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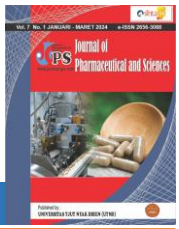

Pharmacist Perception and Knowledge in Pharmaceutical Management Toward Online Pharmaceutical Services at Pharmacies in Medan City

Persepsi Apoteker dan Pengetahuan Apoteker Dalam Manajemen Farmasi Terhadap Pelayanan Kefarmasian Secara Online Pada Apotek Di Kota Medan

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Abstract

Digital transformation is driving significant changes in pharmaceutical services, including the utilization of online drug consultation and sales services. This study aims to analyze the influence of pharmacists' perceptions and knowledge on online pharmaceutical services and to strengthen quantitative findings thru qualitative results. The method used was a nested mixed method sequential explanatory approach, with the initial stage involving a survey of 200 pharmacists, followed by in-depth interviews with 20 informants consisting of 10 pharmacists who had been providing online pharmaceutical services for more than 3 years and 10 pharmacists who had not yet provided online pharmaceutical services but had more than 3 years of work experience as pharmacists. The data analysis results show that perception significantly influences online pharmacy services ($p < 0.001$), as does knowledge ($p < 0.001$). A coefficient of determination of 42.6% (0.426) indicates the significant role of both variables. The interview results with the sources explain the data analysis findings: pharmacists emphasize the importance of technological readiness, regulatory compliance, clear SOPs, and digital competency development as requirements for implementing online pharmaceutical services. This research confirms that strengthening the capacity of pharmacists and the pharmaceutical management system is the foundation for the successful transformation of digital pharmacy services in community pharmacies. This study concludes that pharmacists' perceptions and knowledge significantly influence the quality of online pharmaceutical services. The results of interviews with sources explain the data analysis, showing that technological readiness, regulatory compliance, and pharmacists' digital competence are the main foundations for the successful implementation of online pharmaceutical services in community pharmacies.

Keywords: Pharmacist Perception, Pharmacist Knowledge, Online Pharmaceutical Services, Mixed Methods

Abstrak

Transformasi digital mendorong perubahan signifikan dalam pelayanan kefarmasian, salah satunya melalui pemanfaatan layanan konsultasi dan penjualan obat secara online. Penelitian ini bertujuan menganalisis pengaruh persepsi dan pengetahuan apoteker terhadap pelayanan kefarmasian online serta memperkuat temuan kuantitatif melalui hasil kualitatif. Metode yang digunakan ialah nested mixed method sequential explanatory, dengan tahap awal survei terhadap 200 apoteker, dilanjutkan dengan wawancara mendalam pada 20 informan terdiri dari 10 apoteker yang melakukan pelayanan kefarmasian online lebih dari 3 tahun dan 10 apoteker yang belum melakukan pelayanan kefarmasian online sudah memiliki pengalaman kerja sebagai apoteker lebih dari 3 tahun. Hasil analisis data menunjukkan bahwa persepsi berpengaruh signifikan terhadap pelayanan kefarmasian online ($p < 0,001$), demikian pula pengetahuan ($p < 0,001$). Koefisien determinasi sebesar 42,6% (0,426) memperlihatkan peran penting kedua variabel. Hasil wawancara narasumber menjelaskan hasil analisis data: apoteker menekankan pentingnya kesiapan teknologi, kepatuhan regulasi, kejelasan SOP, serta peningkatan kompetensi digital sebagai syarat implementasi pelayanan kefarmasian online. Penelitian ini menegaskan bahwa penguatan kapasitas apoteker dan sistem manajemen farmasi merupakan fondasi keberhasilan transformasi layanan kefarmasian digital di apotek komunitas. Penelitian ini menyimpulkan bahwa persepsi dan pengetahuan apoteker berpengaruh signifikan terhadap kualitas pelayanan kefarmasian online. Hasil wawancara narasumber menjelaskan hasil analisis data, menunjukkan bahwa kesiapan teknologi, kepatuhan regulasi, dan kompetensi digital apoteker menjadi fondasi utama keberhasilan implementasi layanan kefarmasian berbasis online di apotek komunitas.

