



RESEARCH ARTICLE

The COVID-19 pandemic as a factor of hospital staff compliance with the rules of hand hygiene: assessment of the usefulness of the "Clean Care is a Safer Care" program as a tool to enhance compliance with hand hygiene principles in hospitals

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Keywords

Hand hygiene • Educational program • Efficiency • Disinfection • COVID-19

Summary

Introduction. Hand cleansing and disinfection is the most efficient method for reducing the rates of hospital-acquired infections which are a serious medical and economic problem. Striving to ensure the maximum safety of the therapeutic process, we decided to promote hand hygiene by implementing the educational program titled "Clean Care is a Safer Care". The occurrence of the COVID-19 pandemic affected the compliance with procedures related to the sanitary regime, including the frequency and accuracy of hand decontamination by medical personnel.

Objective. The objective of the study was to assess the usefulness of the educational program titled "Clean Care is a Safer Care" as a tool for increasing compliance with hand hygiene principles.

Methods. We monitored the compliance with the hygiene procedure before implementation of the program as well as during the

hand hygiene campaign by means of direct observation as well as the disinfectant consumption rates.

Results. In the initial self-assessment survey, the hospital had scored 270/500 points (54%). Preliminary audit revealed the hygiene compliance rate at the level of 49%. After broad-scaled educational efforts, the semi-annual audit revealed an increase in hand hygiene compliance rate up to 81% (hospital average) while the final audit carried out after one year of campaigning revealed a compliance rate of 77%. The final score for the hospital increased to 435/500 points.

Conclusions. COVID-19 pandemic dramatically increased accuracy of proper hand hygiene procedures and consumption of disinfectant agents. The educational program has succeeded to reach its goal; however, long-term educational efforts are required to maintain and improve the quality of provided services.

Introduction

Every year, millions of patients acquire infections during hospital treatment. The scale of the problem is best illustrated by data indicating that hospital-acquired infections development in nearly 10% of all hospitalized patients while reaching nearly 50% in case of high-risk groups such as ICU patients, patients subjected to prolonged artificial ventilation, or immunosuppressed patients.

These serious complications increase the length of hospital stay by about 5-10 days, leading to potential disabilities as well as double the morbidity rates in affected patients [1].

Hospital-acquired infections are also a serious economic problem due to the increased treatment costs. As estimated by Urban et al., treatment of mild infections may increase the individual treatment costs by at least 400 USD while the average costs of the treatment of severe nosocomial infections exceed 30,000 USD per patient. In many cases, nosocomial

infections are transmitted by the medical staff due to their failure to comply with aseptic and antiseptic procedures [2].

Strict compliance with hand hygiene principles is of special importance in reducing the nosocomial infection rates. Hand cleansing and disinfection practices are the most economical and most efficient methods to prevent transmission of microorganisms and reduce hospital-acquired infection rates [3]. Despite the simplicity of this measure, non-compliance with its principles is a global problem in the health care sector [1].

The pioneer of hand hygiene as a measure to prevent hospital-acquired infections was Ignaz Philipp Semmelweis (1818-1865) who discovered the correlation between dirty hands of obstetricians and the incidence of postpartum infections and was the first to implement appropriate hand disinfection procedures.

Today, nearly 200 years later, proper compliance with hand hygiene principles is still a problem for medical professionals [4]. The importance of this simple

procedure appears to be underestimated by medical professionals as the World Health Organization estimates that the compliance rates range from 5% to 89% [5]. In 2009, WHO published the guidelines for proper hand hygiene in the medical sector. All around the globe, training is organized for medical professionals as part of the First Global Patient Safety Challenge “Clean Care is a Safer Care” [6]. Poland joined the initiative in 2013. Many hospitals in our country decided to implement the WHO guidelines as a measure to reduce the hospital-acquired infection rates.

The guidelines were also adopted by the Medicover Hospital in Warsaw as a means to ensure the maximum safety of the therapeutic services provided to our patients. Program implementation was coordinated by the Hospital-Acquired Infections Team which worked to increase the awareness of hospital workers in relation to the importance of hand hygiene as well as to strengthen good behavior models to promote proper hand hygiene.

