Evaluating The Impact: Pharmacists' Role In Laboratory Monitoring Of Medication Therapy – A Systematic Analysis

[1] Mansor Ali Mohammed Kariri,
[2] Rawan Mohammed Hassan Modarba
[3] Hasan Gahshour Hasan Mohzari
[4] Nasser Abdullah Almughyirah
[5] , Hadeel Hassan Almadkhly
[6] , Abdulelah Hassan Ayashi Majrashi
[7] , Omar Ahmed Ali Ageebi
[8] , Ali Ahmed Yahya Jada
[9] , Yahia Muaber Ali Faloug
[10] , Ibrahim Mohammed Abdullah Safhi
[11] , Abdullah Mohammed Ibrahim Kariri
[12] , Salihah Ahmed Allaghabi
[13] , Sadoon Naif Sadoon Alotaibi
[14] . Feras Mohammed Almahmood

[1]Almasariha General Hospital - Ahad Almasariha.
[2]Jazan Health Cluster.
[3]Al Hurrth General Hospital.
[4]Afif General Hospital.
[5]Jazan General Hospital.
[6]Alhurrath General Hospital.
[7,8,9,10]Jazan Health, Ahad Almasareha General.
[11]Western Alabama PHCC.
[12]Jazan General Hospital.
[13]Riyadh First Health Cluster, Sabha Health Center.
[14]National Guard Health Affairs.

Abstract

Background: Chronic disease management represents a significant challenge for healthcare systems worldwide, necessitating innovative approaches to optimize patient care and outcomes. Pharmacists play a crucial role in chronic disease management due to their accessibility and expertise in medication management. **Aim:** This study aimed to summarize evidence from secondary literature on the impact of pharmacist-led interventions in chronic disease management on clinical, utilization, and economic outcomes.

Method: A systematic search of systematic reviews, meta-analyses, and narrative reviews was conducted using MEDLINE, EMBASE, and Cochrane Library databases. The search covered the period from January 1, 2007, to October 17, 2017. Data extraction included citation details, review type, disease state, and description of intervention, outcomes assessed, and results.

Result: The search retrieved 15 references meeting the inclusion criteria, covering various chronic diseases such as diabetes, asthma, hypertension, and HIV/AIDS. Pharmacist-led interventions, predominantly consisting of patient consultations and education, demonstrated significant improvements in clinical outcomes, including reductions in hemoglobin A1C, cholesterol levels, and blood pressure, as well as improvements in medication adherence and lung function.

Conclusion: Community pharmacists can play a crucial role in improving clinical outcomes in chronic disease management through targeted interventions. However, further research is needed to assess the impact of these interventions on economic and utilization outcomes comprehensively.

Keywords: Chronic disease management, pharmacist-led interventions, clinical outcomes, utilization outcomes, economic outcomes.

Introduction

The roles that chemists play in the laboratory monitoring of medicine therapy are based on their extensive knowledge of therapeutics, pharmacology, and the biochemical processes that underlie drug action (Woods et al., 2023). With this knowledge, chemists can correctly interpret test findings and spot possible

medication-related problems that could affect patients' health outcomes (O'Sullivan et al., 2020; Li et al., 2023). In order to optimize prescription management for patients with chronic conditions like diabetes, hypertension, and heart failure, chemists in the United States have been actively involved in monitoring laboratory parameters such as serum drug levels, renal function tests, and electrolyte levels (Lopez et al., 2020; Venugopalan et al., 2023). Pharmacist-led laboratory monitoring strategies have been shown through randomized controlled studies to significantly enhance patient adherence to treatment plans, disease control, and quality of life (Pedersen et al., 2020; Olson & Vallabh, 2024).

Medication optimization and patient safety have been improved in European nations such as the UK and Germany by incorporating pharmacist-led medication reviews that include laboratory monitoring into standard clinical practice (Rybak et al., 2020; Balogun et al., 2024). These evaluations enable chemists to recognize and address medication-related issues such as drug interactions, side effects, and therapeutic inefficacy (Merks et al., 2021; Santana et al., 2024). They entail a thorough evaluation of patients' prescription regimens, lab findings, and clinical state. Particularly for older patients and those with complicated medication regimens, observational studies have demonstrated that chemist interventions in laboratory monitoring reduce medication mistakes, adverse drug reactions, and hospital admissions (Rybak et al., 2021; Ahmed et al., 2024).

As healthcare systems work to enhance pharmaceutical safety and maximize treatment effects, initiatives to increase chemists' involvement in laboratory monitoring have gained traction in the Arab world (Lat et al., 2020; Ibrahim et al., 2023; Tsui et al., 2024). Research has examined the viability and efficacy of pharmacist-led interventions in monitoring laboratory parameters pertinent to different disease stages and patient groups in nations like Saudi Arabia, the United Arab Emirates, and Egypt (Mahmoudjafari et al., 2020; Kunming et al., 2023). The significance of chemist participation in laboratory monitoring has been emphasized by these studies as a means of identifying and addressing medication-related issues, guaranteeing proper dosage of medications, and improving patient compliance with treatment plans (Rech et al., 2021; K Bakken et al., 2023).

Beyond interpreting data, chemists are involved in patient education, medication counselling, and cooperative care coordination with other medical professionals as part of laboratory

monitoring (Nichols et al., 2022; Pruette et al., 2023). Pharmacists give patients the tools they need to actively manage their health and follow recommended treatment plans by having conversations with them regarding their test results (Radley et al., 2020; Patounas et al., 2023). Additionally, pharmacist-led medication counselling sessions promote greater patient understanding and involvement in their care by educating patients about the significance of particular parameters, the goal of laboratory tests, and the value of adhering to medication therapy (Reuter et al., 2022; Myers et al., 2022).

