Appraisal of recommended respiratory infection control practices in primary care and emergency department settings

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Background: The severe acute respiratory syndrome (SARS) epidemic and concern about pandemic influenza prompted the Centers for Disease Control and Prevention (CDC) to develop guidelines to prevent the transmission of all respiratory infections in health care settings during first contact with a potentially infected person. The extent to which health care workers and institutions use these CDC recommended practices is uncertain.
Methods: The study examined health care worker adherence to CDC recommended respiratory infection control practices in primary care clinics and emergency departments of 5 medical centers in King County, Washington, using a self-administered questionnaire. All clinical, allied, and administrative health care workers in study settings were invited to participate: 653 (53%) responded, and 630 were included.
Results: The survey revealed important shortcomings in overall personal and institutional use of CDC recommended practices, including deficiencies in posted alerts, patient masking and separation, hand hygiene, personal protective equipment, staff training, and written procedures. Use of recommended measures was generally higher among nursing staff than medical practitioners.
Conclusion: This study found significant gaps in adherence to CDC recommendations for the control of respiratory infections in ambulatory care clinical settings. Practical strategies are needed to identify and reduce barriers to implementation of recommended practices for control of respiratory infections. (Am J Infect Control 2008;36:268-75.)

Health care environments provide an opportune setting for the spread of infectious disease, particularly respiratory diseases, where mere proximity to a coughing or sneezing patient can pose a risk of disease transmission.[1,2] The potential for transmission can be most imminent in primary and emergency care settings, at which people first present to the health care system prior to diagnosis. Patients with respiratory illness congregate with other patients and companions in waiting and clinical care areas, which are often more crowded than usual during outbreaks of acute respiratory illness. The chance of disease transmission increases when a potentially contagious respiratory illness is not recognized, as might occur with the first cases of a new outbreak, or when infection control measures focusing on early recognition and corresponding measures are not consistently utilized.[3,4] The prospects are particularly worrisome for highly transmissible and severe infections, such as pandemic influenza.

Health care workers (HCWs) face a substantial risk for occupationally acquired respiratory infections. The 2003 severe acute respiratory syndrome (SARS) epidemic highlighted this risk. Of the 8096 probable cases of SARS observed worldwide, 20% involved HCWs.[5] SARS transmission was observed among workers who first encountered patients with symptoms of respiratory infection in ambulatory health care settings.[1,3,4] In some settings, the risk was at least as high for workers in reception and other nonclinical support roles as for workers directly involved in clinical care.[6] Occupationally acquired respiratory infections pose more than a personal risk. Infected workers can transmit infections to patients and companions, including in some cases before the worker develops symptoms or continues to work while sick.[1,7-9]

Prompted by the SARS experience and concern about the possibility of an influenza pandemic, the Centers for Disease Control and Prevention (CDC) in 2004 developed new guidelines for HCW and institutional practices to prevent the transmission of respiratory infections, including but not limited to SARS, at the

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first point of contact with an undiagnosed, symptomatic person.[10] These guidelines include recommendations for visual alerts in waiting areas, respiratory hygiene and cough etiquette procedures for patients including masking and separation of persons with respiratory symptoms, and utilization of standard and droplet infection control precautions by HCWs.[11]

The extent to which these recommendations are implemented in practice is not established. Studies of hand hygiene and precautions against bloodborne pathogens in health care settings have consistently found under utilization of recommended practices.[12-15] In general, the ability or willingness of workers to use safety measures is influenced by a variety of factors including workload, resource availability, and other barriers; adequacy of knowledge and necessary skills; organizational norms and safety climate; and individual practices, perceptions, and beliefs.[14-16] An important step toward designing effective measures to promote infection control practices is to assess the extent to which the desired practices are used and to identify subgroups of workers who may benefit from targeted interventions to improve compliance. Therefore, the present study questioned HCWs in primary and emergency care settings about individual and institutional use of recommended CDC respiratory infection control practices.

