

An Educational Strategy for the Prevention of Healthcare-Associated Infections

Blanca Edith Cobián-López¹, Jaime Salvador-Moysén^{1*}, Noé Alfaro-Alfaro²,
Yolanda Martínez-López¹, Ana Cristina Castañeda-Márquez¹

¹Academic Group of Public Health and Epidemiology, Juárez University of the State of Durango, Durango, México

²Interuniversity Network of Public Health of Mexico, Autonomous University of Nayarit, Nayarit, México

Email: *jsmoysen@ujed.mx

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Abstract

Introduction: Epidemiological surveillance of healthcare-associated infections (HAIs) refers to the continuous observation and analysis of the occurrence and distribution of HAIs, as well as their associated factors. Its epidemiological importance stems from its internationally estimated frequency of 5% and 4.7 cases per 100 hospital discharges in Mexico, although these figures vary widely depending on the geographical context and criteria used to estimate their frequency. **Objective:** The objective of this study was the assessment of an educational intervention aimed at strengthening a hospital-based epidemiological surveillance model for HAIs prevention. **Methods:** A quasi-experimental design was implemented, using a playful, theoretical-practical workshop to evaluate the impact of an educational intervention designed to train nursing staff; The tools used were: Banner with the correct handwashing technique, Banner with the 5 moments of opportunity for handwashing and a puzzle with the 5 moments of opportunity for handwashing, Installed intravenous lines banner, wheel with the 7 criteria for prevention of Intravenous line installed, intravenous practice arm mannequin, phlebotomy and venipuncture, and Banner with prevention criteria of installed urinary catheter memory game with prevention criteria of installed urinary catheter. The educational process ran from March 4 to April 30, 2024. **Results:** The observed data showed a favorable impact on the satisfactory performance of each of the indicators in the following assessment techniques: Right handwashing technique, the 5 moments of opportunity for handwashing, prevention criteria of installed intravenous lines and prevention criteria of installed urinary catheter; the results were statistically significant in each of the assessment techniques. **Conclusion:** The results obtained in this study were very satisfactory. Improved performance of the evaluated prevention procedures was observed when comparing the results obtained before and after training.

The values are statistically significant.

Keywords

Epidemiological Surveillance, Healthcare-Associated Infections, Educational Intervention, Infection Prevention and Control

1. Introduction

The prevention and control of Healthcare-Associated Infections (HAIs) was established to ensure the quality of medical care. Healthcare-Associated Infections, in addition to representing a significant problem in the hospital setting, can have adverse economic, family, and social repercussions for affected patients [1] [2]. Healthcare-Associated Infections are defined as infections that were neither present nor incubating at the time the patient was admitted to a hospital or other healthcare facility for specific care. The term refers to an association between patient care and the subsequent onset of symptoms. This onset of infection symptoms can occur while the patient is hospitalized or upon discharge from the hospital or any other healthcare facility [3] [4]. To be considered HAIs, the onset of signs and symptoms must occur between 48 to 72 hours after hospital admission or patient discharge. Different risk factors for the occurrence of HAIs have been documented, among which it is important to mention the following: patients at the extremes of life, patients with immunodeficiencies, poor nutritional conditions, and associated comorbidities.

Regarding its frequency, in the Americas region, data from Canada show the following results: The prevalence of patients with at least one healthcare-associated infection increased from 9.9% in 2002 (28 hospitals), to 11.3% in 2009 (39 hospitals) and then decreased to 7.9% in 2017 (47 hospitals). In 2017, device-associated infections accounted for 35.6% of all healthcare-associated infections [5]. In the US, results obtained from a prevalence survey conducted in 183 hospitals in 2011 indicated that on a given day, approximately 1 in 25 patients hospitalized in acute care hospitals has at least one healthcare-associated infection. Pneumonia and surgical site infection were the most common types of infection [6]. In a multicenter prospective cohort study in 58 ICUs from 34 hospitals in 21 cities of 8 Latin American countries, rates of central line (catheter)-associated bloodstream infections and risk factors were identified; the rate of bloodstream infections was 4.30 per 1000 days of central line use [7]. In a prospective study conducted at a hospital in Durango, Mexico, a rate of 9 infections per 100 discharges was found; the highest specific rates were in the pediatric intensive care unit and neonatology, and the lowest in surgery, pediatrics, and obstetrics and gynecology. Urinary tract infections, pneumonia, and surgical wound infections were the most frequent in adult services, while bacteremias showed a high incidence in pediatric areas [8]. In a study aimed at determining the daily prevalence of HAIs in 254 adult inten-

