Society of Medical Education & Research

2023, Volume 3, Issue 2, Page No: 100-110
ISSN: 3108-4850

Annals of Pharmacy Education, Safety, and Public Health Advocacy

Pharmacy Students' Readiness for Telepharmacy Practice: Knowledge, Attitudes, and Willingness in an Indonesian Multicenter Study

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Abstract

The rapid spread of COVID-19 prompted a global expansion of telepharmacy services as an alternative means of delivering pharmaceutical care. Despite this accelerated adoption, limited research has explored pharmacy students' understanding of telepharmacy, their attitudes toward its use, and their readiness to participate in such services—particularly in countries where telepharmacy was not well developed before the pandemic. As prospective pharmacists, students' preparedness and acceptance are essential for the sustainable integration of telepharmacy into routine healthcare systems.This study sought to assess pharmacy students' knowledge, attitudes, and willingness to provide telepharmacy services in Indonesia, as well as to examine factors influencing these dimensions. A multicenter, cross-sectional study was carried out among pharmacy students enrolled at three public universities in Indonesia, located in Bandung, Surabaya, and the Special Region of Yogyakarta. Participants were recruited using convenience sampling, and data were gathered through a self-administered online questionnaire evaluating telepharmacy-related knowledge, perceptions, and willingness to practice. Ordinal regression was applied to identify predictors of higher knowledge levels, while binary logistic regression was used to determine factors associated with positive perceptions. Associations were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs).In total, 313 pharmacy students completed the survey. The majority of respondents were female (83.4%), with a mean age of 20 years. Only a small proportion (13.2%) demonstrated a high level of telepharmacy knowledge. In contrast, two-thirds of participants (66.5%) expressed favorable attitudes toward telepharmacy, and nearly all respondents (97.4%) indicated their willingness to offer telepharmacy services in their future careers. Increasing age (OR 1.33; 95% CI 1.14–1.54) and higher self-reported smartphone proficiency (OR 5.21; 95% CI 2.03–13.42) were significantly associated with greater knowledge. Additionally, male students were significantly less likely than female students to report positive perceptions of telepharmacy (OR 0.46; 95% CI 0.24–0.85).Pharmacy students in Indonesia generally exhibited limited knowledge of telepharmacy; however, their attitudes toward this service and their willingness to engage in telepharmacy practice were largely positive. These findings underscore the importance of integrating telepharmacy concepts and practical training into pharmacy education. Furthermore, differences related to age, digital literacy, and gender should be taken into account when developing educational and policy initiatives to promote telepharmacy implementation in Indonesia.

Keywords: Telepharmacy, Knowledge, Perception, Willingness, Pharmacy students, Indonesia

Introduction

The global outbreak of coronavirus disease 2019 (COVID-19) led to profound disruptions in healthcare delivery systems, including pharmaceutical care services [1]. Government-imposed mobility restrictions and social distancing measures resulted in a considerable reduction in outpatient visits [2], thereby limiting patients' access to conventional pharmacy services. To address these challenges, telepharmacy has been increasingly promoted as an alternative model of care. Telepharmacy utilizes digital health platforms to enable remote communication between pharmacists and patients, reducing the need for physical contact and lowering the risk of exposure in healthcare environments

Access this article online https://smerpub.com/

Received: 25 August 2023; **Accepted:** 16 November 2023

How to cite this article: Stojanovic M, Petrovic N. Pharmacy Students' Readiness for Telepharmacy Practice: Knowledge, Attitudes, and Willingness in an Indonesian Multicenter Study. Ann Pharm Educ Saf Public Health Advocacy. 2023;3(2):100-10. https://doi.org/10.51847/d0RAAFHnQG

[3]. As a result, this service model has been recommended as an effective adaptive response during the pandemic period [4, 5]. Importantly, the transformation toward remote pharmaceutical care is expected to extend beyond the COVID-19 crisis, emphasizing the need for pharmacists and pharmacy students to develop competencies necessary for telepharmacy practice to support patient health outcomes [6].

