BEME GUIDE

Features of Educational Interventions that Lead to Compliance with Hand Hygiene in Healthcare Professionals within a hospital care setting: A Best Evidence Medical Education (BEME) review: beme Guide No. 22

BEME hand hygiene review

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1 BACKGROUND

Nosocomial infections (or healthcare associated infections (HCAI)) are infections that occur within 48 hours of admission to hospital or within 30 days of discharge and which happen as a result of healthcare treatment. Infections can be transmitted from a colonised healthcare professional (a qualified individual who delivers professional health care in a systematic way to any individual in need of health care services) to a susceptible patient as a result of direct physical contact, such as when bathing or caring for a patient (direct-contact transmission) or transmitted from a colonised object to a susceptible patient, such as needles or gloves (indirect-contact transmission). The most common organisms transmitted via direct-contact transmission are Clostridium difficile (Whitaker et al., 2007) and MRSA(Gill et al., 2009, Larson et al., 2000). The most commonly acquired HCAI are urinary tract infections, surgical site infections (including methicillin resistant *Staphylococcus aureus* (MRSA)) and pneumonias (including ventilator associated pneumonia (VAP)) (Reilly et al., 2007).

In the United Kingdom there are at least 300,000 healthcare associated infections (HCAI) annually costing an estimated £1 billion per year (National Audit Office, 2004). These infections result in longer hospitalisation (2.5 times longer than uninfected patients) disability and death (National Audit Office, 2004). In 1995, a Department of Health (DoH) working party on infection prevention in hospitals suggested that 'in the UK 5000 deaths (1% of all deaths) might be primarily attributable to HCAI and in a further 15,000 cases (3% of all deaths) HCAI might be a substantial contributor (Department of Health, 1995). The same working party suggested that up to 30% of all HCAI were potentially preventable by better application of knowledge and adherence to infection prevention procedures. A more recent national study of HCAI in England, Wales and Ireland identified prevalence in adult patients of 7.59% (range 0 – 34.6%) (Smyth et al., 2008). Healthcare associated infections have been estimated to result in 25 million additional patient days in hospital annually, costing €13-24 billion annually. (World Health Organization, 2009) Prevalence of HCAI in the United States is similar to that in the UK when population size is adjusted for; two million HCAI are estimated to occur annually, resulting in approximately 90,000 deaths (Safdar and Abad, 2008) and costing up to $5.7 billion per year.

The importance of hand hygiene in medicine in reducing disease transmission within hospital environments was first recognised in the 19th century by Semmelweis (Semmelweis, 1983). As a result, hand hygiene is now recognised as the main intervention for reducing nosocomial infections within medical settings (Larson, 1995). Hands become contaminated

during episodes of care both from the patients and the environment (Pittet et al., 2006). Without adequate decontamination the level of bacterial contamination increases with time (Pittet et al., 1999a), potentially allowing transfer to other patients or further contamination of the environment. Hand hygiene refers to the minimisation of disease spread and/or progression through cleansing hands of pathogenic microorganisms, including bacteria and viruses. Effective hand hygiene has been recognised as one of the most important measures for preventing the spread of pathogens (Centers for Disease Control and Prevention, 2002), and, coupled with the use of antiseptic chemicals (for example in soap) and alcohol gel, can reduce the spread of antibiotic resistant organisms (World Health Organization, 2009).

Guidance for hand hygiene has been incorporated into evidence based practice (National Institute for Clinical Excellence, 2003) and legislation for all healthcare professionals within the UK (Department of Health, 2006). The recognition of the importance of compliance with hand hygiene resulted in the implementation of a national campaign in the UK in 2005 (NHS National Patient Safety Agency). Headed by the National Patient Safety Agency, the 'clean**your**hands' campaign actively promotes hand hygiene. Evaluation of the campaign has demonstrated improvement in overcoming physical barriers and compliance, as measured by consumption of hand hygiene products. The most recent update from the National Patient Safety Agency, 'clean hands save lives', was published in September 2008, and highlights the role of healthcare professionals in hand hygiene.

