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Research Article

Immediate impact of an educational intervention on knowledge of use of disinfectants in nurses

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ABSTRACT

Background: Adequate disinfection and sterilization is crucial to prevent hospital acquired infections, this requires knowledge of various types of disinfectants and of the categories of medical and surgical devices. Nurses play a key role in supervising the use of disinfectants. Hence, they are an important target group for educational interventions for rationalization of disinfectant use. We conducted an educational intervention in nurses, related to rational use of disinfectants. The objective was to evaluate the immediate impact of this intervention on change in knowledge of nurses.
Methods: This was a questionnaire-based pre- and post-test cross-sectional study. The questions were formulated to test nurses' ability to (1) categorize commonly used medical and surgical devices (MSDs) (2) categorize disinfectants as high, intermediate and low level disinfectants (3) to evaluate their knowledge about different aspects of disinfectant use. Results of pre and post-test were calculated as a percentage and *Z* test for difference between proportions was applied to test the statistical significance.
Results: A total of 72 nurses filled the pre-test and 70 the post-test. Percentage of correct responders for classification of MSDs improved as follows-critical (77.77% pre-test to 95.71% post-test), semicritical (18.05-54.28%), noncritical (41.66-72.85%). Percentage of correct responders for classification of disinfectants improved from pre- to post-test glutaraldehyde (48.61-88.57%), Hydrogen peroxide (30.55-72.85%), benzalkonium (33.33-58.57%). Identification of chlorine concentration required for cleaning floors improved from 38.88% to 70%. There was a significant improvement seen post-test to items related to different aspects of disinfectant use.
Conclusion: A positive immediate impact was observed, but there is a need for continuing education with interventions focused on various aspects of disinfectant use.

Keywords: Educational intervention, Disinfectants, Knowledge, Nurses

INTRODUCTION

Disinfectants are crucial in preventing hospital acquired infections (HAI) and amount to considerable health care expenditure. Appropriate use of disinfectants not only requires adequate knowledge of various types of disinfectants, but also the categories of medical and surgical devices and risk of infection associated with these. Nurses play a key role in supervising disinfection in hospitals. Their knowledge and perception obviously influences the use of disinfectants in hospital. Data regarding knowledge is important for facilitating improvement. Hence, targeting nurses for educational interventions that aim at rationalizing disinfectant use seems indispensible. Earlier studies have stressed the need for such educational interventions,[1-3] besides rational use of disinfectants in wards also leads to a substantial reduction in requirement of disinfectants.[4] Here, we present the impact of an educational intervention on nurses in terms of pre- and post-interventional changes in knowledge about the use of disinfectants.

METHODS

This questionnaire-based cross-sectional study was conducted at a tertiary-care government hospital. Study was approved by Institutional Ethics Committee.

A structured close-ended questionnaire based on standard literature[5,6] was used. The questions were formulated to test the ability of nurses to (1) categorize commonly used medical and surgical devices (MSDs) as per modified Spaulding classification[5] (Table 1). (2) Categorize routinely available disinfectants (glutaraldehyde, hydrogen peroxide,

formalin, phenol, dichloroxylenol, sodium hypochlorite, benzalkonium, denatured spirit, and bleaching powder) as high, intermediate and low level disinfectants according to their activity (Table 2) and also to (3) evaluate their knowledge about different aspects of disinfectant use such as indication, dilution, and contact time.

The purpose of the questionnaire and workshop was explained, full confidentiality was assured to prevent apprehension induced bias in responses. Questionnaire was presented only to nurses willing to fill up pre-test.

An educational intervention in the form of the workshop was carried out. Issues related to categorization of medical and surgical devices, disinfectants, and factors important for successful disinfection including indications, concentration, and dilution of disinfectants; compatibility with soaps/other disinfectants/organic matter and importance of pre-cleaning, pH, temperature were discussed at length and demonstrations were given wherever necessary.

The same questionnaire was presented to the nurses as post-test.

Statistics

The responses were grouped as right and wrong responses, and the *Z* test for the difference between proportions was used for data analysis.

RESULTS

Of 102 nurses attending the workshop, 72 participated in pre-test and 70 in the post-test survey while two refused, giving an overall response rate of 69.60%.

