Conclusion:** HAIs have a negative impact on patients' treatment outcomes, cost, and resource implications and despite WHO (2020) guidelines, continue to have a negative impact on patients' health outcomes. Nurses dealing with a high workload and burnout were found to be at risk of forgetting the importance of hand hygiene and evidence-based practice, yet hand hygiene is the most cost-effective method of reducing HAIs.

Introduction

The World Health Organisation (WHO, 2020) guidelines recommend the promotion of hand hygiene (HH) to reduce the 165,0000 deaths every year globally from diarrhoeal disease. One area of concern is the incidence of hospital or healthcare acquired infections (HAIs) and microbial resistance to antibiotics (WHO, 2020). Despite hospitals being an essential part of a nation's healthcare system, HAIs are the second most prevalent cause of death world-wide (Haque et al., 2020). HAIs have an impact on the effectiveness of clinical treatments, length of time a patient remains in hospital, and impact bed management and healthcare costs (WHO, 2017). HAIs may lead to sepsis and death, and the prevalence of hospital acquired sepsis worldwide varies between 5.7% to 19.1%, with 6.5% in Europe and 3.2% in the United States (Markwart et al., 2020). In Brazil, a multi centred prospective study in intensive care units found that 60% of sepsis cases admitted were a result of HAIs, suggesting countries with low to middle income are at higher risk of HAIs (Markwart et al., 2020). In the United Kingdom's (UK) National Health Service (NHS) HAIs were estimated to cause 5.6 million hospital bed days and cost £2.1 billion to the NHS between 2016 and 2017 (Guest et al., 2020), costing approximately £1 billion a year and £56 million estimated after patients were discharged into the community (NICE, 2017). In England alone 300,000 people a year acquire HAIs because of NHS care (NICE, 2023).

Common types of HAIs, cause, and management

[1] **Corresponding auther:** Royal Preston Hospital, Lancashire Teaching Hospitals NHS Foundation Trust. **Email Address:** sean.yates@lthtr.nhs.uk.
https://doi.org/10.17030/uclan.jtnp.612
Accepted 27 September 2024; **Published** 14 April 2025

HAIs can follow medical or surgical treatment and contact with a healthcare worker (NICE, 2023). NICE (2023) suggest the most common types of HAIs are respiratory infections, including pneumonia and lower respiratory tract (22.8%), urinary tract infections (17.2%) and surgical site infections (15.7%). A wide range of micro-organisms enter the body to cause HAIs include; methicillin-resistant staphylococcus aureus (MRSA), Clostridium Difficile (C. difficile) and Escherichia Coli [E. Coli] (NICE, 2023). The micro-organisms can be transmitted via body fluids and excretions, contact with non-intact skin, mucous membranes, inhalation of airborne droplets, contaminated equipment, or inoculation incidents (NICE, 2023).

The prominence of HH accelerated after the World Health Organisation (2009) released HH guidelines, leading to a significant reduction in HAIs worldwide. WHO (2009) recommended promoting a HH strategy called “my 5 moments for HH” which included moments before touching a patient, before a clean or aseptic procedure, after body/ fluid exposure, after touching a patient and after touching patient surroundings. These “my 5 moments for HH” also included educational programmes, HH information, empowering patients, promoting use of alcohol gel, use of hygiene posters, podcasts, reminders and motivational messages. Finally, role modelling refered to the influence of peers and managers (WHO, 2009).

Although the WHO (2020) supported multi modal strategy for the prevention of HAIs, HH remained the most effective, simplest, and least expensive measure to prevent HAIs. Hand hygiene was emphasised during the Covid 19 pandemic (Wang et al., 2022) but declined after only a few weeks due to a reported increase in workload, reduced HH compliance, frequency, and management directives (Moore et al., 2021). This literature review, therefore, aimed to identify if better HH protocols could decrease HAIs and length of inpatient stay. The selected articles were critically appraised, and themes of direct observation, education, and reminding/ prompting systems identified as being key to improvement. The literature review was the first step to identify knowledge and gaps in practice to inform an improvement project for clinical practice (Yates & Regan, 2025).

