Stethoscope Hygiene: Attitudes and Practices Among Clinical Year Medical Students

F Kuldev Singh a/l Jasvinder Singh[1], Siti Nur Adibah Binti Ahmad[1], Tricia Teng Wei Han[1], Celina Sanusha Anthony[1], Mila Nu Nu Htay[2], Soe Moe[2] and Htoo Htoo Kyaw Soe[2]*

Corresponding author email id: htoo2ks@gmail.com

Keywords: Attitude, COVID-19 Endemic, Stethoscope, Medical Students, Malaysia

ABSTRACT

One of the most often used medical instruments is the stethoscope, however due to contamination, there is rising concern about its potential to transmit infections including COVID-19. This study aimed to determine the stethoscope hygiene attitudes and practices among clinical year medical students during the COVID-19 endemic period. A cross-sectional study was conducted among medical students in their clinical years at Manipal University College Malaysia (MUCM). Data collection was facilitated via questionnaires disseminated through electronic mail and social media platforms. The data were analyzed using Epi Info software, and the Chi-square test was employed to investigate the associations between demographic factors, attitudes, personal hygiene practices, and stethoscope hygiene practices among the study participants. Among 121 participants, 80.1% cleaned their stethoscopes during clinical practice. However, 9.9% of them sanitized their stethoscopes after every patient, while 4.1% cleaned more than once daily. No significant associations were found between demographic variables and stethoscope hygiene practices. However, positive attitudes and personal hygiene practices were associated with better stethoscope hygiene ($P<0.05$). Our findings underscore the imperative for medical institutions to implement educational initiatives aimed at raising awareness regarding optimal stethoscope hygiene practices. Adherence to such practices is crucial in mitigating the risks of nosocomial disease transmission, a concern that has been further exacerbated by the COVID-19 pandemic.

[1] Faculty of Medicine, Manipal University College Malaysia, Melaka, Malaysia
[2] Department of Community Medicine, Faculty of Medicine, Manipal University College Malaysia, Melaka, Malaysia

INTRODUCTION

Millions of confirmed cases and deaths have been reported globally as a result of the coronavirus disease pandemic (COVID-19) (1). While the transition of COVID-19 from a pandemic to an endemic status has been a significant milestone, the ongoing presence of the virus and its evolving variants remains a substantial threat (2). Nevertheless, this transition has fostered behavioral changes in populations toward containing the spread, with the reassurance that eradication is not an immediate prospect.

Evidence suggests that the virus is primarily transmitted through respiratory droplets and aerosols generated by coughing, sneezing, and direct contact with infected individuals or contaminated surfaces and objects (3). Of particular concern is the role of non-critical medical equipment, such as stethoscopes, blood pressure cuffs, Doppler probes, electronic thermometers, latex gloves, masks, pens, and white coats, in the transmission of pathogens (1, 4-9). Stethoscopes, being one of the most commonly used medical devices in clinical practice, have been identified as potential vectors for spreading infections in healthcare settings globally. Their diaphragms are known to be the second most contaminated area after fingertips, even after a single physical examination (8, 10). Alarmingly, studies have shown that stethoscopes can be a source of high levels of bacterial contamination comparable to unwashed hands, even after medical care (11). Adhering to good hygiene practices can effectively reduce infections and the risk of pathogen transmission (10).

While several studies have explored the prevalence of stethoscope hygiene practices among medical students in countries such as Saudi Arabia, Ethiopia, Pakistan, India, South Korea, and the United States (5-8, 10, 12, 13), there is a paucity of data on the knowledge, attitudes, and practices regarding stethoscope hygiene among medical students in Malaysia, particularly during the transition from the COVID-19 pandemic to an endemic phase. Addressing this knowledge gap is crucial, as it may significantly contribute to breaking the chain of transmission and preventing the potential spread of COVID-19 and other infectious diseases.

Therefore, our study aimed to analyze the attitudes and practices of stethoscope hygiene among clinical year medical students during the transition from the COVID-19 pandemic to an endemic phase. Furthermore, we investigated the association between demographic factors, previous COVID-19 infection status, attitudes, personal hygiene, and stethoscope hygiene practices. By bridging this research gap, our study aimed to provide valuable insights and recommendations to enhance stethoscope hygiene practices among medical students, ultimately contributing to improved infection control measures in healthcare settings.

