REVIEW ARTICLE

DATA-DRIVEN OPTIMIZATION IN PHARMACY OPERATIONS: A PRESCRIPTION FOR ENHANCED PATIENT CARE

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Abstract

The convergence of patient care and business efficiency in community pharmacies through a Comprehensive Datafication Approach marks a transformative journey toward enhanced healthcare services and operational effectiveness. The aim of this study was to examine diverse perspectives on datafication, AI, and emerging technologies in healthcare, with a particular focus on optimizing community pharmacy operations. The implementation of a Comprehensive Datafication Approach in community pharmacies significantly impacts overall operational efficiency and patient care outcomes. The strict criterion mandates studies to report outcomes related to patient care, business efficiency, or operational metrics, ensuring selected literature aligns cohesively with research objectives, providing a robust basis for exploring dimensions associated with optimizing community pharmacy operations through datafication. Drawing from multiple studies, our exploration encompasses the challenges and potentials inherent in the integration of digital technologies. As we delve into the optimization of community pharmacy operations through AI, these diverse perspectives contribute to a nuanced understanding of the challenges and opportunities in data-driven healthcare transformation. The integration of AI necessitates ethical considerations, inclusive practices, and a balance between optimization goals and individual rights, ensuring a holistic approach to healthcare datafication.
Keywords: Artificial intelligence, community pharmacies, datafication, operational efficiency, patient care.

INTRODUCTION

Electronic medical records are currently the best example of the digitalization of healthcare; nevertheless, their acceptance has not been evenly or favourably received. But when done right, digitization can lead to improved patient outcomes, more convenience, a possible reduction in healthcare expenditures, and possibly even higher levels of physician satisfaction[1]. Internet users in Germany anticipate that future developments in digital health care will impact both therapeutic and preventive care. The use of digital technologies for health was associated with higher household income (odds ratio [OR] 1.28, 95% CI 1.11-1.47)[2].

A growing number of aspects of peoples' life are being turned into data in the modern world of data-rich medicine in order to promote healthcare. However, there are significant obstacles to overcome and a great deal of time, money, and experience needed to identify the relevant data or information for clinical applications and customized decision-making. Big data presents new, frequently unsaid forms of work for patients, families, and healthcare professionals in addition to being a field with the potential for revolutionary clinical findings[3]. One of the biggest buzzwords in information and communication technologies (ICT) is big data. It can extract valuable information from unstructured data sets using algorithmic power, offering a plethora of creative ways to improve decision-making.

Applications include demand-driven energy supply, market and trend forecasting, detecting illicit financial transactions, predictive policing, population disease analysis for improved health research, cancer research, software-assisted medical diagnosis, and much more. Big data therefore has a great deal of potential to promote societal well-being[4]. The aim of this study was to examine diverse perspectives on datafication, AI, and emerging technologies in healthcare, with a particular focus on optimizing community pharmacy operations.