The outbreak of the COVID-19 epidemic provided completely new observations of behavior among medical staff. Measurements of the use of liquid soap and hand disinfectant, carried out at that time showed dramatic increase in use.

Objective

The objective of the study was to assess the usefulness of the educational program titled “Clean Care is a Safer Care” as a tool to enhance the compliance with hand hygiene principles before and during COVID-19 pandemic.

Material and methods

Medicover Hospital is a large, broad-profile hospital which provides its patients with high quality, comprehensive health care. The educational program was implemented there in 2014. Education included special training workshops, repeated worksite training for all staff members, and visual accents to remind the personnel of the hand hygiene principles. The promotional material was prepared in collaboration with Ecolab company. Posters highlighting the importance of hand hygiene and information on the efficiency of this measure were placed in strategic locations and points of care across the institution. Care was taken to ensure the constant availability of alcohol-based disinfectant at points of care at every department. In addition, disinfectant dispensers are placed in special holders at all patient beds. An observation study of hand hygiene behaviors was commenced.

The awareness of the role of institutional involvement in the desired change in personnel behaviors led the hospital management and staff administration team to define hand hygiene a priority task for the entire hospital personnel. The study group consisted of all the hospital’s nurses, auxiliary staff, physicians, and other

employees of all hospital departments and the outpatient consultation center.

The study was based on the tools to implement multi-aspect strategy for hand hygiene as developed by the WHO. The strategy consists of 5 key components [7]:

1. systemic change;
2. training and education of health care professionals;
3. assessment and feedback;
4. visual instructions at worksite;
5. promotion of institutional safety.

A maximum of 100 points may be scored in each of these areas (for a maximum overall score of 500).

The package of implementation tools includes the Hand Hygiene Self-Assessment Questionnaire as a validation tool to assess the implementation of the 5 components of the WHO strategy at health care institutions.

Based on the total number of points obtained after completion of the questionnaire, the institution is assigned with one of the four possible levels of hand hygiene promotion and practice, including insufficient, basic, intermediate, and advanced. Institutions classified into the advanced level provide answers to 20 questions in the leaders’ section to obtain a maximum of 20 points. Twelve points are enough to achieve the status of a leader [7].

This study was carried out by means of a diagnostic survey based on the Polish version of the “2010 WHO Self-Assessment Questionnaire” for hand hygiene published in April 2013. The tool facilitates the analysis of current capabilities and knowledge of hand hygiene issues as well as identification of future goals and measures. The compliance with the hand hygiene principles was monitored in a direct as well as an indirect fashion.

Direct monitoring of hand hygiene consisted in direct observation carried out by a specially trained staff and based on the “Five Moments for Hand Hygiene” WHO guidelines. The guidelines present five indications for hand hygiene procedures: before touching a patient, before clean/aseptic procedures, after body fluid exposure/risk, after touching a patient, and after touching patient surroundings [8].

Another WHO implementation tool, *i.e.* the disinfectant consumption rate, was also used to determine the hand hygiene level at the Medicover Hospital. The rate corresponds to the quantity of hand disinfectant consumed per 1,000 person-days at individual departments or in the entire hospital [9]. Based on the form for recording nursing tasks requiring hand hygiene measures, hand hygiene compliance rate was calculated on the basis of average consumption of soap and disinfectant. All these factors were monitored in “non-pandemic” and “pandemic” season.

Results

In the initial self-assessment survey taken in 2014, the Hospital scored a total of 270/500 points (54%), corresponding to the intermediate compliance level. The

poorest scores were obtained in institutional safety and training/education components.

The hand hygiene compliance rate calculated on the basis of the consumption of soap and disinfectants by the hospital staff was 49%. While the overall compliance with hand hygiene measures was 50%, it varied in individual personnel groups, ranging from 63% in nursing staff to as little as 9% in the auxiliary personnel. Soap consumption was 630 L per year, corresponding to 31 mL per person/day; the annual consumption of 460 L of disinfectant corresponded to 22 mL per person/day. The average compliance with the “Five moments for hand hygiene” was 60%.