The first part of questionnaire required correct identification of MSDs as critical, semicritical, noncritical and environmental surfaces as shown in Table 1. The results of pre- and post-test are depicted in Table 3. In pre-test 77.77% of nurses correctly identified critical MSDs. Percentage of nurses correctly identifying semicritical (18.05%), noncritical (41.66%) and medical equipment environmental surfaces (MEES) (34.94%) was relatively low. Post-test statistically significant improvement was observed in percentage of correct responders to all items in this part. A considerable number of participants wrongly continued to regard semicritical MSDs as critical ones (39%), noncritical MSDs as semicritical ones (20%) and MEES as noncritical ones (27%) in post-test.

The second part of questionnaire consisting of seven items required the nurses to categorize given disinfectant on the basis of their activity as high, intermediate or low level as per Table 2. In pre-test (Table 4) majority (75%) of participants correctly identified the activity level of formalin, followed by phenol (52.77%) and glutaraldehyde (48.61%). Lowest percentage of correct responses was observed for bleaching powder (18%). Post-test statistically significant increase was seen in correct responses to most items except formalin and sodium hypochlorite. Breaking down of wrong responses into subgroups revealed the following results: in pre-test a considerable percentage regarded sodium hypochlorite as high level (48.61%) and bleaching powder as low level (55.55%) instead of an intermediate level disinfectant and benzalkonium as intermediate level (30.55%) instead of low level. Post-test 41.42% still regarded sodium hypochlorite as high level and 30% still considered bleaching powder as low level.

Third part of the questionnaire evaluated knowledge of different aspects of disinfectant use (Table 5). Awareness

Table 1: Classification of medical and surgical devices and expected sterilization/disinfection level to be applied.

Classification of MSDs	Criteria based on risk	Example of MSDs	Sterilization/disinfection level to be applied
Critical	Penetrate sterile compartments of the body and come in contact with blood. Maximum risk, may be responsible for fatal infections	Surgical instruments, cardiac catheters, blood side of hemodialyzers	Sterilization
Semicritical	Normally come in contact with mucosa without penetrating body surfaces. High risk	Endoscopes, endotracheal tubes, laryngoscopes, vaginal specula	Sterilization/minimum high level disinfection
Noncritical	Come in contact with intact skin but not mucosa. Lower risk than semicritical	Blood pressure cuffs, stethoscopes some electrodes	Detergent cleaning/low to intermediate disinfection may suffice
MEES	Equipment not coming in contact with patients but frequently touched by health personnel. Low risk	Adjustment knobs/handles on medical equipments, instrument trolleys, trays etc.	Detergent cleaning/low to intermediate disinfection may suffice
Housekeeping environmental surfaces	Housekeeping surfaces, routine contact by all. Lower risk than MEES	Floors, walls, bed railing, side tables etc.	Detergent cleaning/low to intermediate disinfection may suffice

MSDs: Medical and surgical devices, MEES: Medical equipment environmental surfaces

of similarity between sodium hypochlorite and bleaching powder was high (61.11%) in pre-test and improved further in post-test (78.57%). Other pre-test results were as follows: 41.66% were aware that 2% glutaraldehyde cannot act as sterilant if it's contact time with the MSDs is only 20-90 mins. 41.66% correctly indicated that spirit is not ideal as a table surface disinfectant, and 50% rightly agreed that soap and water may be adequate for housekeeping ward floors. Only 38.88% were aware that the requirement of chlorine concentration in sodium hypochlorite solution for disinfecting ward floors was 1000 ppm. Post-test the percentage of correct responses increased significantly for all items except to the item asking if contact time of 20-90 mins is enough for glutaraldehyde to act as sterilant.

Table 2: Classification of level of activity of available disinfectants in the study setting.

Level of activity of disinfectants	Disinfectants
High	Glutaraldehyde, hydrogen peroxide, formaldehyde
Intermediate	Sodium hypochlorite, bleaching powder, denatured spirit, phenol, povidone iodine
Low	Benzalkonium, dichloroxylenol

DISCUSSION

Considering the array of MSDs in use and disinfectants available, choice of correct disinfectant for a given device may prove tricky. Spualding's classification of MSDs and disinfectants though apparently oversimplified;[7] is a helpful guide for users and the basis of many formulated guidelines.[5,6,8] Modified Spualding classification[5] used in this study is further advantageous as it clearly defines the relative risk of HAI by noncritical MSDs and environmental surfaces. Environmental surfaces are grouped as medical equipment surfaces (MEES) and environmental housekeeping surfaces in this classification. Although disinfection procedures for environmental surfaces remain similar to noncritical surfaces, studies indicate that disinfection of MEES is likely to be suboptimal, and their improved cleaning may reduce contamination substantially.[9,10] This study highlighted the need for continuing education in this context.

