

# Utilisation, satisfaction and opinion on telemedicine among undergraduate medical students: A cross-sectional study in Malaysia

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## ABSTRACT

Covid-19 crisis in Malaysia has strengthened the foundation of the country's digital health care services. Currently, the idea on telemedicine is more prevalent among medical students which plays a vital role in their present and future life. This study was aimed at determining the utilization, satisfaction, opinion on telemedicine and their relationship among undergraduate medical students. This study was an analytical cross-sectional study conducted from July 2022 to August 2022, among the undergraduate medical students in a private medical university in Malaysia. We had recruited 158 participants by non-probability purposive sampling. Self-administered questionnaires were distributed online via Google forms to undergraduate students. The data was processed and analysed using Microsoft Excel and Epi Info version 7.2.5.0. Statistical tests used was Chi square test, Fisher's exact test, Unpaired t-test and Correlation. The frequency and percentage were analysed for qualitative data while mean, standard deviation and range for quantitative data. Level of significance was set at  $p < 0.05$  and odds ratio was calculated. Among the 158 participants, only 20.89% participants had self-utilized telemedicine, 24.68% participants utilized for family and friends and 17.09 % participants observed doctors utilizing telemedicine. Mean satisfaction score was  $63.50 \pm 12.11$  and mean opinion score was  $91.21 \pm 15.87$ . Pearson correlation coefficient was 0.7 and it was statistically significant ( $p < 0.001$ ). There was significant, high, and positive linear correlation between satisfaction and opinion on telemedicine utilization. This study

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showed majority have heard and have some information about telemedicine, but few have utilized telemedicine. More participants responded positively in terms of future utilization of telemedicine. There was significant association between utilization, satisfaction and opinion on telemedicine among the students. It is essential for medical students to integrate telemedicine in their future career in view of the rapid digitalisation of healthcare delivery system.

## INTRODUCTION

In this revolutionary era of the Information Age, advancement of technology has boosted the transformation of healthcare systems worldwide to greater heights in terms of provision, accessibility, utilisation, and support delivered to individuals with the overall aim of improving the quality of healthcare services and overcoming the limitations of current conventional medical services. One of the transformations is telemedicine. Telemedicine is the secured digital platform of exchange of medical information via remote doctor-patient communication by the integration of electronic information, telecommunications, and multimedia technologies in order to provide healthcare and healthcare-related services for diagnosis, treatment, and prevention of diseases without geographical barriers [1,2]. To simplify, the term "medicine at a distance" literally refers to telemedicine [2].

During the extreme period of a pandemic, the importance of telemedicine has been expanded to a large scale, particularly as a means of minimizing close contact [3]. It is significant to help reduce the transmission of the virus and act as a protective measure to safeguard healthcare professionals from contagious infection by limiting in-person visits and face-to-face interaction as seen effective in past experiences in the management of prior acute respiratory illnesses like severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome [4,5]. From the perspective of patients, telemedicine can prevent delays in seeking medical attention, diagnosis and management of acute diseases or infections, or psychological problems by reducing waiting times, reducing geographical variability, and the risk of disease development and progression [5]. Telemedicine also showed its importance as a follow-up tool by accelerating the specialist referral process and image transfer, especially in patients suffering from chronic diseases who require constant monitoring for complications [6,7]. A previous study in Malaysia showed that teleconsultation fulfils the demand for access to specialists in terms of quick acquisition of consent and advice for patient management directives [7]. Moreover, telemedicine plays an integral role in relation to the efforts of directing hospital resources to more urgent cases resulting in a decrease in mortality and morbidity and overall operational cost reduction [8].

Prior to the COVID pandemic, telemedicine services were mostly established in high-income countries compared to low-income countries with insufficient infrastructure, mainly to overcome physical barriers for the sole purpose of referral and tertiary care facilities [9]. In 2000, Malaysia launched a telehealth flagship project in line with the implementation of the Malaysian Telemedicine Blueprint 1997 [10]. However, the awareness, knowledge, and utilisation of telemedicine were suboptimal among healthcare providers and medical students globally before the pandemic evidenced in Iran and the

Harvard study, until the entire healthcare system had been severely disrupted by the enforcement of quarantines and lockdowns during the COVID-19 pandemic [11,12]. With respect to this, many studies show that telemedicine is increasingly implemented across nations as the ideal alternative to curb the spread of the coronavirus while delivering patients with high-quality healthcare services during the COVID-19 pandemic [13,14,15]. According to a reputable health system in New York, USA, the utilisation of telemedicine has drastically surged with an increase of 135% in urgent care cases and an increase of 4345% in non-urgent care cases with a decline of over 80% in face-to-face visits during March and April 2020. Those who did not go to see their doctors face-to-face have been utilising telemedicine platforms to replace face-to-face sessions with their doctors [15]. On March 18, 2020, the Malaysian government implemented a Movement Control Order (MCO) by executing standard operating procedures (SOP) that enforced the need for physical distancing as a response to the pandemic evidenced by reduction in staff numbers, gaping of appointments, rescheduling of non-urgent cases, and partial shutdown of certain services in healthcare facilities that led to public hindrance in accessing medical services [16,17]. In light of this, Malaysian hospitals adopted a hybrid COVID-19 institution that permitted continuous medical care through telemedicine by regulating the Telemedicine Act 1997 [17,18]. However, previous literature found that although there was a slight increase of 12% of Malaysian clinicians practising telemedicine after the pandemic, the majority perceived the benefits of telemedicine to be applicable to limited patients only [18]. There was also the establishment of a Command Centre for Telemedicine Services by Sunway Medical Centre in early 2021 to increase the range of telemedicine services [19].

Since telemedicine has been increasingly integrated into medical practice in recent years with the advancement of information technology catalysed by the COVID-19 pandemic, there will be transformative change in the utilisation of telemedicine around the world, including Malaysia, in the future. In a pre-COVID study in the US, only 17.4% of medical students had prior exposure to telemedicine, and 86.5% had no prior exposure. It is found that among the exposed students, they were more inclined to plan for future utilisation compared to those who had never had exposure [20]. This suggests that the lack of exposure to telemedicine among medical students prior to the COVID-19 pandemic affects the satisfaction and opinion on utilisation of telemedicine and the need for incorporation of telemedicine education to increase awareness among medical students. According to Nepal studies conducted during the pandemic, among 59.3% of students who have utilised telemedicine over the phone, 94 % have given positive satisfaction and opinion with their experiences on teleconsultations, with the majority planning to utilise it in their future career [21]. These findings indicated that medical students who had used telemedicine were more likely to have a favourable opinion and a willingness to use it again in the future. Although there is a large body of literature on the knowledge, perception, and attitude toward telemedicine in various countries [20,21], there are a few studies on the utilisation, satisfaction, and opinion on telemedicine in Malaysia. In addition, the current research has a different time frame compared to previous studies, which were conducted either before or during COVID times.