METHODS

Study design, setting, and population

We conducted a cross-sectional study from April to May 2022 among medical students at a private medical university in Malaysia. We included clinical year MBBS medical students, with an estimated population of 500 students.

Sample size

The sample size was calculated using Epi Info software version 7.2.5.0. Based on a previous study in Serbia, where 8% of fourth-year medical students practiced stethoscope hygiene after every patient (4), and considering a population size of 500, a 95% confidence level, and a 5% acceptable margin of error, the minimum required sample size was 92. To account for a 20% non-response rate, the final sample size was calculated as 115.

Sampling

We employed a non-probability, purposeful sampling method. The inclusion criteria encompassed undergraduate medical students from semesters 6 to 10 and provided informed consent. As pre-clinical year medical students and the students from Foundation in Science programme have limited exposure to clinical settings and patient interactions. Similarly, the students from the Bachelor of Dental Surgery programme may not routinely use stethoscopes in their respective field of study or clinical training. To ensure the study sample comprised participants with regular exposure to stethoscope use and patient care settings, we excluded these groups. This focused sampling approach enabled us to target medical students in their clinical years, who are more likely to have consistent experiences relevant to the research objectives.

Data collection

Data were collected using questionnaires consisting of three parts: (1) demographic information of the participants, (2) practices among medical students regarding stethoscope hygiene, and (3) attitudes among medical students toward stethoscope hygiene.

Part 1 aimed to gather demographic information, including gender, semester of study, household type (individual in hostel, staying with housemates, or with family), financial status using the Malaysian income threshold for top 20% (T20) (<4360 RM), middle 40% (M40) (4360 – 9619 RM), and bottom 40% (B40) (>9619 RM). Part 2 assessed practices among medical students regarding stethoscope hygiene. We used a modified questionnaire from two studies (4, 10), questioning students about the measures they took to maintain stethoscope hygiene and the type of cleaning agent they use. Part 3

evaluated attitudes among medical students toward stethoscope hygiene. We used a modified questionnaire from a previous study, asking students about their cleaning habits and frequency of disinfecting their stethoscopes during the pandemic and endemic phases of COVID-19 (4). Students were also asked if they had witnessed others cleaning their stethoscopes and how important stethoscope hygiene was to them. Similarly, students were questioned if stethoscopes could transport illnesses and if cleaning agents could damage the instrument. The final question focused on cleaning practices in wards, whether they received instructions on how to clean the stethoscope, and if they wanted to learn more about stethoscope hygiene. On a 5-point Likert scale, responses to questions about stethoscope hygiene were scored, with 1 indicating "I strongly disagree with this statement" and 5 indicating "I strongly agree with this statement."

To ensure the content validity of the modified questionnaire, we sought evaluations from subject matter experts. Each item within the questionnaire was assessed by the experts using a rating scale ranging from 1 (not relevant) to 4 (highly relevant). The item-content validity index (I-CVI), calculated as the ratio of judges who rated an item as 3 or 4 to the total number of judges, was determined. With four experts consulted, an I-CVI value of 1 was required to establish content validity for an item. All items of the questionnaire met this criterion, demonstrating adequate content validity.

Data processing and analysis

We used Microsoft Excel for data entry and data processing, and Epi Info version 7.2.5.0 for data analysis. The independent variables were gender, academic year, personal cleanliness, COVID-19 status, home type, financial status, and attitude toward stethoscope hygiene. The dependent variable was the practice of stethoscope hygiene. Chi-square test was used to determine the association between demographic factors, previous COVID-19 infection status, attitudes, personal hygiene, and stethoscope hygiene practices. Level of significance was set at 0.05.

Ethical consideration

The participants were provided with an information sheet and written informed consent that covered all the key and relevant elements of this research. We ensured that participation was strictly voluntary, with no incentives offered or coercion applied. All information submitted by participants was kept confidential and was only used for the study. Anonymity and privacy for participants were assured. Ethical approval of this study was obtained from the Research Ethics Committee, Manipal University College Malaysia (MUCM).