In addition, hand hygiene is the principal focus of the World Health Organisation's First Global Patient Safety Challenge (World Health Organization, 2009). One component of this programme is the 'save lives: clean your hands', a global action day launched in 2009. Every 5th May, hospitals registered to the scheme (12394 in February 2011) provide their staff with various educational events (such as videos and displaying posters) which aim to increase awareness and compliance with hand hygiene. Guidelines for hand hygiene in the USA were published in 1981 by the Centers for Disease Control and Prevention (CDC). These were revised in 1988, 1995 and most recently in 2002 (Centers for Disease Control and Prevention, 2002). This revision includes recommendations for the use of alcohol hand hygiene products for patient care, given research suggesting increased compliance with hand hygiene when alcohol-based rub is available (Stone et al., 2007).

However, competence in hand hygiene is not the same as compliance with recommended practice; a healthcare professional can be competent at washing their hands but this may not translate into compliance within everyday practice. Competence encapsulates healthcare professionals' ability to wash their hands effectively and remove pathogens from

their hands using guidance such as that published by the National Patient Safety Agency in the UK (National Patient Safety Agency (NPSA), 2008). Compliance focuses on healthcare professionals' ability to wash their hands at the recommended points of clinical contact. . Indeed since all healthcare professionals must undertake mandatory training and assessment in hand hygiene annually, one may assume that most of them are competent at the point of initial assessment. However, the infection rate in hospitals indicates that they do not comply with standards and guidelines (Erasmus et al., 2010). Whilst there is a well-researched evidence base and clear clinical guidelines as to the most effective method to decontaminate hands, less is known about the most effective ways to promote compliance with hand hygiene in healthcare professionals.

Compliance with hand hygiene is necessary for all healthcare professionals and ancillary staff working within hospital settings. Of these professionals, doctors and nurses make up the largest proportion. Significant variability between health care professionals of up to 22% between ancillary staff and nurses following implementation of a hand washing protocol has been reported (Rosenthal et al., 2005). In addition, poor compliance to recommended hand hygiene practices has been associated with being a physician rather than a nurse, male rather than female, working during the week rather than at the weekend, the wearing of **g**owns/gloves, automated sink use, clinical practices with high risk of cross transmission and a high number of opportunities for hand hygiene per hour of patient care (Boyce and Pittet, 2002). Medical students and doctors have been reported to have the lowest rates of compliance with hand hygiene, with 41% of opportunities for hand decontamination resulting in non-compliance. They were followed by porters at 38%, technicians and physiotherapists at 33%, nurses and student nurses at 28% and healthcare assistants at 21% (Nursing Times).

Most research studies evaluating the effectiveness of educational campaigns to promote hand hygiene practices focus on the compliance of healthcare staff, which has been found to be variable (Pittet et al., 1999b, Thompson et al., 1997). The American National Guidelines published in 2002 (Centers for Disease Control and Prevention, 2002) suggest an average compliance of 40% and lists a number of factors that influence adherence such as insufficient time, lack of knowledge and lack of personal or institutional priority. Research indicates that compliance may vary between healthcare settings and between different units in the same setting (Creedon et al., 2008) with perversely worse compliance in intensive care units (Pittet et al., 1999b, Eveillard et al., 2009).

The World Health Organisation's recommendations for developing an educational intervention (World Health Organization, 2009) describe steps that are based on available evidence and expert opinion. It is recommended that

interventions meet the requirements of the health-care faculty, to enable the infection control team to focus on areas requiring modification; interventions are categorised depending on current practice; baseline compliance rates are measured before the implementation of new guidelines; different types of compliance, such as the use of hand gel should be assessed; interventions should be formulated and executed based on the resistance factors of healthcare professionals (World Health Organization, 2009).

Increased compliance with hand hygiene has been found to be influential in significantly reducing infections rates in the UK (Schelenz et al., 2005) and the USA (Larson et al., 2000). It is therefore necessary to identify the individual components of successful educational interventions in order to produce transferrable, effective interventions to improve compliance with hand hygiene within a hospital care setting. This is particularly important as educational interventions are a frequently used and core method of disseminating knowledge within health care (Cherry et al., 2010). As yet, no published researched has investigated the impact of individual features of educational interventions on compliance with hand hygiene practice in healthcare workers; this is a particularly pertinent research topic given research suggesting the impact of increase hand hygiene compliance on patient infection rates.

