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Perceived Knowledge, Exposure and Attitude Towards Telemedicine among Medical Students in Taiwan

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ABSTRACT

Telemedicine experienced a significant surge in utilization globally during the pandemic. In the post-pandemic era, telemedicine plays an important role in promoting health education and delivery of care. Despite recognizing its significance, medical students across different countries expressed dissatisfaction with the lack of telemedicine training. This study aims to address this gap by exploring the perceived knowledge, exposure, and attitude towards telemedicine among medical students in Taiwan.

Method: The study implemented a cross-sectional design using an online, questionnaire-based survey via Google Forms across the medical schools in Taiwan. The questionnaire consists of 30 questions including demographic information, perceived knowledge, exposure and attitude towards telemedicine in the country. Data were analyzed using descriptive analysis, T-test, and Spearman's rank correlation.

Results: Of 158 surveyed students, 75% were preclinical (n=118) and 25% clinical (n=40). Gender ratio was 49:51 male to female (n=77; n=81). Perceived knowledge declined with question specificity. Exposure to telemedicine for both preclinical and clinical students was notably lacking. Attitudes towards telemedicine varied, with a majority expressing its importance in healthcare, yet dissatisfaction with current practice and training. Bivariate analyses indicated a stronger correlation between perceived knowledge and attitude among preclinical students compared to clinical students.

Conclusion: This study sheds light on the current state of telemedicine education among medical students in Taiwan, revealing significant gaps in perceived knowledge, exposure, and attitudes towards telemedicine. Integrating telemedicine into the standard medical curriculum, providing hands-on experience, and developing formalized training programs are crucial steps towards equipping future physicians with the necessary skills for effective telemedicine practice. This is especially pertinent as the nation transitions towards an aging population, where telemedicine offers promising solutions for healthcare delivery.

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Background of The Study

According to the World Health Organization, telemedicine is referred to as the remote delivery of healthcare services and exchange of information between individuals and healthcare professionals for diagnosis, treatment, and disease or injury protection, through information and communication technologies [1]. Telemedicine enables patients to receive more personalized care and access these healthcare services from afar, reducing unnecessary time and cost for both doctors and patients [1-2].

Moreover, integrating telemedicine into healthcare systems can improve the quality of care and optimize documentation and consultation processes, allowing doctors to cater to more clients within a limited time [2]. The COVID-19 outbreak spurred the adoption of telemedicine around the world, even in countries where telemedicine had been limited such as Taiwan [3-4]. Before the pandemic, Taiwan's Ministry of Health and Welfare (MOHW) restricted telemedicine services to specific scenarios, such as patients in rural areas, post-hospitalization follow-ups, long-term care facilities, and abroad [5]. However, in response to the highly contagious nature of SARS-CoV-2, the government implemented measures to reduce its burden on the national healthcare system, one of which was temporarily easing the Physicians Act, allowing individuals in home quarantine or isolation to access healthcare services via telemedicine [6].

The COVID-19 crisis coincided with Taiwan's transition into a super-aged society, with over 20% of the population expected to be 65 or older by 2025 [7]. Moreover, an MOHW survey revealed that approximately 86.3% of the elderly population live with at least one chronic condition [8]. Consequently, Taiwan's healthcare system faces overlapping challenges of adapting to an aging population while ensuring quality care [7-8]. To address these challenges, the MOHW has undertaken initiatives to enhance long-term care for older adults, including the expansion of telemedicine services [9]. Amendments to the "Rules of Medical Diagnosis and Treatment by Telecommunications" under the Physicians Act earlier this year expanded telemedicine eligibility to encompass patients with chronic diseases and individuals with disabilities [10].

Telemedicine is increasingly recognized globally as a vital tool for meeting ever-increasing and evolving healthcare needs. However, despite its growing importance, numerous studies have identified gaps in telemedicine education and training among healthcare professionals [11-14]. Medical students from various countries have expressed receiving insufficient exposure and education on telemedicine principles and practices during their medical training, highlighting the need to integrate telemedicine into the academic curriculum [15-19]. While numerous studies have investigated the perception and utilization of telemedicine in Taiwan's healthcare landscape, none have delved into the specific experiences and perspectives of medical students in this regard. Hence, this study aims to describe and evaluate the perceived knowledge, exposure, and attitudes towards telemedicine among medical students in Taiwan and to examine factors that may affect their attitudes towards telemedicine.

