Improving access to prescription-based care through patient-centered smart pharmacy ecosystems

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Abstract. In smart cities, community pharmacies offer a range of health services, including clinical data gathering, medication dispensing, and automated alerts for precautions. Our paper reviews smart pharmacies, highlighting a shift from prescription-based treatment to patient-centered care. This transformation involves promoting a culture of cooperation and shared decision-making among stakeholders for value co-creation through seamless integration of pharmaceutical services and technology. Through the lens of Service Dominant (SD) Logic, this conceptual paper sets out to examine the context of smart pharmacies in the contemporary healthcare landscape, revealing their potential in advancing patient-centered care and driving collaborative value creation within a complex healthcare ecosystem.

1 Introduction

"*Effective prescribing requires an understanding of the patient's individual needs, preferences and values*". Corrigan (2005), in their work at the Institute of Medicine, asserted that patient-centered care places patients' values, needs, and preferences at the forefront, guiding decision-making [1].

Customers in the $550 billion retail pharmacy US market† are becoming more and more demanding, expecting a pharmacy experience that is convenient, multichannel, and places home delivery at the center. New medicines for cancer, metabolic disorders, neurological diseases, and other indications lead the field of biomedicine research, and are now available on pharmacy shelves. However, is a treatment actually living up to its promise if patients cannot easily get it?

Community pharmacies can provide diverse health services in smart cities, such as collecting patients' clinical data, dispensing of medicines, applying diagnostic tools, generating automatic alerts about precautions/contra-indications of medicines, follow-up of patients, and/or alerting patients for the necessity of routine exams [2]. There is an increasing reliance on innovative solutions emerging from the integration of technology and modern sciences within smart cities [3]. In an era of 'big data', recent developments in information and communication technologies (ICT) have facilitated the proliferation of affordable smart devices dedicated to managing healthcare data [4]. Concurrently, various pillars of the healthcare ecosystem, including physicians, hospitals, insurance companies, and pharmacies, are actively embracing this technological wave to harness big data, to reduce costs, improve services, and streamline processes [4]. In fact, internet and new

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† Zippia. "25+ Incredible U.S. Pharmaceutical Statistics [2023]: Facts, Data, Trends And More" Zippia.com. Jun. 19, 2023, https://www.zippia.com/advice/us-pharmaceutical-statistics/

omni-channel communication platforms increase consumers' informational access and empower their decision-making beyond traditional service encounters. Responding to these demands, pharmacies shift towards intelligence and connectivity, by becoming smart.

What are smart pharmacies? How can this transformation in the pharmacy service improve access to prescription-based care while promoting a patient centered pharmacy service ecosystem?

2 Methodological approach

Our goal from this conceptual paper is to present an abstract framework that visualize smart pharmacies and their contribution to the healthcare ecosystem, grounded in the foundational premises of service dominant logic (Table 1) [5].

Table 1 - The axioms of S-D logic. Adapted from [5].

Axiom 1	Service is the fundamental basis of exchange where the application of specialized skill(s) and knowledge is the fundamental unit of exchange where goods (both durable and non-durable) derive their value through use, i.e. the service they provide.
Axiom 2	Customer Centricity - Value is cocreated by multiple actors, always including the beneficiary. Actors cannot deliver value but can participate in the creation and offering of value propositions, because service is defined in terms of customer-determined benefit and co-created it is inherently customer oriented and relational
Axiom 3	All social and economic actors are resource integrators forming networks in a complex set of actors including technology in the network ecosystem
Axiom 4	Value is always uniquely and phenomenologically determined by the beneficiary
Axiom 5	Value cocreation is coordinated through actor-generated institutions and institutional arrangements.

We conduct a review of the literature on the scope of smartness in pharma, and the essentials of smart pharmacy ecosystems that shift prescription-based treatment to patient-centered care by promoting a culture of cooperation and shared decision-making among pharmacists and other actors in the smart pharmacy ecosystem.

