Ann. Occup. Hyg., 2016, Vol. 60, No. 5, 619–630
doi:10.1093/annhyg/mew008
Advance Access publication 15 March 2016

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Compliance with the Use of Medical and Cloth Masks Among Healthcare Workers in Vietnam

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Submitted 23 June 2015; revised 18 January 2016; revised version accepted 19 January 2016.

ABSTRACT

Background: Masks are often worn in healthcare settings to prevent the spread of infection from healthcare workers (HCWs) to patients. Masks are also used to protect the employee from patient-generated infectious organisms but poor compliance can reduce efficacy. The aim of this study was to examine the factors influencing compliance with the use of medical and cloth masks amongst hospital HCWs.
Methods: HCWs compliance with the use of medical and cloth masks was measured over a 4-week period in a randomized controlled trial in Vietnam. HCWs were instructed to record their daily activities in diary cards. Demographic, clinical, and diary card data were used to determine the predictors of compliance and the relationship of compliance with infection outcomes.
Results: Compliance rates for both medical and cloth masks decreased during the 4 weeks: medical mask use decreased from 77 to 68% ($P < 0.001$) and cloth masks from 78 to 69% ($P < 0.001$). The presence of adverse events (adjusted RR 0.90, 95% CI 0.85–0.95), and performing aerosol-generating procedures (adjusted RR 0.78, 95% CI 0.73–0.82) were negatively associated with compliance, while contact with febrile respiratory illness patients was positively associated (adjusted RR 1.14, 95% CI 1.07–1.20). Being compliant with medical or cloth masks use (average use ≥70% of working time) was not associated with clinical respiratory illness, influenza-like illness, and laboratory-confirmed viral infection.
Conclusion: Understanding the factors that affect compliance is important for the occupational health and safety of HCWs. New strategies and tools should be developed to increase compliance of HCWs. The presence of adverse events such as discomfort and breathing problems may be the main reasons for the low compliance with mask use and further studies should be conducted to improve the design/material of masks to improve comfort for the wearer.

KEYWORDS: cloth masks; compliance; healthcare workers; masks; medical masks; respiratory infections

BACKGROUND

It is well documented that compared to the general population, hospital healthcare workers (HCWs) are at increased risk of acquiring various nosocomial respiratory infections (Bellei *et al.* 2007; Macintyre *et al.* 2014b). In addition, studies have shown that HCWs

are responsible for contributing to the spread of pathogens in healthcare facilities, especially during outbreaks and pandemics (Horcajada *et al.*, 2003). Medical or surgical masks (hereinafter medical masks) are used by HCWs and sick patients to prevent spread of pathogenic organisms to people surrounding them. Medical masks are also used to protect wearer from splashes and sprays of blood and body fluids. Filtering face piece respirators are fitted devices that are recommended to protect from specific pathogens, during aerosol generating and in high risk situations (Chughtai *et al.*, 2013a; MacIntyre and Chughtai 2015).

Although medical masks and respirators are commonly recommended in Vietnam to protect HCWs from influenza, tuberculosis, and other respiratory infections (Ministry of Health Socialist Republic of Vietnam 2009a, b, 2011), their use is typically limited to certain high risk situations, procedures and patients (Chughtai *et al.*, 2015a; Chughtai *et al.*, 2015b). Most HCWs use either medical or cloth masks and respirators are not widely used in health facilities (Chughtai *et al.*, 2015a; Chughtai *et al.*, 2015b). Although both medical and cloth masks are commonly used in low resource settings, there is a significant difference between the two products (Figures 1 and 2). Medical masks are for single use and generally made of a three ply structure of nonwoven material, usually polypropylene [Institute of Medicine (IOM) National Academy of Sciences 2006; US Food and Drug Administration (FDA)], spunbonded, melt-blown, or wet-laid (US Food and Drug Administration (FDA)). Medical mask use is not regulated, and manufacturing companies are only required to submit testing data to government authorities (US Food and Drug Administration (FDA); Standards Australia Limited/Standards New Zealand 2002; 3M Personal Safety Division 2014). Cloth masks are commonly made of cotton, gauze, or silk and they may be reused after decontamination (Chughtai *et al.*, 2013b). Despite common use in low resource countries, there is only one randomized controlled trial (RCT) of efficacy of cloth masks, and they are not tested or regulated (Chughtai *et al.*, 2015a; MacIntyre and Chughtai 2015).

