Education in Medicine Journal

ORIGINAL ARTICLE

Title: Assessing Pharmacy Students' Perceptions of Tele-Pharmacy: Insights for Enhancing Pharmacy Education

Authors: Ieman Mukhriz Abdul Rapa, Mohammad Suhaidi Sha'ari, Nik Aisyah Najwa Nik Mustaffa Shapri, Nur Syazwani Taridi, Farhana Fakhira Ismail, Janattul Ain Jamal, Munaver Ahmad Nazir Ahmad, Aida Azlina Ali, Mohd Shahezwan Abd Wahab

Submitted Date: 15-10-2024

Accepted Date: 25-05-2025

Please cite this article as: Abdul Rapa IM, Sha'ari MS, Nik Mustaffa Shapri NAN, Taridi NS, Ismail FF, Jamal JA, Nazir Ahmad MA, Ali AA, Abd Wahab MS. Assessing pharmacy students' perceptions of tele-pharmacy: insights for enhancing pharmacy education. Education in Medicine Journal. 2025 (early view).

Assessing Pharmacy Students' Perceptions of Tele-Pharmacy: Insights for Enhancing Pharmacy Education

Ieman Mukhriz Abdul Rapa[1], Mohammad Suhaidi Sha'ari[1], Nik Aisyah Najwa Nik Mustaffa Shapri[1], Nur Syazwani Taridi[1], Farhana Fakhira Ismail[1], Janattul Ain Jamal[1], Munaver Ahmad Nazir Ahmad[2], Aida Azlina Ali[3], Mohd Shahezwan Abd Wahab[1,4,5]

[1]Department of Pharmacy Practice and Clinical Pharmacy, Faculty of Pharmacy, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia

[2]Rhazes Telehealth International Sdn. Bhd., Jalan PJU 7/6, Mutiara Damansara, 47800 Subang Jaya, Selangor

[3]Department of Pharmacology and Life Sciences, Faculty of Pharmacy, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300, Puncak Alam, Selangor, Malaysia

[4]Elderly Medication and Safety, Faculty of Pharmacy, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300, Puncak Alam, Selangor, Malaysia

[5]Non-Destructive Biomedical and Pharmaceutical Research Centre, Smart Manufacturing Research Institute, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300, Puncak Alam, Selangor, Malaysia

ABSTRACT

Tele-pharmacy is an innovative approach to delivering pharmaceutical care at a distance. As this approach is increasingly being integrated into healthcare, pharmacy education providers are incorporating it into their curricula to prepare future pharmacists. This study investigates perceptions of pharmacy students regarding tele-pharmacy and examines how their views are influenced by factors such as their gender, educational background, and stage in their pharmacy programme. Using an online survey, a cross-sectional study was conducted over eight weeks (March 1 to April 30, 2023) among undergraduate pharmacy students at a public university in Malaysia. The survey captured comprehensive data on students' perspectives by asking closed-ended questions. Most participants were female (64.5%) and in their clinical semester (67.5%). Students expressed favourable views of tele-pharmacy, with 95.6% recognising its convenience, 98% highlighting time savings, and 97.5% acknowledging energy savings. However, concerns were raised about accessibility and pharmacists' training. Optimism about and agreement on certain aspects of tele-pharmacy declined with study progression. However, 93.1% desired tele-pharmacy training, and 93.6% showed interest in providing such services, with enthusiasm growing among advanced students. These findings underscore the need for curricular enhancements, including hands-on simulations, structured patient follow-ups, and self-learning modules, to address the evident tele-pharmacy training gaps. Longitudinal research is needed to evaluate how students' perceptions evolve with increased exposure to tele-pharmacy and its practical applications.

Keywords: Tele-pharmacy, perception, pharmacy student, pharmacy education

CORRESPONDING AUTHOR

Mohd Shahezwan Abd Wahab, [1]Department of Pharmacy Practice and Clinical Pharmacy, Faculty of Pharmacy, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia

Email: mohdsh2790@uitm.edu.my

INTRODUCTION

Tele-pharmacy, defined as the provision of pharmaceutical care and services through telecommunications and digital technology, represents a transformative advancement in healthcare delivery (1, 2). This approach enables pharmacists to offer patient counselling, medication management, and other essential services remotely, thus overcoming geographical constraints. Tele-pharmacy has the potential to improve healthcare access, particularly in rural and underserved regions, by bridging gaps between patients and healthcare providers (3).

Numerous tele-pharmacy initiatives worldwide have demonstrated its adaptability across diverse settings. For instance, the "medical chest" system in rural Queensland, Australia, facilitates diagnoses and medication dispensing via telephone (4), while the Guddi Baji programme in Pakistan utilises digital technology to deliver essential pharmaceutical services to peri-urban and rural populations (5). Furthermore, during the COVID-19 pandemic, tele-pharmacy gained global momentum as pharmacists leveraged telecommunication technologies to maintain care continuity for patients with chronic conditions, exemplifying its utility in addressing healthcare challenges (6).

Similarly, clinical pharmacists in Qatar leveraged tele-pharmacy to offer real-time interventions and electronic triage systems, thereby improving the quality of ambulatory pharmaceutical care (7). In critical care settings, tele-pharmacy models in intensive care units have underscored the vital role of remote pharmacists in monitoring physiological parameters and providing immediate feedback, thus enhancing patient outcomes and optimising the workflow of on-site healthcare providers (8, 9).

The potential benefits of tele-pharmacy are substantial. By minimising the need for patient travel, healthcare accessibility is enhanced for individuals with mobility limitations or residents of remote areas (10-12). It also reduces the operational costs associated with physical pharmacy facilities while fostering personalised pharmacist-patient interactions (7, 13). Such interactions have been linked to improved medication adherence and enhanced patient outcomes. Given these advantages, the incorporation of tele-pharmacy into routine pharmacy practice appears imperative, necessitating the development of robust educational frameworks to prepare future pharmacists for this evolution of their role.

In response to the growing relevance of tele-pharmacy, pharmacy education programmes have begun to integrate this field into their curricula (14-16). However, many educators lack adequate training and familiarity with telehealth technologies, which impedes their ability to effectively teach these concepts (17, 18). Additionally, some institutions have insufficient technological infrastructure, particularly in resource-limited settings, posing a significant barrier to the effective delivery of tele-pharmacy education (19-21). Addressing these challenges requires investment in reliable technological infrastructure and targeted faculty training to build the capacity for teaching tele-pharmacy (20).

Furthermore, being predominantly structured around conventional topics, traditional pharmacy curricula often lack the flexibility to incorporate emerging fields such as tele-pharmacy (16). This underscores the need for comprehensive curriculum reviews and redesigns to align educational content with the dynamic demands of modern pharmacy practice. Simulation-based and experiential learning approaches are particularly effective in equipping students with the practical skills necessary for tele-pharmacy practice (15, 16, 22).

Understanding the perceptions of pharmacy students regarding tele-pharmacy is critical to ensuring that curricula meet their educational needs. A growing body of evidence offers insights into students' awareness, attitudes, and preparedness regarding tele-pharmacy. While overall perceptions are generally favourable, findings vary across different contexts. In Saudi Arabia, approximately half of the students surveyed were aware of tele-pharmacy; however, only a quarter had received formal instruction on the subject (23). In contrast, studies conducted in Malaysia and Indonesia reported higher levels of knowledge, with 67% and 97.9% of students, respectively, demonstrating substantial understanding of tele-pharmacy concepts (21, 24). These studies consistently highlight that greater knowledge is positively associated with more favourable perceptions and increased readiness to engage in tele-pharmacy practice (21, 23, 24).