Hand hygiene was measured in general and in individual departments. As shown by the initial audit, the lowest compliance score was observed at the admission room. Subsequent audits suggested a constant improvement in these parameters until final audit. During observation period the ICU became the institution’s leader in this regard.

After initial assessment and identification of institution-specific principles for implementation of the “Clean Care is a Safer Care” educational program, training workshops and worksite training were commenced, and educational materials such as posters and reminders were distributed around the hospital. UV lamps were used to assess the correctness of hand cleansing during the training sessions.

After these broad-scaled educational efforts, the semi-annual audit revealed an increase in hand hygiene compliance rate up to 81% (hospital average, observation day 180) while the final audit carried out after one year of campaigning revealed a compliance rate of 77%.

The largest problem was identified in relation to hand hygiene following the contact to patient surroundings, with relevant principles being complied with only in 22% of cases. This aspect was also associated with the highest increase in the compliance rate, with the percentage of desirable behaviors rising to 60%.

Following the exposure to body fluids, the procedures were complied with in 60% at day 0 to reach 95% at the end of the observation period. The highest mean compliance rates were observed before the commencement of aseptic procedures (77% before the program vs. 88% on observation day 365) as well as following the contact with the patient (51% before the program vs 79% on observation day 365).

According to the final assessment survey (took on observation day 365), the final score for the entire institution in the year 2016 was 435/500 points, with hand hygiene compliance rate reaching the final value of 77%. The increase in the compliance to hand hygiene principles varied in different health care professionals. It increased in physicians and nurses, but the most significance increase was observed in the auxiliary staff (from 9 to 63%). This might be due to the awareness in this workers’ group being initially low and increasing significantly as the result of the educational efforts.

High results were achieved in all individual aspects of hand hygiene, with the change in the preferred alcohol-

based hand disinfectant being generally accepted. Organizational culture-related measures for promoting safer health care require further attention and continued improvement. The analysis carried out at the Medicover hospital during the COVID-19 pandemic compared the use of disinfection fluids in 2019 and the first two months of the epidemic in 2020 an dramatic increase in the use of detergents and disinfectants has been observed. The results of the analysis are collected in the Table I.

Discussion

Hospital hand hygiene is one of the cardinal principles for reducing the transmission of pathogens during therapeutic procedures. Appropriate assessment of the compliance with hygienic guidelines and procedures is an important tool for modeling appropriate behaviors of the medical staff. Methods for the monitoring of the compliance with hand hygiene principles at health care institutions include direct observation, measurement of hand hygiene agents consumption, measurements and studies [10] or electronic devices installed at worksites [11]. However, no standardized assessment method has been developed and none of the existing methods can be considered ideal due to their high costs, subjective nature, or staff behaviors being changed while under observation. It was mainly for this reason that out of 36 campaigns held in 36 European countries in years 2000-2012, only 50% could be assessed for efficiency with the WHO guidelines being implemented in only 55% of this latter group [12].

Nowadays, direct monitoring by specially trained personnel is considered to be a gold standard [13-15]. The method provides detailed information on the hand hygiene behaviors in different groups of the medical staff at the crucial moments that determine the risk of patient-personnel-patient transmission of pathogens. As part of the “Clean Care is a Safer Care” program, the WHO developed a special observation form which facilitates monitoring of hand cleansing and disinfection behaviors on the basis of “Five Moments for Hand Hygiene”, *i.e.* before touching a patient, before clean/aseptic procedures, after body fluid exposure/risk, after touching a patient, and after touching patient surroundings. The Hospital-Acquired Infections Team at the Medicover Hospital used this observation tool in the development of a program to monitor and improve hand hygiene in the personnel involved in patient care [9]. Another WHO implementation tool developed as part of the “Clean Care is a Safer Care” program, *i.e.* the disinfectant consumption rate, was also used to determine the hand hygiene level at the Medicover Hospital. The rate corresponds to the quantity of hand disinfectant consumed per 1,000 person-day at individual departments or in the entire hospital [9]. According to the WHO guidelines, the minimum consumption of hand disinfectants should be at the level of 20 liters per 1,000 person/day [9]. The

Tab. I. Hands sanitizer's use analysis during the SARS-CoV-2 coronavirus epidemic and 2019 year.

