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Journal of Hospital Infection 75 (2010) 299–303

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Infection control practices among hospital health and support workers in Hong Kong

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ARTICLE INFO

Article history:
Received 6 September 2009
Accepted 9 October 2009
Available online 3 March 2010

Keywords:
Clinical audit
Compliance
Disinfection
Infection control

SUMMARY

A report by the Hong Kong government noted that hospital infection control standards were inadequate, requiring audit, development and implementation. In addition, hospital staff needed training in infection control measures. We investigated infection control practices among 162 hospital health workers (109 nurses, 45 doctors and 8 therapists) and 44 support workers in one acute hospital and two rehabilitation hospitals using a non-blinded, observational design. We examined compliance with isolation precautions and infection control guidelines, including proper wearing of a mask, goggles/face shield, or gown; handling patient care equipment, linen, and laundry; routine and terminal cleaning; and terminal cleaning of an isolation room. One major breakdown in compliance was use of sleeveless disposable plastic aprons instead of long-sleeved gowns during procedures likely to generate splashes or sprays of blood and body fluids. In more than half of the observed episodes, participants failed to disinfect medical devices, such as stethoscopes, before re-use. Thorough cleansing of commodes between patients was also lacking. Overall compliance with local and international infection control guidelines was satisfactory, but several aspects required improvement.

Introduction

The escalation of infectious diseases worldwide and, specifically in Hong Kong, the severe acute respiratory syndrome (SARS) outbreak of 2003, have heightened healthcare workers' awareness of workplace health hazards and the precautionary measures needed to combat them. The key lesson is for healthcare workers to be vigilant and prepared to institute infection control measures should the need arise. Thus, education of health and support workers in infection control is vital. They should know current guidelines and be able to incorporate them into their usual work pattern. However, the continued high incidence of hospital-related infections indicates that, despite strong research evidence for changing practice, this may not occur for years due to lack of knowledge, expertise or equipment.[1]

The SARS Expert Committee in Hong Kong found that hospital infection control standards were inadequate and in need of audit, development and implementation and that hospital staff needed training in infection control measures.[2] A survey of 306 nurses in an acute hospital in Hong Kong noted low compliance with, and selective adoption of, universal precautions.[3] However, no study has examined healthcare and support workers' compliance with isolation precautions.

We examined the appropriateness of infection control practices among hospital health (nurses, doctors, and therapists) and support (healthcare assistants, technical service assistants, workmen, cleaners and porters) workers. The study was considered important to identify omissions in the implementation of droplet precautions and other measures against infectious diseases.

Methods

Design and methods

An observational study was used to identify omissions in infection control practice in four clinical settings in an acute hospital (medical wards, surgical wards, accident and emergency department, and intensive care unit), and the medical and surgical

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0195-6701/$ – see front matter
doi:10.1016/j.jhin.2009.10.014

wards in two rehabilitation hospitals. Data were collected in each study ward during morning (56.8%), afternoon (40.8%) and night (2.4%) shifts. Non-participant observations were conducted for 1 h on each ward. In order to reduce observer bias and the Hawthorne effect, observers were trained to observe behaviour in a neutral and non-judgemental manner, and instructed to record any additional activities that occurred during the observation period.

Samples and sampling methods

A non-probability quota sampling method was used and a stratified sample of 206 health and support workers based on years of working experience was assembled. The sample was stratified on the basis of total numbers in each setting. For the acute hospital, samples of 76, 50 and 18 for the three strata (years of working experience of $\leq$5, 6–10, >10) respectively, and 17, 27 and 18 for each stratum for the two rehabilitation hospitals, were required.

The final sample contained 109 (52.9%) nurses, 45 (21.8%) doctors, 8 (3.9%) therapists, and 44 (21.4%) support workers, most of whom were female (72%). Two-thirds (69%) worked in medical wards, 34 (16%) in surgical wards, 14 (7%) in the accident and emergency department, and 16 (8%) in the intensive care unit. Of the participants, 45% had <6 years working experience, 37% had 6–10 years, and 18% >10.

Instrument

Activities were recorded using an observation checklist for two patient care activities: direct (physical examination, basic and technical nursing care) and indirect (computer data entry and disinfection of equipment); and for compliance with isolation precautions and infection control guidelines laid down by the Centers for Disease Control and Prevention (CDC) and the Hong Kong Hospital Authority (HKHA).[4,5] These included wearing a mask, using a goggle/face shield, donning a gown, handling patient care equipment, linen and laundry, routine and terminal cleaning, termination of an isolation room, hand washing, antiseptic hand rub, and donning gloves. The results of hand washing, hand rub and use of gloves are reported elsewhere.