Compliance with the use of mask is, however, reported to be lower compared to gloves, gowns, and goggles (Madan *et al.*, 2001). A systematic review found that compliance with the use of masks ranges from 4 to 55% (mean 30%) (Gammon *et al.*, 2008). Studies show that only 5–10% of HCWs use masks during trauma resuscitation (Madan *et al.*, 2001; Madan *et al.*, 2002) and less than half (46%) use masks during other high risk procedures with trauma cases (Evanoff *et al.*, 1999). Suboptimal compliance with mask use is reported not only during routine patient care but also during outbreaks and pandemics (Park *et al.*, 2004; Wise *et al.*, 2011). It has been previously suggested that HCW compliance with the use of medical mask depends on various individual, organizational, and environmental factors (Gershon *et al.*, 1995; MacIntyre *et al.*, 2011; MacIntyre *et al.*, 2013; Martel *et al.*, 2013; Nichol *et al.*, 2013).

This study aimed to examine factors associated with use of medical and cloth masks and compliance amongst hospital HCWs and examine the relationship of compliance with infection outcomes.

METHODS

Compliance with the use of medical and cloth masks was measured over a 4-week period within

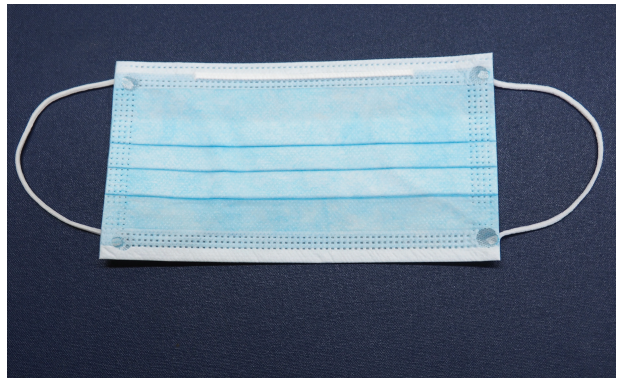

Figure 1 Medical mask.

Figure 2 Cloth mask.

the setting of a RCT in Hanoi, Vietnam (MacIntyre *et al.*, 2015). A total of 1607 HCWs were recruited from 14 Hanoi hospitals—580 (36.1%) HCWs were in the medical masks arm, 569 (35.4%) in the cloth mask arm, and 458 (28.5%) in the control arm. The primary outcomes of the trial were clinical respiratory illness, (CRI), influenza-like illness (ILI), and laboratory-confirmed viral respiratory infection. HCWs in the mask arms were recommended to wear masks during the entire work shift, except while in the toilet or during tea or lunch breaks. All participants were also expected to follow hospital guidelines on hand washing. During aerosol-generating procedures (AGPs) and high risk situations, HCWs used other personal protective equipment (PPE) recommended by the hospitals such as gloves, gowns and goggles.

HCWs who either used a medical mask (n = 580) or a cloth mask (n = 569), were included in this study. As participants in the control arm (n = 498) continued with normal practices, which may or may not have included mask wearing, they were excluded from this study. Participants were supplied with two medical masks per day (medical mask arm) or five cloth masks in total for the study duration (cloth masks arm). Medical masks were discarded after use, while cloth masks were washed with soap and water and were reused over the study period (MacIntyre *et al.*, 2015).

Demographic and clinical data were collected, including age, sex, occupation, smoking history, influenza vaccination, and pre-existing medical condition. During the 4 weeks, compliance with the use of medical and cloth masks was monitored through the use of diary cards. HCWs were instructed to record their daily activities in the diary cards. Information collected included the number of hours worked, number of hours that they wore a mask, number of febrile patients seen, hand-washing practices, and number of AGPs performed per day.