We start with the service ecosystems perspective where a configuration of people, technologies, and other resources interact with other service systems to create mutual value and unlock the complex nature of value cocreation within the society [6] <*S-D logic Axiom 1*>. A focus on service steers attention to the process, patterns, and benefits of exchange, rather than the units of output that are exchanged (e.g., goods). S-D logic argues that in order to create value, that is to maintain and increase wellbeing and viability, actors engage in interdependent and reciprocally beneficial service exchange [6] <*S-D logic Axiom 2*>. Hence, value creation occurs in networks in which resources are exchanged among multiple actors and is therefore more accurately conceptualized as value cocreation [7] <*S-D logic Axiom 3*>.

Through this lens of SD Logic, pharmacists see medications as part of the overall value package. Co-creation in pharmaceutical services represents a partnership between the patient and the pharmacist, focusing on developing valuable services. This process includes responsible supervision protocols to ensure patient participation adheres to ethical considerations and comprehensive oversight <*S-D logic Axiom 4*>. The integration of smart pharmacies in the health ecosystem of smart cities, paves the way for a wide range of

drug discovery, production, supply, circulation, procurement, allocation, and monitoring scenarios <*S-D logic Axiom 5*>.

This paper examines pharmacies within smart cities, exploring their contribution to patient-centered care and collaborative value co-creation. We then close with an interpretation of the investigated phenomena to offer a framework of fundamentals for a learning, patient centric pharmacy service ecosystem.

3 Discussion

Smart cities operate through complex service ecosystems that result from systematic methods of continuous learning, timely data collection, rational innovation, social responsibility, and network governance, rather than relying on basic intuitions [6]. This logic, rooted in service science, aligns with the information revolution, where patients have become active actors in a network of other actors, exerting power and influence based on what they use, share, and exchange [7]. In particular, service science in smart cities, contends that the exploitation of technology, which promotes learning and increases actor participation, facilitates this exchange of resources. Technology is a means of innovation as well as an outcome of innovation, and contributes to value co-creation by enabling the sharing of information within and across service systems, though internal competencies and external capabilities. Advanced service systems, leveraging technology, enable the description and analysis of situations, fostering data-driven decision-making in a predictive or adaptive manner [8].

3.1 Smartness in pharma

Smartness is connectedness; a data-enabled, digitally connected smart city must include platforms geared towards providing a personalized experience, reflecting a pronounced shift in urban priorities towards digital health service delivery. Services include new drug development, drug molecular design, and hospital drug management, clinical drug decision support, modernizing traditional medicine, pharmacy informatization, drug regulation, and other broad areas. In actuality, the emergency of smart pharmacology offers a thorough and efficient way to update the entire drug life cycle management process and breathes fresh life into the advancement of contemporary pharmacy.

The broader scope of services covered by smart pharmacology primarily utilizes big data, cloud computing, artificial intelligence (AI), Internet of Things (IoT), block chain, and other cutting-edge digital technologies to provide whole-process, information-based, intelligence-driven solutions [9]. For example, in the field of Pharma, AI accelerates the diagnosis process and medical research. Partnerships between biotech, MedTech, and pharmaceutical companies are increasingly leveraging AI to speed up the discovery of new drugs [10]. AI's applications in pharmacy span clinical medication management [11], patient engagement, monitoring, communication [12], powering studies of prescription drug interaction, adverse reactions, and fueling data analytics for individual and public health [13]. Such technology shows promise in improving patient outcomes, reducing healthcare costs, and supporting equitable care [15].

The collaborative ventures between pharmacies, healthcare providers, administrators, and technology vendors offer a pathway to achieve personalized pharmacy care, through heightened organization, precision, efficiency, and efficacy [16].

Smartness may also be achieved through practice integration whereby key process improvement methods such as Kanban planning and Lean would add contextual intelligence and continuous feedback into improving a sustained value delivery of care [17]. The incorporation of data-driven scientific approaches is a central goal for pharmacists.

These approaches aid in planning treatments, preventing conditions, and understanding medication impacts, compliance, and side effects.