Based on the Medical Protection survey, 66% of 395 Malaysian doctors recognized the usefulness role of telemedicine in situations similar to the COVID-19 pandemic and could be incorporated as a standard part of medical practice [22]. This proved that telemedicine has potential for integration into healthcare in the future and was beneficial in clinical

practise to a certain extent among healthcare providers. The Malaysian Investment Development Authority has given full opportunities to enhance the adoption of telemedicine to facilitate the growth of new and old healthcare industries in digital health transformation [23]. This research will concentrate on telemedicine, particularly among medical students, because the majority of Malaysian studies are geared toward healthcare professionals, and telemedicine has direct implications for future healthcare provision. With respect to this, it is crucial for medical students as future healthcare professionals to be introduced to the various modalities of medical care, including telemedicine, as part of honing of clinical skills and preparedness to utilise telemedicine in their future profession [24,25]. Current research will help to explore the utilisation, satisfaction, and opinion among undergraduate medical students as users or non-users and also future healthcare regarding telemedicine as a means of delivering healthcare services. Therefore, the purpose of this cross-sectional study was to close this gap by assessing telemedicine utilisation, satisfaction, and opinion among undergraduate medical students in a private medical university in Malaysia.

## **METHODS**

### ***Study design and setting***

This analytical cross-sectional study was conducted for 6 weeks from July 2022 to August 2022, among the undergraduate medical students in a private medical university in Malaysia. The target population of the study was students from clinical years of the MBBS programme.

### ***Sample size and sampling***

By using “Epi Info” version 7.2.5.0, the sample size (n) was calculated. We considered the expected frequency was 59.3% [21]. The total estimated population of clinical year undergraduate medical students was approximately 300 in our university. In this study, the minimum sample size required with 95% confidence level and 6% acceptable margin of error was 139. By considering 10% of non-response rate, the final sample size was calculated: Hence, the final sample size of this study was 153 participants and a total of complete questionnaires collected were 158. Participants were recruited by non-probability purposeful sampling. This method of sampling was used taking account the characteristics of the population and this study objectives. All the international and local undergraduate clinical year MBBS students were recruited in this study. The exclusion criteria were student from other programmes such as Foundation in Science and Bachelor of Dental Surgery, students who provided incomplete questionnaires and those who did not provided consent.

### ***Data collection***

Data were collected using self-administered questionnaire and the data collection tool was structured questionnaire distributed via Google Form. The link to Google Form was

shared through social media, mainly through WhatsApp and email to each batch representative. The questionnaire was adopted and modified partly from previous 2 literatures [ 7,21] and partly from validated self -created questions. The self-created questions. The self-created questions were validated by expert for content validation. Each participant was limited to one response only. Independent variables were age, gender, nationality, ethnicity, academic year, geographical region, utilization of telemedicine and satisfaction on utilization of telemedicine. Dependent variables were utilization, satisfaction, and opinion on telemedicine.

This questionnaire consisted of 6 parts. The first part was demographics which included gender, age, nationality, batch, academic year, state and geographical area. The second part was overview of telemedicine to know the familiarity of participants towards telemedicine as overall picture and was in yes and no answers. The next part was focused on utilization of telemedicine among medical students themselves as self-users, non-self-users or observers in which their families/friends/doctor have utilized telemedicine before. This part used the multiple choices answers. The remaining components were to study the satisfaction on utilization of telemedicine, opinion on knowledge and future utilization of telemedicine among the participants to identify the relationship between utilization, satisfaction, and opinion on telemedicine among medical students. These parts were assessed on a five-point Likert scale (5= strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree) and multiple choices answers.

### ***Data analysis***

The data was downloaded from Google Form in the form of Microsoft Excel and analysed by using Epi Info software version 7.2.5.0. The qualitative data such as age, gender, nationality, ethnicity, academic year, geographical region, utilization satisfaction and opinion on telemedicine were analysed using frequency and percentage. The quantitative data such as score of utilization and satisfaction on telemedicine were analysed using mean, range and standard deviation. The level of significance was set at  $p=0.05$  with 95% confidence interval. The measure of association calculated was odds ratio to find the association of independent and dependent variables as this was a descriptive cross sectional study design.

In this study, satisfaction on utilization of telemedicine is categorized into positive satisfaction ( $\geq 76$ ) and negative satisfaction ( $< 76$ ) with a cut-off point of 76. Opinion on utilization of telemedicine included 2 components which consisted of opinion on knowledge of telemedicine and opinion on utilization of telemedicine as future healthcare professional. The cut-off value for categorizing opinion on telemedicine into positive and negative opinion is a score of 108.

### ***Ethical consideration***

An informed consent form consisting of all the important and relevant particulars of the study were given to participants, so that written informed consent was obtained before answering the questionnaire. The participation was voluntary, and participants were given full freedom to participate in this study. All the information provided by the

participants in this study were to be kept confidential and only restricted for purpose of this research. Participants' anonymity and privacy were maintained throughout. This research was approved by the Research Ethics Committee of Faculty of Medicine, Manipal University College Malaysia (MUCM), Malaysia.

## RESULTS

Table 1 shows the sociodemographic characteristics of participants in which a total of 158 clinical undergraduate students have responded to our online questionnaire. Among the 158 students, 30.38% were male and 69.62% were female. The mean age of the participants was 22 years old and standard deviation of 1.26 years, with a range of 18 to 27 years old. The age was split into two categories as  $\leq 22$  years, which had 63.92% participants, and  $>22$  years, which had 36.08% participants. With respect to the inclusion of international students in our university, we considered the significance of nationality on this study objectives, which had 34.18% Malaysians and 65.82% international students. In terms of ethnicity, participants mostly belonged to others (34.18%), followed by Chinese (31.01%), Indian (29.75%), and Malay (5.06%). The participants were also grouped based on their semester of clinical year corresponding to their respective batches, consisting of 74.68% participants from semester 6 (Batch 45), 18.62% participants from semester 7 (Batch 44), and 5.70% participants from semester 8 (Batch 43). Participants were from various states including Johor, Melaka, Negeri Sembilan, Pahang, Penang, Perak, Sabah, Sarawak, Selangor, Terengganu, Kedah, Colombo, Delhi, and others, with the highest proportion from Colombo (27.22%) and none from Kelantan and Perlis. For geographical region, 89.24% of participants were from urban areas, while 10.76% of participants were from rural areas (Table 1).

Variables	Frequency (n)	Percentage (%)
<b>Gender</b>		
Male	48	30.38
Female	110	69.62
<b>Age (in years)</b>		
≤22 years	101	63.92
>22 years	57	36.08
Mean ±SD	22.18 ±1.26	
Min-Max	18-27	
<b>Nationality</b>		
Malaysian	104	34.18
International	54	65.82
<b>Ethnicity</b>		
Malay	8	5.06
Chinese	49	31.01
Indian	47	29.75
Others*	54	34.18
<b>Academic Year (semester of clinical year)</b>		
Batch 43 (semester 8)	9	5.70
Batch 44 (semester 7)	31	19.62
Batch 45(semester 6)	118	74.68
<b>State</b>		
Johor	10	6.33
Melaka	4	2.53
Negeri Sembilan	7	4.43
Pahang	2	1.27
Penang	11	6.96
Perak	11	6.96
Sabah	8	5.06
Sarawak	3	1.90
Selangor	36	22.78
Terengganu	4	2.53
Kedah	10	6.33
Colombo	43	27.22
Delhi	5	3.16
Kelantan	0	0
Perlis	0	0
Others **	4	2.53
<b>Geographical region</b>		
Rural	17	10.76
Urban	141	89.24

**Table 1:** Sociodemographic characteristics of study participants (n=158)

Other\* = Sri Lankan, Punjabi, Sikh, Pakistani, Kadazan, Eurasian, Brunei

Other\*\*= Punjab, Kandy, Thiruchchi, WP Labuan

Students' response on overview on telemedicine is reported in Appendix table 1. Among the 158 participants, 79.75% have heard about telemedicine, while 20.25% have not heard about telemedicine. From the 126 participants that had heard about telemedicine, participants were allowed to choose more than one option for the source of information about telemedicine. The sources of information about telemedicine included institutions (37.97%); health talks, seminars and webinars (43.67%); parents (15.82%); siblings and relatives (13.30%); friends (24.05%); and searching the internet (48.10%). For telemedicine programmes attended in the past, only 15.82% participants have done training in the past, and the remaining 84.18% have not done any training regarding telemedicine. Only 26.60% of participants answered yes to previous utilisation of telemedicine, and 73.40% had never utilised telemedicine previously (Appendix table 1). In terms of amount of information about telemedicine, 11.39% of participants had enough information, 82.28% of participants had some information while only 6.33% had no information about telemedicine at all (Appendix Figure 1)

Table 2 shows association between sociodemographic characteristic and utilisation of telemedicine. Significant association was observed between the nationality and utilisation of telemedicine (OR 2.67, 95%CI 1.28, 5.56). However, there was no significant association between gender, age, ethnicity, academic year, and geographic regions of the participants and utilisation of telemedicine (Table 2).