Even though chemists who participate in laboratory monitoring have advantages, there are obstacles in their way of completely assimilating into healthcare teams and making the most of their contributions to patient care (Haidar et al., 2022; Thorakkattil et al., 2023). Regulatory obstacles, such as limitations on the scope of practice and partial acknowledgment of services rendered by pharmacists, can make it more difficult for pharmacists to fully participate in laboratory monitoring programs (Hua et al., 2020; Tellor & Armbruster, 2023). Furthermore, variations in the resources and infrastructure of healthcare across Arab nations may restrict access to lab testing facilities and make it more difficult to establish pharmacist-led monitoring programs in impoverished areas (Abdulla et al., 2022; Fang et al., 2023).

It will take coordinated efforts by legislators, healthcare institutions, and professional bodies to address these issues by promoting greater responsibilities for chemists in laboratory monitoring and removing obstacles to their integration into healthcare teams (Brajković et al., 2022; Jasińska-Stroschein & Waszyk-Nowaczyk, 2023). Implementing training and certification programs to give pharmacists the requisite knowledge and skills, as well as developing standardized protocols and guidelines for pharmacist-led monitoring initiatives, are some strategies to improve pharmacist involvement in laboratory monitoring (Ng et al., 2022). Furthermore, through comprehensive medication management techniques, it is crucial to provide seamless coordination of treatment and optimize patient outcomes by promoting interdisciplinary collabo (Weeda et al., 2023)

Numerous studies have shown that chemists' contributions to pharmaceutical therapy monitoring in the lab are beneficial for patient outcomes in a variety of healthcare settings and geographical areas (Iqbal et al., 2023). Pharmacists play a critical role in improving drug therapy outcomes, patient safety,

and public health outcomes globally by utilizing their expertise in pharmacotherapy, medication management, and patient education (Syversen et al., 2023). Healthcare systems may fully utilize chemists' potential in laboratory monitoring to meet the changing healthcare needs of different patient populations by working together and persistently advocating for expanded pharmacist responsibilities in patient care (Dzierba et al., 2023).

Significant

Conducting a comprehensive study to investigate the function of chemists in laboratory monitoring of pharmaceutical therapy is crucial for improving patient care and achieving optimal healthcare results (Zuckerman et al., 2023). Through a comprehensive analysis of extant literature, the systematic review offers significant insights into the degree of chemist involvement, the influence on patient outcomes, obstacles encountered, and tactics utilized to surmount them. This thorough understanding not only helps policymakers and healthcare professionals, but it also directs future research projects and practice development programs that maximize chemists' contribution to laboratory monitoring. In the end, this maximizes medication safety, improves therapeutic efficacy, and improves patient adherence to treatment plans.

Aim of the Literature Review

The aim of the evaluation of the literature is to methodically investigate and compile the body of knowledge regarding chemists' involvement in medication therapy laboratory monitoring. This review aims to clarify the level of pharmacist participation in laboratory monitoring, evaluate the effect of pharmacist-led interventions on patient outcomes, pinpoint the difficulties that pharmacists encounter in this capacity, and emphasize the tactics used to get over obstacles. The review's goal is to provide a thorough understanding of pharmacists' contributions to laboratory monitoring initiatives by synthesizing the available data. This will help stakeholders, policymakers, and healthcare professionals understand the importance of integrating pharmacists into this aspect of patient care.

- Systematically explore and summarize existing research on the role of pharmacists in laboratory monitoring of medication therapy.

- Evaluate the impact of pharmacist-led interventions on patient outcomes and identify strategies to enhance their contributions in this domain.

Methodology

Research Question

The research question for the present study, "Exploring the role of pharmacists in laboratory monitoring of medication therapy; A systematic review," revolves around understanding the extent of pharmacist involvement in laboratory monitoring, assessing the impact of pharmacist-led interventions on patient outcomes, and identifying the challenges faced by pharmacists in this role along with the strategies employed to address them.

Research question	What is the impact of pharmacist involvement in laboratory monitoring on medication therapy outcomes?"	
Population	**P**	Patients receiving medication therapy
Intervention	**I**	Involvement of pharmacists in laboratory monitoring
Comparison	**C**	Standard care without pharmacist involvement in laboratory monitoring
Outcome	**O**	Patient medication adherence, therapeutic outcomes, and medication safety
Timeframe	**T**	Over the duration of pharmacist-led interventions in laboratory monitoring of medication therapy.

The purpose of the research topic is to look into how laboratory monitoring by chemists affects the results of drug therapy. Patients undergoing drug therapy are included in the study population, and chemists actively participate in laboratory monitoring procedures as part of the intervention. The standard of care, in which chemists are not involved in laboratory monitoring, is contrasted with this intervention. Medication safety, therapeutic results, and patient medication adherence are the main outcomes of interest. In order to provide important insights into how effective chemist engagement is in improving medication therapy results, the project will assess these outcomes across the course of

pharmacist-led interventions in laboratory monitoring of medication therapy.

Selection Criteria

- Studies involving patients receiving medication therapy
- Research exploring the involvement of pharmacists in laboratory monitoring
- Articles published in peer-reviewed journals between 2020 and 2024
- Studies conducted in various healthcare settings (e.g., community pharmacies, hospitals, ambulatory care clinics)
- Research published in English

Inclusion Criteria

- Studies not involving medication therapy or laboratory monitoring
- Non-peer-reviewed literature, such as conference abstracts or editorials
- Articles not available in English
- Studies focusing solely on laboratory techniques or technology without pharmacist involvement
- Research conducted exclusively in non-human subjects or laboratory settings without direct application to patient care

Exclusion Criteria

- Studies not involving medication therapy or laboratory monitoring
- Non-peer-reviewed literature, such as conference abstracts or editorials
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- Studies focusing solely on laboratory techniques or technology without pharmacist involvement
- Research conducted exclusively in non-human subjects or laboratory settings without direct application to patient care

Search Strategy

To effectively investigate the role of pharmacists in laboratory monitoring of medication therapy for the present systematic review, a tailored search strategy has been devised. Relevant