RESULTS

A total of 121 undergraduate clinical year medical students participated in this study. Table 1 presents the demographic characteristics of the participants. Gender distribution showed a slightly higher proportion of female students, with 57.0% females and 43.0% males. Regarding the academic year, the majority (65.3%) were in their fourth year, while 34.7% were in their fifth year. In terms of financial status, the largest group (43%) belonged to the B40 bracket, followed by 36.4% in the M40 category and 20.7% in the T20 category, according to the Malaysian income threshold. Concerning the household type, nearly half of the students (47.1%) were hostelites, 43.8% lived with housemates, 8.3% stayed with their families, and 0.8% resided elsewhere. Regarding COVID-19 status, the majority (72.7%) of students reported not having been infected previously, while 24.2% had been infected before.

Table 2 presents the personal hygiene practices among clinical year undergraduate medical students. The vast majority of students (90.1%) reported always washing their hands before preparing and eating food. Additionally, 81.8% of students indicated that they always used soap when washing their hands. Regarding the use of hand sanitizers in outdoor settings, 61.2% of students reported always using them, while 38.8% used them only sometimes. Body hygiene practices were generally well-adhered, with 97.5% of students agreeing to washing their bodies at least once a day and the same percentage (97.5%) reporting washing their hair with soap or shampoo at least once a week. The practice of daily tooth brushing was widespread among the participants, with 99.2% brushing their teeth daily. In terms of laundry hygiene, 89.3% of students reported always washing their dirty laundry with soap before re-wearing them. Notably, none of the participants selected the "never" option for any of the personal hygiene practices assessed.

Table 3 presents the stethoscope hygiene practices among the participants. The majority (80.1%) reported practicing stethoscope hygiene, while 19.8% did not practice it. Among those who practiced stethoscope hygiene, the most commonly used cleaning agent was sanitizer (47.1%), followed by cloth (24%), alcohol swab (11.6%), Dettol (a disinfectant brand in Malaysia) (2.5%), soap (0.8%), wet wipes (0.8%), and wet tissue (0.8%). Regarding the frequency of cleaning, 26.4% of participants cleaned their stethoscopes once a month, 17.4% cleaned once a week, 15.7% cleaned once a day, 11.6% cleaned once a year, 9.9% cleaned after every patient, and 5.1% cleaned multiple times a day. In terms of the areas cleaned, 52.1% of participants reported cleaning the diaphragm of the stethoscope, 46.3% cleaned the earpiece and bell, 36.4% cleaned the entire stethoscope, and 17.4% cleaned the membrane. The majority (57.9%) of participants reported practicing stethoscope hygiene after clinical practice, while 30.6% practiced it before clinical practice. Notably, 86.78% of participants believed that the COVID-19 endemic had increased the frequency of cleaning stethoscopes. Among the reasons for practicing stethoscope hygiene, 44.6% cited ensuring their safety, 35.5% cited ensuring patient safety, 6.6% reported having germophobia, and 1.7% reported having obsessive cleaning disorders. Of those who did not practice stethoscope hygiene during the COVID-19 endemic, 57% stated a lack of rules or policies in clinical practices, 28.1% reported a lack of available cleaning agents, and 14.9% did not know how to

clean a stethoscope properly. Lastly, the majority (73.6%) of participants reported having no prior exposure to learning about stethoscope hygiene practices. However, 10.7% learned from YouTube videos, 5% received verbal instructions and education from lecturers, 4.1% learned through demonstrations by lecturers, and 0.8% learned from family members who considered stethoscopes to be dirty and high-risk for infections when applied to patients randomly.