Variables	Utilisation of telemedicine		Odds ratio (95% CI)	Statistical tests (Chi-Square)	P value
	Yes n (%)	No n (%)			
<b>Gender</b>					
Male	14 (29.17)	34 (70.83)	1.27 (0.59,2.70)	0.37	0.542
Female	27 (24.55)	83 (75.45)	Reference		
<b>Age</b>					
≤ 22 years	25 (24.75)	76 (75.25)	Reference		
> 22 years	16 (28.07)	41 (71.93)	1.19 (0.57,2.47)	0.21	0.648
<b>Nationality</b>					
International	21 (38.89)	33 (61.11)	2.67 (1.28,5.56)	7.15	0.008
Malaysian	20 (19.23)	84 (80.77)	Reference		
<b>Ethnicity</b>					
Malay	3 (37.50)	5 (62.50)	3.00 (0.59,15.16)	1.89	0.181*
Chinese	8 (16.67)	40 (83.33)	Reference		
Indian	13 (28.26)	33 (71.74)	1.97 (0.73,5.32)	1.82	0.177
Others	17 (30.36)	39 (69.64)	2.18 (0.84,5.63)	2.65	0.103
<b>Academic Year (semester of clinical year)</b>					
Batch 43 (semester 8)	1 (11.11)	8 (88.89)	Reference		
Batch 44 (semester 7)	7 (22.58)	24 (77.42)	2.33 (0.25,21.98)	0.57	0.655*
Batch 45(semester 6)	33 (27.97)	85 (72.03)	3.11 (0.37,25.80)	1.21	0.443*
<b>Geographical region</b>					



Urban	34 (24.11)	107 (75.89)	2.2 (0.77,6.23)	2.30	0.147*
Rural	7 (41.18)	10 (58.82)	Reference		

**Table 2:** Association between sociodemographic characteristic and utilisation of telemedicine (n=158)

\*Fisher exact value

Table 3 shows association between sociodemographic characteristic and opinion on telemedicine. There was not significant association between the sociodemographic characteristics and opinion on telemedicine.

**Table 3:** Association between sociodemographic characteristic and opinion on telemedicine (n=158)

Variables	Opinion of telemedicine		Odds ratio (95% CI)	Statistical tests (Chi-Square)	P value
	Positive n (%)	Negative n (%)			
<b>Gender</b>					
Female	14 (12.73)	96 (87.27)	1.37 (0.53,3.52)	0.43	0.511
Male	8 (16.67)	40 (83.33)	Reference		
<b>Age</b>					
≤ 22 years	14 (13.86)	87 (86.14)	Reference		
> 22 years	8 (14.04)	49 (85.96)	1.01 (0.40,2.59)	0.00	0.976
<b>Nationality</b>					
Malaysian	16 (15.38)	88 (84.62)	1.45 (0.53,3.96)	0.54	0.462
International	6 (11.11)	48 (88.89)	Reference		
<b>Ethnicity</b>					
Malay	2 (25.00)	6 (75.00)	1.95 (0.33,11.69)	0.55	0.602*
Chinese	7 (14.58)	41 (85.42)	Reference		
Indian	7 (15.22)	39 (84.78)	1.05 (0.34,3.27)	0.01	0.931
Others	6 (10.71)	50 (89.29)	0.70 (0.22,2.26)	0.35	0.552
<b>Academic Year (semester of clinical year)</b>					
Batch 43 (semester 8)	3 (33.33)	6 (66.67)	3.38 (0.59,19.21)	2.02	0.316*
Batch 44 (semester 7)	4 (12.90)	27 (87.10)	Reference		
Batch 45(semester 6)	19 (16.10)	99 (83.90)	1.30 (0.41,4.13)	0.19	0.786*
<b>Geographical region</b>					
Rural	3 (17.65)	14 (82.35)	1.38 (0.36,5.24)	0.22	0.709*
Urban	19 (13.48)	122 (86.52)	Reference		

Satisfaction with telemedicine utilisation is divided into two categories: positive satisfaction (76) and negative satisfaction (76), with a cut-off point of 76. The highest score that can be obtained from the 5-point Likert scale is 95, and the least score is 19. Satisfaction for all participants was calculated and categorised into groups of positive and negative satisfaction. Among 158 participants, 27 reported positive satisfaction with

telemedicine use, while 131 reported negative satisfaction with telemedicine use. The mean satisfaction score is 63.50, with a standard deviation of 12.11 (Appendix table 2).

Table 4 shows association between sociodemographic characteristic and satisfaction on telemedicine. Significant association was observed between the nationality and satisfaction (OR 1.45, 95% CI 0.53,3.96). However, there was no significant association between gender, age, ethnicity, academic year, and geographic regions of the participants and satisfaction on telemedicine (Table 4).

**Table 4:** Association between sociodemographic characteristic and satisfaction on

Variables	Satisfaction of telemedicine		Odds ratio (95% CI)	Statistical tests (Chi-Square)	P value
	High n (%)	Low n (%)			
<b>Gender</b>					
Male	11 (22.92)	37 (77.08)	1.75 (0.74,4.11)	1.65	0.199
Female	16 (14.55)	94 (85.45)	Reference		
<b>Age</b>					
≤22 years	18 (17.82)	83 (82.18)	1.16 (0.48,2.78)		
>22 years	9 (15.79)	48 (84.21)	Reference	0.11	0.744
<b>Nationality</b>					
Malaysian	13 (12.50)	91 (87.50)	Reference		
International	14 (25.93)	40 (74.07)	2.45 (1.06,5.68)	4.52	0.033
<b>Ethnicity</b>					
Malay	1 (12.50)	7 (87.50)	1.50 (0.15,15.46)	0.12	0.567*
Chinese	8(16.67)	40(83.33)	2.10(0.59,7.52)	1.34	0.247
Indian	4 (8.70)	42 (91.30)	Reference		
Others	14 (25.00)	42 (75.00)	3.50 (1.06,11.51)	4.62	0.032
<b>Academic Year (semester of clinical year)</b>					
Batch 43 (semester 8)	7 (77.78)	2 (22.22)	19.25 (3.70,100.21)	20.46	<0.001*
Batch 44 (semester 7)	7 (21.88)	25 (78.13)	1.54 (0.58,4.09)	0.76	0.384
Batch 45(semester 6)	18 (15.38)	99 (84.62)	Reference		
<b>Geographical region</b>					
Rural	4 (23.53)	13 (76.47)	1.58 (0.47,5.28)	0.56	0.495*
Urban	23 (16.31)	118 (83.69)	Reference		