Students tend to have positive attitudes towards tele-pharmacy. In Malaysia, 61% of a student sample expressed favourable views, particularly appreciating tele-pharmacy's potential to reduce healthcare costs and improve access to services during the COVID-19 pandemic (21). Likewise, 96.6% of Indonesian students reported having a positive attitude towards tele-pharmacy (24). Such stances are often linked to perceived practical benefits, including convenience, cost-effectiveness, and the ability to reach underserved populations (16, 25). In terms of readiness, 68% of Malaysian and 97.4% of Indonesian students indicated a willingness to provide tele-pharmacy services in their future practice (21, 25). However, several concerns remain, such as the potential for higher workloads and the lack of adequate incentives, which may limit the broader implementation of these services (21).

Students' perceptions can be influenced by factors such as their gender, educational background, and stage in the pharmacy programme, which may produce varying levels of exposure and understanding of tele-pharmacy. However, there is a notable gap in the literature regarding how students' perceptions evolve across different educational stages (21, 23, 25-28). Therefore, the aim of the present study was to analyse pharmacy students' perceptions of tele-pharmacy and address these variations based on their gender, educational experience, and pharmacy programme stage. By identifying these differences, the study sought to highlight specific areas in the curriculum that might require further development. Ultimately, this research should contribute to the optimisation of pharmacy education, ensuring that students are well-equipped to meet future challenges and opportunities in the field of tele-pharmacy.

METHODOLOGY

Study Design

This cross-sectional study, conducted using an online survey, took place over eight weeks from March 1 to April 30, 2023. It involved undergraduate pharmacy students from a public university in Malaysia. The survey consisted of closed-ended questions and was designed to gather comprehensive data on the students' perspectives. Ethical approval for the study was received from the Research Ethics Committee of Universiti Teknologi MARA (UiTM), Malaysia (REC[PH]/UG/036/2023).

Study Setting

This study was conducted at the Faculty of Pharmacy, Universiti Teknologi MARA (UiTM), a public university in Selangor, Malaysia. UiTM offers a Bachelor of Pharmacy (B.Pharm) programme whose annual student intake arrives through various pathways, including diploma programmes, foundation studies, and matriculation.

The B.Pharm programme is structured as a four-year course comprising eight semesters. The first five emphasise pharmaceutical sciences, including physiology, pharmaceutical chemistry, pharmacology, and pharmaceutics, while the final three semesters focus on clinical pharmacy and pharmacy practice subjects. Beginning in the sixth semester, students are introduced to tele-pharmacy through lectures and other educational activities.

Specifically, tele-pharmacy content is incorporated into lectures in the 'Introduction to Clinical Pharmacy' course during the sixth semester and the 'Hospital Pharmacy' course during the seventh semester. In the eighth semester, students participate in the Clinical Pharmacy training programme, which requires them to conduct tele-pharmacy sessions with real patients, applying skills such as patient history taking and patient counselling.

Study Participants

The target participants for this study were students enrolled in the UiTM B.Pharm programme. At the time of the study, this course had 675 students across all four years. The eligibility criteria required active enrolment in the UiTM B.Pharm programme and proficiency in reading and understanding English. Those enrolled in B.Pharm programmes at other universities or non-pharmacy programmes at UiTM were excluded from participation.

The sample size was calculated using the Raosoft© sample size calculator, which recommended a sample of 194 students, based on a total population of 675, providing a 5% margin of error and a 90% confidence level and assuming a 50% response distribution. The study was conducted during the March to August 2023 semester. Since the programme admits only one intake annually, at the time of the study, potential participants were in their second, fourth, sixth, or eighth semesters.

The participants were classified into two groups: foundational semester students (those in the second or fourth semesters) and clinical semester students (those in the sixth or eighth semesters). This categorisation was designed to capture a range of perceptions regarding tele-pharmacy. Foundational semester students were included to provide insights into perceptions before any formal exposure to tele-pharmacy concepts. In contrast, clinical semester students were included because tele-pharmacy is introduced and progressively expanded during these semesters. This approach enabled a comparative analysis of the perceptions, including expectations and readiness, held by students with differing levels of exposure to tele-pharmacy within the curriculum.

Study Instrument

The survey questionnaire was developed following a comprehensive review of the relevant literature (16, 21, 23, 25, 27, 28), which guided the item and section development. The final instrument comprised six sections. The first gathered demographic information, while the subsequent sections assessed various perceptions: general perceptions (nine items), benefits (six items), usefulness (four items),

impacts on patients' medication use (six items), and readiness for tele-pharmacy (two items). The response options for each item were categorised as follows: 1 = "Strongly agree", 2 = "Agree", 3 = "Neutral", 4 = "Disagree", and 5 = "Strongly disagree".

The survey instrument was reviewed by six pharmacy lecturers, each with over five years of professional experience, to ensure its relevance, clarity, and alignment with the study objectives. The reviewers were asked to evaluate each item based on three criteria: relevance (rated on a scale from 1 = "Not relevant" to 4 = "Very relevant"), essentiality (rated on a scale from 1 = "Not essential" to 3 = "Essential"), and clarity (rated on a scale from 1 = "Not clear" to 3 = "Very clear"). Additionally, they were invited to provide qualitative feedback on the wording and overall structure of the items.

The content validity index (CVI) for each item was calculated by dividing the number of reviewers who rated the item as "quite relevant" or "very relevant" by the total number of reviewers. All the items achieved a CVI of ≥ 0.83. As recommended by Lynn (1986), for six reviewers, a CVI of ≥ 0.83 indicates acceptable content validity (29). The Scale-level CVI (S-CVI) was calculated as the average of all the I-CVI values across the sections. This yielded a score of ≥ 0.90, indicating good scale-level content validity. Additionally, the mean essentiality and clarity scores were above the threshold of 2.00, confirming that the items were sufficiently clear and essential for the study (Table 1). Based on the reviewers' qualitative feedback, minor revisions were made to improve the wording of several items.

Table 1: Item-level and scale-level content validity indices (I-CVI and S-CVI), essentiality, and clarity scores of the questionnaire items

Items	**I-CVI[a]**	**Essentiality[b]**	**Clarity[c]**
Perceptions of tele-pharmacy			
1. Tele-pharmacy services are convenient.	1.00	3.00	3.00
2. Tele-pharmacy services save patients' time.	1.00	3.00	3.00
3. Tele-pharmacy services save patients' energy.	1.00	2.67	2.67
4. Tele-pharmacy services are easily accessible in Malaysia.	1.00	2.67	2.50
5. Communication between a patient and a pharmacist during tele-pharmacy is easy.	1.00	2.83	2.83
6. Pharmacists in Malaysia are ready to provide tele-pharmacy services.	0.83	2.50	2.33
7. Pharmacists in Malaysia are well-trained to provide tele-pharmacy services.	1.00	2.67	2.50
8. The cost of tele-pharmacy services is affordable.	0.83	2.83	2.83
9. Tele-pharmacy services can protect the privacy and confidentiality of patients.	0.83	2.83	2.83
S-CVI	**0.94**		
Perceptions regarding benefits of tele-pharmacy			
1. Tele-pharmacy services can improve patients' well-being.	1.00	2.67	2.67
2. Tele-pharmacy services can improve patients' health.	0.83	2.83	2.83
3. Tele-pharmacy services can reduce patients' risk of contracting COVID-19.	0.83	2.50	2.67
4. Tele-pharmacy services allow patients to receive personalised treatment.	1.00	2.83	2.67