3.2 Smart pharmacy care ecosystem

Pharmacy care ecosystems are complex and require flawless execution of an integrated activity cycle to provision drugs, store, and track, dispense and deliver. Pharmacists are the principle actors in operating this cycle delivering value to patients with the outcome of wellbeing. Pharmacists usher the process of medication management from the point of prescription, refill management, advising patients, managing quality of the interaction and the product. On the other hand, patient engagement is key and require resource integration with a dynamic capability that must leverage technology in the cycle of value delivery throughout the complete sociotechnical ecosystem.

Smart pharmacies link the process from drug delivery, patient care, demand management, drug repository, and pharmaceutical manufacturers while maintaining regulatory compliances and meaningful integration of data exchange [18]. Advanced AI algorithms analyze various data, such as past sales, seasonal trends, and local health patterns, helping pharmacies predict medication demand. Automated reordering processes save time and maintain optimal stock levels, guaranteeing essential medications are consistently available.

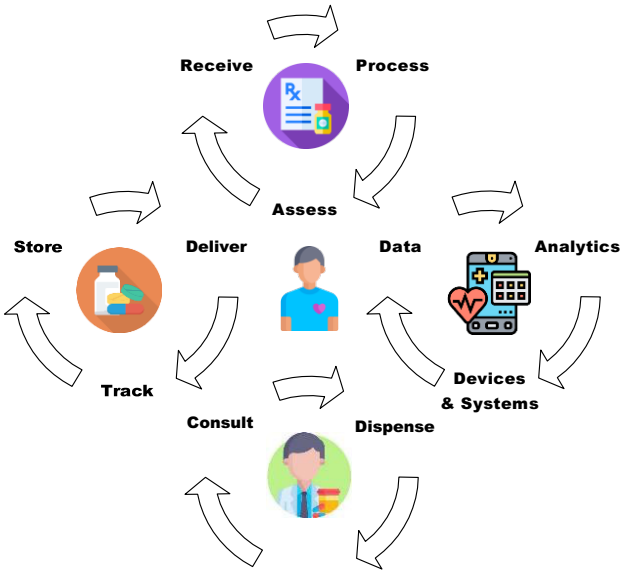

Fig. 1. Patient Centered Smart Pharmacy Ecosystem

Robotic dispensing pharmacies are one of the latest smart technologies that use technology AI, sensing, alerting and messaging, to decrease patient waiting time, reduce cost and errors, while maintaining efficient inventory levels [3]. These smart pharmacies can be quite efficient in dispensing more than 240 prescriptions per hour for instance [19]. Dispensing robots prepare the prescription medication as soon as the prescribing physician enters it into the system, allowing patients to receive it without having to wait once they

arrive at the pharmacy [20]. To reduce errors and improve effciency, these robots use real-time high-accuracy automatic counting algorithm logic, based on multiple computer vision technologies [21], compile automatic alerts about safety precautions and drug contraindications, monitoring patients, and/or reminding patients that they need to schedule regular checkups [2]. Some implementations monitor the distribution of prescribed drugs through internet of things (IoT) technology [22], in order to trace the chain of custody and restrict access to drugs for people who requested them, and away from the wrong hands, that could be risky and in some case, fatal. Other sensing systems are integrated to regulate temperature and humidity, issuing necessary alerts, warnings about drug expiration, and notifying the elderly of important drug information, a smart pharmacy prevents medication from spoiling [23].

Pharmacists, in a smart pharmacy practice, can provide comprehensive medication reviews and medication counseling to improve adherence and avoid potential risks of adverse events [24] through medication dosage and alternatives adjustments. By implementing AI powered rule based prescription support, pharmacies can assist patients with prescription refills, including reminders, online ordering [11], and prescription transfers between pharmacies [13]. For improved medication adherence, and lowering the risk of missed doses, patients receive medication reminders on their portals, wearables and smartphones, including dosage and timing of administration [14]. Direct patient communication can provide personalized support and increase patient's engagement in their health.