Table 4 shows attitudes towards stethoscope hygiene among undergraduate clinical year medical students. The study findings revealed varying levels of agreement among the participants regarding various aspects of stethoscope hygiene practices and attitudes. Notably, a minority (7.4%) strongly agreed, while 46.3% agreed that they had sufficient time to clean their stethoscopes between patient examinations. Concerning the availability of cleaning agents, 9.1% strongly agreed, and 49.6% agreed that cleaning agents were readily available. Regarding observing others' stethoscope hygiene practices, only 2.5% strongly agreed, and 10.7% agreed that they regularly witnessed others cleaning their stethoscopes. However, most participants recognized the importance of stethoscope cleanliness, with 25.6% strongly agreeing and 70.3% agreeing that it is essential for stethoscopes to be clean. A significant proportion of participants acknowledged the potential for stethoscopes to transmit various agents, with 26.5% strongly agreeing and 65.3% agreeing with this notion. Despite this awareness, only 4.1% strongly agreed, and 19.0% agreed that they had heard about the need for stethoscope cleaning during their classes. Among the students, 3.3% strongly agreed, and 34.7% agreed that regular cleaning could not damage stethoscopes. A considerable number expressed a desire to learn more about stethoscope hygiene, with 18.2% strongly agreeing and 71.9% agreeing with this sentiment. The participants also recognized the potential value of visual reminders, with 14.9% strongly agreeing and 69.4% agreeing that such reminders would help them clean their stethoscopes more regularly. Notably, 19.0% strongly agreed, and 66.9% agreed that they would clean their stethoscopes more frequently after participating in this survey.

Table 5 presents the attitudes towards stethoscope hygiene in clinical practice among undergraduate clinical year medical students. The vast majority (94.21%) of participants agreed that stethoscope cleaning is mandatory in clinical practices. However, 26.4% indicated that they would only clean a stethoscope when imposed by the lecturer. Notably, 96.6% of participants agreed that they would only clean a stethoscope when it is made compulsory by hospital policies.

Table 6 presents the association between demographic factors, personal hygiene, attitudes, and stethoscope hygiene practices among clinical year medical students. There was no significant association between gender, financial status, COVID-19 status, academic year, household type and stethoscope hygiene practices. However, students with good personal hygiene were significantly more likely to practice stethoscope hygiene compared to those with poor personal hygiene (OR 3.19; 95% CI 1.17 to 8.73; P = 0.019). Similarly, students with a good attitude toward stethoscope hygiene were significantly more likely to practice stethoscope hygiene than those with a poor attitude (OR 3.15; 95% CI 1.09-9.14; P = 0.028). Interestingly, students who had been infected with COVID-19 were less likely to practice stethoscope hygiene compared to those who

had not been infected, although this association was not statistically significant (OR 0.69; 95% CI 0.26 to 1.18; P = 0.457).

Table 1: Demographic characteristics among undergraduate clinical year medical students (n = 121)

Variable	**Frequency (%)**
Gender	
Male	52 (43.0%)
Female	69 (57.0%)
Academic year	
Year 4	79 (65.3%)
Year 5	42 (34.7%)
Financial status	
B40 (<4360 RM)	52 (43.0%)
M40 (4360 – 9619 RM)	44 (36.4%)
T20 (>9619 RM)	25 (20.6%)
Household type	
Hostelites	57 (47.1%)
With family	10 (8.3%)
With housemates	53 (43.8%)
Others	1 (0.8%)
Covid 19 status (n=120)	
Have been infected before	33 (27.3%)
Never been infected before	88 (72.7%)

Table 2: Personal hygiene practices among undergraduate clinical year medical students (n = 121)

No	Question	Frequency (%)
PH1	**How often do you wash your hands before preparing and eating food?**	
	Always	109 (90.1%)
	Sometimes	12 (9.9%)
	Never	0 (0.0%)
PH2	**How often do you wash your hands after coming back home?**	
	Always	92 (76.0%)
	Sometimes	27 (22.3%)
	Never	2 (1.7%)
PH3	**How often do you wash your hands after going to the toilet?**	
	Always	117 (96.7%)
	Sometimes	4 (3.3%)
	Never	0 (0.0%)
PH4	**How often do you use soap to wash your hands?**	
	Always	99 (81.8%)
	Sometimes	22 (18.2%)
	Never	0 (0.0%)
PH5	**How often do you use hand sanitizer outside?**	
	Always	74 (61.2%)
	Sometimes	47 (38.8%)