5. Tele-pharmacy services allow patients to receive personalised advice.	1.00	2.83	2.83
6. Tele-pharmacy services make patients feel comfortable discussing their health conditions with pharmacists.	1.00	2.67	2.50
S-CVI	**0.94**		
Perceptions regarding the usefulness of tele-pharmacy			
1. Tele-pharmacy services allow more interactions between patients and pharmacists.	1.00	2.67	2.67
2. Tele-pharmacy services are a good platform for patients to receive health information.	1.00	2.83	2.83
3. Tele-pharmacy services allow patients to receive timely feedback from pharmacists.	1.00	3.00	2.83
4. Tele-pharmacy services allow pharmacists to monitor a patient's health.	0.83	2.83	2.67
S-CVI	**0.96**		
Perceptions regarding the impacts of tele-pharmacy on patients' medication use			
1. Tele-pharmacy services can improve a patient's confidence in taking medications.	1.00	2.67	2.67
2. Tele-pharmacy services ensure patients receive appropriate medications.	1.00	2.83	2.83
3. Tele-pharmacy services ensure patients receive safe medications.	1.00	2.83	2.83
4. Tele-pharmacy services ensure that patients understand their medications.	1.00	3.00	3.00
5. Tele-pharmacy services improve a patient's compliance with his/her medications.	1.00	2.83	2.83
6. Tele-pharmacy services make it easier for patients to refill their medications.	0.83	2.83	2.83
S-CVI	**0.97**		
Perceptions regarding readiness for tele-pharmacy			
1. I would like to receive training on tele-pharmacy.	1	3.00	3.00
2. I would like to offer tele-pharmacy services in the future.	1	3.00	3.00
S-CVI	**1**		

I-CVI, Item-level Content Validity Index; S-CVI, Scale-Level Content Validity Index

[a] Calculated by dividing the number of reviewers who rated the item as "quite relevant" or "very relevant" by the total number of reviewers (n = 6).

[b] Mean essentiality score (based on a scale from 1 = "Not essential" to 3 = "Essential").

[c] Mean clarity score (based on a scale from 1 = "Not clear" to 3 = "Very clear").

The finalised questionnaire was converted into an online survey format using the SurveyMonkey platform, which was used to facilitate distribution and administration. To evaluate the survey's practicality and clarity, a pilot test was conducted with ten pharmacy students from various semesters. The pilot study affirmed the survey's effectiveness in terms of functionality and comprehensibility. These responses were excluded from the final data analysis.

Data Collection

A snowball sampling method was employed to recruit participants. Initially, the survey link was distributed to the heads of student batches in the B.Pharm programme, who were requested to share the link with their peers. Invitations were also extended through popular social media platforms, including Facebook, WhatsApp, and Telegram. Participants who received or completed the survey were encouraged to further disseminate the link to others within their network. The survey was accessible for eight weeks to allow sufficient time for responses.

In the introductory section of the online survey, the participants were provided with detailed information about the study's objectives, the estimated time required for completion, and assurances regarding the anonymity and confidentiality of their responses. They were informed that submitting the questionnaire constituted their consent to participate. Subsequent pages of the survey included screening questions to determine eligibility. Individuals who did not meet the eligibility criteria—such as those enrolled in B.Pharm programmes at other universities, in non-pharmacy programmes at UiTM, or who indicated a lack of English proficiency—were redirected to the final page of the questionnaire to end the survey.

The survey was restricted to one response per individual to prevent duplicate entries, and no incentives were offered. Data were collected and securely stored to maintain confidentiality and integrity throughout the study.

Statistical Analysis

All the statistical analyses were conducted using the Statistical Package for the Social Sciences (IBM SPSS) version 28. Categorical data were reported as frequencies and percentages. To identify associations between the students' perceptions and demographic characteristics, a Chi-squared test or Fisher exact test was performed. A p-value of less than 0.05 was considered statistically significant. The results were interpreted to determine the presence of associations between variables.

RESULTS

Demographic Characteristics of the Participants

Figure 1 presents the demographic characteristics of the study participants. Most were female, representing 64.5% (131/203) of the sample. The ethnic distribution was predominantly Malay (95.6%, 194/203). Most participants were between 22 and 23 years old, accounting for 56.2% (114/203) of the sample. Those under 22 years of age constituted 27.6% (56/203) of the total, while those older than 23 years represented 16.3% (33/203). In terms of academic progression, 67.5% (137/203) of the participants were in clinical semesters (sixth or eighth semesters), whereas 32.5% (66/203) were in foundational semesters (second or fourth semesters).

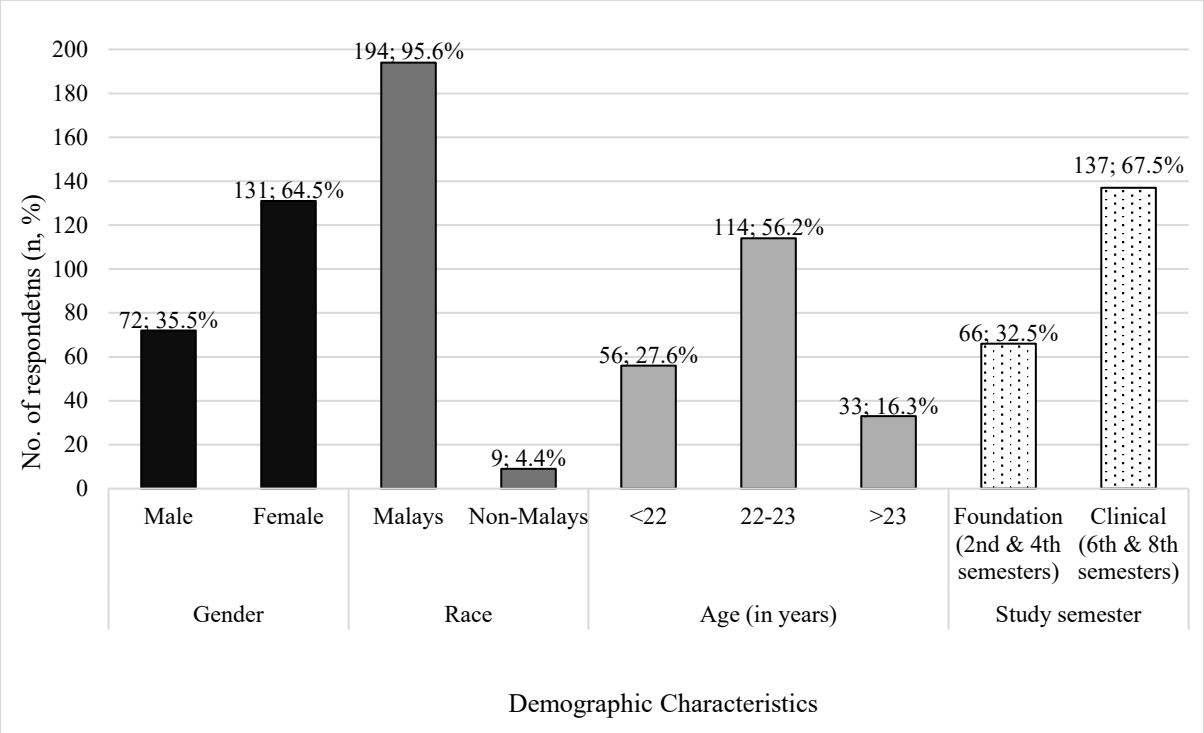

Figure 1: Demographic characteristics of study participants

Perceptions of Tele-Pharmacy

Table 2 summarises the participants' perceptions of tele-pharmacy. They generally expressed positive perceptions, with 95.6% (194/203) believing that the services were convenient, 98% (199/203) acknowledging time savings, and 97.5% (198/203) recognising energy savings. However, fewer than 70% believed that pharmacists in Malaysia were well-trained to provide these services, and only 46.3% (94/203) felt that tele-pharmacy was easily accessible in the country.

