PRACTICES OF JAPANESE NURSES FOR THE PREPARATION OF N95 RESPIRATORS

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Abstract. A delay in the diagnosis of tuberculosis (TB) is a public health problem in Japan. This delay may increase the chance of a TB patient visiting in a medical institution without a TB ward. We evaluated the practices of nurses for fit testing and seal checking their N95 respirator masks at hospitals without tuberculosis wards in Kanagawa, Japan. Of 36 nurses who participated in a medical course on infection control and medical safety in June 2010, 33 (91.7%) answered a questionnaire. Seven (22.6%) and 8 (26.7%) nurses had practical experience of fit testing and seal checking N95 masks, respectively. Nurses affiliated with hospitals having sanatorium wards were more likely to be acquainted with fit testing and seal checking than nurses from hospitals with only general wards [6 (39.9%) *vs* 0 (0%) and 7 (46.7%) *vs* 0 (0%), respectively]. Fewer than 30% of nurses exposed to TB patients had no experience with fit testing and scale checking N95 masks. Only one nurse had practical experience fitting testing at the hospital where she worked. Although the sample size in this study was small, these results showed inadequate experience in handling N95 respirator marks among Japanese nurses at hospitals without tuberculosis wards, which suggests the need to educate nurses practically in fit testing and seal checking N95 respirator masks.

Keywords: infection control, nosocomial infection, tuberculosis, nurse

INTRODUCTION

Infection control measures vary by transmission route of the causative organism. Although the global incidences of tuberculosis (TB) have been falling slowly, TB is still a common disease spread by airborne route, especially in Southeast Asia (WHO, 2011). Healthcare workers (HCW) should wear N95 respirator masks while in contact with suspected TB cases, and both fit testing and the seal checking are recommended prior to using N95 masks (WHO, 1999; Jensen *et al*, 2005). Nurse have a higher risk of contracting TB infection than other HCW (Kilinc *et al*, 2002; Keskiner *et al*, 2004; Ohmori *et al*, 2007). TB infection among nurses may be contracted during cough-inducing procedures, such as suctioning the airway of the patient.

Japan is a TB intermediate-burden country; stagnation in the decline in cases is a matter of concern (WHO, 2011). Another problem for TB control is delay in identifying smear-positive pulmonary TB patients with respiratory symptoms (Ohmori *et al*, 2005). A delay in diagnosis

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may increase the chance of a TB patient visiting a medical institution without a TB ward, increasing the possibility of infecting hospital staff and visitors with TB when infection control at that hospital is inadequate. A higher risk of TB infection among HCW than in the general population has been reported in intermediate-burden countries (Joshi *et al*, 2006; Ohmori *et al*, 2007; Sato and Nagai, 2011). Therefore, HCW, including nurses, at both TB hospitals and general hospitals need to be acquainted with practices to prevent TB infection. In this study, we evaluated the practices of Japanese nurses working at hospitals without TB wards while fit testing and seal checking N95 respirator masks to reduce the risk of contracting nosocomial TB infection.

MATERIALS AND METHODS

Subjects

The subjects were female nurses who had participated in a medical course that was held in Kanagawa, Japan, in June 2010. The workshop was on infection control and medical safety and was presented by our public health center. Thirty-six nurses attended the course, and 33 of them (92%) answered a questionnaire prior to hearing lecture on fit testing and seal checking N95 masks. The nurses were affiliated with a variety of hospitals located in Kanagawa. No subjects worked on a TB ward at the time of the study. All the nurses received on-the-job infection control training twice a year at their hospitals, as specified by the Medical Care Act, per Japanese law. All their hospitals had policies regarding countermeasures, which included the need to use an N95 respirator mask to protect against nosocomial TB infections. This was confirmed by a scheduled examination at our public health center.

This study was conducted in accordance with the recommendations outlined in the Declaration of Helsinki and was approved by the ethics board of Sagamihara Public Health Center.

Questionnaire items

Both theoretical and practical experience regarding fit testing and seal checking N95 respirator masks were assessed using a paper-based anonymous questionnaire (Table 1). The responses were evaluated with 4 methods of grouping: years since qualification, being a member of an infection control team, type of ward where working at an affiliated hospital and experience with nursing TB patients. The number of years after qualification was dichotomized using the median number of years worked, with those working more than and those working less than the median. The type of ward was dichotomized as either a general ward or a sanatorium ward. The experience of nursing TB patients was confined to pulmonary, laryngeal or bronchial TB.

