

AN EVALUATION OF KNOWLEDGE AND AWARENESS OF DISINFECTION AND STERILIZATION AMONG HEALTH CARE WORKERS

KC Keah¹, M Jegathesan¹, SC Tan², SH Chan³, OM Che⁴, YM Cheong¹ and AB Suleiman⁵

¹Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur; ²Department of Laboratory Services, General Hospital, 50586 Kuala Lumpur; ³Department of Pharmacy, General Hospital, 70990 Seremban, Negeri Sembilan; ⁴Pharmacy Section, State Medical and Health Department, 70590 Seremban, Negeri Sembilan; ⁵Ministry of Health, Jalan Cenderasari 50590 Kuala Lumpur, Malaysia

Abstract. Awareness of the disinfection and sterilization policy among hospital staff and their knowledge in basic principles and methods of disinfection and sterilization were studied before and after intervention using a self-administered questionnaire. Survey results showed that awareness (56.2%) before intervention was unsatisfactory. The nurses were more aware of the policy than other groups of medical personnel. Those unaware of the policy perform duties from memory or verbal instructions. A significant increase in awareness to 73.3% was observed after intervention ($p < 0.05$).

Knowledge on methods of decontamination, disinfection and sterilization of equipment varies widely from 28.8% to 90.1%. 23.1% were unaware of the temperature used for sterilization while 72.4% did not know how containers of disinfectant should be refilled. Only 14.7% knew the recommended method for washing containers. With education improvement was observed. The average knowledge improved from 44.4% to 57.3%.

Our results indicated that continuous in-service education is needed to improve, supplement and update knowledge in this field after basic training. In addition orientation programs for new staff should also be aimed at creating awareness and providing information on guidelines and policies related to their duties.

INTRODUCTION

The origin of nosocomial infection can be endogenous or exogenous. One common cause of exogenous infections is the failure in disinfection and sterilization of instruments used on patients. If aseptic or hygienic measures in the hospital breakdown, the frequency of nosocomial infection may increase to epidemic proportions. In some places, despite apparent adherence to adequate disinfection and sterilization procedures, outbreaks involving organisms like *Trichosporon beigelli*, *Mycobacterium tuberculosis*, *Candida parapsilosis*, *Serratia marcescens*, *Achromobacter xylosoxidans* and *Acinetobacter calcoaceticus* due to contamination of endoscopic instruments, bronchoscopes, pressure transducers and reusable ventilator circuits still occur (Beck-Sague *et al*, 1989; Fereres, 1988; Gahn-Hansen *et al*, 1988; Hartstein *et al*, 1988; Singh *et al*, 1989; Wheeler *et al*, 1989). Some of these outbreaks may be

attributed to inadequate cleaning, improper selection of disinfecting agents, insufficient exposure time or failure to expose a portion of the equipment to the disinfectant because of its intricate design.

Studies have shown that processing and disinfecting of one device varies from one place to another and in some cases was inadequate (Arora *et al*, 1992; Foss and Monagan, 1992). Knowledge of personnel has also been inadequate as shown in some studies (Morgan *et al*, 1990). However, there had been no attempts in educating the personnel involved and evaluating their performance thereafter.

With increasing complexity in processing instruments, there is a need for continuing education, quality reviews and clearly documented guidelines. The Ministry of Health, Malaysia has published a policy on disinfection and sterilization and distributed its first edition in 1979 (Ministry of Health Malaysia, 1979, 1990). Thus, we decided to evaluate the awareness of our health care workers regarding the existence of this policy, their knowledge on the principles of disinfection and sterilization and types of disinfectants used on some instruments listed in the policy. This was done both before and after

Correspondence: KC Keah, Division of Bacteriology, Institute for Medical Research, Jalan Pahang, 50588 Kuala Lumpur, Malaysia

education with the use of a questionnaire. This paper reports the results of the study done in 6 general hospitals in Malaysia.

MATERIAL AND METHODS

A self-administered questionnaire was designed, consisting of sections to obtain the following information:

- 1) the awareness of the availability of the disinfection and sterilization policy of the Ministry of Health;
- 2) problems in implementation;
- 3) basic principles of disinfectant usage;
- 4) knowledge on acceptable methods required to provide sterile instruments, methods of disinfection and dealing with spillages.

Participants were scored on (3) and (4) to determine their knowledge.

