

THE KEY DRIVERS AND BARRIERS IN THE ADOPTION OF MEDICATION DISPENSING TECHNOLOGY

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ABSTRACT

Purpose - This research aims to identify the key drivers and barriers that influence the adoption of medication dispensing technology. The study seeks to contribute to inform the seamless integration of healthcare technology into the fabric of modern medical practices.

Design/methodology/approach - This research employs an interview approach. Qualitative data is gathered through semi-structured interviews with healthcare stakeholders.

Findings - The findings reveal a complex interplay of key drivers and barriers influencing medication dispensing technology adoption. Clinical benefits emerge as a primary driver, with healthcare professionals emphasizing improved patient outcomes.

Research limitations/implications - Limitations of this research are potential participant response only conceptual framework of key drivers and barriers of sample size, and generalizability constraints. The research primarily focuses on specific Thai healthcare.

Practical implications - The research findings offer valuable insights for healthcare stakeholders. Organizations can leverage the understanding of influencing factors to develop tailored adoption strategies. Healthcare providers can better navigate the complexities of technology integration and can refine their offerings to align with healthcare needs.

Originality/value - This research contributes to the field by comprehensively analyzing the multifaceted key drivers and barriers that impact medication dispensing technology adoption. It offers a nuanced understanding of stakeholders' complex decision-making processes, contributing to healthcare technology adoption.

Keywords – drivers, barriers, healthcare, medication dispensing, technology

Introduction

Integrating advanced technology into healthcare has revolutionized medical practices, promising enhanced patient care, streamlined processes, and improved outcomes (Akhtar et al., 2023). Technology is a revolutionary concept in the realm of intelligence technology (Islam et al., 2015), offering promising solutions for enhancing healthcare services, particularly within the medication dispensing process. It has the potential to minimize errors and optimize processes for greater efficiency (Nadhira & Dachyar, 2020; Prajapati et al., 2018).

However, successful medication dispensing technology adoption is not solely technological. It is a complex interplay of multifaceted factors determining the extent and pace of implementation (Nadhira & Dachyar, 2020). In addition, the successful implementation of technology in the medication dispensing process

necessitates careful consideration of critical decision factors by both the medication dispensing process and hospital stakeholders (Aamir *et al.*, 2018)

In order to understand these factors becomes paramount as technology continues to reshape the healthcare landscape. This research aims to comprehensively analyze the key drivers and barriers healthcare organizations and providers face when considering integrating new technologies. The adoption of healthcare technology transforms medical practices and improves patient care (Kraus *et al.*, 2021). This research method provides a comprehensive understanding of the complexities surrounding medication dispensing technology used in healthcare by employing qualitative interviews. Shedding light on these factors can gain insights into the challenges and opportunities that arise during the adoption process. An in-depth interview can pave the way for informed the seamless integration of healthcare technology into the fabric of modern medical practices.

This research starts with an introduction to this study. Following that is section two, which encompasses the literature review about the comprehensive importance of medication dispensing technology. The subsequent section focuses on the research methods, describing the methodology and outlining the steps undertaken. Section four is dedicated to presenting the results, and finally, the last section encompasses the conclusion and summarizing the research findings.

The important of medication dispensing technology

Healthcare organizations face increasing regulatory requirements for medication management. Technology solutions can assist in meeting these standards and reduce the risk of error (Astier *et al.*, 2020). This section explains the literature review, which covers the importance of medication dispensing technology. That has been extensively explored in existing research, ensuring adoption and implementation within healthcare services.

Technology in the medication dispensing process can help ensure the proper medication, dosage, and administration time, improving patient safety (Alam *et al.*, 2018). Modern technology enables precise medication dosing and administration, reducing the risk of under-dosing or over-dosing. That is particularly crucial in complex treatment regimens. Technology, such as electronic prescribing (e-prescribing), Internet of Things, sensors, barcode, pick-to-light, dispensing machine, and computerized physician order entry (CPOE) (Ciapponi *et al.*, 2021), significantly reduce medication errors (Kuiper *et al.*, 2007). Automating medication management processes generally leads to time savings for healthcare professionals. This efficiency allows them to focus more on direct patient care, ultimately improving the overall patient experience (Alam *et al.*, 2018).

Technology facilitates accurate and comprehensive record-keeping, enabling healthcare providers to track medication histories, monitor interactions, and assess patient responses more effectively (Haleem *et al.*, 2021, 2022). In addition, access to real-time patient data through electronic health records (EHRs) and other systems supports better decision-making by healthcare professionals during medication administration (Schopf *et al.*, 2019). Technology can aid in monitoring patient adherence to prescribed medications. That is especially important for patients with chronic conditions where medication non-adherence can lead to treatment inefficacy (Chen *et al.*, 2020). Healthcare organizations must adhere to strict regulatory guidelines in medication management. Technology helps ensure compliance and reduces the risk of medication-related errors. While initial costs might be associated with implementing technology, it can lead to long-term cost savings by reducing errors, preventing adverse events, optimizing inventory management, and improving overall operational efficiency (Buer *et al.*, 2021).