In the first part, although pre-test awareness about critical MSDs was high, many nurses wrongly assigned higher category than actual to semicritical, noncritical MSDs and MEES indicating low awareness about classification of MSDs among nurses. Being knowledgeable about classification of MSDs is important because disinfection or sterilization treatment required varies accordingly (Table 1).

Table 3: Pre- and post-test responses of nurses for categorization of medical and surgical devices.

Class of medical devices	Responses in pre-test (n=72)					Responses in post-test (n=70)				
	C	SC	NC	ES	NR	C	SC	NC	ES	NR
C	**56 (77.77)**	11 (15.27)	1 (1.38)	1 (1.38)	3 (4.16)	**67 (95.71)*****	3 (4.28)	0 (0)	0 (0)	0 (0)
SC	49 (68.05)	**13 (18.05)**	7 (9.7)	1 (1.38)	2 (2.77)	27 (38.57)	**38 (54.28)*****	4 (5.71)	1 (1.42)	0 (0)
NC	6 (8.33)	20 (27.77)	**30 (41.66)**	13 (18.05)	3 (4.16)	0 (0)	14 (20)	**51 (72.85)*****	4 (5.71)	1 (1.42)
MEES	4 (5.55)	17 (23.61)	23 (31.94)	**23 (31.94)**	5 (6.94)	1 (1.42)	4 (5.71)	19 (27.14)	**44 (62.85)****	2 (2.85)

Results are expressed as n (%), Correct responses are shown in bold print, p<0.05*, p<0.01**, p<0.001*** statistically significant. NR: Non-responders, C: Critical devices, SC: Semicritical devices, NC: Noncritical devices, MEES: Environmental surfaces

Table 4: Pre- and post-test responses of nurses for categorization of disinfectants to various levels.

Name of disinfectant	Responses in pre-test (n=72)				Responses in post-test (n=70)			
	High level	Intermediate level	Low level	Non-responders	High level	Intermediate level	Low level	Non-responders
Glutaraldehyde	**35 (48.61)**	13 (18.05)	4 (5.55)	20 (27.77)	**62 (88.57)*****	2 (2.85)	3 (4.28)	3 (4.28)
Hydrogen peroxide	**22 (30.55)**	27 (37.5)	11 (15.27)	12 (16.66)	**51 (72.85)*****	18 (11.42)	3 (4.28)	8 (11.42)
Formalin	**54 (75)**	6 (8.33)	4 (5.55)	8 (11.11)	**59 (84.28)**	7 (10)	1 (1.42)	3 (4.28)
Phenol	11 (15.27)	**38 (52.77)**	13 (18.05)	10 (13.27)	6 (8.5)	**48 (68.57)***	10 (14.28)	6 (8.57)
Sodium hypochlorite	35 (48.61)	**47 (65.27)**	3 (4.16)	9 (12.5)	29 (41.42)	**35 (50)**	2 (2.85)	4 (5.71)
Bleaching powder	10 (13.88)	**13 (18.05)**	40 (50.55)	9 (12.5)	13 (18.9)	**32 (45.71)*****	21 (30)	4 (5.71)
Benzalkonium	9 (12.5)	22 (30.55)	**24 (33.33)**	17 (23.61)	3 (4.28)	13 (18.57)	**41 (58.57)****	13 (18.57)

Results are expressed as n (%), Correct responses are shown in bold print, p<0.05*, p<0.01**, p<0.001 ***statistically significant

Table 5: Pre- and post-test responses of nurses for questions related to different aspects of disinfectant use.