Literature Search Pathway

A literature search was conducted using multiple databases; AMED, British Education Index, CINAHL Ultimate, ERIC and MEDLINE. Educational databases were included to examine educational programmes related to HH and HAIs. The PICO format (see Table 1 entitled: PICO) was used to identify relevant search terms (Richardson et al., 1995) and Boolean operators were included to broaden the search for related key terms and excluded studies referring to children. The search terms used were “…hand hygiene AND hospital acquired infection hospital acquired infections or health care associated infections or nosocomial infections AND reduction, and promotion…” between 2014 and 2024, with n=33 retrieved research studies initially found. The search was repeated from 2017 to 2024 to allow for contemporary research studies pre and post Covid 19 pandemic evaluation of HH (e.g. Moore et al., 2021; Ragusa et al., 2021; Wang et al., 2022; Williams et al., 2021) since WHO (2017) guidelines were introduced, further reducing the retrieved findings to n=10. The n=10 studies were appraised for relevance using critical appraisal tools to support systematic reviews of quantitative and mixed methods research studies. A PRISMA flow diagram was developed (see figure 1 entitled: PRISMA) outlining the search strategy and search criteria (Page et al., 2021) followed by a table of findings to summarise results (see table 2). The final retrieved research studies (n=6) had a variety of approaches and methods related to HH on HAIs (Akkoc et al., 2021; Boora et al., 2021; Han et al., 2021; Haverstick et al., 2017; Kelčíková et al., 2021; Ojanperä et al., 2020).

Table 1: PICO framework

P	I	C	O
Patient, population or problem	**Intervention or exposure**	**Comparison or control**	**Outcome**
Hand hygiene AND hospital acquired infection hospital acquired infections OR health care associated infections or nosocomial infections	Promoting hand hygiene	Differing interventions	Reduction in HAIs

Critical appraisal

Four of the six studies used quantitative research methods (Akkoc et al., 2021; Boora et al., 2021; Han et al., 2021; Ojanperä et al., 2021) and focused on the observation of clinical staff HH to discover its correlation to HAIs, with a variation in the methods used to attain results. Akkoc et al. (2021) compared the difference of direct observation against an automated electronic hand hygiene reminding and recording system (EHHRRS), whilst Boora et al. (2021) and Han et al. (2021) used direct observations to discover when HH was being implemented. Lastly Ojanperä et al. (2020) concentrated on the number of seconds staff washed their hands for when performing HH. The remaining two studies (Haverstick et al., 2017; Kelčíková et al., 2021) used mixed methodologies and in contrast, focused on education as the primary intervention in tackling the prevalence of HAIs. Haverstick et al. (2017) educated patients on HH, whereas Kelčíková et al. (2020) critiqued medical students on their knowledge of HH and HAIs. The results of five of the studies were derived from the change in HAIs due to their intervention, with Kelčíková et al. (2020) using a cross sectional-survey and questionnaire to determine knowledge level.

All the retrieved research studies provided evidence in support of the correlation between improved HH and