Methods
Study Design and Settings
An online questionnaire-based survey was conducted from August 26, 2023 to September 26, 2023. Participants received the questionnaire through Google Forms, and prior to proceeding with it, an informed consent was obtained by selecting "I agree" on the first page. Each email address was limited to filling out the survey only once, preventing any duplicate entries. The study population was obtained through convenient sampling of medical students from all study levels (first to sixth years), excluding post-baccalaureate medical students, across all medical schools in Taiwan.

Participants
Individuals eligible to participate in the study were current first to sixth-year students enrolled in M.D. programs affiliated with any university in Taiwan. However, medical students enrolled in post-baccalaureate medical programs were excluded from the study.

Questionnaire
The questionnaire was designed via Google Forms, an online survey platform (see Appendix A). Questions were developed by adaptations of previously published literature [16-18]. The survey consisted of 30 questions including demographic information (3 items), telemedicine knowledge (5 items), exposure to telemedicine (12 items), and attitudes towards telemedicine (10 items). Demographic questions included age, year of study and medical school. Likert Scale and multiple-choice questions were used to assess the telemedicine knowledge and exposure of medical students in Taiwan. Furthermore, the Likert Scale questions on knowledge were designed to have increasing specificity (i.e., general telemedicine, applications of telemedicine, telemedicine tools, telemedicine guidelines) across the questions asked. The survey was disseminated via social media platforms such as LINE, Instagram, Facebook to different student representatives studying at different medical Universities, then forwarded and shared to their own student channels at their own convenience.

Analysis
The data obtained from the survey were inputted into Excel 2013 and then exported to SPSS 26. The data were categorized based on the medical universities, the level of study (preclinical for first to fourth years/clinical for fifth and sixth years), and gender. Furthermore, perceived knowledge, exposure, and attitude toward various factors were extracted from the survey responses and analyzed statistically using t-test, and Spearman's rank correlation coefficient in SPSS.

A total of 158 responses were obtained. The average age of the study participants was 21.67 ± 2.14 years, of which 48.7% (n=77) were male and 51.2% (n=81) were female participants (see Appendix B). Survey responses were obtained from various medical schools in Taiwan, including 54.4% (n=86) from National Defense Medical Center being the most, 18.3% (n=29) from Kaohsiung Medical University, and 7.6% (n=12) from National Taiwan University, and 19.7% (n=31) from other medical universities (see Appendix B). Participants consisted of medical students from the first to the sixth years with the most responses coming from the second year students (n=36, 22.8%), followed by the third year (n=29, 18.4%) and the first year (n=28, 17.7%; see Appendix B). Comparing the number of responses between pre-clinical (i.e., first to fourth year) and clinical students (i.e., fifth and sixth year), a majority of the responses were obtained from preclinical students (n=118, 74.7%; see Appendix B).

Perceived Knowledge of Telemedicine
Regarding perceived knowledge of telemedicine, more than half (n=85, 53.8%) responded that they were familiar or very familiar (referred to as "familiar" herewith) with telemedicine, while less than half responded that they are familiar with telemedicine application in the medical field (n=70, 44.3%). Only 25.3% (n=40) and 13.3% (n=21) of the participants answered familiar with telemedicine tools and telemedicine guidelines respectively (Table 1).

Table 1: Perceived Knowledge of Telemedicine according to Preclinical and Clinical Years

	Very unfamiliar n%	Unfamiliar n%	Familiar n%	Very familiar n%	Total	Mean
To what extent are you familiar lemedicine technology?						
Pre-clinical	6(5.1)	50(42.4)	60(50.8)	2(1.7)	118	2.49
Clinical	1(2.5)	16(40.0)	20(50.0)	3(7.5)	40	2.63
To what extent are you familiar with the medical applications of telemedicine technology?						
Pre-clinical	10(8.5)	59(50.0)	46(39.0)	3(2.5)	118	2.36
Clinical	3(7.5)	16(40.0)	19(47.5)	2(5.0)	40	2.50
To what extent are you familiar with telemedicine tools?						
Pre-clinical	26(22.0)	64(54.2)	25(21.2)	3(2.5)	118	2.04
Clinical	6(15.0)	22(55.0)	10(25.0)	2(5.0)	40	2.20
To what extent are you familiar with telemedicine guidelines?						
Pre-clinical	50(42.4)	56(47.5)	11(9.3)	2(1.7)	118	1.70
Clinical	10(25.0)	22(55.0)	7(17.5)	1(2.5)	40	1.98