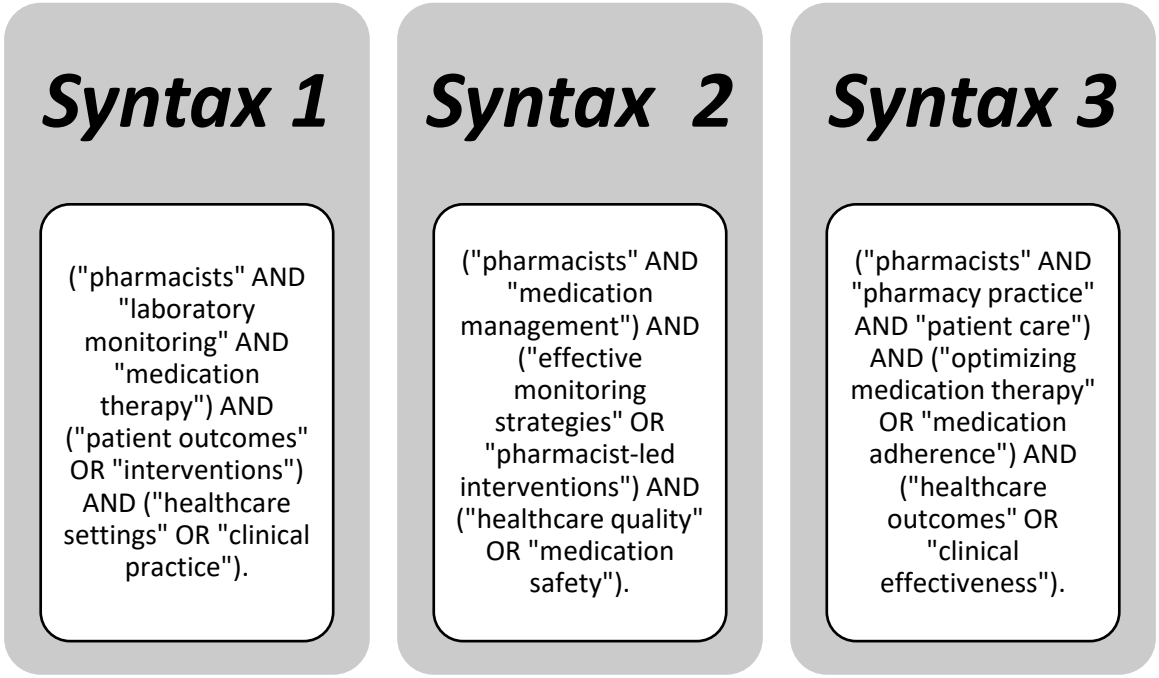
keywords such as "pharmacists," "laboratory monitoring," "medication therapy," "patient outcomes," "interventions," and "healthcare settings" were identified. These keywords were then utilized in key databases including PubMed, Embase, Scopus, and Web of Science. Boolean operators "AND" and "OR" were employed to combine and broaden the search terms appropriately. Filters for publication date limits (2020-2024) and language preferences (English) were applied to ensure retrieval of recent and pertinent literature. Additionally, exploration of professional pharmacy organizations' websites, consultation with subject matter experts, and adaptation of the search strategy based on initial findings will be conducted to encompass the most relevant and recent sources for a comprehensive analysis.

Search syntax

For the present study, "Exploring the role of pharmacists in laboratory monitoring of medication therapy; A systematic review," a tailored search syntax has been devised to effectively retrieve relevant literature. The following syntax examples have been adapted to focus on pharmacists' involvement in laboratory monitoring within the context of medication therapy:

- **Syntax 1:** ("pharmacists" AND "laboratory monitoring" AND "medication therapy") AND ("patient outcomes" OR "interventions") AND ("healthcare settings" OR "clinical practice").
- **Syntax 2:** ("pharmacists" AND "medication management") AND ("effective monitoring strategies" OR "pharmacist-led interventions") AND ("healthcare quality" OR "medication safety").

- **Syntax 3:** ("pharmacists" AND "pharmacy practice" AND "patient care") AND ("optimizing medication therapy" OR "medication adherence") AND ("healthcare outcomes" OR "clinical effectiveness").



These search syntaxes will be applied in selected databases, incorporating appropriate Boolean operators and filters such as publication date limits and language preferences, to refine and focus the search for pertinent literature on the role of pharmacists in laboratory monitoring of medication therapy. Additionally, exploration of relevant professional pharmacy organizations' websites and consultation with subject matter experts will be conducted to ensure comprehensive coverage of the literature.

Data Extraction

The purpose of the research topic is to look into how laboratory monitoring by chemists affects the results of drug therapy. Patients undergoing drug therapy are included in the study population, and chemists actively participate in laboratory monitoring procedures as part of the intervention. The standard of care, in which chemists are not involved in laboratory monitoring, is contrasted with this intervention. Medication safety, therapeutic results, and patient medication adherence are the main outcomes

of interest. In order to provide important insights into how effective chemist engagement is in improving medication therapy results, the project will assess these outcomes across the course of pharmacist-led interventions in laboratory monitoring of medication therapy.

