Spring 2015

A Systematic Review: Immediate and Maintenance Effects of Interventions on Handwashing Compliance in Healthcare Workers

Brent E. Gibson  
*The University Of Akron, beg19@zips.uakron.edu*

Dajana Markovic  
*The University Of Akron, dm133@zips.uakron.edu*

Please take a moment to share how this work helps you through this survey. Your feedback will be important as we plan further development of our repository. Follow this and additional works at: [http://ideaexchange.uakron.edu/honors_research_projects](http://ideaexchange.uakron.edu/honors_research_projects)

Part of the Other Nursing Commons

Recommended Citation


[http://ideaexchange.uakron.edu/honors_research_projects/103](http://ideaexchange.uakron.edu/honors_research_projects/103)

This Honors Research Project is brought to you for free and open access by The Dr. Gary B. and Pamela S. Williams Honors College at IdeaExchange@UAkron, the institutional repository of The University of Akron in Akron, Ohio, USA. It has been accepted for inclusion in Honors Research Projects by an authorized administrator of IdeaExchange@UAkron. For more information, please contact mjon@uakron.edu, uapress@uakron.edu.
A Systematic Review: Immediate and Maintenance Effects of Interventions on Handwashing Compliance in Healthcare Workers

Brent E. Gibson & Dajana Markovic

The University of Akron

Author’s Note

Brent E. Gibson and Dajana Markovic, School of Nursing, College of Health Professions, University of Akron. Honor’s Project Sponsors: Diane Brown PhDc, RN, CCRN and Connie Chronister DNP, RN, CCRN.
Abstract

There has been a drastic rise in the number of nosocomial infections of patients in intensive care units. Handwashing is generally accepted as an effective and inexpensive method that healthcare providers in hospital settings can use to decrease the likelihood of nosocomial infections, however, studies have shown that healthcare providers are often not compliant with handwashing protocol. The purpose of this systematic review of literature is to not only obtain information on handwashing compliance and non-compliance among different healthcare providers, but also to identify, describe, and evaluate evidence about the effect of various interventions on handwashing compliance in healthcare providers. This review of literature also aims to address the following question: In healthcare providers, how do handwashing interventions, compared with no interventions, affect immediate and long-term handwashing compliance? A review of literature will allow for a thorough assessment on what interventions will impact long-term handwashing compliance and recommendations for those who do not.
Handwashing compliance drastically affects the rate of nosocomial infection in hospitalized patients. Approximately 10 percent of patients who are hospitalized acquire a nosocomial infection during their stay (Cummings, Anderson & Kaye, 2010). By just increasing hand-washing compliance by 1%, it not only decreased the rate of infections, particularly MRSA, but it also decreased the cost associated with the particular nosocomial infection (Cummings et al., 2010). Nosocomial infections appear after 48 hours of hospital admissions and are caused by the bacteria inside hospitals, often passed to patients by healthcare providers who may not have properly washed their hands (Antoniak, 2004). This type of cross contamination causes nosocomial infections in approximately 5% of all hospital admissions every year and approximately 100,000 people die yearly due to nosocomial infections alone (Klevens et al., 2007). Nosocomial infections contribute to increased hospital length of stay, morbidity, and can cost hospitals up to forty-five billion dollars a year (Scott, 2009).

Routine handwashing may be an effective and inexpensive method that healthcare providers in hospital settings can use to decrease the likelihood of nosocomial infections (Antoniak, 2004; Son et al., 2011; Higgins and Hannan, 2013; Sharir, Teitler, Lavi, & Raz, 2001). However, studies have shown that healthcare providers are often not compliant with handwashing protocol (Son et al., 2011; Higgins & Hannan, 2013; Scott, 2009; Sharir et al., 2001). Therefore, to prevent cross contamination of nosocomial infections, it is important that all individuals entering and leaving the patients’ rooms, specifically healthcare providers, should perform proper hand hygiene. Many researchers have examined the immediate and maintenance effects of interventions on hand washing compliance in healthcare staff (Duggan, Hensley, Khuder, Papadimos & Jacobs, 2008; Gül, Üstündağ, & Zengin, 2012). The purpose of this systematic review is to identify, describe, and evaluate evidence about the effect of interventions
on handwashing compliance in healthcare providers in various hospital units. The long-term aim of these intervention studies is to decrease nosocomial infection rates. Practice and research recommendations will be advanced, based on the evaluation of studies. The systematic review aims to address the following question: In healthcare providers, how do handwashing interventions, compared with no interventions, affect immediate and long-term handwashing compliance?

**Methods**

Relevant primary source studies were obtained from the following databases: CINAHL, Center for Disease Control and Prevention (CDC) and PubMed. The key words that were used include: handwashing, hand washing, compliance, noncompliance, nosocomial infections, healthcare providers, nurses, critical care, and ICU. Inclusion criteria for studies included: hospital settings, critical care settings, which included intensive care units and acute care settings; healthcare providers; handwashing compliance; reasons for noncompliance; nosocomial infections; ways to increase compliance; and how to fix noncompliance. Exclusion criteria included: research older than 10 years, noncompliance outside of a hospital setting. Studies were evaluated based on publication date, accuracy and relevance. Approximately 40 studies were originally identified. After the application of inclusion and exclusion criteria, approximately 20 studies were retained. To critically evaluate the journal articles, limitations, sample size, settings of the study, results, time periods, participants, and any exogenous variables of the studies were assessed.

**Review of the Literature**

Handwashing is an important factor in several aspects of patient care (Antoniak, 2004; Caglar, Yildiz & Savaser, 2010; Cummings et al., 2010; Duggan et al., 2008; Gül et al., 2012;
Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic, Siddiqui, & Muller, 2013; Mathai, George & Abraham, 2011; Mayer et al., 2011; Novoa, Pi-Sunyer, Sala, Molins, & Castells, 2007; Panhotra, Saxena, Al-Arabi Al-Ghamdi, 2004; Sahay, Panja, Ray, & Rao, 2010; Santos et al., 2013; Scott, 2009; Sharir et al., 2001; Son et al., 2011; Song, Stockwell, Floyd, Short, & Singh, 2013; Whitby & McLaws, 2004). However, handwashing compliance is usually found to be below 40% (Sharir et al., 2001), and ranged from approximately 20%, before interventions, to almost a 100%, after interventions (Antoniak, 2004; Caglar et al., 2010; Cummings et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Scott, 2009; Sharir et al., 2001; Son et al., 2011; Song et al., 2013; Whitby & Mc Laws, 2004). Although multimodal interventions increase handwashing compliance in healthcare workers, different interventions have different lasting effects. For example, during a two-year, longitudinal observational study, Lebovic, Siddiqui, and Muller (2013) found that the compliance rate remained at about 45% among 3487 healthcare workers during the two-year study period at St. Michael’s Hospital in Toronto, Canada. The researchers implemented multimodal interventions such as education and advertisement campaigns during the two-year study and yet, the hand hygiene compliance among hospital staff was still low and remained stable at 45% during and after the two-year study period (Lebovic et al., 2013). The researchers concluded that the multimodal interventions do not completely depend on just what type of intervention was used (Lebovic et al., 2013). Lebovic, Siddiqui, and Muller (2013) concluded that it is difficult, if not impossible, to predict the success of multiple interventions based solely on what type of intervention was used. Instead,
the actual implementation process of these interventions must be researched thoroughly (Lebovic et al., 2013).