Table 2: Perceptions of tele-pharmacy (n = 203)

Perceptions of tele-pharmacy										
	n (%)									
	Gender		*p*-value[a]	**Previous qualification**		*p*-value[a]	**Study semester**		*p*-value[a]	All
	Male (n = 72)	Female (n = 131)		Diploma (n = 51)	Other[b] (n = 152)		Foundational: 2nd & 4th (n = 66)	Clinical: 6th & 8th (n = 137)		(n = 203)
Tele-pharmacy services are convenient.										
D & SD	0 (0.0)	2 (1.5)	0.612*	2 (3.9)	0 (0.0)	***0.023****	0 (0.0)	2 (1.5)	1.000*	2 (1.0)
U	3 (4.2)	4 (3.1)		0 (0.0)	7 (4.6)		2 (3.0)	5 (3.6)		7 (3.4)
A & SA	69 (95.8)	125 (95.4)		49 (96.1)	145 (95.4)		64 (97.0)	130 (94.9)		194 (95.6)
Tele-pharmacy services save patients' time.										
D & SD	0 (0.0)	0 (0.0)	0.129*	0 (0.0)	0 (0.0)	0.574*	0 (0.0)	0 (0.0)	0.306*	0 (0.0)
U	3 (4.2)	1 (0.8)		0 (0.0)	4 (2.6)		0 (0.0)	4 (2.9)		4 (2.0)
A & SA	69 (95.8)	130 (99.2)		51 (100.0)	148 (97.4)		66 (100.0)	133 (97.1)		199 (98.0)
Tele-pharmacy services save patients' energy.										
D & SD	0 (0.0)	0 (0)	0.349*	0 (0.0)	0 (0.0)	0.334*	0 (0.0)	0 (0.0)	1.000*	0 (0.0)
U	3 (4.2)	2 (1.5)		0 (0.0)	5 (3.3)		1 (1.5)	4 (2.9)		5 (2.5)
A & SA	69 (95.8)	129 (98.5)		51 (100.0)	147 (96.7)		65 (98.5)	133 (97.1)		198 (97.5)
Tele-pharmacy services are easily accessible in Malaysia.										
D & SD	14 (19.4)	22 (16.8)	0.050	7 (13.7)	29 (19.1)	0.620	14 (21.2)	22 (16.1)	0.575	36 (17.7)
U	18 (25.0)	55 (42.0)		18 (35.3)	55 (36.2)		21 (31.8)	52 (38)		73 (36.0)
A & SA	40 (55.6)	54 (41.2)		26 (51.0)	68 (44.7)		31 (47.0)	63 (46.0)		94 (46.3)
Communication between a patient and a pharmacist during tele-pharmacy is easy.										
D & SD	1 (1.4)	7 (5.3)	0.249	2 (3.9)	6 (3.9)	0.357	1 (1.5)	7 (5.1)	0.089	8 (3.9)
U	10 (13.9)	24 (18.3)		12 (23.5)	22 (14.5)		7 (10.6)	27 (19.7)		34 (16.7)
A & SA	61 (84.7)	100 (76.3)		37 (72.5)	124 (81.6)		58 (87.9)	103 (75.2)		161 (79.3)
Pharmacists in Malaysia are ready to provide tele-pharmacy services.										
D & SD	4 (5.6)	7 (5.3)	0.872	7 (13.7)	4 (2.6)	***0.010***	0 (0.0)	11 (8.0)	0.057	11 (5.4)
U	16 (22.2)	34 (26.0)		10 (19.6)	40 (26.3)		16 (24.2)	34 (24.8)		50 (24.6)
A & SA	52 (72.2)	90 (68.7)		34 (66.7)	108 (71.1)		50 (75.8)	92 (67.2)		142 (70.0)
Pharmacists in Malaysia are well-trained to provide tele-pharmacy services.										

D & SD	5 (6.9)	11 (8.4)	0.916	6 (11.8)	10 (6.6)	0.492	3 (4.5)	13 (9.5)	***0.010***	16 (7.9)
U	17 (23.6)	33 (25.2)		13 (25.5)	37 (24.3)		9 (13.6)	41 (29.9)		50 (24.6)
A & SA	50 (69.4)	87 (66.4)		32 (62.7)	105 (69.1)		54 (81.8)	83 (60.6)		137 (67.5)
The cost of tele-pharmacy services is affordable.										
D & SD	3 (4.2)	7 (5.3)	0.715	6 (11.8)	4 (2.6)	***0.029***	1 (1.5)	9 (6.6)	0.311	10 (4.9)
U	14 (19.4)	32 (24.4)		12 (23.5)	34 (22.4)		15 (22.7)	31 (22.6)		46 (22.7)
A & SA	55 (76.4)	92 (70.2)		33 (64.7)	114 (75.0)		50 (75.8)	97 (70.8)		147 (72.4)
Tele-pharmacy services can protect the privacy and confidentiality of patients.										
D & SD	4 (5.6)	8 (6.1)	0.876	6 (11.8)	6 (3.9)	0.149	3 (4.5)	9 (6.6)	***0.032***	12 (5.9)
U	7 (9.7)	16 (12.2)		5 (9.8)	18 (11.8)		13 (19.7)	10 (7.3)		23 (11.3)
A & SA	61 (84.7)	107 (81.7)		40 (78.4)	128 (84.2)		50 (75.8)	118 (86.1)		168 (82.8)

D, disagree; SD, strongly disagree; U, unsure; A, agree; SA, strongly agree

[a] Chi-squared test unless specified otherwise, [b] Foundation or matriculation certificate, * Fisher exact test used

The perception that tele-pharmacy services were convenient was significantly associated with the prior qualifications of the students ($p = 0.023$). A higher percentage with a diploma (96.1%, 49/51) agreed with this statement, compared to those with non-diploma qualifications (95.4%, 145/152). Notably, a small proportion with non-diploma qualifications (4.6%, 7/152) were unsure about the convenience of tele-pharmacy. Furthermore, tele-pharmacy services were perceived as affordable by a significantly higher percentage of students with non-diploma qualifications (75%, 114/152) compared to those with a diploma (64.7%, 33/51) ($p = 0.029$).

Significant associations were observed between prior qualifications ($p = 0.010$) and the belief that Malaysian pharmacists were ready to provide tele-pharmacy services. A higher percentage of students with non-diploma qualifications (71.1%, 108/152) expressed agreement with this statement, compared to diploma holders (66.7%, 34/51).

The perception that pharmacists were well-trained to provide tele-pharmacy services was significantly associated with the study semester ($p = 0.010$). Higher percentages of students in the second or fourth semesters (81.8%, 54/66) agreed with this perception, compared to those in more advanced semesters. Notably, agreement with two statements—that pharmacists were ready to provide tele-pharmacy services and well-trained to offer these services—progressively declined between students in earlier semesters and those at a later study stage.

Confidence in the protection of patient privacy and confidentiality was significantly associated with the study semester ($p = 0.032$). A higher percentage of students in the sixth or eighth semesters (86.1%, 118/137) expressed confidence in these aspects, compared to their junior counterparts.

Perceptions Regarding Benefits of Tele-Pharmacy

Table 3 summarises the participants' perceptions regarding the benefits of tele-pharmacy. Over 85% held positive views, agreeing that tele-pharmacy improves patient well-being and health, reduces the risk of COVID-19 transmission, and facilitates personalised advice. Furthermore, tele-pharmacy was perceived as enhancing patient comfort when discussing health conditions with pharmacists. Notably, a progressive decrease in agreement with the statement that tele-pharmacy services can improve patients' health was observed, with declining percentages from the foundational to the clinical semesters.

While no significant associations were identified between the respondents' perceptions and their demographic characteristics for most items in this section, a notable exception was the perception that tele-pharmacy services can improve patient well-being. This view was significantly associated with the study semester ($p = 0.037$). Specifically, a higher percentage of students in the foundational semesters (98.5%, 65/66) agreed with this statement, compared to those in the clinical semesters (88.3%, 121/137).