Question based on	Pre-test (n=72)			Post-test (n=70)		
	Right respondents	Wrong respondents	Non-responders	Right respondents	Wrong respondents	Non-responders
Resemblance of bleaching powder to sodium hypochlorite	44 (61.11)	19 (26.38)	9 (12.5)	55 (78.57)*	10 (14.28)	5 (7.14)
Adequacy of 20-90 mins contact time for 2% glutaraldehyde to act as a sterilant	30 (41.66)	34 (47.22)	8 (11.11)	39 (55.71)	25 (35.71)	6 (8.57)
Adequacy of spirit as a table surface disinfectant	30 (41.66)	36 (50)	6 (8.33)	52 (74.28)*	13 (18.57)	5 (7.14)
Adequacy of soap and water for cleaning of housekeeping surfaces like floors	36 (50)	20 (27.77)	16 (22.22)	47 (67.14)*	7 (10)	16 (22.85)
Concentration of chlorine in sodium hypochlorite required to disinfect wards	28 (38.88)	28 (38.88)	16 (22.22)	49 (70)***	10 (14.28)	11 (15.71)

Results are expressed as n (%), p<0.05*, p<0.01**, p<0.001*** statistically significant

There was a significant increase in correct responses post-test to all items Secondly though our results show that pre-test awareness about critical MSDs was high in nurses this does not necessarily cite the status of their disinfection quality since many nurses in the present study were unaware of the contact time required for glutaraldehyde to act as a sterilizing agent. Other studies also have indicated wide variations in knowledge related to sterilization/disinfection methods (from 28.8% to 90.1%).[11]

Based on activity level against microorganisms disinfectants are classified as having high, intermediate and low level of activity (Table 2). Awareness regarding this was low in pre-test. Significant improvement was observed post-test (Table 4). With respect to level of activity, in pre-test benzalkonium was wrongly assigned higher level, possibly due to its good detergent action and visibly clean effects. Other studies have also reported wide[12] and wrong use[13] of benzalkonium as a sterilizing agent. Glutaraldehyde and bleaching powder were erroneously perceived as lower level than actual while sodium hypochlorite was perceived as higher level. This was despite the high percentage of nurses being aware of similarity between sodium hypochlorite and bleaching powder (Table 5). Unlike sodium hypochlorite, in our setup indication of bleaching powder is limited to being an economical alternative for cleaning toilets. This might have undermined it's level as a disinfectant. In addition, the statistically insignificant improvement in post-test with respect to identification of sodium hypochlorite activity level may indicate that the nurses may be perceiving the importance of a disinfectant, based on the frequency of its everyday use in the wards rather than any set guidelines.

With respect to different aspects of disinfectant use significant improvement to most items was seen in post-test. In pre-test most respondents (38%) seemed to be unclear about the requirement of chlorine concentration in diluted sodium hypochlorite for housekeeping ward floors although it is mentioned on the product label. Another study has reported use of unrecommended dilutions of disinfectants.[14] Emphasis on proper dilution of concentrated disinfectants has shown improved disinfection practices[10] for environmental surfaces. As mentioned above many nurses in the present study were unaware of the contact time required for glutaraldehyde to act as a sterilizing agent. A study in Italy reported that contact time with glutaraldehyde for sterilization of endoscopes varied and 10% nurses allowed 10 mins contact time.[12] Results of the present study identify the need for future interventions to be focused on various aspects of disinfection such as indication, contact time, correct dilution, etc. A study in Nigeria also identifies the need for adherence to disinfection policy by healthcare workers in hospitals to eliminate/minimize nosocomial infections.[3] Hence, we made handouts and dilution charts and distributed these to all wards for easy reference and reinforcement.

Overall a positive impact of the workshop was seen on knowledge of disinfectants in nurses. Workshops seemed to be one of the preferred sources of acquiring information in a study.[15] In another study improvement in knowledge of common disinfection and sterilization practices in nurses following an intervention[16] was seen. A study has shown that compliance to hand hygiene improved following a single lecture.[17] Another study has proved that simple educational interventions directed at housekeeping staff resulted in improved decontamination of environmental surfaces.[18]

Limitations; Owing to the need for maintaining confidentiality, we did not collect demographic data and hence one to one correlation of pre- and post-intervention data were not possible nor could, we correlate the results with demographic profile of respondents. We also could not plan this study to include the impact of the intervention on actual changes in disinfectant consumption since at the time of our study

consumption was confounded by a problem of irregular supply.

We conclude that a positive impact of the workshop was seen on knowledge of nurses. This study points out to the fact that there is a need for continuing education in the form of such workshops, which are easy to conduct and cost-effective. Future interventions should focus on various aspects of disinfection such as indication, contact time, correct dilution, etc.

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