	Consumption per 1 patient in 2019 year	Number of hospitalizations, epidemic (March-April 2020)	Consumption of disinfectant on the ward during the epidemic in liters	Consumption per patient during the epidemic in liters	Consumption per 1 patient in 2019 in ml	Consumption per 1 patient in epidemic in ml	Increase in percentage
Surgery clinic	0.04	93	32	0.4	40	320	800
Internal Medicine and Cardiology clinic	0.07	204	70	0.34	70	340	486
Internal Medicine and Cardiology clinic	0.24	37	20	0.54	240	540	225
Internal Medicine and Cardiology clinic	0.07	257	80	0.31	70	310	443
Child health clinic	0.06	35	20	0.57	60	570	950
Anesthesiology and Intensive care clinic	0.26	54	30	0.55	260	550	211

advantages as well as disadvantages of this method have been broadly discussed in the literature. The advantages consist in relatively simple data collection as well as a lower number of staff members being involved in the monitoring resulting in lower costs. The disadvantage consists in measurement inaccuracies as *e.g.* cases of disinfectant spills or cleaning agents being used by the patients are not accounted for. Despite the above, the disinfectant consumption rate is often associated with the hand hygiene behavior rate; according to some authors, it is a priority method which should be considered more important than direct observation [16-19]. As the result of the educational program being implemented in the hospital, the compliance with the hand hygiene guidelines has improved significantly. The program was based on worksite training, poster campaign, observational studies, disinfectant consumption monitoring and promotion of hand disinfectant use. Of note is the fact that hygiene consultants used UV lamps to better visualize potential risks during the workshop training. In relation to the low compliance with the hand hygiene principles as defined by the "Five Moments for Hand Hygiene", particularly in relation to the contact with patient's surroundings (only 22% of proper behaviors as determined during the initial audit), an assumption was made that the personnel was unaware of the risk of pathogen transmission in cases when no direct contact with the patient has occurred. Thanks to the use of UV lamps, employees could better see that the patient's surroundings (bed, pajamas, personal items) are a reservoir of pathogens which are easily transmitted onto professionals' hands even when the patient is

absent, and therefore, that appropriate hygiene measures should be taken after touching such items. As shown by this example, it is rational to include various techniques for better visualization of the pathogen transmission stages in educational materials as this may result in higher compliance of hygiene principles by the health care staff [20]. In the course of our study, we observed that hand hygiene behaviors were significantly more common after touching the patient than before touching the patient (60 vs 54% at day 0 and 95 vs 80% at day 365). Whitby et al. highlighted that health care workers are more likely to comply with hygiene principles when self-preservation imperative is involved, *i.e.* when they perceive their hands to be contaminated and have the potential for transmitting the infection to employees themselves as well as those close to them (*i.e.* after touching the patient or their biological material) [8]. Therefore, promotion of attitudes stressing the personnel's responsibility for the patients' health, including legal liability in case of any claims from patients having acquired nosocomial infection, is very important. According to many authors, nurses are more aware of the problem as compared to physicians [21, 22]. Boscard et al. suggest that the motivation behind hand hygiene compliance in nurses consists in their concern for the safety of themselves as well as their close ones, since nurses are aware of risks associated with the failure to comply with the procedures [23]. Regardless of the monitoring method, appropriate reporting of results, and feedback on observation and disinfectant consumption results should be an important educational as well as motivational component of the hand hygiene