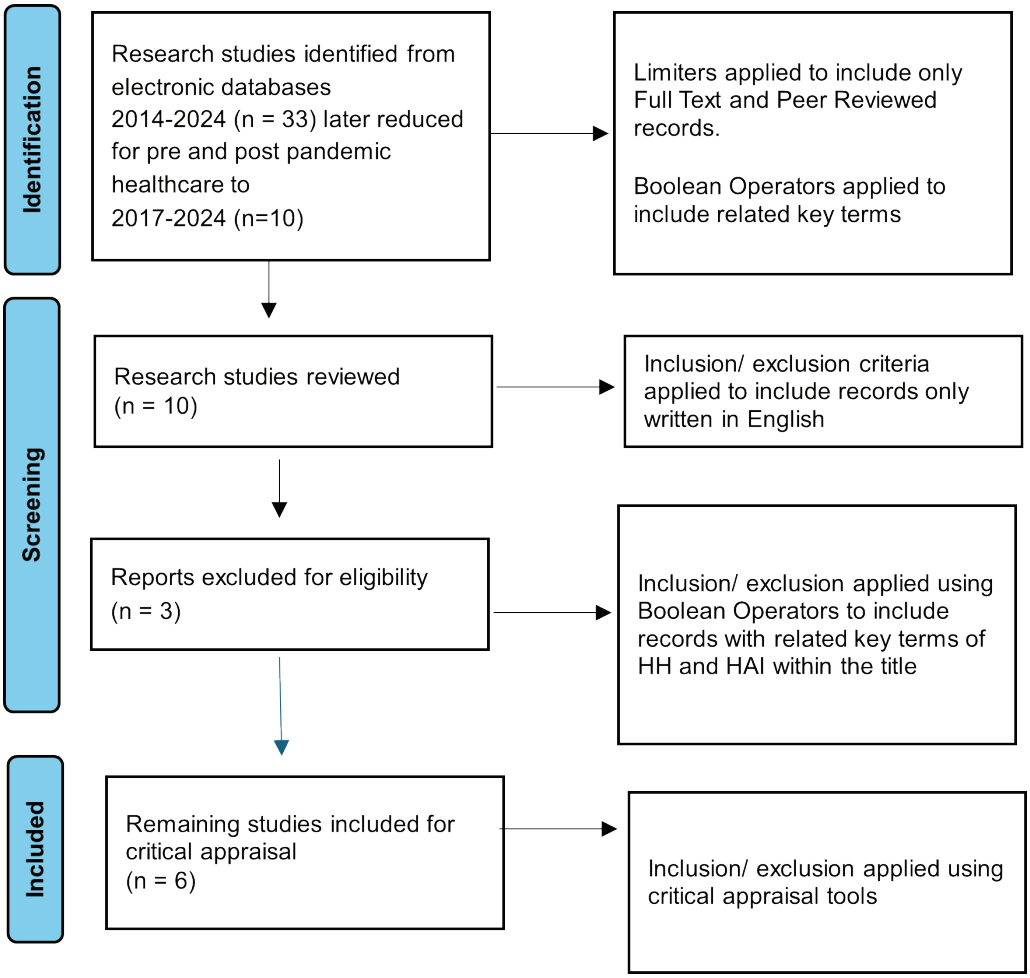

Figure 1: PRISMA flow diagram

the reduction of HAIs. All studies used the WHO (2009) guidelines on HH in health care, demonstrating consistency and a standard measure between papers. However, inconsistency was found in the specific type of HAI explored in each study. Four of the studies only reported the effect of HH on HAIs without alluding to any specific infection type (Boora et al., 2021; Han et al., 2021; Kelčíková et al., 2021; Ojanperä et al., 2020) whilst Akkoc et al. (2021) and Haverstick et al. (2017) focused on specific HAIs without reference to other/all HAI reductions.

The sample size and time periods for each study were varied, which was be expected with different method approaches and separate groups used as the subject. However, some of the studies gathered comparatively lesser amounts of data in which to base their conclusions upon. Kelčíková et al. (2021) collected n=250 HH knowledge questionnaires but only n=238 self-assessment questionnaires showing inconsistency in their collection. Boora et al. (2021) conducted their study over a five-year period yet made no reference to the amount of data collected. Likewise, Haverstick et al. (2017) and Akkoc et al. (2021) conducted their studies within 1 to 4 months, respectively. Whilst Akkoc et al. (2021) discussed the barriers encountered that accounted for the smaller time, the lack of sample size and time-period diluted the possibility of meaningful conclusive results (Schünemann et al., 2024). In contrast, two of the studies collected significant amounts of data over a longer time period (Han et al., 2021; Ojanperä et al., 2020). Larger sample sizes have been shown to develop more robust and accurate models in healthcare (Riley et al., 2020). This could be seen with Ojanperä et al. (2020) making 52,115 observations over five years, and Han et al. (2021) 480,943 observations over four years.