The inter-observer reliability, calculated as percentage agreement between the observers, was 0.95, indicating a satisfactory level of agreement between the observers.

Data analysis

Descriptive and inferential statistics were used to analyse the data using SPSS-PC Version 16.0. Participants' infection control practices were summarised using descriptive statistics. One-way analyses of variance (ANOVA) were used to compare differences between the performance scores among participants with different years of working experience and with different occupations. Independent *t*-tests were used to determine significant differences in performance scores between participants working in acute or rehabilitation hospitals. The level of significance in all analyses was set at 0.05.

Results

Type of activities

The infection control practices of each participant were recorded and observed for four time slots within an hour, each time slot lasting for 15 min. The number of infection control episodes observed in 206 h is presented in Table I.

Overall compliance with infection control guidelines

Operational definitions of compliance were based on CDC and HKHA infection control guidelines for SARS and droplet infection.[4,5] Use of a mask/respirator was defined as wearing a surgical mask when working within three feet of a patient or wearing a respirator when caring for a patient with SARS coronavirus, or known or suspected pulmonary and laryngeal tuberculosis (1 = done, 0 = not done); use of a gown was defined as wearing a gown during procedures likely to generate splashes or sprays of blood, body fluids, secretions or excretions (1 = done, 0 = not done); use of goggles or a face shield was defined as wearing goggles or a face shield during procedures likely to generate splashes or sprays of blood, body fluids, secretions or excretions (1 = done, 0 = not done); handling patient care equipment was defined as handling or disinfecting a medical device or patient care equipment and disposing of used articles (1 = done, 0 = not done); handling linen and laundry was defined as proper handling of clean, soiled or contaminated textiles and fabrics (1 = done, 0 = not done); routine and terminal cleaning was defined as cleaning and disinfecting bedside equipment or environmental surfaces or cleaning and decontaminating spills of blood or other potentially infectious materials (1 = done, 0 = not done); and terminal cleaning of an isolation room was defined as cleaning and disinfecting all surfaces in contact with the patient after discharge, transfer or death (1 = done, 0 = not done).

There was 97% compliance with wearing a mask, 70% a gown and 50% goggles or a face shield, 81% with handling patient care equipment, 96% with handling linen and laundry, 67% with routine and terminal cleaning and 100% with terminal cleaning of an isolation room (Table II).

Infection control performance of participants

The performance score reflects the degree of compliance with the recommended standards for each procedure and was calculated as a ratio of observed satisfactory performance over the total numbers of opportunities indicated.

Table I
Numbers of observed infection control practice episodes

	Nurse	Doctor	Therapist	Support worker	Total (100.0%)
Wearing a mask/respirator	435 (53.0%)	180 (22.0%)	30 (3.7%)	175 (21.3%)	820
Putting on a gown	33 (41.2%)	12 (15.0%)	3 (3.8%)	32 (40.0%)	80
Wearing goggles/face shield	16 (72.7%)	0	2 (9.1%)	4 (18.2%)	22
Handling patient care equipment and articles	267 (53.1%)	87 (17.3%)	15 (3.0%)	134 (26.6%)	503
Handling linen and laundry	24 (30.0%)	0	0	56 (70.0%)	80
Routine and terminal cleaning	0	0	0	15 (100.0%)	15
Terminal cleaning of an isolation room	0	0	0	1 (100.0%)	1

Table II
Compliance with infection control guidelines

	Nurse	Doctor	Therapist	Support worker	Overall
Compliance	n (%*)	n (%*)	n (%*)	n (%*)	n (%*)
Wearing a surgical mask	435 (98.6%)	180 (97.2%)	30 (73.3%)	175 (97.7%)	820 (97.2%)
Putting on a gown	33 (78.8%)	12 (100%)	3 (66.7%)	32 (50.0%)	80 (70.0%)
Wearing goggles/face shield	16 (43.8%)	NA	2 (0%)	4 (100%)	22 (50.0%)
Handling patient care equipment and articles	267 (89.1%)	87 (43.7%)	15 (93.3%)	134 (87.3%)	503 (80.9%)
Handling linen and laundry	24 (87.5%)	NA	NA	56 (100%)	80 (96.3%)
Routine and terminal cleaning	NA	NA	NA	15 (66.7%)	15 (66.7%)
Terminal cleaning of an isolation room	NA	NA	NA	1 (100%)	1 (100%)