program [24]. In our experience gained during implementation of the monitoring program at the Medicover Hospital, direct observation and feedback was the most effective measurement method. Although an improvement was achieved, there is no certainty as to how long the new compliance rates would hold after intervention is discontinued. This would require further observations and development of efficient methods for the strengthening of behavior patterns. Many authors have highlighted that numerous health care professionals have problems with complying to hand hygiene principles. The reported causes of such a non-compliance include heavy workload and non-availability of disinfectants as well as insufficient number of protective gloves [25]. These, however, are not the only causes: problems with availability of protective gloves or disinfectants had never been encountered at Medicover Hospital, suggesting a significant importance of the “human factor”, the lack of appropriate procedures, education, and hygiene monitoring. According to WHO recommendations, hand cleansing or disinfection should be performed at the point of care, *i.e.* at a place where the three elements: the patient, the health care professional, and a medical procedure, exist concurrently. Hand cleansing and disinfection agents should be readily available at points of care so that health care professionals do not have to leave the patient zone [10]. On the basis of these recommendations, hand disinfectant holders were placed on patient beds in the Medicover Hospital. Studies confirmed that disinfecting hands using an alcohol-based rub is more efficient than washing while being easy to implement and inexpensive. According to calculations, prevention of 8 cases of hospital-acquired pneumonia would compensate the annual cost of hand disinfection agents [26]. As shown by such calculations, implementation of hand hygiene programs leads to measurable therapeutic and economic benefits [27]. Most employees of the Medicover Hospital changed their behavioral habits and the compliance rate has increased significantly as the result of increased use of hand disinfectants from 49% at the initial audit to 81% at day 180 and 77% at day 365. A significant increase in the tested parameters was observed in the semiannual audit, followed by a slight decrease in the final audit. Our results correspond to those obtained in other studies as medical personnel appears to be somewhat bored with the hand hygiene campaigns. It might show that the best method for the improvement in hand hygiene consists in placing hand cleansing instructions at the key points of care [9]. According to Pittet et al. [28], best results are achieved when education is combined with hand hygiene reminders such as posters, brochures, memes, etc. Although posters are considered to be somewhat outdated as an educational tool, they may provide useful reminder when placed at the point of care. The importance of posters developed using the social marketing concept was demonstrated by Forrester in Canada [29] as well as by successful national campaigns in Australia and Europe.

Implementation of current graphical trends and aggressive content increases the impact of this type of media [30, 31]. Introduction of hand hygiene programs for medical personnel at health care institutions is of high importance in the prevention of infections. As shown by Pittet et al., implementation of these recommendations in the University Hospital In Geneva reduced the nosocomial infection rate from 16.9 to 9.9% [32, 33]. Rosenthal et al. showed that the improvement in hand safety contributed to a significant reduction in the rate of nosocomial infections (from 47.55 to 27.93 per 1,000 patient/day) [34]. Multi-aspect campaigns unambiguously increase the hand hygiene compliance rates. During a 2-year campaign carried out by the WHO in 8 regions of the world (2004-2006), the mean compliance rate increased from 39.6 to 56.9%; notably, the impact of the intervention was higher in the developing countries where the access to knowledge and protection measures was more limited [35]. However, it must be noted that compliance with high hygienic standards is also associated with the institutional structure of the health care system which differs in different countries. Epidemiological studies revealed a correlation between infection rates and the low number of personnel in relation to the high number of patients. As the result of the number of patients or physicians being too low, hand hygiene behaviors are reduced or even absent between provision of consecutive patients [36, 37]. Without appropriate employment rates, it would be very difficult to expect an improvement in the quality of services and maintenance of high hygienic standards. Considering the dwindling number of applicants for health care jobs in Poland as well as the aging of the society and health care professionals combined with economically-driven emigration, maintenance of high treatment standards may become increasingly difficult in near future. Notably, the degree of hand hygiene program implementation is associated with the quality of epidemiological process monitoring. As shown by the studies, appropriate number of epidemiologists is required in relation to the number of hospital beds [7]. According to the common consensus, the appropriate rate is 1:250; however, as demonstrated by Delphi [38], a ratio of 0.8-1/100 might be required for an improvement to be observed. In Poland, the ratio has been statutorily established at 1:200; many hospitals, however, fail to comply with this requirement. In our study, the organizational culture and safety of health care was shown to be the weakest link of the Multi-aspect Strategy for Hand Hygiene (55 points). This result is not satisfactory since the support from health care administration and local governments is crucial for hand hygiene being considered a priority for patient safety and for educational programs being continued [39]. According to the self-assessment survey administered at the Medicover Hospital, the advancement of the hand hygiene program was “intermediate” at the beginning and closer to “advanced” at the end showing that hygiene practices