Portals and EHR platform applications extend smart capabilities to the home environment, offering patients information on the proper use and quality of their medications. The addition of electronic health record (EHR') access for the patient allows for a closed cycle of the care each patient receives in both inpatient and outpatient medical settings, providing a clear view of the patient's recent vitals, labs, and diagnoses that support the prescribing of a specific medication [25]. Patients with access to their EHRs leads to improved adherence to prescribed medications and better adherence to guidance from pharmacists [26]. This is particularly crucial in preventing lapses in effectiveness due to exposure to unfavorable conditions like temperature and humidity or expiration, which could render the treatment ineffective and diminish the potential benefits of the desired health outcomes [27]. These applications are also equipped to deliver timely alerts and valuable tips to patients concerning their medications and essential healthcare instructions, often including services like home drug delivery, remote medication order reviews, and patient education facilitated through phone or video calls with the pharmacist [28]. Some implementations claim timesaving benefits with an end-to-end prescription tracker that enables patients to have full view of where their prescription is from issue, to dispensing, through to collection.

The integration of intelligence from clinical guidelines powered by AI within the platform is mandatory in smart pharmacies, to reduce the extra time that the pharmacist spends reviewing these records, and conducting medication reconciliation. AI's ability to cross-reference dispensed medication against patients' health records provides an extra safeguard, promptly alerting pharmacists of potential drug interactions, contra-indications, or patient allergies, thus greatly enhancing patient safety [29].

Through smart, connected services, pharmacists evolve from actors dispensing drugs to value creators, through realizing positive patient health outcomes. Achieving desired therapeutic outcomes involves active patient engagement as co-creators of these outcomes. Smart pharmacies, by actively involving patients in the development and evaluation of pharmacy services, uphold the independence of research initiatives, aligning with guidelines that promote an unbiased and transparent approach to healthcare innovation. With active patient involvement in the development and evaluation of pharmacy services,

co-creation serves as a mechanism for the responsible selection and evaluation of proposals, integrating patient perspectives and preferences into the decision-making process [7].

3.3 Learning pharmacy ecosystem

At the macro level of public health, technology such as AI can assist healthcare providers (physicians, pharmacists and caregivers) with reconciling medication lists between different care settings, this improved coordination of care [13]. AI powered decision systems can assist healthcare providers with triaging patients based on their medication-related needs [11] and provide a data rich platform for screen patients for potential medication-related issues, such as non-adherence or drug interactions. Data analytics tools use AI to analyze patient data to identify trends and patterns in medication adherence, drug interactions, and adverse drug reactions [14]. These tools, track patient medication adherence and provide alerts to healthcare providers and patients if non-adherence is detected. To reduce risk of adverse drug interactions, large data models in AI based decision support systems collect and analyze drug interaction for screening and alerting [14]. These systems monitor patients for adverse drug reactions and alert healthcare providers and patients if any symptoms are detected [13]. Structured override reasons for drug-drug interaction alerts in electronic health records, assist practitioners in reducing adverse events and in adjusting medication dosages based on patient data [30]. Decision support systems integrated with EHRs, provide healthcare providers with real-time updates on patient medication management and treatment progress thus improving coordination of care with attending pharmacists, and informing, in real time, about selecting medications based on patient data and formulary requirements [31].

A smart "learning" pharmacy practice, for instance, continuously produces data- powered discoveries as a byproduct of pharmacists' interactions with patients during the patient care process (PPCP), information from patients about drug interactions, to support clinical and research findings [32], and information transformation for the purpose of equitable care [33]. Each interaction produces data that teams of data scientists and pharmacists combine with already-existing data to analyze. The newly acquired information is then applied to all upcoming contacts in the form of predictions and practical advice. Information Common Goods are produced by the cycle of knowledge transformation, helping to democratize information and make it accessible for long-term societal growth [34]. This leads to the non-optional transformation of the care ecosystem into a self- learning system using technology, data and analytics to maximize the value and equity of care [15].