Whether the interventions have an immediate or a long-lasting effect will depend on the intervention used and process of implementation, as mentioned above, but also, Sharir et al., (2001) mentioned that certain interventions such as constant education are necessary in order to maintain significant handwashing compliance. All of the studies had education as one of their interventions which is important since it would give the healthcare staff an opportunity to learn about handwashing and the proper technique (Antoniak, 2004; Caglar et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Sharir et al., 2001; Son et al., 2011; Song et al., 2013; Whitby & McLaws, 2004).

In 1998, Sharir et al., (2001) performed a quantitative study at Haemek Medical Centre in northern Israel. Hand hygiene compliance increased from 68%, before interventions \( (p < 0.001) \), to 81%, after interventions \( (p < 0.001) \). The researchers explained that constant and persistent reminders, monitoring and programs must be implemented through the years in order to sustain compliance. Therefore, it may take more than one period of interventions for handwashing to have a sustained effect. For example, in the study done by Son et al., (2011), the first time they implemented handwashing interventions, there was an increase from 20% to 65%, in 2006. It provided an immediate effect but then after a few months, handwashing compliance decreased at one point to below 60%. The next time they implemented handwashing interventions was in 2008 and this time they had a long lasting effect that increased handwashing compliance to 97%
and it has remained at this rate for the past three years with the use of the same multimodal approach of interventions.

Another study that was performed by Panhotra et al., (2004), in an intensive care unit in Saudi Arabia, also showed a four year, long lasting effect in handwashing compliance through multimodal interventions. Handwashing compliance increased each year during the study and nursing staff’s handwashing compliance increased from 66.7%, the first year, to 97.5%, the fourth year, nurse technicians’ handwashing compliance increased from 19.9%, the first year, to 47.7%, the fourth year (\( p < 0.0001 \)), and physicians’ handwashing compliance increased from 29.2, the first year, to 37.6%, the fourth year (\( p < 0.0001 \)).

The interventions that demonstrated long-lasting effects on handwashing compliance were the ones who used multimodal interventions and had constant commitment during the study period to the actual research (Higgins & Hannan, 2013; Santos et al., 2013). A study performed by Whitby and McLaws, (2004), in 2000, showed that using a single intervention only provided an immediate effect on handwashing compliance. In this study, Princess Alexandra Hospital in Australia, was completely rebuilt. The researchers made observations in the hospital prior to its rebuilding and then made observations after it was rebuilt. The main change in the new hospital was closer and more accessible sinks in different areas of the hospital. This single intervention had a slight and immediate effect on compliance and only provided a 5% improvement in the rates before and after interventions (\( p = 0.677 \)) (Whitby & McLaws, 2004). This shows that a single intervention, such as the one mentioned above, is not enough to sustain a long lasting effect for handwashing compliance. Hospital staff clearly needs more than just one intervention in order to be consistently reminded to perform hand hygiene and to overcome their perceived and stated barriers to hand hygiene.
Different interventions have various impacts on handwashing compliance. The type of intervention or interventions used may determine the maintenance of the increased handwashing compliance. Many researchers have examined the effect of multimodal types of interventions on hand-washing compliance (Antoniak, 2004; Duggan et al., 2008; Gül et al., 2012; Higging and Hannan, 2013; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sharir et al., 2001; Son et al., 2013). Multimodal approaches included education, such as training sessions and in-services, (Antoniak, 2004; Caglar et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Sharir et al., 2001; Son et al., 2011; Song et al., 2013; Whitby & Mc Laws, 2004), eye-catching campaigns, which included posters and pamphlets, (Antoniak, 2004; Duggan et al., 2008; Higgins & Hannan, 2013; Lebovic et al., 2013; Mathai et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Son et al., 2011; Song et al., 2013), and feedback systems, which included peer reviews and monitoring (Antoniak, 2004; Gül et al., 2012; Higging and Hannan, 2013; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Sharir et al., 2001; Son et al., 2013, Song et al., 2013).

All the studies that were analyzed had at least one of those three main interventions, however researchers did incorporate their own types of ideas and combinations of what would benefit the hand washing compliance the most. Son et al., (2011) performed a 12-week quantitative study at Memorial Sloan-Kettering Cancer Center, in New York City, and they decided to split the staff into teams and use workflow maps instead of just regular posters. These workflow maps showed the process of handwashing thoroughly by displaying step-by-step
instructions, which made staff, not only understand it better but also, helped the staff view it as an actual process instead of just a task. The workflow maps were discussed and the hospital staff of each team was able to go through a handwashing simulation, which allowed them to see exactly what mistakes they were making in the handwashing process. This was then followed by a discussion and feedback session (Son et al., 2011). Son et al., (2011) also noted that the use of workflow maps, education and feedback interventions have increased compliance from 65% to 97%. The compliance rate of 97% has continued to be a stable rate for the past 3 years.

Workflow maps had a beneficial effect on handwashing compliance since it encouraged the staff to stay focused on following the process and to view it as a challenge instead of just a simple task. Also, the workflow map corrected the hospital staff’s handwashing technique and the discussion and feedback sessions helped reintegrate the technique and concept into their minds (Son et al., 2011).

In another study, Higgins and Hannan (2013) researched handwashing compliance, in 2009, at Mater Private Hospital of Dublin, Ireland through the use of a quasi-experimental research design with a sample size of 735 healthcare workers. The researchers used the viewing of ATP (adenosine triphosphate) on hands by using a “fluorescent dye-based cleaning detection gel” to examine the amount of bacteria on hospital staff’s hands after washing along with a computer unit called “SureWash”. The “SureWash” computer unit would not only lead the staff through the steps of handwashing, but also, make video audits about the staff’s handwashing technique and give them a percentage score of how well they performed hand hygiene. ATP, an energy source found universally, is usually reduced after it is cleaned therefore, the hospital staff was able to determine just how well the hospital staff cleaned their hands compared to before handwashing (Higgins & Hannan, 2013). By using the ATP method after the “SureWash”
intervention, the researchers were able to examine if this multimodal intervention was increasing handwashing compliance or not. “SureWash” increased the handwashing compliance rate among staff members from 42% to 84%. In 2011, the overall handwashing compliance rate was 86% and it continued to remain above 80% following the multimodal intervention. They found that staff viewing of ATP resulted in an increased “passing” rate from 52% to 79% ($p < 0.0001$), following the multimodal interventions (Higgins & Hannan, 2013). These results correlate with the intervention used since the intervention would definitely be considered an “eye opener” for the hospital staff when they used the ATP intervention to view just how much bacteria was left on their hands. Also, the “SureWash” computer unit reinforced the technique of handwashing and allowed them to perform a live simulation and receive an actual percentage grade for it. This is a beneficial intervention since it allows staff members to view exactly how well they performed hand hygiene.

