

Effect of the COVID-19 Pandemic on Compliance with Contact- and Droplet-precaution Measures in Siriraj Hospital's Internal Medicine and Pediatrics Ward Nurses

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ABSTRACT

Objective: To determine the effect of the COVID-19 pandemic on personal medical discipline toward infection preventive measures.

Materials and Methods: An online questionnaire on personal preventive measure was developed. The content of the questionnaire was reviewed by content experts and tested for internal consistency reliability. Nurses in the Internal Medicine and Pediatrics wards were invited to answer the questionnaire.

Results: In total, 188 individuals were included. Sixty-five percent of the protective measure statements showed a statistical improvement in compliance during the pandemic. Most of the protective measures, including hand washing, wearing a mask, and wearing glasses or a face shield, were statistically more complied with during the pandemic. However, some important protective measures, such as wearing a mask when performing aerosol-generating procedures or when in close contact with droplet-precaution patients, did not show a statistically significant increase in compliance during the pandemic. There was no significant correlation between the demographic data and compliance level. The main reasons for non-compliance were time constraints, thought that the measures are not important, and equipment inadequacy.

Conclusion: During the COVID-19 pandemic, there was some improvement in compliance with contact- and droplet-precaution measures in Siriraj Hospital's Medicine and Pediatrics wards, but compliance with measures against some high-risk procedures that can spread the infection, such as aerosol generation or contacting with droplets, were not followed properly. The importance of precaution measures should be emphasized and the adequacy of protective equipment should be addressed to reduce the risk of spreading infection to healthcare workers and other patients.

Keywords: COVID-19; pandemic; contact precaution; droplet precaution; compliance (Siriraj Med J 2022; 74: 357-363)

INTRODUCTION

Nosocomial infection can have negative impacts on patients and healthcare systems, such as leading to an increased length of stay and increased cost of treatment.¹ The elimination of drug-resistance nosocomial infection can reduce the cost of treatment and increase the quality-

adjusted life years of patients.² A previous study at Siriraj Hospital, which is a tertiary care university hospital in the capital of Thailand, demonstrated that between 2009 to 2013, 8.01% of pediatrics inpatients contacted nosocomial infection.³

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Various precaution methods can be used to prevent nosocomial infection, such as contact precaution, droplet precaution, and airborne precaution. A previous study in another tertiary care university hospital in Bangkok revealed that their medical staff were aware of these precaution measures but did not or could not fully comply with them.⁴

Coronavirus disease 2019 (COVID-19) is an emerging disease caused by SARS-CoV2 virus. The disease is spread rapidly and becomes pandemic in March 2020. COVID-19 patients may suffer not only from respiratory symptoms such as cough, dyspnea but also from non-respiratory symptoms such as diarrhea, nausea and vomiting, increase transaminase levels⁵, and sudden sensorineural hearing loss.⁶ Moreover, some patients may experience persistent symptoms after recovery or Long COVID which can cause fatigue, dyspnea, cardiovascular abnormality, cognitive impairment, and others.⁷ These symptoms have negative impact on physical function, cognitive function, and quality of life.⁸

Since the start of the SARS-CoV2 outbreak up to July 22, 2021, there have been more than 190M COVID-19 cases and more than 4M deaths globally resulting from the ongoing pandemic.⁹ Due to the inadequacy of proper personal protective equipment in low to middle income countries, these countries have suffered high rates of nosocomial COVID-19 infections.¹⁰ Preventing healthcare workers from COVID-19 infection is crucial to maintain the resilience of the healthcare system during the pandemic.¹¹ In this regard contact- and droplet-precaution measures are critical as the virus can be transmitted via respiratory droplets and via contact fomites.¹²

A previous study in Hong Kong after the outbreak of severe acute respiratory syndrome (SARS) in 2004 showed there was a significant improvement in compliance with hand hygiene practice after the outbreak, with the rate of handwashing after contact with a patient increasing from 72.5% to 100%.¹³ However, a study in Qatar during the COVID-19 outbreak demonstrated that compliance with utilizing full personal protective equipment was still not perfect. The report showed that among COVID-19-infected healthcare workers, 82% and 68% of the personnel from COVID-19 facilities and from non-COVID-19 facilities used full personal protective equipment properly.¹¹ During the current COVID-19 pandemic, a study in Iran demonstrated a reduction in the nosocomial infection rate.¹⁴ A study in Wuhan, China, demonstrated that overall hand hygiene compliance among healthcare workers improved after the outbreak of COVID-19 from 88.69% to 96.37%, and overall droplet-isolation compliance improved from

76.93% to 87.94%.¹⁵ However, the effect of the pandemic on the compliance with infectious diseases prevention in Thailand has not yet been reported.