\*Fisher exact value

Table 5 shows utilisation of telemedicine as self-users in which among the 158 participants, 20.90% participants utilised telemedicine for their own purposes as telemedicine users, while 79.10% participants had never used telemedicine for themselves to consult a doctor. Various online platforms were used for telemedicine consisting of email, phone calls, video calls, text messages, health applications and others, with the majority of the self-users utilising telemedicine through video (6.96%) and phone calls (6.96%). With respect to the COVID-19 pandemic, the highest utilisation of telemedicine among the participants was during COVID-19 (10.13%), followed by after COVID-19 (7.59%) and the lowest utilisation before COVID-19 (3.16%). The reasons for the use of telemedicine were minor acute ailments (12.66%), follow-up for pre-existing or previous disease (8.23%), disclosure of lab results (3.16%), health education (2.53%) and others (0.63%). Participants consulted online doctors from different departments of practice, with the majority consulting a general practise (12.66%). In terms of frequency of utilisation, 11.39% of participants utilised telemedicine occasionally, 6.33% of participants utilised sometimes, 3.20% of participants utilised often, and none of participants utilised always. There were 5.70% of participants who utilised telemedicine before face-to-face consultation, while the remaining 15.19% participants utilised it after face-to-face consultation (Table 5).

**Table 5:** Utilisation of telemedicine as self-users (n=158)

<b>Variables</b>	<b>n (%)</b>
<b>Consultation via telemedicine in the past</b>	
No	125 (79.10)
Yes	33 (20.90)
<b>Online platform</b>	
Email	1 (0.63)
Video call	11 (6.96)
Phone call	11 (6.96)
Text	5 (3.16)
Health applications	4 (2.53)
N/A	125 (79.11)
Others (website)	1 (0.63)
<b>Telemedicine with respect to COVID-19</b>	
Before	5 (3.16)
During	16 (10.13)
After	12 (7.59)
N/A	125 (79.11)
<b>Reason of utilisation of telemedicine*</b>	
Minor acute ailments	20 (12.66)
Follow-up for pre-existing or previous disease	13 (8.23)
Disclosure of lab results	5 (3.16)
Health education	4 (2.53)
Other (Made appointments in place for my mother)	1 (0.63)
N/A	125 (79.11)

<b>Department of practice of consultants*</b>	
General practice	20 (12.66)
Psychiatrist	1 (0.63)
Pharmacist	4 (2.53)
Obstetrics and Gynecology	3 (1.90)
Surgeon	5 (3.16)
Ophthalmologist	1 (0.63)
ENT	2 (1.27)
Dental	4 (2.53)
Radiology	1 (0.63)
Oncology	0
Orthopaedics	1 (0.63)
Dermatologist	4 (2.53)
Cardiologist	0
Anaesthesiology	0
N/A	125 (79.11)
Others(endocrinologist)	2 (1.27)
<b>Frequency of utilisation of telemedicine</b>	
Occasionally	18 (11.39)
Sometimes	10 (6.33)
Often	5 (3.2)
Always	0
N/A	125 (79.11)
<b>Utilisation of telemedicine before or after face to face consultation</b>	
Before	9 (5.70)
After	24 (15.19)
N/A	125 (79.11)

\*Multiple choice answers

Table 6 shows utilisation of telemedicine as non-self-users in which among the 158 participants, 24.68% participants answered their family members or friends have utilised telemedicine while 75.32% participants answered their family members or friends have never utilised telemedicine in the past. Various online platforms were used for telemedicine consisting of email, phone calls, video calls, text messages, health applications, and others, with the majority of the family members or friends of the participants utilising telemedicine through phone calls (8.86%). With respect to the COVID-19 pandemic, the highest utilisation of telemedicine by family members or friends of the participants was during COVID-19 (15.82%), followed by before COVID-19 (6.33%) and the lowest utilisation after COVID-19 (2.53%). The reasons for utilisation of telemedicine were minor acute ailments (13.29%), follow-up for pre-existing or previous disease (10.76%), disclosure of lab results (5.06%), health education (2.53%) and others (1.90%). Online doctors consulted from various departments of practice, with the majority consulting a general practice (15.19%). In terms of frequency of utilisation, 15.82% of participants' family members or friends utilised telemedicine occasionally; 6.96% of them utilised it sometimes; 0.63% of them utilised it often; and 1.27% of them utilised it always. There were 10.13% of participants' family members or friends who

utilised telemedicine before face-to-face consultation, while the remaining 14.56% utilised it after face-to-face consultation (Table 6).

**Table 6:** Utilisation of telemedicine as non-self-users (n=158)

<b>Variables</b>	<b>n (%)</b>
<b>Consultation via telemedicine in the past by family members or friends</b>	
No	119 (75.32)
Yes	39 (24.68)
<b>Online platform used by family members and friends</b>	
Email	3 (1.90)
Video call	10 (6.33)
Phone call	14 (8.86)
Text	11 (6.96)
Health applications	1 (0.63)
N/A	119 (75.32)
Others	0
<b>Telemedicine with respect to COVID-19</b>	
Before	10 (6.33)
During	25 (15.82)
After	4 (2.53)
N/A	119 (75.32)
<b>Reason of teleconsultation*</b>	
Minor acute ailments	21 (13.29)
Follow-up for pre-existing or previous disease	17 (10.76)
Disclosure of lab results	8 (5.06)
Health education	4 (2.53)
Other	3 (1.90)
N/A	119 (75.32)
<b>Department of practice of consultants*</b>	
General practice	24 (15.19)
Psychiatrist	3 (1.90)
Pharmacist	5 (3.16)
Obstetrics and Gynecology	2 (1.27)
Surgeon	2 (1.27)
Ophthalmologist	3 (1.90)
ENT	4 (2.53)
Dental	4 (2.53)
Radiology	1 (0.63)
Oncology	0
Orthopaedics	2 (1.27)
Dermatologist	5 (3.16)
Cardiologist	2 (1.27)
Anaesthesiology	1 (0.63)

N/A	119 (75.32)
Others	0
<b>Frequency of utilisation of telemedicine</b>	
Occasionally	25 (15.82)
Sometimes	11 (6.96)
Often	1 (0.63)
Always	2 (1.27)
N/A	119 (75.32)
<b>Utilisation of telemedicine before or after face-to-face consultation</b>	
Before	16 (10.13)
After	23 (14.56)
N/A	119 (75.32)

\*Multiple choice answers

Table 7 shows observations of telemedicine in clinical postings in which among the 158 participants, 17.09% of participants observed doctors utilise telemedicine during clinical postings, while 82.91% participants did not observe doctors utilise telemedicine. Various online platforms were used for telemedicine consisting of email, phone calls, video calls, text messages, health applications, and others, with the majority of the family members or friends of the participants utilising telemedicine through phone calls (8.23%) . With respect to the COVID-19 pandemic, the highest utilisation of telemedicine by doctors was after COVID-19 (10.13%), followed by before COVID-19 (6.96%). For the reasons for the use of telemedicine by doctors, 15 participants weren't aware of the reasons, while 12 participants knew the reasons with statements given such as "better income," "save time," "for patients' convenience," "to avoid diseases spreading" etc. The top three highest departments of practise observed by participants were from general practise (5.06%), followed by pharmacists (4.43%) and oncology (3.16%). (Table 7).

