

Patient-Centric Pharmacy Governance through AI Integration from SERVQUAL: A Conceptual Approach

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Abstract

This conceptual paper explores a patient-centric governance model for pharmacy services that integrates artificial intelligence (AI) capabilities with the SERVQUAL service quality framework. SERVQUAL's five dimensions, reliability, responsiveness, assurance, empathy, and tangibles, are adapted to evaluate how AI can strengthen pharmacy services when supported by strong governance. The study situates the problem in a global, ASEAN, and Malaysian context, highlighting persistent challenges in medication safety, uneven access to pharmacy services, and the rapid digitalisation of health systems. The proposed conceptual framework links AI functions to SERVQUAL dimensions under pharmacy governance, aiming to advance patient satisfaction while ensuring patient trust and safety.

Keywords: Patient-Centric Pharmacy, AI, SERVQUAL, Healthcare Quality, Governance, Satisfaction

Introduction

Medication safety continues to pose a significant global challenge. The World Health Organization (WHO) estimates that unsafe medication practices and errors are a leading cause of avoidable harm, with associated costs of approximately USD 42 billion annually (World Health Organization, 2017). In ASEAN, governments are rapidly adopting digital health solutions to enhance access, efficiency, and safety. A regional assessment emphasized the urgent need for interoperability standards, cross-border collaboration, and stronger governance to address the risks posed by fragmented systems and unregulated data use

(ASEAN-Japan Centre, 2021). This regional trend is further supported by rapid technological diffusion; for example, smartphone penetration in Asia-Pacific is projected to reach 94 percent by 2030, creating opportunities to expand digitally enabled health services (GSMA, 2023).

In Malaysia, community pharmacy services are widely utilized but remain unevenly distributed. A study by Hassali et al. (2012) found a substantial maldistribution, with ratios ranging from one pharmacy per 4,830 residents to one per 61,707 residents in different districts of West Malaysia, and between one per 6,015 and one per 42,480 in East Malaysia. In addition, utilization of community pharmacy services remains relatively low. Using national health data, Rampal et al. (2007) reported that only about 10.3 percent of adults in Malaysia had accessed community pharmacies during the study period. These challenges are compounded by growing medicine consumption and complexity as shown in the Malaysian Statistics on Medicines report (Ministry of Health Malaysia, 2017), underscoring the need for innovative governance approaches that ensure safe and efficient dispensing and counselling. Evidence indicates that electronic medication systems and e-prescribing tools are effective in reducing prescribing errors. Reviews such as those by Ammenwerth et al. (2008) and Nuckols et al. (2014) highlight that e-prescribing systems significantly improve medication accuracy, although their effects on clinical outcomes depend on system design and implementation. Integrating AI-enabled decision-support tools within pharmacy governance could enhance these gains, but robust governance frameworks are essential to manage risks such as algorithmic bias, data misuse, and workflow disruptions.

Meanwhile, the SERVQUAL model developed by Parasuraman, Zeithaml, and Berry conceptualizes service quality through five dimensions: reliability, responsiveness, assurance, empathy, and tangibles (Parasuraman et al., 1988). In pharmacy contexts, service quality is understood through both technical accuracy, such as safe and correct dispensing, and functional quality, such as communication and patient counselling. Malaysian research on patient satisfaction with pharmacy services has demonstrated the relevance of SERVQUAL dimensions. For instance, Shafie et al. (2019) validated patient satisfaction measures for pharmacy settings in Malaysia and showed how demographic characteristics and patient knowledge influenced satisfaction, demonstrating that SERVQUAL can guide measurement in this context.