Due to the increasing specificity of the questions, scores were initially normalized by considering only the responses of participants who indicated being "familiar" or "very familiar" with the preceding question. As illustrated in Figure 1, out of 158 participants, 85 (53.8%) reported familiarity with telemedicine in general. Among these 85 participants, only 63 (74.1%) claimed to possess knowledge regarding the medical applications of telemedicine. From the subset of 63 respondents, 36 (57.1%) indicated being "familiar" or "very familiar" with telemedicine tools. Finally, only 17 out of the 36 participants (47.2%) expressed that they were knowledgeable of telemedicine guidelines in the country.
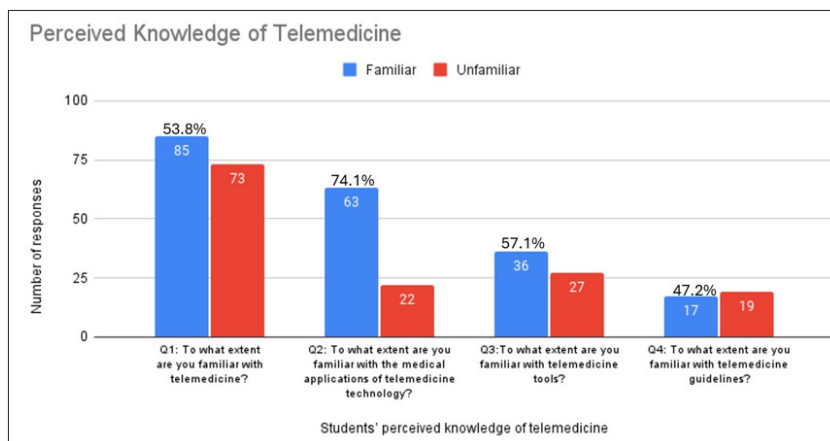

Figure 1: Adjusted Values of Students' Perceived Knowledge of Telemedicine

Regarding the definition of telemedicine, nine out of 158 (5.7%) respondents answered the only incorrect option "the use of telephone only is considered telemedicine, not video call, messaging or email." As seen in Table 2, the majority selected the definitions "telemedicine is the remote delivery of healthcare services" (n=144; 91.1%) and "telemedicine uses information and communication technology to disseminate health services" (n=135; 85.4%). These results were followed by a few participants who responded that telemedicine also facilitates professional health education, public health and primary care (n=107; 67.7%) and the exchange of information between doctors providing healthcare is considered telemedicine (n=69; 43.7%).

Table 2: "Agree" Responses on Telemedicine Definition

Definition of Telemedicine	n	%
Telemedicine is the remote delivery of healthcare services	144	91.1%
Telemedicine uses information, communication, and technology in disseminating health services	135	85.4%
Telemedicine helps facilitate professional health education, public health and health administration	107	67.7%
The exchange of information between doctors to provide healthcare is considered telemedicine	69	43.7%
The use of telephone only is considered telemedicine, not video call,	9	5.7% messaging or email

Exposure to Telemedicine

8.2% of the participants (n=13) had direct clinical exposure to telemedicine, while 91.8% (n=145) had not (see Table 3). Of the 13 participants, most had 1 hour or less of patient contact using telemedicine via video chat and only 1 participant had exposure up to 2 hours. Half of them (n=6) expressed that they had increased interest in telemedicine after having exposure to using direct telemedicine service. 23.4% of the participants (n=37) responded that telemedicine is included in their academic curriculum. Only 5% of the participants (n=5) had attended telemedicine related events, workshops or programs from conference or online courses. 38% of the participants (n=60) had consulted a doctor via telemedicine, with 50 of them having consultation through video chat function and 90% of participants (n=54) were satisfied with the health service delivered by the telemedicine doctor via whichever medium.

Table 3: Students' Exposure on Telemedicine

	Yes n (%)	No n (%)	Total N (%)	Mean
I have had clinical (direct patient care) exposure to telemedicine				
Total	13 (8.2)	145 (91.8)	158 (100)	0.15
Preclinical	7 (4.4)	111 (70.3)	118 (74.7)	
Clinical	6 (3.8)	34 (21.52)	40 (25.3)	
Is telemedicine included in the curriculum of your university?				
Total	37 (23.4)	121 (76.6)	158 (100)	0.23
Preclinical	28 (17.7)	90 (57.0)	118 (74.7)	
Clinical	9 (5.7)	31 (19.6)	40 (25.3)	

Have you attended any event, workshop, or program regarding telemedicine?				
Total	8 (5)	150 (95)	158 (100)	0.15
Preclinical	2 (1.3)	116 (73.4)	118 (74.7)	
Clinical	6 (3.8)	34 (21.5)	40 (25.3)	
Have you ever consulted a doctor via telemedicine?				
Total	60 (38)	98 (62)	158 (100)	0.28
Preclinical	49 (31.0)	69 (43.7)	118 (74.7)	
Clinical	11 (7.0)	29 (18.3)	40 (25.3)	

Attitude Towards Telemedicine

29 participants were unsatisfied with the telemedicine practice and training of medical students and 79 participants were neutral about it. Only 17.7% participants (n=28) were satisfied with the amount of usage of telemedicine in Taiwan currently. However, 13 participants were not planning to utilize telemedicine in my practice in the future and 66 participants were in between.