**Table 7:** Observations of telemedicine in clinical postings (n=158)

<b>Variables</b>	<b>n (%)</b>
<b>Observe telemedicine used by doctors during clinical posting</b>	
Yes	27 (17.09)
No	131 (82.91)
<b>Online platform used by doctors observed</b>	
Email	2 (1.27)
Video call	10 (6.33)
Phone call	13 (8.23)
Text	1 (0.63)
Health applications	2 (1.27)
N/A	131 (82.91)
others	0
<b>Telemedicine with respect to COVID-19</b>	
Before	11 (6.96)
After	16 (10.13)
N/A	131 (82.91)

<b>Reason of utilisation of telemedicine</b>	
No,I don't know	15 (9.49)
Yes,I know	12 (7.59)
N/A	131 (82.91)
<b>Department of practice of consultants*</b>	
General practice	8 (5.06)
Psychiatrist	3 (1.90)
Pharmacist	7 (4.43)
Obstetrics and Gynecology	4 (2.53)
Surgeon	2 (1.27)
Ophthalmologist	3 (1.90)
ENT	1 (0.63)
Dental	1 (0.63)
Radiology	1 (0.63)
Oncology	5 (3.16)
Orthopaedics	2 (1.27)
Dermatologist	1 (0.63)
Cardiologist	1 (0.63)
Anaesthesiology	1 (0.63)
N/A	131 (82.91)
Others(paediatrics)	1 (0.63)

\*Multiple choice answers

Table 8 shows satisfaction on utilisation of telemedicine in which 56.96% of participants have a neutral opinion of overall satisfaction with the use of telemedicine, with 34.185 participants agreeing and 8.86% participants disagreeing with this statement. Most participants had a neutral opinion on all of the statements concerning internet quality, diagnosis, treatment planning, symptom relief, cost, payment system, relationship with doctor, history taking, system operation, privacy, and confidentiality. 46.2% of participants agreed that online health information through telemedicine improved their knowledge, followed by 45.57% of participants who answered neutral with this statement, and only 8.23% disagreed with it. Over half of participants had a neutral opinion on the utilisation of telemedicine again in the future for self-health, elderly and younger family members. The statement that the quality of telemedicine is better or equal to face-to-face consultation received a neutral response from 46.84% of participants, while 34.175 disagreed. During COVID-19, however, 53.16% of participants agreed that telemedicine is a better option and more beneficial. 45.57% of participants would suggest telemedicine to family and friends. 47.47% of participants were not sure and 6.96% of participants would not suggest telemedicine to family and friends (Table 8).

**Table 8:** Satisfaction on utilisation of telemedicine(n=158)

Variables	Strongly agree/agree	Neutral	Disagree/stro ngly disagree
	n (%)	n (%)	n (%)
Overall, I'm satisfied with using telemedicine	54 (34.18)	90 (56.96)	14 (8.86)
I'm satisfied with the quality of internet during teleconsultation session. (video/voice)	51 (32.28)	86 (54.43)	21 (13.29)
I get a clear idea of my condition / diagnosis after teleconsultation	56 (35.45)	80 (50.63)	22 (13.92)
Online health information through telemedicine has improved my knowledge	73 (46.20)	72 (45.57)	13 (8.23)
I'm contented with the arrangement for treatment	50 (31.65)	91 (57.59)	17 (10.76)
My symptoms relieved quickly / my condition got controlled during follow up sessions	45 (28,48)	100 (63.29)	13 (8.23)
The cost of treatment is affordable	49 (31.01)	98 (62.03)	11 (6.96)
I'm satisfied with the payment system	53 (33.54)	92 (58.23)	13 (8.23)
My relationship with my doctor is improved	42 (26.58)	96 (60.76)	20 (12.66)
Medical information (history of patients) can be collected accurately by telemedicine	52 (32.91)	83 (52.53)	23 (16.46)
I felt telemedicine consultation procedures save time, cost and energy	86 (54.43)	64 (40.51)	8 (5.06)
I am comfortable using telemedicine because the system is simple and easy to understand	57 (36.08)	87 (55.06)	14 (8.86)
Consultations via telemedicine-maintained privacy and confidentiality	58 (36.71)	85 (53.80)	15 (9.49)
I would use telemedicine again for my health	54 (34.18)	89 (56.33)	15 (9.49)
I would like to use telemedicine again for my elderly family members	50 (31.65)	85 (53.80)	23 (14.65)
I would like to use telemedicine again for my young children family members	52 (32.91)	82 (51.90)	24 (15.19)
The quality of telemedicine is better or equivalent to face-to-face consultation	30 (18.99)	74 (46.84)	54 (34.17)
Telemedicine is a better option and beneficial during COVID-1	84 (53.16)	64 (40.51)	10 (6.33)
Will you suggest telemedicine to your family / friends	72 (45.57)	75 (47.47)	11 (6.96)



Table 9 shows opinion on knowledge of utilisation of telemedicine in which majority of participants agreed on the statements "Telemedicine helps to overcome geographical barriers to assess medical services" and "Online health information via telemedicine improves patient health related knowledge" and "Telemedicine is essential in countries like Malaysia" with proportions of 68.99%, 40.51%, and 45.57%, respectively. In terms of quality of care, doctor-patient relationship, data security and privacy, and patients' holistic view improvement, a higher percentage of participants gave neutral opinions followed by positive and negative opinions. 58.23% of participants agreed that telemedicine reduces healthcare costs and administration, with a minority (4.43%) disagreeing with that. Among the 158 participants, 43.04% were neutral towards replacing non-essential real-time appointments with telemedicine, with 38.61% participants agreeing and 18.35% participants disagreeing on it. 48.10% of participants have a positive opinion with respect to the implementation of telemedicine in the curriculum of the medical education system in Malaysia. There were 46.84% of participants not sure about the popularity of telemedicine in our country, while 20.89% agreed and 32.38% disagreed that telemedicine is popular in our country (Table 9).

**Table 9:** Opinion on knowledge of utilisation of telemedicine (n=158)

Variables	Strongly agree/agree	Neutral	Disagree/strongly disagree
	n (%)	n (%)	n (%)
Do you think telemedicine help you to overcome geographical barrier to assess to medical services?	109 (68.99)	44 (27.85)	5 (3.16)
Online health information via telemedicine improves patient health related knowledges	91 (57.59)	57 (36.08)	10 (6.33)
Quality of care is equal in telemedicine and face to face hospital visits	46 (29.11)	64 (40.51)	48 (30.38)
Telemedicine improves interaction between physicians and patients and enhances doctor patient relationship	62 (39.24)	73 (46.20)	23 (14.56)
Telemedicine reduces healthcare costs and administration	92 (58.23)	59 (37.34)	7 (4.43)
Data security and privacy are guaranteed for electronically collected health data	60 (37.97)	76 (48.11)	22 (13.92)
Collecting health data via telemonitoring improves the holistic view of the patients	66 (41.77)	80 (50.64)	12 (7.59)
Telemedicine should replace nonessential real time appointment	61 (38.61)	68 (43.04)	29 (18.35)
Telemedicine is essential in countries like Malaysia	72 (45.57)	74 (46.80)	12 (7.60)
The medical education system of Malaysia should implement telemedicine in its curriculum	76 (48.10)	72 (45.57)	10 (6.33)
Telemedicine is popular in our country	20.89%	46.84%	32.38%

Table 10 shows telemedicine utilisation as future healthcare provider where among 158 participants, 75.32% participants planned to use telemedicine in their future professional career, while 24.68% participants had shown less willingness to utilise telemedicine in their career. Among those who planned to utilise telemedicine, the 68.99% of participants would utilise telemedicine sometimes or often and 24.05% participants would utilise telemedicine rarely in their career (Table 10).