The questionnaire was tested in a pilot study at the Seremban General Hospital where 94 staff of various categories participated. This trial was conducted to assess the adequacy of the questionnaire and to get feedback regarding question design. Minor modifications were made after the trial run.

The modified questionnaire was then used to evaluate 6 general hospitals.

A pre-intervention survey was conducted. The questionnaires were administered by the infection control nurses at each hospital. The participants were reminded to fill up the questionnaire independently and without discussion or reference. Respondents were not identified by name. Staff who participated in the survey included doctors, nursing sisters, staff nurses, assistant nurses, medical assistants, medical laboratory technologists and attendants.

An education program aimed at correcting misconceptions of the basic knowledge was planned. Lectures covering topics such as factors influencing the use of chemical disinfectants, monitoring the use of disinfectants, advantages of heat over other methods of disinfection, methods of disinfection and sterilization in our local hospitals and the use of sterilization controls were given. Another evaluation was done using the same questionnaire.

A total of 1,808 questionnaires were distributed randomly to different categories of staff in both

surveys. The staff categories sampled were doctors (139), sisters (80), staff nurses (674), assistant nurses (358), medical assistants (23), medical laboratory technologist (148) and attendants (386). The completed questionnaires returned were analysed by using the software program, Paradox 3.0. (Borland International) Proportions were compared using the test. Scores between different categories of staff were compared by the Student-Newman-Keuls test at $p = 0.05$.

RESULTS

Table 1 shows the sampling and response rate for both the pre and post-intervention survey.

Awareness and problems of implementation

Personnel shortage was perceived to be the most common problem by 30.6% of the respondents as to why the guidelines could not be implemented fully. 20.9% stated that there was insufficient supply of disinfectant while 21.7% stated that the guidelines were not readily available, not clear or not in the language they were familiar with.

Of the 635 who responded to the question on how they carried out procedures without knowing the existence of guidelines, 66.9% did not refer to any written instructions. They depended on memory or verbal instructions. Only 29.4% followed some kind of written instructions.

Awareness among the nursing sisters was 83.6% but only 57.5% knew where the booklet was kept. The nursing staff were the most aware (62.2% - 83.6%) of the existence of the policy and the medical laboratory technologists the least aware (19.2%) in the pre-intervention survey. An overall average of 56.2% were aware of the policy and only 47% knew where the booklet was kept. 5.3% knew it was in the drawer, 47.2% on the nurses table, 26% in the sister's office and 11.5% in cupboards, files, hung on the wall or in the microbiologist's office.

In the post-intervention survey, 73.3% were aware of these guidelines and knew where to locate it if required for reference. 51.5% in this survey indicated that the booklet was now placed on the nurse's table for reference.

Knowledge

Knowledge on the use of disinfectants and sterilization among the different groups of staff

KNOWLEDGE ON DISINFECTION AND STERILIZATION

Table 1
Sampling and response rate.

Group	% of total population sampled	Total questionnaires returned		Response rate (%)	
		*Pre	*Post	Pre	Post
Doctors	34.9	136	117	97.8	84.2
Nursing sisters	76.9	73	79	91.3	98.8
Staff nurses	47.1	641	606	95.1	89.9
Assistant nurses	43.4	344	305	96.1	85.2
Medical assistants	11.1	18	21	78.3	91.3
Med lab technologists	61.9	147	120	99.3	81.1
Attendants	36.4	370	339	95.9	87.8
Total	42.4	1,729	1,587	95.6	87.8

* Pre = Pre-intervention
* Post = Post-intervention

Table 2
Knowledge on use of disinfectant and sterilization.

Group	Average score (%)		Range	% score ≥ 50%
	Pre	Post		
Doctors	Pre	48.3	0 - 75	53.7
	Post	52.4		
Nursing sisters	Pre	54.5	19 - 84	72.6
	Post	67.6		
Staff nurses	Pre	50.6	0 - 84	53.4
	Post	62.2		
Assistant nurses	Pre	49.5	0 - 76	54.1
	Post	59.8		
Medical assistants	Pre	57.4	29 - 79	66.7
	Post	58.6		
Med lab technologists	Pre	31.7	0 - 79	25.9
	Post	48.1		
Attendants	Pre	30.1	0 - 72	16.2
	Post	49.3		
Total	Pre	44.4	0 - 84	44.2
	Post	57.3		

increased from an average of 44.4% to 57.3% after intervention (Table 2). 2.3% of the respondents scored 0% in the preintervention knowledge survey.

