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Design and using novel smart and technological strategies as part of E-Pharmacy digitalization

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Abstract

Conventional systems have been utilized to automate the rising prevalence of contemporary technologies. These systems encompass services provided to both corporations and individuals, including healthcare. Pharmacy data management systems that are conventional in nature encounter various obstacles such as limited capacity, time constraints, inventory management issues, restricted drug accessibility, and the requirement of proficient personnel to fulfill employer demands. Therefore, this study aims to investigate the main pharmacy implemented technological strategies that can be to improve healthcare.

Keywords: Smart application - Technological strategies - E-Pharmacy - Pharmacy digitalization

Introduction

The digitalization trend has also impacted the pharmacy industry. The introduction of technological advancements, such as robots, has caused significant disruptions in the field of pharmacy (Peltoniemi *et al*., 2021). The electronic prescription, commonly referred to as e-Prescription, is a significant factor that impacts this industry (Park *et al*., 2022). It is characterized as the utilization of computing devices to input, alter, assess, and produce or transmit medication prescriptions. The potential benefits of electronic prescribing are widely discussed in the literature, as it is believed to enhance the efficiency and efficacy of medication dispensation. The prospective advantages encompass a reduction in medication errors and effective detection of unfavorable outcomes (von Woedtke *et al*., 2013).

The utilization of electronic prescriptions has been extensively embraced on a global scale. The Finnish community pharmacy sector has undergone a notable transformation with the implementation of the direct dispensing model (Giravi *et al*., 2022). This model utilizes innovative technology to simplify the prescription-only (PO) customer service process. The

present article aims to analyze the implications of the modifications on Finnish pharmacies, while also exploring their sociotechnical repercussions (Davies *et al*., 2014).

The susceptibility of recall bias and untruthful reporting by users in self-reported e-pharmacy use may result in an underestimation of the true prevalence (Frost and Adams, 2017). The differentiation between legitimate and illicit players was not made in our study due to the potential for online retailers to mislead customers or encounter difficulty in distinguishing between the two (Westerling *et al*., 2011). Consequently, the sample is representative of the patient population at the national level, rather than the entire populace of Hungary. Furthermore, this could potentially be considered a strength as individuals may be more inclined to obtain prescriptions and be more susceptible to the hazards associated with e-pharmacies (Dhina *et al*., 2021). The prevalence and attitudes of inpatients were previously evaluated and disclosed by the authors (Alsahali, 2021).

Individuals who utilize online pharmacies, regardless of their legality, procure medications for both short-term and long-term illnesses, including controlled substances. Improper usage of medicines, including both prescription and non-prescription drugs, as well as dietary supplements, can result in harmful consequences (Davies *et al*., 2014; Riantini, 2020). It is essential to seek the guidance and supervision of a medical practitioner or pharmacist to ensure safe and effective use. Insufficient or inaccurate data pertaining to the patient's medical condition and medication regimen, incorrect self-assessment, or suboptimal management of medication-related issues (Kurniawan *et al*., 2023). The primary concerns encompass polypharmacy, duplications in therapy, unfavorable effects, and interactions between drugs or drugs and herbal remedies. Illicit online pharmacies pose a considerable threat to patients as they vend spurious medications and substandard products. Nonetheless, even performers who are operating within the bounds of the law express apprehensions regarding their usage (Subramanian *et al*., 2021).

On a global scale, there has been an increase in the allocation of funds towards national pharmaceutical budgets (Crilly and Kayyali, 2020). The accessibility of medications for consumers may be restricted due to economic limitations, which may prompt them to procure medicines from a cost-competitive online marketplace (Trenfield *et al*., 2022). Ensuring consumer protection and enhancing the caliber of drug-selling websites that operate beyond state and national boundaries pose formidable challenges. The objective is to hinder the establishment of deceitful and misleading websites while facilitating the emergence of novel, principled pharmaceutical services (van de Pol *et al*., 2019).