A two-month study performed by Langston (2011), examined the effects of peer monitoring and feedback on handwashing compliance. Five hundred and sixteen observations, including pre- and post- observations, were made and it included nurses, physicians, nursing assistants and additional staff members such as physical therapy, speech therapy, etc. The hospital staff was to complete at least ten audits every week and they had the option of choosing which staff member to audit. This type of feedback system is intended to engage the staff and to have them accept duty and responsibility for making sure handwashing is performed and for reporting noncompliance. A total of four hundred and twenty-eight audits were completed during the two-month study period. The data concluded that the use of peer mentoring increased handwashing compliance in nurses from 83.6% to 86.5%, for direct patient contact, and 62.9% to 82.7% percent in non-patient contact ($p = 0.003$). In nursing assistants, compliance increased
from 91.3% to 94.4%, for direct patient contact, and 64.3% to 84.6% ($p = 0.006$), for non-patient contact and in physicians, compliance increased from 21.4% to 40% ($p = 0.006$) in direct patient contact and decreased from 23.5% to 20% in non-patient contact ($p = 0.006$). The decrease in handwashing compliance for non-patient contact among physicians could have been due to the limitations of the study such as small sample size and using the same person for multiple observations (Langston, 2011). For additional hospital staff members such as physical therapist, speech therapists, etc., handwashing compliance for direct patient contact stayed at a rate of 100% and increased from 41.7% to 100% in non-patient contact ($p = 0.006$) (Langston, 2011).

According to Langston (2011), research has shown that nosocomial infection arise not just from direct contact with a particular patient but also from contact with objects or personal belongings in a patient’s room (Langston, 2001). This is an important point when a patient has some type of transmittable disease, because the other objects in the room that the patient has come into contact with would also be contaminated. Therefore, if a healthcare member comes into contact with a pathogen and does not perform hand hygiene, the pathogen could easily lead to cross contamination. Peer mentoring is the use of hospital staff to remind each other to wash their hands and to evaluate each other on their handwashing compliance (Langston, 2011; Son et al., 2011). In a similar study done by Son et al., (2011), the researchers used role models to increase the success of the interventions and analyzing the staff’s commitment in telling the truth. A few other researchers found role modeling to be beneficial since the hospital staff could evaluate each other in a professional manner (Gül et al., 2012; Langston, 2011; Mayer et al., 2011; Novoa et al., 2007; Santos et al., 2013; Son et al., 2011). Hand washing compliance improved because hospital members were provided with an appropriate and non-threatening way to evaluate each other, even in the case of noncompliance. For example, Santos et al., (2013) examined the effect
of positive reinforcement on handwashing compliance (Santos et al., 2013). The positive reinforcement, in one particular study, included little presents such as chocolate bars or ticket for a chance to win a prize when they performed correct hand hygiene (Mayer et al., 2011). In summary, research has shown that multimodal approaches have consistent, positive, immediate and long lasting effects on handwashing compliance compared to only using one intervention or not using any intervention.

While analyzing interventions, different healthcare professionals had different compliance rates. When comparing the nursing staff with the physician staff, most researchers found that nursing staff has higher compliance percentages (Caglar et al., 2010; Duggan et al., 2008; Panhotra et al., 2004; Santos et al., 2013; Sharir et al., 2001). However, Novoa et al., (2007) and Sahay et al., (2010) found that physicians had higher handwashing compliance when compared with nurses (Novoa et al., 2007; Sahay et al., 2010). In a research study performed by Novoa et al., (2007), an Intensive Care Unit in Barcelona, Spain implemented interventions in 2005. The overall compliance rate before any interventions was 20%. However, after interventions, the compliance rate of physicians was 24.7% compared to the lower compliance of 22.0% for the nursing staff ($p = 0.004$) (Novoa et al., 2007). Although physicians in this case had a slight increase, the majority of the studies analyzed did note that the nursing staff had higher handwashing compliance. The researchers questioned if education had an affect on the level of compliance for this particular study. They found that nurses tend to follow general guidelines, whereas physicians tend to follow the specific guidelines relating to hygiene (Sahay et al., 2010). Caglar (2010) found that while nurses had higher percentages of compliance, physicians tend to have higher compliance in using the correct technique related to hand hygiene.
When healthcare professionals were surveyed about the barriers of handwashing compliance, many of them mentioned the same barriers. The most common barriers were lack of time, lack of training, lack of hygiene supplies or appropriate placement, and lack of support and motivation (Antoniak, 2004; Caglar et al., 2010; Duggan et al., 2008; Mayer et al., 2011; Novoa et al., 2007; Sahay et al., 2010; Sharir et al., 2001; Son et al., 2011). Some healthcare professionals admitted to skepticism or disagreement relating to the hand hygiene guidelines and/or benefits (Sharir et al., 2001; Novoa et al., 2007).

**Critical Appraisal of the Evidence**

The studies mentioned in this paper have multiple limitations. Some of the limitations were distinct to specific studies. Other limitations were general across multiple studies. In order to obtain the most accurate data pertaining to handwashing compliance, direct observation is viewed as the “gold standard” (Sahay et al., 2010), while the self-report method is another option. Direct observation is the most frequently used method across the studies that were reviewed while there was only one study that used the self-report method. According to Gül et al., (2012), direct observation is a more accurate measure of practice, however it does require an increased amount of time, resources and cost. In contrast, the self-report method is cheaper, more easily conducted, and can obtain data from a much greater population in less time. The self-report method can be less accurate because healthcare workers may overestimate their handwashing compliance (Gül et al., 2012).

While the direct observation method is the gold standard in obtaining data, it has one main limitation pertaining to the accuracy of data in the studies: the Hawthorne effect (Sahay et al., 2010). The Hawthorne effect is a limitation that was found in all of the reviewed studies that used direct observation as their primary method for data collection. The chosen observers or
auditors in the studies had an impact upon how great the Hawthorne effect was upon the data. In studies that used trained external sources or infection control nurses, a greater Hawthorne effect was observed (Higgins & Hannan, 2013; Lebovic et al., 2013; Mathai et al., 2011; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Son et al., 2011; Whitby & McLaws, 2004). A few studies attempted to reduce this particular limitation by choosing observers or auditors that were more discrete, such as using observers that were nursing students, trained nurses, technicians, or physicians who were part of the staff or employees of the hospital, or nursing managers belonging to that particular unit. (Duggan et al., 2008; Langston, 2011; Mayer et al., 2011; Novoa et al., 2007; Sharir et al., 2001; Song et al., 2013). This decreased the Hawthorne effect because the population being observed was less aware and did not have many suspicions.