Keyword : Persepsi Apoteker, Pengetahuan Apoteker, Pelayanan Kefarmasian Online, Mixed Method

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Introduction

Given the growing number of diseases that are appearing as a result of the highly contaminated environment, health is one of the most essential things in our sophisticated period. Unusual lifestyles, harsh weather, and environmental changes are all becoming health issues. People in society are expected to keep themselves and their surroundings healthy. It is expected of society to be critical in order to recognise the significance of health for their life, which has even evolved into a basic necessity [1].

The rapid development of digital technology has fundamentally transformed healthcare delivery systems worldwide, including pharmaceutical services. Globally, the adoption of digital health, telepharmacy, and online pharmaceutical services has expanded significantly, driven by the need for accessible, efficient, and patient-centered care. Online pharmaceutical services enable remote drug consultation, electronic prescriptions, medication delivery, and drug information services, thereby improving continuity of care and expanding access, particularly in urban populations with high digital literacy [2].

Significant changes in healthcare service systems, including pharmacy, have been prompted by the advancement of information technology. With the public's growing need for quick, flexible, and secure access to healthcare services, online pharmaceutical services have emerged as a quickly expanding innovation. Direct drug delivery to patients' homes, computerised prescription refills, and virtual consultations are all made possible by this service [3] . Significant changes in healthcare service systems, including pharmacy, have been prompted by the advancement of information technology. With the public's growing need for quick, flexible, and secure access to healthcare services, online pharmaceutical services have emerged as a quickly expanding innovation. Direct drug delivery to patients' homes, computerised prescription refills, and virtual consultations are all made possible by this service [2].

In Indonesia, the digitalization of pharmaceutical services has accelerated in recent years, especially following the COVID-19 pandemic, which reshaped public expectations regarding healthcare accessibility. The Indonesian government has responded to this transformation by establishing regulatory frameworks to ensure patient safety and service quality. The Ministry of Health has issued regulations such as Minister of Health Regulation No. 74 of 2016 on Pharmaceutical Service Standards in Pharmacies and Minister of Health Regulation No. 14 of 2021 concerning Standards of Business Activities and Products in Risk-Based Licensing in the Health Sector, which provide legal foundations for technology-based pharmaceutical services. In addition, the National Agency of Drug and Food Control (BPOM) regulates the distribution of medicines through electronic systems to prevent illegal online drug sales and ensure compliance with pharmaceutical standards. These regulations emphasize the critical role of pharmacists in supervising, managing, and delivering safe online pharmaceutical services [4,5].

Given the growing number of diseases that are appearing as a result of the highly contaminated environment, health is one of the most essential things in our sophisticated period. Unusual lifestyles, harsh weather, and environmental changes are all becoming health issues. People in society are expected to keep themselves and their surroundings healthy. It is expected of society to be critical in order to recognise the significance of health for their life, which has even evolved into a basic necessity [6].

Previous studies have examined online pharmacy services, telepharmacy implementation, or public perceptions of digital health services. However, most existing research focuses on either perceptions or knowledge separately and predominantly employs single-method approaches. There remains a significant research gap, particularly in Indonesia, regarding studies that integrate pharmacists' perceptions and knowledge using both quantitative and qualitative approaches. Moreover, limited evidence is available from

urban settings such as Medan City, where digital infrastructure is relatively advanced and community pharmacies are actively adapting to digital service models [7]

There is a great demand for pharmacies in the community, according to research on how the general public views pharmacy services. In addition to manufacturing and delivering pharmaceuticals, pharmacies are expected to offer other services. One of the needs of society nowadays is the screening of patients' ailments. To support public health, OWA's existence must be maximised [8]. Pharmacists play a crucial role in community pharmacies as managers who supervise the pharmacy's operations, including the use of technology-based services, in addition to providing pharmaceutical services [9]. The way that online pharmaceutical services are provided may be significantly impacted by pharmacists' opinions of pharmaceutical management, including planning, inventory control, drug information services, and regulatory compliance. While unfavourable perceptions may impede service innovation, favourable and flexible perceptions will promote the deployment of more expert online services [10].