Pharmacy Practice digital applications

The employment of teleconsultations within the domain of pharmaceutical care has been a subject of discourse for a significant duration (Badowski *et al*., 2021). Currently, as a result of the measures implemented to curb the spread of the pandemic and the necessity for significant social distancing, there has been a significant increase in the use of pharmaceutical care through teleconsultations on a global level. Several research studies have been carried out to investigate the application of digital technologies in delivering clinical pharmacy services, which include

health education, chronic disease management, and medication review (Martin *et al*., 2018). It is highly probable that in several nations, the integration of these methodologies into the healthcare delivery system will transpire subsequent to the pandemic. It is crucial to recognize that there are disparities in the availability of technological resources among different nations and demographic groups. The ability of patients to effectively utilize healthcare technologies may be influenced by various factors, including their financial resources and level of digital literacy (Patel *et al*., 2010).

The integration of diverse digital technologies, such as teleconsultations, is becoming more prevalent in the field of pharmacy practice. The technologies encompass robotic and barcode-assisted drug dispensation, electronic health records management, computerized decision-making support systems, and the integration of artificial intelligence and big data analytics (Davies *et al*., 2014). The development of rigorous research studies is a crucial aspect in relation to this topic. It is imperative that these studies utilize evidence-based methodologies in order to implement and assess digital interventions from various standpoints. The aforementioned initiative has the potential to generate high-quality empirical data that may prove beneficial to various parties, such as executives, managers, pharmacists, pharmacy personnel, medical practitioners, nursing staff, and individuals seeking healthcare services. The field of pharmacy practice is incorporating implementation science, behavioral theory, and diverse stakeholder viewpoints to promote evidence-based strategies for implementing and evaluating pharmaceutical interventions and services, regardless of the use of digital technologies (Hope *et al*., 2022).

The utilization of E-prescription and the direct dispensing model

The pharmacy industry has experienced substantial transformations in recent times. The implementation of electronic prescription has been extensively embraced in Finland since 2010, and it was established as the exclusive mode of prescription in 2017 (DiDonato *et al*., 2015). In Saudi Arabia, the utilization of electronic prescription and its associated centrally regulated databases is a legal requirement, as stipulated by the relevant legislation. The KanTa, or Finnish Patient Data Repository, is a centralized database that stores personal healthcare records, with a distinct partition dedicated to medicine prescriptions (Trenfield *et al*., 2022).

The KanTa system is a comprehensive digital ecosystem that facilitates the integration of healthcare service providers and pharmacies (Javaid *et al*., 2023). This is achieved through a centralized data source that contains records for every Finnish citizen (Woods *et al*., 2016). The integration mechanism in question is widely regarded as pivotal within the supply chain of medicine. Medical practitioners have the ability to examine past prescriptions issued by any healthcare provider during the process of prescribing medication (Fang and Li, 2016). Pharmacists retrieve prescriptions from a database when dispensing medication and said prescription can be filled at any pharmacy (Solomon and Rudin, 2020). This differs from certain countries where prescriptions are exclusively transmitted to a designated pharmacy.

The advantages of fully digitizing the process of prescribing medicine encompass the prevention of medication duplication, a comprehensive understanding of the patient's entire

medication regimen, and standardized medication data across healthcare facilities and pharmacies (Raut *et al*., 2022). As per the findings of Aanestad *et al*. (2017), electronic prescription systems possess the capability to enhance the management of medication expenses and associated performance evaluation. The implementation of a centralized ePrescription solution on a large scale is a rare occurrence globally, including within Europe.

The implementation of e-Prescriptions played a significant role in the evolution of the pharmacy dispensing process. Pharmacists are now able to retrieve, manage, and authorize the dispensation of medication through a centralized online e-Prescription service, without the need to duplicate the prescription information into the pharmacy's IT system (Clark *et al*., 2017). This has been documented in previous studies. The implementation of the "direct dispensing model" necessitated a transformation in the medication dispensation process across all pharmacy settings, replacing the previously employed "traditional dispensing model (Awad *et al*., 2021)."