Patient satisfaction remains a crucial indicator of pharmacy service quality and has significant implications for healthcare outcomes. In Malaysia, extensive research efforts have been dedicated to measuring satisfaction among pharmacy users. A study by Ismail, Gan, and Ahmad (2020) developed the PHC-PSQ tool to assess satisfaction in public health clinics. This instrument featured three domains—administrative competency, technical competency, and convenience of location—across 22 items, achieving a high reliability coefficient (Cronbach's $\alpha = 0.96$). The study found that patient satisfaction was relatively high, with a mean score of 7.56 (SD = 1.32). Important factors associated with higher satisfaction included frequency of visits, self-perceived health status, and general knowledge regarding pharmacists, while older age and higher education were linked to slightly lower satisfaction scores (Ismail et al., 2020). Another line of inquiry examined value-added services and their effect on patient wait times. Loh and colleagues (2017) observed that the increase in the proportion of prescriptions managed through such services led to a reduction in refill prescription volume, which in turn

shortened waiting times in ambulatory pharmacies. Their regression analysis demonstrated that increases in the number of pharmacy technicians and refill prescriptions were significant predictors of waiting time improvements, as was the number of pharmacy counters (Loh et al., 2017).

One Malaysia Clinics (1MC) offer further insight into service quality using the SERVQUAL model. A study in Kota Bharu measured differences between expectations and perceptions across the five SERVQUAL dimensions and found notable gaps in areas such as responsiveness and assurance, indicating that patients' service perceptions often fell short of their expectations (Gül, 2023).

These empirical findings underscore the importance of service quality in pharmacy delivery. They also highlight the value of frameworks like SERVQUAL for measuring dimensions that matter to patients. A Malaysian study on hospital service quality confirmed that factors such as administrative processes, medical care procedures, infrastructure, trustworthiness, patient safety, and organizational image are significant predictors of patient satisfaction (Universiti Putra Malaysia & Universiti Sains Malaysia, 2019).

At the same time, the pharmacy sector is experiencing growing interest in artificial intelligence. A recent scoping review pointed out that AI applications in Southeast Asian pharmacies, including Malaysia—span areas such as detection of atypical orders, mass screening enhancements, and medication adherence via intelligent systems (Chang, 2025). More broadly, AI has been shown globally to streamline operations, including robotic dispensing systems that can achieve high accuracy, inventory management systems that predict demand, and automated safety checks that detect potential adverse drug interactions (Artificial intelligence in pharmacy, 2023).

Despite these technological advances, integration into pharmacy governance remains nascent. Building upon WHO's call to halve medication-related harm, there is a pressing need to weave AI tools into existing governance systems in a way that enhances service quality and ensures patient safety (World Health Organization, 2017). The convergence of high patient satisfaction standards, digital service expectations, and emerging AI capabilities presents both an opportunity and a challenge. Proper governance structures must be designed to support these innovations, ensuring they deliver real benefits to patients while mitigating risks.

Problem Statement

There are four interlinked gaps that this paper addresses. First, there is a safety gap, as unsafe medication practices continue to impose approximately USD 42 billion annually in costs despite global safety initiatives (World Health Organization, 2017). Second, there is a service quality gap, as pharmacy access and utilization in Malaysia remain limited and uneven, reflecting perceived or real barriers to service quality (Hassali et al., 2012; Rampal et al., 2007). Third, there is a governance gap in digital health, as ASEAN's rapid digitalization requires stronger governance in interoperability, data protection, and algorithm oversight (ASEAN-Japan Centre, 2021). Finally, there is an evidence-to-practice gap, as electronic medication systems reduce errors but their contribution to patient satisfaction remains inconsistent without proper integration into pharmacy workflows and governance (Ammenwerth et al., 2008; Nuckols et al., 2014).