METHODS

Between July and December of 2005, HCWs were recruited from 5 medical centers in King County, Washington. Eligible study settings included emergency departments (EDs) and primary care (PC) clinics associated with each medical center; one center restricted participation to the emergency department. Eligible subjects included HCWs who currently work in either a PC or an ED setting ≥1 day per week at a study location, with routine patient contact through clinical care or reception and admittance. Participating clinic managers provided the investigators with the estimated number of potentially eligible HCWs (1363) by job category: physicians, 398 (29%); physician assistants or nurse practitioners, 54 (4%); nurses or nurse aides, 533 (39%); allied professionals, 170 (12%); and reception or administration staff, 208 (15%). Of those, survey materials were distributed anonymously to 1241 HCWs, and 122 unused surveys were returned to the investigators. With the exception of one medical center per Institutional Review Board restriction, a coffee coupon ($3) was included as an incentive with each survey. Completed surveys were returned in a stamped addressed envelope (n = 653; 53%, overall). The percent response ranged from 39% to 76% at each institution. The Institutional Review Board of the medical center with the 39% response rate did not allow use of the incentive. Response rates for the remaining 4 medical centers ranged from 56% to 76%. Among all respondents, 630 met eligibility criteria and were included as study subjects. Twenty-three survey respondents did not meet subject eligibility criteria and were excluded from the study. Estimated percent participation by job type was as follows: physicians, 46%; physician assistants and nurse practitioners, 45%; nurses and nurse aides, 57%; allied professionals, 53%; and administrative staff, 44%.

The study protocol was approved by the University of Washington Human Subjects Division. In addition, one center required an independent review by its own Institutional Review Board.

Questionnaire items involving reported use of infection control practices were derived from CDC guidelines,[11,17-19] particularly ''Respiratory Hygiene/Cough Etiquette in Healthcare Settings.''[10] Question responses used Likert scales, with the exception of questions about demographic background and lengths of time. Questions about practices used responses of Almost Always, Often, Sometimes, Rarely, Never, and either Does Not Apply or Don't Know. Responses of Does Not Apply or Don't Know were treated as missing values but are shown in the Tables; response percentages were based on the number of subjects who provided a measurable response. Demographic questions were based on previously used questionnaires,[14,15] when possible, or were developed by the investigators. Between-group comparisons used contingency tables and χ^2 tests of homogeneity. Data were analyzed with Stata 9.1 software (StataCorp LP; College Station, TX, 2005).

RESULTS

Survey respondents were combined into 5 job categories for display and analysis (Table 1). Medical practitioners (physicians, physician assistants, nurse practitioners) and nurses (registered nurses, licensed practical nurses) each comprised approximately 30% of respondents. Nurse aides, allied professionals, and administrative staff each comprised 13% to 15%. Within these categories, 88% of medical practitioners was physicians, 94% of nurses was registered nurses, 86% of nurse aides was medical assistants, and 77% of administrative staff was patient receptionists. Allied professionals included radiology (44%), phlebotomy (7%), medical (32%) technicians, and respiratory therapists (17%).

Most subjects were employed at 2 medical centers (D and E, 72%; Table 1). A majority of medical practitioners, nurse aides, and administrative staff was from PC settings, but most nurses were from EDs. Allied professionals were equally divided between the 2 settings. Most subjects were female (73%). The highest