sive care units in Mexico, an incidence of 23.2% was observed; the most frequently reported infections were pneumonia (39.7%), urinary tract infections (20.5%), wound infections (13.3%) and bacteremia (7.3%) [9]. In another study, information obtained from 10 general hospitals in the Health Sector of Mexico is presented. Of the total number of patients studied, a prevalence of HAIs of 16.6 per 100 hospitalized patients was observed; 50.4% were male patients and 49.6% were female patients. The age group from 51 to 70 years was the one that presented the highest frequency of cases (43.5%) and the group from 18 to 30 years presented the lowest frequency (9.2%) [10]. Hospital-based epidemiological surveillance for the prevention of HAIs represents a support tool for the proper functioning of health services and programs provided in hospitals. There is currently a recognized need to consolidate current epidemiological surveillance programs and procedures and expand their coverage through the timely management of the information necessary for the prevention and control of HAIs. Therefore, it is considered essential to standardize the procedures that guide and facilitate the daily implementation of these activities [11]-[13]. Particular importance has been given to educational interventions aimed at correctly performing hand washing, intravenous line installed and installed urinary catheter. Different studies have shown that the proper performance of these procedures results in a significant decrease in the different HAIs. An important aspect to highlight in these studies, in addition to the favorable results observed, is the diversity of strategies that have been used to train health personnel [14]-[19]. The correct application of the different prevention measures, carried out by healthcare personnel, favors the reduction of the transmission of pathogenic microorganisms from one patient to another and consequently the decrease of HAIs in the different hospital areas [20]. Epidemiological surveillance programs contribute to reducing healthcare-associated infections, length of stay in hospital, and costs associated with hospitalization [21] [22].

The objective of this study was to design an educational intervention strategy for the prevention of healthcare-associated infections (HAIs).

2. Methods

2.1. Type of Study

A quasi-experimental study [23] was conducted using a pre-test-post-test design. This study consisted of an educational intervention aimed at strengthening the use of HAIs prevention measures. To this end, a training program was implemented for the nursing staff of the hospital where the study was conducted. The program aimed at strengthening the following procedures: handwashing, intravenous line prevention criteria, and urinary catheter prevention criteria [24]. This training consisted of the following stages: (1) Diagnostic assessment; (2) Educational training; (3) Implementation of the educational intervention; and (4) Assessment of the impact of the educational intervention. The total duration of the different stages of the educational process was from March 4 to

April 30, 2024.

1) Diagnostic assessment. This stage was carried out in the different clinical services, during daily visits to the different clinical services. This stage lasted 12 days and evaluated the manner in which HAIs prevention procedures, routinely performed by nursing staff, were carried out. The assessment was performed by rating compliance with the various indicators related to the three hospital procedures aimed at reducing HAIs: correct handwashing technique, care of the installed intravenous line, and care of the set up urinary catheter.

The assessment of handwashing technique and the installed intravenous line was performed on 198 patients, and the evaluation of the installed urinary catheter was performed on 105 patients. These patients represent the total number of patients hospitalized at the time of the study. The results obtained at this stage were compared with those observed after the educational intervention had been carried out.