Consequently, this study focused on the effect of the COVID-19 pandemic on compliance with contact- and droplet-precaution measures in Siriraj Hospital's Internal Medicine and Pediatrics wards. The objective of this study was to gain an insight into the interaction between a pandemic and medical personal discipline with regards to precaution measures. The result of this study can be used for further study to explore the behavioral factors affecting compliance with infectious control precaution measures.

MATERIALS AND METHODS

This study was a questionnaire-based cross-sectional study approved by Siriraj Institutional Review Board (Si 606/2020), conducted between July 2020 and February 2021. Eligible participants were registered nurses and practical nurses who had been working in Siriraj Hospital's Internal Medicine and Pediatrics wards at least since September 2019. Recruitment of the participants was conducted via electronic messages. A Thai-language self-administered online questionnaire was provided with the recruitment messages and informed consent was obtained at the first page of the questionnaire survey. In total, 188 participants consented and answered the questionnaire.

The questionnaire consisted of three parts. The first part focused on the characteristics of the participant, including gender, age, department, professional category, number of years worked, and whether the participant had enrolled in a training course on nosocomial infection prevention. The second part involved a 5-point Likert rating scale composed of 20 statement questions designed to evaluate the compliance of the medical staff with contact- and droplet-precaution measures prior to and during the COVID-19 pandemic, concerning both patient safety and staff safety. The questions in this part could be classified into two groups: the first group consisted of 12 questions about compliance with the contact-precaution measures and the second group consisted of 8 questions about compliance with the droplet-precaution measures. These 20 questions were reviewed by 2 content experts and analyzed for internal consistency reliability using Cronbach's alpha. The third part of the questionnaire involved an open-ended question, asking for the reason for non-compliance, if there was any instance of non-compliance. Participants were permitted to leave the answer to the third part blank or to provide more than one reason.

Good compliance with the precaution measures was defined as a rating of 4 or 5 on the Likert scale, while poor compliance was defined as a rating lower than 4. Data analysis was performed using PASW Statistics for Windows version 18 (SPSS Inc., Chicago, Ill, USA) and STATA 16.0. The Fisher exact test was used to compare compliance before and during the pandemic. A p-value of less than 0.05 was considered statistically significant.

The sample size calculation was based on data from Yang et al¹⁵ which showed overall hand hygiene compliance among health care workers improved after outbreak of COVID-19 from 88.69% to 96.37%, and overall droplet isolation compliance improved from 76.93% to 87.94%. Thus, the sample size needed for this study was calculated as followed.

$$\text{Sample size} = \frac{(Z_{1-\alpha/2}) + Z_{\beta})^2 [P_1(1-P_1) + P_2(1-P_2)]}{d^2}$$

Where $Z_{1-\alpha/2} = 1.96$ for significant level of 0.05, $Z_{\beta} = 0.84$ for 80% power. Then the sample size needed for determining the change in overall hand hygiene compliance is 180 and for determining the change in overall droplet isolation compliance is 184.

RESULTS

The characteristics of the participants are as shown in Table 1. Most of the participants were female and most of them were registered nurses.

The Cronbach's alpha coefficients for internal consistency reliability of groups of items in the questionnaire are as shown in Table 2.

The results of the second part of the questionnaire, converted into the level of compliance, are shown in Table 3. Out of 20 statements about compliance with the contact and droplet-precaution measures, 14 statements were found to indicate a statistically significant improvement in compliance during the pandemic.

Table 4 demonstrated logistic regression which was performed to determine whether age, department, professional category, number of years worked, or had enrolled on a nosocomial prevention course had any correlation with increasing compliance with the protective measures. Data from participants who reported good compliance in all items was not included in this analysis. Thus, the number of participants included in this analysis was 123. No significant correlation was demonstrated.