**Table 10:** Overview on telemedicine utilisation as future healthcare provider (n=158)

Variables	n (%)
<b>Plan on future utilisation telemedicine in career</b>	
Yes	119 (75.32)
No	39 (24.68)
<b>If yes, frequency of utilisation of telemedicine</b>	
Rarely	38 (24.05)
Sometimes/often	109 (68.99)
Always	11 (6.96)

Table 11 shows opinion on telemedicine utilisation in terms of adopting telemedicine as a future healthcare professional, 66.45% of participants said they would use it for non-serious illnesses in the future, while only 1.90% participants would not. 51.90% of participants have a positive opinion and recommend telemedicine to colleagues and friends, while a minority (8.86%) would not recommend telemedicine. Most of the participants agreed that telemedicine would enable effective accomplishment of medical tasks, allow cooperation with other doctors or specialists faster and easier, enable a fast referral process, improve overall effectiveness of patient care management, improve documentation and utilisation of resources, keep knowledge updated, be useful for learning new medical information, and ensure patients stay a distance away from the hospital to get medical information. The statements "telemedicine can save patients' lives, especially during emergencies" and "telemedicine can reduce patient transfers or admissions from primary to tertiary hospitals" received neutral responses from 39.24% and 46.20% of participants, respectively. 55.70% of participants answered that telemedicine can coexist with face-to-face clinical sessions, while 2.53% participants answered telemedicine cannot coexist with face-to-face clinical sessions. 39.87% of participants were not sure whether telemedicine had the potential to replace face-to-face clinical sessions in the future, while 32.91% opined that telemedicine had the potential to replace face-to-face clinical sessions in the future, and the remaining 27.22% had a negative opinion on the future potential of telemedicine (Table 11).

**Table 11:** Opinion on telemedicine utilisation as future healthcare provider (n=158)

Variables	Strongly agree/agree	Neutral	Disagree/strongly disagree
	n (%)	n (%)	n (%)
I will use telemedicine for non-serious illness in future	105 (66.45)	50 (31.65)	3 (1.90)
I will recommend and advise telemedicine to colleagues and friends	82 (51.90)	62 (39.24)	14 (8.86)
Telemedicine would enable me to accomplish medical task effectively	77 (48.73)	70 (44.31)	11 (6.96)
Telemedicine enables me to cooperate with doctors or specialists more easily and faster	88 (55.70)	58 (36.71)	12 (7.59)
Telemedicine can save patient's life especially during emergency	60 (37.98)	62 (39.24)	36 (22.78)
Telemedicine enables me to quicken the referral process for specialist access	85 (3.80)	63 (39.87)	10 (6.33)
Telemedicine improves overall effectiveness of patient care management	72 (45.57)	70 (44.30)	16 (53.80)
Telemedicine can reduce patient transfer or admissions from primary to tertiary hospital	72 (45.57)	73 (46.20)	13 (8.23)
Telemedicine can improve documentations, data transfer and better utilisation of hospital resources	79 (50.00)	72 (45.57)	7 (4.43)
Telemedicine helps me as future health professional to keep my knowledge updated in a faster and more efficient way.	80 (50.63)	71 (44.94)	7 (4.43)
Telemedicine is useful to me as a future healthcare provider, and it aids me in terms of learning new information about various diseases and symptoms	79 (50.00)	73 (46.20)	6 (3.80)
In your opinion, can telemedicine co-exist with face-to-face clinical sessions?	88 (55.70)	66 (41.77)	4 (2.53)
Telemedicine has the potential to replace face-to-face clinical sessions in the future	52 (32.91)	63 (39.87)	43 (27.22)
Telemedicine ensures patients that stay at a distance away from the hospital to get some information	94 (59.50)	60 (37.97)	4 (2.53)

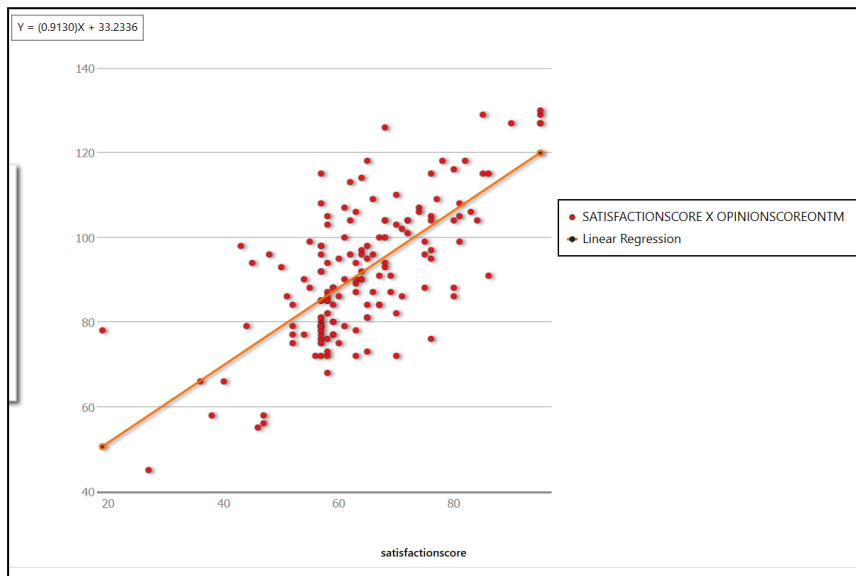
about their symptoms/ disease			
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Table 12 shows association between utilisation with satisfaction and opinion on utilisation of telemedicine. Significant association was observed between utilisation of telemedicine as self-users, non-self-users and observers during clinical postings with satisfaction of utilisation of telemedicine (p value < 0.001). Participants that utilised telemedicine as self-users have a mean satisfaction score of 70.61 with a standard deviation of 11.28. There was also significant association between utilisation of telemedicine as self-users, non-self-users and observers during clinical postings with opinion on utilisation of telemedicine (p value < 0.001). The mean opinion score for participants that utilised telemedicine as self-users have of 96.72 with a standard deviation of 15.27 (Table 12).

**Table 12:** Association between utilisation and satisfaction and opinion on utilisation of telemedicine(n=158)

Variables	Satisfaction score on utilisation of telemedicine			Opinion score on utilisation of telemedicine		
	Mean (SD)	Mean difference (95% CI)	P value	Mean (SD)	Mean difference (95% CI)	P value
<b>Utilisation of telemedicine as self-users (n=33)</b>						
Yes	70.61 (11.28)	-8.98 (-13.46, -4.50)	<0.001	96.72 (15.27)	-6.98(-13.03,-0.92)	0.024
No	61.62 (11.66)			89.75 (15.76)		
<b>Utilisation of telemedicine as non- users (n=39)</b>						
Yes	69.97 (11.31)	-8.60 (-12.81, -4.38)	<0.001	98.21 (14.31)	-9.29(-14.90,-3.68)	0.001
No	61.38 (11.65)			88.92 (15.73)		
<b>Observation of telemedicine utilisation during clinical postings (n=27)</b>						
Yes	71.74 (10.75)	-9.94 (-14.76, -5.11)	<0.001	100.22 (13.66)	-10.87(-17.29,-4.45)	0.001
No	61.80 (10.75)			89.35 (15.69)		