About 65.8% of participants (n=104) agreed that telemedicine is essential in countries like Taiwan. 74.7% of participants (n=118) believed that the medical education system of Taiwan should include telemedicine in its curriculum. Additionally, 72.8% of participants (n=115) believed that clinical (direct patient care) exposure to telemedicine is an important aspect of medical school training. Being the minority, 8.9 % of participants (n=14) disagreed that telemedicine is relevant for the patient as well as that telemedicine reduces healthcare costs and administration. Almost half of the participants (45.6%, n=72) agreed that telemedicine should replace nonessential real-time appointments. Moreover, 65.8% of participants (n=104) agreed that telemedicine offers location-Independent health services.

Table 4: Students' Attitude Towards Telemedicine

Strongly n%	disagree n%	Disagree n%	Neutral Agree n%	Strongly Agree n%	Total	Mean
I am satisfied with the telemedicine practice and training of medical students						
4(2.5)	25(15.8)	79(50.0)	40(25.3)	10(6.3)	158(100)	3.17
I am satisfied with the telemedicine practice and training of medical students						
6(3.8)	49(31.0)	75(47.5)	26(16.5)	2(1.3)	158(100)	2.79
I plan to utilize telemedicine in my practice in the future						
2(1.3)	11(7.0)	66(41.8)	63(39.9)	16(10.1)	158(100)	3.49
Telemedicine is essential in countries like Taiwan						
2(1.3)	14(8.9)	38(24.0)	68(43.0)	36(22.8)	158(100)	3.75
I think that the medical education system of Taiwan should include telemedicine in its curriculum.						
2(1.3)	6(3.8)	32(20.3)	79(50.0)	39(24.7)	158(100)	3.91
I think that clinical (direct patient care) exposure to telemedicine is an important aspect of medical school training						
2(1.3)	11(7.0)	30(19.0)	85(53.8)	30(19.0)	158(100)	3.80
Telemedicine is relevant for the patient						
2(1.3)	12(7.6)	41(25.9)	73(46.2)	30(19.0)	158(100)	3.74
Telemedicine reduces healthcare costs and administration						
3(1.9)	11(7.0)	34(21.5)	70(44.3)	40(25.3)	158(100)	3.84
Telemedicine should replace nonessential real-time appointments						
5(3.2)	27(17.1)	54(34.2)	56(35.4)			
Telemedicine offers location-independent health services						
5(3.2)	14(8.9)	34(21.5)	82(51.9)	23(14.6)	158(100)	3.66

Bivariate Comparison of Knowledge and Exposure Towards Telemedicine

Comparing exposure to the different areas of perceived knowledge, t-test revealed that exposure through direct clinical experience in providing telemedicine services had a significant difference of $p<0.021$ towards perceived knowledge of telemedicine tools (see Appendix C). Meanwhile, no statistical significance was obtained for other types of perceived knowledge (i.e., general telemedicine, applications of telemedicine, telemedicine guidelines). Other types of exposure to telemedicine (i.e., in-curriculum activities, out-of-curriculum workshops, receiving telemedicine services as a patient) did not show any significant difference with any of the areas in perceived knowledge.

Bivariate Comparison of Knowledge and Attitude Towards Telemedicine

Using the normalized values of perceived knowledge, no statistical significance was found between perceived knowledge and attitude. However, upon comparing correlations by gender (refer to Table 5) and clinical year (refer to Table 6), a positive correlation was observed among preclinical students regarding their perceived knowledge and attitude towards telemedicine in general (i.e., "AGeneral"; r=0.616, p<0.044) and towards telemedicine in Taiwan (i.e., "ATaiwan"; r=0.804, p<0.003). Similarly, a positive correlation was identified among clinical students, though without statistical significance.