Previous research has demonstrated that telepharmacy-based interventions can achieve therapeutic and clinical outcomes comparable to those obtained through traditional in-person pharmaceutical care [7, 8]. In addition, telepharmacy services have been associated with improved patient satisfaction across various healthcare settings [8-11]. Despite these advantages, successful telepharmacy implementation requires specialized technical, communication, and clinical skills that are insufficiently addressed in current pharmacy education curricula [11-15]. Consequently, pharmacists often face challenges when adapting established face-to-face counseling techniques to virtual platforms [11], as existing training structures and practice environments are predominantly designed for direct patient interactions. Evidence suggests that without targeted telepharmacy training, pharmacy students demonstrate greater proficiency in conventional in-person consultations compared to telepharmacy-based service delivery [16].

Globally, telepharmacy adoption remains uneven and relatively limited [17], particularly in low- and middle-income countries where telepharmacy infrastructure and regulatory frameworks were underdeveloped prior to the COVID-19 pandemic. Acceptance by healthcare professionals has been identified as a critical enabler of telepharmacy integration [18], underscoring the importance of evaluating the perspectives of both current practitioners and future professionals. Assessing pharmacy students' levels of knowledge and perception is therefore essential for understanding their acceptance of telepharmacy services. Enhanced knowledge and favorable perceptions are likely to increase students' willingness to engage in telepharmacy practice following graduation [19-21]. Such insights are vital for informing curriculum development and capacity-building strategies. However, evidence regarding pharmacy students' readiness to provide telepharmacy services in Indonesia remains scarce, as no prior study has examined their knowledge, perceptions, and willingness in this context. To address this gap, the present study aimed to evaluate pharmacy students' knowledge, perceptions, and willingness to provide telepharmacy services, as well as to identify factors associated with higher knowledge levels and more positive perceptions in Indonesia.

Materials and Methods

Participants, study design, and setting

This study employed a multicenter, cross-sectional survey design involving pharmacy students from three public universities situated in Bandung City, Surabaya City, and the Special Region of Yogyakarta, Indonesia. Data collection was conducted between August and September 2022. All registered pharmacy students at the selected universities were eligible to participate. Students who had resided outside Indonesia for more than three years prior to the survey were excluded from participation.

Ethical approval was granted by the Health Research Ethics Committee of Universitas Padjadjaran, Indonesia (No. 614/UN6.KEP/EC/2022). Participation was voluntary, and electronic informed consent was obtained from all respondents before they accessed the survey questionnaire. The reporting of this study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional research [22]

Data collection

Participants were recruited from undergraduate Bachelor of Pharmacy programs encompassing all academic stages, from the first through fourth year. Recruitment was conducted exclusively online using a convenience sampling strategy. Study information and access to the questionnaire were disseminated via the Qualtrics platform through both group-based and individual messaging channels, facilitated by appointed class representatives. To prevent repeat participation, the survey system was configured to allow only a single submission per email account. No personally identifiable information, including names or email addresses, was collected, ensuring full respondent anonymity. Completion of the questionnaire required approximately 10 minutes.

The survey instrument comprised four main components: participant demographics, knowledge of telepharmacy, perceptions of telepharmacy, and willingness to provide telepharmacy services. The items measuring knowledge, perception, and willingness were adapted from a

previously published questionnaire [23]. The adaptation process adhered to established guidelines issued by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) [24]. Translation of the questionnaire followed a standardized forward–backward translation approach. Two independent professional translators translated the original English version into Indonesian and then back into English. The translated questionnaire was subsequently reviewed by three clinical pharmacy academics to assess item clarity and relevance. Feedback from these experts was incorporated before finalizing the instrument.

After completing content and face validation, a pilot study involving 34 pharmacy students was undertaken to evaluate item comprehensibility. Based on participant feedback and results from cross-validation analyses, revisions were made to the questionnaire, primarily within the willingness domain. Due to the presence of multicollinearity among items, only one of the six original willingness questions was retained for the final analysis. Additionally, an item addressing willingness to pay for a telepharmacy application was excluded, as it was not suitable for a student population and had the potential to generate confusion and bias.

The finalized Indonesian version of the questionnaire demonstrated acceptable psychometric properties. Item-to-total correlation coefficients exceeded 0.679 for knowledge items, 0.645 for perception items, and 0.346 for willingness items. Internal consistency was confirmed with Cronbach's alpha values of 0.782 for knowledge, 0.797 for perception, and 0.651 for willingness to provide telepharmacy services.