There are discernible distinctions in the workflows of the two dispensing models under consideration. From the perspective of the customer, the primary distinction between the direct dispensing model and the traditional dispensing model pertains to the way they are served (D Aungst *et al*., 2021). In the direct dispensing model, a solitary pharmacist utilizes an IT system to manage prescriptions and serves the customer in an uninterrupted episode. Conversely, the traditional dispensing model involves the participation of multiple pharmacists and technical workers in the workflow (Ramljak, 2017).

Two dispensing models are presented in the following figure,

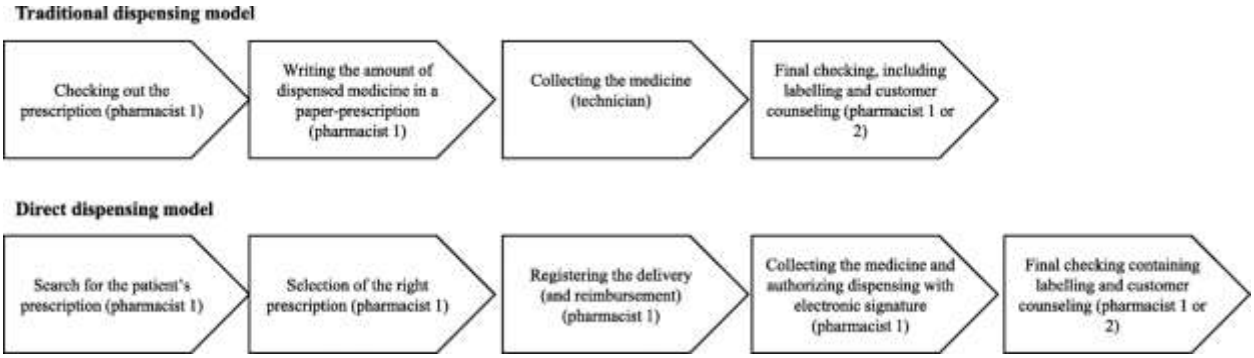

Figure 1 Traditional and novel dispensing models (Peltoniemi *et al*., 2021)

Mobile application as novel approach for pharmacy dispensing and medication management

The convenient accessibility of community pharmacists to patients renders them a pivotal resource in augmenting medication adherence. Moreover, mHealth possesses the capability to function as a mechanism for community pharmacists to actively engage patients through an interactive mobile application (Car *et al*., 2017). Currently, there are 424 applications designed to facilitate self-management of medication. The variability in the quality, content, and functionality of these applications is significant (van de Pol *et al*., 2019). The development of a mobile application, spearheaded by pharmacists, has the capacity to provide a high level of quality and care that may assist individuals in proficiently managing their medications and

enhancing adherence (Javaid *et al*., 2023). The phrase 'pharmacist driven' pertains to the utilization of mobile technology by a pharmacist to achieve accuracy in patient data, facilitate the dissemination of patient-centered health information, and establish a means of direct communication between the pharmacist and the patient (Awad *et al*., 2021).

Two recent scholarly investigations have evaluated a variety of currently available mobile adherence technologies. In a study conducted by Dayer *et al*. (2013) healthcare providers assessed the perceived value and utility of various medication adherence applications designed for smartphones. The features were evaluated by the providers and categorized into ratings of modest, moderate, or high. The study conducted by Bailey *et al*. (2014) aimed to assess the efficacy of mobile applications in promoting self-administration of medication. The studies did not evaluate the patients' perspectives regarding the advantages obtained from a mobile application technology facilitated by pharmacists to improve adherence, and the capacity of this technology to overcome typical obstacles to adherence. The resolution of this knowledge gap could enable the identification of patients who are more likely to benefit from the application's use, as well as those who are unsuitable for its use. The utilization of this technology has the potential to assist application developers in optimizing their products to better meet the needs and desires of patients.

