THE INTERVENTIONS TO IMPROVE STANDARD PRECAUTIONS (SP) KNOWLEDGE AND PRACTICE AMONG HEALTHCARE WORKERS (HCWS): A SYSTEMATIC REVIEW

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ABSTRACT

Background: Standard Precautions (SP) is the basic requirement in infection control measures to reduce healthcare-associated infections (HAIs) as well occupational infection in healthcare settings. Many interventions have been done to increase the knowledge and practice of SP among healthcare workers (HCWs).

Objectives: To assess the effectiveness of interventions to improve knowledge and practice on Standard Precautions among HCWs.

Materials and Methods: Articles were searched through Pubmed, Medline, Scopus and Google Scholar search engines using keywords “Standard Precautions OR infection control AND interventional study OR experimental study”. Types of studies included are randomised control trials of individuals, cluster-randomised trials, non-randomised trials, controlled before-after studies, and cross sectional study. Only articles written in English published from 2010 to 2018 and accessible as free full texts were included in this review. The articles must evaluate the multiple components of Standard Precautions simultaneously.

Result: There are 14 articles included in this study. Most of the studies implemented educational and training intervention with or without infection control support. Other intervention strategies were theory-based module, self-instructed computer module with clinical case simulation, checklist and coloured cues for communication enhancement as well as Healthcare-Associated Infection Prevention Initiative (CHAIPI). However, different studies used different measures to assess the knowledge and practice of Standard Precautions among HCWs.

Conclusion: Because of this heterogeneity, it is difficult to draw a clear conclusion about the effectiveness of different interventions. However, it was shown that interventions do promote Standard Precautions knowledge and practice, but further research is warranted to determine which interventions are the most effective.

Keywords: Standard Precautions, intervention, healthcare workers, knowledge, practice.
1.0 Introduction

Disease infections among population in both community and healthcare settings have been the core business of healthcare providers for centuries. For the past few decades, an increased focus on the prevention and control of healthcare-associated infections (HAIs) has taken place. HAI is an infection acquired by a patient while receiving care in healthcare facility either hospital, outpatient clinic or others. Occupational infections acquired by the healthcare worker (HCWs) at workplace are also classified as HAIs (World Health Organization (WHO), 2011).

The overall prevalence of HAIs was reported to be higher in developing countries as compared to developed countries (Allegranzi et al., 2011). In the developed countries the prevalence varies between 5.1% and 11.6% while the prevalence rates vary from 5% to 19% in the developing countries (WHO, 2011). The most common HAIs among patients are respiratory infections such as pneumonia and lower respiratory tract infections (LRTI) (22.8%), urinary tract infections (UTI) (17.2%) and surgical site infections (SSI) (15.7%) (Health Protection Agency, 2012).

Occupational infections among HCWs are also similarly healthcare-related. For example, there are high risk of blood-borne infections such as Human Immunodeficiency Virus (HIV), Hepatitis B virus (HBV) and Hepatitis C virus (HCV) as a result of percutaneous exposure of contaminated sharps and also airborne infections can occur among HCWs (Occupational Safety & Health Administration U.S. Department of Labor, 2017). The most common occupational infection was chicken pox (66.7%), followed by measles (29.2%) and pulmonary tuberculosis (4.2%) (Assiri, Hathout, Anwar, Dalatony, & Kader, 2013).

HAIs and occupational infections have resulted in prolonged hospital stays and disability of patients, excess mortality, increased antimicrobial resistance, increased financial burden of the health organization as well as psychosocial and economic impacts on the patients and their family. When it affects the HCWs, it will give a bad impact to the quality and productivity of the healthcare services provided (WHO, 2011; Andersson, Bergh, Karlsson, & Nilsson, 2010).

In order to control and prevent HAIs, Standard Precautions (SP) practices need to be implemented. It summarises the strategies to be used to prevent transmission of microorganisms in healthcare settings (Centers for Disease Control and Prevention, 2016). SP include the use of hand washing, appropriate use of personal protective equipment, proper cleaning, disinfection and sterilisation of patient-care equipment, proper housekeeping, management of contaminated laundry and disposal of sharps and clinical wastes and cough etiquette to reduce droplet transmission (WHO, 2007; Siegel, Rhinehart, Jackson, & Chiarello, 2007).