Unsafe medication practices persist as a major global challenge, imposing significant harm and cost. The World Health Organization estimates that medication errors and unsafe use lead to an annual global expenditure of approximately USD 42 billion (World Health Organization, 2017). In the ASEAN region, digital health adoption is growing rapidly but remains uneven, with governance gaps in areas such as legislation, interoperability, data protection, and workforce capacity (ASEAN-Japan Centre, 2024). This digital lag and regulatory fragmentation pose risks to patient safety, particularly as healthcare systems incorporate digital tools such as e-prescribing or pharmacy kiosks without uniform oversight. Malaysia's pharmacy governance framework operates under a complex array of legal instruments. The Sale of Drugs Act 1952, the Poisons Act 1952, and the Medicines (Advertisement and Sale) Act 1956, together with the Control of Drugs and Cosmetics Regulations 1984, set out rules for the sale, advertising, and regulation of pharmaceutical products (Ministry of Health Malaysia, n.d.). These Acts are overseen by the National Pharmaceutical Regulatory Agency (NPRA) and the Drug Control Authority (DCA), which manage registration, licensing, and pharmacovigilance to ensure drug safety and efficacy (Freyr Solutions, 2025). Despite this robust legal structure, challenges remain in extending oversight to digital and AI-integrated services.

Recent Malaysian policy developments signal the growing importance of regulating digital health, including e-pharmacy. The Ministry of Health released the *Guidelines on Online Healthcare Services* in May 2025, which define orderly requirements for virtual clinics and platform providers, including mandatory registration with the Companies Commission of Malaysia, presence of licensed pharmacists, secure record-keeping, grievance mechanisms, and compliance with data protection laws (Ministry of Health Malaysia, 2025). These guidelines are intended to serve as interim regulation pending enactment of legislation such as a Telemedicine Act, reflecting a recognition of evolving service modalities and risks.

Access to pharmacy services in Malaysia remains uneven. A study of community pharmacy distribution found ratios ranging from one pharmacy for every 4,830 to one per 61,707 people in West Malaysia, and between one per 6,015 and one per 42,480 in East Malaysia (Hassali et al., 2012). Additionally, community pharmacy utilization is modest: only about 10.3% of adults reported accessing such services in a national study (Rampal et al., 2007). These disparities underscore the need to improve service quality and reach, particularly in underserved areas. Antimicrobial stewardship highlights another operational gap. The Pharmaceutical Services Programme's Strategic Plan for 2021–2025 prioritizes prudent use of antimicrobials and emphasizes post-prescription review and feedback (PPRF) as a core strategy to reduce resistance (Pharmaceutical Services Programme, 2025). These efforts underscore the importance of governance that can adapt to evolving health threats and prescribing complexity.

Collectively, these factors, persistent medication safety costs, uneven access to pharmacy services, evolving digital service modalities, and incomplete governance coverage—create a context of fragmented service delivery and patient dissatisfaction. Electronic prescribing systems reduce errors in controlled environments (Ammenwerth et al., 2008; Nuckols et al., 2014), but their impact on patient experience and satisfaction depends on aligned governance frameworks. The intersection of AI integration and pharmacy governance serves as a vital

area for intervention to ensure that technological enhancements lead to improved patient outcomes and trust.

Hence, this paper conceptualizes the integration of AI into pharmacy services as a mechanism to strengthen SERVQUAL dimensions under a governance framework. AI-driven e-prescribing systems and automated dispensing verification can improve reliability by reducing prescribing and dispensing errors (Ammenwerth et al., 2008; Nuckols et al., 2014). Responsiveness can be improved through AI-enabled queue management systems, chatbots for patient enquiries, and automated refill reminders. Assurance may be strengthened if AI systems provide transparent, explainable decision support, while ensuring that pharmacists retain authority and responsibility for decisions. Empathy, though inherently human, can be supported through AI tools such as natural language processing to produce patient-friendly medication labels in multiple languages, thereby improving understanding and adherence in Malaysia's multilingual population. Finally, tangibles can be enhanced through telepharmacy portals and user-friendly mobile interfaces, particularly given the high smartphone adoption projected in Asia-Pacific (GSMA, 2023).

However, the benefits of AI cannot be realized without strong governance. Data governance frameworks must protect patient privacy and ensure data minimization. Model governance is required to validate algorithms and prevent bias. Clinical governance should ensure that pharmacists remain accountable for final decisions, while operational governance should measure performance using SERVQUAL-aligned indicators such as dispensing error rates, waiting times, counselling comprehension, and patient satisfaction surveys.