Table 1. Demographic characteristics by health care worker occupation

	Medical Practitioner (n = 187)	Nurse (n = 180)	Nurse aide (n = 97)	Allied professional (n = 82)	Administration (n = 84)
Medical center					
Medical center A	5 (3)	19 (11)	0 (0)	18 (23)	3 (4)
Medical center B	15 (8)	14 (8)	10 (11)	3 (4)	9 (11)
Medical center C	13 (7)	48 (27)	13 (14)	1 (1)	1 (1)
Medical center D	52 (29)	55 (31)	35 (39)	56 (72)	35 (42)
Medical center E	95 (53)	40 (23)	32 (36)	0 (0)	35 (42)
Medical setting					
Primary care	107 (66)	33 (19)	72 (77)	32 (49)	64 (77)
Emergency care	54 (34)	143 (81)	21 (23)	33 (51)	19 (23)
Sex					
Male	87 (46)	30 (17)	9 (9)	36 (44)	10 (12)
Female	99 (53)	149 (83)	86 (91)	46 (56)	74 (88)
Age, yr					
21-29	28 (15)	15 (9)	34 (37)	9 (12)	23 (28)
30-39	52 (28)	43 (26)	26 (28)	15 (20)	15 (18)
40-49	55 (30)	44 (26)	14 (15)	23 (31)	25 (30)
50+	48 (26)	65 (39)	18 (20)	28 (37)	19 (23)
Education					
High school	0 (0)	3 (2)	35 (38)	9 (11)	22 (26)
Associates	1 (1)	58 (33)	40 (43)	42 (52)	26 (31)
College	2 (1)	97 (54)	12 (13)	25 (31)	28 (33)
Grad	183 (98)	20 (11)	6 (7)	5 (6)	8 (10)
Ethnicity					
Asian	20 (11)	10 (6)	12 (13)	3 (4)	12 (16)
Black	0 (0)	2 (1)	10 (11)	2 (3)	8 (10)
Native American	1 (1)	3 (2)	2 (2)	0 (0)	2 (3)
White	156 (87)	152 (87)	63 (68)	69 (91)	52 (68)
Other	3 (2)	7 (4)	5 (5)	2 (3)	3 (4)
Work week, hr					
≤40	68 (37)	142 (79)	69 (73)	46 (56)	52 (62)
>40	118 (63)	37 (21)	26 (27)	36 (44)	32 (38)
Current employer, yr					
≤5	98 (53)	88 (49)	61 (64)	41 (50)	42 (50)
>5	88 (47)	91 (51)	34 (36)	41 (50)	42 (50)
Present occupation, yr					
≤5	67 (36)	37 (21)	40 (42)	24 (29)	47 (56)
>5	119 (64)	142 (79)	55 (58)	58 (71)	37 (44)
Health care, yr					
≤5	42 (23)	14 (8)	32 (34)	13 (16)	29 (35)
>5	144 (77)	165 (92)	63 (66)	69 (84)	55 (65)
Supervisor					
No	138 (74)	136 (77)	89 (95)	74 (90)	68 (81)
Yes	48 (26)	41 (23)	5 (5)	8 (10)	16 (19)

NOTE. Table shows number of respondents (column percentages by variable in parentheses).

percentage of females was observed among nurse aides, followed by administrative staff and nurses. Approximately half of the medical practitioners and allied professionals were female. Nurse aides and administrative staff comprised the youngest workers and nurses and allied professionals, the oldest. There was a wide range of education in all categories except medical practitioners.

Medical practitioners were most likely to work >40 hours per week, although overtime was common in all jobs (Table 1). Approximately half of all subjects had been with their current employer, and two thirds had been in their present occupation, for >5 years. Most subjects had worked in health care for >5 years. Approximately one fifth of subjects had supervisor roles. All of the demographic variables showed significant differences between the job categories (χ^2 test, $P < .001$) except years with current employer ($P = .27$).

Patient visual alerts

Overall, approximately three quarters of subjects said that the recommended visual alerts advising patients to inform staff if they had respiratory symptoms were present in their workplace, although 10% did not know (Table 2). Administrative and allied professional workers reported less often that visual alerts were

Table 2. Reported use of patient guidance, masking, and separation recommendations

	Medical practitioner (n = 187)	Nurse (n = 180)	Nurse aide (n = 97)	Allied professional (n = 82)	Administration (n = 84)	*P* value*
Visual alerts						
Inform staff of respiratory symptoms	133 (84) [28]	129 (76) [10]	70 (78) [7]	47 (64) [9]	51 (65) [6]	.004
Practice respiratory precautions	116 (74) [30]	121 (72) [13]	69 (77) [7]	50 (67) [7]	58 (72) [3]	.70
Patient instructions						
I instruct patients about respiratory precautions	86 (48) [6]	134 (76) [4]	56 (63) [8]	31 (41) [7]	26 (37) [13]	<.001
Patients are instructed about how to prevent spread to others	132 (76) [14]	143 (84) [9]	70 (90) [19]	27 (79) [48]	13 (87) [69]	.11
Patient masking and separation						
Disposable masks are offered to coughing patients	143 (86) [20]	166 (94) [4]	76 (83) [5]	54 (74) [9]	71 (91) [6]	<.001
ILI patients are asked to sit 3 feet from others	29 (43) [119]	39 (28) [40]	21 (36) [38]	12 (35) [48]	12 (23) [31]	.12
ILI patients are placed in a private exam room	81 (65) [62]	105 (64) [15]	41 (47) [10]	19 (43) [38]	22 (46) [36]	.004

NOTE. Table shows number and, in parentheses, percent positive responses. A positive response (ie, reported use or practice) is a response of either almost always or often. Percentage is based on the number of subjects who provided a measurable response to the question. Number of nonresponses (subjects who provided a does not apply, don't know, or blank response) is shown in square brackets.
*P value based on χ^2 test of homogeneity.

present than did subjects directly involved in patient care (medical practitioners, nurses, nurse aides). Most subjects reported that visual alerts are posted or that instructions are given to patients about how to prevent spread of infection; however, nurses and nurse aides were much more likely to report doing so personally than other types of HCWs, notably medical practitioners.