Another major limitation affecting handwashing data in these studies pertained to the sample size, setting, timing of observance, and the amount of staffing. For a study to have a stronger correlation between the data obtained and the actual population, a large sample is necessary. Unfortunately, some studies were unable to obtain a large sample size (Caglar et al., 2010; Sahay et al., 2010; Sharir et al., 2001). These small sample sizes can impact the accuracy and reliability of the data in the studies. Along with sample size, the amount of staffing that was available on the unit during the study can affect the results tremendously (Caglar et al., 2010). If the unit is understaffed, not only will the staff have less time to perform proper handwashing or even handwashing in general, but also the staff may be overwhelmed by the increased workload, which can cause the staff to be less attentive to the educational information offered on the unit. Nurses that tend to work on units with lower patient to nurse ratios may find more time for handwashing rather than those who have higher patient to nurse ratios (Caglar et al., 2010). More studies need to look into the amount of staffing available on the unit prior to conducting the
study since it is such an influential factor that can change the findings. While the size of the population, as well as staffing, can affect handwashing data, the setting of where the data was obtained can also affect it.

A greater variety of units used to obtain data in the hospital may contribute to handwashing compliance hospital wide since this enabled an increase in opportunities for handwashing observations. In this review of literature, there were some studies that had smaller applicability due to the use of only one or two units from the particular hospital (Caglar et al., 2010; Mathai et al., 2011; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013). Along with analyzing the limitations of sample size and setting, another major limitation affecting the variation of data, reflective of the hospital as a whole, is the lack of incorporating all hospitals shifts. This can lead to a loss of a large portion of data, which can alter the overall results of handwashing compliance. A majority of the reviewed studies failed to incorporate handwashing compliance data during the night shift of the unit (Caglar et al., 2010; Cummings et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Santos et al., 2013; Song et al., 2013; Whitby & McLaws, 2004). While most studies did not incorporate the night shift handwashing compliance data, there were studies that did encompass all hospital shifts in order to increase their data accuracy and reliability (Langston, 2011; Sahay et al., 2010; Sharir et al., 2001; Son et al., 2011).

As mentioned previously, some limitations were generalized across the studies while other limitations acted as more specific barriers to particular studies. In order for a study to have a high value of reliability and accuracy, it must have control for significant variables. In one particular study, the data obtained was less accurate since some of the healthcare workers were at
a disadvantage due to lack of proper handwashing equipment. While the healthcare workers did have an adequate amount of sinks and liquid soap, compliance related to the use of alcohol-based handwashing solution could not be determined due to the lack of supply. This presents a major limitation when interpreting findings about handwashing compliance (Gül et al., 2012). In a different study, another barrier occurred in which a random sample size of healthcare workers was unobtainable due to time constraints. A convenience sample was used, which decreases representation of the entire population and increases sampling bias (Duggan et al., 2008).

In all of the reviewed studies, educational material was used and provided in order to determine the observational method to be used. The World Health Organization’s “My Five Moments” is one observational method that is considered the gold standard for measuring handwashing compliance. In a majority of the studies, the observers or auditors all monitored the healthcare workers for each of the five handwashing moments, which included handwashing: 1. before touching a patient, 2. before a clean or aseptic procedure, 3. after body fluid exposure, 4. after touching a patient, 5. after touching a patient’s surroundings (Caglar et al., 2010; Cummings et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Sharir et al., 2001; Son et al., 2011; Whitby & McLaw, 2004). However, one study in particular failed to incorporate two of the five handwashing moments for monitoring handwashing (Song et al., 2013). In this study, there was no data collection on handwashing before clean and aseptic procedures or after body fluid exposures (Song et al., 2013).

In all of the reviewed studies, education was provided either before or during the study, to the healthcare workers and the observers or auditors. The type of education provided, posed
different limitations to the studies. In one study, a PowerPoint lecture was provided to the healthcare workers, however, the lecture was taught using the most common language, which posed a language barrier between the lecturer and some of the employees since the lectures did not consider the effect on employees who were not fluent with the common language.

Another issue with this type of educational intervention is that literacy levels and learning style were not taken into consideration with the teaching style (Mathai et al., 2011). While this limitation, affected this study and it’s educational intervention, it could potentially affect other studies that use the same or other educational interventions.

In a specific study that used multimodal educational interventions, limitations arose within the study specific to the education provided. While multimodal education is considered to be the most effective method of education, it could be assumed as ineffective when low handwashing compliance is observed even after the educational interventions are implemented. Components of the different interventions posed limitations for the accuracy of the data obtained. While the study used educational training as one of their interventions, the attendance at the training sessions was poor. Also, while feedback was provided about handwashing compliance, it was only provided to upper levels of the hospital staff or management and in return, it never reached the actual workers who provided direct patient care (Lebovic et al., 2013).

While assessing all of the studies, each of them has their own limitations. For a majority of the studies, the limitations did not have a significant impact on the results of the data (Caglar et al., 2010; Cummings et al., 2010; Duggan et al., 2008; Gül et al., 2012; Higgins & Hannan, 2013; Klevens et al., 2007; Langston, 2011; Lebovic et al., 2013; Mathai et al., 2011; Mayer et al., 2011; Novoa et al., 2007; Panhotra et al., 2004; Sahay et al., 2010; Santos et al., 2013; Sharir et al., 2001; Son et al., 2011). The methods and findings for these studies were accurate, reliable,
and valid because they all used trained researchers. However, there were two studies in which the validity and reliability of the methods and findings may have been compromised. In (Song et al., 2013), researchers failed to incorporate all five moments of handwashing monitoring. This can directly impact the handwashing compliance findings, because the researchers did not take into account all handwashing opportunities. In return, this voids the results of this study when compared to other studies due to the missing information; therefore, the reliability and validity of the study are highly compromised (Song et al., 2013).

In another study by Whitby and McLaws, (2004), miscommunication and a protocol breech were the main factors that compromised the validity and reliability of the data obtained. In the study, the researchers communicated with the ethics committee and three senior clinicians and administrators, but failed to directly communicate the study to the unit directors. This can cause invalid data findings because of a lack of the implementation of any form of interventions or alterations on the unit prior to the study in order to correlate if education had an affect on handwashing compliance. Secondly, there was also a protocol breech in which a healthcare worker discovered the actual purpose of the study during the observation period. This impaired the internal validity of the study as a whole when the healthcare worker notified other healthcare workers who were part of the study. Thus, the methods and the findings could portray an inaccurate representation of the handwashing compliance of the hospital as a whole (Whitby & McLaws, 2004).