Literature Review

The integration of artificial intelligence (AI) in the governance of the pharmacy has become a fundamental mechanism to improve patient -centered services. When analyzing the dimensions of the SERVQUAL model (reliability, response capacity, guarantee, empathy and tangible), this review of literature seeks to elucidate how these dimensions contribute to improve the quality of the service and patient satisfaction in pharmaceutical care.

To begin with, the provision of reliable services is a fundamental expectation in medical care. Badr and Khiami (2024) emphasize that intelligent pharmacy ecosystems centered on the patient, who take advantage of AI technologies, can significantly improve the reliability of attention based on prescription. Automated systems ensure that medications are dispensed and customized precisely according to the specific needs of patients, minimizing errors that could compromise patient safety. This automation reinforces the reliability dimension of SERVQUAL, since patients experience a higher level of confidence in the accuracy of their pharmaceutical care.

The response capacity of pharmacy services is crucial to address the needs of patients with promptness. Awala and Olutimehin (2024) discuss how the integration of automatic learning and the AI improves telepharmacy services, providing patients with rapid responses to their consultations and medical care needs. These technologies allow pharmacists to access patient data quickly, administer prescriptions efficiently and provide timely consultations, thus improving the response capacity of pharmacy services. The increase in accessibility and rapid

service response encourage a more patient centered approach, which is essential for patient satisfaction.

In addition to the reliability and response capacity, the SERVQUAL guarantee dimension plays a vital role in promoting patient's confidence in pharmacy services. A study by Park et al. (2016) presents a patient-centered quality evaluation framework that underlines the importance of guarantee in medical care services. Through AI capacities in data analysis and customisation, pharmacies can assure patients of their experience and quality of care provided. For example, AI algorithms can analyze the patient's story to suggest the best treatment options or warn about possible interactions, instilling confidence in patients with respect to their pharmaceutical care (Megha et al., 2025).

Empathy, another critical dimension of the SERVQUAL, is approached uniquely through AI in the governance of the pharmacy. While traditional pharmacy practices may have difficulty providing personalized attention to each patient, AI can analyze patients and historical data to better meet individual needs. For example, Chava (2025) highlights how next generation technologies can facilitate the delivery of personalized care plans that consider the emotional and psychological aspects of patient's interactions. This personalized approach not only improves the perceived empathy of pharmacy services, but also leads to greater satisfaction and loyalty of the patient.

The tangible aspect of the quality of the service, which covers the physical facilities, the equipment and the appearance of the staff, is also influenced by the integration of AI. Al-Assaf, Bahroun and Ahmed (2024) illustrate how medical care 4.0, an was characterized by digital transformation into medical care, can raise the standards of tangibles in pharmacy services. With IA -driven solutions, pharmacies can optimize their operations, optimize store designs and improve patient interactions through advanced digital interfaces. Such improvements in tangible contribute to a more cozy and efficient environment, thus improving the general quality of the service.

The implications of AI in pharmacy operations extend to continuous improvement processes. Sallam (2024) argues that the synergy of thin efficiency with precision methodologies such as Six Sigma, improved by AI capacities, can significantly increase the quality of the service. By continuously monitoring and analyzing data, pharmacies can identify areas that need improvements and implement strategic changes rapidly, thus improving both service quality and patient satisfaction in real time.

The Lean Digital Framework proposed by Estrada (2022) advocates an approach focused on human beings in pharmaceutical care, where IA supports continuous improvement in patient processes. This not only increases the efficiency of the service but also customises the experiences of the patients, ensuring that the human element remains at the forefront of AI applications in the governance of the pharmacy.

Hence, the integration of AI in the governance of the pharmacy improves the patient-centred services through the strategic application of the dimensions of the SERVQUAL model. By improving reliability, response capacity, guarantee, empathy and tangibles, pharmacies can significantly raise the quality of the service provided. The resulting increase in patient

satisfaction underlines the value of AI in the development of innovative pharmaceutical care solutions, efficient and patient focused. As this field continues to evolve, research and ongoing implementation will be critical to maximising the benefits of AI to improve patient-centred governance within the pharmacy sector.