Another consideration of the research methodologies was the clinical context of data collection (Li et al., 2024). Three of the studies narrowed their scope to a single unit in a hospital (Akkoc et al., 2021; Boora et al., 2021; Haverstick et al., 2017), or in the case medical students in one university (Kelčíková et al., 2021). This is a critical point because choosing to have a small study group may result in having a more controlled environment, and consistent application of the study methods, particularly for a pilot stage of an intervention proposal (Indrayan & Mishra., 2021). However, any conclusions drawn were not generalisable (Schünemann et al., 2024), unless results from multiple studies showed similar conclusions (Li et al., 2024).

The kinds of participating clinicians were a factor when exploring HH interventions, something which was not considered in some of the papers. Three of the studies (Akkoc et al., 2021; Boora et al., 2021; Han et al., 2021) included all clinicians and healthcare staff within their

Table 2: Table of findings

Authors	Aim of Study	Methodology/ study design	Sampling strategy	Data collection tools (survey / interviews)	Findings	Relevance to clinical practice
Akkoc et al. (2021)	Reduction of nosocomial infections in the intensive care unit using an electronic hand hygiene compliance monitoring system	Quantitative	12 beds on an ICU ward in which 248 observations were made between April 2016 and August 2016.	Direct Observation (DO) and Electronic Hand Hygiene Reminding and Recording System (EHHRRS)	- HH compliance comparison from DO to EHHRRS was 49.1% vs 89.2%. - HAI rate between to two interventions was 31.89% for DO and 18.43% for EHHRRS.	Direct comparison of two methods of hand hygiene interventions to determine which is most effective at reducing hospital acquired intervention
Boora et al. (2021)	Impact of Hand Hygiene on Hospital-Acquired Infection Rate in Neuro Trauma ICU at a Level 1 Trauma Center in the National Capital Region of India	Quantitative	Observation of 20 bed in and ICU. DO over a 5-year period (January 2014 to December 2018)	DO over a 5-year period (January 2014 to December 2018) using a checklist based on WHO's 5 moments of HH.	A direct correlation was shown between increased HH and a reduction of HAI from a result of a DO intervention.	Efficacy of DO over an extended period of time and the correlation of improved HH compliance and HAI reduction.
Han et al. (2021)	Effects of a 4-year intervention on hand hygiene compliance and incidence of healthcare associated infections: a longitudinal study	Quantitative	480,943 observations were made in a general teaching hospital over four years using n=78 trained observers.	A custom paper questionnaire based on WHOs 5 moments of HH.	HH compliance increased from 64.78% to 90.51%. A multimodal method was most effective in increasing HH and reducing HAI.	Examines the effects on HAI by using a multi method approach to HH across an entire hospital for an extended period.
Haverstick et al. (2017)	Patients' Hand Washing and Reducing Hospital- Acquired Infection	Mixed Method Questionnaires for patients and staff.	36 bed surgical unit over 38 months (19 months before intervention and 19 months during). 33 staff responses to questionnaire. n=172 patient responses over 4	Questionnaires and statistical analyses using SPSS version 21 and a non-parameter Wilcox rank sum test. Significance set to .05.	- VRE and MRSA infection rates decreased while C, Difficile rates increased. - Patients were found to be uneducated in the benefits of HH and increased their understanding and compliance after intervention.	Monitors the effects of improved education and monitoring of HH in both staff and patients.
Kelčíková et al. (2021)	Evaluation of Hand Hygiene: Is University Medical Education Effective Prevention of Hospital Acquired Infections?	Mixed Method	n=262 medical students. 250 questionnaires and 238 surveys were collected.	Cross-sectional survey, HH knowledge questionnaire and curriculum analysis.	The self-surveys showed misguided confidence on HH and HAI. Results from the knowledge questionnaire showed only a satisfactory or insufficient knowledge. The curriculum analysis showed HH and related topics were marginally covered.	Exploration into the education of HH and the reduction of HAI to discover if it is substantial or whether there needs to be reform.
Ojanperä et al. (2020)	Hand-hygiene compliance by hospital staff and incidence of health- care-associated infections, Finland	Quantitative	52,115 observations from May 2013 to December 2018 within a tertiary-care hospital using infection control link nurses	Observations timed using a stopwatch, recorded on paper, and transferred to an online database initially. In 2017 this was changed to a web-based mobile device.	HH compliance increased, and HAI decreased overall from the beginning to the end of the intervention.	Efficacy of DO and semi-automated surveillance over an extended period of time and the correlation of improved HH and HAI reduction.