Perceptions Regarding the Usefulness of Tele-Pharmacy

Table 4 illustrates the participants' perceptions of the usefulness of tele-pharmacy services. Most expressed positive views, recognising the role of tele-pharmacy in enhancing interactions with pharmacists, serving as a platform for health information, and providing timely feedback. However, less than 80% (161/203) of the participants believed that tele-pharmacy services sufficiently enabled pharmacists to monitor patients' health.

A significant association was found between the perception that tele-pharmacy services allow patients to receive timely feedback from pharmacists and the students' study semester ($p = 0.024$). Specifically, a higher percentage of those in the clinical semesters (89.1%, 122/137) agreed with this statement, compared to foundational semester students (81.8%, 54/66).

Table 3: Perceptions regarding benefits of tele-pharmacy (n = 203)

Perceptions regarding benefits of tele-pharmacy, n (%)										
	Gender		*p*-value[a]	**Previous qualification**		*p*-value[a]	**Study semester**		*p*-value[a]	All
	Male (n = 72)	Female (n = 131)		Diploma (n = 51)	Other[b] (n = 152)		Foundational: 2nd & 4th (n = 66)	Clinical: 6th & 8th (n = 137)		(n = 203)
Tele-pharmacy services can improve patients' well-being.										
D & SD	1 (1.4)	1 (0.8)	0.268*	0 (0.0)	2 (1.3)	1.000*	0 (0.0)	2 (1.5)	***0.037****	2 (1.0)
U	8 (11.1)	7 (5.3)		4 (7.8)	11 (7.2)		1 (1.5)	14 (10.2)		15 (7.4)
A & SA	63 (87.5)	123 (93.9)		47 (92.2)	139 (91.4)		65 (98.5)	121 (88.3)		186 (91.6)
Tele-pharmacy services can improve patients' health.										
D & SD	0 (0.0)	2 (1.5)	0.479*	0 (0.0)	2 (1.3)	0.234*	1 (1.5)	1 (0.7)	0.302*	2 (1.0)
U	9 (12.5)	12 (9.2)		8 (15.7)	13 (8.6)		4 (6.1)	17 (12.4)		21 (10.3)
A & SA	63 (87.5)	117 (89.3)		43 (84.3)	137 (90.1)		61 (92.4)	119 (86.9)		180 (88.7)
Tele-pharmacy services can reduce patients' risk of contracting COVID-19.										
D & SD	1 (1.4)	0 (0.0)	0.496*	0 (0.0)	1 (0.7)	0.477*	0 (0.0)	1 (0.7)	0.685*	1 (0.5)
U	4 (5.6)	8 (6.1)		1 (2.0)	11 (7.2)		5 (7.6)	7 (5.1)		12 (5.9)
A & SA	67 (93.1)	123 (93.9)		50 (98.0)	140 (92.1)		61 (92.4)	129 (94.2)		190 (93.6)
Tele-pharmacy services allow patients to receive personalised treatment.										
D & SD	7 (9.7)	8 (6.1)	0.373	4 (7.8)	11 (7.2)	1.000	7 (10.6)	8 (5.8)	0.458	15 (7.4)
U	11 (15.3)	14 (10.7)		6 (11.8)	19 (12.5)		7 (10.6)	18 (13.1)		25 (12.3)
A & SA	54 (75.0)	109 (83.2)		41 (80.4)	122 (80.3)		52 (78.8)	111 (81)		163 (80.3)
Tele-pharmacy services allow patients to receive personalised advice.										
D & SD	5 (6.9)	5 (3.8)	0.501*	3 (5.9)	7 (4.6)	0.739*	2 (3.0)	8 (5.8)	0.200*	10 (4.9)
U	5 (6.9)	8 (6.1)		4 (7.8)	9 (5.9)		7 (10.6)	6 (4.4)		13 (6.4)
A & SA	62 (86.1)	118 (90.1)		44 (86.3)	136 (89.5)		57 (86.4)	123 (89.8)		180 (88.7)
Tele-pharmacy services make patients feel comfortable discussing their health conditions with pharmacists.										
D & SD	0 (0.0)	3 (2.3)	0.188*	1 (2.0)	2 (1.3)	1.000*	0 (0.0)	3 (2.2)	0.763*	3 (1.5)
U	5 (6.9)	17 (13.0)		5 (9.8)	17 (11.2)		7 (10.6)	15 (10.9)		22 (10.8)
A & SA	67 (93.1)	111 (84.7)		45 (88.2)	133 (87.5)		59 (89.4)	119 (86.9)		178 (87.7)

D, disagree; SD, strongly disagree; U, unsure; A, agree; SA, strongly agree

[a] Chi-squared test unless specified otherwise, [b] Foundation or matriculation certificate, * Fisher exact test used

Table 4: Perceptions regarding the usefulness of tele-pharmacy (n = 203)

Perceptions regarding the usefulness of tele-pharmacy										
	n (%)									
	Gender		*p*-value[a]	**Previous qualification**		*p*-value[a]	**Study semester**		*p*-value[a]	All
	Male (n = 72)	Female (n = 131)		Diploma (n = 51)	Other[b] (n = 152)		Foundational: 2nd & 4th (n = 66)	Clinical: 6th & 8th (n = 137)		(n = 203)
Tele-pharmacy services allow more interactions between patients and pharmacists.										
D & SD	3 (4.2)	10 (7.6)	0.091	3 (5.9)	10 (6.6)	0.813	3 (4.5)	10 (7.3)	0.636	13 (6.4)
U	4 (5.6)	19 (14.5)		7 (13.7)	16 (10.5)		9 (13.6)	14 (10.2)		23 (11.3)
A & SA	65 (90.3)	102 (77.9)		41 (80.4)	126 (82.9)		54 (81.8)	113 (82.5)		167 (82.3)
Tele-pharmacy services are a good platform for patients to receive health information.										
D & SD	1 (1.4)	4 (3.1)	0.760*	1 (2.0)	4 (2.6)	1.000*	0 (0.0)	5 (3.6)	0.376*	5 (2.5)
U	3 (4.2)	8 (6.1)		3 (5.9)	8 (5.3)		4 (6.1)	7 (5.1)		11 (5.4)
A & SA	68 (94.4)	119 (90.8)		47 (92.2)	140 (92.1)		62 (93.9)	125 (91.2)		187 (92.1)
Tele-pharmacy services allow patients to receive timely feedback from pharmacists.										
D & SD	2 (2.8)	3 (2.3)	0.937*	1 (2.0)	4 (2.6)	0.187*	0 (0.0)	5 (3.6)	***0.024****	5 (2.5)
U	7 (9.7)	15 (11.5)		9 (17.6)	13 (8.6)		12 (18.2)	10 (7.3)		22 (10.8)
A & SA	63 (87.5)	113 (86.3)		41 (80.4)	135 (88.8)		54 (81.8)	122 (89.1)		176 (86.7)
Tele-pharmacy services allow pharmacists to monitor a patient's health.										
D & SD	8 (11.1)	9 (6.9)	0.597	3 (5.9)	14 (9.2)	0.614	5 (7.6)	12 (8.8)	0.559	17 (8.4)
U	9 (12.5)	16 (12.2)		5 (9.8)	20 (13.2)		6 (9.1)	19 (13.9)		25 (12.3)
A & SA	55 (76.4)	106 (80.9)		43 (84.3)	118 (77.4)		55 (83.3)	106 (77.4)		161 (79.3)

D, disagree; SD, strongly disagree; U, unsure; A, agree; SA, strongly agree

[a] Chi-squared test unless specified otherwise, [b] Foundation or matriculation certificate, * Fisher exact test used

Perceptions Regarding the Impacts of Tele-Pharmacy on Patients' Medication Use

Table 5 summarises the participants' perceptions regarding the impact of tele-pharmacy on patients' medication use. Most conveyed positive views, indicating that tele-pharmacy enhances patients' confidence, ensures they receive appropriate and safe medications, and improves their understanding of medications. However, fewer than 80% of those surveyed agreed that tele-pharmacy positively influences medication compliance and the ease of refilling prescriptions.