Patient masking and separation

Most subjects, regardless of occupation, said that masks are offered to coughing patients (Table 2). Most subjects indicated that patients with influenza-like illness (ILI) are *not* asked to sit at least 3 feet away from others; a large number of subjects (44%) did not know or respond. Only approximately half to two thirds of subjects in clinical care roles (medical practitioners, nurses, nurse aides) said that ILI patients are placed in a private examination room; again, many clinicians (19%) gave no calculable response. Medical practitioners were generally least knowledgeable about separation practices.

Hand hygiene

Nearly all respondents reported practicing hand hygiene before direct contact with a patient (91%) and after working with a coughing patient (95%; Table 3). Fewer reported practicing hand hygiene immediately after removing disposable gloves (81%); medical practitioners were less likely than nurses, nurse aides, or allied professionals to do so ($P < .001$). Only half of the medical practitioners and nurses reported practicing hand hygiene after taking a pulse or blood pressure. Less than half of medical practitioners but approximately 60% of nurses and nurse aides reported practicing hand hygiene after touching items in the vicinity of a patient.

Personal protective equipment

Approximately three quarters of nurses and allied professionals reported wearing gloves when they attended a patient with ILI symptoms (Table 3), but only half of the nurse aides and 28% of medical practitioners reported doing so. Almost all respondents in patient care or allied professional roles removed gloves promptly after use and before going to another patient. However, one quarter or less of subjects in any occupation reported using eye protection or a mask in the presence of sneezing or coughing patients.

Written first encounter procedures

Overall, 77% of subjects reported that their practice setting had clear written procedures on what to do, and what infection control actions to take, when an undiagnosed patient arrives with symptoms of respiratory infection. Conversely, almost 20% of medical practitioners and 15% of administrative staff, but only 6% of nurses and nurse aides, indicated they did not know whether their setting had developed first-encounter procedures.

Infection control training

One quarter (24%) of medical practitioners; approximately 15% of nurses, nurse aides, and allied professionals; and 40% of administrative staff reported that they had not received any training on respiratory infection control and personal protection practices during the previous 12 months ($P < .001$). Of those who received training, approximately half of medical practitioners (52%), nurses (47%), nurse aides (46%), allied

Table 3. Reported use of hand hygiene and personal protective equipment recommendations

	Medical practitioner (n = 187)	Nurse (n = 180)	Nurse aide (n = 97)	Allied professional (n = 82)	Administration (n = 84)	*P* value*
Hand hygiene						
Before direct contact with a patient	174 (94) [1]	165 (92) [1]	86 (91) [2]	70 (86) [1]	58 (83) [14]	.06
After taking a pulse or blood pressure	92 (56) [24]	91 (51) [1]	63 (67) [3]	32 (74) [39]	5 (71) [77]	.02
After working with a coughing patient	178 (96) [1]	173 (97) [1]	90 (95) [2]	80 (98) [0]	65 (90) [12]	.20
After touching items near a patient	81 (44) [1]	103 (58) [2]	62 (66) [3]	60 (73) [0]	57 (75) [8]	<.001
After removing my disposable gloves	135 (75) [6]	151 (85) [2]	82 (88) [4]	68 (85) [2]	20 (69) [55]	.01
Disposable gloves						
Wear when with an ILI patient	52 (28) [1]	135 (76) [2]	47 (52) [7]	61 (74) [0]	11 (31) [49]	<.001
Remove promptly after use (icp6)	174 (99) [11]	178 (100) [2]	93 (100) [4]	78 (99) [3]	26 (100) [58]	.47
Change before going to another patient	176 (100) [11]	178 (100) [2]	89 (100) [8]	77 (97) [3]	11 (100) [73]	.02
Eye protection						
Wear when with a sneezing patient	36 (20) [5]	39 (22) [4]	18 (20) [7]	20 (25) [1]	3 (10) [54]	.52
Respiratory protection						
Wear a mask when examining a coughing ILI patient	41 (22) [2]	57 (33) [5]	28 (34) [14]	25 (34) [9]	2 (20) [74]	.11