In addition, no previous systematic reviews considering the effectiveness of individual features of educational interventions to improve compliance with hand hygiene within a hospital care setting were identified in searches of the published literature conducted for this review. Several systematic reviews have considered the effectiveness of education in reducing nosocomial infections. Safdar (Safdar and Abad, 2008) reviewed educational interventions to prevent HCAI and concluded that educational interventions may reduce HCAI considerably. A systematic review by Mathai (Mathai et al., 2010) looked at educational interventions to improve hand hygiene but did not explicitly focus on compliance, and found that healthcare professional education has a positive impact on improving hand hygiene and reducing healthcare-associated infection. Aboelela (Aboelela et al., 2007) considered the effectiveness of bundled behavioural interventions on reducing HCAI. This review did not solely focus on educational interventions, but included studies using educational programmes, multi-disciplinary quality improvement team, compliance monitoring and feedback and a mandate to sign a hand hygiene agreement. As bundles of interventions were used, they concluded that it was difficult to determine the effectiveness of individual interventions. Despite this literature base, no review has to date evaluated or identified individual features of education that have the most profound and long term impact on aseptic hand hygiene practices.

2 REVIEW AIMS

The aim of this review was to determine the effectiveness of individual features of structured educational interventions (educational processes designed to increase, improve or enhance the hand hygiene performance of healthcare professionals) that impact on hand hygiene compliance and associated changes in clinical welfare of patients within hospital care settings.

3 METHODS

3.1 Identification of studies

The search was divided into two sections - an electronic search of 16 relevant health and educational databases, and augmentation of this search using hand searching of high-yield journals and screening of reference lists of included papers and relevant systematic reviews. The search incorporated a number of strategies, combining index terms and free text words. The search strategies had no language restrictions and did not include methodological filters that would limit results to a specific study design. All references were exported to an EndNote bibliographic database.

Electronic databases were chosen to span clinical and educational databases. The following electronic databases were searched for relevant published literature for the period 1995 to March 2011: The Cochrane Library; EMBASE; Health Technology Assessment database; ISI Web of Science- Proceedings (Index to Scientific & Technical Proceedings) and Science Citation Index Expanded; MEDLINE; CINAHL; PsycINFO; BNI; HMIC; Database of Abstracts of Reviews of Effectiveness (DARE); NHS Economic Evaluation Database (NHS EED); ERIC; National Research Register; COPAC; Open SIGLE; British Library Catalogue.

3.2 Selection of evidence

Inclusion and exclusion criteria are described in Table 1. The records identified in the electronic searches were assessed for inclusion in two stages. Two reviewers (NS and GC) independently scanned all titles and abstracts identified in the search, to identify reports which could have been relevant to the clinical review. Full text versions of all records selected during the initial screening process were obtained to permit more detailed assessment and to minimise the risk of missing relevant papers. These were assessed independently by two reviewers (JG and GC), using the inclusion and exclusion criteria shown in

. The inclusion/exclusion assessment of each reviewer was recorded on a pre-tested, standardised form. Disagreements were resolved by discussion, and if necessary another reviewer was consulted.

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3.2.1 Data extraction

Data was extracted from each full text paper. A random sample of 20% of studies was doubly coded to ensure that appropriate, consistent and matching data were collected. Five discrepancies were found between reviewers, for which a third member of the review team was consulted. It was therefore deemed appropriate for one individual (GC) to singly code all papers and for another (NS) to check all data extraction for consistency. Data was entered into Microsoft Excel.

3.2.2 Quality assessment

Quality of included papers was assessed by two reviewers (GC and NS) using a tool adapted from Downs (Downs and Black, 1998). Where no data was present, for example relating to group size, this was scored as "not reported" rather than "not present", and a quality score was calculated as a percentage to allow for as adequate a comparison between studies as possible.