3.4 Patient centric service ecosystem

Patients nowadays expect to pick up their prescriptions from pharmacies, shortly after their doctors prescribe them medications. A delay in prescription preparation tests the patience of the person needing the medicine, who may not wait for it, which reduces adherence to the medicine and most likely worsening their condition [35]. For those unable to visit the pharmacy directly, a mobile pharmacy service could be available, ensuring that medications are transported to patients' homes. Competitors have already proven they can provide two-day delivery and prescription fulfillment at home[‡]. Stakeholders should place a high premium on two patient archetypes: one that values convenience above all else and one that wants to maintain a connection with their pharmacist to assist their chronic diseases and

[‡] https://www.cnet.com/health/medical/best-prescription-delivery-services/

prescription requirements. Patients who prioritize convenience are starting to test out innovative, digital-only pharmacies that enable in-home pharmacy experiences.

This was especially true in light of the COVID-19 pandemic, which has resulted in an increase in the population of people who are homebound. On the other hand, those with multiple chronic conditions—are seeking higher-touch clinical support models in the home and digitally, as well as wanting guidance from a trusted pharmacist in managing multiple medications. These developments put pressure on the pharmacy ecosystem attempting to define their future pharmacy value propositions.

As smart pharmacies learn to accommodate different patient personalities and objectives, a dyadic interaction between human and machine is becoming more complicated. Artificial Intelligence, in particular, has created new opportunities to develop ecosystems around value exchange based on the design of intelligent services, along with their architecture of digital platforms and ecosystems, to enable a smooth evolutionary path and adaptability for human-centric collaborative systems and services [36]. AI platforms provide personalized medication management and support, tailored to each patient's unique needs, especially important in cases of chronic conditions. Patient can be aware of their medication regimens, including dosage, frequency, and timing of administration [12]. Such educational resources on medication management, disease management, and other health- related topics can improve patient knowledge and increased patient engagement [37]. By enabling patients to participate in decision-making and increasing their engagement in the delivery of health care services, wearable IoT device adoption in health care opens up new prospects and undermines the conventional and traditional style of health care service delivery [38].

These AI applications assist in monitoring people's health, warning them of potential dangers, and providing assistance when requested or needed. AI's capacity to extract insights from millions of patient clinical records holds the potential to improve population health by enabling more individualized, fine-grained diagnosis and treatment. Likewise, wearable device-derived personal environmental data collection offers promise for the advancement of tailored treatment. The advantages of this increases adherence of patients to medication regimens and improved coordination of care. Patients, through access to their EHR, can actively monitor various aspects of their health, such as the accuracy of listed medications. This not only fosters a more engaged patient-pharmacist relationship but also contributes to the overall improvement of healthcare processes [39].

Because of the interactional character of the environment and the ongoing adjustment that actors make to how they perceive value, each actor is constantly learning how to better serve and function in it [7]. Smart pharmacies have enaged a task force of mobile pharmacists who can visit patients wherever they are, tele-pharmacy technologies, or both, are necessary to provide these services at home [40]. With at-home care settings, patient experience extends beyond dyadic relationships and is mediated by a vast array of technologies and platforms [41]. Care at home is a result of interplay of actors in the healthcare ecosystem that adapt technology for patient empowerment with systemic changes that present new focus areas for stakeholders across the value chain [33]. Also, by treating patients at the right time and place and expanding access to high-quality healthcare for previously neglected or marginalized communities, at home technology is making healthcare proactive rather than reactive. This value-based care, delivered with the help of digital healthcare, is expected to improve health and produce noticeable outcomes.

4 Fundamental concepts

We continue with this conceptual argument, to present essential foundational premises to developing smart pharmacy ecosystems, grounded in a clear research design [44], analysed

through the lens of service dominant logic [5]. By framing our synthesis in the 5 axioms of SD Logic (Table 2), we summarize with key concepts for improving access to prescription-based care and transforming the pharmacy service while promoting a patient centered pharmacy service ecosystem.