In spite of widespread adoption of SP by organisations, there are gaps in their implementation as they require accountability and behavioural change from the HCWs in order to be implemented (Clock, Cohen, Behla, Ross, & Larson, 2010). Many interventions have been used to promote the practice of Standard Precautions as the basic requirement for infection prevention and control (IPC). The objective of this review is to assess the effectiveness of interventions that can be used to improve knowledge and practice of SP among HCWs.

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2.0 Materials and Methods

A review was conducted to search for articles on interventions related to infection prevention and control measures. Articles were searched using Pubmed, Medline, Scopus and Google Scholar search engines. The keywords used are “Standard Precautions AND interventional study OR experimental study”, “infection control AND interventional study OR experimental study”. A total of 675 articles were initially searched from the search engines. Duplication articles were removed and 546 articles underwent primary screening for relevant articles based on titles and abstract. After screening, 132 articles underwent secondary review for eligibility. Inclusion criteria are articles written in English published from 2010 to 2018, and also accessible as full texts. Types of studies included are randomised control trials, cluster-randomised trials, quasi-experimental study, controlled or non-controlled pre and post studies as well as cross sectional studies. We excluded studies that evaluated only one component of Standard Precautions. Finally, 14 articles were included as the final articles for review. The flow diagram of literature search in this review is illustrated in Figure 2.1.

Figure 2.1 PRISMA 2009 flow diagram of literature search.
### 3.0 Result

Table 1: Literature review of articles from 2010 to 2018 that examined the effect of interventions of Standard Precautions.