Methodology

This study employs a conceptual and analytical methodology to explore how artificial intelligence can be integrated into pharmacy governance through the SERVQUAL model. It is grounded in secondary data, drawing from published journal articles, policy documents, and regulatory circulars that address pharmacy practice, service quality, and digital health governance. The objective is to build a conceptual framework that links AI functions to the five SERVQUAL dimensions within the context of pharmacy governance.

The review began with literature related to medication safety, digital health adoption, and pharmacy service quality in Malaysia and ASEAN. Global initiatives such as the World Health Organization's Global Patient Safety Challenge (World Health Organization, 2017), ASEAN reports on digital health readiness (ASEAN-Japan Centre, 2024), and Malaysia's Guidelines on Online Healthcare Services (Ministry of Health Malaysia, 2025) provided the contextual and regulatory foundation. These were complemented by systematic reviews on electronic prescribing systems and their effectiveness in reducing medication errors (Ammenwerth et al., 2008; Nuckols et al., 2014), as well as studies measuring pharmacy service satisfaction in Malaysia (Ismail et al., 2020; Shafie et al., 2019).

The conceptual mapping aligned the SERVQUAL dimensions of reliability, responsiveness, assurance, empathy, and tangibles with AI-enabled functions such as e-prescribing, telepharmacy, explainable algorithms, personalized communication, and mobile interfaces. These were then considered under governance structures including data, model, clinical, and operational governance. This structured approach ensures the framework is both theoretically grounded and contextually relevant to pharmacy governance in Malaysia and the wider ASEAN region.

Discussion

The exploration of the integration of artificial intelligence in the governance of the pharmacy reveals profound progress in services focused on the patient, who is at the centre of health care. By using the SERVQUAL model as a framework for the evaluation, we illuminate the vital dimensions of the quality of the service - reliability, responsiveness, assurance, empathy, and tangibles - which are at the basis of criticism underlying the patient's satisfaction (Megha et al., 2025). The progressive incorporation of artificial intelligence technologies within the pharmacy environments offers transformative potential, in particular in improving Tele-Farmacy services. This innovative method of providing the service facilitates greater access to prescription-based care, exemplifying a movement to personalised health interactions (Awala and Olutimehin, 2024).

The Tangibles dimension is significantly influenced, since the AI-based platforms can optimise the physical aspects of the service delivery. For example, intuitive interfaces and simplified processes raise the overall visual charm and functionality of tele-pharmacy systems. These improvements are not simply additives; They serve as qualifying critics of patient involvement

and trust. In addition, the dimensions of reliability significantly benefit from the automation of the AI, since algorithms can provide drug levels, manage top-ups and guarantee timely notifications for patients. This new consistency in the supply of services faces common concerns regarding the reliability of pharmacy services, promoting an environment in which the needs of patients are carefully satisfied and over time (Al-Assaf, Bahroun and Ahmed, 2024).

Reactivity is a dimension enriched by the real-time capacity of the AI. Chatbots and virtual health assistants can provide instantaneous guidance and support to patients, reducing waiting times and improving users' experiences. This immediacy aligns in close contact with contemporary expectations for health services, in which patients seek faster and more definitive resolutions to their investigations. The incorporation of AI facilitates a dynamic feedback circuit between healthcare professionals and patients, ensuring that the improvements of the service can be quickly implemented according to direct input.

In terms of guarantee, artificial intelligence technologies contribute robustly to the construction of trust within the interactions of the patient-pharmacy. Automatic learning algorithms can improve decision-making processes by analyzing patients' data to suggest optimal drug therapies, thus instilling the trust between patients regarding the accuracy of their treatment. In addition, the ability of artificial intelligence to provide measure on customized health promotes a sense of security and support, strengthening the patient's conviction in the competence of the pharmacy staff.