Table 2: Key concepts for a patient centered pharmacy service ecosystem

Technology driving specialized skills (SDL Axiom 1)	**A smart "learning" pharmacy practice, powered by technology** The application of specialized skill(s) and knowledge as the fundamental unit of exchange - Utilizes big data, cloud computing, artificial intelligence (AI), Internet of Things (IoT), Robotics, block chain, and other cutting-edge digital technologies to provide information-based and intelligence-driven solutions.
Patient Centricity (SDL Axiom 2)	**Customized and tailored care practices** place patients at the center of the pharmacy practice. Improved medication adherence, and lowering the risk of missed doses, patients receive medication reminders on their portals, wearables and smartphones, including dosage and timing of administration. AI powered decision systems can reconcile medication lists between different care settings, this improved coordination of care. **Access, convenience and safety** - home deliveries
Resource integration (SDL Axiom 3)	**Information integration:** AI's ability to cross-reference dispensed medication against patients' health records provides an extra safeguard, promptly alerting pharmacists of potential drug interactions, contra-indications, or patient allergies, thus greatly enhancing patient safety. **Practice integration:** Smartness through practice integration whereby key process improvement methods such as Kanban planning and Lean would add contextual intelligence and continuous feedback into improving a sustained value delivery of care.
Patient Involvement (SDL Axiom 4)	**Patient engagement:** Portals and EHR platform applications extend smart capabilities to the home environment, offering patients information on the proper use and quality of their medications. **Direct patient communication** can provide personalized support and increase patient's engagement in their health. Actively involving patients in the development and evaluation of pharmacy services, uphold the independence of research initiatives, aligning with guidelines that promote an unbiased and transparent approach to healthcare innovation.
Ecosystems, Institutional arrangements (SDL Axiom 5)	**Ecosystem of institutions:** The collaborative ventures between pharmacies, healthcare providers, administrators, and technology vendors offer a pathway to achieve personalized pharmacy care, through heightened organization, precision, efficiency, and efficacy.

4.1 Technology driving specialized skills

Our first observation, in simple terms, looks at smart pharmacies as pharmacies that use technology to improve the quality and safety of their services. Technology driving specialized skills, leveraging big data, cloud computing, artificial intelligence (AI), Internet of Things (IoT), Robotics, block chain, and other cutting-edge digital technologies provide information-based and intelligence-driven solutions. Core pharmacy capabilities (such as the ability to sort and repackage medications, deliver directly to patients at home, and offer on-demand pharmacist consultations) powered by digital technology are likely necessary

for success in the future health ecosystem[§]. Analytics can provide critical insights to improve access, lower costs, monitor and support adherence and reduce medication errors, however, must be executed without the risk of unauthorized breach to sensitive patient data [42]. The integration of big data into smart healthcare systems has driven the adoption of electronic and mobile health (e/m-health), fostering cost reduction, increased efficiency, and healthcare equity by closing care gaps that have been created by current care models, and hence ensuring continuity of care [43].

4.2 Patient centricity

Second, we have seen in our search that « smartness » requires patient centricity that incorporates ways to achieve personalized pharmacy care on a large scale that is marked by increased organization, precision, efficiency, and efficacy. Customized and tailored care practices place patients at the center of the pharmacy practice. Value is measured as improved medication adherence, and lowering the risk of missed doses, patients receive medication reminders on their portals, wearables and smartphones, including dosage and timing of administration. Patient centered care encourages the active collaboration and shared decision-making between patients, families, and providers to design and manage a customized and comprehensive care plan. Smart pharmacies must focus on this centricity to realize value. Smartness via the power of technology and data driven decision making can guarrantee that the right service is provided at the right time and correctly, while information is shared fully and in a timely manner so that all actors can extract value from the interaction and patients reach a healthy outcome. For instance, AI powered decision systems can reconcile medication lists between different care settings, this improved coordination of care.