Demographic characteristics

This section collected information on participant attributes that could influence telepharmacy-related outcomes. Variables included age at the time of survey completion, sex (male or female), and cumulative grade point average (GPA). Experience with smartphone use was also assessed, including self-perceived level of smartphone proficiency (beginner, expert, or advanced), average daily smartphone usage (1–4 hours or ≥5 hours), and the presence of internet access in the home environment (yes or no).

Knowledge of telepharmacy services

Students' understanding of telepharmacy was measured using five items: familiarity with the benefits of telepharmacy; awareness of telepharmacy applications and platforms available in Indonesia; exposure to telepharmacy practices in other countries; familiarity with recently issued national telepharmacy guidelines; and participation in telepharmacy-related conferences or webinars [23]. Responses were recorded on a five-point Likert scale ranging from 1 ("very low") to 5 ("very high").

Total knowledge scores were categorized according to Bloom's cut-off criteria. Scores between 20 (80%) and 25 (100%) indicated a high level of knowledge, scores ranging from 15 (60%) to 19.75 (79%) reflected moderate knowledge, and scores below 15 (less than 60%) were classified as low knowledge [25, 26].

Perception of telepharmacy services

Students' views regarding telepharmacy were measured using five evaluative statements addressing different aspects of this service model. These statements examined whether telepharmacy could function as a comprehensive mode of patient care delivery, support technological integration in healthcare, decrease time demands and workload, lower service-related costs, and be feasibly implemented using existing telepharmacy applications available in Indonesia [23]. Responses were captured using a binary response format, with agreement coded as 1 and disagreement coded as 0. Perception scores were calculated by summing responses across all items. A total score below 2.5 (less than 50%) indicated an unfavorable perception, whereas a score of 2.5 or higher (50% or above) was classified as a favorable perception of telepharmacy services [23].

Willingness to provide telepharmacy services

Students' intention to engage in telepharmacy practice in their future professional careers was evaluated using a single-item measure. Participants were asked whether they were willing to incorporate telepharmacy into existing healthcare systems for future service delivery [23]. Responses were dichotomized, with affirmative responses assigned a value of 1 and negative responses assigned a value of 0.

Sample size calculation

Because no previous studies were available to inform the expected distribution of study outcomes, sample size estimation was performed using Slovin's formula [27]. With a confidence level set at 95%, an allowable margin of error of 0.10, and an assumed statistical power of 80%,

the minimum required sample size was calculated to be 300 pharmacy students.

Data analysis

Descriptive statistical techniques were applied to summarize participant characteristics. Before inclusion in multivariable analyses, independent variables were assessed for multicollinearity using variance inflation factor diagnostics. Analytical procedures were conducted using two distinct regression frameworks corresponding to knowledge and perception outcomes. Ordinal regression modeling was applied to examine both unadjusted and adjusted associations between student characteristics and levels of telepharmacy knowledge. For perception outcomes, binary logistic regression was used to evaluate univariate and multivariate relationships with participant characteristics. Effect estimates were reported as odds ratios (ORs) along with 95% confidence intervals (CIs). Statistical significance was established at a threshold of $p < 0.05$. All analyses were conducted using IBM SPSS Statistics for Windows, version 27.0 (IBM Corp., Armonk, NY, USA).

Results and Discussion

Baseline characteristics

A total of 313 pharmacy students participated in the study. The majority of respondents were female (83.4%), with an average age of 20 years. Most students self-identified as having an expert level of smartphone proficiency (76.7%), and more than three-quarters reported using smartphones for over five hours per day (78.0) **(Table 1).**

Despite the widespread use of digital technology, only a small proportion of participants demonstrated a high level of knowledge regarding telepharmacy (13.2%). In contrast, over half of the students expressed favorable views toward telepharmacy services (66.5%), and nearly all respondents indicated their intention to provide telepharmacy services in their future professional practice (97.4%) **(Table 1).**

Table 1. Demographic and baseline characteristics of the study participants (N = 313)

Variable	Frequency (%)
Sex	
Male	52 (16.6)
Grade point average (GPA)*, mean (SD)	3.4 (0.11)
Age (years), mean (SD)	20.0 (1.63)
Daily smartphone usage duration	
1–4 hours	69 (22.0)
≥5 hours	244 (78.0)
Self-rated smartphone proficiency	
Advanced	35 (11.2)
Expert	240 (76.7)
Beginner	38 (12.1)
Internet access at home	
Not available	47 (15.0)
Available	266 (85.0)
Level of telepharmacy knowledge	
Moderate	189 (60.4)
Low	83 (26.5)
High	41 (13.1)
Intention to provide telepharmacy services in the future	
No	8 (2.6)
Yes	305 (97.4)
Perception toward telepharmacy services	
Positive	208 (66.5)
Negative	105 (33.5)

Note: Grade point average (GPA) is defined as the cumulative mean of final grades obtained across courses over time, measured on a scale from 1.0 to 4.0.