At the end of the study, the participants completed a structured exit survey and provided information on adverse events associated with mask use, communication issues, perceived risk of acquiring infection, and importance of other infection control practice such as hand washing. Demographic, clinical, exit interview, and diary card data were used to examine factors associated with HCW compliance with the use of medical and cloth masks.

Study and outcome factors

The primary outcome measure of this study was self-reported HCW compliance with the use of medical and cloth masks over the 4-week trial period. HCWs recorded the number of working hours and number of hours that they wore a mask in diary cards at the end of each day. To measure compliance, a continuous variable was created by dividing the average hours of mask use over the 4-week trial period by the average number of working hours over the same period ('Outcome 1'). Holidays and other nonworking days were excluded. A binary variable was created to examine the factors affecting compliance ('Outcome 2'). HCWs were categorized as 'compliant' if the average mask use over the trial period was greater than or equal to 70% of the working time during the same period. The cut-off was set based on the mean value for compliance being approximately 70% and has been used in our previous published mask study (MacIntyre *et al.*, 2013).

HCWs were categorized as being in 'contact with febrile respiratory illness patients' if they reported that they examined at least one febrile respiratory illness patient per day during the trial period. The mean of the number of self-reported hand washes performed by a HCW over the trial period was calculated. The mean of all AGPs performed over the 4-week trial period was estimated by self-report, and a binary variable 'aerosol generating procedures' was created if HCWs performed at least one AGP per day during the trial period (Macintyre *et al.*, 2014b). AGPs were defined as procedures which generate respiratory aerosols, such as suctioning of airways, sputum induction, endotracheal Intubation, chest physiotherapy, positive airway pressure (BIPAP), and bronchoscopy. HCWs reported various adverse events during the study period, such as headache, skin rash, breathing problems, allergies, and general discomfort. A binary variable 'presence of an adverse event associated with mask use' was created if any adverse event was reported by a HCW.

Analysis

Longitudinal analysis was performed to examine the trends of mask use over the 4-week period. To account for the correlation of compliance and study period for HCWs, we used mixed models (PROC MIXED) with a random intercept and slope (Fitzmaurice *et al.*, 2012). The continuous compliance variable ('Outcome 1') was used for the longitudinal analysis.

A multivariable log binomial model was fitted using generalized estimating equation (GEE) to estimate relative risk (RR) of being compliant at least 70% of the time after adjusting for potential confounders (Vittinghoff *et al.*, 2012). As hospital wards were the unit of randomization, we made an adjustment for clustering by wards. A binary compliance variable was the outcome measure ('Outcome 2') for regression analysis. First, univariable analysis was conducted with the main exposure variable (randomization arm) and all other important variables. Any variable that had a $P < 0.25$ in the univariable analysis was included in the multivariable analysis. A backward elimination method was applied and variables that did not have any confounding effect were removed from the final model. Data on self-reported adverse events for 19 HCWs were missing and these cases were excluded from the final model. Distribution of the 19 missing cases was generally similar between study and outcome factors. The data were analysed using SAS, version 9.4.

As pre-existing medical conditions and self-reported adverse events (such as discomfort) were significant predictors of compliance in the univariable analysis, we performed an additional analysis to examine the nature of HCW illness and type of adverse event associated with compliance. Compliance rates were estimated among HCWs with pre-existing medical conditions and among those who reported an adverse event. Univariable log binomial models were fitted using GEE to estimate the RR of being compliant at least 70% of the time (Vittinghoff *et al.*, 2012).

To examine the relationship of compliance with infection outcomes, we compared the rates of CRI, ILI, and laboratory-confirmed viral respiratory infection among compliant and noncompliant groups. RR of CRl, ILI, and laboratory-confirmed viral respiratory infection were calculated using the log binomial model under GEE framework.

Ethical approval

Ethical approval for this trial was obtained from the Institutional Review Board at the National Institute for Hygiene and Epidemiology (NIHE) (approval number 05 IRB) and the Human Research Ethics Committee of the University of New South Wales (UNSW), Australia, (HREC approval number 10306).