Table 5: Spearman's Correlation coefficient of gender and attitude

Gender			KTotal	ATotal	ATaiwan	AGeneral
Female	K Total	Correlation Coefficient	1.000	0.664	0.531	0.664
		Sig (2-tailed)		0.150	0.278	0.150
		N	6	6	6	6
Male	K Total	Correlation Coefficient	1.000	0.521	0.576	0.456
		Sig (2-tailed)		0.101	0.064	0.158
		N	11	11	11	11

Table 6: Spearman's Correlation Coefficient of Year Level and Attitude

Year	Level		KTotal	ATotal	ATaiwan	AGeneral
Pre clinical	K Total	Correlation Coefficient	1.000	0.764**	0.804**	0.616*
		Sig (2-tailed)		0.006	0.003	0.044
		N	11	11	11	11
Male	K Total	Correlation Coefficient	1.000	0.676	0.487	0.600
		Sig (2-tailed)		0.140	0.327	0.208
		N	6	6	6	6

Note: **Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Discussion

This study is the first to evaluate the knowledge, exposure, and attitude towards telemedicine among medical students in Taiwan and contributes to understanding the landscape of telemedicine education in Taiwan.

Despite the surge in telemedicine usage during the COVID-19 pandemic, students' perceived knowledge of telemedicine across various domains fell below satisfactory levels. Among the 85 participants familiar with telemedicine, there was a declining trend in responses indicating "familiar" or "very familiar" as questions became more specific, covering medical applications of technology, telemedicine tools, and telemedicine guidelines. These findings align with data from similar studies in other countries, suggesting inadequate comprehensive and applicable knowledge of telemedicine among medical students, spanning both preclinical and clinical years [14-17]. The limited perceived knowledge of specific telemedicine topics, such as guidelines and tools, may stem from the scarcity of telemedicine-related content in medical curricula, as well as inadequate exposure in professional and public communications [16-18]. These findings highlight the urgent need to incorporate telemedicine education into the training of future physicians.

Regarding the definition of telemedicine, most participants selected only one or some of the four correct definitions. "Telemedicine is the remote delivery of healthcare services" had the most responses, while "The use of telephone only is considered telemedicine, not video call, messaging or email" had the least. These results were similar with findings from France and Nepal, in which asynchronous tele-expertise was the least recognized definition of telemedicine [17-19]. Comparable results were obtained by Ashfaq and colleagues who conducted a parallel study among doctors and found that participants generally agreed telemedicine to be a "remote diagnosis and treatment of patients by means of telecommunication technology." However, only 10% or less among the participants regarded telemedicine to encompass consultations over the phone or through text message and emailing of patient reports [20]. Challenges with identifying the precise and comprehensive definition of telemedicine may be attributed to the rapidly evolving nature of telemedicine, especially in the digital age as mentioned by Roy et al. The authors found a lack of standardized definition on telemedicine and its related terms such as "telehealth," not to mention the emergence of newer terms such as "mHealth" or "eHealth". The authors also mentioned that the absence of a general consensus regarding their definitions can create confusion and result in communication barriers between patients and healthcare professional, thus the need to establish consistency in this field [21].

The level of clinical exposure to telemedicine was alarmingly low with less than 10% of participants in their clinical years reported experiencing telemedicine as a service provider. Moreover, only a minority of the participants in both preclinical and clinical groups reported having attended telemedicine related workshops or conferences and responded having it included in

their curriculum. These findings suggest a significant insufficiency of telemedicine exposure and training for medical students in the country, which is also seen in similar studies in other countries [14-16]. Studies conducted among healthcare professionals (e.g., psychiatrists, physicians) also reported little exposure to telemedicine whether in the form of workshops, lectures, or hands-on practice, leading to decreased confidence and increased anxiety during patient interaction [11-13]. Navigating through the "digital divide," according to Sartori and colleagues, requires unique communication and technical skills different from traditional in-person consultations. These skills, although undeniably essential for effective service delivery, are often neglected in current medical education programs [22]. Therefore, exposing preclinical medical students to telemedicine tools and concepts in the early stage of their training may be necessary, using various training modalities to guide them in integrating telemedicine into their future practice [23-28].

Among the four domains of telemedicine exposure—clinical experience, formal curriculum, out-of-curriculum workshops, and exposure as a patient—only direct clinical experience was gnificantly associated with perceived knowledge, particularly regarding telemedicine tools. This highlights the crucial role of actual practice in enhancing medical students' proficiency in telemedicine and suggests that hands-on experience may be an effective method for grasping more technical concepts such as telemedicine tools. This finding is supported by Budakoğlu and colleagues who found actual patient engagement being one of the two most prominent methods of teaching telemedicine and hands-on practice greatly contributing to building the telemedicine skills of undergraduate students [29].

While solid evidence on this has yet to be established, numerous research and recommendations regarding development of a formal telemedicine curriculum are already on the rise. Jumreornvong et al recommended using various teaching methods, such as lectures on telehealth history, discussions on applications and ethics, supervised patient encounters, and hands-on exercises with telehealth equipment to explore specific telemedicine domains, namely, access to care, cost, cost-effectiveness, patient experience, and clinician experience [25].