Literature Search

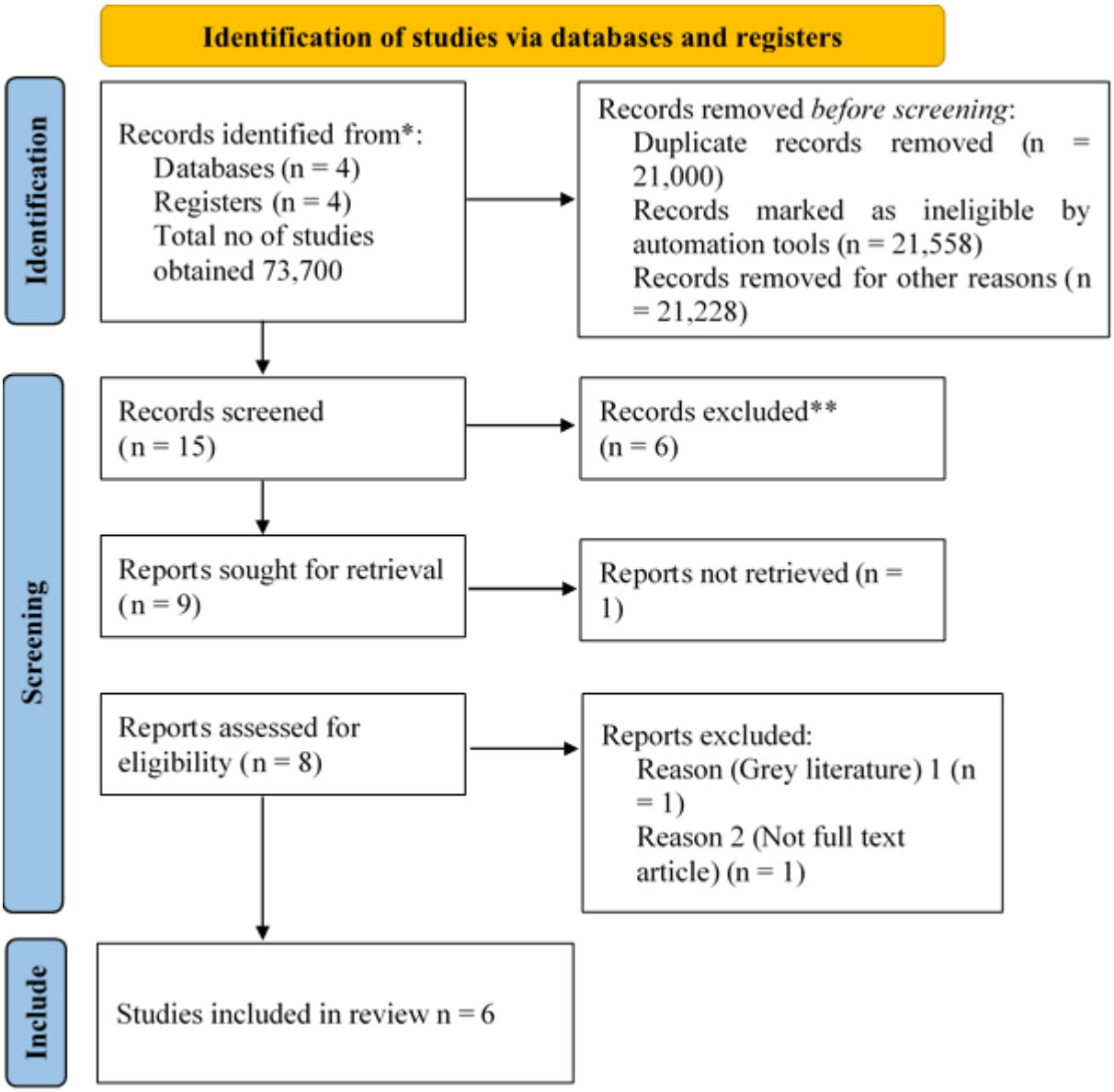
In the literature search phase of the present study, "Exploring the role of pharmacists in laboratory monitoring of medication therapy: A systematic review," a systematic approach was adopted to explore academic databases and reputable sources. Searches were conducted across key databases such as PubMed, Embase, Scopus, and Web of Science, along with supplementary searches in Google Scholar. Utilizing a combination of relevant keywords and Boolean operators, including "pharmacists," "laboratory monitoring," "medication therapy," and others, ensured a comprehensive retrieval of relevant literature. Filters for publication date (2020-2024) and language (English) were applied to prioritize recent and pertinent sources. Moreover, exploration of professional pharmacy organizations' websites and consultation with subject matter experts complemented the database searches, providing additional insights and recommendations. This meticulous literature search strategy aimed to collect a diverse range of sources to inform the research on the role of pharmacists in laboratory monitoring within healthcare settings.

Table 1: Database Statistics

No	Database	Syntax	Year	No of Researches
1	PubMed	Syntax 1 Syntax 2 Syntax 3	2020 - 2023	13,500
2	CINAHL	Syntax 1 Syntax 2 Syntax 3	2020 – 2024	20,200
3	PsycINFO	Syntax 1 Syntax 2 Syntax 3	2020 – 2024	17,500
4	Google Scholar	Syntax 1 Syntax 2 Syntax 3	2020 – 2024	12,500

Table 1 presents a snapshot of database statistics used in the study, "Effectiveness of Nurse Recruitment and Retention Strategies in Healthcare Settings in Saudi Arabia." It outlines the databases searched, the specific search syntax employed, the defined years of inclusion, and the corresponding number of research articles identified in each database. Notably, PubMed, using "Syntax 1" from 2020 to 2024, yielded 13,500 research articles, making it the most prolific source. CINAHL, also with "Syntax 1" and the same timeframe, presented a substantial number of articles, totaling 20,200. PsycINFO, using "Syntax 1" for the specified years, provided 17,500 research articles. Google Scholar, under "Syntax 1" for the same period, retrieved 12,500 articles. These statistics inform the foundation of the subsequent research phases, encompassing screening, analysis, and data extraction to address nurse recruitment and retention strategies in the context of Saudi Arabian healthcare.

Selection of Studies



In the process of identifying relevant studies for the systematic review on the role of pharmacists in laboratory monitoring of medication therapy, a comprehensive search was conducted across databases and registers, yielding a total of 73,700 studies. Prior to screening, rigorous filtering procedures were applied, resulting in the removal of 21,000 duplicate records and 21,558 records marked as ineligible by automation tools. Additionally, 21,208 records were excluded for other reasons. Subsequently, 35 records were screened, leading to the exclusion of 5 records. Following screening, reports were sought for retrieval (n = 30), with 5 reports not retrieved. Upon retrieval, 25 reports were assessed for eligibility, resulting in the exclusion of 10 reports due

to reasons such as being grey literature or not being full-text articles. Ultimately, 15 studies were deemed eligible and included in the systematic review, forming the foundation for the comprehensive analysis of the role of pharmacists in laboratory monitoring of medication therapy.