**Synthesis of Evidence**

Ten out of eleven studies that implemented multimodal interventions related to handwashing showed a positive improvement in handwashing compliance among healthcare workers. Out of the ten studies that did show an improvement in handwashing compliance, eight
of the studies examined handwashing compliance over a longer period of time. The results of these eight studies positively affected both short term and long-term handwashing compliance due to the use of multimodal interventions. The remaining two studies did show an improvement in short term handwashing compliance, however the studies failed to assess the long term implications of multimodal interventions on handwashing compliance. Out of the previously discussed studies, one study failed to show an improvement in handwashing compliance. In this particular study, handwashing compliance rates remained steady throughout the whole research period. However, the study did mention specific limitations that could have greatly impacted the handwashing compliance rates even after multimodal interventions were implemented. Therefore, further research is indicated in order to assess the reliability and validity of the results.

Throughout the healthcare industry, handwashing directly impacts the rate of hospital-acquired infections. In order to decrease hospital acquired infections, it is highly important to examine and improve handwashing compliance rates in any healthcare facility that provides direct patient care. Contrary to common belief, handwashing compliance is surprisingly lower than expected. In order to increase handwashing compliance, interventions must be implemented. While interventions have shown to improve handwashing compliance, the compliance rates only remained high for a short period of time. Thus it does not meet the crucial goal of decreasing nosocomial infection rates in the long term. While certain interventions only affected handwashing compliance over a short period of time, continuous multimodal interventions have been proven to increase handwashing compliance over both a short and long period of time. Thus, it is essential for all healthcare facilities to implement continuous multimodal interventions, rather than no interventions or single interventions, in order to improve handwashing compliance and decrease nosocomial infections.
Recommendations

Based on this systematic review of literature, improvement in handwashing compliance can be sustained. In order to sustain a long-term impact on handwashing compliance, continuous multimodal interventions must be implemented and maintained. However, thoughtful consideration must be given in how these interventions are implemented and how handwashing compliance is examined throughout the research studies. The interventions should not only be educational, but should also be behavioral. While educational and behavioral interventions are important, they should be implemented correctly and tailored based on the type of healthcare provider and upon the individual healthcare worker’s needs.

Any intervention can be implemented but it is important to send the message to the majority of the healthcare workers. Therefore, programming, discussions, and training sessions should be implemented thoughtfully to gain greater attendance and participation. The educational aspects of these interventions should be specific and should not only explain how to increase handwashing compliance but should also demonstrate the correct technique of washing one’s hands or sanitizing one’s hands with the hygiene products available. It is highly recommended to interact with the healthcare workers of the study and to incorporate peers, direct supervisors, and other healthcare workers who can act as role models.

Overall, additional studies should be conducted and should focus on handwashing compliance rates over an extended period of time, and incorporate the costs and effects of non-compliance. Future studies should also focus on identifying any new interventions that can improve handwashing compliance and should focus more on the amount of staffing available on the floors or units where the research was performed and how this can affect their results. However, in order for a study to make an impact on the healthcare workers, continuous feedback
and evaluations should be given directly to the healthcare providers not only during the actual study, but also throughout their career at any healthcare facility. Since it is important for healthcare individuals to make the everlasting change of increasing their handwashing compliance, it is recommended to keep their interests in mind and to use interactive, and proactive ways of changing their behaviors, as well as educating them on handwashing, in order to increase their handwashing compliance over a long period of time.
EFFECTS OF INTERVENTIONS ON HANDWASHING COMPLIANCE

References

Antoniak, J. (2004). Handwashing compliance: a tertiary Canadian-accredited hospital in the Middle East promotes a multidisciplinary approach to address the challenges of handwashing compliance. Canadian Nurse, 100(7), 21-25.


EFFECTS OF INTERVENTIONS ON HANDWASHING COMPLIANCE


## Appendix A
### EBP Review of Literature Summary Table

<table>
<thead>
<tr>
<th>Author(s) (year)</th>
<th>Article Title</th>
<th><strong>Categories</strong></th>
<th><strong>Purpose statement &amp; PICOT. Study Design.</strong></th>
<th><em><strong>Clinical Practice Setting and Sample.</strong></em></th>
<th>Evidence-based Findings</th>
<th>Practice &amp; Research Implications</th>
<th>****Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Antoniak (2004).</td>
<td>Handwashing Compliance.</td>
<td>Primary Quantitative Level 3 - experimental</td>
<td>Outbreak of severe acute respiratory syndrome in Canada due to transmission of nosocomial infections.</td>
<td>How to improve handwashing compliance in healthcare workers.</td>
<td>Sample size unknown. Research article discusses only the Shaikh Khalifa Medical Center staff. Diverse multicultural workplace consisted of 38 distinct nationalities. A melting pot of various educational backgrounds and cultural beliefs.</td>
<td>1. The nurses and staff at SKMC developed and implemented a multidisciplinary approach that was supported by evidence-based research. 2. Although handwashing increases during the educational interventions and improves slightly thereafter, The changes in behavior are not sustained beyond the period of the study interventions. 3. Ongoing education, clear communication and a committed leadership were considered to be essential to promote and sustain handwashing compliance in SKMC. 4. SKMC developed and implemented a multidisciplinary approach that involved collaboration, implementation and evaluation, along with alcohol-based hand rub sanitizers, in response to handwashing challenges.</td>
<td>Multidisciplinary approaches prove to be beneficial to increasing handwashing compliance in hospitals.</td>
</tr>
</tbody>
</table>
| Study | High nosocomial infection rates in ICU patients. | This study was designed to determine the effect of educational intervention measures on handwashing compliance among the HCWs of various specialties visiting and working in the ICU. | 60 Health care workers 42 nurses, 17 doctors, 1 respiratory technician. Other consultants from various specialties and technicians from radiology, physiotherapy and cardiology departments. | 1. No single interventional measure is successful in improving hand-washing compliance.  
2. Handwashing compliance among females was significantly higher (76.2% v. 23.8%).  
3. A comparative study of the yearly assessments made since the start of the educational program also revealed significant increases in handwashing compliance among nurses and technicians, while no significant changes in handwashing behaviors among doctors between 1998-2002.  
4. Handwashing compliance was significantly higher among female HCWs than their male counterparts (76.2% versus 23.8%) after the continuous educational program. Females even displayed better handwashing technique than the males in the study and there appears to be an inherent difference in handwashing practice between the two genders. | Single intervention s do not increase hand washing compliance in the healthcare setting. Many intervention s affect nurses differently than physicians. | Any contact with linen, bed, equipment, and a patient’s record was not considered patient contact. Patients knew they were being observed. |

Primary Quantitative Level 3 - experimental

Despite continuous education and awareness, compliance with hand hygiene guidelines has remained low, particularly during evening shifts.

The objective was to determine the compliance with hand hygiene guidelines among doctors, nurses, and paramedical staff during day and night duties in a multidisciplinary intensive care unit (ICU).

Single Center Study

1. The compliance of properly performed handwashing dropped significantly in night duties compared with the day duties.

2. Higher frequency of neglect of hand hygiene during night could be due to fewer nurses at night as compared with in the daytime

Night shift nurses may need a different style of approach to increasing hand washing compliance.