Having a stronger correlation between perceived knowledge and attitude among pre-clinical students compared to clinical students implies that building theoretical understanding in the early stages of medical education may impact their attitudes more significantly towards patient care and clinical practice. Although medical students typically do not engage in direct patient care until their clinical years, incorporating telemedicine into the preclinical curriculum has been shown to yield several advantages [25-26]. To date, only a few studies have been found to explore telemedicine program integration in the preclinical years, most of which focused on student satisfaction and curriculum development [27]. Meanwhile, no studies have yet been conducted to explore its long-term impact on the future practice of recipients (i.e., current preclinical students). Cruz-Panesso et al found that medical residency or postgraduate medical education has been the primary focus of most of the recent research on teaching and developing telehealth skills.26 This may explain the lack of in-depth and wide-scale studies regarding telemedicine curriculum among preclinical medical students. Notably, a survey conducted across various medical training programs in the US revealed an increase in the provision of formalized telehealth curriculum, ranging from 1 to 10 hours, predominantly offered during the clinical years of medical

education, not in the preclinical years [30]. The contemporary approach to medical education supports the integration of topics throughout all years of study.27 However, further research and efforts are necessary to determine the most effective methods of formalizing telemedicine training as an integral component of the standard medical curriculum, particularly during the preclinical years. It is important to note though, that although no significant correlation between knowledge and attitude was found among clinical students (or 'clerks') in our study, current literature suggests that incorporating telemedicine program for postgraduate students, residents, and clerks have been found to improve various aspects of their performance such as completion of telemedicine visit, documentation, and perceived ease of use [13-29].

Conclusion
The findings of this study serve as a foundation in understanding the current status of telemedicine among the medical students of the country, specifically in terms of perceived knowledge, exposure, and attitude towards telemedicine. Results of this study underscore the need for more efforts in developing and integrating comprehensive telemedicine education in medical training programs for both preclinical and clinical medical students. This is evidenced by the perceived knowledge and exposure that were below satisfactory levels. Integrating telemedicine education into the standard medical curriculum, providing hands-on experience, and developing a formalized telemedicine curriculum are crucial steps towards preparing future physicians for the digital age of healthcare delivery, especially as the country moves towards an aging population [31].

Limitations
In this study, we aimed to investigate the impact of perceived knowledge, exposure and attitude towards telemedicine among medical students in Taiwan. Despite our rigorous methodology and comprehensive data analysis, it is essential to acknowledge the limitation imposed by our relatively small sample size of 158 eligible participants which may notably prevent the extrapolation of our findings to broader demographics. Additionally, the limited sample size might have hindered our ability to detect subtle but clinically significant associations between the explored variables. Although our study provides valuable insights into this important area of research, future studies with larger and more diverse samples are warranted to confirm and extend our findings. Another limitation includes our sampling approach, arising from the inherent nature of social media, where survey dissemination relies heavily on existing connections and network reach.

Consequently, individuals who are not active users of these platforms or who are not within our online social networks may be overlooked, leading to an incomplete sample size that may not adequately represent the diversity and characteristics of the entire population under study. This limitation could potentially introduce bias and compromise the external validity of our findings, as the perspectives and experiences of excluded individuals may differ significantly from those captured within our sample. The self-reporting aspect of the study may have introduced voluntary bias since the perspectives of students who did not participate in the survey were not considered. Moreover, the results of the study may also be influenced by Hawthorne bias, which refers to the alteration in the behavioral performance of research participants due to their awareness of being observed, monitored, assessed, or part of the research itself. Finally, the study merely explored specific aspects of telemedicine from the perspective of medical students, which does not encompass the viewpoint of all medical

professionals in the field. Hence, exploring the perspectives of the other stakeholders (e.g., patients, caregivers) is also essential to create a more holistic approach as we move forward.

