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Major article

Respiratory hygiene in emergency departments: Compliance, beliefs, and perceptions

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Background: Low respiratory hygiene compliance among health care workers of emergency departments has become a major concern in the spread of respiratory infections. Our objective was to determine the compliance with respiratory hygiene of triage nurses at 2 university hospital centers and to identify factors influencing compliance to the respiratory hygiene principles of emergency health care workers.

Methods: A 2-part, cross-sectional, descriptive study was conducted at 2 training centers. An anonymous observation of compliance with respiratory hygiene by triage emergency nurses was performed. A self-administered, voluntary questionnaire on attitudes, perceptions, and knowledge of respiratory hygiene guidelines was distributed to the health care workers at the emergency department of the 2 hospital sites.

Results: Median objective compliance with respiratory hygiene measures of triage nurses was 22% (interquartile range [IQR], 11%-33%). Median perceived compliance of the health care workers was 68% (IQR, 61%-79%). Median actual knowledge score was 75% (IQR, 75%-100%). Overall, 91.9% of respondents believed that the mask was an effective preventive measure. The main obstacles toward mask wearing by the health care worker were "tendency to forget" (37.8%) and "discomfort" (35.1%).

Conclusion: The compliance rate at our institution is very low. We identified a few factors affecting adherence to respiratory hygiene measures that are of potential use in targeting groups and formulating recommendations.

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The emergency department is the point of entry into the hospital for many patients and as such constitutes a prime location for the propagation of respiratory infections.¹ These communicable diseases can then be further spread into the hospital as well as back into the community, creating a significant societal burden. The recent severe acute respiratory syndrome epidemic and H1N1 pandemic demonstrated that vaccination alone, a mainstay of infection prevention,² cannot completely protect communities from widespread propagation of respiratory diseases.³⁻⁵ In particular, with respect to severe acute respiratory syndrome, the strict respiratory precautions, including handwashing, were thought to be largely responsible for controlling the spread of disease.

The limitations of vaccination can also be demonstrated with influenza. Every winter, influenza is a main cause of respiratory deterioration, admissions, and death. Although the rate of vaccination is better among at-risk individuals, the vaccination rate in the general population has been as low as 35% in 2005.⁶ Furthermore, we know that, with the correct vaccine strain and healthy individuals, the efficacy reaches only 70% to 90%.⁶ This is decreased in at-risk populations, such as children and the immunocompromised.⁶ Because antiviral medication is not part of current preventive strategies in Canada,⁷ respiratory precautions become very important in the control of seasonal as well as pandemic strains of influenza.⁵

Many experts have reflected on nonpharmacologic preventive strategies.^{8,9} There is currently evidence regarding the use of handwashing. Despite this incontestable evidence, handwashing has only a 40% health care compliance rate around the world.¹⁰

When it comes to respiratory infection transmission, the literature makes reference to respiratory hygiene as a mode of prevention. In particular, the department of Health and Human Services in the United States¹¹ emphasises 5 key measures: (1)

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education of health care professionals, patients, and visitors; (2) posted instructions for patients and visitors; (3) control measures aimed at the index patient (mask, tissues, and others); (4) hand hygiene; and (5) spatial separation between infected and noninfected patients. Patient and visitor education is vital because it has been shown that spread of infection often occurs even before patient has been seen by medical personnel.¹

Although respiratory hygiene care has been well defined, there are few studies with disappointing results regarding compliance to these measures.^{12,13} A health promotion model Predisposing, Reinforcing and Enabling Factors in Educational Diagnosis and Evaluation (PRECEDE) has been developed,¹³ and the PRECEDE-PROCEED approach¹⁴ can be used for the evaluation of public health measure efficacy.^{9,15–19}

As efforts regarding teaching and advocating infection control have been made at our institution, the objectives of this study were, first, to assess the compliance with respiratory hygiene by emergency triage nurses at our university hospital center and, second, to document the attitudes, perceptions, and knowledge of the health staff on respiratory hygiene working at the emergency department using a knowledge-attitudes-practices self-applied questionnaire.

MATERIALS AND METHODS

We conducted a 2-part study during the month of February 2010. The study took place at 2 hospital sites of Sherbrooke University Hospital Center, in Sherbrooke, Quebec, Canada. The project was approved by the Ethics Committee of the Department of Community Health.