Table 3 shows the pre and post-intervention knowledge of how containers should be treated and refilled.

Boiling at 100°C was thought to be a form of sterilization in 23.1% of the respondents and 22.8% of the nurses before intervention and in 20.1% and 19.1% respectively after intervention.

Table 4 shows the percentage of correct responses to the method of disinfection and sterilization of some instruments used in the hospital.

DISCUSSION

The disinfection and sterilization policy of the Ministry of Health, Malaysia was meant for use in hospitals and health centers. Awareness of this policy among the different categories of staff differed greatly from 19.2% to 83.6%. The nursing sisters as managers of the wards were the most aware of the existence of this policy. 57.5% of them knew where it was kept. The overall awareness rate of 56.2% and 47% for respondents who were aware of the presence of the policy and its location in the wards was unsatisfactory as it was meant for reference by staff. Keeping these policies in offices of nursing sisters or

Table 3
How containers should be treated and refilled.

Response		Total (%)	Nurses (%)
Recommended method/practice			
Washed and disinfected with hot boiling water for 20'	Pre	244/1659 (14.7)	126/1049 (12.0)
	Post	632/1526 (41.4)	397/963 (41.2)
	p value	< 0.05	< 0.05
Measuring disinfectant and water when diluting	Pre	1370/1667 (82.2)	668/1040 (64.2)
	Post	1346/1597 (84.3)	842/961 (87.6)
	p value	> 0.05	< 0.05
Unacceptable method/practice			
Washed or rinsed with hot water	Pre	903/1659 (54.4)	597/1049 (56.9)
	Post	563/1526 (36.9)	380/963 (39.5)
	p value	< 0.05	< 0.05
Not necessary to wash and disinfect	Pre	512/1659 (30.9)	326/1049 (31.1)
	Post	331/1526 (21.7)	186/963 (19.3)
	p value	< 0.05	< 0.05
Adding fresh disinfectant to a container of partially finished disinfectant	Pre	257/1626 (15.8)	126/1006 (12.5)
	Post	197/1531 (12.9)	102/938 (10.9)
	p value	< 0.05	> 0.05
Pouring together same disinfectants from two different containers	Pre	921/1626 (56.6)	614/1006 (61.0)
	Post	713/1531 (46.6)	421/938 (44.9)
	p value	< 0.05	< 0.05

Table 4

Percentage of responses to the correct method of sterilization, disinfection and decontamination.

Instruments	Methods		Correct responses (%)	
	Unacceptable	Acceptable	Pre	Post
Rubber tubing	Hot air oven, boiling	Ethylene oxide Autoclave (if no E O available)	983/1404 (70.0)	1055/1431 (73.7)
Bottled fluids	Hot air oven, boiling, ethylene oxide	Autoclave	529/1369 (38.6)	542/1370 (39.6)
Glassware	Boiling, ethylene oxide	Autoclave, Hot air oven	1032/1657 (62.2)	1075/1705 (63.0)
Endoscopes	Steam at 100°C	glutaldehyde autoclave for heat resistant ones)	1086/1205 (90.1)	1256/1382 (90.9)
Cheattle forceps	Chemical disinfectant (iodine, hypochlorite)	Autoclave	1134/1401 (80.9)	1291/1481 (87.2)
Dressing forceps	Chemical disinfectant (alcohol, chlorhexidine)	Autoclave	1162/1721 (67.5)	1309/1724 (75.9)
Catheters (If reused)	Chemical disinfectant (chlorhexidine, iodine)	Autoclave	827/1442 (57.4)	1014/1493 (67.9)
Spillage of blood, body fluid	Detergent and water, phenolic	Hypochlorite	571/1986 (28.8)	1016/2065 (49.2)
Food preparation surfaces	Aldehyde, iodine	Hypochlorite	609/1008 (60.4)	759/1130 (67.2)

microbiologists, drawers or cupboards showed that it was not readily available for reference. A significant increase ($p < 0.05$) in the awareness to 73.3% in the post-intervention survey was attributed to efforts in drawing the attention of hospital staff regarding the existence of this policy.

There was a general improvement in the knowledge of every category of staff in the post intervention survey (Table 2). The percentage of nursing sisters scoring $\geq 50\%$ was the among the highest. The nursing sisters were the first person in the ward to receive information from the higher authorities and they supervised the nurses and attendants.