MATERIALS AND METHODS

Literature search and methodology

In conducting this narrative review, the research seeks to focus specifically on studies addressing the deployment or assessment of datafication methodologies within community pharmacy operations. The selection of relevant literature was based on the author's expertise in the field, and an extensive search was conducted using Google scholar to identify studies published since 1st January 2020 till data available in 20th January 2024. In our search, we used keywords related to "Medication Inventory", "Datafication", "Community Pharmacy", "Patient Records", "Sales and Revenue Data", "Prescription Fulfillment", "Adverse Reactions Reporting", "Customer Loyalty Programs", "Staff Productivity", Supplier Management"," Vendor Management", "Health Education Programs", "Health Education literacy", "Patient Satisfaction Survey", "Inventory Analysis", "Compliance Monitoring", "Pharmacist Interventions Record", "Medication Therapy Management (MTM) Programs", " Community Health Trends", "Digital Marketing Effectiveness", "Workflow Optimization", "Remote Patient Monitoring", and "Environmental Impact". This research aims to investigate the optimization of community pharmacy operations through the non-systematic implementation of datafication strategies, with a specific emphasis on the improvement of patient care and the enhancement of business efficiency. To ensure methodological rigor and relevance, a set of predefined inclusion criteria has been instituted for the identification and selection of pertinent literature. Included within the scope of consideration are studies of diverse formats, such as peer-reviewed journal articles, conference proceedings, books or book chapters, and reports emanating from reputable sources. The temporal constraint for inclusion spans the preceding decade, reflecting the imperative of contemporary insights into prevailing practices within community pharmacy settings. Language inclusivity extends to studies published in English or other languages germane to the research scope and available resources. While the research purview is global, allowances are made for the inclusion of studies conducted in specific countries or regions contingent upon their contextual relevance to the research objectives. Encompassed within the spectrum of acceptable study designs are empirical investigations, case studies, systematic reviews, meta-analyses, and observational studies. The target population for inclusion comprises stakeholders within community pharmacies, including pharmacists, pharmacy staff, and patients. Topics of interest include, but are not confined to, advanced medication inventory management, patient record digitization, nuanced analysis of sales and revenue data, optimization of prescription fulfilment processes, systematic reporting of adverse reactions, assessment of customer loyalty programs, evaluation of staff productivity metrics, strategic supplier and vendor management, impact assessment of health education programs, comprehensive analysis of patient satisfaction surveys, meticulous examination of inventory shrinkage, judicious monitoring of regulatory compliance, integration of telepharmacy services, meticulous recording of pharmacist interventions, appraisal of medication therapy management programs, scrutiny of community health trends, evaluation of digital marketing effectiveness, strategic workflow optimization initiatives, implementation of remote patient monitoring, and assessment of environmental impact. Integral to the inclusion criteria is the stipulation that studies report outcomes related to the augmentation of patient care, heightened business efficiency, or other salient operational metrics resultant from the instituted datafication approaches within community pharmacy settings. This stringent criterion ensures that the selected literature aligns cohesively with the overarching research objectives, providing a robust basis for the exploration of the multifaceted dimensions associated with optimizing community pharmacy operations through the prism of datafication.

RESULTS AND DISCUSSION

Data justice

In the study conducted by Anthony K J Smith *et al.*, involving 16 qualitative semi-structured interviews with key informants from stigmatized communities in Australia, distinct concerns and perceptions emerged regarding the implementation of electronic health records (EHRs). Individuals representing communities such as those living with HIV, sex workers, people who inject drugs, gay and bisexual men, and transgender and gender-diverse people expressed skepticism about the anticipated benefits of EHRs for their specific contexts. Privacy risks and fears of potential discrimination based on health data were prominent apprehensions. In response to these challenges, participants proposed meaningful consultation processes, robust consent mechanisms, and the necessity of addressing structural stigma within healthcare systems.

The study underscores the importance of tailoring digital health systems to the unique needs and concerns of stigmatized communities, advocating for inclusive practices and data justice[5]. Klaus Hoeyer *et al.*[6], discuss the evolving landscape of international health data sharing within the framework of the European Health Data Space initiative. Klaus Hoeyer critically examines the European Health Data Space (EHDS) initiative, highlighting its limited understanding of data integration by predominantly framing it as a legal and technical challenge. Hoeyer proposes a more comprehensive conceptualization of "data space", introducing three formative (promises, work, and users) and four experiential (right, true, present, and valuable) dimensions. He argues that data spaces are sociotechnical enactments, challenging the notion that they can be strictly controlled through legal and technical means. This perspective calls for a paradigm shift in research towards socially informed studies of data dynamics, fostering more realistic ambitions and better-informed legislation. The study also addresses

the tension between citizen empowerment and potential loss of control over personal health data, emphasizing the experiential aspect of this challenge. Hoeyer concludes with a profound reflection on the transformative impact of data infrastructures on individuals' lives, noting that as we build data infrastructures, they, in turn, shape us, leading to a life suspended in data space[6].