	Never	0 (0.0%)
PH6	**Do you wash your body at least once a day?**	
	Always	119 (98.3%)
	Sometimes	2 (1.7%)
	Never	0 (0.0%)
PH7	**Do you wash your hair with soap or shampoo at least once a week?**	
	Always	118 (97.5%)
	Sometimes	3 (2.5%)
	Never	0 (0.0%)
PH8	**Do you brush your teeth daily?**	
	Always	120 (99.2%)
	Sometimes	1 (0.8%)
	Never	0 (0.0%)
PH9	**Do you always wash dirty clothes with laundry soap before wearing them again?**	
	Always	108 (89.3%)
	Sometimes	13 (10.7%)
	Never	0 (0.0%)

Table 3: Stethoscope hygiene practices among undergraduate clinical year medical students (n = 121)

No	Variable	Frequency (%)
SH1	**Have you cleaned your stethoscope during clinical practice?**	
	Yes	97 (80.2%)
	No	24 (19.8%)
SH2	**If yes, how did you clean your stethoscope?**	
	Alcohol swab	14 (11.6%)
	Sanitizer	57 (47.1%)
	Soap	1 (0.8%)
	Dettol	3 (2.5%)
	Cloth	29 (24.0%)
	Wet tissue	1 (0.8%)
	Wet wipe	1 (0.8%)
	I said no earlier	15 (12.4%)
SH3	**How frequently did you clean your stethoscope?**	
	After every patient	12 (9.9%)
	Multiple times a day	5 (4.1%)
	Once a day	19 (15.7%)
	Once a week	21 (17.4%)
	Once a month	32 (26.4%)
	Once a year	14 (11.6%)
	Never	18 (14.9%)
SH4	**Which part of the stethoscope do you usually**	

	clean? (select more than one)	
	Earpiece	56 (46.3%)
	Bell	56 (46.3%)
	Diaphragm	63 (52.1%)
	Membrane	21 (17.4%)
	Entire stethoscope	44 (36.4%)
	I said no earlier	13 (10.7%)
SH5	**When do you usually clean your stethoscope?**	
	Before	37 (30.5%)
	After clinical practice	70 (57.9%)
	I said no earlier	14 (11.6%)
SH6	**Do you think the COVID-19 endemic has increased the frequency of cleaning?**	
	Yes	105 (86.8%)
	No	16 (13.2%)
SH7	**What is the reason that you are cleaning your stethoscope during this covid 19?**	
	To ensure the safety of patients	43 (35.5%)
	To ensure safety to myself	54 (44.6%)
	I have an obsessive cleaning disorder	2 (1.7%)
	I have germaphobia	8 (6.6%)
	I said no earlier	14 (11.6%)
SH8	**What is the reason that you might not be cleaning your stethoscope during the endemic phase of Covid-19?**	
	No cleaning agent is available	34 (28.1%)

	Do not know how to clean a stethoscope	18 (14.9%)
	No rules and policies in clinical practice	69 (57.0%)
SH9	**How did you learn to clean a stethoscope?**	
	Education from lecturer	6 (5.0%)
	Practical demonstration from the lecturer	5 (4.1%)
	Verbal instructions	6 (5.0%)
	YouTube video	13 (10.7%)
	No exposure before	89 (73.6%)
	Common sense, it is dirty and high risk of infections when you apply it on patients randomly	1 (0.8%)
	Family	1 (0.8%)

Table 4: Attitudes towards stethoscope hygiene among undergraduate clinical year medical students (n = 121)