Adherence to drugs and mobile applications

Smartphones are multifunctional gadgets that come equipped with internet capabilities, allowing users to have uninterrupted access to communication and information. Additionally, smartphones are capable of performing a diverse range of tasks. Most operations are performed using specialized software applications (DiDonato *et al*., 2015), commonly known as apps, that are easily accessible for consumers to download and utilized to assist in a wide range of functions. Incorporating a smartphone application is a novel approach to augmenting patient behavior and adherence. This methodology provides uninterrupted availability, involves and educates the individual, and provides a repository for patient and medication-centric information. The use of a medication adherence-focused mobile application (adherence apps) has the potential to streamline the user's medication-related information, leading to a more effective means of educating the individual about their medical condition or treatment (Dalgaard *et al*., 2013).

Applications that promote adherence to prescription medication are widely accessible at a low or insignificant expense, and their benefits can be realized by individuals who are undergoing pharmacotherapy. However, it is worth noting that these applications have the potential to offer significant benefits to individuals with complex treatment regimens or to caregivers responsible for the well-being of others (Chan *et al*., 2013; (Kao and Liebovitz, 2017). The widespread prevalence of smartphones in the United States, combined with their constant and easy availability, makes adherence applications an appealing choice for many individuals because of their affordability and ability to provide customized information (Zao *et al*., 2010).

The prevalence of medication management applications aimed at streamlining the arrangement and dispensation of medication by individuals is increasing across the primary

mobile platforms. Currently available adherence applications in the market offer diverse functionalities, including but not limited to scheduling reminders for medication consumption and refills (Spinks *et al*., 2017), recording doses, enabling patients to access and upload data logs to care providers, and furnishing medication-related information such as dosages, adverse effects, toxicities, and specialized provider notes. The aforementioned characteristics can be promptly obtained through tactile interaction. In addition, it is possible for these software programs to integrate alarm notifications that are synchronized with a calendar system (Solomon and Rudin, 2020). These reminders can be customized to correspond to particular dosages or features that merge medication inventories with comprehensive drug data (Schofield *et al*., 2019). Furthermore, these applications have the capability to consolidate contact details of pharmacies and primary healthcare providers, as well as furnish discount cards for prescription drugs. Presently, efforts are underway to integrate health-monitoring devices with smartphones, enabling the direct transmission of resulting data to either patients or healthcare professionals (Hilliard *et al*., 2014). The literature concerning the clinical integration of smartphones and their associated applications in the domain of health and wellness, particularly in the area of weight management, is progressively growing. Nonetheless, a scarcity of empirical investigations exists that scrutinizes patient employment of smartphones and their corresponding applications as a strategy for fostering adherence (Senbekov *et al*., 2020).

E-prescription system

The electronic prescription system was first introduced in 2010, and presently, almost all prescriptions, comprising 99.9%, are electronically processed (Al-Shammary *et al*., 2018). Healthcare professionals possess the ability to produce electronic prescriptions for both medications and medical devices. Physicians employ computer software to accomplish an electronic prescription form during the medication prescribing process, which is then conveyed to the national prescription center (Trenfield *et al*., 2022). The prescription can be made available at any pharmacy in a timely manner upon the patient's request. To obtain prescription medications or medical equipment, patients must provide a form of identification that includes a photograph and personal identification code, such as an ID-card, driver's license, or passport, at the pharmacy (DiDonato *et al*., 2015). The e-prescription system retrieves data from the national health insurance fund, thereby enabling the automatic presentation of all applicable patient benefits. As a result, the medication is discounted proportionally. Additionally, the system enables automated billing processes from pharmacies to the Estonian Health Insurance Fund. The system enables data sharing with the e-Patient Portal, allowing patients to access information regarding their available prescriptions and previously dispensed medications. The implementation of a centralized electronic system has yielded temporal benefits for both healthcare providers and patients. This phenomenon can be attributed to the recent development where routine prescription refills can be dispensed without necessitating a scheduled consultation with a medical practitioner (Zanjal and Talmale, 2016). The e-prescription system offers a notable advantage in that it allows for the monitoring of prescribing patterns, tracking of patient

medication usage, and ensuring adherence to prescribed treatments by healthcare workers and authorities. The e-prescription system functions as the principal means for pharmacists to obtain essential patient data, such as the present medication regimen and diagnoses, since pharmacies do not have access to patients' electronic health records.