AI in healthcare: Humanistic perspectives

Ostherr explores AI's impact on healthcare, emphasizing medical humanities' role. Four key areas include data regulation, social determinants, narrative medicine, and tech-mediated care. The study underscores privacy, bias, and transparency concerns. Ostherr calls for humanists to contribute, urging further research on AI's influence, especially in disability, genomics, and diverse medical contexts[7]. As we explore the potential of AI in optimizing community pharmacy operations, it is insightful to draw parallels with advancements in healthcare, particularly in the realm of patient-generated health data (PGHD). Zhaoyuan Su's study, "What is Your Envisioned Future?": Toward Human-AI Enrichment in Data Work of Asthma Care," investigates into the envisioning process of healthcare providers regarding the integration of AI in the analysis of PGHD for asthma care[8]. The concept of human-AI enrichment, where humans and AI mutually enhance each other's work over time could explain the future of AI in community pharmacies, this collaborative and enriching relationship between humans and AI aligns with the universal goal of improving patient care and operational efficiency. The work of Jon Aaen on the dark side of data ecosystems sheds light on potential risks and obstacles associated with data analytics activities, which are important to consider as we dive deeper into the integration of AI for optimizing community pharmacy operations. Aaen provides insightful information about the intricacies of data reuse and its unexpected ramifications through their longitudinal research of the DAMD project in the Danish healthcare system. Aaen's proposed Data Analytics Ecosystem Model, provides a conceptual framework that could integrate this model into the exploration of AI in community pharmacies enriches the understanding of the potential pitfalls and challenges inherent in data analytics for healthcare optimization[9]. Datafication and governance models have larger implications that must be considered as we investigate the integration of AI for optimizing community pharmacy operations. Anne S. Y. Cheung's review on China's Social Credit System (SCS) introduces the concept of the "data state", a governance model where comprehensive monitoring, evaluation, and control are facilitated through datafication[10]. Community pharmacies using AI-driven optimization may need to address ethical questions about patient autonomy, permission, and privacy. Understanding governance models such as the data state encourages a critical analysis of the application of AI and data-driven efforts in the healthcare industry, calling for a balance between individual rights and optimization aims. It's important to exercise caution when integrating AI into community pharmacies in light of Cheung's concern about the formation of an unstoppable and irreversible ecosystem for the data state. Protecting patient autonomy and privacy requires us to be on the lookout for unforeseen effects and making sure that optimization efforts are in line with ethical standards.

Social media datafication

Bruno Campanella's work sheds light on the datafied spaces of social media platforms, emphasizing their role in organizing media practices and creating economic value. Understanding the working logics of these platforms is crucial as we examine the implications of datafication for community pharmacies. The review by Campanella emphasizes how critical it is to understand the processes at work in datafied environments, especially on social media[11]. A comparison with the dynamics of recognition in these platforms can be made as we investigate the use of AI to optimize digital and non-digital pharmacy operations especially over the counter (OTC) medicine that does not need a prescription. Platform choices on what and when to display to users reflect the opportunities and difficulties associated with gathering and displaying pertinent data in a pharmaceutical setting.

Gamification tactics and staff productivity

Gianluca Iazzolino and Amarilli Varesio's study on migrant food delivery couriers provides insightful information on the complex dynamics of algorithmic control and worker agency as we investigate the optimization of community pharmacy operations through AI. Comparing the issues of the gig economy to the setting of community pharmacy employee productivity reveals commonalities[12]. Iazzolino and Varesio highlight the use of gamification by food delivery platforms to shape couriers as entrepreneurial and productive individuals. This aligns with the overarching concept of algorithmic control, which is similarly observed in the data-driven transformation of community pharmacy operations. Examining how gamification contributes to the formation of workers' subjectivity provides insight into the intricate relationship between agency and control within labor contexts. Within community pharmacies, the pursuit of optimization may unintentionally shape the subjectivity of staff through the process of datafication. Much like gig workers, pharmacy staff may find themselves adhering to productivity expectations influenced by algorithmic systems. It is essential to scrutinize the gap between the envisioned entrepreneurial subjectivity and the real experiences of workers to comprehend the potential effects on staff morale and well-being. Iazzolino and Varesio identify antagonist geographies where legal advice and views on platform work are exchanged, overlapping with forms of labor activism. Similarly, in community pharmacies, the spaces and times where staff interact and share experiences of datafication and productivity expectations may serve as platforms for emerging forms of labour activism or solidarity-building. The concluding thoughts on transforming rule-bending ingenuity into drivers of social and labor justice align with the broader question of how staff productivity challenges in community

pharmacies can be addressed. While unions and grassroots movements grapple with regulatory changes, the question arises: How can the insubordination or resistance embedded in staff networks contribute to a transformation that prioritizes worker well-being and justice in the context of datafication?