Among pharmacy students who had knowledge of telepharmacy services, 24.6% reported being highly familiar and 1.9% reported being very highly familiar with the advantages of telepharmacy. In contrast, familiarity with telepharmacy applications and platforms in Indonesia was limited, with 31.6% indicating low familiarity and 8.9% indicating very low familiarity **(Figure 1).** Awareness of recently issued telepharmacy guidelines in Indonesia was also insufficient, as 48.9% reported low familiarity and 16.0% reported very low familiarity. Additionally, engagement in telepharmacy-related training was minimal, with 45.7% reporting low participation and 24.0% reporting very low participation **(Figure 1).**

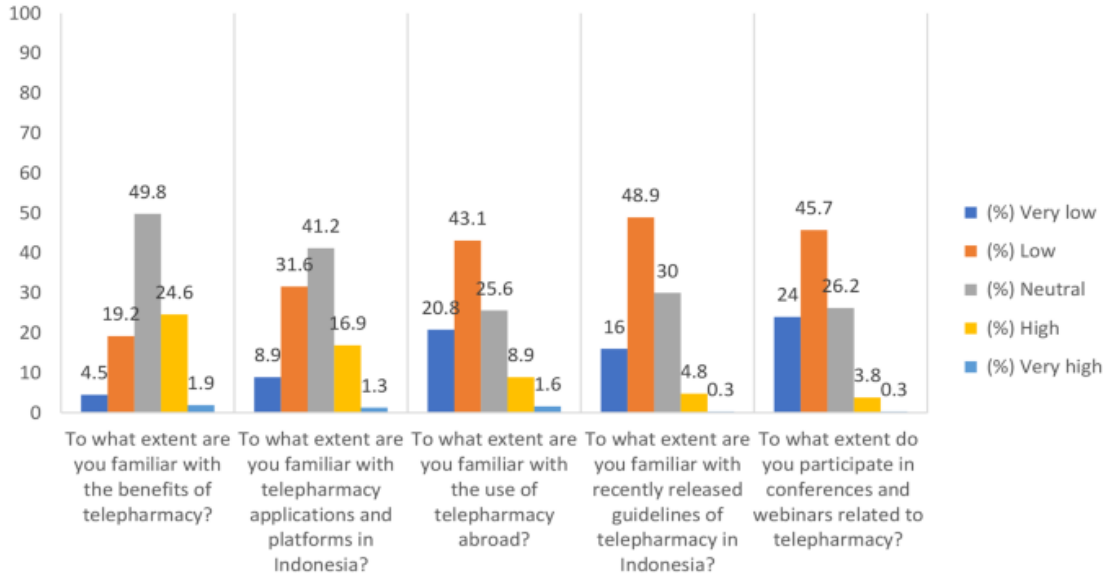

Figure 1. Responses regarding knowledge of telepharmacy services (N = 313)

The majority of pharmacy students believed that telepharmacy provides multiple advantages, including improved access to comprehensive patient care (97.4%), increased integration of technology within healthcare services (99.4%), greater efficiency through time and effort savings (96.2%), and lower healthcare service costs (86.3%). Nevertheless, a smaller proportion of respondents (77.3%) agreed that telepharmacy applications currently available in Indonesia are readily adaptable for use **(Figure 2).**