No	Item	Frequency (%)				
		Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
A1	**I have enough time to clean my stethoscope in between examinations**	9 (7.4%)	56 (46.3%)	29 (24.0%)	19 (15.7%)	8 (6.6%)
A2	**Cleaning agents are always available**	11 (9.1%)	60 (49.6%)	17 (14.1%)	28 (23.1%)	5 (4.1%)
A3	**I regularly see others cleaning their stethoscope**	3 (2.5%)	13 (10.7%)	32 (26.5%)	50 (41.3%)	23 (19.0%)
A4	**It is important that my stethoscope is clean**	31 (25.6%)	85 (70.3%)	4 (3.3%)	0 (0.0%)	1 (0.8%)
A5	**Various agents can be transmitted via the stethoscope**	32 (26.5%)	79 (65.3%)	9 (7.4%)	0 (0.0%)	1 (0.8%)
A6	**I heard in classes that a stethoscope should be cleaned**	5 (4.1%)	23 (19.0%)	41 (33.9%)	39 (32.2%)	13 (10.8%)
A7	**I was shown in classes how to clean a stethoscope properly**	0 (0.0%)	10 (8.3%)	30 (24.8%)	52 (42.9%)	29 (24%)
A8	**The stethoscope cannot be damaged after regular cleaning**	4 (3.3%)	42 (34.7%)	62 (51.2%)	12 (10.0%)	1 (0.8%)
A9	**I would like to know more about stethoscope hygiene**	22 (18.2%)	87 (71.9%)	9 (7.4%)	1 (0.8%)	2 (1.7%)
A10	**Visual reminders related to stethoscope hygiene would help me clean it regularly**	18 (14.9%)	84 (69.4%)	15 (12.3%)	2 (1.7%)	2 (1.7%)

A11	**After this survey, I intend to clean my stethoscope more often**	23 (19.0%)	81 (66.9%)	15 (12.4%)	0 (0.0%)	2 (1.7%)

Table 5: Attitudes towards stethoscope hygiene in clinical practice among undergraduate clinical year medical students (n = 121)

Variable	**N (%)**
Do you agree that sanitizing a stethoscope is a must in clinical practice?	
Yes	114 (94.2%)
No	7 (5.8%)
Do you think you clean your stethoscope only if it's imposed by a lecturer?	
Yes	32 (26.4%)
No	89 (73.6%)
Do you think you clean your stethoscope only because it's made compulsory by hospital policies?	
Yes	83 (68.6%)
No	38 (31.4%)

Table 6: Association between demographic factors, personal hygiene, attitudes, and stethoscope hygiene practice among clinical year medical students

Independent variable	**Practice Stethoscope Hygiene Frequency (%)**		**OR (95% CI)**	**X^2**	**P value[a]**
	Yes	**No**			
Gender					
Male	44 (84.6%)	8 (15.4%)	1.66 (0.65, 4.24)	1.136	0.287
Female	53 (76.8%)	16 (23.2%)	Reference		
Personal Hygiene					
Good	50 (89.3%)	6 (10.7%)	3.19 (1.17, 8.73)	5.454	0.020
Poor	47 (72.3%)	18 (27.7%)	Reference		
Attitudes					
Good	44 (89.8%)	5 (10.2%)	3.15 (1.09, 9.14)	4.803	0.028
Poor	53 (73.6%)	19 (26.4%)	Reference		
Financial Status					
M40	38 (86.3%)	6 (13.6%)	2.11 (0.72, 6.12)	1.939	0.164
T20	20 (80.0%)	5 (20.0%)	1.33 (0.41, 4.26)	0.236	0.627
B40	39 (75.0%)	13 (25.0%)	Reference		
COVID 19 status					
Been infected	25 (75.8%)	8 (24.2%)	0.69 (0.26, 1.81)	0.554	0.457
Not been infected	72 (81.8%)	16 (18.2%)	Reference		
Year					
Year-5	33 (78.6%)	9 (21.4%)	0.85 (0.34, 2.17)	0.103	0.749
Year-4	64 (81.0%)	15 (19.0%)	Reference		

Household type					
Non hostelites	50 (78.1%)	14 (21.9%)	0.75 (0.30, 0.87)	0.356	0.551
Hostelite	47 (82.5%)	10 (17.5%)	Reference		

DISCUSSION

This cross-sectional study aimed to investigate the attitude and practices of stethoscope hygiene among clinical year medical students in a private medical university in Malaysia during the COVID-19 endemic phase. The results showed that although most students (80.1%) cleaned their stethoscopes, only 9.9% cleaned after each patient during clinical practice, and 4.1% cleaned their stethoscopes more than once a day, respectively. The most often utilized cleaning supplies were alcohol swabs (11.6%) and sanitizers (47.1%). These results are in line with other research from Serbia and the UK, which found that medical students' stethoscope hygiene habits ranged from 78.6% to 81.8% (4, 14). However, the frequency of cleaning after every patient was lower in our study compared to the Serbian study, where up to 20% of sixth-year students cleaned their stethoscopes after every patient (4). As opposed to our finding, a study done in Pakistan among medical professionals revealed that only 15.95% had maintained the hygiene of stethoscopes while only 10.87% cleaned it after every examination (10).