RESULTS

Demographic characteristics of participants are detailed in Table 1. Among the 1149 HCWs in the medical and cloth mask groups, 79% were female, 70% were nurses, and 81% had a graduate degree. The mean age of participants was 40 years (± 10.6 SD) and 4% had received the influenza vaccine in the last year. Around 2.63% (30/1149) of participants were asthmatic, 1.1% (13/1149) of participants were immunocompromized and 8.89% (101/1149) of participants had 'other' medical conditions. General discomfort and breathing problems were the most commonly reported adverse events. Around 35% (397/1130) of participants reported general discomfort and 18.3% of participants (207/1130) reported breathing problems.

Table 1. Demographic characteristics

Variable	Number	Percent
Type of mask		
Cloth mask	569	49.5
Medical mask	580	50.5
Gender		
Male	245	21.3
Female	904	78.7
Age (mean and SD)		35.9 (± 10.6 SD)
Work type		
Doctor	341	29.7
Nurse	808	70.3
Work year (mean and SD)		10.5 (±9.8 SD)
Education		
Postgraduate	213	18.5
Graduate	936	81.5
Smoking status		
Current/ Ex. Smoker	157	13.7
Non smoker	992	86.3
Influenza vaccine		
Yes	42	3.7
No	1107	96.3
Pre-existing medical conditions		
Yes	136	11.8
No	1013	88.2
Presence of adverse events		
Yes	469	40.8
No	661	57.5
Missing data	19	1.7
Contact with febrile patient[a]		
Yes	588	51.2
No	561	48.8
Hand washing per day (Mean and SD)		15.6 (±11.0 SD)
Aerosol generating procedures[b]		
Yes	768	66.8
No	381	33.2

[a]Examined at least one febrile respiratory illness patient per day during the trial period.
[b]Performed at least one AGP per day during trial period.

Longitudinal analysis showed that the HCW compliance with use of medical and cloth masks decreased over the four week period. Mean compliance rates over the time period were 74 and 72% for the cloth and medical masks, respectively. The compliance rates in cloth mask group decreased from 78% on day 1 to 69% on day 28 ($P < 0.001$) and in medical mask group decreased from 77% on day 1 to 68% on day 28 ($P < 0.001$). There were no differences in compliance between medical and cloth masks ($P = 0.155$) and the use of both types of masks decreased by 9% over the 4-week trial period.

A majority of participants (57% of HCWs in each group) used a surgical or cloth mask for 70% or more of their working time. The following variables were found to be a significant predictor of compliance during univariable regression analysis: age, pre-existing medical conditions, adverse events associated with mask use, contact with at least one febrile respiratory illness patient per day and performing at least one AGP per day (Table 2). Age was positively associated with compliance ($P = 0.046$). HCWs with a pre-existing medical condition were 18% more compliant than those without a reported medical illness. Adverse events connected with mask use (such as breathing problems and discomfort) were associated with 15% lower compliance levels. Participants who saw at least one patient with a febrile respiratory illness per day were 30% more compliant, compared to those who

Table 2. Predictors of compliance with the use of medical and cloth masks—Univariable analysis

Variable	Compliance[a]		Univariate analysis		
	Number	%	RR	(95% CI)	*P* value
Type of masks (Arm)					
Cloth mask	323/569	56.8	1.00	0.91–1.11	0.941
Medical mask	328/580	56.6	Ref		
Gender					
Male	134/245	54.7	0.96	0.84–1.09	0.491
Female	517/904	57.2	Ref		
Age			1.00	(1.00–1.01)	0.046
Work type					
Doctor	201/341	58.9	1.06	0.95–1.18	0.302
Nurse	450/808	55.7	Ref		
Work year			1.00	(1.00–1.01)	0.604
Education					
Postgraduate	129/213	60. 6	1.08	0.96–1.23	0.187
Graduate	522/936	55.8	Ref.		
Smoking status					
Current/Ex. Smoker	93/157	59.2	1.05	(0.91–1.21)	0.472
Non smoker	558/992	56.2	Ref.		
Flu vaccine					
Yes	23/42	54.8	0.97	0.73–1.28	0.804
No	628/1107	56.7	Ref.		
Pre-existing medical condition					
Yes	89/136	65.4	1.18	1.03–1.35	0.016
No	562/1013	55.5	Ref.		
Presence of adverse events[b]					
Yes	242/469	51.6	0.85	0.77–0.95	0.004
No	399/661	60.4	Ref.		
Contact with febrile patient[c]					
Yes	375/588	63.8	1.30	1.17–1.44	<0.001