3.2.3 Methods of data analysis and synthesis

The relevant outcome measures from each primary paper were extracted and assessed based on modified Kirkpatrick's 1967 model of hierarchical outcomes(Kirkpatrick, 1967) at four levels, as illustrated in Table 2. Additional predetermined or secondary outcome measures were also accepted and recorded.

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4 RESULTS

4.1 Number of studies identified and included

The database search identified 11,697 articles (8,845 after duplication), with the hand search yielding a subsequent 29 studies. The full text of 204 papers (2.3% of the initial cohort) were obtained and were independently reviewed by two members of the review team (GC and NS). Opinion as to suitability was divided on four papers, and consensus from a third member (JB) was sought. From this discussion, 30 studies were identified as fulfilling all inclusion criteria and therefore suitable for inclusion in the review. Study characteristics are presented in Table 3.

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4.2 Quality assessment of included studies

The methodological quality of the included papers is summarised in Table 3. Overall, methodological reporting and quality was inconsistent. The intervention implementation strategy was often poorly reported. Few studies reported sufficient detail about study design and there was often insufficient reporting of length of follow up for numerous studies. Additionally, most studies did not provide data as to whether the intervention was mandatory or voluntary, and group size of participants was infrequently reported. Whilst no study was excluded from the review based on its quality, quality was taken into account when drawing conclusions from the data.

4.3 Analysis of coded data from included studies

4.3.1 Demographics of included studies

Of the 30 included studies, twelve were based in the USA, three in China, two each in Thailand, Brazil, Germany and Australia and one each in The Philippines, The Netherlands, Switzerland, Spain, Argentina, the UK and Taiwan. Twenty-five studies contained both nurses and doctors (including postgraduate trainees) as participants, whilst two focused solely on doctors (Benton, 2007, Salemi et al., 2002), two solely on nursing staff (Huang et al., 2002, Picheansathian et al., 2008), and one did not specify their participant group (Bhutta et al., 2007).

4.3.2 Outcome measures

Eleven studies solely measured a change in healthcare professionals' behaviour (Kirkpatrick level 3) as an outcome measure (Danchaivijitr et al., 2005, Dierssen-Sotos et al., 2010, Helms et al., 2010, Huang et al., 2002, Muto et al., 2000, Rosenthal et al., 2009, Rosenthal et al., 2003, Sharek et al., 2002, Won et al., 2004, Benton, 2007, Doron et al., 2011, Buffet-Bataillon et al., 2010) and five solely measured change in patient outcomes (Kirkpatrick level 4b) as an outcome measure (Conrad et al., 2010, Helder et al., 2010, Schelenz et al., 2005, Trautmann et al., 2007, Zhang et al., 2010). Fourteen studies evaluated both change in healthcare professionals' behaviour (Kirkpatrick level 3) and change in patient outcome (Kirkpatrick level 4b) as outcome measures (Bhutta et al., 2007, Gill et al., 2009, Grayson et al., 2008, Johnson et al., 2005, Lam et al., 2004, Larson et al., 2000, Lobo et al., 2005, Lobo et al., 2010, Picheansathian et al., 2008, Pittet et al., 2000, Salemi et al., 2002, Trick et al., 2007, Doron et al., 2011, Lederer et al., 2009b, Lederer et al., 2009a). Of the 21 studies measuring change in healthcare professionals' behaviour as an outcome measure, all of them considered change in compliance with hand hygiene practices as an outcome measure (Benton, 2007, Danchaivijitr et al., 2005, Dierssen-Sotos et al., 2010, Grayson et al., 2008, Helms et al., 2010, Huang et al., 2002, Johnson et al., 2005, Lam et al., 2004, Lobo et al., 2010, Muto et al., 2000, Picheansathian et al., 2008, Pittet et al., 2000, Rosenthal et al., 2009, Rosenthal et al., 2003, Salemi et al., 2002, Sharek et al., 2002, Trick et al., 2007, Won et al., 2004, Doron et al., 2011, Lederer et al., 2009b, Buffet-Bataillon et al., 2010). There was variation in outcome measures used. Of the 14 studies measuring change in patient outcomes, six used MRSA rates as the main outcome measure (Benton, 2007, Conrad et al., 2010, Huang et al., 2002, Larson et al., 2000, Schelenz et al., 2005, Trautmann et al., 2007, Lederer et al., 2009b, Lederer et al., 2009a). The remainder looked at the broadly defined change in nosocomial infection rates (Helder et al., 2010, Zhang et al., 2010), risk of death per 1000 ICU admissions (Gill et al., 2009), catheter-related blood stream infections (Bhutta et al., 2007, Lobo et al., 2005, Lobo et al., 2010) and changes in rates of MRSA, VRE and *Clostridium difficile* (Doron et al., 2011).