NOTE. Table shows number and, in parentheses, percent positive responses. A positive response (ie, reported use or practice) is a response of either almost always or often. Percentage is based on the number of subjects who provided a measurable response to the question. Number of nonresponses (subjects who provided a does not apply, don't know, or blank response) is shown in square brackets.

*P value based on χ^2 test of homogeneity.

professionals (48%), and administrative staff (43%) reported <1 hour of training during the previous year ($P = .83$).

Primary versus emergency care settings

There were significant differences in some practices between ED and PC settings, although this was partially associated with differences in job distribution. Overall, 70% of subjects working in ED settings but only 38% in PC settings reported wearing disposable gloves when working with coughing ILI patients ($P < .001$). The ED workers also reported more often that ILI patients are placed in a private examination room (66%) or that patients are given personal instructions about respiratory precautions (69%; versus PC, 48% and 46%, respectively; $P < .001$). Other differences, although statistically significant ($P < .05$), were less pronounced (absolute difference, ≤10%).

DISCUSSION

This study identified shortcomings in HCWs knowledge and reported use of recommended infection control practices to prevent transmission of respiratory infections in primary and emergency care settings. Lapses were observed across all HCW occupations, although nurses tended to be more compliant with recommended practices than workers in other occupations, and medical practitioners tended to be less compliant. The study institutions commonly lacked, or workers had no knowledge of, written infection control procedures for undiagnosed patients presenting with respiratory infection symptoms. It is especially concerning that HCWs commonly reported little or no recent training in respiratory infection control and personal protection practices, despite the current concern regarding a potential influenza pandemic.[20] Reception, administration, and allied professional staff who routinely interact with patients were particularly unfamiliar with recommendations that are relevant to their work situation, suggesting a need for greater inclusion of nonclinical workers in infection control efforts. The importance of such efforts was illustrated by the SARS epidemic, during which one study in Hong Kong found higher SARS attack rates for nonmedical support staff (2.7%) than for nurses (1.2%) and other medical staff (0.3%).[6]

Infection control and personal protective measures for respiratory infections are intended to be used routinely. However, because of practical constraints such as limited funding; material resources; and space, job, and productivity demands, and human nature, significant challenges can prevent reliable implementation of recommended practices. Unfortunately, although gaps in recommended practices can be inconsequential during routine conditions, they can have severe impacts during an unanticipated outbreak of a highly communicable infection. By the time an emergent event is recognized, there may already be substantial spread of disease to HCWs and other patients.[21] The SARS outbreak in Canada provided a wake-up call regarding the importance of strict adherence to infection control measures and a high baseline level of preparedness for prevention of respiratory infections. The containment of this outbreak in Vancouver, in contrast to the experience in Toronto, has been related to appropriate and timely infection control efforts.[21]

The CDC recommendation for clinics to display visual alerts instructing patients to inform health care staff of their respiratory symptoms upon arrival and providing basic respiratory infection control instructions is relatively new.[19] Although most medical practitioners and nursing staff reported that visual alerts were adequate in their practice setting, fewer administrative staff in front-desk reception areas agreed, suggesting a need for enhanced attention to visual alerts at clinic entrances. The patient's role in preventing the spread of infection to others is further reinforced when health care providers give personal instructions beyond the institutional alerts. During the SARS epidemic, personal hygiene education was associated with reduced incidence of influenza and other common respiratory illnesses in the community.[22] In the present study, nurses were much more likely to instruct patients personally about how to prevent the spread of respiratory infections than were medical practitioners or other workers with patient contact in technical or administrative roles. In general, responses from all occupations were lower when asked about information actively conveyed by the worker, compared with information passively conveyed by the institution.