Table 2. *Continued*

Variable	Compliance[a]		Univariate analysis		
	Number	%	RR	(95% CI)	*P* value
No	276/561	49.2	Ref		
Hand washing per day			1.01	(0.96–1.05)	0.838
Aerosol generating procedures[d]					
Yes	368/768	47.9	0.65	(0.59–0.71)	<0.001
No	283/381	74.3	Ref.		

[a]HCWs were categorized as 'compliant' if the average use was greater than or equal to 70% of the working time.
[b]Missing data for 19 participants.
[c]Examined at least one febrile respiratory illness patient per day during the trial period.
[d]Performed at least one aerosol generating procedure (AGP) per day during trial period.

did not see febrile patient. Performing at least one AGP during the trial period was associated with 35% reduction in compliance (Table 2).

Adverse events associated with mask use, contact with febrile respiratory illness patients and performing AGPs remained significant predictors of compliance during multivariable analysis (Table 3). After adjusting for other factors, compliance was significantly lower among those HCWs who reported an adverse event associated with the mask use (adjusted RR 0.90, 95% CI 0.85–0.95). Compliance was 14% higher in those HCWs who examined at least one febrile respiratory illness patient per day. Finally, HCWs who performed at least one AGP per day during the trial period had 22% lower compliance compared to those who did not perform any AGP (Table 3). Compliance was significantly higher in HCWs who had asthma (RR 1.37, 95% CI 1.11–1.68) (Table 4) and was significantly lower among participants who reported discomfort (RR 0.89, 95% CI 0.79–0.99) and breathing problems (RR 0.75, 95% CI 0.64–0.88) (Table 5).

Exit interviews provided insight into the use of medical and cloth masks in various situations. Approximately 34% of participants believed that it is important to wear a mask for every patient interaction and 50% believed that it is necessary to wash hands after touching a mask. 22% of participants reported that it is difficult to communicate with patients when wearing a mask and 15% thought that it was 'rude' to wear a mask when communicating with patients. Only 11% of participants reported that it is easy to forget to put mask on before having contact with a patient.

Table 3. Predictors of compliance[a] with the use of medical and cloth masks—Multivariable analysis

Variable	RR	(95% CI)	*P* value
Type of masks			
Cloth masks	1.02	(0.97–1.08)	0.458
Medical masks	Ref		
Presence of adverse events[b]			
Yes	0.90	(0.85–0.95)	<0.001
No	Ref		
Contact with febrile patient[c]			
Yes	1.14	(1.07–1.20)	<0.001
No			
Aerosol generating procedure per day[d]			
Yes	0.78	(0.73–0.82)	<0.001
No	Ref		

[a]HCWs were categorized as 'compliant' if the average use was greater than or equal to 70% of the working time.
[b]Missing data for 19 participants.
[c]Examined at least one febrile respiratory illness patient per day during the trial period.
[d]Performed at least one aerosol generating procedure (AGP) per day during trial period.