The third part of the questionnaire was answered by 47 participants. The answers were classified as shown in Table 5. The most common reason for non-compliance with the protective measures was time constraints. The second most common reason was the inadequacy of the protective equipment.

TABLE 1. Characteristics of the participants.

Characteristics	N (%)
Gender	
Male	6 (3.2)
Female	180 (95.7)
Other	2 (1.1)
Department	
Medicine	79 (42)
Pediatrics	109 (58)
Professional category	
Registered nurse	129 (68.6)
Practical nurse	59 (31.4)
Had enrolled in a training course on nosocomial infection prevention	
Yes	140 (74.5)
No	48 (25.5)
	Mean (SD)
Age	35.78 (10.98)
Number of years worked	14.09 (11.16)

TABLE 2. Characteristics of the participants.

Groups of Items	Cronbach's alpha Coefficient
Questions about compliance with the contact-precaution measures prior to the pandemic	0.93
Questions about compliance with the droplet-precaution measures prior to the pandemic	0.89
Overall preventive measure prior to the pandemic	0.95
Questions about compliance with the droplet-precaution measures during the pandemic	0.96
Questions about compliance with the contact-precaution measures during the pandemic	0.91
Overall preventive measure during the pandemic	0.96

TABLE 3. Level of compliance with contact- and droplet-precaution measures prior to and during the pandemic.

Statement	Prior to the pandemic		During the pandemic		P-value
	Good compliance	Poor compliance	Good compliance	Poor compliance	
Wash your hands before contact with every patient.	154	34	176	12	0.001
Wash your hands before performing every clean or sterile procedure.	169	19	184	4	0.002
Wash your hands after contact with a patient's secretion, wound, or abnormal skin, whether you are wearing gloves or not.	182	6	186	2	0.284
Wash your hands instantly after taking off your gloves.	167	21	179	9	0.035
Wash your hands when changing from a contaminated site to a sterile site while performing a procedure on the same patient.	138	50	179	9	<0.001
Wash your hands after contact with a patient's environment.	148	40	180	8	<0.001
Wash your hands after contact with every patient.	167	21	182	6	0.004
Wear gloves every time before contact with contact-precaution patients.	172	16	184	4	0.010
Wear gloves every time before contact with droplet-precaution patients.	160	28	178	10	0.003
Wear gloves before contact with a patient's secretion, mucosa, or abnormal skin.	179	9	184	4	0.258
Change your gloves during procedures when your gloves contact an object that seems to be contaminated.	175	13	183	5	0.088
Change your gloves when you move on to perform a procedure on another patient.	181	7	184	4	0.543
Clean equipment which is shared between patients after use.	175	13	182	6	0.156
Wear a gown every time when performing aerosol-generating procedures on every patient.	143	45	171	17	<0.001
Wear a gown every time when examining or performing procedures on contact-precaution patients.	156	32	174	14	0.007
Wear a gown every time when examining or performing procedures on droplet-precaution patients.	145	43	172	16	<0.001
Wear a mask every time when performing aerosol-generating procedures on every patient.	175	13	181	7	0.250
Wear a mask every time when you are in close contact with droplet-precaution patients.	178	10	184	4	0.171
Wear glasses or a face shield every time when performing aerosol-generating procedures on every patient.	95	93	153	35	<0.001
Wear glasses or a face shield every time when you are in close contact with droplet-precaution patients.	96	92	155	33	<0.001

TABLE 4. Logistic regression analysis result.

Demographic data	Odds ratio	P-value	95% Confidence interval
Age	0.88	0.389	0.67 – 1.17
Department	1.08	0.907	0.31 – 3.70
Professional category	2.50	0.220	0.58 – 10.79
Numbers of years worked	1.12	0.449	0.84 – 1.48
Had enrolled on a nosocomial prevention course	3.12	0.064	0.94 – 10.38

TABLE 5. Reasons for non-compliance with the protective measures.