The e-prescription system is composed of three discrete classifications, specifically public, authorized, and private. As a default setting, all prescriptions are publicly accessible. Notwithstanding, the prescriber retains the discretion to alter the category at the time of prescribing, or alternatively, the patient may effect such changes via the e-Patient Portal. The e-prescription system, which is privately operated, limits the procurement of medications exclusively to the patient (Minaam and Abd-ELfattah, 2018). Additionally, it provides the opportunity to authorize a designated individual's access to the patient portal. In the case of a default public prescription, individuals who possess the patient's personal identification code would have the ability to access the prescription information and acquire the medication from a pharmacy. The provision of personal documentation by the purchaser is a requisite for the transaction, and the pertinent buyer details shall be documented in the e-prescription system (Melton and Lai, 2017).

In the case of our sample patient, who bears the primary responsibility of procuring her medications from the pharmacy. To obtain Patient's prescribed medications (Senbekov *et al*., 2020), Pharmacist presents his identification card to the pharmacist and verbally provides his grandmother's personal identification code. Since Patient's prescriptions are accessible to the public by default, Pharmacist is capable of obtaining any prescription medication on Patient's behalf without encountering any constraints. The prescription system consistently furnishes a thorough record of medications comprising the prescribed active ingredient, potency, and formulation that are currently available in the pharmacy. The arrangement of these medications is determined by their cost, either in ascending or descending order. Pharmacists are mandated by legal obligations to recommend the most cost-effective alternatives as the primary option. Furthermore, the system employs a color-coding scheme to signify products that are either at or below the reference price. The pharmacist possesses the capacity to access information pertaining to the particular brand name that the patient has previously chosen to obtain. Moreover, the pharmacist possesses the ability to access the comprehensive medication regimen from the prescription system and offer suitable advice.

Smart technologies for medications' reminding and patients' care

The New Pharmacy Contract, which was implemented in 2005, resulted in a substantial alteration in the duties of community pharmacists (Zao *et al*., 2010). Pharmacists are mandated to undertake a number of critical responsibilities, which encompass the dispensation of prescriptions, provision of advanced services such as 'medicines use reviews' (MURs) and 'new medicines service' (NMS), and delivery of enhanced services such as smoking cessation. These obligations unavoidably contribute to their everyday tasks and could potentially result in heightened levels of stress (Davies *et al*., 2014).

Undoubtedly, the optimization of healthcare-related tasks has become an increasingly crucial aspect in contemporary times (Westerling *et al*., 2011). The deployment of mobile applications on devices has the potential to reduce the time required to perform a particular service or activity, which is a notable benefit for pharmacists. In order for a mobile application to be deemed a valuable healthcare tool, it must fulfill several key functions, including but not limited to augmenting the decision-making process, facilitating education for pharmacists, staff, and patients, serving as a communication aid, and providing support to patients within a community context (Hope *et al*., 2022).

Within the realm of pharmacy, mobile applications are regarded as a more advantageous alternative in comparison to printed reference materials due to their convenient usability, intuitive interface, and regular updates. It is worth considering that numerous prominent pharmaceutical companies have created mobile applications in addition to traditional hard-copy formats. One instance of this phenomenon can be observed in the development of the British National Formulary (BNF) application by The Royal Pharmaceutical Society (Crilly and Kayyali, 2020). This app facilitates the retrieval of the BNF by healthcare practitioners from any geographical location. Additional resources that fall under this category are 'The Pharmacist Letter' and 'Medscape (Davies *et al*., 2014)'. These resources facilitate the efficient retrieval of relevant literature on a particular topic. The study conducted by DeArment (2011) aimed to assess the suitability of pharmacy staff who were assigned the role of 'Wellness Ambassadors'. The participants were equipped with tablet devices and assigned the responsibility of assisting customers in choosing from a range of non-prescription drugs and dietary supplements. The aim was to empower clients to make knowledgeable choices based on their individual needs. The deployment of the aforementioned technology received favorable responses from both staff and customers. The intervention successfully resolved a previously identified inadequacy in the coordination between the front-end operations and the pharmacy.