First, a cross-sectional descriptive study was performed, consisting of an anonymous systematic observation of nurses in triage from 11th to 18th of February. Five students in medicine documented actual observance of respiratory hygiene by emergency triage nurses in the presence of a patient with fever and cough. The sample was a nonprobability convenience sample because all nurses meeting a patient with symptoms of respiratory infection between the 11th and 18th of February, during day, evening, and night shift, were part of our study ($n = 115$ observations). Nurse participation was voluntary, with only 1 refusal. They were also informed that the observations were designed to improve the quality of care.

The shift observed (day, evening, or night), as well as the sex of the worker were recorded. Data were gathered on respiratory precaution etiquette.^{4–16} Nine items (Table 1) regarding proper identification and isolation of respiratory infection were evaluated (observation tool available on request to corresponding author). If the patient was already wearing a mask or appropriately isolated before seeing the nurse, these facts were noted. Several opportunities could be reported for a single nurse. Because of ethical issues, all health workers chosen for observation were nurses because direct observation could be performed in the waiting room without disturbing patient care. We then conducted a second cross-sectional descriptive study with a knowledge-attitudes-practices questionnaire (questionnaire available on request to corresponding author), distributed on February 18 and 19 to health care personnel at the 2 emergency units. The questionnaire assessed knowledge, attitudes, and subjective compliance and was administered on a voluntary basis to all health staff members present in both emergency rooms (triage and observation rooms) on February 18 and 19, 2009, during different shifts (day, evening, night). The questionnaire was a combination derived from the literature.^{13,15,19–22} This tool allowed us to collect demographic data on (real or perceived) knowledge, attitudes, and practices collected in connection with the observance of the respiratory precautions. A 0 to 4 Likert scale was used for the following elements of the questionnaire: frequency of recommendation of wearing mask by patient, wearing mask by staff, hand

Table 1

Overall compliance rates to respiratory hygiene measures of the triage nurses at both hospital sites

Respiratory hygiene measure	Compliance rate (%)
Verify the presence of fever or cough	82
Wash hands after patient contact	53
Wash hands before patient contact	43
Inform patient of need to wear mask	18
Appropriately isolate patient	12
Inform patient regarding proper mask technique (covering nose and mouth)	9
Inform patient to change mask when wet	2
Ask patient to disinfect his/her hands	0
Inform patient of need to wash hands after contact with respiratory secretions	0

hygiene before and after patient contact, as well as informing other colleagues of respiratory precautions. These elements were combined to calculate a score of perceived compliance. A perceived knowledge score was calculated with a 0 to 4 Likert scale using a question about perceived level of knowledge on respiratory precautions. The actual knowledge score was calculated by combining the following elements: the mode of transmission of infectious agents, the usefulness of hand hygiene, and the recommendation of the handwashing and droplet precautions. The attitudes section was rated using a modified visual analogue scale from 0 to 8 and evaluated the fear of acquiring infection respiratory, beliefs on effective protection by mask, and barriers to use of mask. In addition, vaccination against influenza in the year of the study was assessed. To verify the quality of the questionnaire, the clarity of the questions, and the length of the latter, we conducted a 10-subject pretest on a population of medical students and nurses and subsequently reconstructed some of our questions.

Statistical analysis

We compared the dependent variables (subjective respiratory etiquette and actual observance) according to different independent variables (data population, knowledge, attitudes), with a database software EXCEL (Microsoft Corp, Redmond, WA) and statistical tests using SPSS software (SPSS Inc, Chicago, IL). The value of P for a statistically significant result was set at $\leq .05$. The Kolmogorov-Smirnov test allowed us to determine whether our data were normally distributed. When normal, χ^2 , 1-way analysis of variance followed by multiple comparisons, t test, and Fisher exact tests were used, taking into account the number of data and variables. Mann-Whitney and Kruskal-Wallis tests were used when data were nonparametric. In this case, the median and interquartile range (IQR) (25th–75th percentile) were reported. When the results were statistically significant, we also calculated the odd ratios (OR).

RESULTS

Direct observation

The convenience sample consisted of 118 patients with fever and cough out of total 372 patient visits (31.1%). The total number of observation opportunities was 115 (58 for hospital site 1 and 57 for hospital site 2). Seventy-one (61.7%) observations were performed during the day shift, 39 (33.9%) during the evening, and 5 (4.3%) during the night shift. Nurses were mostly women (87%).