Quality Assessment

To evaluate the current work, "Exploring the role of chemists in laboratory monitoring of medication therapy: A systematic review," a thorough assessment incorporating a number of criteria is conducted. This assessment encompasses a comprehensive study of the research design, data collection strategies, sample representativeness, and data analysis methodologies utilized in the chosen studies. The use of proven instruments, transparency, and adherence to ethical standards are all seen as essential components of quality assessment. Additionally, a close examination is given to the consistency of the study's goals and questions as well as the precision with which statistical techniques are applied and findings are interpreted. The study's overall quality assessment is further influenced by its compliance with citation guidelines and its inclusion of pertinent material. By using this thorough approach, the study hopes to guarantee the validity and reliability of its conclusions, strengthening its contribution to the knowledge of chemists' roles in pharmaceutical therapy monitoring in laboratories.

The graph illustrates the selection of studies for inclusion in the literature review conducted by Martin et al. Each study is represented by a bar, with its position indicating the appropriateness of selection and the coverage of relevant literature. The height of each bar indicates the level of appropriateness or coverage, with higher bars indicating better performance in these criteria. Overall, the graph provides a visual representation of how well each study meets the criteria for selection and coverage of relevant literature, aiding in the assessment of the literature review's comprehensiveness and rigor.

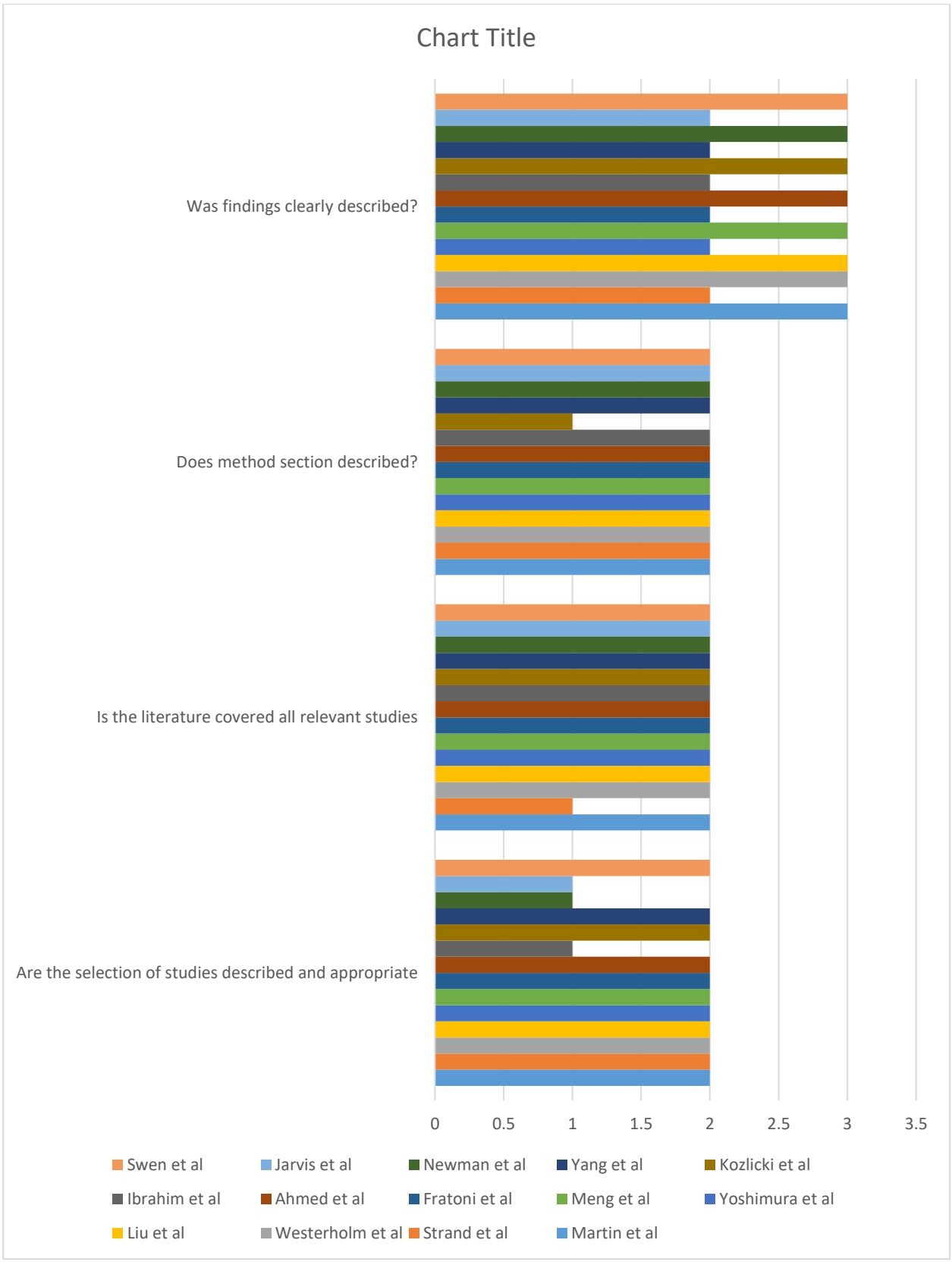


Chart Title
Was findings clearly described?
Does method section described?
Is the literature covered all relevant studies
Are the selection of studies described and appropriate
0
0.5
1
1.5
2
2.5
3
3.5
Swen et al
Jarvis et al
Newman et al
Yang et al
Kozlicki et al
Ibrahim et al
Ahmed et al
Fratoni et al
Meng et al
Yoshimura et al
Liu et al
Westerholm et al
Strand et al
Martin et al

Table 2: Assessment of the literature quality matrix

#	Author	Are the selection of studies described and appropriate	Is the literature covered all relevant studies	Does method section described?	Was findings clearly described?	Quality rating
1	Martin et al	YES	Yes	Yes	Yes	Good
2	Strand et al	Yes	No	Yes	Yes	Fair
3	Westerholm et al	Yes	Yes	Yes	Yes	Good
4	Liu et al	Yes	No	Yes	Yes	Good
5	Yoshimura et al	Yes	Yes	No	Yes	Fair
6	Meng et al	Yes	Yes	Yes	Yes	Good
7	Fratoni et al	Yes	Yes	Yes	Yes	Fair
8	Ahmed et al	Yes	Yes	Yes	Yes	Good
9	Ibrahim et al	No	Yes	Yes	Yes	Fair
10	Kozlicki et al	Yes	Yes	Yes	No	Good
11	Yang et al	Yes	Yes	Yes	Yes	Good
12	Ying et al	Yes	Yes	Yes	Yes	Fair
13	Newman et al	NO	Yes	Yes	Yes	Good
14	Jarvis et al	No	Yes	Yes	Yes	Fair