As mentioned above, this research aims to thoroughly identify the critical factors that impact the adoption of medication dispensing process technology within healthcare services. Through identifying primary drivers and barriers, this study seeks to offer valuable insights that empower informed decision-making and the

creation of efficient strategies, all aimed at achieving a smooth integration and maximizing the benefits of medication dispensing technology. The following section will describe the research methodology.

Research methodology

The research methodology was used for in-depth interviews on the key drivers and barriers to healthcare technology adoption. That is a systematic framework encompassing data collection, analysis, and interpretation. The primary goal is to comprehensively understand the intricate factors influencing the adoption of medication dispensing technology. Figure 1 presents the research outlines the essential components of this research methodology.

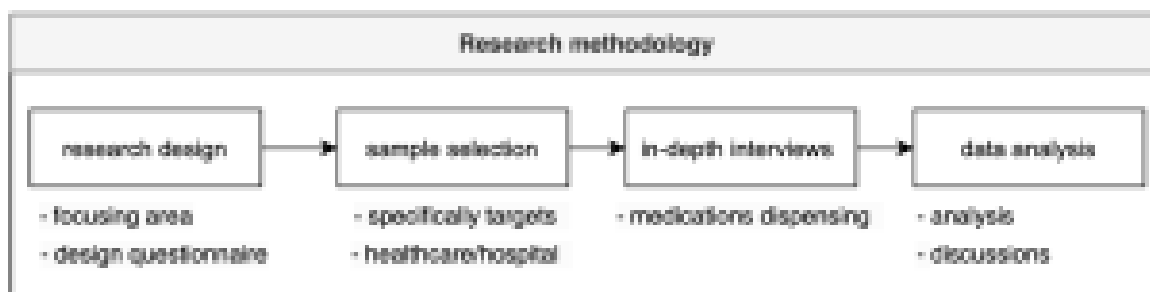


Figure 1: Research methodology

The initial phase is the research design, which on conducting in-depth interviews with healthcare professionals and administrators. These interviews serve as a crucial means to capture nuanced insights and perceptions.

Question 1: What drivers impact adaptation/used medication dispensing technology?

Question 2: What are the limitations or constraints in medication dispensing technology?

Following this, the sample selection, this research specifically targets involved in medication dispensing, including healthcare professionals, administrators, and pharmacists. This research selects the healthcare/hospital, including public and private hospitals.

The subsequent step involves data analysis. This qualitative approach examines interview transcripts and discussions to identify recurring themes and patterns. The insights from this analysis highlight the key drivers and barriers, thus providing valuable guidance for decision-making, technology design, and effective implementation strategies.

Through applying this research methodology, the study aims to shed light on the intricate complexities associated with adopting healthcare technology. The resulting insights offer valuable guidance to stakeholders navigating the ever-evolving landscape of modern healthcare practices.

Research Result

This research delves into the key drivers and barriers shaping medication dispensing technology adoption, exploring the intricate connections between clinical efficacy, regulatory compliance, and user experience.

This research conducted field visits to observe the actual work practices and interview executives' hospital team, administration, and medical staff involved in medication dispensing, both for inpatients and outpatients. This interview is about integrating technology solutions into the medication dispensing process. This study covered six large hospitals in Thailand, categorized into two public hospitals, two private hospitals, and two university hospitals.

Following the interview and observations allowed the researchers to identify significant issues, particularly in the prescription screening and managing a large volume of medications. These issues led to a decrease in the efficiency of medication dispensing, longer waiting times for patients, and a decline in the overall system performance.

Ultimately, it is essential to consider the factors that impact the system's performance to analyze the implementation of IoT for enhancing the efficiency of the medical supply/medication storage system, "What drivers impact adaptation/used medication dispensing technology?" and "What are the limitations or constraints in medication dispensing technology?". The researchers found that by summarizing the key factors that affect the system's efficiency, as Table 1

Drivers	public hospitals		private hospitals		university hospitals	
	A1	A2	B1	B2	C1	C2
falling number of pharmacists	✓	✓	✓	✓	✓	✓
more difficult or complex diseases		✓		✓	✓	✓
increasing number of drugs			✓		✓	
growing number of patients	✓	✓	✓	✓	✓	✓
technology transformation	✓		✓		✓	
Barriers						
unfriendly user interface	✓	✓	✓		✓	
slow robots speed in high demand				✓	✓	✓
limitation throughput technology				✓		✓
modifying machine to a new drug			✓	✓	✓	✓
limited LASA drugs	✓	✓	✓	✓	✓	✓

Table 1: Keys driver and barriers of medication dispensing technology

Drivers impact adaptation/used medication dispensing technology

The falling number of pharmacists is the first driver impacting the adaptation/use of medication dispensing technology. Healthcare is facing a shortage of qualified pharmacists, which can impact the quality of patient care and lead to increased workloads for existing pharmacists. This shortage can be attributed to an aging population, increased demand for healthcare services, and expanding pharmaceutical roles beyond traditional pharmacy settings.