In addition to perception, the success of online pharmaceutical services is also influenced by the degree of expertise of chemists. Pharmacists will be better equipped to deliver safe and high-quality services if they have a sufficient understanding of information technology, pharmacy administration, pharmaceutical service standards, and laws. Numerous studies have demonstrated that the adoption of online healthcare services is influenced by the attitudes and expertise of healthcare professionals. However, there is currently a dearth of research, especially in Medan City, that focusses on integrating pharmacists' perspectives and knowledge about online pharmacy services at the community pharmacy level utilising a mixed methods approach. Thus, the purpose of this study is to examine how chemists' attitudes and knowledge affect online pharmacy services and to support quantitative findings with qualitative investigation.

Research Design

This study employs a layered mixed-method sequential explanatory design and a mixed methods technique. This strategy starts with the primary way of gathering and analysing quantitative data, which is further developed by gathering qualitative data as a supporting technique to bolster and clarify the quantitative conclusions. This design was chosen in order to gather a thorough picture of how chemists' attitudes and expertise impact online pharmaceutical services, both statistically and based on the actual experiences of chemists working in the industry [11,12].

Populations and Sample

The population in this study consists of all pharmacists working in community pharmacies in Medan City. The sample used in this study was the Slovin technique, which is used to determine the minimum sample size required from a population so that the research results can be generalized.

Research Instruments and Validation

The study employed both qualitative and quantitative research tools, including in-depth interview guidelines and structured questionnaires on the variables of pharmacist perception, pharmacist expertise, and online pharmaceutical services. In order to better understand chemists' experiences, perceptions, and opinions regarding the adoption of online pharmaceutical services, the instrument was developed based on a review of the literature, the findings of earlier studies, and the current regulations for pharmaceutical services in Indonesia [12].

Instrument Development and Validity–Reliability Testing

Data Collection and Intervention Procedures

In accordance with the nested mixed method sequential explanatory design, data collection for this study was carried out in phases, starting with quantitative data collection and continuing with qualitative data collection to support the findings. The researcher started the data collection phase by distributing questionnaires to 200 pharmacists employed at Medan City community pharmacy after securing research licenses from the appropriate institutions. Following the results of the quantitative analysis, the qualitative phase of data collection was carried out through in-depth interviews with 20 informants, 10 of whom had been offering online pharmaceutical services for more than three years and 10 of whom had not. In order to get a variety of information, the informants were purposefully chosen [13].

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Data Analysis

Software called SPSS Statistics 26.0 was used to analyse the data. To ascertain the impact of chemists' perceptions and knowledge on online pharmaceutical services, the analytical step includes a normality test and multiple linear regression analysis. The significance level for hypothesis testing was set at 0.05. The F-test is used to evaluate the simultaneous influence of independent factors on the dependent variable, and the t-test is used to examine the partial influence of each independent variable. Furthermore, the degree to which pharmacists' perspectives and expertise help to explain the diversity in online pharmaceutical services is assessed using the coefficient of determination (R^2). In the meantime, a thematic analysis method was used to examine the qualitative information gathered through in-depth interviews.

Results and Discussion

Experience and Information Sources about Online Pharmaceutical Services

An overview of respondents' experiences and various sources of information used to find out and understand online pharmaceutical services.

Table 1. Distribution of Respondents' Experience and Information Sources

Descriptionn	Sample	Percentase (%)
Are you aware that pharmaceutical services can be provided online in Indonesia?		
Yes	194	97
No	6	3
Have you ever been directly involved in online pharmaceutical sales services?		
Yes	104	52
No	96	48
Sources of information regarding online pharmaceutical sales		
Social media	131	65.5
Seminars/Webinars	22	11
Educational Instution	13	6.5
Work Experience	16	8
Other	18	9

Based on the research results, it appears that the majority of respondents have a fairly high level of understanding regarding the existence of online pharmaceutical services in Indonesia. Ninety-seven percent of respondents (194 people) stated they were aware that pharmaceutical services can be provided online, while only three percent (six people) were unaware.