A noteworthy trend was observed in the level of agreement that tele-pharmacy services ensure patients understand their medications. This agreement progressively decreased across the study semesters, with foundational semester students showing more agreement than those in advanced semesters. Despite these trends, no significant associations were evident between participants' perceptions and their demographic characteristics for any of the items in this section.

Perceptions Regarding Readiness for Tele-Pharmacy

Table 6 presents the participants' perceptions of their readiness for tele-pharmacy. A majority indicated readiness, with 93.1% (189/203) expressing a desire for training and 93.6% (190/203) showing interest in offering tele-pharmacy services in the future. Notably, agreement with these sentiments progressively increased across the study semesters, with more advanced students expressing a stronger desire for training and a greater interest in providing tele-pharmacy services.

Table 5: Perceptions regarding the impacts of tele-pharmacy on patients' medication use (n = 203)

Perceptions regarding the impacts of tele-pharmacy on patients' medication use, n (%)										
	Gender		*p*-value[a]	**Previous qualification**		*p*-value[a]	**Study semester**		*p*-value[a]	All
	Male (n = 72)	Female (n = 131)		Diploma (n = 51)	Other[b] (n = 152)		Foundational: 2nd & 4th (n = 66)	Clinical: 6th & 8th (n = 137)		(n = 203)
Tele-pharmacy services can improve a patient's confidence in taking medications.										
D & SD	3 (4.2)	3 (2.3)	0.659*	1 (2.0)	5 (3.3)	0.630*	1 (1.5)	5 (3.6)	0.679*	6 (3.0)
U	10 (13.9)	22 (16.8)		10 (19.6)	22 (14.5)		12 (18.2)	20 (14.6)		32 (15.8)
A & SA	59 (81.9)	106 (80.9)		40 (78.4)	125 (82.2)		53 (80.3)	112 (81.8)		165 (81.3)
Tele-pharmacy services ensure patients receive appropriate medications.										
D & SD	0 (0.0)	1 (0.8)	1.000*	0 (0.0)	1 (0.7)	0.737*	1 (1.5)	0 (0.0)	0.459*	1 (0.5)
U	10 (13.9)	19 (14.5)		6 (11.8)	23 (15.1)		9 (13.6)	20 (14.6)		29 (14.3)
A & SA	62 (86.1)	111 (84.7)		45 (88.2)	128 (84.2)		56 (84.8)	117 (85.4)		173 (85.2)
Tele-pharmacy services ensure patients receive safe medications.										
D & SD	0 (0.0)	5 (3.8)	0.191*	0 (0.0)	5 (3.3)	0.499*	3 (4.5)	2 (1.5)	0.420*	5 (2.5)
U	7 (9.7)	18 (13.7)		7 (13.7)	18 (11.8)		9 (13.6)	16 (11.7)		25 (12.3)
A & SA	65 (90.3)	108 (82.4)		44 (86.3)	129 (84.9)		54 (81.8)	119 (86.9)		173 (85.2)
Tele-pharmacy services ensure that patients understand their medications.										
D & SD	2 (2.8)	3 (2.3)	0.415*	0 (0.0)	5 (3.3)	0.248*	2 (3.0)	3 (2.2)	0.541*	5 (2.5)
U	4 (5.6)	15 (11.5)		7 (13.7)	12 (7.9)		4 (6.1)	15 (10.9)		19 (9.4)
A & SA	66 (91.7)	113 (86.3)		44 (86.3)	135 (88.8)		60 (90.9)	119 (86.9)		179 (88.2)
Tele-pharmacy services improve a patient's compliance with his/her medications.										
D & SD	3 (4.2)	6 (4.6)	0.635	2 (3.9)	7 (4.6)	1.000	3 (4.5)	6 (4.4)	0.878	9 (4.4)
U	11 (15.3)	27 (20.6)		10 (19.6)	28 (18.4)		14 (21.2)	24 (17.5)		38 (18.7)
A & SA	58 (80.6)	98 (74.8)		39 (76.5)	117 (77.0)		49 (74.2)	107 (78.1)		156 (76.8)
Tele-pharmacy services make it easier for patients to refill their medications.										
D & SD	5 (6.9)	10 (7.6)	0.070	4 (7.8)	11 (7.2)	0.827	4 (6.1)	11 (8.0)	0.923	15 (7.4)
U	4 (5.6)	22 (16.8)		5 (9.8)	21 (13.8)		9 (13.6)	17 (12.4)		26 (12.8)
A & SA	63 (87.5)	99 (75.6)		42 (82.4)	120 (78.9)		53 (80.3)	109 (79.6)		162 (79.8)

D, disagree; SD, strongly disagree; U, unsure; A, agree; SA, strongly agree

[a] Chi-squared test unless specified otherwise, [b] Foundation or matriculation certificate, * Fisher exact test used

Table 6: Perceptions regarding readiness for tele-pharmacy (n = 203)

Perceptions regarding readiness for tele-pharmacy										
	n (%)									
	Gender		*p*-value[a]	**Previous qualification**		*p*-value[a]	**Study semester**		*p*-value[a]	All
	Male (n = 72)	Female (n = 131)		Diploma (n = 51)	Other[b] (n = 152)		Foundational: 2nd & 4th (n = 66)	Clinical: 6th & 8th (n = 137)		(n = 203)
I would like to receive training on tele-pharmacy.										
D & SD	2 (2.8)	0 (0.0)	0.095*	0 (0.0)	2 (1.3)	0.345*	1 (1.5)	1 (0.7)	0.412*	2 (1.0)
U	6 (8.3)	6 (4.6)		1 (2.0)	11 (7.2)		2 (3.0)	10 (7.3)		12 (5.9)
A & SA	64 (88.9)	125 (95.4)		50 (98.0)	139 (91.4)		63 (95.5)	126 (92.0)		189 (93.1)
I would like to offer tele-pharmacy services in the future.										
D & SD	2 (2.8)	1 (0.8)	0.497*	0 (0.0)	3 (2.0)	0.088*	1 (1.5)	2 (1.5)	0.225*	3 (1.5)
U	3 (4.2)	7 (5.3)		0 (0.0)	10 (6.6)		1 (1.5)	9 (6.6)		10 (4.9)
A & SA	67 (93.1)	123 (93.9)		51 (100.0)	139 (91.4)		64 (97.0)	126 (92.0)		190 (93.6)

D, disagree; SD, strongly disagree; U, unsure; A, agree; SA, strongly agree

[a] Chi-squared test unless specified otherwise, [b] Foundation or matriculation certificate, * Fisher exact test used

DISCUSSION

These findings provide valuable insights into the perceptions held by pharmacy students of tele-pharmacy. Overall, positive attitudes towards tele-pharmacy were demonstrated, aligning with previous research involving such students (21, 23, 25, 27, 28). They recognised its benefits, usefulness, and potential impact on improving patients' medication use, and they expressed a readiness to be trained and engage in tele-pharmacy practices. However, variations in perceptions were observed based on their educational background and stage within the pharmacy programme, underscoring the need for targeted curriculum enhancements to prepare students for the evolving landscape of pharmacy practice.