NA = not applicable
n = total numbers of observed infection control practice episodes
* = percentage of compliance in each of the total number of observed infection control practice episodes

Use of personal protective equipment (PPE)

Mask

The performance of wearing a surgical mask was good; nearly all participants wore one when working within three feet of a patient, and most of them did not touch the outside of the mask during use. However, 30 (60%) participants did not dispose of the mask into a rubbish bin with a cover. Using an N95 mask was unusual: one support worker was observed wearing the mask while working in an isolation ward but did not perform a fit check while putting it on to ensure a proper seal between the respirator's sealing surface and the wearer's face.

Gown

One major breakdown in compliance was wearing sleeveless disposable plastic aprons instead of long-sleeved gowns during procedures likely to generate splashes or sprays of blood, body fluids, secretions or excretions, and especially when providing perineal care.

Goggles/face shield

Lack of compliance was failure to wear goggles or face shields during open suctioning of patients with artificial airways.

Handling patient care equipment

Participants ensured that single-use items were discarded correctly and placed used articles in appropriate containers or bags, and handled urinals and urine measuring jugs properly. However, in >50% of observed episodes, participants failed to disinfect medical devices such as stethoscopes, and patient care equipment such as walking frames and sliding boards, before re-use on other patients. In only 25% of episodes were nurses and support workers observed covering used bedpans/urinals for transport to dirty utility rooms. Thorough cleansing of commodes and shower trolleys between patient contacts among support workers was not observed.

Handling linen and laundry

Overall compliance was good and most nurses and support workers adhered to the guidelines. However, no colour-coding of bags or containers for contaminated linen was used in two hospitals.

Routine and terminal cleaning

The support workers who performed this work demonstrated good compliance, though one was found not to wear a gown during the terminal cleaning of bedside equipment of a patient requiring contact precaution, and some failed to clean and disinfect environmental surfaces such as doorknobs, faucet handles and floors.

Terminal cleaning of an isolation room

Only one episode was observed and the support worker cleaned and disinfected all surfaces that had been in contact with the patient and wiped down mattresses and headboards with hypochlorite. The privacy curtain was not removed and laundered.

Subgroup analysis

Apart from measuring compliance with infection control guidelines, this study also sought to examine the degree of healthcare and support workers' compliance with the recommended standards for each procedure. A performance score, which took into consideration all the recommended steps for each procedure, was calculated for each individual. This was calculated according to:

$$\frac{\text{Total no. of 'Yes' items}}{\text{Total items} - \text{NA items}} \times 100 = x\%$$

where NA is 'not applicable'.

Years of experience and performance

No significant mean differences in the performance scores for proper wearing of a mask, goggles or gown, handling linen and laundry, routine and terminal cleaning, and termination of an isolation room, were found between the three groups with: ≤5, 6–10, >10 years of experience. The only significant difference was in relation to that on handling patient care equipment, with those with ≤5 years of service performing less satisfactorily.

Types of hospitals and performance

Significant differences in performance scores on the proper wearing of a gown were found between the two groups of hospitals, with those working in the acute hospital performing better ($t = 2.10$, $P = 0.042$).

Association between occupation and performance

Significant differences in performance scores on the proper wearing of a gown were found when comparing nurses and support workers ($t = 2.62$, $P = 0.013$), in favour of the former. No comparison was made with doctors as only three episodes were observed among them. A significant difference was also found in performance scores of handling patient care equipment ($F = 46.36$, $P < 0.0005$). Post-hoc analysis using the Bonferroni multiple comparison procedure revealed that nurses and support workers performed better than doctors in this activity.

Discussion

Staff generally wear surgical masks when they should. After the SARS outbreak, staff may have a greater awareness of droplet precautions and the threat of avian influenza. Use of a mask significantly reduced the risk of infection in a local survey of 241 non-infected and 13 infected healthcare workers when caring for index patients with SARS.[6] None of 334 medical students surveyed in another study wore masks during history taking and physical examination prior to the SARS outbreak in 2003, whereas after the outbreak 86.1% and 93.8% of the 169 students working in the same hospital reportedly wore masks during history taking and physical examination respectively.[7]

An N95 mask was rarely used: one support worker wore a respirator (N95) while working in an isolation ward, but in an unsatisfactory manner. However, the major breakdown in compliance with protective clothing was wearing of a disposable plastic apron with no sleeves, thus providing inadequate protection. More training in these two areas is warranted.