Reasons	Number of participants who agreed with the answer (N = 47)
Time constraints, such as emergency situations and heavy workloads.	26 (55.32%)
Thought that the measures are not important.	12 (25.53%)
Inadequacy of protective equipment.	11 (23.40 %)
The equipment was considered an obstacle to work, regardless of the time constraints, such as blurred vision from wearing a face shield and feeling hot from wearing a gown.	7 (14.89%)
Protective equipment was not readily available at the site.	3 (6.38%)
Forgot the protective measures.	2 (4.26%)

DISCUSSION

According to the study results, 65% of the protective measure statements showed a statistical improvement in compliance with the protective measures during the pandemic. However, even though the statistics indicated that compliance was better during the pandemic, it was still not perfect. For example, 18.62% of participants still had poor compliance with wearing glasses or a face shield every time when performing aerosol-generating procedures on every patient, which might not be enough to prevent the spread of the pandemic or to protect from any pathogens in general. A systematic review and meta-analysis has revealed that protection of the eyes was correlated with a lower infection rate,¹⁶ hence the improvement of eye protection compliance should be emphasized to reduce the workplace infection risk. The other 35% of protective

measure statements might not statistically show more compliance during the pandemic because some of them already having nearly perfect compliance in the first place. Other factors including age of participants, department where participants work, professional category (technical or registered nurse), duration of work in years, and had training in nosocomial prevention course do not have significant association with improvement in preventive measure. However, training in nosocomial prevention may still be necessary for medical personnel to ensure compliance with protective measures for both patients' and personnel's safety.

The third part of the survey, which was an open-ended question, revealed some of the reasons for the non-compliance, with the main reason being time constraints. In fact, there were quite a few true emergency situations

in the Medicine and Pediatrics wards where rapid action is critical. To improve compliance with the precaution measures, there is a need to emphasize the importance of maintaining the safety of the practitioners, which also reflects on the safety of the patients, in every situation. Other reasons for non-compliance were concerns about the inadequacy or inconvenience of the protective equipment; hence there is a need to make sure that the protective equipment is adequate, easy to use, and readily available. It is also important to acknowledge that staff avoiding these infection-control measures risk increasing the rate of nosocomial infection in both patients and staff, which can lead to increasing the length of hospital stay for the patient, the staff workload, and the cost of hospitalization.

A study by Brewe et al¹⁷ demonstrated some protective behavior regression after vaccination. Further study might investigate whether compliance with current COVID-19 protective measures declines after immunization.

In April 2020, Royal college of Surgeons of Thailand had published an announcement on guidance for surgery in COVID-19 patients¹⁸, which provided meticulous details on management of patients, staffs, and operating room in COVID-19 cases from patient transportation to post-operative management. Thai Association for Gastrointestinal Endoscopy and Endoscopy Nurse Society (Thailand) had also provided recommendations for the practice of endoscopy during the COVID-19 pandemic.¹⁹ Further study might investigate the compliance of the staff with these recommendations.

There are some limitations to note with this study, including the fact the study involved a self-administered questionnaire and the selection of participants was not done by randomization, so there might have been a reporting bias and volunteer bias. In addition, this study might not be a good representation of the true practices in wards, which consist of multidisciplinary teams of other professionals rather than nurses alone. Also, a recall bias might have occurred because the questionnaire asked about compliance in the past. The questions used in this questionnaire for this study were validated only by experts in infectious diseases and prevention.

CONCLUSION

During the COVID-19 pandemic, while there was some improvement in compliance with contact- and droplet-precaution measures by nurses in Siriraj Hospital's Medicine and Pediatrics wards, precaution measures for some high-risk procedures that can spread the infection, such as aerosol generation or contacting with droplets, were not always followed properly. The importance of precaution measures should be emphasized because if

healthcare workers are infected, healthcare workforce would be immediately affected and long COVID might affect healthcare workforce in the long term. Also, the adequacy of the protective equipment should be assured to decrease the risk of spreading infection to healthcare workers and other patients.