<table>
<thead>
<tr>
<th>Author, year, country</th>
<th>Study population</th>
<th>Type of study</th>
<th>Methods, instruments, interventions</th>
<th>Findings of the study</th>
<th>Limitations of the study</th>
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<tbody>
<tr>
<td>(Zeighemat, Ebadi, Rahmati - najarkolaei, &amp; Ghadamgahi, 2016) Mashhad, Iran.</td>
<td>135 nurses from 2 hospitals in Mashhad, Iran (for pre-test). 35 nurses in intervention group, 65 in control group (for post test).</td>
<td>Quasi experimental with pre and post test and a control group.</td>
<td>1. Self-administered questionnaires, self-reporting on knowledge, perceived susceptibility, severity, benefit and barrier, self-efficacy and performance on controlling nosocomial infection. 2. A 45 minutes of educational programs (individual and groups). 3. Pamphlets and posters.</td>
<td>There was a significant difference between the scores of the two groups after intervention in term of knowledge (p=0.001), perceived threat (p=0.004), barrier (p=0.001) and benefit (p=0.001) related to nurses and practice regarding hands washing (p=0.01) and safe injection practice (p=0.008).</td>
<td>1. Self-reported tools 2. A small sample size</td>
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<td>(Baldwin et al., 2010) Northern Ireland.</td>
<td>12 nursing homes in intervention group and 12 nursing homes in control groups (20 staff and residents in each nursing home)</td>
<td>Cluster randomised control trial</td>
<td>1. Observation audit tool of compliance to infection control 10 standards and audit feedback every three monthly. 2. A two hour infection control education and training programme. 3. Designated of link nurses. 4. Nasal and wound swab and urine analysis. (For MRSA surveillance)</td>
<td>Infection control audit scores were significantly higher in the intervention homes (82%) compared with the control homes (64%) at 12 months (P=0.0001). However, in term of MRSA prevalence, there is no change (RR: 0.99, 95%CI: 0.69-1.42)</td>
<td>1. Drop-out of residents (frail older population) 2. It was not possible to blind the researcher who carried out the infection control audit and participants allocation (single blinding). 3. The Hawthorne effect might occur during the infection control audits.</td>
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<tr>
<td>(Chauhan &amp; Kumari, 2016) Shimla- Himachal Pradesh, India.</td>
<td>50 staff nurses from ICU, CCU, and operation theatre.</td>
<td>Quasi experimental, one group pre- post-test design</td>
<td>1. Structured knowledge questionnaires. 2. One-day Planned Teaching Program (PTP) intervention.</td>
<td>The mean ± SD post-test knowledge score (37.30 ± 4.722) was higher than the pre-test knowledge score (32.32 ± 5.709) with t =5.61 and p&lt;0.05.</td>
<td>1. Convenient sampling technique. 2. One group pre-test post-test research design (no control group).</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size and Source</td>
<td>Study Design</td>
<td>Interventions</td>
<td>Outcomes</td>
<td>Limitations</td>
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</table>
| (Mahrous, 2016), Cairo, Egypt.          | 50 nurses from the specialized medical wards at Ain Shams University Hospital | Quasi-experimental study, pre and post test design (no control group) | 1. Questionnaires on sociodemographic and knowledge on Hepatitis B.  
2. Observation checklist on nurses practice  
3. Education teaching (lectures, group discussions, demonstration.  
4. Posters and booklets. | Scores of knowledge on SP among subjects were increased after the education program (p<0.01). Majority of SP practices (hand hygiene and PPE) scores are significantly increased at post-test (p<0.01) except for sharp management (needles are bend after used). | 1. Convenience sampling technique.  
2. One group pre-test post-test research design (no control group). |
| (Adly, Amin, & Ahamed Abd El Aziz, 2014) | 60 nurses from 4 paediatric critical care units at El Mansoura University Children's Hospital | Quasi-experimental design (Pre and post intervention study design) No control group. | 1. Structured interview questionnaire (knowledge and barriers)  
2. Nurses’ observational checklists (practice)  
3. Nurses' self-reported compliance to Standard Precautions  
4. Educational and training intervention. | There are significant differences of mean score of knowledge, practice and compliance to SPs among nurses at pre-intervention, immediately post-intervention and at follow up (p=0.001). | 1. Purposive sampling technique  
2. One group pre-test post-test research design (no control group). |
| (Atalla, Aboalizm, & Shaban, 2016) Menoufia, Egypt. | 50 nursing students in intervention group and 50 students in control group from Menofia University. | Quasi-experimental research design with pre, post and follow up of control and intervention groups. | 1. Structured questionnaire to measure knowledge.  
2. Performance observational check list.  
3. Attitude related to infection control measure scale  
4. Nursing Guideline on Infection Control as educational intervention. | There are significant differences in mean score of knowledge (p=0.001), attitude (p=0.001) and compliance (p=0.001) between groups at post-intervention and follow up. | 1. Lack of randomisation as this is a quasi-experimental research design. |
<p>| (Halpin et al., 2013) California, U.S. | 34 CHAIPI hospitals and 149 non-CHAIPI | Cross sectional study | 1. Statewide structured, computer-assisted telephone interview survey of California’s general acute care | At multivariate regression model, CHAIPI hospitals demonstrated a greater improvements in adoption | 1. Self-reported HAIs rate and have not been independently validated. |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Design</th>
<th>Interventions</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>(Kappes Ramírez, 2018) Chile, South America.</td>
<td>49 nursing students in each control and intervention group in San Sebastian University, Chile.</td>
<td>Randomised control trial</td>
<td>1. Questionnaires on Standard Precautions. 2. Intervention group: self-instructed computer module and clinical simulation. 3. Control group: theoretical lectures and clinical presentation.</td>
<td>The intervention group showed a significant higher knowledge score in the post-test multiple-choice questions (p=0.002), essay questions (p=0.043) and in the simulated scenario (p&lt;0.05), as compared to the control group.</td>
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<tr>
<td>(Edet, Edet, &amp; Samson-Akpan, 2010) Calabar, Nigeria.</td>
<td>42 students in third and fourth year of Nursing Science, University of Calabar, Nigeria.</td>
<td>Quasi-experimental, pre-post one group design (no control group).</td>
<td>1. A 24 items self-developed questionnaires. 2. Structured Training Session (educational intervention) on Standard Precautions.</td>