4.3.3 Educational delivery

From the analyses we identified several methods of educational delivery. The format of the education varied between studies, creating six groups of intervention. These six groups are; multimodal education with a demonstration, multimodal education with no demonstration, multimodal education with self study module, multimodal education with a video, multimodal education with demonstration, and a video and multimodal education with an online element. The format of education used in each study is shown in Table 4.

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Educational Intervention 1: Education, multimodal with demonstration

Four studies measured behavioural change in healthcare professionals (Kirkpatrick level 3) (Huang et al., 2002, Lobo et al., 2005, Pittet et al., 2000, Buffet-Bataillon et al., 2010), and three measured change in patient or organisational outcome (Kirkpatrick level 4b) (Lobo et al., 2005, Pittet et al., 2000, Schelenz et al., 2005).

Demonstrations included those regarding the use of universal precaution techniques (Huang et al., 2002). Studies also contained other components, in addition to education for hand hygiene (Huang et al., 2002). Other components of the interventions included: needlestick and sharps training (Huang et al., 2002); the use of monitoring, feedback, closed wards, more gel gloves and aprons, screening, and patient isolation (Schelenz et al., 2005); and performance feedback from the study in the form of a newsletter to all healthcare professionals (Pittet et al., 2000).

Educational Intervention 2: Education, multimodal without demonstration

Twelve studies measured behavioural change in healthcare professionals (Kirkpatrick level 3) (Danchaivijitr et al., 2005, Dierssen-Sotos et al., 2010, Larson et al., 2000, Lobo et al., 2010, Muto et al., 2000, Picheansathian et al., 2008, Rosenthal et al., 2009, Rosenthal et al., 2003, Sharek et al., 2002, Won et al., 2004, Doron et al., 2011, Lederer et al., 2009b, Lederer et al., 2009a) and 10 measured change in patient or organisational outcome (Kirkpatrick level 4b) (Conrad et al., 2010, Larson et al., 2000, Lobo et al., 2010, Picheansathian et al., 2008, Sharek et al., 2002, Trautmann et al., 2007, Won et al., 2004, Zhang et al., 2010, Doron et al., 2011, Lederer et al., 2009b, Lederer et al., 2009a). Of these studies eight (Conrad et al., 2010, Danchaivijitr et al., 2005, Lobo et al., 2010, Trautmann et al., 2007, Won et al., 2004, Zhang et al., 2010, Doron et al., 2011, Lederer et al., 2009b, Lederer et al., 2009a) used performance feedback in addition to the education interventions. This performance feedback undertook several forms such as use of ultra violet lamp technology (Conrad et al., 2010, Dierssen-Sotos et al., 2010) and newsletters regarding current compliance with hand hygiene (Lobo et al., 2010).

Educational Intervention 3: Education, multimodal, with self-study

Four studies measured behavioural change in healthcare professionals' compliance (Kirkpatrick level 3) (Benton, 2007, Helms et al., 2010, Lam et al., 2004, Trick et al., 2007) and two measured change in patient outcome (Kirkpatrick level 4b) (Helder et al., 2010, Lam et al., 2004, Trick et al., 2007). The use of self study took many different forms such as one

study used copies of policy documents and journal articles (Benton, 2007); whilst another used a fact sheet and a promotional handout (Trick et al., 2007); and another required the healthcare professionals to produce a papers on the topic of hand washing if they were consistently found not to be complying to guidelines (Helms et al., 2010). Two of these studies (Helder et al., 2010, Helms et al., 2010) used ultra violet (UV) lamp technology to provide performance feedback to the healthcare professionals on the effectiveness of their hand washing; this however is not a measured outcome in the studies as they focus on compliance rather than competence.