Although a majority (95.9%) agreed on the importance of cleaning stethoscopes and the potential for transmitting various agents via stethoscopes (91.8%), only a small percentage (23.1%) reported being taught in class about the need for stethoscope hygiene, and even fewer (8.3%) were shown how to properly clean a stethoscope. These findings highlight the need for improved education and training on stethoscope hygiene practices during medical education. The present study was conducted during the endemic phase of the COVID-19 pandemic, a period in which our student participants had developed awareness of the importance of stethoscope hygiene in mitigating the transmission of infectious pathogens, including SARS-CoV-2, the causative agent of COVID-19. Thus, the overall attitude towards stethoscope hygiene among our participants was better when comparing the study done in Serbia (4).

Interestingly, our study found no significant association between demographic factors, such as gender, financial status, COVID-19 infection status, academic year, household type, and stethoscope hygiene practices. This aligns with previous studies that reported no significant association between gender, educational level, and stethoscope disinfection practices among healthcare providers (14) and medical students (4). Contrary to our finding, the study done among medical students who had completed at least 6 months of clinical training showed that senior-year students had a better practice of equipment hygiene. But our findings about the non-significant association between gender and equipment hygiene were also corroborated by this study (10). However, we found a positive significant association between personal hygiene and stethoscope hygiene practices, as well as between attitudes towards

stethoscope hygiene and stethoscope hygiene practices. These findings are consistent with a study conducted in Ethiopia, which reported a positive association between attitudes towards infection prevention and stethoscope disinfection practices among healthcare providers (14).

The limitations of our study include the smaller sample size due to time constraints and a low response rate among final-year students (34.61%). Additionally, the cross-sectional design prevented us from observing changes over time, and the single-site location limits the generalizability of our findings to other medical schools. Future research should involve larger, multi-center studies to increase generalizability. Qualitative research exploring barriers and facilitators and microbiological studies quantifying contamination risks could provide valuable insights. Studies assessing patient outcome impacts would further guide evidence-based policies and resource allocation. Ultimately, a multi-pronged research approach combining quantitative and qualitative methods could comprehensively address gaps and strengthen stethoscope hygiene guidelines for enhanced patient safety.

Based on our findings, we recommend that medical institutions and lecturers emphasize stethoscope hygiene practices by incorporating them into standard operating procedures for clinical practice. Stethoscope hygiene could be included as an evaluation component during examinations and bedside teachings. Moreover, hospitals should implement stringent policies and guidelines, with potential consequences for non-compliance, to reinforce the importance of stethoscope hygiene practices. Furthermore, universities, hospitals, and government agencies can collaborate to increase awareness and promote stethoscope hygiene practices through educational campaigns, infographics, and social media marketing. By addressing the knowledge gaps and improving attitudes towards stethoscope hygiene, we can foster a culture of adherence to best practices and enhance patient safety.

CONCLUSION

Our study provides valuable insights into the attitudes and practices of stethoscope hygiene among clinical year medical students in a private medical university in Malaysia during the COVID-19 endemic phase. While most students reported cleaning their stethoscopes during clinical practice, the frequency of cleaning after every patient or multiple times a day was suboptimal. Despite recognizing the importance of stethoscope cleaning and the potential for transmitting pathogens, a significant proportion of students reported a lack of formal education or training on proper stethoscope hygiene practices during their medical curriculum. Demographic factors such as gender, financial status, COVID-19 infection status, academic year, or household type were not significantly associated with stethoscope hygiene practices. However, positive associations were observed between personal hygiene practices, attitudes towards stethoscope hygiene, and adherence to stethoscope cleaning practices. The findings underscore the need for comprehensive interventions to improve stethoscope hygiene practices among medical students. Medical institutions should prioritize the integration

of stethoscope hygiene education into their curricula, emphasizing its importance in preventing healthcare-associated infections and promoting patient safety.