Dataveillance

In the context of community pharmacies, where wearable's might play a role, the need for ethical scrutiny aligns with the call for a better understanding of the underlying political economy of data exchange. Community pharmacies could incorporate various types of wearables to enhance healthcare services and improve patient outcomes. Wearables that track vital signs such as heart rate, blood pressure, and sleep patterns can provide valuable data for pharmacists to assess a patient's overall health. Pharmacies can monitor adherence and send alerts or interventions as needed. Integrated with wearables, these apps can send notifications to remind patients to take their medications or refill prescriptions. Wearables that monitor blood glucose levels in real-time can be beneficial for diabetic patients. Pharmacists can use this data to provide personalized advice on medication management and lifestyle changes. Devices capable of recording electrocardiograms (ECGs) can help identify irregular heart rhythms. Pharmacists can use this information to collaborate with healthcare providers for better patient care. Wearables equipped with temperature sensors can assist in monitoring fevers or detecting early signs of infection. Clothing with embedded sensors can monitor various health metrics, such as body temperature and posture. This could be particularly useful for assessing musculoskeletal issues. Pharmacists could use smart glasses for augmented reality consultations, helping them provide more detailed information to patients about their medications, potential side effects, and proper usage. Wearables that measure stress levels or track activity patterns indicative of mental health can help pharmacists identify patients who may need additional support or counseling. Kristin Bergtora Sandvik's investigation of children's digital bodies through wearables in aid raises ethical issues that are relevant to the healthcare sector as we dive into the optimization of community pharmacy operations using AI. Sandvik's work underscores the rise of dataveillance as a central practice in aid, emphasizing the creation of "digital bodies". Drawing parallels, the use of wearables in community pharmacy operations for data collection echoes the ethical concerns related to surveillance, data flow, and the implications of expanding technological capacity. Sandvik's concern about the deeply unequal relationship between innovators and recipients, leading to increased dataveillance, raises questions about the moral economy rationale in healthcare datafication[13].

Blockchain and supply chain management

As we explore the optimization of community pharmacy operations through AI, Jillian Crandall's investigation into the equity of tokenized systems, particularly in land and housing, prompts critical reflections on the ethical dimensions of datafication. Concerns concerning the socio-technical ramifications

of such systems are brought up by Crandall's examination of blockchain's function in tokenizing real estate and housing. Comparably, the use of AI in healthcare raises questions about equity, exclusion, and the possible financialization of patient data. This is especially true when it comes to patient data management. This corresponds with issues in artificial intelligence (AI) within healthcare, where considerations about accessibility, ownership of data, and the effects on vulnerable groups take center stage. There are challenges related to intentional complexity and navigating regulatory hurdles presented by advancing technologies. In order to ensure that the advantages of AI are shared fairly, it is imperative that we actively oppose any practices that could misuse patient data as we implement it in community pharmacies[14]. Maral Sotoudehnia et al., empirical study on Canadian policymakers draw on entrepreneurial discourses of digital leadership, transparent data management and digital empowerment to justify their plans in 'making block chain real'. These regulatory discourses promote datafication through block chains as a way to improve government services[15].

Datafication abundance

The study by Isabelle Aimé et al., titled as "The brand, the persona and the algorithm: How datafication is reconfiguring marketing work" explores the transformative impact of datafication on marketing practices. Employing sociomateriality and affordance theory, it reveals challenges companies face in adapting to data abundance. As we explore the enhancement of community pharmacy operations via a thorough datafication strategy, it becomes crucial to acknowledge the wider consequences of datafication spanning various sectors[16]. Community pharmacies face complexities in tracking and interpreting patient data, which may come from various sources and systems, potentially hindering a comprehensive understanding of patient needs and preferences.