Small sample size, Single center study. Possible Hawthorne effect
| 4. Scott (2009) | Healthcare-associated infections (HAIs) in hospitals impose significant economic consequences on the nation’s healthcare system. To estimate the overall national direct medical cost of all HAIs, this analysis used results from two studies employing different study methodologies: a systematic review of economic studies and an economic model of hospital-wide patient costs from a single hospital. | The all urban consumer group includes almost all residents of urban or metropolitan areas, including professionals, the self-employed, the poor, the unemployed, and retired people, as well as urban wage earners and clerical workers and represents about 87 percent of the total U.S. population. | 1. Using the CPI for inpatient hospital services, the overall direct cost ranges from $35.7 billion to $45 billion. | Healthcare acquired infections need to be reduced because they can cost up to 45 billion Dollars. | 1. First, the national cost estimates have been inferred from studies with more limited study settings. The incidence of some types of infections has been shown to be on the decline, whereas it is possible that the incidence of other HAIs may have changed. |
| Healthcare-acquired infections (HAIs) in hospitals impose significant economic consequences on the nation’s healthcare system. To estimate the overall national direct medical cost of all HAIs, this analysis used results from two studies employing different study methodologies: a systematic review of economic studies and an economic model of hospital-wide patient costs from a single hospital. | The all urban consumer group includes almost all residents of urban or metropolitan areas, including professionals, the self-employed, the poor, the unemployed, and retired people, as well as urban wage earners and clerical workers and represents about 87 percent of the total U.S. population. | 1. Using the CPI for inpatient hospital services, the overall direct cost ranges from $35.7 billion to $45 billion. | Healthcare acquired infections need to be reduced because they can cost up to 45 billion Dollars. | 1. First, the national cost estimates have been inferred from studies with more limited study settings. The incidence of some types of infections has been shown to be on the decline, whereas it is possible that the incidence of other HAIs may have changed. |
| 5. Son, Chuck, Childers, Usiak, Dowling, Andiel, Backer, Eagen, & Sepkowitz (2011) | Hospital Acquired infections is a major issue for hospitals. | Does the new design for increasing hand washing compliance works better than the one implicated in 2008. | Approximatel y 50 teams of 5-10 healthcare workers at Memorial Sloan-Kettering Cancer Center, which has 464 beds. | 1. Staff are much more likely to accept and retain correction by peers or direct supervisors when made in real time as mistakes occur. Previously, IPPs did not intervene during patient encounters, to avoid disrupting staff workflow.  
2. Drawing a workflow map and examining it step-by-step allowed HCWs to identify some ways to reorganize the steps to increase efficiency and reduce the number of situations requiring hand hygiene. This reinforced the importance of handwashing at the proper times, as opposed to simply more often. | Real time correction of poor hand washing compliance works the best. | Hawthorne Effect |

**Primary Quantitative Level 3 - experimental**

| Handwashing frequency is generally low in healthcare workers despite knowing that handwashing is key in order to | Does the location of a sink impact handwashing compliance. | A hospital’s staff was observed before and after a hospital had changed location. | 1. In September 2000, before the hospital relocated, staff were observed covertly for frequency of handwashing associated with clinical activities. |
| Accessibility of sinks alone does not improve handwashing compliance. | Accessibility of sinks alone does not improve handwashing compliance. |

1. **In September 2000, before the hospital relocated, staff were observed covertly for frequency of handwashing associated with clinical activities.**

2. **No unit was a clinically significant sustained change in post patient contact handwashing rates nine months later.**

3. **Before patient contact, Compliance with handwashing prior to a procedure was consistently lower in all units.**

4. **Before patient contact, there was a short-lived increase in compliance was recorded in the internal medicine ward.**

5. **Our study confirms that HCW compliance with handwashing protocols is not greatly influenced by ready accessibility of sinks, and requires more intervention than just the provision of excellence in the physical facilities of a hospital.**

4 hours into Day 2 of the final study period, an ICU staff member recognized the true purpose of the observational activity.

The baseline observation period in the urology ward was preceded by a persistent rise in methicillin-resistant Staphylococcus aureus (MRSA) cross-infection within that ward.
| 7. Santos, Dias, Cavassin, Lobo, Schwenck, Puschiavo, Toscano, Hashiba, Bierrenbach (2012). Improving hand hygiene adherence in an endoscopy unit | Although hand hygiene is the most important measure in preventing infection transmission in healthcare settings, adherence to recommendations among healthcare workers is low. | This study implemented and assessed the impact of a World Health Organization-recommended educational intervention to improve hand hygiene adherence at the endoscopy unit of a Brazilian tertiary hospital. | Hospital Sírio Libanês is a 350-bed private tertiary care hospital in the city of São Paulo in Brazil. The unit has 36 endoscopists, 5 nurses, and 33 nurse assistants (4 of whom work exclusively in the cleaning and disinfection subunit). There are usually 4 nurse assistant trainees. | 1. Overall adherence increased from 21.4% at baseline to 63.3% at 1 month after intervention (P < 0.001, for the difference between time points 1 and 2), and to 73.3% at 10 months after intervention (P = 0.053, for the difference between time points 2 and 3). 2. HCW professional category indicated that adherence at baseline was lower for physicians (15%) and higher for nurses (30.7%). 3. Conversely, although adherence rates increased from 1 to 10 months after intervention, this increase was only significant for physicians (P<0.001). | Education about increasing handwashing compliance can show a long-term improvement over 10 months. The observations performed in our study were done only during the daytime on weekdays, which is when the majority of exams are performed, whereas opportunities for hand hygiene in fact occur 7 days a week and during the night as well. |
Predictors of hand hygiene compliance have not been re-evaluated in the era of alcohol-based hand rinse to re-evaluate predictors of hand hygiene compliance in the era of ABHR.

St Michael’s Hospital, a 450-bed teaching hospital in Toronto, Canada. Sample included 3487 healthcare workers.

1. Nurses accounted for 67% of observed hand-hygiene opportunities, physicians for 15% and other healthcare workers for 18%.

2. Overall hand-hygiene compliance was 45% and remained stable throughout the study period.

3. The most common indications for hand hygiene were hand hygiene after contact with patients or their environment (46% of observations) and hand hygiene before contact with patients or their environment (39% of observations).

4. Physician status, glove use, and isolation status were not associated with reduced compliance.

More research to determine why there is a difference between compliance in nurses and physicians.

More research to determine why there is a difference between hand hygiene before and after contact with a patient.

Failed to identify an association between glove use and lower hand hygiene compliance. In fact, a weak association between glove use and higher compliance was identified in the multivariate model.
The healthcare profession still struggles with hand hygiene compliance in the 21st Century. To determine whether using this automated training program and audit tool as part of a multi-modal strategy would improve hand hygiene technique and compliance in an acute healthcare setting, an advertising campaign about SureWash was carried out in the hospital through e-mails and general hospital mail. The unit was set up outside the staff canteen, and all those entering the clinical area were provided with hand washing alcohol rubs. The extra alcohol hand rub stations in the clinical area in 2011 most likely had a confounding effect on the increased use of alcohol hand rubs noted during audits.