<td>The mean ± SD score of the respondents on knowledge of standard precaution at pre-test was 1.0 ± 1.6 while at post-test it increased to 6.1 ± 3.1 (p&lt;0.001).</td>
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<td>(Rajini &amp; Kalyani, 2016) Dehradun, India.</td>
<td>60 staff nurses from ICU in Shir Mahant Indriresh Multispeciality Hospital, Dehradun, India.</td>
<td>Quasi experimental, non equivalent control group design</td>
<td>1. Self administered questionnaires. 2. Structured Teaching Program (STP): lecture on define of infection, chain of infection, preventive measures and Standard Precautions.</td>
<td>The overall pre- and post-test mean knowledge for intervention group was found to be 31.46% ± 4.24 and 43.56% ± 4.08 respectively with significant difference (t=11.41, p=0.05). For control group, there is no significant difference.</td>
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2. Participation of hospital in CHAIPI was self-selected. 3. This study might not be the representative of United States as a whole.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Participants</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Pre-test Results</th>
<th>Post-test Results</th>
<th>Conclusion</th>
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<tr>
<td>(Rose, 2015) Tumkur District, India.</td>
<td>60 staff nurses working in paediatric and labour units of selected hospitals in Tumkur district</td>
<td>Quasi experimental study, one group pre-test and post-test design</td>
<td>1. Questionnaires on knowledge about nosocomial infection in newborns. 2. A 45 minutes structured teaching programme regarding nosocomial infection, causes, mode of transmission, prevention and complication of nosocomial infection.</td>
<td>The overall pre-test means knowledge score was 21.11 and the overall post-test mean score was 35.47 with a mean ± SD difference of -14.366 ± 5.889. The result was significant with paired t-test= 23.413, df= 89 and P=0.001.</td>
<td>1. One group pre-test post-test research design (no control group).</td>
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<td>(Nmadu, Kabir, &amp; Istifanus, 2016) Kaduna State, Nigeria.</td>
<td>172 Primary HCWs in two local government areas.</td>
<td>Quasi experimental study with pre and post test of two groups (intervention and control groups.)</td>
<td>1. A structured and coded interviewer-administered questionnaires. 2. An observation check list and a health facility check list. 3. An eight days training intervention including lectures with the aid of audio-visuals, practical demonstrations and active group participation. * Post-intervention data was collected 6 months after the training.</td>
<td>Baseline pre test mean ± SD knowledge scores were 3.7 ± 3.3 and 4.6 ± 3.2 (maximum 10) and mean ± SD self-reported practice scores were 33.1 ± 3.8 and 32.9 ± 3.7 (maximum 42) in intervention and control groups respectively. After the intervention, there were significant improvements in mean knowledge scores (p=0.0001) and mean self-reported practice scores (p=0.001) of the intervention group. Observation of UP practice has no significant difference.</td>
<td>1. Lack of randomisation due to quasi-experimental research design</td>
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<tr>
<td>(Ong et al., 2013) Australia.</td>
<td>11 radiological porters were observed over 300 patient</td>
<td>Randomised crossover trial, a 2x2 factorial</td>
<td>1. Structured data collection tool: observational form 2. Interventions: (i) A pre-transfer checklist used by</td>
<td>There are significant increased in compliance rate in the intervention groups when applying the coloured cue intervention (73%), the pre-</td>
<td>1. Small number of participants (result may not be generalisable across settings).</td>
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<td>Transfers (from radiology department to wards)</td>
<td>Design with two interventions.</td>
<td>Radiology porters to confirm a patient’s infectious status; (ii) A coloured cue to highlight written infectious status information in the transfer form.</td>
<td>Transfer checklist intervention (71%) and when both interventions were applied together (74%) as compared to 38% compliance rate in the control group (p&lt; 0.01).</td>
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<td>86 nurses from Baringo County Referral Hospital (BCRH) as intervention group and 74 nurses from Nandi County Referral Hospital (NCRH) as control group.</td>
<td>Quasi experimental study, pre- and post-test of two groups (intervention and control groups)</td>
<td>1. Self-administered questionnaires 2. Observational checklist 3. Structured education based on Social Cognitive Theory</td>
<td>There was a significant differences in the means scores in knowledge for intervention group (8.6 ± 0.9) and control group (6.4 ± 1.0), (t=13.932, p&lt;0.01). There was a significant differences in the means scores in mean scores in self-reported compliance for intervention group (5.4 ± 0.8) and control group (4.0 ± 0.8), (t=3.466, p&lt;0.01). There was a significant differences in means scores in observed compliance for interventional group (13.4 ± 0.7) and control group (12.3 ± 0.9), (t= 7.350, p&lt;0.01).</td>
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<td>(Mukhtar, Karani, &amp; Mirie, 2017) Kenya.</td>
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<td>2. The carry-over effects, where earlier exposure to one intervention affects a subject’s response when a different intervention is applied. 3. Hawthorne effects.</td>
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1. Lack of randomisation in participant allocation to intervention and control group. 2. Total population sampling is used due to relatively small size population.
From the review, five types of intervention have been identified. Of 14 reviewed studies, 11 implemented educational and training intervention (Adly et al., 2014; Atalla et al., 2016; Baldwin et al., 2010; Chauhan & Kumari, 2016; Edet et al., 2010; Mahrous, 2016; Mukthar et al., 2017; Nmadu et al., 2016; Rajini & Kalyani, 2016; Rose, 2015; Zeigheimat et al., 2016). They are either education intervention alone or with additional infection control support strategies or with theory-based intervention module. Other intervention strategies were self-instructed computer module with clinical case simulation and another study use a checklist and coloured cues as intervention (Kappes Ramirez, 2018; Ong et al., 2013). There is also a study evaluating the effect of California Healthcare-Associated Infection Prevention Initiative (CHAIPi) which provides intervention in the form of comprehensive technology services model that can identify and track infection outbreaks earlier, track antibiotic resistance, and mine data related to HAIs (Halpin et al., 2013).