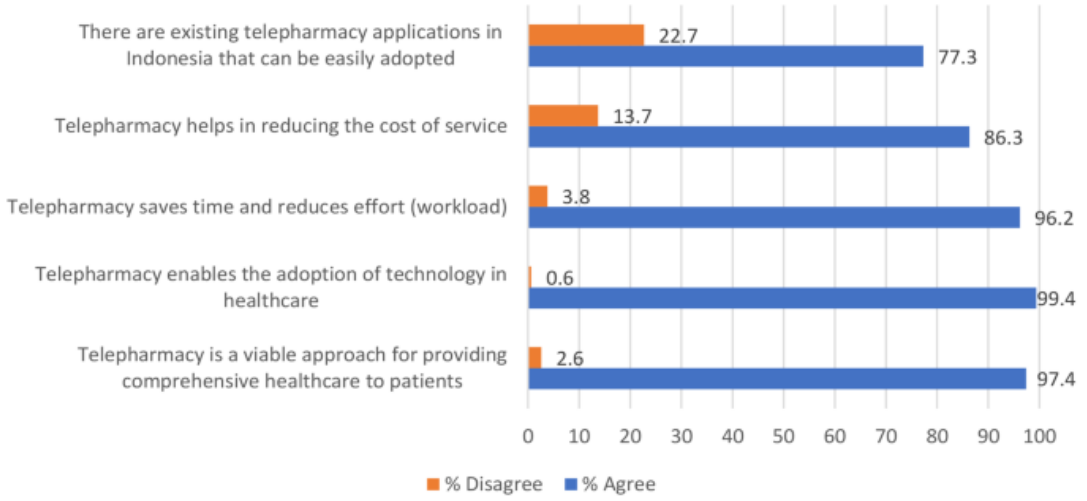

Figure 2. Distribution of pharmacy students' views on telepharmacy services (N = 313)

Analysis of variables related to telepharmacy knowledge and attitudes

Examination of the regression diagnostics confirmed that inter-variable correlation did not pose a concern, as all variance inflation factor values were below the threshold of 10. When controlling for confounding factors, age showed a positive association with achieving a high category of telepharmacy knowledge rather than moderate or low categories (OR 1.33; 95% CI 1.14–1.54). Technical competence with smartphones also played a major role, with students identifying as expert users exhibiting greater odds of high knowledge (OR 2.52; 95% CI 1.28–4.99), followed by those reporting advanced proficiency (OR 5.21; 95% CI 2.03–13.42) **(Table 2).** In contrast, gender differences were observed for perception outcomes, where male students demonstrated decreased likelihood of holding positive views toward telepharmacy services (OR 0.46; 95% CI 0.24–0.85) **(Table 3).**

Table 2. Regression outcomes identifying predictors of elevated telepharmacy knowledge (N = 313)

Characteristic	Subcategory	Moderate (n=189)	Low (n=83)	High (n=41)	Unadjusted OR (95% CI)	Unadjusted p-value	Adjusted OR† (95% CI)	Adjusted p-value†
Gender	Female	166 (63.60%)	64 (24.52%)	31 (11.88%)	Reference		Reference	
	Male	23 (44.23%)	19 (36.54%)	10 (19.23%)	0.81 (0.44–1.49)	0.493	0.77 (0.41–1.44)	0.415
Home Internet Availability	Yes	161 (60.53%)	67 (25.19%)	38 (14.29%)	Reference		Reference	
	No	28 (59.57%)	16 (34.04%)	3 (6.38%)	0.59 (0.32–1.09)	0.093	0.65 (0.36–1.23)	0.188
Level of Smartphone Proficiency	Beginner	21 (55.26%)	16 (42.11%)	1 (2.63%)	Reference		Reference	
	Expert	145 (60.42%)	63 (26.25%)	32 (13.33%)	2.29 (1.18–4.45)	0.015	2.52 (1.28–4.99)	0.008*
	Advanced	23 (65.71%)	4 (11.43%)	8 (22.86%)	5.15 (2.05–12.92)	0.000	5.21 (2.03–13.42)	0.001*
Daily Smartphone Usage Duration	1–4 hours	45 (65.22%)	17 (24.64%)	7 (10.14%)	Reference		Reference	
	≥5 hours	144 (59.02%)	66 (27.05%)	34 (13.93%)	1.02 (0.61–1.74)	0.921	0.91 (0.53–1.57)	0.744
GPA, mean (SD)		3.41 (0.12)	3.42 (0.12)	3.44 (0.06)	1.28 (0.19–8.46)	0.796	1.37 (0.20–9.20)	0.747
Age, mean (SD)		20.14 (1.75)	19.45 (1.22)	20.59 (1.45)	1.33 (1.14–1.57)	0.000	1.33 (1.14–1.54)	0.000*

1. GPA refers to grade point average, and OR denotes odds ratio.
2. †The pseudo R-squared value was 5.71%.
3. *Results were considered statistically significant at the 5% level, with $p < 0.001$.