Association between satisfaction and opinion on telemedicine was evaluated through correlation analysis. The correlation coefficient was 0.70 demonstrated a positive and high association ( $p < 0.001$ ). When satisfaction on utilization of telemedicine increases, there is also increase in positivity of opinion towards telemedicine (Figure 1)



**Figure 1:** Scatter plot of association between mean satisfaction and mean opinion on utilisation of telemedicine

## DISCUSSION

This cross-sectional research aimed to study the utilization, satisfaction and opinion on telemedicine and their association among undergraduate medical students. This study was carried out among the medical students in a private medical university during post-pandemic era to explore their utilization, satisfaction and opinion on telemedicine. Many studies have been done to assess the knowledge, attitude and perception of telemedicine among medical students across the nation and showed that there was significant suboptimal knowledge regarding telemedicine that may have or have no influence on the attitude and perception of medical students utilizing telemedicine. One of the studies conducted in Pakistan reported that satisfactory level of knowledge of telemedicine among their medical students gave an outcome of higher positive attitude and perception on telemedicine utilization in healthcare system compared to those with poor level of knowledge [24]. In contrast with evidence of nil influence shown in a cross-sectional study conducted in a private institution of India revealing more than half of the medical students had insufficient knowledge of telemedicine but majority had positive perception and willingness to use telemedicine in career [26]. In view of many studies about telemedicine, there were limited literatures that studied how utilization of telemedicine may have influence on satisfaction and opinion towards telemedicine among medical students. Thus, this study opted to explore the relationship between utilisation, satisfaction and opinion on telemedicine in terms of knowledge and willingness for future use in career among medical students.

Based on these findings, there were significant satisfactory responses showing that majority of the students had heard about telemedicine from various sources of information although the adoption of telemedicine technology status in Malaysia is quite lagging compared to other developed countries like United Kingdom and Australia. Only a few of the students have attended telemedicine programme and received some training on telemedicine. These findings were consistent with a cross sectional study conducted in Nepal among their medical students reported that most of their students had heard about telemedicine and relatively few students have attended telemedicine training [21]. This phenomenon may be due to the abrupt and massive interruption to medical access which had been a major devastating global issue that caused Malaysia to accelerate the adoption of telemedicine with the onset of COVID-19 pandemic and this may contributed to the increase in familiarity to our medical students regarding telemedicine [27], but telemedicine programmes and the telemedicine guidelines in Malaysia is still in nascent stage. Based on an article from The Edge Malaysia Weekly, teleconsultation usage in private hospitals increased exponentially from approximately 300 calls per day prior to the pandemic to between 1,000 and 1,500 teleconsultations per day during pandemic signifying the rapid uptake of telemedicine [27].

This study revealed that only a few students had experience of utilizing telemedicine in the past and it may due to the matter of fact that our medical students may have lack of awareness towards telemedicine, lack of training and formal education given in medical curriculum. According to a study on Medical Students Viewpoints towards Development of Telemedicine Methods at Army University of Medical Sciences, only 17.4% of students have experience in the field of telemedicine [28]. These results may suggested that incorporation of more education and clinical exposure to telemedicine should be done to increase the

exposure to telemedicine among medical students which prepare them to utilize telemedicine in their future career as a healthcare professional following the rise of telemedicine usage during and after pandemic [20]. This approach was further elaborated in a study conducted at Icahn School of Medicine at Mount Sinai among the 4<sup>th</sup> year undergraduate medical students which proposed longitudinal telemedicine curriculum in terms of 5 domains [29].

Among the online platform used, the participants prefer to use video call or voice call to communicate with their doctor. This is maybe because compared with other platforms, the participants will feel more confident and secure if they can communicate with their doctor live and can get the answers they seek immediately. Among the many fields of specialization, general practitioners are mostly getting consulted online by the participants. This might be because in other specializations, the specialist may actually need to see the patient in person to do examinations on him or her or carry out a surgery if required.

Based on this study, utilization of telemedicine among participants as non-self-user which includes the family members and friends of the participants was the highest followed by utilization of telemedicine as self-user and observers during clinical postings with majority utilize telemedicine for minor acute ailments followed by follow -up for pre-existing disease. These findings may indicate that movement restrictions imposed during pandemic had caused participants to switch to utilize telemedicine platform for their family members and friends to help them in accessing medical health care through virtual consultation. There was an upward trend of utilization of telemedicine observed during COVID-19 pandemic compared to before COVID-19 supported by Malaysia Healthcare article stating that there was a noticeable positive change in customer behaviour during lockdowns where there was high acceptance to telemedicine services compared to prior pandemic [30]. Besides, telemedicine had proven to be an ideal way of assisting family members or friends in taking notes of doctor's advice, asking questions and having a clear picture of the diagnosis, which may contribute to higher utilization among the non-self-users [31].

This research also showed that majority have low satisfaction score of utilization of telemedicine due to majority participants had no experience of utilising telemedicine before, resulting in unable to provide satisfaction scale reflected in the results that showed most of them gave neutral responses of Likert scale regarding statements of satisfaction on utilization of telemedicine in our questionnaire. This phenomenon is presumed to be due to lack of real experience of telemedicine usage among our medical students supported by the study conducted in United States [20]. However, those who had utilized telemedicine as self-user had a higher mean satisfaction score of 70.61 than those who had not utilized telemedicine suggested that majority of users had high satisfaction on utilization of telemedicine in terms of the benefits received and important roles played by telemedicine during pandemic and post pandemic period. According to a randomized controlled trial study conducted among first year medical students from Edward Via College of Osteopathic Medicine-Carolinas, there was significant increased satisfaction and confidence of medical students with telemedicine after encountered standardized patient experience over telemedicine [32]. Similarly, a cross sectional study conducted in Nepal reported high mean satisfaction score among the medical students that have utilized telemedicine [21]. Hence, this study results showed consistency with the studies mentioned signifying there was

significant association between utilization and satisfaction on telemedicine among medical students.

Besides that, there was a high proportion of students having negative opinion score on utilization of telemedicine due to majority participants having no experience of utilizing telemedicine before, resulting in inability to give a well-informed opinion on knowledge and future utilization of telemedicine in career. As seen from the findings, majority had some knowledge about telemedicine and most of them were neutral to opinion on knowledge of utilization of telemedicine. Considering the fact that the lack of incorporation of telemedicine in our medical curriculum and lack of telemedicine programmes attended in Malaysia, the limited level of knowledge about telemedicine in medical students deprived them the ability to form either positive or negative opinion on utilization of telemedicine. Previous study reported that delivery of hands-on telehealth into medical curriculum facilitate medical students to formulate their opinion on utilization of telemedicine [33]. Surprisingly, more than 50% of our students have positive opinion to utilize telemedicine in their future career with majority foresee the potential of telemedicine as a very useful tool in assisting doctor-patient and doctor-doctor interaction in view of occurrence of COVID-19 pandemic based on an article on Career in Telemedicine [34]. This was further supported by the fact that most of them would recommend telemedicine to their colleagues and friends. These results were consistent with the cross-sectional study conducted in Germany where most of the medical students had some knowledge (63%) and opined that telemedicine would help them in their future career (60%) [35]. For all the reasons, it can be said that being exposed to benefits and drawbacks of telemedicine through utilization of telemedicine affects opinion on knowledge of telemedicine and future inclination to adopt telemedicine in career. Thus, this study results indicated that high mean opinion score of 96.72 was observed among the self-users, implying there was significant association between utilization and opinion on utilization of telemedicine among medical students.