Statistical analysis

The Fisher's exact probability test was used to evaluate differences between groups. Statistical analysis was performed with R, version 2.13.2 (Ihaka and Gentleman, 1996). A probability value of less than 0.05 was considered significant.

RESULTS

Six nurses (19.3%) had practical experience with fit testing the N95 mask, 7 nurses (22.6%) had no experience with this test (Table 2). The results of cross tabulation show 19 nurses (63.3%) were familiar with both fit testing and seal checking the N95 respirator mask, whereas 21 nurses (70%) had no practical experience (Fig 1).

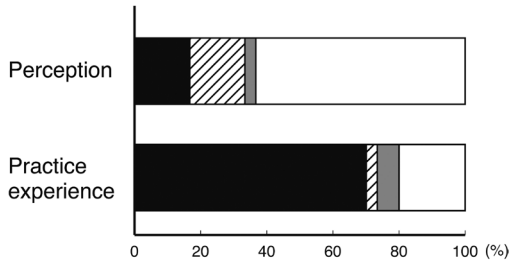

Fig 1–Theoretical and practical experience of nurses with fit testing and seal checking the N95 mask. The results of cross tabulation for each procedure are shown: closed bar, neither procedure; shaded bar, fit testing only; gray bar, seal checking only: open bar, both procedures. The *p*-values for the theoretical and practical experiences calculated with the Fisher's exact probability test were $p=0.009$ and $p<0.001$, respectively.

Nurses who had qualified more recently had no better knowledge of fit testing or seal checking than those who had a longer period since qualification. Significant differences in fit testing and seal checking were observed by type of ward worked at. No significant difference was seen between those who worked on an infection control team and those who did not. Fewer than 30% of nurses who had experience nursing TB patients know how to fit test or seal check N95 respirator masks.

One nurse, not a member of an infection control team, had practical experience of fit testing N95 masks at the hospital where she worked. The most common reason given (14/24) for not having to fit test an N95 mask, including nurses experienced with caring for TB patients, was having no plan for fit testing and the second most common reason given (6/24) was the cost of purchasing a fit test kit.

Nurses who reported wanting to attend a fit test course accounted for 78.1% (25/32) of the study subjects. Nurses who had attended the course on the job accounted for 34.4% (11/32). Nurses with no opinion about participation in the course accounted for 15.6% (5/32).

DISCUSSION

In this study, nurses without practical experience seal checking or fit testing the N95 mask accounted for more than 70% of subjects. Participation in an infection control team did not increase the experience with those procedures. A previous study of 196 hospitals in Japan found 34% of hospitals had no directions on how to wear N95 respirator masks in order to protect against TB infection (Shimouchi *et al*, 2005). Another study conducted in a Brazilian hospital reported the usage of N95 respirator masks among HCW ranged from 8.8% to 69.2% based on the department (Biscotto *et al*, 2005). Theirs and our observations suggest insufficient preparation among nurses against TB infection.

Japanese hospital managers are legally required to formulate guidelines regarding nosocomial infections and implement on-the-job training for infection control. All the nurses in this study were affiliated with hospitals that supposedly satisfied these criteria for infection control, and they had periodically attended training courses. The limited practical experience reported in this study suggests grasping the basic principles for infection prevention may not lead to better knowledge and compliance. Nosocomial infections can be prevented when HCW are informed about infectious diseases through appropriate education programs (Apisarnthanarak *et al*, 2007; Yilmaz *et al*,

Table 1
Questionnaire items on experiences with preparing N95 respirators.

I. Your profile	
Q1. Please indicate the number of years since you qualified.	years
Q2. Are you a member of an infection control team in your hospital?	(1) Member, (2) Non-member
Q3. Please indicate the type of ward you work at in your hospital.	(1) General ward only (2) With sanatorium ward
Q4. Do you have experience nursing patients with pulmonary, laryngeal, or bronchial tuberculosis?	(1) Yes (2) No
II. Experiences preparing N95 respirators	
Q1. Do you understand the procedure for fit testing an N95 respirator mask?	(1) Yes (2) No
Q2. Do you have practical experience fit testing an N95 respirator mask?	(1) Yes (2) No
Q3. Do you understand the procedure for seal checking an N95 respirator mask?	(1) Yes (2) No
Q4. Do you have practical experience seal checking an N95 respirator mask?	(1) Yes (2) No
Q5. Do you have practical experience fit testing the N95 respirator mask at your current hospital?	(1) Yes (Please go to III) (2) No (Please go to Q6)
Q6. What is the reason for not fit testing N95 masks at your current hospital? Please write in the box.	
III. Intention to attend a fit test course	
Q1. Please indicate whether you want to attend a fit test course?	(1) Attend the course voluntarily (2) Attend the course on the job (3) No opinion

Table 2
Nurses with theoretical and/or practical experience fit testing and seal checking N95 masks, *n* (%).