Appendix A: Questionnaire
Demographics
Sex assigned at birth (M/F)
Current level in medical school (Year one, Year two, Year three, Year four, Year five, Year six)
Age
Course
Medical school

Knowledge (4-point likert scale: 1-Very Unfamiliar, 2-Unfamiliar, 3-Familiar, 4-Very Familiar)
3. To what extent are you familiar with telemedicine
- To what extent are you familiar with telemedicine technology?
- To what extent are you familiar with the medical applications of telemedicine technology?
- To what extent are you familiar with telemedicine tools?
- To what extent are you familiar with telemedicine guidelines?
4. In your understanding, which of the following points describe telemedicine? (can choose more than one)
- It is the remote delivery of healthcare services.
- It uses information, communication, and technology in disseminating health services.
- It also helps facilitate professional health education, public health and health administration
- Exchange of information between doctors to provide healthcare is considered telemedicine
- Use of telephone only is considered telemedicine, not video call, messaging or email

Exposure (Yes/No)
5. I have had clinical (direct patient care) exposure to telemedicine
- If Yes, go to Question 6.
- If No, go to Question 9.
6. If yes, how much time was spent in direct patient care via telemedicine?
- hour or less of patient contact
- Total of 1-2 hours of patient contact
- Total of 2-3 hours of patient contact
- 4 hours or more of patient contact
7. If yes, what was the medium used for providing telemedicine services? (can choose more than one)
- Telephone
- Texting chat
- Email
- Video chat
8. If yes, my telemedicine patient care experience:
- Increased my interest in telemedicine
- Decreased my interest in telemedicine
- Did not affect my interest in telemedicine
9. Is telemedicine included in the curriculum of your university?
- If Yes, go to Question 10.
- If No, go to Question 12.
10. Have you attended any training regarding telemedicine?
- YES
- NO
11. Does your medical school offer didactic exposure to telemedicine such as lectures or conferences?
- YES
- NO
12. Have you attended any event, workshop, or program regarding

telemedicine?
- YES
- NO
13. If yes, which of the following have you attended? (can choose more than one)
- Workshop
- Conference
- Lecture
- Online course
14. Have you ever consulted a doctor via telemedicine?
- If Yes, go to Question 15.
- If No, go to Question 17.
15. What was the medium used for telemedicine ? (can choose more than one)
- Telephone
- Text/chat messaging
- Email
 Video chat
- Others
16. How satisfied were you with your experience?
- Very satisfied
- Satisfied
- Unsatisfied
- Very unsatisfied

Attitude (5-point likert scale: 1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree)
17. Which extent do you agree with the following statements ?
- I am satisfied with the telemedicine practice and training of medical students
- I am satisfied with the amount of usage of telemedicine in
Taiwan currently
- I plan to utilize telemedicine in my practice in the future.
- Telemedicine is essential in countries like Taiwan.
- I think that the medical education system of Taiwan should include telemedicine in its curriculum
- I think that clinical (direct patient care) exposure to telemedicine is an important aspect of medical school training.
- Telemedicine is relevant for the patient.
- Telemedicine reduces healthcare costs and administration
- Telemedicine should replace nonessential real-time appointments
- Telemedicine offers location-independent health services
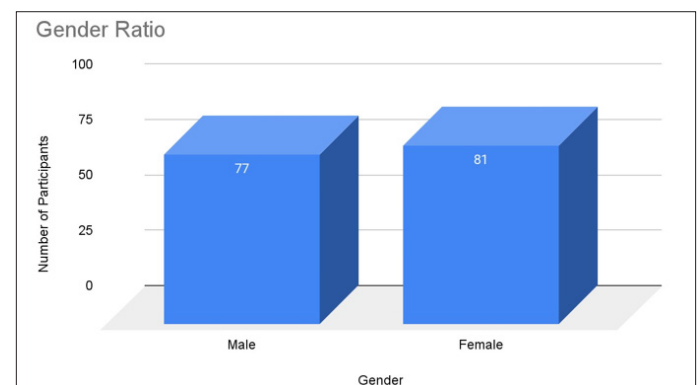
Appendix B: Participant Demographics
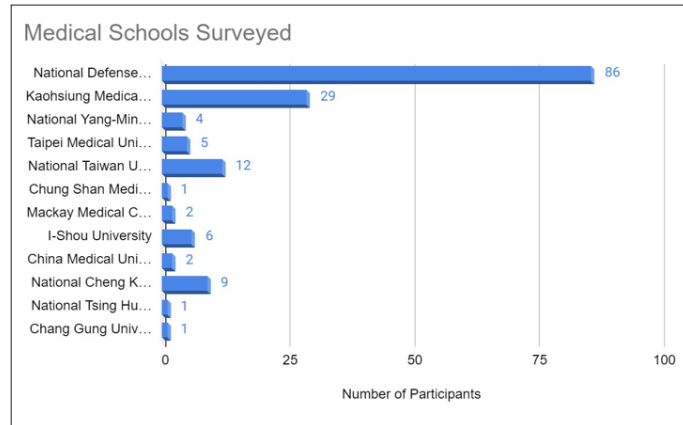