The dimension of empathy has improved through AI's ability to understand and predict the patient's preferences and behavioral models. By analyzing historical data, artificial intelligence tools can facilitate a more nuanced approach to the care of individual patients, ensuring that health workers meet not only medical needs but also the emotional and psychosocial dimensions. This empathic approach aligns with the general objectives of Healthcare 4.0, which emphasise holistic and patient-centred solutions.

Through a complete application of the SERVQUAL model in this context, it becomes evident that the integration of the AI in the governance of the pharmacy is not simply technological progress: it represents a fundamental step towards a more reactive and patient healthcare panorama. Each dimension of the quality of the service, if improved by artificial intelligence, contributes to a more satisfying patient experience and reflects a commitment to evolving pharmaceutical practices within a governance framework that gives priority to excellence in patient care. The integration of artificial intelligence (AI) within the governance of the pharmacy highlights a critical opportunity to refine the provision of services, promoting an environment where approaches focused on the patient thrive. Recent analyzes elucidate that the use of AI technologies accelerates operational efficiency, thus allowing pharmacists to provide timely and relevant information to patients - an increasingly required factor in today's health care landscape (Chava, 2025). This alignment with patient expectations is essential because contemporary consumers actively seek not only accuracy but also transparency and responsiveness throughout their health trips (Vats, 2024).

When evaluating these dynamics, the serve model serves as a fundamental tool, facilitating the identification and rectification of gaps in the provision of services. By retrospectively

evaluating the five dimensions of the use of the use, reactivity, insurance, empathy and tangibles, the pharmacy services can be continuously improved thanks to the integration of AI. For example, the dimension of reliability is considerably strengthened by the AI capacity to minimise human error in the distribution and management of drugs, ensuring that patients receive precise and trustworthy health solutions. Thanks to predictive analysis, pharmacies can anticipate the needs of patients, thus meeting the concern of reliability and improving the overall patient experience.

In addition, reactivity, one of the pivotal dimensions of SERVQUAL, greatly benefits from the data processing capacities in real time of the AI. AI tools can synthesise patient requests and health records, allowing pharmacists to respond quickly and precisely. This improvement is directly in correlation with the increased satisfaction of patients, as individuals frequently express the desire for rapid and competent responses of their health care providers (Badr and Khiami, 2024). In scenarios where traditional response times can lead to the frustration or confusion of patients, the role of AI in the rationalisation of communication channels is transformative.

The insurance dimension, which concerns the perception of patients on the competence and credibility of pharmacists, is also enriched by AI technologies. By implementing AI-focused training programs, pharmacies can guarantee that staff members are not only well informed, but also use technology to effectively manage patient interactions. This improves professional image and establishes confidence in patients, thus raising the perceived quality of the care they receive.

The dimension of empathy, which emphasises the human element in care, should not be overshadowed by technological progress. The AI can facilitate empathetic interactions by providing pharmacists with more in-depth overview of the history and patient preferences. This can allow more personalized care strategies, promote solid pharmacist relationships and respond more effectively to individual needs. By adapting the provision of services to resonate emotionally with patients, pharmacies can maintain loyalty and improve overall satisfaction.

The tangible component of SERVQUAL - referring to the physical aspects of the service environment - can also be improved thanks to the deployment of AI. Intelligent pharmacy environments equipped with AI-focused stock management systems can guarantee that essential drugs and resources are easily available, thereby reducing waiting times and improving the physical experience of the visit of a pharmacy. As studies reveal, the perception of a well-organized and effective pharmacy space considerably influences the levels of satisfaction of patients.

The integration of AI into the governance of the pharmacy is aligned not only with but also enriches the serve frame. By focusing on improving the five dimensions of the quality of services, pharmacies can improve their provision of patient centered services, thus leading to higher health results and high patient satisfaction. As health systems are changing, synergy between AI technologies and quality executives established as serve will undoubtedly shape the future landscape of pharmacy services., The integration of Artificial Intelligence (AI) in the Governance of Pharmacy emerged as a central mechanism to improve patient-centered

services, highlighting the importance of adapting the service model to measure service quality and patient satisfaction. As platforms for patient involvement evolve, understanding the impacts of digital transformation becomes crucial to addressing the growing complexities of health services (Abomusallam, 2023). A well-integrated AI structure not only softens operational efficiencies, but also actively involves patients in their health hours, promoting a more personalized experience.