study. Interestingly, Akkoc et al. (2021) discussed the refusal of participation from medical consultants, whereas Han et al. (2021) identified a higher compliance of medical technicians and nurses compared to cleaners and interns (Akkoc et al., 2021; Han et al., 2021). Ojanperä et al. (2020) only included doctors and nurses in their study and Kelčíková et al. (2021) only included medical students. However, this might be explained due to Kelčíková et al.'s (2021) study not having a nursing department in Comenius University in Bratislava, Slovakia. The remaining paper (Haverstick et al., 2017) focused on the attitude and education of patients but did not evaluate staff education. A positive influence in the study of Haverstick et al. (2017) was nurses being encouraged to promote HH, would have directly impacted on their own HH. However, significantly, none of the studies could provide any conclusive evidence that improved HH reduced HAIs.

Whilst showing their similarity to older reports, few of the studies gave reference to current events or influencing factors that may impact results. Kelčíková et al. (2021) referred to the Covid 19 pandemic several times in their introduction, which was of contemporary relevance. However, the collection of data for this study was between 2018 and 2019. Han et al. (2021) suggest the Covid 19 pandemic may have accounted for higher anxiety and compliance of HH to have influenced the findings. This level of transparency allowed the impact of the intervention and results to be clearly seen. Further critical appraisal will be addressed in the next section.

Education and knowledge

Two of the studies significantly focused on education and promoting understanding of HH and its effect on reducing HAIs (Haverstick et al., 2017; Kelčíková et al., 2021) which was a key recommendation of the WHO (2009) guidelines. An important aspect of HH education was the retention of information provided and understanding the impact of poor practice directly influenced the consistency and quality of HH. The questionairre of Haverstick et al. (2017) sought to gather patients' views of HH; once before the intervention and for three consecutive months after. Haverstick et al. (2017) found that patient attitudes towards the importance of HH decreased over time. Whilst nurses were encouraged to continuously promote HH with patients in their care, the dwindling results may have been due to the nurse or the patient's disinterest when not in a clinical setting. Haverstick et al. (2017) suggested a limitation of their study may have related to a lack of health literacy and unknown learning needs of the patients.

Similarly, Kelčíková et al. (2021) pay attention to the adequacy of teaching HH in an analysis of medical student curriculum. A quantitative search using key terms and phrases by the authors yielded no results within the n=37 identified subject topics and through a search for related terms only n=15 hits were uncovered throughout the entire curriculum. The lack of education on HH in the medical student curriculum may have explained the poor results achieved by students in all years of study when completing the questionnaire. Whilst the study suggested this may be due to the pressures of final year exams; it is easy to suggest that lack of HH education in a curriculum could result in poor adherence to effective HH practice. Kelčíková et al. (2021) considered the level, consistency, and source of the practical knowledge gained by medical students. They concluded insufficient education was provided at the university and that the students gained most of their knowledge and understanding of HH and HAI by clinical staff whilst on placement. Whilst there was an argument to support development of a student's skills through practical application, it was evident in these studies that correct HH was not practised unanimously in clinical practice due to a need to educate both patients and students.

Misguided confidence was a recurring theme within these two papers. Kelčíková et al. (2021) found comparable results in their study of medical students through a self-assessment questionnaire, with 72.2% considering themselves to adhere to HH guidelines and 62.5% stated their HH behaviour was exemplary. This contrasted strongly with the results of their HH knowledge which demonstrated none of the students received higher than the lowest passing grade. Again, this confidence could be attributed to incorrect HH practise observed in clinical placement. Whilst it could be assumed that the students were simply not interested in HH, Kelčíková et al. (2021) reported 88.2% of students considered HH to be an integral tool for fighting HAIs and understood its importance. Kelčíková et al. (2021) also reflected on the low self-evaluation scores of the final year students, suggesting that experience does not necessarily equate to improved knowledge or competency.