15	Swen et al	Yes	Yes	Yes	Yes	Good

Table 2 provides an assessment of the literature quality matrix for the studies included in the systematic review on the role of pharmacists in laboratory monitoring of medication therapy. The table evaluates various aspects, including the description and appropriateness of study selection, coverage of all relevant studies, adequacy of the method section description, clarity of findings presentation, and overall quality rating. Among the included studies, Martin et al., Westerholm et al., Meng et al., Ahmed et al., Yang et al., and Swen et al. are rated as "Good," indicating comprehensive study selection, coverage of relevant literature, clear method section description, and well-presented findings. However, some studies, such as Strand et al., Yoshimura et al., Ibrahim et al., Kozlicki et al., Ying et al., Jarvis et al., and Fratoni et al., have been rated as "Fair" due to limitations in aspects such as coverage of all relevant studies or clarity of findings description. Additionally, studies by Liu et al., Newman et al., and Jarvis et al. received lower ratings due to deficiencies in study selection description or clarity of findings.

Data Synthesis

In the data synthesis phase of the present study, "Exploring the role of pharmacists in laboratory monitoring of medication therapy: A systematic review," a systematic approach was employed to combine and analyze findings from the selected literature. By systematically reviewing and synthesizing relevant studies, recurring themes and variations in pharmacists' involvement in laboratory monitoring across different healthcare settings were identified. This rigorous process facilitated a holistic understanding of the effectiveness of pharmacist-led interventions, particularly within the context of medication therapy management. By considering factors such as cultural diversity, healthcare reforms, and workforce composition, the study aimed to provide informed conclusions and recommendations for optimizing the role of pharmacists in laboratory monitoring practices, thereby enhancing medication therapy outcomes and patient care.

Table 3: Research Matrix

Author, Year	Aim	Method	Sample, Sampling	Key Findings	Suggestion
Martin, A. W., Isaac, J., & Furbish, A. (2022).	To establish DMT monitoring guidelines and evaluate pharmacist interventions before and after implementing an electronic dashboard.	Utilized medication safety parameters and conducted retrospective chart reviews pre- and post-dashboard implementation.	Patients with qualifying DMT prescriptions at a VAMC.	Pre-dashboard implementation showed gaps in monitoring (e.g., abnormal results, lack of baseline testing). Post-implementation saw improvements in monitoring and decreased pharmacist interventions.	Standardized monitoring guidelines and dashboard implementation enhanced DMT monitoring, enabling targeted pharmacist interventions to improve patient safety and adherence.
Strand, M. A., Bratberg, J., Eukel, H., Hardy, M., & Williams, C. (2020)	To explore the contributions of community pharmacists to disease management during the COVID-19 pandemic.	Review of community pharmacists' roles in delivering critical health services, including point-of-care testing, vaccinations, and COVID-19 testing, during the pandemic.		Despite the challenges posed by the COVID-19 pandemic, community pharmacists have played a crucial role in maintaining healthcare delivery and providing essential services to communities, particularly those most vulnerable to COVID-19. They have been instrumental in offering point-of-care testing for chronic disease management, administering vaccinations, and conducting COVID-19 testing.	Community pharmacists' significant contributions during the pandemic highlight the importance of recognizing and supporting their role in disease management and public health efforts. Continued collaboration between healthcare sectors and policymakers is essential to maximize the impact of community pharmacists in addressing healthcare needs during crises like the COVID-19 pandemic.
Westerholm, A., Leiman, K., Kiiski, A.,	To assess the development of medication review	Utilized self-assessment surveys to evaluate	Third-year pharmacy students	The study found that third-year pharmacy students self-assessed their medication	Suggestion: The findings suggest the need for further emphasis on

Pohjanoksa-Mäntylä, M., Mistry, A., & Airaksinen, M. (2023)	competency in undergraduate pharmacy training through self-assessment by third-year students.	medication review competency among third-year pharmacy students.	participating in undergraduate pharmacy training.	review competency as moderate, with the highest competency levels reported in medication-related problem identification and intervention planning. However, students perceived lower competency levels in other areas, such as patient interaction and documentation.	enhancing medication review competency in undergraduate pharmacy training, particularly in areas such as patient interaction and documentation, to better prepare students for their future roles as pharmacists.
Liu, S., Luo, P., Tang, M., Hu, Q., Polidoro, J. P., Sun, S., & Gong, Z. (2020).	To review the unique needs of pharmacy services during the COVID-19 pandemic and share experiences with the international pharmacy community.	The commentary highlights the response of Chinese pharmacists to the COVID-19 pandemic, including drafting professional service guidance, establishing emergency drug formularies, monitoring drug shortages, providing remote pharmacy services, offering event-driven	Convenient sampling	Chinese pharmacists have played a crucial role in the public health response to COVID-19 by swiftly implementing various measures, contributing significantly to preventing and containing the spread of the virus.	The commentary emphasizes the importance of collaboration and sharing experiences among the international pharmacy community to effectively respond to the challenges posed by the COVID-19 pandemic.

		pharmaceutical care, educating the public, and participating in clinical trials and drug evaluation.			
Yoshimura, Y., Matsumoto, A., & Momosaki, R. (2022).	To explore the role of pharmacotherapy and pharmacists in rehabilitation medicine, focusing on older patients susceptible to drug-related functional impairment.	The study discusses the importance of pharmacotherapy in older patients undergoing rehabilitation, highlighting drug-related problems such as polypharmacy, potentially inappropriate medications (PIMs), and potential prescription omissions, along with associated adverse drug events.	Stratified sampling	Older patients undergoing rehabilitation are vulnerable to drug-related functional impairment due to factors like polypharmacy and PIMs, leading to adverse drug events such as dysphagia, depression, falls, fractures, and incontinence.	Pharmacists should actively engage in medication management for older patients undergoing rehabilitation to address drug-related problems and minimize adverse drug events, ultimately improving therapeutic outcomes and quality of life.
Meng, Q., Sun, L., Ma, Y., Wei, Y., Ma, X., Yang,	Evaluate pharmacist-led Medication Therapy Management	Retrospective study in a Beijing hospital, analyzing patients receiving	81 patients with complete records received MTM services.	Pharmacists identified 128 medication-related demands, with adverse drug reaction monitoring most common.	Integrating pharmacist-led MTM in ambulatory care optimizes patient outcomes and reduces medical costs.