improved significantly. The measures are being continued to date. The compliance with hand hygiene principles at the Medicover Hospital in “non-pandemic period” was pretty good; it was higher than at numerous sites in developed countries assessed in the similar manner. We expect, that further improvements will be still possible, particularly by increasing institutional safety, continuing the educational measures and optimizing the epidemiological personnel employment ratios. We were estimate that particular attention must be paid to measures related to the organizational culture promoting health care safety. This element is particularly difficult to change as it is related to the culture of work modeled by the management staff who must acquire, strengthen, and implement new knowledge in their own behaviors before implementing efficient methods to promote, strengthen, and enforce hand hygiene behaviors at all levels of subordinate personnel. Changes in organizational culture are considered to take longer and require significant time and resources; they become visible in longer time frames, and they require continuous monitoring and strengthening. However, they are an efficient way for promoting appropriate hygiene habits in large health care institutions (hospitals, health care networks). We were not expecting that other factor can change totally hospital staff behaviors. Continuation of the study of hygiene practices related to hand washing after the outbreak of the COVID-19 epidemic provided completely new observations of behavior among medical staff. Measurements of the use of liquid soap and hand disinfectant carried out at that time showed more than 550-fold increase in consumption.

The results of this part of the study indicate the accompanying component of the psychosocial factor promoting protective behavior during the pandemic. Similar observations were made during the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003, it was recorded that with an increased number of cases of infection, care for hand hygiene increases significantly [40]. Perception of threat is a subjective phenomenon, even pragmatic than based on experience, Leppin et Aro referred to this as a cognitive-emotional phenomenon [41]. Greater levels of anxiety may be associated with significant behavioral changes, e.g. more frequent washing, disinfecting hands to protect against infection, its complications and potential death. Recent studies by the National Health Commission of China in Chinese hospitals in February 2020 estimated the transmission of infection between COVID-19 patients and medical personnel to be 3.8%. Guo et al. they compared the COVID-19 pandemic with the Middle East Respiratory Syndrome (MERS) epidemic in Saudi Arabia in 2012 and SARS in South Korea in 2015. Outbreaks were concentrated in hospitals and the percentage of infections among healthcare professionals ranged between 33-42%. Unfortunately, the transmission risk factor has not been clearly defined [42]. Current research confirms that widely available detergents, including soap, are a reliable and cheap form of minimization of viral transmission between patients and others peoples including medical staff. Other

compounds with proven effectiveness in preventing hand-transmitted infections are disinfectant based on alcohol. Current quality requirements of disinfectants indicate that the concentration of alcohol having proven antiviral efficacy in the prevention of COVID-19 is 62-71% [43]. Hand washing still remains the most effective form of prevention of transmission infectious respiratory diseases including COVID-19 [44]. Our study had a certain limitation consisting in randomization being impossible due to the single-site, all-hospital character of the intervention. Due to the multimodality of the campaign, it is difficult to pinpoint the most effective element of the strategy. However, our results suggest that long-term, planned epidemiological activity promoting proper behaviors and habits in relation to hand hygiene may significantly increase the indices of epidemiological safety in hospital treatment.

Conclusions

Providing education to healthcare professionals in relation to proper hand hygiene during providing care to the patients is the most important element of multimodal interventional strategies aimed at hand hygiene improvement. The First Global Patient Safety Challenge “Clean Care is a Safer Care” has acquired its desired effect; however, long-term educational measures are required to maintain and further increase the quality of services and patient safety. COVID-19 pandemic dramatically increase accuracy of proper hand hygiene procedures and consumption of disinfectant agents.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

MK developed the original idea. RD, MA, BW, TP carried out the literature search. MK, RD, MA collected the data. MK carried out the statistical analysis. MK, BW drafted the manuscript. All authors have read and approved the latest version of the manuscript for publication.

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