However, in term of outcome measures, different studies used different measures to assess the knowledge and practice of Standard Precautions among HCWs. Two studies measured the knowledge, attitude/perception and practice score of SP (Atalla et al., 2016; Zeigheimat et al., 2016). Whereas, four studies measured the knowledge and practice score of SP (Adly et al., 2014; Mahrous, 2016; Mukthar et al., 2017; Nmadu et al., 2016). Another five studies assessed only the knowledge related to infection control in reducing HAIs (Chauhan & Kumari, 2016; Edet et al., 2010; Kappes Ramirez, 2018; Rajini & Kalyani, 2016; Rose, 2015). Meanwhile three studies measured the score of practice of SP alone (Baldwin et al., 2010; Halpin et al., 2013; Ong et al., 2013).

There are several limitations in this review. We found that majority (10 out of 14) of articles included have a serious risk of bias especially at the research design stage. Most of the studies adapted the quasi-experimental study design which has lack of randomisation in participants’ allocation to intervention or control group. Apart from that, there is heterogeneity in the outcome measurements across the studies which are difficult to compare and evaluate the best intervention among all studies.

4.0 Discussion

Overall, observed knowledge and practice of Standard Precautions from variety of interventions increased with significant improvement even though most studies reported considerable variation in the baseline knowledge and practice, extent of differences both between and within subjects, as well as slight differences in practices assessed. Among interventions identified from this review are educational interventions with or without infection control support, theory-based intervention module, communication enhancement with checklist and coloured cues, self-instructed computer module and clinical simulation and California Health Associated Infection Prevention Initiative (CHAIPi).

4.1 Education Intervention with or without Infection Control Support

Education intervention alone without infection control support improves the knowledge of Standard Precautions mainly, the attitude, practice and compliance to SP (Adly et al., 2014; Atalla et al., 2016; Mahrous, 2016; Mukthar et al., 2017; Nmadu et al., 2016; Zeigheimat et
Education with additional strategy such as designated infection control nurse can also significantly improve compliance to Standard Precautions to a greater extent. Education with additional infection control support probably leads to little or no difference in MRSA prevalence (Baldwin et al., 2010). This may be due to more effort contributed by the infection control link nurse in reminding, observing and auditing the SP practice among the colleague. However, no change in the multidrugs resistant Staphylococcus Aureus (MRSA) prevalence in the study might be due to short study duration that cannot capture significant reduction in number of MRSA colonisations.

4.2 Theory-based Intervention Module

There are several studies showed improvement of compliance and practice of SP among HCWs after their enrolment in theory-based intervention module. Intervention module integrated with constructs of Health Belief Model (HBM) and Social Cognitive theories (SCT) are widely used in health studies in an attempt to predict or explain health behaviours. For example, HBM focused on one’s belief and perceptions such as the susceptibility and severity of acquiring infection due to failure in practicing recommended preventive measures such as SP, perceived benefits of practicing the SP and the perceptions on the obstacles in practicing SP (barriers) and the self-efficacy or one’s ability to successfully perform the recommended health behaviours. On the other hand, the SCT emphasized that human beings learn by observing others (vicarious learning), within the context of social interactions in the environment. The learned behaviours are central to one’s personality. Studies have proved that theory-based intervention module is important for a greater impact and desirable outcomes pertaining to compliance to SP practice (Zeigheimat et al., 2016; Mukthar et al., 2017).