Educational Intervention 4: Education, multimodal with video

All the studies measured behavioural change in healthcare professionals (Kirkpatrick level 3) and change in patient or organisational outcome (Kirkpatrick level 4b) following educational interventions that included the use of video. One of the studies (Salemi et al., 2002) used educational feedback in addition to the components listed above.

Educational Intervention 5: Multimodal education with demonstration and video

This study (Grayson et al., 2008) measured both behavioural change in healthcare professionals (Kirkpatrick level 3) and measured change in patient outcome (Kirkpatrick level 4b) following an educational intervention that involved video and demonstration.

Educational Intervention 6: Multimodal education with an online element

This study(Johnson et al., 2005) measured both behavioural change in healthcare professionals (Kirkpatrick level 3) and measured change in patient outcome (Kirkpatrick level 4b).

The intervention also contained the following components: feedback, incentives to staff members, and consisted of four steps to intervention: ACHRS, alcohol impregnated wipes, mupirocin and triclosan body washes and a culture change program. There was also the use of performance feedback in this study as well as the use of educational interventions that took place in the form of providing senior staff with data from the study as it progressed.

The outcome measures, Kirkpatrick levels and statistical significance of the studies within each group are summarized in Table 5.

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5 DISCUSSION

This systematic review aimed to identify individual features of educational interventions that impact on hand hygiene compliance in healthcare professionals within a hospital care setting. The results of this review provide medical and healthcare professionals, trainers, educationalists and educational researchers with practice points for implication of educational interventions within their institution. The inclusion of 30 studies with a follow up period of more than six months illustrates the growth in literature pertaining to educational interventions for infection control within a hospital care setting

The delivery of educational interventions related to hand hygiene compliance was divided into six groups in order to meet the aim of the review: multimodal education with a demonstration, multimodal education with no demonstration, multimodal education with a video, multimodal education with demonstration, and a video, multimodal education with self study module and multimodal education with an online element.

All interventions were multi-component, and no study employed an intervention consisting of only one mode of delivery. However, although we were able to discriminate amongst groups and identify six groups of intervention, the differences between these individual modality elements were unclear. It was therefore not possible to identify one mode of delivery that was more effective than any other.

All interventions appeared to have some impact on the learning and behaviour of participants, assessed six months post-intervention, which suggests that any active, multi-component educational intervention aiming to increase hand hygiene compliance has an impact on recipients' attitudes and/or behaviours. Equally, all studies within reported some degree of statistically significant change for both patient outcomes, change in healthcare professionals' behaviour or both. However, most interventions contained more than one component, thus making the effects of individual features of the interventions difficult to isolate.

Generally, post intervention, infection rates dropped and compliance rates improved. This relationship remained consistent regardless of mode of educational intervention delivery. Rates of compliance with hand hygiene practices post-intervention was reported to be between 60% and 70% for most studies. However there was a large range of compliance rates pre-intervention, with a rate as low as 4.5% being reported (Danchaivijitr et al., 2005). It is possible that hand

washing compliance rates which are low have more scope or chance of significant improvement. However there seems to be a ceiling effect after which improvement in compliance becomes more difficult.

The key to successful intervention is building on these improvements to push compliance rates higher, particularly when initial compliance is reasonably high in the first place. One way of doing this may be by academic detailing (dissemination of information through peers of higher management) which has been shown to have an effect on improving practice (Larson et al., 2000). In most studies compliance rates were generally similar across professional groups. However, one study (Muto et al., 2000) concluded that physician compliance rose significantly when following the attending physician on ward rounds, and in another by Buffet-Batillion (Buffet-Bataillon et al., 2010) multivariate analyses suggested hand hygiene compliance was related to job seniority, and suggested that senior healthcare workers could act as role models for junior healthcare workers to boost compliance. It could equally be argued that for compliance rates to improve further, hand washing practices must become intrinsic within professional practice and implemented within teams rather than from external sources.