Unprotected exposure to a SARS patient at a distance of less than 3 feet, with or without physical contact, was identified as a potential infection hazard during the SARS epidemic.[1] The CDC recommends that patients with respiratory symptoms be encouraged to sit 3 feet from others in waiting areas, particularly during periods of increased respiratory illness in the community.[10] In the present study, respondents from all occupations rarely indicated that ILI patients are asked to sit 3 feet apart, and almost half did not know whether spatial separation was practiced in their setting. Similarly, only approximately half of direct care providers reported placing ILI patients in a private examination room as recommended by the CDC. Patient separation was reported more commonly in ED than PC settings, which may reflect differences in physical layout and capacity of the facilities. However, although evidence suggests that spatial separation can reduce the spread of droplet-transmissible infections,[23] implementation in a crowded waiting room is challenging[24] and in most settings requires significant planning and financial resources to identify appropriate additional space.

An alternative strategy involves ''cohorting'' or grouping patients with the same infection or symptoms in areas separated from other patients.[11,18] This practice was successfully used in Toronto and Taiwan to help control SARS transmission in hospitals.[25] The CDC recommends offering a surgical or procedure mask to coughing patients to contain the spread of infected droplets, particularly during periods of high respiratory illness in the community.[10,26] This was judged to be an effective preventive measure during the SARS epidemic.[25] In the present study, most respondents reported offering masks to coughing patients, although nurses and administrative staff were more likely to do so than medical practitioners, nurse aides, or technical staff. However, our data are contradicted by a random-dialed telephone survey of 2231 households in 11 emerging infections programs surveillance areas of the United States (February 2004).[27,28] Eighteen percent of adults indicated that they had an illness they thought was flu in the preceding 6 months; of those, only 8% of adults who sought treatment said their health care provider asked them to wear a mask, although 82% said they would do so if requested.[28] The differences in the results of these 2 studies may reflect differing methodologies used to collect data: self-administered questionnaires may overreport effort, and telephone surveys may underreport effort because of limitations of recall. These findings, plus those of the present study, indicate a need to enhance efforts to provide masks for coughing patients at clinic entrances, with particular attention toward HCWs in occupations in which this may be less likely to be considered their responsibility.

Hand hygiene and the use of personal protective equipment were identified as critical infection control measures during the SARS epidemic,[29-32] but the present study found that they are not used as thoroughly as recommended. Most workers reported practicing hand hygiene before (90%) and after (95%) direct contact with a patient, but fewer did so immediately after touching items near a patient with ILI symptoms (59%) or checking a pulse or blood pressure (58%). Glove use with ILI patients was inconsistent (54%), particularly among medical practitioners (28%). This may reflect a perception that the risks are low through touching intact skin or objects, even though there is a strong theoretic rationale for the recommendation.[17] Eye protection was rarely used (21%). However, except for patients with suspected SARS or avian influenza, this recommendation is unresolved.[19]

The present study had several limitations. The overall participation rate of 53% may have biased sample selection toward workers who participated because of knowledge of, or interest in, infection control. If so, the true use of respiratory infection control practices may be even lower than observed. Regardless, it is reassuring that the overall participation rate in the present study is comparable with that achieved in similar, previous studies,[14,15,33] suggesting that the present study can reasonably be compared with existing literature. All HCW occupations were similarly represented with estimated percent response by job category ranging from 44% to 57%. The generalizability of study findings is also potentially limited by the study's reliance on

reported practices, rather than observations or other independent confirmation. Many previous, broadly based studies of HCW practices, however, have relied on similar study designs and self-reported knowledge, beliefs, or behaviors.[14,15,33,34] Nevertheless, studies comparing observed versus self-report hand hygiene practices have demonstrated inaccuracies in self-reporting.[35-37] Bias may have been introduced by a tendency to report desirable practices. Responses might also have differed if the survey had been conducted during the winter influenza season with heightened awareness of respiratory infection control needs, rather than during summer and fall. On the other hand, the chosen study approach is appropriate for describing practices during routine circumstances rather than in response to a seasonal outbreak. Finally, the study was restricted to 5 independent medical centers in a metropolitan area, possibly limiting generalization of findings to other populations or settings. Despite the acknowledged limitations of this study, we believe our findings of HCW and institutional practices in primary and emergency care settings are likely to reflect practices in other facilities and communities in the United States.