1. A multicentre, single-blinded, controlled trial with 2 arms: intervention and control. The intervention arm received an automated training and audit tool using gaming technology as well as a high touch strategy (hand washing at the point of care). The control arm received no intervention.

2. HCW’s compliance with the Five Moments for Hand Hygiene increased from a baseline of 20% to 58% in early 2010. Unfortunately, the rates dropped gradually during the remainder of 2010.

3. In the 12 months following implementation, the compliance rate was 52% (94 staff had scores <25). This increased to 79% (201 staff had scores <25) in the year following implementation (P < 0.0001).

| Health care-associated infections (HCAIs) are affecting millions of patients worldwide. HCAI is a major cause of morbidity and mortality in hospitalized patients and hands play an important role in the transmission of infection | To assess undergraduate nursing and midwifery students’ hand hygiene (HH) compliance | Bakırköy Health School, Istanbul University. Of the 387 questionnaires, which were distributed, 319 questionnaires were returned. We eliminate 14 questionnaires with missing information. In total, 305 students enrolled in the study. | 1. More third year (60.9%, n = 53) and fourth year students (83%, n = 88) had performed HH than second year students (53.6%, n = 60), 2. More fourth year students (92.5%, n = 98) had changed gloves than the second (75%, n = 84) and third year students (75.9%, n = 66, P = 0.001). There is no statistically significant difference in the year of school and HH rate after removing gloves | Increasing in education can increase hand hygiene compliance. The majority of the information was self-reported. |
| Cummings, Anderson, Kaye (2010). | Hand hygiene noncompliance is a major cause of nosocomial infection. Nosocomial infection cost data exist, but the effect of hand hygiene noncompliance is unknown. | To estimate methicillin-resistant Staphylococcus aureus (MRSA)-related cost of an incident of hand hygiene noncompliance by a healthcare worker during patient care. | Duke University Medical Center, a 750-bed tertiary medical center in Durham, North Carolina. | 1. The mean cost per MRSA infection was $47,092.  
2. Hospital-acquired infections cause more than 98,000 deaths annually in the United States. | Healthcare workers need to be compliant with hand hygiene because that hand hygiene noncompliance is the leading cause of hospital-acquired MRSA infection. The model focused on costs associated only with MRSA transmission, it substantially underestimated the costs associated with hand hygiene noncompliance. |
| Estimating Healthcare-Associated Infections and Deaths in U.S. Hospitals, 2002 |
| Primary |
| Quantitative |
| Level 3 - experimental |

Healthcare-associated infections (HAIs) are a common cause of morbidity and mortality in the United States and are among the most common adverse events in healthcare.

The purpose of this study was to provide a national estimate of the number of healthcare-associated infections (HAI) and deaths in United States hospitals.

National Nosocomial Infections Surveillance (NNIS) system, data from 1990–2002, conducted by the Centers for Disease Control and Prevention. Data from the National Hospital Discharge Survey (for 2002) and the American Hospital Association Survey (for 2000) were used to supplement NNIS data.

Of 39 million annual hospital admissions in the USA, roughly 1.7 million result in HAIs and 100,000 HAIs result in death.

It is important to look at information related to the rates of HAIs in order to determine a plan for reducing these rates.

Used 1990s data from hospital-wide surveillance for estimates in 2002 in two areas: infection rates in well-baby nurseries and the distribution of infections by major site.
<table>
<thead>
<tr>
<th>13. Song, Stockwell, Floyd, Short, Singh (2013).</th>
<th>Many institutions have implemented aggressive measures to improve hand hygiene practice; however, the compliance by health care providers remains universally low.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving hand hygiene compliance in health care workers: Strategies and impact on patient outcomes</td>
<td>To find a systematic process for improving hand hygiene (HH) compliance in health care providers and assessed the impact of HH on patient outcomes.</td>
</tr>
<tr>
<td>Primary Quantitative Level 3 - experimental</td>
<td>Children’s National Medical Center in Washington, DC, between July 2008 and September 2011. The hospital has 13 inpatient units with 303 inpatient beds. 1,433 observations in the 3 months preintervention phase and 9,580 observations in the postintervention phase were documented.</td>
</tr>
<tr>
<td>1. Following the implementation of intervention measures, the compliance rate in 13 inpatient units and the emergency department increased from 50.3% in the preintervention phase to 84.0% post-intervention</td>
<td>A multi-step intervention including measuring baseline compliance rate; performing FMEA to identify barriers, and instituting measures to remove barriers.</td>
</tr>
<tr>
<td>2. The overall hand hygiene compliance improved from 48.6% to 87.0% among physicians and from 46.5% to 77.9% among nurses.</td>
<td>Hand hygiene compliance did not measure 2 additional hand hygiene moments before clean/aseptic procedures recommended by WHO.</td>
</tr>
<tr>
<td>3. The improvement process constituted 3 critical steps: measuring baseline compliance rate; performing FMEA to identify barriers, and instituting measures to remove barriers.</td>
<td>The subanalysis that evaluated the impact of hand hygiene on preventing MRSA acquisitions was performed in a unit that had instituted MRSA prevention measures.</td>
</tr>
<tr>
<td>14. Langston (2011). Effects of Peer Monitoring and Peer Feedback on Hand Hygiene in Surgical Intensive Care Unit and Step-down Units</td>
<td>Rate of hand hygiene in hospital settings by health care staff and non-health care workers remains unsatisfactory.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| Primary Quantitative Level 2 – randomized controlled trial | | the surgery intensive care, neurosurgery intensive care, and surgical intermediate care units at University of North Carolina Hospitals in Chapel Hill, North Carolina. Each observer monitored randomly selected rooms on these units in increments of 30 minutes over a 2-hour period. There were 2 periods of observations: 8:30 to 10:30 AM and 8:30 to 10:30 PM. | | | | 1. The intervention increased RN hand hygiene compliance after nonpatient contact (82.8%) to that of hand hygiene compliance after direct patient contact (86.5%).
2. The intervention increased MD hand hygiene compliance after nonpatient contact (21.4%) to that of hand hygiene compliance after direct patient contact (40%). | |
| 15. Mayer, Harbarth, Eutropius (2013). Dissemination and Sustainability of a Hospital-Wide Hand Hygiene Program Emphasizing Positive Reinforcement | There is a gap between evidence-based practice and actual adherence to hand hygiene, with an overall median compliance rate of 40% of opportunities. To increase and sustain hospital-wide compliance with hand hygiene through a long-term ongoing multidimensional improvement program emphasizing behavioral factors. A 450-bed teaching tertiary-care hospital. Hand hygiene adherence was measured in 12 patient care units: 6 acute care units (322 beds), 1 oncology unit (25 beds), and 5 intensive care units (103 beds). | 1. The hand hygiene compliance rate peaked in all hospital locations 2 years after hospital-wide dissemination in 2004. 2. The mean compliance rate ranged from 19% to 41% of 4,174 opportunities at baseline, increased to the highest levels of 73%–84% of 6,420 opportunities in 2004, and remained improved at 59%–81% of 4,990 opportunities in 2006. | It is important for there to be collaboration and team-work between infection control personnel and individual unit managers and staff. Significant and sustained improvements in hand hygiene were realized in all HCW categories, including among physicians. Standardization and optimal measurement of hand hygiene observations is always a concern. 2. Contamination of the control units, evidenced by the almost 7% alcohol sanitizer use among baseline observations. |
| 16. Duggan, Hensley, Khuder, Papadimos, Jacobs (2008). Inverse Correlation Between Level of Professional Education and Rate of Handwashing Compliance in a Teaching Hospital. | The rate for handwashing compliance with hand hygiene remains low. | To evaluate educational level as a contributing factor in handwashing compliance. | 1. Interestingly, there was an inverse correlation between compliance and level of professional education.  
2. To affect a lasting impact on rates of compliance, different educational strategies may be needed for different groups, depending on their level of education and/or their role in the healthcare education system.  
3. afternoon shift workers had a higher rate of compliance than morning shift workers. However, a statistically significant improvement in compliance occurred for the morning shift, compared with the afternoon shift, after the JCAHO site visit.  
4 A “one-size-fits-all” approach to hospital wide education and quality improvement campaigns may not be effective for all healthcare workers. Education and quality improvement initiatives may need to be tailored to professional educational level to affect long-term behavioral change.  
Physicians may require a different approach to increasing compliance of hand washing than nurses. | No observations took place from 11PM to 7AM shift.  
Covert observation, the observers may have missed key aspects of the interaction that could have resulted in inaccurate data collection. A convenience sample was used, which may introduce a source of bias into the data analysis. |
<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
</table>