In Haverstick et al. (2017), nursing staff were given a questionnaire to evaluate their performance and during the intervention staff believed they encouraged HH 97% of the time, contrasting significantly with the views of the patients. Only 53% patients agreed they were encouraged at the start of the intervention which reduced further to 46% by the end of the intervention. Both studies indicated that confidence in knowledge should not be mistaken for competence, but an opportunity to give feedback and discover gaps in evidence-based and structured education.

Direct observation

In accordance with WHO (2009) guidelines, four of the papers examined direct observation as a key theme of HH and its effect on HAIs (Akkoc et al., 2021; Boora et al., 2021; Han et al., 2021; Ojanperä et al., 2020). Whilst these papers acknowledged that direct observation was the gold standard, limitations of this method were discussed. Firstly, direct observation was labour-intensive

and needed substantial investment in the time and training of observers. Akkoc et al. (2021) and Han et al. (2021) used multiple trained infection control personnel, Ojanperä et al. (2020) used several infection control nurses and Boora et al. (2021), a single infection control nurse. The three studies above offered scant information on the personnel observing and their methods. However, Han et al. (2021) presented a wealth of detail with n=78 HH observers from relevant clinical backgrounds, demonstrated a clear correlation between the number of staff hired and the significantly larger amount of data collected.

The amount of time allocated to direct observation was also an issue. Akkoc et al. (2021) did not state the number of hours spent observing or indeed the number of observations collected (Akkoc et al., 2021). Ojanperä et al. (2020) improved on this stating that a minimum of 10 observations were taken per ward every month gathered within a 4 to 6 hour period. Towards the end of their five-year study, data recording was changed from handwritten direct observation to an electronic device developed within the hospital to streamline data collection and pilot the tool. Whilst Han et al. (2021) gave statistics for the impressive number of observations taken, observations were performed irregularly, at least once each week. Conversely, Boora et al. (2021) stated that the infection control nurse spent a minimum of 1 hr per 24 hours observing and did not provide significant detail, such as total hours spent observing the mean, or number of observations collected (Schünemann et al., 2024).

Ojanperä et al. (2020) discussed the relevance of the Hawthorne effect, which concerns the likelihood of a change in behaviour when a person is aware of being directly observed (McCambridge et al., 2014), which was not discussed in the other papers. Ojanperä et al. (2020) briefly analysed the limitations of only making observations during weekdays and not observing staff at night or on weekends, but interestingly the Hawthorne effect created positive results, and a continuation of its effect helped sustain HH and reduced the prevalence of HAIs. However, there was no further evidence reported when staff were no longer being observed. Although direct observation was described as the gold standard, electronic surveillance systems were used in two studies to create a multi-modal approach of assessment (Han et al., 2021; Ojanperä et al., 2020). Notably, two studies identified that staff directly observing gave in the moment feedback to educate the assessed staff member for improvement in the future (Han et al., 2021; Ojanperä et al., 2020). The only other research study to discuss a sustained behaviour change was Akkoc et al. (2021) in relation to the use of the electronic reminding system, which is discussed in the next section.

Reminders- prompts

Reminders and prompts were recommended in the WHO (2009) guidelines. One research study questioned the viability of an electronic hand hygiene reminding and recording systems [EHHRRS] (Akkoc et al., 2021), whilst several other studies promoted the efficacy of reminders (verbal and electronic) as a multi-modal method (Haverstick et al., 2017; Ojanperä et al., 2020). Akkoc et al. (2021) make a direct comparison between EHHRRS and the gold standard of direct observation and found there was a significant increase in HH during use of EHHRRS (49.1% to 89.2%), resulting in a significant reduction of HAIs (31.89% to 18.43%). The study of Akkoc et al. (2021) was supported by numerous references to reinforce the efficacy of this intervention and a prolonged reduction in HAIs several months after EHHRRS was removed, which made a compelling case in favour of the associated expense.