This study raises important concerns about the adequacy of first-encounter response for control of respiratory infections in clinical settings. There is a clear need to promote broader use of CDC recommended practices and to identify and reduce barriers to their implementation. One such barrier is that, under certain circumstances, taking care of patients' needs may take precedence over the willingness of workers to protect themselves.[14] To implement effective change of infection control practices, it may be necessary to target both the individual and the organizational environment.[38-41]

References

1. Varia M, Wilson S, Sarwal S, McGeer A, Gournis E, Galanis E, et al, for the Hospital Outbreak Investigation Team. Investigation of a nosocomial outbreak of severe acute respiratory syndrome (SARS) in Toronto, Canada. CMAJ 2003;169:285-91.
2. Bridges CB, Kuehnert MJ, Hall CB. Transmission of influenza: implications for control in health care settings. Clin Infect Dis 2003;37:1094-101.
3. Health Canada. National Advisory Committee on SARS and Public Health. Learning from SARS: renewal of public health in Canada. Health Canada, Ontario. 2003. Available at: http://www.hc-sc.gc.ca/english/protection/warnings/sars/learning.html. Accessed September 17, 2004.
4. The SARS Commission. The Final Report of the Independent SARS Commission. The Commission to Investigate the Introduction and Spread of SARS in Ontario, the Honourable Archie Cambell, Commissioner, Toronto, Ontario. 2006. Available at: http://www.sarscommission.ca/index.html. Accessed February 26, 2007.
5. World Health Organization; Summary of probable SARS cases with onset of illness from November 1, 2002, to July 31, 2003 (based on data as of December 31, 2003). April 2004. Available at: http://www.who.int/csr/sars/country/table2004_04_21/en/. Accessed February 26, 2007.
6. Lau T, Yang X, Leung P, Chan L, Wong E, Fong C, et al. SARS in three categories of hospital workers, Hong Kong. Emerg Infect Dis 2004;10:1399-404.
7. Wright SW, Decker MD, Edwards KM. Incidence of pertussis infection in health care workers. Infect Control Hosp Epidemiol 1999;20:120-3.
8. Kurt TL, Yeager AS, Guenette S, Dunlop S. Spread of pertussis by hospital staff. JAMA 1972;221:264-7.
9. Christie CD, Glover AM, Wilke MJ, Marx ML, Reising SF, Hutchinson NM. Containment of pertussis in the regional pediatric hospital during the Greater Cincinnati epidemic of 1993. Infect Control Hosp Epidemiol 1995;16:556-63.
10. Centers for Disease Control and Prevention. Respiratory hygiene/-cough etiquette in healthcare settings—fact sheet. 2004. Available at: http://www.cdc.gov/flu/professionals/pdf/resphygiene.pdf. Accessed April 9, 2006.
11. Garner J. Hospital Infection Control Practices Advisory Committee; CDC guideline for isolation precautions in hospitals. Centers for Disease Control and Prevention. 1997. Available at: http://www.cdc.gov/ncidod/dhqp/gl_isolation.html#. Accessed November 26, 2006.
12. Pittet D, Mouraouga P, Perngeger TV. Compliance with handwashing in a teaching hospital. Ann Intern Med 1999;130:126-30.
13. Pittet D, Simon A, Hugonnet S, Pessoa-Silva CL, Sauvan V, Perneger TV. Hand hygiene among physicians: performance, beliefs and perceptions. Ann Intern Med 2004;141:1-8.
14. Gershon R, Vlahov D, Felknor S, Vesley D, Johnson P, Delclos G, et al. Compliance with universal precautions among health care workers at three regional hospitals. Am J Infect Control 1995;23:225-36.
15. Gershon R, Karkashian C, Grosch J, Murphy L, Escamilla-Cejudo A, Flanagan P, et al. Hospital safety climate and its relationship with safe work practices and workplace exposure incidents. Am J Infect Control 2000;28:211-21.
16. Sexton J, Helmreich R, Neilands T, Rowan K, Vella K, Boyden J, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. BMC Health Serv Res 2006;3:6-44.
17. Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APOC/IDSA Hand Hygiene Task Force. MMWR Morb Mortal Wkly Rep 2002;51(RR-16):1-44.
18. Centers for Disease Control and Prevention. Public health guidelines for community-level preparedness and response to severe acute respiratory syndrome (SARS), version 2/3 (May 3, 2005, revision). Supplement I: infection control in healthcare, home, and community settings. Available at: http://www.cdc.gov/ncidod/sars/guidance/i/pdf/i.pdf. Accessed November 26, 2006.
19. Centers for Disease Control and Prevention. Draft guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee (HICPAC), CDC. Closed for public comment on August 13, 2004.
20. Fauci AS. Pandemic influenza threat and preparedness. Emerg Infect Dis 2006;12:73-7.
21. Skowronski DM, Petric M, Daly P, Parker R, Bryce E, Doyle P, et al. Coordinated response to SARS, Vancouver, Canada. Emerg Infect Dis 2006;12:155-8.
22. Lo J, Tsang T, Leung Y, Yeung E, Wu T, Lim W. Respiratory infections during SARS outbreak, Hong Kong. Emerg Infect Dis 2003;11:1738-41.
23. Feigin RD, Baker CJ, Herwaldt LA, Lampe RM, Mason EO, Whitney SE. Epidemic meningococcal disease in an elementary school classroom. N Engl J Med 1982;307:1255-7.
24. Chen WK, Wu HD, Lin CC, Cheng YC. Emergency department response to SARS, Taiwan. Emerg Infect Dis 2005;11:1067-73.