2) Educational training. The training activities were conducted in a space specifically adapted for these purposes, outside the hospitalization and medical care area of the hospital where the study was conducted. The training was conducted through theoretical and practical workshops, using processes standardized by the Pan American Health Organization, the World Health Organization [3] [4], and the Ministry of Health [24]-[28] for the prevention of healthcare-associated infections. A play-full theoretical-practical workshop provided training on proper handwashing techniques, including right technique intravenous line installed, and right technique installed urinary catheter. The tools used were: a diagram of the different techniques, a puzzle, a roulette wheel, a memory game, and a phlebotomy arm mannequin. The actions of each of the following procedures were graded: proper handwashing technique, puzzle completion for the five opportunities for handwashing, compliance with the seven Intravenous line installed prevention indicators, and solving memory games for the nine indicators for set up urinary catheter prevention.

The data obtained from the evaluations were recorded in specific formats for each of the procedures performed. This information was then entered into Excel format and subsequently statistically analyzed. Both in the initial evaluation and in the one carried out after the training process, there was blinding on the part of the observer.

We worked using a station method, in each of these a specific topic was worked on. This stage was carried out in a group with the project participants over a period of 3 days, with an average duration of 5.5 hours per day.

The number of stations were 4:

Figure 1 (below) describes each of the 4 stations, as well as the material used and the activities carried out in each of them, by the health personnel who participated in the study.

Figure 2 (below) shows the training of participating health personnel on how to perform the correct handwashing technique.



Figure 1. Diagram of the four stations.



Figure 2. Right handwashing technique.

Figure 3 (below) shows educational material with which participating health personnel were trained on the correct handwashing technique.



Figure 3. Banner about the right handwashing technique.

Figure 4 (below) shows educational material with which participating health personnel, were trained in the 5 moments of opportunity for handwashing.

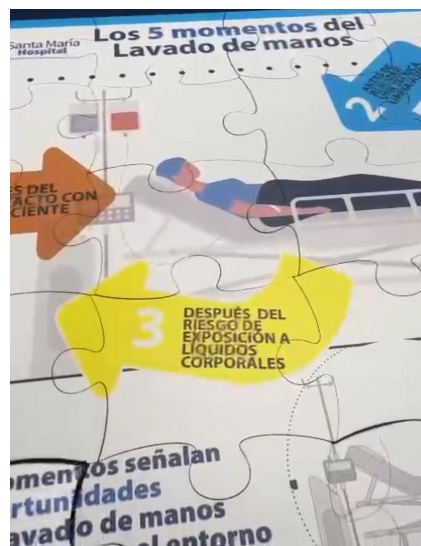


Figure 4. Poster with the 5 moments of opportunity for handwashing.

Figure 5 (below) shows the teaching material with which the participating health personnel were trained, in the technique intravenous line installed.

Figure 6 (below) shows the technique of practical training of participating health personnel, in the intravenous line installed.

Figure 7 (below) shows educational material used to train participating, with criteria about of right technique, installed urinary catheter.

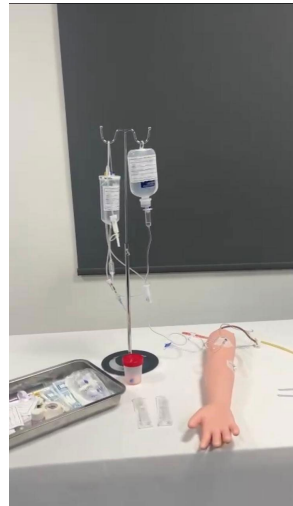


Figure 5. Material used in the training of the technique about intravenous line installed.



Figure 6. Practical training in technique of the intravenous line installed.



Figure 7. Banner with criteria about of right technique, installed urinary catheter.

3) Implementation of the educational intervention. This stage consisted of implementing HAIs prevention procedures following educational training provided to the nursing staff. This implementation took place in the hospital's various clinical services during daily visits.

4) Assessment of the impact of the educational intervention. This stage assessed the results obtained after the educational training, including the level of compliance with the indicators for proper handwashing technique, installed intravenous lines, and installed urinary catheter. among hospitalized patients in the various clinical services. The evaluation of the different techniques for preventing HAIs was carried out on the total number of patients hospitalized at this time, a number that corresponded practically to the number of patients evaluated during the first stage.

The different stages of the educational process were carried out and supervised by two members of the team responsible for the work.