There was only 50% compliance with goggles/face shield precautions. Use of eye shields/goggles when exposed to splashing of discharge or fluids was also found to be low in another Hong Kong study of 306 nurses in acute care settings. The self-reported compliance rate was low and ranged from 25% (answered 'always' to this item) to 28% (answered 'sometimes').[3] The need for eye wear during open suction of patients with artificial airways should be reinforced.

Good practice was promoted in the hospitals by using leak-resistant, water-soluble bags for linen soiled with blood and secretions. Colour coding was also used in one hospital to identify bags with contaminated and infected linen.

Proper handling and disinfecting of equipment is fundamental and all re-usable equipment should be cleaned and reprocessed appropriately before use on another patient. However, no thorough cleansing of commodes or shower trolleys between patient use was observed. Both of these items of equipment have the potential to spread infectious disease.[8,9] In a study on the role of the environment in spread of *Clostridium difficile*, commodes were found to be fomites.[9] This highlights the need to ensure that re-usable equipment is thoroughly cleaned between uses. Use of disposable surface cleaning wipes should be explored, though their efficacy in reducing bacterial counts on hard surfaces and their ease of use and disposability need to be determined.

Low compliance with regards to disinfection of stethoscopes was found. Stethoscopes are reported as a potential source of nosocomial infection and a study that determined the bacterial load on stethoscope membranes found that 234 of the 355 sampled carried two or more different bacterial species and that 31 carried potentially pathogenic bacteria such as *Staphylococcus aureus* and acinetobacter. Although some bacteria survived for up to 18 h on stethoscope membranes, none survived after disinfection.[10] Another study sampling 74 stethoscopes, including communal ones from hospital wards and 36 personal ones, also showed that the bell/diaphragm of 50% were colonised by significant numbers of bacteria including coagulase-negative staphylococci and non-fermenting Gram-negative bacilli.[11] Using alcohol wipes to clean the diaphragm and the bell in between examinations is a simple step that could minimise the risk of cross-infection.[10]

Some support workers did not clean and disinfect environmental surfaces such as doorknobs, faucet handles, and floors after patient discharge. Numerous studies have reported the frequent contamination of such surfaces in the ward and hospital environment with infectious materials that are able to survive for a few hours to days.[12] The SARS coronavirus in respiratory samples survived for 5 days at room temperature and surfaces contaminated with patients' droplets could pose a health risk to both patients and health personnel.[13] It has been reported that high-touch areas such as doorknobs and light switches around toilets in patients' rooms are not regularly terminally cleaned despite CDC recommendations. This is an area that merits reinforcement.[12]

In the one episode, the support worker cleaned and disinfected all surfaces that were in contact with the patient and wiped down mattresses and headboards with hypochlorite. However, the privacy curtain was not removed for laundry and caution needs to be taken as a small scale study of 28 curtains on seven wards in one hospital showed that all curtains were contaminated with bacteria, and meticillin-resistant *S. aureus* (MRSA) was identified on plates taken from one of the wards with an MRSA outbreak.[14]

Health and support workers in the two rehabilitation hospitals performed poorly in the wearing of a gown, suggesting that additional training is warranted to enhance their knowledge of disease transmission. Nurses performed better in a number of isolation precautions, including putting on a gown and handling patient care equipment. They consistently have better attitudes towards, and are more compliant with, universal precautions.[15] In order to minimise the risk of occupationally acquired infections and the possibility of cross-contamination, all health and support workers should be more vigilant of all aspects of infection control practice. Those hospital workers with $\leq$5 years of experience performed less satisfactorily in handling patient care equipment, suggesting that opportunities for on-the-job training and continuous monitoring of infection control practice should be offered to younger and newer staff, with more experienced peers serving as role models for best practice.

The lessons learned from the SARS outbreak and the threat of avian influenza have heightened staff awareness in Hong Kong of workplace health hazards and of precautionary measures to combat infectious diseases. The overall level of compliance with local and CDC infection control guidelines was satisfactory, though several aspects require improvement, including the use of gowns and handling patient care equipment. Reinforcement through education is warranted.

Conflict of interest statement
None declared.

Funding source
This study was supported by a grant from the Research Fund for the Control of Infectious Diseases, Hong Kong.

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