The median overall score for objective compliance with respiratory hygiene measures (all recommendations) was 22% (IQR 25th–75th percentile, 11%–33%), and 18.3% of patients had applied the mask recommendations prior to triage. Despite clearly visible respiratory

hygiene posters in both hospital sites, necessary materials such as masks and tissues were missing in 9.6% of the cases. Compliance rates with regards to different respiratory hygiene measures are shown in Table 1. Patient isolation and decontamination measures were rarely or never applied. Hospital site 1 had a lower compliance rate than hospital site 2 for the measure "inform patient of need to wear mask" ($P < .001$, Fisher exact test). Only 1 nurse in hospital site 1 applied this respiratory precaution versus 16 at site 2 with an OR of 15 (95% confidence interval: 2.07-108.7). The compliance rates for the other measures were similar between sites. There was no significant difference in compliance rates between genders or shifts.

Questionnaire

Of 114 questionnaires distributed to the health care personnel, 75 (61%) were completed. Respondents' characteristics are presented in Table 2. There was a majority of women (65.3%), and most respondents were nurses (57.3%). The actual and perceived knowledge scores are presented in Table 3. The overall actual knowledge median score was 75 (IQR, 75-100). No correlation between perceived and actual knowledge was found. Physicians had a higher perceived knowledge score than the other workers ($P = .036$, Mann-Whitney test) but not when compared with nurses alone ($P = .08$, Mann-Whitney test). With respect to attitudes, residents were significantly less concerned about contracting infections than the other categories of health care workers (Fig 1).

Overall, 91.9% of the respondents believed that the mask was an effective preventive measure. Table 4 summarizes the reasons cited as obstacles toward the wearing of a mask by the health care workers. The reasons "tendency to forget" (37.8%) and "discomfort" (35.1%) were the most often cited.

The overall median score for perceived compliance with respiratory hygiene was 68% (61%-79%). Perceived compliance scores of the respondents were similar between sites and genders and among shifts (not shown). Mask comfort showed a trend toward playing a compliance role in subjects with less than 10 years experience as compared with those with greater than 10 years (46.7% vs 17.25%, respectively; $P = .010$, Pearson χ^2 test). Persons for whom "tendency to forget" was a reason cited as obstacle toward mask wearing reported lower perceived compliance to recommendations than the other respondents ($P < .001$, Pearson χ^2 test), as did those for whom lack of comfort was considered an obstacle to wearing a mask ($P = .03$, Pearson χ^2 test). However, lack of time, inaccessibility to respiratory hygiene material (masks and tissues), and interference with patient relations did not affect perceived compliance.

The results showed no correlation between the perceived compliance score and actual knowledge score ($P = .868$, Spearman rank correlation test). However, a correlation between perceived compliance to measures and perceived knowledge was demonstrated ($P = .016$, Spearman correlation coefficient = 0.279). There was no relation between knowledge scores, site, and presence of at-risk family members and self-reported compliance. Residents reported requesting patients to wear a mask much less frequently than nurses (14.3% vs 83.3%, respectively; $P < .05$, Fisher exact test). Finally, 94.1% of health care workers would recommend mask wearing to a patient with fever and cough.

DISCUSSION

This study describes respiratory hygiene compliance by emergency triage nurses (including mask precautions) at our institution and identifies factors that may influence compliance with respiratory hygiene guidelines by emergency health care workers. Although many studies have looked at handwashing, few have looked at adherence to mask precautions.^{12,13} Fewer studies have

Table 2

Characteristics of the questionnaire respondents: n = 114

Characteristic	Respondents (%)
Age, yr	
≤24	17.3
25-34	45.3
35-44	17.3
45-55	17.3
>55	2.7
Function	
Physician	10.7
Nurse	57.3
Resident	9.3
Medicine student	8.0
Others	14.7
Years of experience	
0-4	38.7
5-9	22.7
10-14	21.3
15-19	5.3
20-29	9.3
≥30	2.7

Table 3

Actual and perceived knowledge scores according to hospital site, gender, and profession of the health care worker: nurse versus physician

	Actual knowledge score	Perceived knowledge score
Hospital site		
Site 1 (n = 35)	75 (75-75)	60 (60-80)
Site 2 (n = 36)	100 (75-100)*	60 (60-80)
Gender		
Women (n = 49)	75 (75-100)	60 (60-80)
Men (n = 26)	75 (50-100)*	60 (60-80)
Profession		
Nurse (n = 43)	100 (75-100)	60 (60-80)
Physician (n = 8)	75 (31.25-93.75)*	80 (65-80)

NOTE. Data are median (interquartile range, 25th and 75th quartiles) and are presented as percentages.