Despite this high level of awareness regarding the existence of these services, pharmacists' direct experience with online drug sales or services appears to be limited. Only 52% of respondents (104 people) had been directly involved in online drug sales services, while 48% (96 people) had no such experience. The information sources respondents used to learn about online drug sales services also showed an interesting pattern. Social media was the primary source of information, used by 65.5% of respondents (131 people). This concludes that the development of information related to online pharmaceutical services is significantly influenced by digital exposure, particularly from easily accessible and widely used platforms.

Characteristics of Respondent Identity

A total of 200 pharmacists working in community pharmacies in Medan City participated as respondents in this study. Based on characteristics such as gender, age, experience as a pharmacist, and online pharmacy services. The distribution of sample characteristics in this test can be seen in Table 2.

Based on gender characteristics, 74.5% (149 people) were female and 25.5% (51 people) were male. Of the male pharmacists, 60.8% (31 people) were involved in online pharmacy services, while 49% (73 people) were female. This concludes that although female pharmacists are more numerous, male pharmacists have a higher proportion of involvement in online pharmacy services, as male pharmacists tend to be quicker to adopt digital-based innovations.

The findings indicate that pharmacists generally demonstrate a high level of awareness regarding the implementation of online pharmaceutical services in Indonesia. However, this awareness is not fully accompanied by practical involvement, as a considerable proportion of pharmacists have not yet participated

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directly in online pharmaceutical service delivery. This discrepancy suggests a gap between conceptual understanding and real-world implementation of digital pharmaceutical services in community pharmacy settings. Regarding sources of information, pharmacists primarily relied on informal digital platforms to obtain knowledge about online pharmaceutical services, while the contribution of formal education and structured professional training remained relatively limited. This pattern highlights that information related to digital pharmaceutical services is predominantly disseminated through easily accessible digital media rather than through formal professional development channels. Such reliance on non-formal information sources may result in variability in pharmacists' understanding and preparedness, potentially affecting the consistency and quality of online pharmaceutical service implementation in accordance with professional standards and regulatory requirements.

Table 2. Respondent Characteristics

Characteristics	Sample (n)	Percentage (%)	Online User	
	Gender		**Yes**	**No**
Male	51	25.5	31 (60.8%)	20 (39.2%)
Femele	149	74.5	73 (49%)	76 (51%)
	Age (years)			
20 – 35	108	54	65 (62.5%)	43 (44.8%)
36 – 45	47	23.5	20 (19.2%)	27 (28.1%)
46 – 56	28	14	14 (13.5%)	16 (16.7%)
> 56	17	8.5	5 (4.8%)	16 (16.7%)
Professional Experiences as a Pharmacist (years)				
1 – 5	92	46	47 (51%)	45 (49%)
6 – 10	57	28.5	35 (62.5%)	21 (37.5%)
11 – 15	19	9.5	10 (52.6%)	9 (47.4%)
16 – 20	9	4.5	3 (15.8%)	6 (31.6%)
> 20	23	11.5	9 (37.5%)	
Experience in Online Pharmaceutical Services (years)				
0	96	48	0	96 (100%)
1 – 3	93	46.5	93 (100%)	0 (0%)
> 3	11	5.5	11 (100%)	0 (0%)

Pharmacists' Perceptions in Pharmaceutical Management Regarding Online Pharmaceutical Services

In the pharmacist's perception, several data analysis stages were carried out, such as Kolmogorov-Smirnov, Simple Regression, and Coefficient of Determination.

Table 3. Results of Data Analysis Stages

Data Analysis Stages	Influence Value
Kolmogorov-Smirnov sig. ($p > 0.05$)	0.063
Simple Regression ($p < 0.05$)	0.001
Coefficient of Determination	0.491

It is clear from the research findings that most respondents had a rather high degree of awareness about the availability of online pharmacy services in Indonesia. Just 3% (6 people) of respondents said they were unaware that pharmaceutical services might be offered online, compared to 97% (194 people) who said they were. Pharmacists' direct experience with online medicine sales or services seems to be limited, despite the high level of awareness of their availability. Of the respondents, just 42% (84 people) have firsthand experience with internet drug sales services, while 58% (116 people) have not. An intriguing trend may also be seen in the information sources that respondents utilised to research online drug sales services. According to 65.5% of respondents (131 individuals), social media is the main information source. It is found that digital exposure, particularly from easily available and widely used platforms, has a significant impact on the creation of information relevant to online pharmacy services [18].