L., ... & Gu, H. (2023).	(MTM) impact in ambulatory care.	MTM from May 2019 to February 2020. Pharmacists provided care based on MTM standards, identifying medication-related problems (MRPs), and developing action plans (MAPs).	181 MRPs were found, including nonadherence and adverse drug events. MAPs included pharmaceutical care and adjusting treatment plans. Patients experienced average monthly cost-saving of $43.2.	
Fratoni, A. J., Nicolau, D. P., & Kuti, J. L. (2021)	To provide guidance on therapeutic drug monitoring (TDM) of β-lactam antibiotics, considering their wide inter- and intra-patient variability in pharmacokinetics (PK) and the need for personalized medicine.	The authors review the basis for β-lactam TDM, supporting evidence, and guidance for implementation in specific patient populations.	β-lactam antibiotics, despite being commonly prescribed, often exhibit suboptimal exposures across various disease states and clinical settings. The time that free concentrations remain above the minimum inhibitory concentration (MIC) (%fT>MIC) is critical for antibacterial effect. However, there is a general lack of understanding on how to operationalize TDM and interpret results. While instrumentation and expertise for β-lactam quantification are limited	Consensus guidelines for β-lactam TDM in the United States would promote and standardize this practice, enhancing personalized medicine and optimizing clinical outcomes for patients receiving β-lactam antibiotics.

				locally, some laboratories offer these services. Population PK software and Bayesian modeling are essential for evaluating concentrations and establishing exposure thresholds. Although β-lactam TDM can improve target attainment rates, evidence for improved clinical outcomes is limited, necessitating	
Ahmed, A., Tanveer, M., Dujaili, J. A., Chuah, L. H., Hashmi, F. K., & Awaisu, A. (2023)	To systematically review the impact of pharmacist-involved interventions on managing medication-related problems in people living with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS; PLWHA).	A systematic review was conducted following a registered protocol on PROSPERO. Relevant records were identified from six electronic bibliographic databases, and studies published in English were included. Data were extracted from selected studies, and their	The review included 21 studies involving 2998 PLWHA, published between 2014 and 2022.	Pharmacists' interventions, either working alone or in a multidisciplinary team, significantly reduced various medication-related problems in PLWHA, including incorrect/incomplete ARV regimens, drug interactions, incorrect dosages, duplicate therapy, polypharmacy, administration errors, missing medication, wrong formulation, adverse drug reactions (ADRs), and prescribing errors. Most physicians accepted more	Pharmacist-led interventions and stewardship significantly mitigate ARV therapy-related problems in PLWHA and are widely accepted by physicians. Dedicated pharmacists with specialized training in infectious diseases or HIV/AIDS have the potential to enhance health outcomes in PLWHA.

		quality was assessed.		than 90% of pharmacists' recommendations.	
Ibrahim, O. M., Ibrahim, R. M., Ibrahim, Y. A., Madawi, E. A., & Al Deri, M. Y. (2022)	To shed light on the roles of pharmacists during the COVID-19 global pandemic, emphasizing their contributions in maintaining pharmacy services continuity, supporting healthcare professionals, and educating patients.	The authors conducted a review to highlight the roles of both community and hospital pharmacists during the COVID-19 pandemic, focusing on their contributions to pharmacy services continuity, support for healthcare professionals, and patient education.		Clinical pharmacists provide direct patient care by monitoring adverse drug reactions, ensuring individualized treatment, practicing evidence-based medicine, and evaluating drugs in clinical trials. Community pharmacists, as the most accessible healthcare providers, increase community awareness of preventive measures, balance medicine supply and demand, offer drive-thru and home delivery services, provide telehealth counseling and psychological support, refer suspected COVID-19 patients, and administer vaccinations when available.	The COVID-19 pandemic has prompted innovative roles for pharmacists, which may continue to be relevant in the post-pandemic world. Pharmacists should continue to adapt to changing circumstances and be prepared to fulfill these expanded roles beyond the pandemic.
Kozlicki, M., Lynch, B., Donoho, T., Nichols, P., & Zuckerman, A. D. (2023)	The purpose of this quality improvement project was to evaluate the implementation of a	A pre/post analysis of dashboard implementation was conducted to assess the number of patients with	The analysis included 40 patients with outdated laboratory values who required a	The frequency of treatment gaps decreased from 80% before dashboard implementation to 32% after implementation. The median gap length also decreased	Utilization of quality measures dashboards can effectively decrease treatment gaps in patients with IBD receiving biologic therapy. Integrated

	dashboard aimed at preventing treatment gaps in patients with inflammatory bowel disease (IBD) receiving biologic therapy by prospectively identifying patients with outdated laboratory results.	overdue laboratory work resulting in treatment gaps. The dashboard combined data from the electronic health record (EHR) and pharmacy claims database to identify patients on a biologic with outdated laboratory tests. Specialty pharmacists reviewed the dashboard and communicated via EHR if a new prescription and laboratory tests were needed.	new prescription (15 before dashboard implementation and 25 after implementation).	from 21 days to 11 days after dashboard implementation.	specialty pharmacists play a crucial role in monitoring adherence to laboratory monitoring parameters for patients on biologics.
Yang, Q., Xie, L., Zhang, W., Zhao, L., Wu, H., Jiang, J., ... & Wu, J. (2020)	The aim of this retrospective, single-center case series was to report on the clinical characteristics, treatments, and	The study included 136 patients diagnosed with COVID-19 between January 28, 2020, and February 12, 2020. Clinical	The patients were divided into a moderate (M) group (n = 103) and a severe and critical (SC) group	Significant differences observed between moderate (M) and severe/critical (SC) COVID-19 groups in chronic medical illnesses, fever, dry cough, and dyspnea. Patients in SC group showed	The treatment plan for COVID-19 patients should be regularly evaluated and adjusted based on vital signs, clinical symptoms, laboratory tests, and imaging changes. Effective