Figure 1: Gender Ratio of Participants

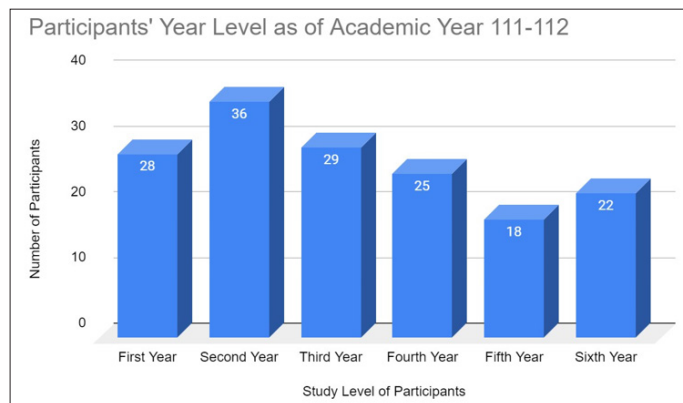**Figure 2:** Medical Schools in Taiwan of surveyed participants

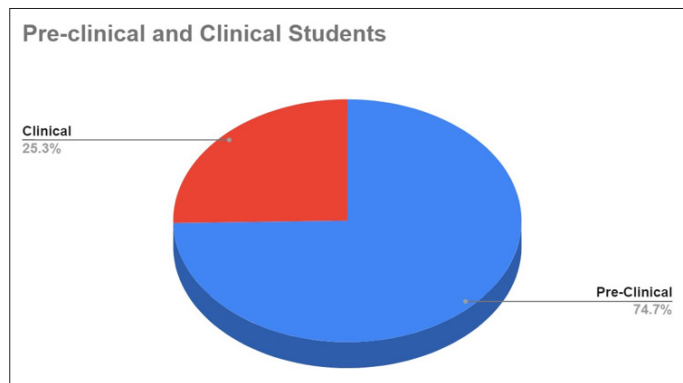**Figure 3:** Participants' year level as of academic year 111-112

Figure 4: Ratio of Pre-Clinical and Clinical Students

Appendix C: Bivariate Comparison of Knowledge and Exposure

E1: Direct experience		N	Mean	SD	p value
K1: To what extent are you familiar with telemedicine	Yes	13	2.92	0.760	0.241
	No	145	2.49	0.614	
K2: To what extent are you familiar with the medical applications of telemedicine technology?	Yes	13	2.77	0.725	0.241
	No	145	2.36	0.674	
K3: To what extent are you familiar with telemedicine tools?	Yes	13	2.85	0.899	0.021
	No	145	2.01	0.687	

Figure 5: Comparison table for Direct Clinical Experience with Perceived Knowledge

E2: Curriculum		N	Mean	SD	p value
K1: To what extent are you familiar with telemedicine technology?	Yes	37	2.84	0.501	0.942
	No	121	2.43	0.643	
K2: To what extent are you familiar with the medical applications of telemedicine technology?	Yes	37	2.73	0.608	0.942
	No	121	2.29	0.676	
K3: To what extent are you familiar with telemedicine tools?	Yes	37	2.35	0588	0.399
	No	121	2.00	0.764	
K4: To what extent are you familiar with telemedicine guidelines?	Yes	37	1.97	0.726	
	No	121	1.71	0.712	0.942

Figure 6: Comparison table for Curriculum with Perceived Knowledge

E4: Being a Patient		N	Mean	SD	p value
E3: Out-of Curriculum Workshops		N	Mean	SD	p value
	Yes	8	3.00	0.535	0.942
	No	150	2.50	0.632	
K1: To what extent are you familiar with telemedicine technology? K2: To what extent are you familiar with the medical applications of telemedicine technology?	Yes	8	3.00	0.535	0.942
	No	150	2.36	0.678	
K3: To what extent are you familiar with telemedicine tools?	Yes	8	3.00	0.756	0.808
	No	150	2.03	0.709	
K4: To what extent are you familiar with telemedicine guidelines?	Yes	8	3.13	0.641	0.327
	No	150		0.653	

Figure 7: Comparison table for Out-of-Curriculum workshops with Perceived knowledge

K1: To what extent are you familiar with telemedicine technology?	Yes	60	2.62	0.640	0.942
	No	98	2.47	0.629	
K2: To what extent are you familiar with the medical applications of telemedicine technology?	Yes	60	2.48	0.651	0.942
	No	98	2.34	0.703	
K3: To what extent are you familiar with telemedicine tools?	Yes	60	2.18	0.770	0.808
	No	98	2.02	0.718	
K4: To what extent are you familiar with telemedicine guidelines?	Yes	60	1.68	0.725	0.942
	No	98	1.83	0.718	

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