Participants: Eligibility. Nurses assigned to the hospital where the study was conducted were considered eligible. The group consisted of 31 nurses; they received an invitation, which they accepted and signed. All participants successfully completed the training. Prior to training nursing staff, an assessment was conducted regarding the implementation of HAIs prevention procedures, with the aim of comparing them with the results obtained after the educational intervention.

The group of participants was the same both in the pre-training evaluation and in the assessment of the prevention procedures carried out after the educational intervention, such that the same group of trained participants represented their own control group.

2.2. Instruments Used

To evaluate right handwashing technique. and the 5 opportunities for performing this procedure, the right handwashing technique published by the WHO and PAHO was used [3] [4]. To evaluate compliance with the prevention criteria of installed intravenous lines., the specific form for this procedure was used, which measures seven criteria with dichotomous responses: yes and no [10] [24]. To assess compliance with prevention criteria of installed urinary catheter, the specific form for this procedure was used, which measures 9 criteria with dichotomous responses: yes and no [24].

2.3. Statistical Analysis

Descriptive statistics were used to characterize the personnel participating in the educational intervention, and the McNemar test was used to compare the results observed in both the pre-training and post-training evaluations.

3. Results

Table 1 shows that the 30 - 39 age group is the most prevalent in the participant group, with the lowest percentage observed in the over-50 age group.

Table 1. Age distribution of the participating group.

Age group	Subjects	
	n	%
20 - 29	8	25.8
30 - 39	14	45.2
40 - 49	6	19.3
>50	3	9.7
Total	31	100

Of the group of participants who received training in HAIs prevention techniques, 29 (93.5%) were female and 2 (6.5%) were male. Regarding the level of professional training of the participants, it was observed that 10 (32.2%) were nursing assistants, 3 (9.8%) were nursing technicians, 13 (42%) were nursing graduates, and 5 (16%) were general nurses.

Regarding the right handwashing technique, **Table 2** shows that prior to the educational intervention, the participating group only received positive evaluations on 7 of 13 indicators. Following the educational intervention, the entire participating group received positive evaluations on all 13 indicators assessed; there was a statistically significant difference between the evaluations conducted before and after the training.

Table 2. Right handwashing technique, pre- and post-educational intervention assessment.

	Pre				Post				p-value
	Yes		No		Yes		No		
	n	%	n	%	n	%	n	%	
Soap is available for hand hygiene	31	100	0	0	31	100	0	0	
Alcohol gel is available for hand hygiene	31	100	0	0	31	100	0	0	
Running water is available	31	100	0	0	31	100	0	0	
Wets the hands with running tap water	31	100	0	0	31	100	0	0	
Enough soap amount is used	31	100	0	0	31	100	0	0	
rubs the hands together	26	83.9	5	16.1	31	100	0	0	0.02
rubs both backs of his hand	25	80.7	6	19.3	31	100	0	0	0.01
rubs the spaces between the fingers	28	90.3	3	9.7	31	100	0	0	0.01
rubs both hand knuckles	30	96.8	1	3.2	31	100	0	0	0.31
rubs both thumbs with rotating movements	22	71	9	29	31	100	0	0	0.002
Using a rotating motion, rubbing the fingertips against the palm of the opposite hand and vice versa.	30	96.8	1	3.2	31	100	0	0	0.31

Continued

Rinses hands with water	31	100	0	0	31	100	0	0
Dries hands with a disposable towel	31	100	0	0	31	100	0	0

Test of McNemar.

Table 3 shows that in relation to the 5 moments of handwashing, 2 of the 5 indicators were evaluated unfavorably in practically the entire group of participants prior to the educational intervention. After the training process, it was observed that the entire participating group satisfactorily performed the 5 moments of handwashing, observing a difference with statistically significant values when comparing the two assessments.

Table 3. The 5 moments of opportunity for handwashing; pre- and post-intervention assessment.