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REFERENCES

1. Luangasanatip N, Hongsuwan M, Lubell Y, Srisamang P, Limmathurotsakul D, Cooper B. Excess length of stay due to hospital-associated infections in Thailand: 8 years retrospective data. *Int J Infect Dis*. 2012;16:e378-e9.
2. Phodha T, Riewpaiboon A, Malathum K, Coyte PC. Excess Annual Economic Burdens From Nosocomial Infections Caused by Multi-Drug Resistant Bacteria in Thailand. *Expert Rev Pharmacoecon Outcomes Res*. 2019;19(3):305-12.
3. Chokephaibulkit K, Asanathong NW, Rongrungrung Y, Assanasen S, Pumsuwan V, Wiruchkul N, et al. Epidemiology and trends of important pediatric healthcare-associated infections at Siriraj Hospital, Thailand. *Southeast Asian J Trop Med Public Health*. 2017;48(3):641-54.
4. Punpop M, Malathum P, Malathum K. Adherence of Healthcare Workers Toward the Contact Precaution Guidelines for Patients With Multidrug-Resistant Organisms in a Tertiary Care Hospital. *Rama Med J*. 2018;41(4):56-64.
5. Wasuwanich P, Thawillarp S, Ingviya T, Karnsakul W. Coronavirus Disease 2019 (COVID-19) and Its Gastrointestinal and Hepatic Manifestations. *Siriraj Med J*. 2020;72(4):272-8.
6. Swain SK, Das S, Lenka S. Sudden Sensorineural Hearing Loss among COVID-19 Patients-Our Experiences at an Indian Teaching Hospital. *Siriraj Med J*. 2021;73(2):77-83.
7. Crook H, Raza S, Nowell J, Young M, Edison P. Long covid—mechanisms, risk factors, and management. *BMJ*. 2021;374:n1648.
8. Tabacof L, Tosto-Mancuso J, Wood J, Cortes M, Kontorovich A, McCarthy D, et al. Post-acute COVID-19 Syndrome Negatively Impacts Physical Function, Cognitive Function, Health-Related Quality of Life, and Participation. *Am J Phys Med Rehabil*. 2022; 101:48-52.
9. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard [Internet]. 2021 [cited 2021 Jul 22]. Available from: <https://covid19.who.int/>
10. Mehta S, Machado F, Kwizera A, Papazian L, Moss M, Azoulay É, et al. COVID-19: a heavy toll on health-care workers. *Lancet Respir Med*. 2021;9(3):226-8.
11. Alajmi J, Jeremijenko AM, Abraham JC, Alishaq M, Concepcion EG, Butt AA, Abou-Samra A. COVID-19 infection among healthcare workers in a national healthcare system: The Qatar

- experience. *Int J Infect Dis.* 2020;100:386-9.
12. Tizaoui K, Zidi I, Lee KH, Ghayda RA, Hong SH, Li H, et al. Update of the current knowledge on genetics, evolution, immunopathogenesis, and transmission for coronavirus disease 19 (COVID-19). *Int J Biol Sci.* 2020;16(15):2906-23.
 13. Wong TW, Tam WW. Handwashing practice and the use of personal protective equipment among medical students after the SARS epidemic in Hong Kong. *Am J Infect Control.* 2005;33(10):580-6.
 14. Jabarpour M, Dehghan M, Afsharipour G, Abaee EH, Shahrabaki PM, Ahmadimejad M, et al. The Impact of COVID-19 Outbreak on Nosocomial Infection Rate: A Case of Iran. *Can J Infect Dis Med Microbiol.* 2021;2021:6650920.
 15. Yang Q, Wang X, Zhou Q, Tan L, Zhang X and Lai X. Healthcare workers' behavior on infection prevention and control and their determinants during the COVID-19 pandemic: a cross-sectional study based on the theoretical domains framework in Wuhan, China. *Arch Public Health.* 2021;79(1):118.
 16. Derek KC, Elie AA, Stephanie D, Karla S, Sally Y, Holger JS, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet.* 2020;395:1973-87.
 17. Brewer NT, Cuite CL, Herrington JE, Weinstein ND. Risk compensation and vaccination: can getting vaccinated cause people to engage in risky behavior? *Ann Behav Med.* 2007;34(1):95-9.
 18. Siri Wittayakorn P. Announcement of the Royal College of Surgeons of Thailand on Guidance for Surgery in COVID-19 Patients. *Siriraj Med J.* 2020;72(5):431-5.
 19. Kongkam P, Tiankanon K, Ratanalert S, Janthakun V, Kitiyakara T, Angsuwatcharakon P, et al. The Practice of Endoscopy during the COVID-19 Pandemic: Recommendations from the Thai Association for Gastrointestinal Endoscopy (TAGE) in collaboration with the Endoscopy Nurse Society (Thailand). *Siriraj Med J.* 2020;72(4):283-6.