Table 3. Variables associated with a favorable perception of telepharmacy services among participants (N = 313).

Characteristic	Subcategory	Positive (n=208)	Negative (n=105)	Unadjusted p-value	Unadjusted OR (95% CI)	Adjusted p-value†	Adjusted OR† (95% CI)
Sex	Female	181 (69.35)	80 (30.65)		Ref		Ref
	Male	27 (51.92)	25 (48.08)	0.016	0.48 (0.26–0.87)	0.013*	0.46 (0.24–0.85)
Internet access at home	Yes	180 (67.67)	86 (32.33)		Ref		Ref

	No	28 (59.57)	19 (40.43)	0.280	0.70 (0.37–1.33)	0.442	0.77 (0.40–1.49)
Expertise in smartphone usage	Beginner	25 (65.79)	13 (34.21)		Ref		Ref
	Advance	27 (77.14)	8 (22.86)	0.288	1.75 (0.61–5.02)	0.254	1.86 (0.64–5.44)
	Expert	156 (65.00)	84 (35.00)	0.925	0.96 (0.47–1.99)	0.791	0.90 (0.43–1.90)
Duration of smartphone use in a day	1–4 h	46 (66.67)	23 (33.33)		Ref		Ref
	≥5 h	162 (66.39)	82 (33.61)	0.966	0.99 (0.56–1.74)	0.884	0.96 (0.53–1.72)
GPA scale, mean (SD)		3.41 (0.1)	3.43 (0.1)	0.380	0.37 (0.04–3.35)	0.488	0.43 (0.04–4.52)
Age, mean (SD)		19.88 (1.7)	20.27 (1.43)	0.061	0.86 (0.74–1.01)	0.051	0.86 (0.73–1.01)

1. GPA stands for grade point average, while OR indicates odds ratio.
2. †The pseudo R-squared value was 4.93%.
3. *Findings were deemed statistically significant at the 5% significance level ($p < 0.05$).

Although only a limited proportion of pharmacy students in this study demonstrated a high level of knowledge about telepharmacy, the majority expressed favorable perceptions and a strong intention to offer telepharmacy services in the future. Older age was linked to a greater likelihood of possessing higher telepharmacy knowledge, whereas male students were less likely to report positive perceptions of telepharmacy services.

In this study, female pharmacy students constituted a substantially larger proportion of participants (74.4%) compared with male students (16.6%), which aligns with national projections indicating that women will make up approximately 86% of pharmacists in Indonesia by 2030 [28]. Additionally, the overall level of telepharmacy knowledge observed among students in this study was lower than that reported among pharmacy students in Malaysia [21] and the United States [29], where female students also predominated. While most respondents acknowledged the advantages of telepharmacy, more than half were unfamiliar with telepharmacy platforms and the most recent national guidelines. This lack of awareness may be explained by the limited availability of telepharmacy services in Indonesia relative to telemedicine [30]. Telemedicine has received greater visibility, resources, and public attention, which may have contributed to the comparatively low knowledge levels observed among pharmacy students.

Furthermore, inadequate knowledge of telepharmacy functions—such as medication selection, order verification, dispensing, patient counseling, and monitoring—may be related to regulatory gaps, insufficient dissemination of information, and poor promotion of telepharmacy platforms. Another contributing factor is the absence of formal telepharmacy education within pharmacy curricula. Only a small number of students reported prior exposure to telepharmacy through conferences or webinars, which is consistent with the limited availability of such training opportunities. Consequently, introducing telepharmacy concepts earlier in undergraduate pharmacy education may promote greater adoption, as early exposure strongly influences students' knowledge and perceptions regarding their future professional roles [11, 31, 32]. Previous studies have shown that integrating telepharmacy into educational programs enhances students' understanding of drug therapy issues and improves their ability to communicate patient care plans effectively [33, 34].