In the preintervention survey, 14.7% of the respondents were aware of the recommended method to clean containers before refilling. A total of 72.4% said that topping up containers of disinfectant and pouring together the contents of two different containers of the same disinfectant were acceptable practices. 82.2% were aware that when diluting disinfectants, both diluent and disinfectant must be measured. Fresh disinfectants could be contaminated

if containers are not properly cleaned and disinfected. Containers should not be topped up and the contents of different containers should not be mixed as any contamination in either one would cause the whole lot to be contaminated. Correct recommended dilutions of disinfectant must also be used at all times as a lower concentration of disinfectant used due to wrong dilution can lead to failure in disinfection (Maurer, 1985).

Sterilization was not carried out in the wards and many of the respondents were not involved in sterilizing the instruments they used. 23.1% in the pre-intervention survey were not aware of the temperature for sterilization. Many wards have boiling water bath at 100°C operating as "sterilizers". 100°C is not the recommended temperature for sterilization.

An improvement in the knowledge of these basic principles (Table 3) and methods on decontamination, disinfection and sterilization (Table 4) was observed in the post-intervention survey.

Our results indicate that merely handing out poli-

cies and guidelines without proper education does not help to improve practices and knowledge of health care workers in this area. A proper and effective orientation program to inform new staff of policies and guidelines pertaining to their daily duties is necessary. Revision in recommendations will also be required as new products and technology are introduced into the market. It is important for health care workers to understand the rationale behind these guidelines, recommendations and precautions to be taken before they can be fully implemented. Hence, continuing education, constant review of recommendations as well as proper management and supervision of staff are needed.

ACKNOWLEDGEMENTS

This project was funded by a Research and Development grant (No. 3-08-01-041) from the Ministry of Science Technology and The Environment. We thank the medical superintendents and matrons of the six hospitals for their continued support throughout the project, the microbiologists and the infection control nurses for technical assistance and administration of questionnaires. We would also like to thank Dr MS Lye and Prof Rama C Nair for helping with the statistical analysis.

REFERENCES

- Arora A, Seth S, Tandon RK. Gastrointestinal endoscope disinfection practices in India. *Indian J Gastroenterol* 1992; 11 : 62 - 4.
- Beck-Sague CM, Jarvis WR. Epidemic blood stream infections associated with pressure transducers : a persistent problem. *Infect Control Hosp Epidemiol* 1989; 10 : 54 - 9.
- Ministry of Health, Malaysia. Disinfection and Sterilization Policy and Practice, 1st ed. 1979.
- Ministry of Health, Malaysia. Disinfection and Sterilization Policy and Practice, 2nd ed. 1990.
- Fereres J. Equipment related infections - national policies. *J Hosp Infect* 1988; 11 (suppl A) : 292 - 4.
- Foss D, Monagan D. A national survey of nurses' and physicians' attitudes towards endoscope cleaning and the potential for cross-infection. *Gastroenterol Nurs* 1992; 15 : 59 - 65.
- Gahn-Hansen B, Alstrup P, Dessau R, et al. Outbreak of infection with *Achromobacter xylosoxidans* from contaminated intravascular pressure transducers. *J Hosp Infect* 1988; 12 : 1 - 6.
- Hartstein AI, Rashad AL, Liebler JM, et al. Multiple Intensive care unit outbreak of *Acinetobacter calcoaceticus* subspecies *anitratus* respiratory infection and colonization associated with contaminated reusable ventilator circuits and resuscitation bags. *Am J Med* 1988; 85 : 624 - 31.
- Maurer IM. Chemical disinfectants : fiction and facts. In : Maurer IM, ed. Hospital Hygiene. 3rd ed. Richard Clay, Great Britain. 1985: 59 - 74.
- Morgan DR, Lamont TJ, Dawson JD, Booth C. Decontamination of instruments and control of cross infection in general practice. *Br Med J* 1990; 300: 1379 - 80.
- Singh S, Singh N, Kochhar R, Mehta SK, Talwar P. Contamination of an endoscope due to *Trichosporon beigelli*. *J Hosp Infect* 1989; 14 : 49 - 53.
- Wheeler PW, Lancaster D, Kaiser AB. Bronchopulmonary cross-colonisation and infection related to Mycobacterial contamination of suction valves of bronchoscopes. *J Infect Dis* 1989; 159 : 49 - 53.