This study illustrates that students in earlier semesters, likely due to their limited clinical experience, demonstrated higher levels of optimism regarding the potential of tele-pharmacy to enhance patient well-being and the training adequacy of pharmacists. This optimism may be attributed to their minimal exposure to the practical challenges of this concept, which include technological barriers, inadequate training, and integration difficulties (7, 27, 30). Conversely, advanced students exhibited less agreement, particularly regarding the adequacy of pharmacists' training and tele-pharmacy's potential to improve patient well-being. This scepticism likely stems from their increased exposure to real-world challenges and greater critical understanding of tele-pharmacy's limitations (21, 27). A previous study is consistent, having shown that older students are more likely to possess higher tele-pharmacy knowledge levels, which reflects how educational progression and exposure influence their understanding of this emerging field (25).

The new observations indicate a progressive decline in agreement regarding the effectiveness of tele-pharmacy in improving patients' health and ensuring medication understanding, with foundational semester students expressing higher agreement than those in advanced semesters. Notably, fewer than 80% of the respondents agreed that tele-pharmacy enhances medication compliance or facilitates prescription refills. These findings suggest potential curriculum inadequacies in terms of coverage of tele-pharmacy's long-term health outcomes (16, 25, 28), possibly due to students having limited opportunities to conduct post-interaction patient follow-ups. Interestingly, despite the increased scepticism among advanced students, they continued to acknowledge tele-pharmacy's benefits, such as improved patient privacy and timely feedback, highlighting their recognition of its potential advantages (21, 23, 25, 27, 28).

In the current study, educational background also influenced perceptions. Students with a diploma qualification, who likely had prior exposure to the Malaysian healthcare system, perceived tele-pharmacy services as convenient but expressed greater scepticism regarding their affordability and the readiness of pharmacists to offer such services. These doubts may stem from an awareness that tele-pharmacy is in an early developmental stage in Malaysia, with the payment model still evolving and training opportunities for pharmacists remaining limited (21). Additionally, diploma-holders are primarily trained for technical tasks such as stock management, medication preparation, and in-person patient interactions, which aligns with traditional, in-person pharmacy roles (31). As a result, they might perceive tele-pharmacy services as less affordable due to the costs associated with implementing the necessary technological infrastructure and remote delivery model (20). This traditional training background might also have contributed to their reservations about whether pharmacists were ready to transition into tele-pharmacy practices.

To address gaps in tele-pharmacy education, tele-pharmacy concepts must be integrated early in the pharmacy curriculum, which would establish the necessary foundational knowledge of its benefits, applications, and challenges (15, 17, 23, 25, 27). This grounding could be progressively expanded to include advanced topics, such as the practical, technical, and economic complexities of tele-pharmacy, enabling students to develop a comprehensive understanding of its potential and the barriers to its

implementation (17, 25). To address the constraints of overloaded pharmacy curricula (23), flexible learning methods can be employed, such as self-learning materials and online platforms. These approaches align with the preferences of contemporary students and support efficient knowledge acquisition (32, 33). Incorporating innovative strategies, including educational games, simulations, and role-playing, could further reinforce theoretical concepts while enhancing practical application. These approaches could help connect the theory with real-world scenarios, equipping students with the confidence and skills needed to effectively manage patient care through tele-pharmacy (34).

Furthermore, exposure to relevant software, applications, and devices is essential for equipping students with the technical skills required for effective, patient-centred care (16, 21, 25, 27, 35, 36). Additionally, integrating structured patient follow-ups allows students to observe the long-term impact of tele-pharmacy services, while complementary activities such as guest lectures, workshops, and case studies provide practical insights and link theoretical knowledge with real-world applications (37, 38). Balancing discussions of the challenges of tele-pharmacy with its success stories is crucial for maintaining optimism and enthusiasm among students. Mentorship and collaboration with experienced professionals can offer valuable perspectives, helping barriers to be navigated and fostering innovative problem-solving. These initiatives, paired with critical discussion and problem-based activities, will create an academic environment that promotes sustained engagement with tele-pharmacy (39, 40).

Despite the clear need to strengthen tele-pharmacy education within the pharmacy curriculum, it is equally important to ensure that students are exposed to its potential limitations and risks. These include the inability to conduct physical assessments, an elevated risk of miscommunication due to the absence of visual cues, and dependence on potentially unreliable technology (41). Critical concerns exist over ensuring patient confidentiality and data security, especially in digital environments where breaches could undermine trust (13, 20). Moreover, disparities in digital literacy and access to technology may limit the effectiveness of tele-pharmacy among elderly and underserved populations. By incorporating these challenges into the curriculum, educators can help students develop a more balanced and critical understanding of tele-pharmacy, better preparing them to address practical and ethical issues in their future practice.

Despite revealing a combination of scepticism and acknowledgement about tele-pharmacy and the necessity for curriculum refinements, these findings demonstrated a clear interest among students in receiving training and delivering tele-pharmacy services. This observation aligns with results from previous studies (21, 23, 25), highlighting a valuable opportunity for pharmacy programmes to leverage this enthusiasm. Additionally, the findings highlight the critical importance of systematically and continuously gathering feedback from students at different educational stages. This would ensure that tele-pharmacy education remains aligned with the evolving demands and practical realities of contemporary pharmacy practice.

Limitations of the Study

Several limitations potentially affected this study. Firstly, its cross-sectional nature meant that only a snapshot of responses and perceptions was provided at a single point in time. Additionally, the sample exhibited a disproportionate representation between male and female students, Malays and non-Malays, as well as those in clinical versus foundational semesters, which may affect the generalisability of the findings. The study was conducted at one public university in Malaysia, further restricting the applicability of the results to other pharmacy education institutions. Furthermore, social desirability bias could have influenced the participants to either over- or under-report their responses. While the study examined differences in perceptions based on educational background, gender, and study semester, no changes in the responses over time were tracked. Future research could benefit from a larger sample size, the inclusion of multiple pharmacy education institutions, and the use of a

longitudinal study design to gain a more comprehensive understanding of students' perceptions of tele-pharmacy.

CONCLUSION

This study provides an insightful analysis of pharmacy students' perceptions of tele-pharmacy, highlighting both their enthusiasm and scepticism. Variations were evident in certain perceptions based on educational stage and prior qualifications. Advanced students showed greater scepticism about pharmacists' readiness to implement tele-pharmacy while demonstrating more awareness of some aspects of the benefits of tele-pharmacy. The limitations of the study include its cross-sectional nature and focus on a single institution, which may impact the generalisability of the results. Longitudinal studies across multiple institutions might offer a more comprehensive view. Furthermore, integrating innovative educational strategies, such as practical simulations and self-learning modules, could enhance students' preparedness for tele-pharmacy. The study underscores the importance of continuously updating pharmacy curricula to align with the evolving needs of the healthcare sector, ensuring that future pharmacists are well-equipped to effectively embrace tele-pharmacy.

REFERENCES

1. Le T, Toscani M, Colaizzi J. Telepharmacy: A New Paradigm for Our Profession. J Pharm Pract. 2020;33(2):176-82.

2. Win AZ. Telepharmacy: Time to pick up the line. Res Social Adm Pharm. 2017;13(4):882-3.

3. Strasser R. Rural health around the world: challenges and solutions. Fam Pract. 2003;20(4):457-63.

4. Tan ACW, Emmerton L, Hattingh HL. A review of the medication pathway in rural Queensland, Australia. Int J Pharm Pract. 2012;20(5):324-39.

5. Bukhari N, Siddique M, Bilal N, Javed S, Moosvi A, Babar Z-UD. Pharmacists and telemedicine: an innovative model fulfilling Sustainable Development Goals (SDGs). J Pharm Policy Pract. 2021;14(1):96.

6. Lewis T-AJ, Kaiser ME, Goldshteyn N, Sepkowitz D, Briggs WM. A Retrospective analysis of the disruptions in the HIV continuum of care during the COVID-19 pandemic: lessons from a clinic-based study. Cureus. 2024;16(2): e53416.