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were. This finding reflects the growing prevalence of digital pharmacy practices in society and shows that the chemists who responded are well-versed in the conversation surrounding online pharmaceutical services. Pharmacists' direct experience in online medicine sales or service supply appears to be limited, despite the high level of awareness of the presence of such services [19]. Of the respondents, just 42% (84 individuals) have ever had firsthand experience with internet drug sales services, whereas 58% (116 individuals) have not. This condition shows that there is a gap between respondents' knowledge and practical experience since, despite their awareness of the concept, not all of them have the means or chance to use online pharmaceutical services in their daily lives. An intriguing trend may also be seen in the information sources that respondents utilised to research online drug sales services. With 65.5% of respondents (131 individuals) using social media, it has emerged as the main information source. It is found that digital exposure, particularly from easily available and widely used platforms, has a significant impact on the creation of information relevant to online pharmacy services. Seminars or webinars (11%), educational institutions (6.5%), and work experience (8%), while in smaller percentages, are additional information sources that are also important. Furthermore, 9% of participants gathered knowledge from additional sources, including news media, professional associations, and professional debates. Overall, the distribution of responses shows that chemists are highly exposed to information about online pharmacy services, especially through social media. However, given that over 50% of the respondents have never used digital drug sales platforms, direct involvement in practice still has to be addressed. This leads to the conclusion that in order for chemists to be better equipped to deal with the advancements in telepharmacy and the digitalisation of pharmaceutical services in the contemporary day, more training, competency development, and the supply of more suitable facilities are required.

Pharmacist Knowledge in Pharmaceutical Management Toward Online Pharmaceutical Services

In the analysis of pharmacists' knowledge data, several data analysis stages were carried out, such as Kolmogorov-Smirnov, Simple Regression, and Coefficient of Determination.

Table 4. Results of Data Analysis Stages

Data Analysis Stages	Influence Value
Kolmogorov-Smirnov sig. ($p > 0.05$)	0.071
Simple Regression ($p < 0.05$)	0.001
Coefficient of Determination	0.623

The results of the Kolmogorov-Smirnov test for chemists' knowledge revealed a significance value of 0.071, which is higher than the 0.05 p-value limit. This suggests that chemists' knowledge is widely dispersed and applicable to the following phase of data analysis: their understanding of online pharmaceutical services. With a significance value of 0.001, well below the α = 0.05 limit, a straightforward regression study of pharmacists' knowledge of online pharmaceutical services revealed that pharmacists' expertise significantly influences online pharmaceutical services. These findings show that chemists' degree of expertise directly affects the calibre of online services they offer, including drug education, online consultations, and drug usage monitoring. Pharmacists' knowledge of online pharmaceutical services accounts for 62.3% of the variation in online pharmaceutical services, according to the analysis of the coefficient of determination for this knowledge. This figure suggests that the degree of chemists' expertise accounts for over half of the variations in the calibre of digital services[20].

Table 5: Pharmacist Knowledge Categories

Category	Pharmacist Knowledge	Knowledge Score
Low	2 (1%)	10 – 20
Moderate	42 (21%)	21 – 30
High	156 (78%)	31 – 40

Based on the results presented, the majority of pharmacists fall into the high knowledge category, with 156 respondents (78%). This finding indicates that the majority of pharmacists have a very good understanding of the basic principles of online pharmaceutical services, including aspects of drug use safety, patient education obligations, consumer protection, and compliance with online pharmacy service regulations.

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Online Pharmaceutical Services

In the analysis of online pharmaceutical services data, several data analysis stages were carried out, namely Kolmogorov-Smirnov and the Coefficient of Determination.