4.3 Resource integration

Third, the integrative capacity to process information in order to produce a service that is "intelligent" within its context, using cyber-physical systems and technology (IoT, AI, RFID, etc.), is a prerequisite for smartness. By establishing comprehensive linkages between patient data, pharmacists can collaboratively engage with patients to develop tailored medication plans and therefore enhance overall treatment outcomes. AI's ability to cross-reference dispensed medication against patients' health records provides an extra safeguard, promptly alerting pharmacists of potential drug interactions, contra-indications, or patient allergies, thus greatly enhancing patient safety. Outside the technology actors, patient centered care can also be achieved through practice integration whereby key process improvement methods such as Kanban planning and Lean would add contextual intelligence and continuous feedback into improving a sustained value delivery of care.

4.4 Patient involvement

Fourth, the collaborative partnership between patients and pharmacists establishes a responsible research environment based on data, where patients actively contribute insights and feedback, ensuring that their needs and concerns are effectively addressed. The accessibility of interconnected patient information encourages active patient participation, empowering them to contribute insights and identify potential areas for improvement within

[§] https://www.mckinsey.com/industries/healthcare/our-insights/pharmacys-new-era-in-the-home

their medication regimens. Portals and EHR platform applications extend smart capabilities to the home environment, offering patients information on the proper use and quality of their medications. Direct patient communication can provide personalized support and increase patient's engagement in their health. Patient enablement places their health information at their fingertips; they can stay informed about their healthcare plans and medication regimens. Moreover, incorporating interactive features within these applications empowers patients to communicate important information, seek clarifications, or pose questions directly to their pharmacists. This two-way communication channel fosters a collaborative and informed healthcare environment, where patients actively participate in their treatment plans and receive timely guidance, ultimately contributing to improved health outcomes. Furthermore, actively involving patients in the development and evaluation of pharmacy services, uphold the independence of research initiatives, aligning with guidelines that promote an unbiased and transparent approach to healthcare innovation.

4.5 Ecosystems and institutional arrangements

Finally, patients, providers, and pharmaceutical firms should not have to be concerned about the underlying complexity or the dependability of services. With help from machine learning algorithms and other technologies, drug companies, nonprofits and pharmacies can dive into key information about patient access, compliance, and other issues. The collaborative ventures between pharmacies, healthcare providers, administrators, and technology vendors offer a pathway to achieve personalized pharmacy care, through heightened organization, precision, efficiency, and efficacy.

5 Conclusion, limitation and future research

Grounded in SD logic, we present this topical paper to set the context of smartness in today's pharmacy ecosystem and pave the way for more focused research on value co- creation in a patient centered service ecosystem of pharma. Smart pharmacies can transform pharma from prescription-based care to patient centered care; with an emphasis to better serve the underserved and yield improve care outcomes. This shift stresses collaborative value co-creation through the seamless integration of technology and pharmaceutical services. By fostering a culture of collaboration and shared decision-making within the framework of smart pharmacy, a significant paradigm shifts from access to prescription based care to patient centered care.

Within the framework of smartness, our exploration calls for the incorporation of technology, knowledge, and skills essential for monitoring medication safety, adherence, and outcomes involving data, analytical tools, and operational technologies. This interconnected system operates through cyber-physical mechanisms, data connections, with a main role in converting raw data into actionable information. The entire process is embedded within a dynamic "learning" ecosystem, acknowledging the evolution in data capture efficiency with the transition from handwritten patient charts to electronic health records (EHR), open to review by the patient. The accessibility of data from different sources into extensive databases covering millions of patients globally mark a theoretical but transformative prospect. The refinement of analytical tools further strengthens the potential for identifying associations and patterns within data. This has the potential to lead to new disease definitions, insights into disease etiology, and relatively greater effectiveness of drug therapies. The refinement of analytical tools is examined within the methodological framework, with a focus on their potential to identify associations and patterns within data. This analytical capability holds promise for the emergence of new

disease definitions, insights into disease etiology, and improved effectiveness of drug therapies.

We therefore invite researchers to springboard from this study into further research. While we advance a framework grounded in the literature, we indicate that this work has limitations, inherent in a conceptual study methodology [45]. This warrants further research in empirical examinations and case studies to further inspect the phenomena explored in our work and develop a deeper understanding of the smartness concepts, and patient centric approaches in smart pharmacies and learning pharmacy ecosystems.

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