Despite limited knowledge, most pharmacy students in this study demonstrated positive attitudes toward telepharmacy and expressed willingness to provide such services in the future. These findings are consistent with earlier research conducted among pharmacy students in the United States [29] and among medical and allied health students in India [23]. Students generally perceived telepharmacy as beneficial, particularly in terms of saving time and reducing workload. However, awareness of telepharmacy applications suitable for implementation in Indonesia remained low, likely due to inadequate information dissemination and limited

marketing efforts. A subset of students also expressed concerns regarding the potential cost of telepharmacy services, especially if devices or platforms were expensive. This highlights the importance for policymakers to ensure that telepharmacy services are affordable and accessible. Introducing compulsory telepharmacy-related coursework may further enhance students' perceptions, as demonstrated by a study among Australian undergraduate students that reported significant improvements in perception following an eHealth workshop [35].

Nearly all participants indicated a willingness to provide telepharmacy services in the future, which is a critical factor for successful implementation. This suggests that telepharmacy has strong potential for integration into pharmacy practice in Indonesia beyond the COVID-19 pandemic. Nevertheless, several additional factors must be addressed, including regulatory frameworks, infrastructure, facilities, and patient acceptance [36, 37].

Older students were more likely to demonstrate higher levels of telepharmacy knowledge, potentially due to increased exposure to diverse curricular content at more advanced stages of their education. However, many of these students still reported limited participation in telepharmacy-related activities. Additionally, students who rated themselves as advanced smartphone users were more likely to have higher telepharmacy knowledge compared with beginners. This may reflect higher levels of eHealth literacy [38], which can facilitate greater understanding of telepharmacy services. In contrast, male students were less likely to hold positive perceptions of telepharmacy, a finding that contrasts with previous research suggesting that men tend to adopt technology more readily than women [39]. One possible explanation is that greater familiarity with technology may heighten awareness of potential technical challenges, such as data security and system complexity. Concerns regarding privacy, confidentiality, and reliability of telepharmacy services may therefore contribute to negative perceptions [40]. To address these concerns, strategies such as emphasizing strong security measures, encryption protocols, secure platforms, and clear regulatory oversight should be implemented [41-43].

This study did not find significant associations between home internet access, smartphone expertise, or duration of smartphone use and telepharmacy knowledge. This may reflect widespread digital access, where internet availability is no longer strongly differentiated by smartphone-related factors.

To our knowledge, this is the first study in Indonesia to examine pharmacy students' knowledge, perceptions, and willingness to provide telepharmacy services within a higher education context. The inclusion of students from multiple universities across different regions enhances the generalizability of the findings. However, several limitations must be acknowledged. The use of an online questionnaire may reduce data reliability due to the absence of trained interviewers and the potential for self-selection bias. Nevertheless, participant characteristics were comparable to those reported in other studies involving Indonesian pharmacy students [44, 45]. The response rate could not be calculated because the number of eligible students who declined participation was unknown, and online surveys are generally associated with lower response rates than paper-based methods [46]. Causal relationships could not be established due to the cross-sectional design, and self-reported data may be subject to social desirability bias. Although the target sample size was achieved, a larger and more geographically diverse sample might yield different findings. The use of stepwise regression may also increase the risk of chance associations, and future studies should base variable selection more explicitly on existing literature. Additionally, the relatively low pseudo R-squared values suggest that other unmeasured factors may influence telepharmacy knowledge and perceptions.

Overall, the findings highlight a discrepancy between the knowledge required for telepharmacy implementation and students' strong willingness to provide such services. Previous research showing positive public perceptions and willingness to use telepharmacy in Indonesia [47] presents an opportunity for pharmacy students. The education system must adapt to evolving healthcare needs by strengthening capacity building. Incorporating telepharmacy practice models into pharmacy curricula is essential to better prepare future pharmacists. Further research involving faculty and staff is recommended to assess the feasibility of integrating tele-education into pharmacy programs.

Conclusion

Despite limited knowledge of telepharmacy, most pharmacy students demonstrated positive perceptions and expressed willingness to provide telepharmacy services in their future professional practice. Individual characteristics—such as age and smartphone expertise

influencing knowledge, and gender influencing perception—should be taken into account when designing strategies to support telepharmacy adoption in Indonesia.

Acknowledgments: None

Conflict of Interest: None

Financial Support: None

Ethics Statement: None

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