Often, there were other facets in addition to education that are operating to increase the effectiveness of an intervention, such as informal feedback, reminders and promotion through buttons or stickers. Fox (Fox et al., 1989) stated learning occurs through a series of "impactors", thus multiple-approach interventions are generally deemed to be most effective in changing behaviour. In the studies included in this review, often, external infection control teams delivered the educational interventions. Furthermore there were other interactions in addition to education that were operating to increase the effectiveness of an intervention. These were reminders in the form of both formal reminders such as posters, feedback, surveillance, incentives and checklists, and informal reminders, such as informal surveillance or skills testing. Whilst other systematic reviews have considered the effects of reminders as an isolated intervention (Gordon et al., 1998) and deemed reminders to be effective means of behavioural change, for the purpose of this review, only structured educational interventions were considered, thus reminders alone were not sufficient to comprise an educational intervention. It is therefore not possible to draw conclusions as to the usefulness of reminders as a standalone intervention.

Formal educational meetings, with and without demonstration, formed large parts of seven interventions studied in this review. However, they are rarely used as single interventions. Nor are audit and feedback, which have been shown to produce statistically significant increases in behaviour when combined with educational meetings or material (Hulscher et al., 2001). It has been difficult, in this review, to identify the most effective part of the intervention; yet effective bundles

of interventions have been identified as part of this review. This supports the work of Peloso (Peloso and Stakiw, 2000) and lends support to the conclusion that multiple interventions are more useful in terms of eliciting and sustaining behavioural change than single interventions (Oxman et al., 1995, Grilli and Lomas, 1994, Davis et al., 1995).

Only studies which considered a follow up period of longer than six months were included in this review, as interventions must be shown to be effective in long term practice rather than in the few months following an intervention (which may be attributable to a Hawthorne-like effect immediately following an intervention). Several studies found this "wash-out" effect with healthcare professionals' hand hygiene compliance declining to baseline levels post-intervention. Repetition of educational interventions every six months was recommended (Helder et al., 2010) in order to maintain high compliance rates with hand hygiene. This was further supported; compliance with hand hygiene was found to increase only marginally on long-term follow up with no continuous interventions (Dierssen-Sotos et al., 2010). Support for the concept of continuous interventions was also reported by Lobo et al (Lobo et al., 2010), who randomised healthcare professionals to receive either continuous education or a single lecture intervention. Continuous education was found to reduce infections rates after nine months, whereas no reduction was found in the single intervention comparison group (Lobo et al., 2010).

Feedback was an intrinsic and important component of nine interventions. Feedback can take place in several different forms such as the use of UV lamp technology and continuous updates on outcome results. Several studies (Helder et al., 2010, Helms et al., 2010, Conrad et al., 2010, Dierssen-Sotos et al., 2010) made use of UV lamp technology as part of an educational intervention in order to provide performance feedback to the healthcare professionals. This intervention, although in itself mainly assesses the ability and therefore competence of hand washing, is another form of education that demonstrates practically to healthcare professionals the importance of complying to hand hygiene guidelines. It also is likely to make the education more memorable as there is interaction involved. Feedback, in the form of monthly study results, has been found to be effective at increasing compliance with hand hygiene (Lobo et al., 2010) and reducing infection (Zhang et al., 2010), and the effectiveness of multifaceted approaches combined with continuous feedback have been recognised (Naikoba and Hayward, 2001). All studies that included the addition of feedback (Lobo et al., 2010, Zhang et al., 2010, Doron et al., 2011) regarded feedback to healthcare professionals an important and effective measure to improve both healthcare professionals' behaviour and patient outcomes. However, from this review it is not possible from the studies in the review to conclude the nature, place or time of booster sessions with feedback in improving the effectiveness of interventions. However, these finding lend support to the notion that interventions consisting of multiple

components appear to have the most prolonged effect, and that repeated sessions, fed into daily practice, also improve practice (Cherry et al., 2010) (supporting the work of Fox) (Fox et al., 1989).

Only one study (Doron et al., 2011) considered the attitudes and personal values of the healthcare professionals as a basis for the development of the intervention, a factor indicated as pre-requisite for some interventions to be successful (Burgers et al., 2003, Grol et al., 1998).This study increased compliance rates from 90% to 96%, possibly helped by this consideration of the ward culture prior to implementation of the intervention, a suggestion laid out by the World Health Organisation in their guidelines for improving hand hygiene compliance (World Health Organization, 2009).