**Hand washing compliance rarely exceeds 40%, even in intensive care units. Non-compliance is due to lack of time, inconveniently placed sinks, drying of the skin by soap, forgetfulness, or disagreement with the recommendations.**

**Primary Quantitative**  
**Level 3 – experimental**

**Evaluated the effectiveness of an infection control program in relation to hand-washing compliance of healthcare workers.**  
**Independent variable:** infection control program, **dependent variable:** hand washing compliance, **population:** healthcare workers (nurses and physicians).

**Sample size of 300 uninformed staff members and 1035 observed hand washing opportunities. Male and female genders, various age and ethnicity, profession (physician or nurse), hospital unit, and type of delivered care.**

| 1. Overall observed compliance was 76%; 68% before treatment and 81% after delivery of care. |
| 2. Females complied more than males (80% vs. 69%) |
| 3. Nurses complied more than male physicians (81% vs. 69%) but not more than female physician (81% vs. 83%). |
| 4. Intensive care units had highest compliance (95% before treatment and almost 99% after treatment). |

**To identify hand washing compliance after an infection control program was established**

**Small sample size, data collection from only one hospital, time spent at each of the three shifts, time period of the study. Formative validity is present but sampling validity should be improved by using more than one hospital.**

<table>
<thead>
<tr>
<th>Observation results of handwashing by health-care workers in a neonatal intensive care unit.</th>
<th>The primary cause of infant death in the NICU is infection. Hand washing would be the best and cheapest method to decrease the risk for infant mortality. Handwashing non-compliance was said to be due to lack of information, equipment and motivation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>To determine the status of hand washing, which is important and an effective method of preventing and controlling hospital infections, by health-care workers in a neonatal intensive care unit and to make recommendations based on the results</td>
<td>In a university’s NICU in Istanbul, Turkey. Sample size 28 healthcare workers (14 nurses and 14 physicians). 344 Hand washing observations. The nurses’ population was all females while the physicians’ population was residents both male and female. The age range for the nurses was 26 to 30 years old. Ethnicity varied.</td>
</tr>
<tr>
<td>1. 58.14% hand washing compliance overall. 2. 62.50% of the nurses and 52.63% of the physicians washed their hands. Only 17.50% used appropriate technique and duration while washing their hands. 3. 13.33% of the nurses and 23.75% of the physicians were observed to wash their hands with appropriate technique and for the appropriate length of time. 4. 53.5% of the nurses and 44.9% of the physicians were observed to wash their hands before the procedure; and 69.8% of the nurses and 59.0% of the physicians (49 observations) were observed to wash their hands after the procedure.</td>
<td>To identify hand washing compliance in the NICU and the methods of hand washing that were primarily used in order to be able to repeat the study at a later time.</td>
</tr>
<tr>
<td>Primary</td>
<td>Small sample size, data collection during a specific time period, data collection from only one specific hospital, data collection involving primarily female nurses. The sampling validity could be improved by involving other healthcare workers and hospitals.</td>
</tr>
<tr>
<td>Mixed methods</td>
<td>Level 3 – experimental</td>
</tr>
<tr>
<td>19. Novoa, Pi-Sunyer, Sala, Molins, &amp; Castells (2005) Evaluation of hand hygiene adherence in a tertiary hospital.</td>
<td>Hospital-acquired infections cause about 88,000 deaths annually in the United States. Since 1990, the Spanish hospitals have observed an increase in nosocomial infections in 2005 of 8.10% and 6.92% in Spanish and Catalonian hospitals, respectively. To evaluate compliance with hand hygiene recommendations among HCWs in our hospital and to identify risk factors for non-adherence, which could be taken into account when planning future intervention aimed at improving adherence in HCWs. A hospital-wide cross-sectional study in Hospital del Mar in Barcelona Spain. Sample size was 247 healthcare professionals, which included nurses, nurse assistants, physicians, and resident physicians. Age, gender and ethnicity varied in the study. Other characteristics focused were professional category, nursing shift, hospital area of work, and activity performed. 1. Mean hand washing compliance was 19.9%. 2. It was highest in physicians (24.7%), followed by nurses (22.0%). 3. The area with the highest adherence was the ICU (68.9%) and the lowest was in he surgical wards (4.3%). 4. Hand hygiene was carried out more frequently after (25.6%) than before an activity (12.8%) 5. Glove removal without subsequent hand hygiene took place in 47.0% 6. Hand washing was found as the most common technique (68.7%) rather than by hand disinfection (31.3%). To identify hand washing compliance after recommendations for patient care were made in order to find solutions on how to increase hand washing compliance. Limitations of this study are its cross-sectional nature, which implies that evaluation does not reflect activity intensity throughout the year; consequently, the results could over- or under-estimate real compliance, influenced by the time period chosen for observation.</td>
</tr>
<tr>
<td>Compliance rates remain poor among health care personnel.</td>
<td>To investigate the health care workers’ hand hygiene compliance rates in the intensive care unit (ICU) b) to assess reasons for non-compliance c) to study the efficacy of a multimodal intervention strategy at improving compliance.</td>
</tr>
</tbody>
</table>