Rates of clinical respiratory illness (CRI) were 6.9 and 5.2% in compliant and non-compliant groups respectively and the rates of ILI in the two groups

Table 4. Compliance of the healthcare workers having medical conditions

Medical conditions	Number compliant[a] (%)	RR[b]	(95% CI)	*P* value[b]
Asthmatic				
Yes	23/30 (76.7%)	1.37	1.11–1.68	0.003
No	628/1119 (56.1%)	Ref		
Immune-compromised				
Yes	6/13 (46.2%)	0.81	0.45–1.47	0.490
No	645/1136 (56.8%)	Ref		
Other medical conditions				
Yes	64/101 (63.4%)	1.13	0.97–1.32	0.125
No	587/1048 (56.0%)	Ref		

[a]HCWs were categorized as 'compliant' if the average use was greater than or equal to 70% of the working time.
[b]Unadjusted RR and *P* values.

were 1.7 and 0.6%, respectively. Four percent of HCWs in the compliant group and 4.8% of HCWs in the noncompliant group had laboratory-confirmed viral respiratory infection. Compliance was not associated with CRI (RR 1.32, 95% CI 0.83–2.12), ILI (RR 2.80 and 95% CI 0.79–10.00), or laboratory-confirmed viral respiratory infection (RR 0.83, 95% CI 0.48–1.43).

DISCUSSION

High compliance among HCWs who had contact with febrile respiratory illness patients and among HCWs with pre-existing medical conditions shows that perceived risk of infection might influence compliance and use of medical and cloth masks in the healthcare setting. The use of both medical and cloth masks decreased over the 4-week study period, which might be due to overexertion and the presence of adverse events associated with mask use. Design and material of facemasks may be improved to increase comfort and acceptability. We were unable to show any association between compliance and infection and this could be explained by lack of protective efficacy of either cloth or medical masks. Our previous RCTs of face masks failed to show efficacy of medical masks and potential harm from cloth masks (MacIntyre *et al.*, 2011, 2013, 2015).

Like previous studies, mask use increased in high risk situations, such as contact with a patient with febrile respiratory illness and the presence of medical conditions in the HCWs (Madan *et al.*, 2001; Mitchell *et al.*, 2013; Shigayeva *et al.*, 2007; Chughtai *et al.*, 2015b). High compliance in these situations might be due to perceived risk of infections and individual beliefs that are thought to be highly associated with the adoption of protective behaviour (Rosenstock *et al.*, 1988; Bish and Michie, 2010). If risk is perceived to be high, mask use may increase (Ferng *et al.*, 2011) and superior respiratory protection will often be recommended (MacIntyre *et al.*, 2014a). In a focus group discussion in the US after the H1N1 pandemic, participants reported high compliance with the use of PPE during the initial phase of the pandemic when severity of disease was not yet known. Compliance later reduced when the risk and severity of disease were perceived to be lower (Rebmann and Wagner 2009). Studies have shown that working in paediatric unit is associated with low mask use due to low perceived risk of infections (Mitchell *et al.*, 2013).

Low compliance during AGPs is concerning and might also be due to low risk perception. Moreover, the compliance variable was created by dividing the average hours of mask use over the 4-week trial period by the average number of working hours over the same period, and it is possible that HCWs used medical and cloth masks while performing AGPs but did not use them during other time. It may also be

Table 5. Compliance of the healthcare workers with an associated adverse event

Adverse effects	Number compliant[a,b] (%)	RR[c]	(95% CI)	*P* value[c]
Headache				
Yes	37/80 (46.2%)	0.80	0.63–1.02	0.077
No	604/1050 (57.5%)	Ref		
Skin rash				
Yes	20/31 (64.5%)	1.14	0.87–1.49	0.329
No	621/1099 (56.5%)	Ref		
Breathing problem				
Yes	92/207 (44.4%)	0.75	0.64–0.88	<.0001
No	549/923 (59.5)	Ref		
Allergy				
Yes	8/20 (40.0%)	0.70	0.41–1.20	0.197
No	633/1110 (57.0%)	Ref		
General discomfort				
Yes	208/397 (52.4%)	0.89	0.79–0.99	0.035
No	433/733 (59.1%)	Ref		
Other				
Yes	15/26 (57.7%)	1.02	0.73–1.42	0.919
No	626/1104 (56.7%)	Ref		

[a]HCWs were categorized as 'compliant' if the average use was greater than or equal to 70% of the working time.
[b]Unadjusted RR and *P* values.
[c]Missing data for 19 participants.

possible that HCWs who did AGPs were working in busier settings and therefore less likely to wear PPE.