	Pre				Post				
	Yes		No		Yes		No		
	n	%	n	%	n	%	n	%	
Washes the hands, before touching the patient	31	100	0	0	31	100	0	0	
Washes the hand, before performing a clean/aseptic task	31	100	0	0	31	100	0	0	
Washes the hands, after risk of exposure to bodily fluids	31	100	0	0	31	100	0	0	
Washes the hands, after touching the patient	0	0	31	100	28	90.3	3	9.7	<0.0001
Washes the hands, after contact with the patient's environment	1	3.2	30	96.8	28	90.3	3	9.7	<0.0001

Test of McNemar.

Table 4 shows the results obtained in the assessment regarding the correct compliance of the 7 indicators related to the care of the installed intravenous line. The high values obtained in the second assessment, in compliance with the 7 indicators, are observed. The comparison of the results obtained before the training and the values observed after the educational intervention show statistically significant differences.

Table 4. Intravenous line installed; pre- and post-educational intervention assessment.

	Pre				Post				p-value
	Yes		No		Yes		No		
	n	%	n	%	n	%	n	%	
The solution has been installed for more than 24 hours	47	23.6	152	76.4	0	0	199	100	<0.0001
The solution has a letterhead that obeys with the regulations	169	84.9	30	15.1	197	99	2	1	<0.0001
The intravenous line and equipment have less than 72 hours installed	194	97.5	5	2.5	195	98	4	2	0.73

Continued

The intravenous line equipment is free of debris	175	88.4	23	11.6	196	98.5	3	1.5	0.0001
The puncture site and peripheral area of the intravenous line are free of infection signs.	192	96.5	7	3.5	199	100	0	0	0.008
The catheter is firmly set up and the fixation is clean	181	90.9	18	9.1	194	97.5	5	2.5	0.004
The parenteral solution has a closed circuit	196	98.5	3	1.5	199	100	0	0	<0.0001

Test of McNemar.

Table 5 shows the results obtained during the first assessment regarding compliance with the 9 indicators related to proper care of the set up urinary catheter; 3 of the indicators were rated unfavorably. In the second assessment, conducted after the educational intervention, an improvement was seen in the 3 indicators initially rated unfavorably, while the remaining 6 indicators maintained their high values. In the second evaluation, all 9 indicators were rated favorably, with statistically significant values observed when comparing the final evaluation with the initial one.

Table 5. Right technique, installed urinary catheter, pre- and post-intervention assessment.

	Pre				Post				p-value
	Yes		No		Yes		No		
	n	%	n	%	n	%	n	%	
The collection bag is kept below bladder level	110	100	0	0	110	100	0	0	
The urinary catheter is fixed according to the patient's sex.	109	99.1	1	0.9	111	100	0	0	0.31
The catheter is labeled with identification	110	100	0	0	110	100	0	0	
The drainage system remains is always connected	110	100	0	0	110	100	0	0	
Records data regarding the operation of the catheter and drainage tube	3	2.7	107	97.3	108	98.2	2	1.8	<0.0001
Records catheter set up, days and corroborates medical prescription	110	100	0	0	106	96.4	4	3.6	0.04
Reports absence or presence of signs and symptoms that indicate urinary tract infection	110	100	0	0	110	100	0	0	
Carries out and records hygiene measures for the patient	4	3.6	106	96.4	110	100	0	0	<0.0001
Records the guidance measures provided to the patient and family	0	0	110	100	106	96.4	4	3.6	<0.0001

Test of McNemar.

4. Discussion

The importance of measures aimed at preventing HAIs is widely recognized, and they are currently considered a relevant indicator of medical care quality. Due to