It would be good to put your conclusions in here and to relate these to the title and review aim of finding out what are the individual features of effective educational interventions that impact on hand hygiene compliance.

5.1 Limitations of analysis

The research team accept that it was not possible to separate competence acquisition from compliance when assessing the impact of the included papers. Most papers re-taught correct methods of handwashing (competence) and then assessed compliance with this behaviour, thus assessing both competence and compliance simultaneously. Compliance is a broad term that implies whether individuals complete an action they know should be undertaken. However, for the purpose of this review the research team sought to identify papers reporting compliance as a primary outcome measure and data has been presented accordingly.

Measures were taken to report the methodological quality of each included study. However, despite this strategy, the scoring of items as "not reported" rather than "not present" may still have lead to an under-reporting of degree of bias, and consistent variations in reporting may have prevented firm comparisons and made the drawing of conclusions difficult. In addition, outcomes of included studies were reported using Kirkpatrick's hierarchy (Kirkpatrick, 1967). The research team acknowledge that other models may also be suitable to categorise the outcomes of reviews such as this.

No study assessed the motivation of healthcare professionals to change as a contributing factor to the success of educational interventions, regardless of mode of delivery. It has been hypothesised that motivation alone may have a substantial effect on the success of educational interventions when the topic is of low interest to healthcare professionals (Foy et al., 2002). Differences in motivation between participants may affect the reported results, although this will be

difficult to identify. This should be taken into consideration, both when generalising the results from this review and planning future research.

5.2 Conclusions

It was not possible to identify the individual features of educational interventions that impacted on hand hygiene compliance in healthcare professionals within a hospital care setting due to each study reporting multi-component interventions. However, several conclusions were drawn. Educational interventions had a greater impact if compliance to hand hygiene compliance best practice was low. Multiple interventions were better than single interventions in terms of eliciting and sustaining behaviour change. Continuous interventions had more of an impact than single interventions in sustaining behaviour change. However, it was uncertain as to how long a change in behaviour would persist after an educational intervention and data were not available to determine the time, nature and type of booster sessions with feedback needed for a permanent change in hand hygiene compliance.

5.3 Implications for practice

Following this systematic review, several implications for practice can be suggested.

1. Taking part in any structured educational intervention designed to improve hand hygiene compliance in a hospital environment is likely to be effective in improving practice.

2. Combining an educational intervention with other components (reminders, incentives, checklists, surveillance, audit, and feedback) is the most effective way of reinforcing the educational message.

3. Repeated sessions feed into daily practice will maintain compliance.

4. The first step to improving hand hygiene compliance should be to target educational interventions in areas where compliance to best-practice is poorest.

5. Consider using performance feedback when educating healthcare professionals. Performance feedback in the form of performance reports or the use of ultra violet technology is likely to increase hand hygiene compliance.

6. Ensure that hand washing practices become intrinsic within professional practice by using internal teams to deliver interventions rather than external sources.

5.4 Implications for research

To inform future reviews to investigate and clarify factors relating to the effectiveness of delivery of education within healthcare, several implications for research must be taken from these findings. Future research could focus on directly assessing trainee engagement in deliberate hand hygiene behaviours, the lasting effects of this on the impact of the educational intervention with regards to hand hygiene compliance. Research should also focus on strategies to embed educational practice within the workplace, and the time, type and nature of booster sessions to maximise educational effectiveness.

With respect to educational interventions, group sizes need to be large enough to measure the relatively small effects of each educational component with adequate specificity and accuracy. Sensitive, generalisable and validated measures are needed to allow for adequate determination of baseline knowledge, attitudes, motivation and behaviour of healthcare professionals regarding hand hygiene practices, and for comparisons post-intervention. Before and after measurements of hand hygiene compliance are required, with sufficient follow-up periods to ensure longitudinal stability in results. More within-study comparisons of conflicting modes of educational delivery are also needed in future research.

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