* $P < .05$ for site 1 versus site 2, for men versus women and for nurses versus physicians, with the Mann-Whitney test.

combined adherence to emergency room prevention measures with a questionnaire.²³⁻²⁵

The distribution of genders reflects the distribution found in nursing, and the 2 hospital sites account for equal numbers of observations. The most striking result of our study is the median overall low compliance of 22% (IQR 25th-75th percentile, 11%-33%). This is despite prominently displayed respiratory precaution posters in both hospital sites.

Nurses frequently asked about fever and cough (82%), which could be explained by the fact that the emergency room evaluation sheet included an inquiry regarding cough and fever, but they rarely informed the patient of the need to wear a mask (18%). This could be explained by a lack of knowledge regarding the increased transmission risk in the presence of fever and cough. However, despite the fact that the self-applied questionnaire was not completed by the same health care workers, 94.1% of them reported that they would recommend mask wearing to a patient with fever and cough. Even though hygiene equipment (such as masks) was present 94.4% of the time, only 18.3% of patients had applied the mask recommendations prior to triage.

In spite of Centers for Disease Control and Prevention recommendations, patient handwashing measures were never met. The absence of posters focusing on this measure, in contrast to the importance of wearing a mask by patient, may result in the slightly higher adherence to the mask precaution (18% vs 0%, respectively).

Several factors could explain that only 9% of nurses informed patients about proper mask technique. Some nurses were seen to

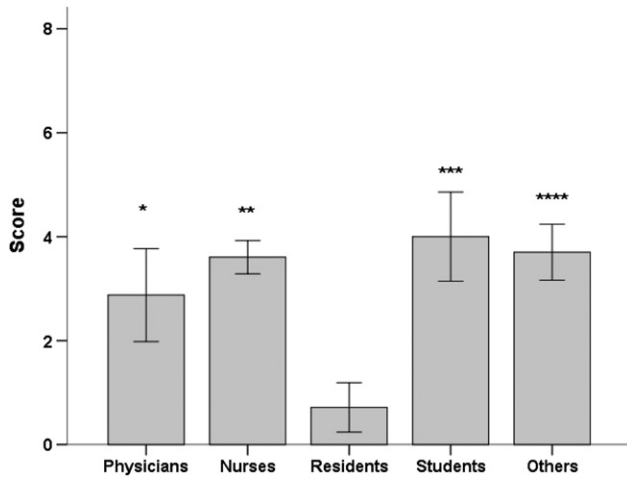


Fig 1. Mean score of the concerns about contracting infections according to the category of health care personnel (1-way analysis of variance and multiple comparisons). * $P = .044$ for residents versus physicians; ** $P = .001$ for residents versus nurses; *** $P = .005$ for residents versus students; **** $P = .004$ for residents versus others.

request isolation precautions instead. Also, when masks were well positioned, nurses did not further address proper application. Moreover, some nurses may have overestimated patient knowledge regarding the need for mask to cover both nose and mouth and be changed when wet.

Despite evidence that spatial separation can reduce droplet spread of infection,³ we showed a very low compliance to patient isolation (12%). We know that implementation of these measures in many crowded waiting rooms remains particularly difficult.³ However, both hospitals sites had well-identified areas for this purpose.

Regarding handwashing, 53% of nurses did so after seeing the patient, and only 40% applied recommendation before. However, given a great turnover of patients, nurses may have just washed their hands after the last patient assessment and be already decontaminated for the next. Some handwashing may have been missed because nurses often left our site of observation immediately before and after seeing the patient.

Interestingly, ensuring that patient wears a mask was done less often in site 1 than in site 2 ($P < .001$, Fisher exact test). However, this difference cannot easily be explained.

As for the questionnaire, it was distributed to all emergency health professionals. Unfortunately, because of our Ethics Committee's recommendation, we could not study the relationship between the observance of a given staff member and his/her questionnaire results. The fact that the questionnaire was not completed by the same health care workers who were observed was a major limitation of this study.