HAI's high incidence in hospitals virtually worldwide, measures adopted to reduce the frequency of these infections are particularly important. One of the alternatives that have proven useful in recent decades are educational actions aimed at strengthening hygiene practices and specific techniques in various hospital procedures that result in a HAI's decrease. It is important to highlight the use of diverse educational strategies aimed at strengthening proper compliance with the various procedures aimed at caring for hospitalized patients; such as handwashing, prevention criteria of installed intravenous lines, and prevention criteria of installed urinary catheter. The significance of these educational measures lies in the wide variety of methods used to foster the attitudes of healthcare personnel providing hospital care. The focal aspects of these interventions are oriented toward communication or educational techniques, the duration of these interventions, the measurement of the impact of the educational processes, and the time elapsed between the educational intervention and its results. The results obtained from numerous studies [29]-[34], with minor variations, agree on the positive results of these educational interventions; whether they are talks, educational messages, or workshops with direct interaction with healthcare personnel, these workshops offer the advantage of direct communication and interaction between the trainer and the healthcare personnel receiving the educational intervention. This enables the development of an empathetic and supportive environment, fostering an optimal attitude of collaboration among the personnel responsible for implementing the preventive practices they seek to strengthen. The strategy adopted in this study was to design and implement an educational intervention for nursing staff at a private hospital in Durango, Mexico. The intervention consisted of a theoretical and practical course designed to strengthen three procedures: handwashing, intravenous installed intravenous lines, and installed urinary catheter. The results demonstrate the positive impact of the educational intervention, with optimal performance of HAI's prevention procedures observed after the intervention. A statistically significant difference was observed when comparing these results with those obtained prior to nursing staff training. It is important to mention that regardless of the wide age range of the participants and the different levels of academic training, the favorable response to educational training was uniform throughout the group that participated. Our findings validate the results observed in numerous studies conducted for HAI's prevention. It is important to emphasize that, regardless of the educational strategy used to positively modify behaviors associated with the correct performance diverse hospital procedures, the results obtained have been positive; the differences lie in the educational approach used. We believe that educational strategies that involve building a friendly and empathetic work environment between the facilitator or instructor and the health care staff, increase the efficiency of programs and actions aimed at preventing the occurrence of HAI's, due to greater motivation and commitment of the staff participating in these training processes. A fundamental aspect to consider when designing educational intervention programs aimed at HAI's prevention, is identifying from

a social, cultural, and institutional perspective, which strategy represents the best fit. It is also important to have, in addition to the institutional physical infrastructure and financial resources, the full support of management staff. It is considered important to periodically implement these types of educational approaches, both to motivate healthcare personnel and to ensure optimal quality of hospital care and service.

It is important to mention two limitations of the scope of this work; 1) Although we consider that the results are valid and generalizable to health institutions located in the same geographic and social context in which the investigation was conducted, the small study group limits the generalizability of the findings to broader and different geographic and socioeconomic environments; 2) The results obtained from the educational training assessment the immediate effect of said educational process. It is considered important to carry out a second follow-up evaluation with the intention of observing whether the satisfactory implementation of the HAIs prevention procedures persists, since there is no certainty that the modifications observed as a result of the training will be maintained for longer periods.

5. Conclusions

HAIs represent a major global public health problem, the complexity of which has increased due to the emergence of antibiotic-resistant strains and the presence of various comorbidities in hospitalized patients. One of the most effective strategies for reducing this health problem is represented by a set of educational actions aimed at the optimal implementation of the following preventive procedures routinely practiced in healthcare institutions—handwashing, intravenous line placement, and urinary catheterization. The results obtained in this study show an improvement in the performance of participating healthcare personnel in implementing the preventive procedures evaluated. When comparing the results obtained before and after training, the values observed in the comparison of both evaluations were statistically significant.

The results of this study validate the importance of educational intervention as an alternative that enables optimal results in the correct implementation of various HAIs prevention procedures. The educational approach used in this study, characterized by close interaction between the training staff and the study participants, strengthened the effectiveness of the messages conveyed, resulting in optimal performance of the procedures performed. According to numerous studies conducted in this field, periodic implementation of this educational intervention is considered important to maintain the optimal levels observed as a result of healthcare personnel training.

Ethical Considerations

The Public Health and Epidemiology Master's Research Project Review Committee evaluated the ethical aspects of the study and granted approval 005 folio. In-

formed consent was obtained from the healthcare personnel who participated in the training, and strict confidentiality was maintained regarding the information obtained. This research is part of a Master's thesis in Public Health and Epidemiology from the Juárez University of the State of Durango, Mexico.

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Conflicts of Interest

The authors declare that they have no conflict of interest.

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