Another significant finding in this study was the linear correlation between satisfaction and opinion on utilization of telemedicine. There is positive, significant, and high correlation between satisfaction and opinion on telemedicine. When satisfaction on utilization of telemedicine increases, there was also an increase in positivity of opinion towards telemedicine. This explained the findings in Germany's study that the higher satisfaction on utilization of telemedicine resulted in more favourable opinion towards telemedicine and the higher willingness for future utilization in professional career [35].

In this study, there was no significant association between demographic profile (gender, age, ethnicity, academic year and geographical region) and utilization of telemedicine among medical students of MUCM. There was also no significant association between demographic profile (gender, age, ethnicity, nationality, academic year and geographical region) and satisfaction on utilization telemedicine among medical students of MUCM. In addition, there was no significant association between demographic profile (gender, age, academic year and geographical region) and opinion on utilization telemedicine among medical students of MUCM. However, there was significant difference in utilization and opinion on telemedicine among the Malaysian and International medical students. The International participants are 2.67 times more likely to utilize telemedicine and 2.45 times more likely to have high satisfaction on telemedicine than Malaysian participants. This may be due to the barriers to



telemedicine practice in different countries in terms of differences in regulatory guidelines implemented, sociocultural factors, state of technological advancement and economical status.[36] For ethnicity, there was significant difference in opinion on telemedicine among the Malay, Chinese and other ethnicity participants probably due to the presumption of difference in sociocultural and socioeconomic status among them.

There were few limitations in this study. This study was conducted within a short time frame of 6 week and thus we were unable to include all medical students in our institution to participate this study. Only clinical undergraduate medical students from batch 43,44 and 45 and medical students from our institution, MUCM were included. This study design was an analytical cross-sectional study in which data collection was from sample size resulting in high probability of sampling error. The response rate from batch 43 was relatively low compared to responses from batch 44 and 45 due to different location of campuses making it hard for us to approach them leading to limitation of ability to compare the association between utilization, satisfaction and opinion on telemedicine among 3 batches. Furthermore, the method employed in this study was non probability purposive sampling in which the researcher chose the desired participants that have higher potential to answer the research objectives. Besides, we collected the data at one point of time which did not allow us to measure the effect of changes on utilization, satisfaction and opinion on telemedicine over time among the students. Hence, these may lead to selection bias resulting in an unequal representative nature of this sample and non-generalizability of the findings to the total population and other settings.

## CONCLUSION AND RECOMMENDATION

In conclusion, overall, this study revealed that most of our student have heard about telemedicine and have some information about telemedicine but only a number of students have utilized telemedicine either as self-user, non-self-user and observer. Opinion on utilization of telemedicine was categorized into groups of positive ( $\geq 108$ ) and negative opinion ( $< 108$ ) while satisfaction on utilization of telemedicine was categorized into positive satisfaction ( $\geq 76$ ) and negative satisfaction ( $< 76$ ). We also have found out that utilization of telemedicine has significantly association with satisfaction and opinion on utilization of telemedicine. High satisfaction, positive opinion on knowledge and willingness to utilize telemedicine in future career was predominant findings among medical students that have utilized telemedicine compared to those who had not. Furthermore, there was significant, high and positive linear correlation between satisfaction and opinion on utilization of telemedicine.

Telemedicine in medical profession has currently gained significance in a short interval due to COVID-19 outbreak that paralyzed the entire healthcare system of the world. As a medical student, it is of utmost importance to be equipped with clinical skills and knowledge regarding utilization of telemedicine for future incorporation to their career. Medical students are often the main providers of telemedicine in the clinic, and they can use this technology to improve the quality of diagnosis and treatment. However, the utilization rate was sub optimally low among medical students and thus it is vital to reinforce the telemedicine related medical curriculum in the form of training including enhancing the clinical skills and knowledge for remote care among undergraduate medical students for

future preparation in response to future pandemics. Therefore, quality care is possible to be maintained with adequate amount of knowledge on telemedicine. Without accelerated training implementation, telemedicine will continue to be a challenge faced by medical students in their career rather than an opportunity to increase overall effectiveness of medical care.

In view of this study setting and study population, future studies should include all participants from a university and participants from public universities for comparison with participants from private universities to generate a more representative and generalized result. Based on these findings, we would like to recommend the adoption of studies on barriers and interventions of utilization of telemedicine among medical students to resolve the barriers and improve utilization rate of medical students. We would also like to suggest studies to explore the perspectives of clinicians and educators on medical education incorporation into medical curriculum and their influence on the utilization of telemedicine among the medical students in Malaysia. Besides, we would also want to know the insights into the perception of telemedicine among the policy makers in Malaysia to allow standardization of telemedicine guidelines and wider scale of enforcement of utilization of telemedicine among medical students and public.

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## APPENDIX

**Appendix Table 1:** Students' response on overview on telemedicine (n=158)

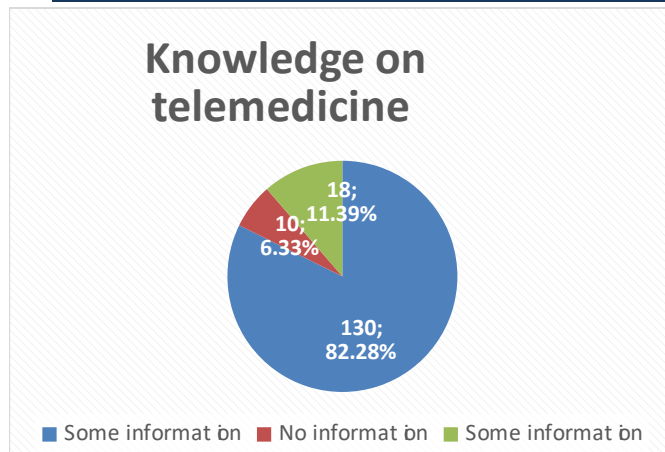
Variables	n (%)
<b>Heard about telemedicine</b>	
Yes	126 (79.75)
No	32 (20.25)
<b>Source of information of telemedicine*</b>	
Institution	60 (37.97)
Health talks, seminar, webinars	69 (43.67)
Parents	25 (15.82)
Siblings, relatives	21 (13.30)
Friends	38 (24.05)
Searching the internet	76 (48.10)
N/A	32 (20.30)
<b>Telemedicine programs attended in the past</b>	
Yes	25 (15.82)
No	133 (84.18)
<b>Previous utilisation of telemedicine</b>	
Yes	42 (26.60)
No	116 (73.40)

\*Multiple choice answers

**Appendix Table 2:** Category of satisfaction on telemedicine as self-users among the participants with respect to the satisfaction score obtained (n=158)

Variables	n (%)
<b>Satisfaction on utilisation of telemedicine</b>	
High ( $\geq 76$ )	27(17.09)
Low ( $<76$ )	131(82.01)
Mean $\pm$ SD	63.50 $\pm$ 12.11
Min-Max	19-95





**Appendix Figure 1:** Overview on knowledge of telemedicine utilisation (n=158)

**Appendix Table 3:** Category of opinion on utilisation of telemedicine in relation to opinion score obtained. (n=158)

Variables	n (%)
<b>Opinion on utilisation of telemedicine</b>	
Positive ( $\geq 108$ )	22(13.92)
Negative ( $< 108$ )	136(86.08)
Mean $\pm$ SD	91.21 $\pm$ 15.87
Min-Max	45-130