4.3 Communication Enhancement with Checklist and Coloured Cues

Communication enhancement through checklists of radiology porters and coloured cues in the patient transfer form is used to alert the receiving staff on infectious status of the transferred patient. Both interventions improved compliance to Standard Precautions such as hand hygiene, glove and gown use, and overall adherence with infection control recommendations. However, this randomised crossover trial did not report the effect of both interventions on SP knowledge and MRSA prevalence (Ong et al., 2013). Overall, both interventions led to increase compliance to SP.

4.4 Self-instructed Computer Module and Clinical Stimulation

Interactive computer modules allow the use of all available technology to be incorporated as teaching tool. In this study, as a learning method, students were given access to a self-instructional computer module related to SP without guide from a teacher as well as self-assessment questions (Kappes Ramirez, 2018). At the end of the learning session, a clinical simulation was carried out for a clinical case in a nursing laboratory using dummy patients in a simulated clinical environment to identify relevant infection control measure pertaining to the specific cases. It was found that the student showed the best performance in the multiple-choice post-test and essay questions regarding SP knowledge as well as in the evaluation of a simulated scenario as compared to the control group. This study demonstrates that it is possible to transfer some teaching subjects on the prevention of HAIs to self-learning by
means of virtual teaching strategies with good results. However, this intervention study has its limitation that it did not measure the practice or compliance to SP.

4.5 California Healthcare-Associated Infection Prevention Initiative (CHAIPi)

CHAIPi is an initiative funded by a private sector, the Blue Shield of California Foundation which funded USD$3.5 million to support the participation of 50 California hospitals in the CHAIPi. It offered participating hospitals to use automated surveillance technology (AST) as part of its grant. Participating hospital received education and training on HAI prevention best practices and guidelines, discussion as well as monthly measurement and reporting of results. Each participating hospital also conducted at least one HAI reduction project as a component of the collaborative (Blue Shield of California Foundation, 2009). This intervention in the form of combination of financial and technical support are able to demonstrate greater improvements in adoption and implementation of written evidence-based practices (EBP) for overall patient safety and prevention of HAs and also in increasing HCWs compliance with SP practices. However, in term of HAs rate, there were no significant differences in the changes between CHAIPi and non-CHAIPi hospitals over the time period from 2008 to 2010 (Halpin et al., 2013).

5.0 Conclusion and recommendation

As a conclusion, it is difficult to determine the most effective intervention or recommendation to improve knowledge and practice of SP due to limited studies being evaluated in a similar way as well as insufficient evidence on which to derive a conclusion. Although numerous interventions has been done to promote hand hygiene (Gould, Moralejo, Drey, & Chudleigh, 2010), as well as interventions tackling specific types of infections such as tuberculosis infection control, limited research has been conducted to measure the effectiveness of intervention related to SP as a whole, a bundle of infection control elements. However, the evidence presented in this review is applicable to practice worldwide.

In this review, it was found that education alone can improve knowledge on SP as well as self-instructed computer module and clinical simulation whereas education with additional infection control support may slightly improve practice and compliance. On the other hand, education with the use of cues and checklists, and financial and technical support such as CHAIPi can probably improve compliance to SP. Theory-based intervention modules are also important especially in promoting human behavioural change towards better compliance to SP practice.

It is recommended that further research to be carried out to determine which interventions are most effective. There is a need to minimise potential bias at the study design stage and throughout a research in order to produce a high quality findings and evidence. Standardized outcome measurement must also be established in order to compare and evaluate interventions promoting SP practice among HCWs in the future.
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Declaration

Authors declare that there is no conflict of interest with the publication of this article.

Authors contribution

Author 1: literature finding, draft manuscript
Author 2: manuscript review and editing

References


Baldwin, N. S., Gilpin, D. F., Tunney, M. M., Kearney, M. P., Crymble, L., Cardwell, C., &


Chauhan, K., & Kumari, K. (2016). A study to assess the effectiveness of Planned Teaching Program (PTP) on knowledge regarding prevention of Nosocomial Infection among the Staff Nurses working in selected areas of Indira Gandhi Medical College and Hospital, Shimla- Himachal Pradesh. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 5(1), 5–10. https://doi.org/10.9790/1959-05150510


Mahrous, F. M. (2016). Effect of Universal Precautions Intervention Program on Nurses’