Perception	Practical	Total	Years since qualification[a]		Affiliated hospital		Member of infection control team		Experience of nursing tuberculosis patients	
			<Median	>Median	General ward only	With sanatorium ward	Yes	No	Presence	Absence
Fit testing										
(+)	(+)	7 (22.6)	2 (15.4)	5 (27.8)	0 (0)	6 (39.9)	2 (18.2)	4 (22.2)	6 (28.5)	1 (11.1)
(+)	(-)	18 (58.1)	6 (46.1)	12 (66.6)	10 (71.4)	7 (46.8)	7 (63.6)	10 (55.6)	9 (42.9)	8 (88.9)
(-)	(-)	6 (19.3)	5 (38.5)	1 (5.6)	4 (28.6)	2 (13.3)	2 (18.2)	4 (22.2)	6 (28.6)	0 (0)
p-value			0.092		0.037		1.000		0.061	
Seal checking										
(+)	(+)	8 (26.7)	4 (30.8)	4 (23.5)	0 (0)	7 (46.7)	2 (18.2)	4 (23.5)	6 (28.6)	2 (25.0)
(+)	(-)	12 (40.0)	4 (30.8)	8 (47.1)	6 (46.2)	5 (33.3)	6 (54.5)	6 (35.3)	8 (38.1)	3 (37.5)
(-)	(-)	10 (33.3)	5 (38.4)	5 (29.4)	7 (53.8)	3 (20.0)	3 (27.3)	7 (41.2)	7 (33.3)	3 (37.5)
p-value			0.719		0.012		0.611		1.000	

P-values calculated using the Fisher's exact probability test. [a]Median = 29 years.

2007; Huang and Wu, 2008). In this study, most of the perticipants wanted to acquire experience performing the fit test and nearly 30% of participants wanted to attend a fit test course on the job. These findings suggest prevention of nosocomial TB infection requires education and practical application are both needed by the hospital as a whole.

Nurses affiliated with hospitals with specialty wards were more acquainted with both procedures than nurses from hospitals with only general wards. The majority of patients in hospitals with a sanatorium ward are geriatric patients. The proportion of elderly TB patients has increased in Japan (Toyota and Sasaki, 2010). This situation may increase the need to know how to fit test and seal check N95 masks in such hospitals.

The pass rates for fit testing depend not only on the product but also on the race: Asians have higher failure rates in fit testing than Whites (Wilkinson *et al*, 2010). Kawabe *et al* (2004) reported a low pass rate among Japanese HCW; this rate markedly improved by giving adequate instructions and by changing the product. Recently, it was reported that user seal checks without a fit testing are sufficient for an adequate face seal (Danyluk *et al*, 2011). However, Lam *et al* (2011) found among Asians, the user seal check should not be used in place of fit testing. These reports emphasized the need for both procedures, at least among Asians in order to ensure prevention of nosocomial TB infections in health care institutions.

Most of the nurses in our study wanted to learn how to do fit testing,

but more than half of them felt the reason for not having undergone fit testing previously was that there was no need at their hospital. The prevalence of TB has decreased in Japan and this decrease has generated misconceived notions, such as the lack for the need of a proactive approach against TB infection. Some nurses stated the cost to purchase a fit test kit was a barrier to implementation of fit testing. However, Kellerman *et al* (1998) reported the annual cost for fit testing is lower than the estimated cost. Our public health center offers fit test kits to rent for hospitals to solve the cost problem.

There were some limitations to this study. The major limitation was the small sample size. Previous studies have reported TB infections among Japanese nurses (Ohmori *et al*, 2007; Sato and Nagai, 2011). These infections may be partly due to inadequate infection control in their hospitals. Although we need to be cautious not to overinterpret our results, they do point out the need to 1) evaluate the qualification of nurses to fit test N95 masks in a larger study population and 2) offer the opportunity for nurses to obtain practical experience with fit testing and seal checking N95 masks to prevent TB infections.

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