The application of AI in customer relationship management (CRM) in the configuration of pharmacy allows different interactions that are aligned with the individual needs and preferences of patients (UNANAH & MBANUGO, 2025). This personalized approach, driven by the data analysis and machine learning algorithms, enhances the dimensions of reliability and response capacity of the service. For example, pharmacies can now predict drug adherence gaps, providing timely interventions that increase patient results. In addition, IA-oriented virtual chatbots and assistants offered immediate answers to their consultations, reinforcing their confidence in pharmacy services and improving the dimensions of guarantee and quality empathy.

Current advances in the pharmaceutical scenario forced stakeholders to adopt next-generation technologies that not only simplify processes but also enrich patient experiences. The competitive advantage obtained through AI integration allows pharmacies to innovate continuously, allowing them to adapt to changes in market demands and patient expectations (Miozza, 2025). For example, AI tools can analyze the patient's feedback in real time, facilitating adjustments to service offers that directly reflect patient satisfaction levels. This cyclic feedback loop is critical to promoting an environment in which patients' voices are fundamental, echoing the empathic approach adopted in the SERVQUAL model.

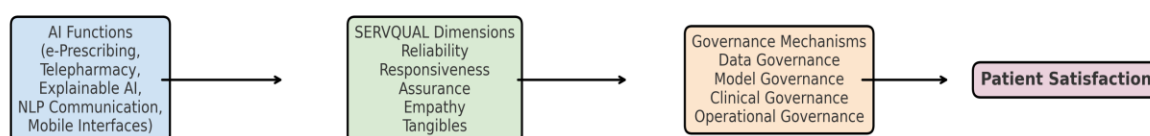
Moreover, the emphasis on a digital lean thinking structure is essential as it promotes continuous improvement in pharmacy governance. By using AI-oriented ideas, pharmacies can identify inefficiencies and areas for improvement, thus evolving with the dynamic expectations of health consumers (Estrada, 2022; Sallam, 2024). The alignment of digital tools with the governance of the pharmacy not only positions organizations as more responsive, but also cultivates a culture of excellence centered on patient results.

As the integration of AI technologies becomes more widespread in pharmacy governance structures, it is essential to continually evaluate the impact on the quality of service through the dimensions of SERVQUAL. This evaluation will provide information not only on patient satisfaction, but also the broader implications of AI integration for pharmacy services in local and global contexts. The adoption of a rigorous evaluation structure allows the refinement of data oriented strategy, ensuring that pharmacies remain resilient and adaptable in a scenario in constant evolution of health.

In progressing in these transforming changes, it is important to recognize that AI integration into pharmacy governance is not just a trend, but a fundamental change towards a more patient-centered approach. This evolution requires research and collaboration in progress between stakeholders to explore the full extent of AI potential to raise quality of service and increase patient satisfaction in pharmacy services.

Illustration 1: Conceptual Framework

Conceptual Framework: AI Integration → SERVQUAL → Governance → Patient Satisfaction



The conceptual framework illustrates by Illustration 1 show the pathway through which artificial intelligence (AI) applications contribute to patient satisfaction in pharmacy services, guided by the SERVQUAL model and reinforced by governance mechanisms. On the left, AI functions such as e-prescribing, telepharmacy, explainable algorithms, natural language processing for communication, and mobile interfaces represent technological tools increasingly used in modern pharmacy practice. These functions align with the five SERVQUAL dimensions, which are reliability, responsiveness, assurance, empathy, and tangibles. For example, e-prescribing improves reliability by reducing errors, while telepharmacy enhances responsiveness by reducing waiting times and expanding access.