Mobile platforms have been found to be appropriate for the management of chronic medical conditions such as diabetes. This is due to their ability to encourage safe insulin usage and minimize the incidence of hypoglycemia (Spinks *et al*., 2017). The capacity of mobile devices to establish connections with supplementary monitoring platforms through the utilization of sensing technology is a pervasive capability (Salem *et al*., 2020). The feasibility of establishing a connection between a glucose sensor and a smartphone using Bluetooth technology was investigated by Cai *et al*. (2012). The previously mentioned method enabled the patient to document and maintain data regarding their blood glucose levels on a handheld electronic device, which could then be transmitted to the internet for analysis by a monitoring entity. If predetermined thresholds of blood glucose levels were exceeded, an alarm would be triggered to send a text message to the patient, providing supportive information and, if necessary, the contact details of the nearest emergency contacts.

The utilization of technology possesses the capability to enhance healthcare education. 10 The significance of education in the healthcare domain is paramount owing to the frequent emergence of novel products and information (Patel *et al*., 2010). The breadth of this subject

matter is inherently extensive, and a thorough explanation is beyond the scope of this document. The salient considerations pertaining to the utilization of mobile applications comprise the continuous education of pharmacists, personnel training, and patient education (Peltoniemi *et al*., 2021).

The maintenance of a current and comprehensive knowledge base by healthcare professionals is widely anticipated by regulatory bodies and the general public as a means of ensuring the delivery of optimal healthcare. Pharmacists who are based in the United Kingdom are obligated to participate in ongoing professional development activities, which serve as a fundamental aspect of their current registration requirements (Frost and Adams, 2017). The suggested methodology involves participating in educational pursuits and collecting corroborative evidence along with introspective evaluation (Badowski *et al*., 2021), with the ultimate aim of augmenting one's professional proficiency. Although Continuing Professional Development (CPD) holds educational value, studies suggest that pharmacists often lack motivation to partake in this process (Minaam and Abd-ELfattah, 2018). Their participation is primarily driven by the mandatory requirement imposed by their profession. Mobile applications possess the capacity to furnish a prompt and expedient method of gaining access to medical information and facilitating the recording of related educational endeavors (von Woedtke *et al*., 2013).

Conclusion

The implementation of E-Prescription and the direct dispensing model resulted in an acceleration of the dispensing process. Additionally, there is evidence to suggest that the procedure has become increasingly anticipatory and regulated. The statement suggests that the dispensing process has shifted towards a greater emphasis on technical proficiency and a reduced reliance on human aptitude and orientation.

A prevalent argument posits that the Finnish community pharmacy sector has undergone significant digitalization, largely due to the implementation of E-Prescription. This has led to the adoption of the direct dispensing model and other digital solutions within pharmacies.

Regarding constraints, our findings are exclusively applicable to the pharmacy system in Finland. There exists a considerable degree of variation in the execution of electronic prescriptions both across and within national boundaries. Diverse modes of integration may exist between the E-Prescription and pharmacy system, despite operating within a shared electronic prescription infrastructure. Apart from the aspect of system integration, the adaptability of pharmacies and individual workers to electronic prescription exhibits varying capabilities. Moreover, the assessment was conducted during the initial implementation phase of electronic prescription. A recent study conducted in Finland reveals that both pharmacy owners and employed pharmacists identify themselves as innovators who exhibit a willingness to adopt IT innovations.

Potential future research directions may involve conducting analogous measurements to those carried out in this study in diverse nations and various types of pharmacies. It is possible to

conduct an analysis of the variations in services provided to distinct customer segments. Incorporating the essential perspective of the customer during the service process through the exploration of their experiences can enhance our comprehension of the delivery process. The extraction of service times from system log data has been proposed as a viable option. However, in our current setting, the implementation of such a system has been deemed excessively complex, given the technical limitations of the systems in use.

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