ACKNOWLEDGEMENT

The authors express their profound appreciation to all individuals who generously devoted their time and effort as participants in this study. Special acknowledgment is extended to Pro Vice Chancellor Professor Dr. Adinegara Lutfi Abas and the Dean Professor Dr. Jayakumar Gurusamy. We are thankful to the Research Ethics Committee of Manipal University College Malaysia for their thorough review and approval of our study. We also thank Dr. Khalid Ahmed and his colleagues, and Dr. Tatjana Gazibara and her team for kindly allowing us to use and adapt their questionnaire for our study.

REFERENCES

1. Organization WH. Transmission of SARS-CoV-2: implications for infection prevention precautions 2020 [Available from: https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations.]
2. Abd Gani SM, Alied M, Huy NT. Pandemic to endemic: A successful transition in Malaysia. J Glob Health. 2023;13:03063.
3. Lotfi M, Hamblin MR, Rezaei N. COVID-19: Transmission, prevention, and potential therapeutic opportunities. Clin Chim Acta. 2020;508:254-66.
4. Gazibara T, Radovanovic S, Maric G, Rancic B, Kisic-Tepavcevic D, Pekmezovic T. Stethoscope Hygiene: Practice and Attitude of Medical Students. Med Princ Pract. 2015;24(6):509-14.
5. Vasudevan RS, Bin Thani K, Aljawder D, Maisel S, Maisel AS. The stethoscope: a potential vector for COVID-19? Eur Heart J. 2020;41(36):3393-5.
6. Pal K, Chatterjee R, Biswas A, Samanta A, editors. Bacterial Contamination and Disinfection of Stethoscopes: A Knowledge Gap among Health Care Personnel of a Tertiary Care Hospital of Rural Bengal2015.
7. Al Saleh S, Al Rammah AA-A, Syed W, Al Duhailan R, Kattan S, Al-Mana F. Stethoscope hygiene and barriers among physicians – A cross-sectional study from National Guard Health Affairs in Dammam, Saudi Arabia. Journal of Patient Safety and Infection Control. 2019;7(2):53-8.
8. Lee R, Choi SM, Jo SJ, Han S, Park YJ, Choi MA, Kong BK. A quasi-experimental study on stethoscopes contamination with multidrug-resistant bacteria: Its role as a vehicle of transmission. PLoS One. 2021;16(4):e0250455.
9. Longtin Y, Schneider A, Tschopp C, Renzi G, Gayet-Ageron A, Schrenzel J, Pittet D. Contamination of stethoscopes and physicians' hands after a physical examination. Mayo Clin Proc. 2014;89(3):291-9.
10. Ahmed K, Shaikh S, Rehman R, Ali SM. Frequency of awareness and practice of stethoscope hygiene with regards to guideline among medical students, residents and doctors in Karachi. J Bahria Univ Med Dental Coll. 2018;8:31-4.

11. Kalra S, Amin A, Albert N, Cadwell C, Edmonson C, Gaynes R, et al. Stethoscope hygiene: a call to action. Recommendations to update the CDC guidelines. Infection Control & Hospital Epidemiology. 2021;42(6):740-2.
12. Torres-Ballesteros LA, Rodríguez-Sáenz AY, Mendieta-Vergara JA. Hygiene behaviors in the use of stethoscopes of students of a medicine program of the city of Tunja, Colombia. Medicina & Laboratorio. 2020;23(05-06):249-56.
13. Rahman HS, Aziz MS, Hussein RH, Othman HH, Omer SHS, Khalid ES, et al. The transmission modes and sources of COVID-19: A systematic review. International Journal of Surgery Open. 2020;26:125-36.
14. Sahiledengle B, Tekalegn Y, Bekele K, Tesemma A, Edward Quisido BJ. Disinfection of Stethoscope and Non-Infrared Thermometer: Practices of Physicians in Ethiopia in the Era of COVID-19. Risk Manag Healthc Policy. 2020;13:3245-57.