A decrease in compliance over time may be attributed to discomfort and breathing difficulty, which generally increase with wearing time (Shenal *et al.*, 2012). Mask use is generally associated with more discomfort than other PPE such as glove and goggles (Nickell *et al.*, 2004). Despite the severity and high case fatality of SARS, exhaustion was a factor and people were more at risk for errors and infections after working long hour shifts and for many days. Mask use in hot and humid environments may lead to higher risk of dehydration, impaired professional performance and higher risk of infection (Kuklane *et al.*, 2015).

Individual attitudes and beliefs also play a role in accepting or rejecting certain behaviour. Like previous studies, our participants also reported difficulty in communication (Seale *et al.*, 2009) and interference with patient relationships, which might influence compliance (Willy *et al.*, 1990; Martel *et al.*, 2013). In contrast to other studies, very few of our participants reported a 'tendency to forget' as a major cause of low compliance (Martel *et al.*, 2013). Other reasons discussed in the literature for being non-compliant are: interference in patient care activities, time factors, identification problems and sense of isolation (Madan *et al.*, 2002; Nickell *et al.*, 2004). Low compliance with hand hygiene and low vaccine uptake among HCWs

also highlights the importance of behaviour change campaigns (Pittet, 2001; Li *et al.*, 2008; Grayson *et al.*, 2009; La Torre *et al.*, 2011). Like previous studies, gender, education, and work years did not predict compliance in our study (Nichol *et al.*, 2013).

Compliance with the use of medical and cloth masks was not associated with infection risk in this study. The study may be underpowered to detect the difference due to small sample size and few cases of CRI, ILI, and laboratory confirmed respiratory viruses. It may also be due to lack of efficacy of both medical and cloth masks.

There are some limitations in this study. We analysed self-reported data from the diary cards, collected over a period of 4 weeks. Self-reported compliance is reported to be higher compared to the actual practices (Martel *et al.*, 2013) and it may not be free from recall and other biases (Bradburn *et al.*, 1987). High compliance during the initial phase may be due to recent emphasis on the diary cards and HCWs may revert back to their usual practices at later stage. We could not assess organizational factors (e.g. training and monitoring) which might impact compliance (Shigayeva *et al.*, 2007; Nichol *et al.*, 2013).

To the best of our knowledge, this is the first study to examine the factors associated with the compliance of wearing medical and cloth masks amongst a large group of HCWs in a RCT setting. Most compliance studies are cross sectional and rely on participants or staff members self-reporting their compliance with mask use and adverse events.

CONCLUSION

The use of both cloth and medical masks decreased over a 4-week period when continuous use was recommended. HCWs had low levels of compliance with the use of medical and cloth masks, which may jeopardise not only their safety but also the safety of people surrounding them. Adverse events such as breathing problems and discomfort were associated with decreased use of masks, while perceived risk of acquiring an infection predicted increased compliance. New strategies and tools should be developed to identify barriers and improve compliance of HCWs.

FUNDING

This study was supported by Australian Research Council (ARC) (LP0990749).

CONFLICT OF INTERESTS

All authors have completed the Competing Interest form (available on request from the corresponding author) and declare that

1. A.C. has had filtration testing of masks for his PhD thesis conducted by 3M Australia. 3M products are not used in this study.
2. H.S. has also received funding from vaccine manufacturers GSK, bio-CSL and Saniofi Pasteur for investigator-driven research and presentations.
3. R.M. has in the past received funding for investigator-driven research on facemasks from 3M in the form of an Australian Research Council Industry Linkage grant (where 3M was the industry partner) and supply of masks for clinical research. She also has received funding or in-kind support from GSK, Merck, BioCSL, and Pfizer for investigator-driven research on infectious diseases.
4. The remaining authors declare that they have no competing interests and have no non-financial interests that may be relevant to the submitted work.

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