7. Alhmoud E, Al Khiyami D, Barazi R, Saad M, Al-Omari A, Awaisu A, et al. Perspectives of clinical pharmacists on the provision of pharmaceutical care through telepharmacy services during COVID-19 pandemic in Qatar: A focus group. PLoS ONE. 2022;17(10):e0275627.

8. Hilgarth H, Wichmann D, Baehr M, Kluge S, Langebrake C. Clinical pharmacy services in critical care: results of an observational study comparing ward-based with remote pharmacy services. Int J Clin Pharm. 2023;45(4):847-56.

9. Griffiths CL, Kosmisky DE, Everhart SS, Smith KA. Characterization of tele-pharmacy interventions performed via an expanded tele-critical care pharmacist protocol. J Am Coll Clin Pharm. 2023;6(8):900-8.

10. Bynum A, Hopkins D, Thomas A, Copeland N, Irwin C. The effect of telepharmacy counseling on metered-dose inhaler technique among adolescents with asthma in rural Arkansas. Telemed J E Health. 2001;7(3):207-17.

11. Chambers B, Fleming C, Packer A, Botha L, Hawthorn G, Nott S. Virtual clinical pharmacy services: a model of care to improve medication safety in rural and remote Australian health services. Am J Health Syst Pharm. 2022;79(16):1376-84.

12. Rebello KE, Gosian J, Salow M, Sweeney P, Rudolph JL, Driver JA. The Rural PILL Program: A Postdischarge Telepharmacy Intervention for Rural Veterans. J Rural Health. 2017;33(3):332-9.

13. Viegas R, Dineen-Griffin S, Soderlund LA, Acosta-Gomez J, Maria Guiu J. Telepharmacy and pharmaceutical care: a narrative review by International Pharmaceutical Federation. Farm Hosp. 2022;46(7):86-91.

14. Dickinson D. Please take a seat in the virtual waiting room: telepharmacy education in the pharmacy curriculum. Curr Pharm Teach Learn. 2022;14(2):127-9.

15. Frenzel J, Porter A. The need to educate pharmacy students in telepharmacy and telehealth. Am J Pharm Educ. 2021;85(8):8566.

16. Frenzel JE, Porter AL. Design and assessment of telepharmacy and telehealth training in two pharmacy programs. Am J Pharm Educ. 2023;87(2):ajpe8800.

17. Bingham JM, Axon DR. Telehealth integration into pharmacy practice curricula: an exploratory survey of faculty perception. Pharmacy. 2023;11(4):110.

18. Cruz-Panesso I, Tanoubi I, Drolet P. Telehealth competencies: training physicians for a new reality? Healthcare (Basel). 2023; 12(1): 93.

19. Alowais M, Rudd G, Besa V, Nazar H, Shah T, Tolley C. Digital literacy in undergraduate pharmacy education: a scoping review. JJ Am Med Inform Assoc. 2024;31(3):732-45.

20. Baldoni S, Amenta F, Ricci G. Telepharmacy services: present status and future perspectives: a review. Medicina. 2019;55(7):327.

21. Elnaem MH, Akkawi ME, Al-Shami AK, Elkami R. Telepharmacy knowledge, perceptions, and readiness among future malaysian pharmacists amid the COVID-19 pandemic. Indian J Pharm Educ Res. 2022;56(1):9-16.

22. Volmer D, Sepp K, Raal A, Atkinson J. Pharmacy practice and education in Estonia. Pharmacy. 2019;7(3):87.

23. Alsultan MM, Baraka MA, Alahmari AK, Elrggal ME, Mahmoud MA, Alrasheed MA, et al., editors. Knowledge and perception of pharmacy students toward telepharmacy education in Saudi Arabia. Healthcare (Basel); 2024; 12(18): 1806.

24. Ilma DL, Putri KM, Mustikaningtias I, Sholihat NK, Parmasari DH. Telepharmacy knowledge, attitude, and experience among pharmacy students in Indonesia: a cross-sectional study. Pharm Educ. 2024;24(1):40-7.

25. Alfian SD, Khoiry QA, Andhika APM, Pradipta IS, Kristina SA, Zairina E, et al. Knowledge, perception, and willingness to provide telepharmacy services among pharmacy students: a multicenter cross-sectional study in Indonesia. BMC Med Educ. 2023;23(1):800.

26. Porter AL, Frenzel JE, Siodlak MM. Assessment of a two-school collaborative telepharmacy simulation. Curr Pharm Teach Learn. 2022;14(2):215-21.

27. Tegegne MD, Wubante SM, Melaku MS, Mengiste ND, Fentahun A, Zemene W, et al. Telepharmacy perception, knowledge and associated factors among pharmacy students in northwest Ethiopia: an input for implementers. BMC Med Educ. 2023;23(1):130.

28. Skoy ET, Eukel HN, Frenzel JE, Schmitz TM. Performance and perceptions: evaluation of pharmacy students' consultation via telepharmacy. J Pharm Technol. 2015;31(4):155-60.

29. Lynn MR. Determination and quantification of content validity. Nurs Res. 1986;35(6):382-6.

30. Muhammad K, Baraka MA, Shah SS, Butt MH, Wali H, Saqlain M, et al. Exploring the perception and readiness of pharmacists towards telepharmacy implementation; a cross sectional analysis. PeerJ. 2022;10:e13296.

31. Alkhateeb FM, Shields KM, Broedel-Zaugg K, Bryan A, Snell J. Credentialing of pharmacy technicians in the USA. Int J Pharm Pract. 2011;19(4):219-27.

32. Azhari FA, Jasmi NN, Abd Wahab MS, Mohd S, Jofrry KSL, Ming LC. Students' perceptions about social constructivist learning environment in e-learning. Indian J Pharm Educ Res. 2020;54(2).

33. Wahab MSA, Wan Ismail WNS, Ali AA, Ibrahim N, Othman N, Mohd Nor Hazalin NA, et al. Self-Learning about herbal and dietary supplements: perspectives using the theoretical domains framework. Int J Environ Res Public Health. 2022;19(17):10901.

34. Abd Wahab MS, Rashid A, Ali AA, Zaki IAH, Alias R, Mustaffa MF, et al. Development of a board game to assist pharmacists learning the potentially inappropriate medications in older people. Curr Pharm Teach Learn. 2022;14(5):635-46.

35. Dat TV, Tran TD, My NT, Nguyen TTH, Quang NNA, Tra Vo Nguyen M, et al. Pharmacists' perspectives on the use of telepharmacy in response to COVID-19 pandemic in Ho Chi Minh City, Vietnam. J Pharm Technol. 2022;38(2):106-14.

36. Badowski ME, Bente JA, Davis EM, Isaacs D, Lewis L, Martello JL, et al. Telehealth and technological applications in patient-centered care: implications for pharmacy learners and clinical pharmacists. J Am Coll Clin Pharm. 2021;4(8):1044-55.

37. Emadi F, Ghanbarzadegan A, Ghahramani S, Bastani P, Baysari MT. Factors affecting medication adherence among older adults using tele-pharmacy services: a scoping review. Arch Public Health. 2022;80(1):199.

38. Alshahrani A. The use of guest speakers in higher education and implications for pharmaceutical teaching: a systematic review of literature. F1000Research. 2024;13:862.

39. Waghel RC, Wilson JA, Battise DM, Frye J. Reflections on a year-long student and pharmacist paired mentorship program. Curr Pharm Teach Learn. 2017;9(4):713-8.

40. Cisneros RM, Salisbury-Glennon JD, Anderson-Harper HM. Status of problem-based learning research in pharmacy education: a call for future research. Am J Pharm Educ. 2002;66(1):19-26.

41. Cowan KE, McKean AJ, Gentry MT, Hilty DM. Barriers to use of telepsychiatry: clinicians as gatekeepers. Mayo Clin Proc. 2019;94(12):2510–23.