After COVID-19 pandemic situation, diseases are more difficult or complex. The emergence of new diseases or the increasing complexity of existing diseases (e.g., drug-resistant strains) places additional demands on healthcare systems. Addressing these challenges requires continuous medical research, innovative treatments, and effective public health measures. That challenges pharmacists in terms of understanding disease mechanisms and treatment options and managing patient medications effectively.

Following this, diseases will become more complex cause of an increasing number of drugs or medications. The pharmaceutical industry is continually developing new drugs to treat a wide range of conditions. While this expands treatment options, it also necessitates robust regulatory oversight to ensure drug safety and efficacy—which affect the medication dispensing process and treatment.

Due to the aging society, the growing number of patients is one of the main drivers to accept technology in healthcare services. Population growth, aging demographics, and improved healthcare access can lead to a more significant number of patients seeking medical care. That requires healthcare systems to scale their services, manage patient flow efficiently, and address the needs of diverse patient groups.

In addition, the technology transformation. Technological advancements, such as telemedicine, electronic health records, automation and artificial intelligence, and AI-driven diagnostics, are transforming healthcare operations. While these innovations offer opportunities to improve efficiency and patient outcomes, they also require careful implementation and consideration of ethical, legal, and privacy concerns.

Finally, safety standards are critical in healthcare to ensure patient well-being. Healthcare providers must adhere to rigorous safety protocols to minimize patient risks, including hygiene, infection control, and medication management. Ensuring patient safety is paramount in pharmacy practice. Pharmacists must stay vigilant about medication errors, adverse drug reactions, and proper dispensing procedures to maintain high safety standards.

These points highlight the evolving landscape of pharmacy and healthcare, where pharmacists must navigate a range of challenges related to workforce shortages, medical complexities, technological changes, and patient care. Adapting to these changes often requires ongoing education and training to ensure pharmacists can provide their patients with the best possible care.

Barriers, limitations or constraints in medication dispensing technology

The first barrier of using medication dispensing technology from the interview is unfriendly user interface. The user interface of a system, software, or device used in a pharmacy is not user-friendly, it can lead to inefficiencies, errors, and frustration among pharmacy staff. A well-designed interface is crucial to ensure smooth operations and reduce the potential for mistakes.

The second barrier is robots in the peak-time duration. In high demand (high number of prescriptions), pharmacists can work faster than dispensing machine (leading to higher error rates and significantly increased workload). While robots can help reduce errors in medication dispensing, they may work at a slower pace due to the complexity of their processes and the need to follow precise steps programmed from the control system.

Moreover, the "pick to light" technology, which guides workers to specific items using lights, might be efficient but can limit throughput, as only one person can work at a time. It could lead to slower overall operations and workflow, leading to inefficiencies, especially if there is a high demand for medication dispensing.

Introducing new drugs could necessitate changes in automated systems. Adapting a machine to accommodate a different drug involves modifying its software and hardware components to be configured and dispensing the correct medications. Modifying a machine's setup for a new drug requires taking it to the factory, causing delays and interruptions in the medication process.

Lastly, the dispensing machine is still limited to Look Alike Sound Alike (LASA) drugs. LASA refers to drugs that have similar names or appearances, which can potentially lead to medication errors if not properly identified. This is an important safety concern in healthcare, as errors related to LASA drugs can have serious consequences.

Conclusion

This study aims to provide insights to medication dispensing process administrators, outlining essential drivers and barriers that pave the way for the effective integration of technologies into the medication dispensing process setting.

Following a dep-interview in six hospitals in Thailand, the research found that medication dispensing technology can help reduce errors in tasks of medication dispensing. Due to the falling number of pharmacists, more difficult or complex diseases, a growing number of patients, safety standards, and technology transformation. It is essential for medication dispensing operations to adapt technology in service.

Finding the right solutions that minimize errors while optimizing speed and efficiency is a crucial challenge. While automatic machines can deliver medications, there might still be issues with LASA drug conditions and demand time and operate slower due to their programmed steps and several limitations. It is essential to consider a balance between automated processes' speed and error rate to ensure patient safety and satisfaction. That also includes user interfaces, efficiency, and accuracy. Continuous improvement and adaptation to emerging technologies are crucial for providing safe and effective pharmaceutical services.

Limitations of this research are potential participant response only conceptual framework of key drivers and barriers of sample size, and generalizability constraints. The research primarily focuses on specific Thai healthcare.

Future research will develop the technology road mapping for the medication dispensing process. This roadmap aims to guide the strategic implementation of technology within the medication process, leading to notable enhancements in patient efficiency, workload management, and reduced errors across healthcare systems.

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