Similar to other studies, the actual compliance rate was lower than perceived observance. A social desirability bias¹⁹ may explain the higher self-reported scores. Because perceived knowledge and perceived compliance were correlated, this may be explained by a personal propensity to overestimate skills. Bias because of the voluntary response may also affect our results. The overall response to the questionnaire was only 61% and could have resulted in a selection bias for workers being knowledgeable and feeling more concerned by the infection control. However, it is reassuring that obtained participation rate was slightly higher than in other similar studies.^{26–28}

We showed a difference of actual compliance between the 2 hospital sites that was not perceived by the employees. Again, this may relate to overestimation of compliance in the questionnaire. The actual difference in compliance between the 2 institutions may

Table 4

Main reasons cited as obstacles toward the wearing of a mask by the health care workers

Reasons to ignore mask wearing	%
Tendency to forget	37.8
Discomfort	35.1
Interference with the relationship with the patient	23.0
Inaccessibility to masks and tissues	20.3
Lack of time	14.9
Because of vaccination	5.4
Unaesthetic	4.1
Useless	2.7
Lack of knowledge	2.7
No one does it	1.4
It is complicated	0

be due to the local culture of each hospital, including the strengthening of prevention practices.²²

At site 1, we noted significantly reduced compliance, and, in this same location, the inaccessibility of the required respiratory hygiene material (masks and tissues) was noted on the questionnaire as an obstacle to mask wearing. This is consistent with clear evidence in the literature between the accessibility of the equipment and the observance of a practice.²⁹

Surprisingly, we also found a difference in actual knowledge between our 2 sites. This may be due to a disparity in the quality of training or an unknown difference between populations. In keeping with recent American data,²⁶ only 25.3% of our workers received infection prevention training in the last year. Given that literature reports a correlation between the rate of training and observance,¹⁹ we again have difficulty explaining the low actual compliance.

Because there was no relation between the measured knowledge and self-reported frequency of application of each of the items, we are unable to recommend the type of training required to improve adherence, contrary to what has already been reported in other studies.¹²

The difference between the level of actual knowledge of the doctors and nurses was unexpected. Indeed, the literature on this subject is not unanimous.^{15,30} Because of the small number of doctors, we suspect an undefined selection bias. Another possibility is that our knowledge test contained only 4 questions obtained from the literature that were not validated on their own. This may have favored nurse respondents.

Despite a different knowledge score between the genders, there was no difference in actual observance. This is in contrast to a study previously conducted at our institution regarding standard precautions.¹⁰ There is no published literature to explain the higher women's scores in the current study. However, other characteristics differentiating the 2 populations may have influenced these results.

Furthermore, 2 obstacles to mask wearing (forgetting and discomfort) stood out. There was also a correlation to decreased perceived compliance. As such, measures to reduce these 2 factors may effectively increase wearing of a mask among professionals.

Given the short time period for data collection, a selection bias was inevitable with respect to direct observations because we had to carry out a sampling of convenience. It is possible that some staff members were observed a greater number of times or that some shifts were over-represented to increase the number of observations.

However, the equal representation of both sites as well as addition of a questionnaire are significant strengths in our study. This study serves as an impetus for larger scale studies. Several factors identified as significantly affecting adherence to respiratory hygiene measures are of potential use with respect to target groups and formulation recommendations.¹⁹

Recommendations

Given the data presented above, we recommend the following measures to standardize adequate practices:

1. Visual tools specifically designed for the emergency waiting room displayed prominently (eg, on the door of the room), encouraging the following basic steps: disinfection of hands and wearing of mask by patient with fever and cough.
2. Modification of present visual tools in waiting rooms to mention real indications for mask wearing: coughing, sneezing, and runny nose and not only fever and cough because they are common.
3. Modification of the emergency department sheet, reminding nurses of the association between fever and cough and the need for patients to wear mask.
4. Positive reinforcement of respiratory hygiene compliance by supervisors and training on respiratory hygiene/respiratory etiquette of emergency personnel with creation of measures such as online courses aimed at facilitating learning and improving accessibility and flexibility as well as reducing costs.

CONCLUSION

The results of our study confirmed the relevance of such investigation, with a view to improving quality of care. It is clear that respiratory precautions are used much less than desired. If the consequences of a suboptimal adherence to respiratory hygiene result in inconspicuous professional emergencies on a daily basis, the impact on the health care system can be a major unexpected outbreak of a respiratory infection. Because transmission of these pathogens occurs before the evaluation of patients, there is a great potential benefit of raising awareness of simple measures such as coughing in the fold of the elbow rather than in the palms of the hands as well as health care worker preventive measures previously outlined.

In the future, it will be important to have feedback on practice to adjust interventions for hospital staff. Our observation tool could be reused to fill this role. Our questionnaire could be modified to target the factors limiting the implementation of respiratory hygiene measures.

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