Literacy

In the contemporary era of digitization, proficiency in digital literacy is imperative for fostering responsible citizenship. Since the concluding years of the 20th century, it has been acknowledged as an indispensable element in the pedagogical landscape, spanning diverse educational levels within the domains of open, remote, and digital education[17]. For those receiving treatment, health literacy is a crucial competency. for literacy-addressing measures are not applied for disseminating health information, individuals with low literacy risk inequities in their care and health outcomes[18]. The ability of people to search for, comprehend, analyze, and evaluate health information on the internet or in other digital sources and share the information with others to help make decisions related to their health and solve health problems, both individually and collectively, is known as digital health literacy (DHL), which is an extension of e Health literacy[19,20].

Carmi and Yates conduct a3-year empirical project research project on data literacies in United Kingdom and observed that citizens remain unaware of key aspects of the digital ecosystem, which exacerbate the

power imbalance between big technology (data processors) companies and citizens (data subjects)[21].

Compliance Monitoring

With data mining-assisted decision-making processes, big data introduces a new culture of decision-making. Meta-data is one of this mechanism's main sources, and it helps to set up the right circumstances for mass monitoring surveillance. The belief in these systems sparks debates about big data divide, big data arrogance, and big data utilization as a social classification tool[22]. Jaeho Kang's research, titled "The Media Spectacle of a Techno-City: COVID-19 and the South Korean Experience of the State of Emergency", examines the heightened surveillance measures during the COVID-19 pandemic and the swift process of datafication in society. This essay critically examines the distinctive approach of the South Korean government in managing COVID-19, focusing on the state of emergency. It highlights that the Western media largely attributes South Korea's successful handling of the pandemic to the effective utilization of information and communication technologies and Confucian collectivism. These seemingly contradictory elements are portrayed as not incompatible but rather coexisting under the framework of techno-Orientalism[23].

CONCLUSIONS

In conclusion, datafication plays a crucial role in optimizing Community Pharmacy Operations in several ways. One such avenue is Medication Inventory Management, which involves a thorough analysis and tracking of data related to stocked medications, encompassing critical details such as quantity, expiration dates, and sales trends. The digitization and organization of Patient Records aim to improve record-keeping and enable personalized care by incorporating information on patient details, prescriptions, and medication history. Monitoring Sales and Revenue Data is of paramount importance, serving to identify popular products, assess profitability, and optimize inventory management strategies. The tracking of prescription fulfillment Times contributes to enhanced efficiency and improved customer service. To ensure patient safety, the implementation of adverse reactions reporting systems is vital, enabling the collection and analysis of data on reported adverse reactions. Leveraging data on customer purchasing habits becomes imperative for enhancing the effectiveness of Customer Loyalty Programs. Concurrently, monitoring staff productivity facilitates optimal resource allocation and efficiency. Supplier and vendor management involve organizing data to streamline procurement processes. The engagement and outcomes of Health Education Programs are tracked for effectiveness assessment, drawing valuable insights from Patient Satisfaction Surveys for improvement. Inventory Shrinkage Analysis utilizes data to identify and mitigate losses due to theft or expiration. Compliance Monitoring is integral for ensuring adherence to regulatory requirements by documenting compliance data. If applicable, data from

Telepharmacy Services, including usage, patient feedback, and outcomes, is collected and analyzed. Pharmacist Interventions are recorded and analyzed, providing insights into the impact of their expertise. The effectiveness of Medication Therapy Management (MTM) Programs is evaluated through data on patient outcomes, adherence, and cost savings. Community Health Trends are monitored and analyzed, tailoring services and recommendations accordingly. Digital Marketing Effectiveness is assessed to optimize community outreach. Workflow Optimization utilizes data to identify and improve efficiency bottlenecks. If applicable, data from Remote Patient Monitoring devices is collected and analyzed for proactive healthcare management. Finally, environmental impact is tracked and minimized through initiatives such as waste reduction and energy efficiency.

AUTHOR'S CONTRIBUTION

Aslam MS: conceptualized and designed the study, literature search, data analysis, manuscript drafting.

DATA AVAILABILITY

Upon request, the accompanying author can furnish the empirical data used to bolster the findings of the study.

CONFLICT OF INTEREST

None to declare.

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