Table 6. Results of Data Analysis Stages

Data Analysis Stages	Influence Value
Kolmogorov-Smirnov sig. (p > 0.05)	0.068
Coefficient of Determination	0.669

Online pharmacy services' Kolmogorov-Smirnov test findings showed a significance value of 0.068, which is higher than 0.05. This suggests that there are no patterns of departure and that online pharmaceutical services are dispersed regularly. In the research model, chemists' views and knowledge account for 66.9% of the variation in online pharmaceutical services, according to the results of the coefficient of determination for these factors, which has a value of 0.669. The size of this contribution shows that the model is dependable and has a strong predictive power when it comes to characterising the variables affecting the calibre of online pharmacy services [21].

Interview Results with Sources on Pharmacists' Perceptions and Knowledge of Pharmaceutical Management Regarding Online Pharmaceutical Services

Online pharmacy services' Kolmogorov-Smirnov test findings showed a significance value of 0.068, which is higher than 0.05. This suggests that there are no patterns of departure and that online pharmaceutical services are dispersed regularly. In the research model, chemists' views and knowledge account for 66.9% of the variation in online pharmaceutical services, according to the results of the coefficient of determination for these factors, which has a value of 0.669. The size of this contribution shows that the model is dependable and has a strong predictive power when it comes to characterising the variables affecting the calibre of online pharmacy services.

Integration of Data Analysis Results and Key Informant Interview Results on Pharmacists' Perceptions and Knowledge of Online Pharmaceutical Services

The findings of the data analysis show that online pharmaceutical services are greatly influenced by the opinions and expertise of chemists. Pharmacists' attitudes, views, and acceptance of online services are important determinants in the effective deployment of these services, as evidenced by the fact that their perceptions have a greater impact than their expertise. The expertise of chemists has also been shown to be essential in guaranteeing that online pharmacy services adhere to legal requirements and service standards. The results of the interviews, which show that chemists who have a favourable opinion are more likely to be receptive to innovations in digital services and more assured while offering online pharmaceutical services, corroborate the data analysis findings [22]. Pharmacists who are well-versed in information technology, pharmaceutical service standards, and legislation are also seen to be better equipped to provide online services in a safe and competent manner. The combination of these two findings suggests that the attitude and competency readiness of chemists, who serve as the primary service providers, have a significant impact on the effectiveness of online pharmacy services in addition to technical and technological factors. Therefore, enhancing positive attitudes through policy support and expanding knowledge through ongoing training are crucial tactics in the growth of community pharmacies' online pharmacy services.

It is clear from the research findings that most respondents had a rather high degree of awareness about the availability of online pharmacy services in Indonesia. Just 3% (6 people) of respondents said they were unaware that pharmaceutical services might be offered online, compared to 97% (194 people) who said they were. This finding reflects the growing prevalence of digital pharmacy practices in society and shows that the chemists who responded are well-versed in the conversation surrounding online pharmaceutical services. Pharmacists' direct experience in online medicine sales or service supply appears to be limited, despite the high level of awareness of the presence of such services [23]. Of the respondents, just 42% (84 individuals) have ever had firsthand experience with internet drug sales services, whereas 58% (116 individuals) have not. This condition shows that there is a gap between respondents' knowledge and practical experience since, despite their awareness of the concept, not all of them have the means or chance to use online pharmaceutical services in their daily lives. An intriguing trend may also be seen in the information sources that respondents

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Conclusions

This study confirms that pharmacists' perceptions and knowledge significantly influence the implementation of online pharmaceutical services in community pharmacies. Mixed-methods findings indicate that positive perceptions—driven by perceived benefits and ease of use—combined with adequate technical and regulatory knowledge are key factors supporting successful service delivery. While quantitative results demonstrate a strong combined effect of both variables, qualitative findings further explain that clarity of regulations, well-defined standard operating procedures, and digital competence enhance pharmacists' readiness and confidence. Therefore, professional associations, regulators, and pharmacy management should focus on targeted training, clear operational guidelines, and supportive digital infrastructure to strengthen the quality and sustainability of online pharmaceutical services.mpact on the success of online pharmacy services and is not exclusively impacted by technological availability.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article. This research was conducted independently without any financial, commercial, or institutional relationships that could be construed as a potential conflict of interest.

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