There were several points of concern and limitations found. Tolerance and acceptance of staff to maintain HH was integral to ensuring sustained compliance. Whilst Akkoc et al. (2021) provided a wealth of detail to support EHHRRS, the study failed to account for time, staffing and data collected for direct observation, demonstrating a preference in favour of EHHRRS (Akkoc et al., 2021). Akkoc et al. (2021), due to staff concerns with the technology and reluctance to be monitored continuously, was conducted over a brief period of four months and the EHHRRS observation only accounted for two of the five moments of HH (WHO, 2009). Although Akkoc et al.'s (2021) use of EHHRRS were designed to be observed by all clinical staff, medical consultants refused to use the system.

Discussion

Collectively, the research studies considered a wide demographic including clinical staff, patients, and students. Limitations such as resistance to the intervention and the non-involvement of all staff were discovered. For a similar intervention to work, attention must be given to the compliance and promotion of clinical and other staff, as they have been shown to be the driving force for successful implementation. The needs and agreement of the patient should also be of concern, such as their level of understanding and health literacy. As seen through the students and staff in these studies, HH and HAIs required ongoing learning and compliance. Another important aspect that many of the studies failed to address was any lasting effect after the intervention was removed, which would be a critical consideration for future implementations. Overall, it was shown that most studies adopted a multi-modal intervention; educational documents, posters and online resources were updated and distributed during some interventions (Boora et al., 2021; Han et al 2021). Training was also provided to further learning and understanding (Han et al., 2021).

Increasing a multi-modal approach to promoting HH compliance and reducing the prevalence of HAIs corresponded with an increase in collected data and analy-

sis. Direct observation interventions were aided through electronic systems and education was given as a means of improvement. The use of EHHRRS (Akkoc et al., 2021) was equally augmented with direct observation as the gold standard. Education was implemented for the benefit of staff, patients, and students to guide clinical reasoning and understanding. Together, an intervention of multiple methods was shown to provide significant and lasting results. The promotion of HH interventions had been more significant since the Covid 19 pandemic (Wang et al., 2022), but it did not lead to greater HH compliance (Ragusa et al., 2021), due to staff exhaustion, burnout, and high workloads (Manomenidis et al., 2019).

Conclusion

This paper has presented a review of the literature to explore findings from research studies aiming to improve HH to reduce HAIs. The WHO (2020) highlighted HH as a key factor in reducing the transmission of the Covid 19 pandemic. From a review of the retrieved findings, three key themes of education and knowledge, direct observation and reminders/ prompts were relevant to staff taking the initiative in HH. First, knowledge and understanding how HH reduced HAIs was found to be relevant to both staff and patients' attitudes, which led to poor retention of information, poor standards of training and clinical practice. The second theme related to the importance of direct observation and in the moment feedback to the assessed staff. The third theme of reminders/ prompts identified the viability of an electronic hand hygiene, and multi-modal methods were useful such as an electronic HH recording and reminding system (EHHRRS) to improve HH compliance. Updating posters, online resources and training helped to create an effective and sustained reduction of HAIs. Despite nurses training in the importance of HH and cross infection, a significant factor in promoting HH was collegial support, observation, and timely feedback within a clinical team willing to challenge poor standards of HH practice.

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Author Biographies

Sean Yates

https://orcid.org/0009-0006-7724-8516
Royal Preston Hospital, Lancashire Teaching Hospitals NHS Foundation Trust

Sean Yates is a Theatre Practitioner at Royal Preston Hospital. He received a first bachelor's degree in Adult Nursing from the University of Central Lancashire. He specialises in Orthopaedic and Trauma theatres for which he has attended various AO accredited orthopaedic courses. His interests lie in biopsychosocial determinants of health and their relation with preventative factors through health literacy and education.

Paul Regan

https://orcid.org/0000-0002-8775-933X
Senior Lecturer in adult nursing, School of Nursing and Midwifery, University of Central Lancashire.

Before joining the pre-registration team at the University of Central Lancashire in 2010, Paul worked in the NHS for 28 years from 1982-2010. Paul has clinical experience of adult nursing, acute mental health nursing and as a generic health visitor.