In the next stage, governance mechanisms are positioned as mediators that ensure AI systems deliver safe and trustworthy results. Data governance focuses on patient privacy and security, model governance on the validation and monitoring of AI algorithms, clinical governance on ensuring pharmacists remain central in decision-making, and operational governance on monitoring key performance indicators such as error rates and waiting times.

Finally, the framework culminates in patient satisfaction as the outcome, representing the degree to which patients perceive pharmacy services as safe, efficient, and empathetic. By integrating AI into SERVQUAL under structured governance, this framework emphasizes the dual importance of innovation and accountability in achieving patient-centered pharmacy care.

Conclusion

Pharmacy services are becoming increasingly complex, shaped by the dual pressures of rising demand for medications and the integration of digital technologies into healthcare delivery. This complexity is further compounded by persistent safety risks, such as medication errors, and the continuing challenge of uneven access to quality pharmacy services across regions in Malaysia and the wider ASEAN community. These realities highlight the urgent need for

governance structures that are both patient-centric and responsive to technological transformation.

The conceptual model developed in this paper positions artificial intelligence as a vital enabler of improved pharmacy service delivery, particularly when aligned with the SERVQUAL framework. By mapping AI applications onto dimensions such as reliability, responsiveness, assurance, empathy, and tangibles, the model illustrates how technology can directly enhance the quality of services experienced by patients. However, these benefits are only meaningful if supported by strong governance mechanisms that address risks related to data protection, algorithm validation, clinical responsibility, and operational performance. Patient satisfaction emerges as the central outcome of this alignment, representing the trust and confidence patients place in pharmacy services that are safe, efficient, and empathetic.

The model also provides a platform for future empirical research. While this paper is conceptual, it outlines a structured pathway for validating the relationships between AI, SERVQUAL dimensions, governance frameworks, and patient satisfaction. In this way, the study contributes not only to academic debates on service quality but also to practical considerations for policy makers and practitioners seeking to enhance patient-centered pharmacy governance.

Implications

The theoretical implications of this paper extend the SERVQUAL model by positioning AI and governance as critical antecedents to patient satisfaction. While SERVQUAL has traditionally been applied to measure perceptions of service quality, this paper expands its scope by showing how digital technologies interact with governance to shape patient outcomes. In doing so, it opens new theoretical ground for integrating service quality frameworks with technology adoption and health governance literature.

Methodologically, the paper underscores the value of adopting a mixed approach in future studies that combine subjective patient-reported outcomes with objective performance metrics. Surveys based on SERVQUAL dimensions could be complemented with data such as medication error rates, waiting times, or adherence patterns, offering more robust insights. This methodological synthesis would strengthen validity and provide a fuller picture of patient experience in AI-supported pharmacy settings.

Practically, the framework carries direct implications for healthcare policy, regulation, and practice in Malaysia and ASEAN. For policy makers, the model highlights the importance of aligning AI adoption with regulatory reforms that safeguard patients and promote interoperability across systems. For regulators, it emphasizes the need to establish clear guidelines for algorithm validation, data privacy, and professional accountability to ensure that AI augments rather than undermines clinical judgment. For practitioners, the framework demonstrates how AI can enhance day-to-day pharmacy operations, from reducing dispensing errors to improving patient counselling and communication.

Finally, the paper aligns with broader international and regional agendas. At the global level, it reinforces the World Health Organization's 2017 call to reduce medication-related harm by half, underscoring the potential role of AI-enabled pharmacy systems in advancing patient

safety. At the regional level, it echoes ASEAN's digital health priorities, which emphasize the development of standards, cross-border collaboration, and governance mechanisms for sustainable digital transformation. By situating pharmacy governance within these wider frameworks, the paper ensures that its recommendations remain relevant not only locally but also within global and regional health governance debates.

In summary, this study highlights that the future of pharmacy services lies in integrating technology with governance while keeping patient satisfaction at the core. Robust governance structures, when combined with innovative AI applications and anchored in the SERVQUAL framework, can drive meaningful improvements in safety, access, and trust across Malaysia and ASEAN.

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