25. McDonald L, Simor A, Su I, Maloney S, Ofner M, Chen K, et al. SARS in healthcare facilities, Toronto and Taiwan. Emerg Infect Dis 2004;10: 777-81.
26. Centers for Disease Control and Prevention. Interim guidance for the use of masks to control influenza transmission: guidelines and recommendations. 2005. Available at: http://www.cdc.gov/flu/professionals/infectioncontrol/maskguidance.htm. Accessed September 30, 2006.
27. Pinner RW, Rebmann CA, Schuchat A, Hughes JM. Disease surveillance and the academic, clinical, and public health communities. Emerg Infect Dis 2003;9:781-7.
28. Centers for Disease Control and Prevention. Experiences with influenza-like illness and attitudes regarding influenza prevention—United States, 2003-2004 influenza season. MMWR Morb Mortal Wkly Rep 2004;53:1156-8.
29. Chen Y, Huang L, Chan C, Su C, Chang S, Chang Y, et al. SARS Research Group of National Taiwan University College of Medicine and National Taiwan University Hospital. SARS in hospital emergency room. Emerg Infect Dis 2004;10:782-8.
30. Farquharson C, Baguley K. Responding to the severe acute respiratory syndrome (SARS) outbreak: lessons learned in a Toronto emergency department. J Emerg Nurs 2003;29:222-8.
31. Chen Y, Chen P, Chang S, Kao C, Wang S, Wang L, et al. SARS Research Group of National Taiwan University College of Medicine and National Taiwan University Hospital. Infection control and SARS transmission among healthcare workers, Taiwan. Emerg Infect Dis 2004;10:895-8.
32. Chow CB. Post-SARS infection control in the hospital and clinic. Paediatr Respir Rev 2004;5:289-95.
33. Osborne S. Influences on compliance with standard precautions among operating room nurses. Am J Infect Control 2003;31:415-23.
34. Williams CO, Campbell S, Henry K, Collier P. Variables influencing worker compliance with universal precautions in the emergency department. Am J Infect Control 1994;22:138-48.
35. O'Boyle CA, Henly SJ, Larson E. Understanding adherence to hand hygiene recommendations: the theory of planned behavior. Am J Infect Control 2001;29:352-60.
36. Jenner E, Fletcher B, Watson P, Jones F, Miller L, Scott G. Discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals. J Hosp Infect 2006;63:418-22.
37. Kretzer EK, Larons EL. Behavioral interventions to improve infection control practices. Am J Infect Control 1998;26:245-53.
38. Haas JP, Larson EL. Measurement of compliance with hand hygiene. J Hosp Infect 2007;66:6-14.
39. Seto WH. Staff compliance with infection control practices: application of behavioural sciences. J Hosp Infect 1995;30(Suppl):107-15.
40. Larson EL, Early E, Cloonan P, Sugrue S, Parides M. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. Behav Med 2000;26:14-22.
41. Moore C, Gamage B, Bryce E, Copes R, Yassi A. Protecting health care workers from SARS and other respiratory pathogens: organizational and individual factors that affect adherence to infection control guidelines. Am J Infect Control 2005;33:88-96.