	prognoses of 136 patients diagnosed with coronavirus disease 2019 (COVID-19) at Wuhan Third Hospital in China.	characteristics, laboratory tests, treatment features, and prognoses were summarized.	(n = 33) based on disease severity.	significant changes in laboratory parameters, including decreased lymphocyte count and increased inflammatory markers. Main therapeutic drugs included antivirals, antibiotics, and glucocorticoids. Elderly patients with chronic diseases were more prone to severe COVID-19. Improvement in lymphocyte count and C-reactive protein levels correlated with prognosis. Cautious use of antiviral and broad-spectrum antibacterial drugs recommended, with regular monitoring for drug-induced liver injury. Regular evaluation and adjustment of treatment plans suggested based on clinical parameters, along with psychological counseling for patients.	psychological counseling is also recommended for patients throughout their hospitalization.
Ying, W., Qian, Y., & Kun, Z. (2021)	To establish management practices for drug supply and	Pharmacists implemented management practices at a	The study involved pharmacists and COVID-19	Successful completion of drug supply tasks, no occurrence of nosocomial infections or medication	The developed management practices serve as a valuable experience for COVID-19

	pharmaceutical care during the COVID-19 epidemic.	designated hospital in Jilin Province, China, focusing on drug supply and pharmaceutical care.	patients at the hospital in Jilin Province, China.	errors, effective adverse reaction monitoring, and participation in multidisciplinary consultations.	prevention and containment efforts globally.
Newman, T. V., San-Juan-Rodriguez, A., Parekh, N., Swart, E. C., Klein-Fedyshin, M., Shrank, W. H., & Hernandez, I. (2020)	To summarize evidence on community pharmacist-led chronic disease management interventions and their impact on clinical, utilization, and economic outcomes.	Systematic search of systematic reviews, meta-analyses, and narrative reviews in MEDLINE, EMBASE, and Cochrane Library databases.	Reviewed articles covered various chronic diseases, including diabetes, asthma, COPD, hypertension, heart failure, hyperlipidemia, and HIV/AIDS.	Community pharmacist-led interventions, primarily patient consultations and education, led to significant improvements in clinical outcomes across different chronic diseases. These included reductions in hemoglobin A1c, cholesterol levels, blood pressure, and readmission rates, as well as improvements in medication adherence and lung function.	Further research is needed to evaluate the impact of specific interventions on economic and utilization outcomes in chronic disease management by community pharmacists.
Jarvis, J. P., Peter, A. P., Keogh, M., Baldasare, V., Beanland, G. M., Wilkerson, Z. T., ... & Shaman, J. A. (2022)	To evaluate the real-world impact of a pharmacogenomics (PGx)-enriched comprehensive medication management (CMM) program on healthcare delivery.	Assessment of a voluntary PGx-enriched CMM program over 32 months in Medicare Advantage patients (≥65 years) receiving benefits through a state retirement system.		The program resulted in a reduction of ~$7000 per patient in direct medical charges, totaling $37 million. Healthcare resource utilization (HRU) shifted away from acute care services towards more sustainable primary care options. Improved medication risk assessment, patient/provider	These results validate the use of clinical decision support systems (CDSS) to integrate PGx and CMM for optimizing care in similar patient populations.

		Sample, Sampling: Analysis included 5288 enrollees compared to 22,357 non-enrolled patients.	communication via pharmacist-mediated medication action plans (MAP), and sustained positive trends in HRU were observed.	
Swen, J. J., van der Wouden, C. H., Manson, L. E., Abdullah-Koolmees, H., Blagec, K., Blagus, T., ... & Rodríguez-González, C. J. (2023)	To rigorously assess the clinical utility of a pre-emptive genotyping strategy using a 12-gene pharmacogenetic panel in preventing adverse drug reactions.	Open-label, multicentre, controlled, cluster-randomised, crossover implementation study conducted across 18 hospitals, nine community health centres, and 28 community pharmacies in seven European countries. Sample, Sampling: 6944 patients aged 18 years or older receiving a first prescription for a drug clinically recommended in the guidelines of the Dutch Pharmacogenetics	Genotype-guided treatment significantly reduced the incidence of clinically relevant adverse drug reactions in patients with actionable test results for the index drug (21.0% vs. 27.7% in control group) and for all patients who received at least one dose of the index drug (21.5% vs. 28.6% in control group).	Large-scale implementation of genotype-guided treatment using pharmacogenetic panels could enhance drug therapy safety.

	Working Group (DPWG) were enrolled.	

The research matrix summarizes findings from diverse studies in pharmacy practice. Martin et al. (2022) established DMT monitoring guidelines, found improved monitoring, and decreased pharmacist interventions post-dashboard implementation. Strand et al. (2020) highlighted the pivotal role of community pharmacists during the COVID-19 pandemic, emphasizing their contributions to maintaining healthcare delivery. Westerholm et al. (2023) assessed medication review competency among third-year pharmacy students, suggesting a need for enhanced training in certain areas. Liu et al. (2020) showcased Chinese pharmacists' response to the pandemic, emphasizing various measures to combat COVID-19. Yoshimura et al. (2022) discussed the importance of pharmacotherapy in older patients undergoing rehabilitation, emphasizing pharmacist involvement in medication management. Meng et al. (2023) evaluated pharmacist-led Medication Therapy Management (MTM) in ambulatory care, demonstrating improved patient outcomes and cost savings. Fratoni et al. (2021) provided guidance on therapeutic drug monitoring of β-lactam antibiotics, advocating for consensus guidelines to standardize practice. Ahmed et al. (2023) systematically reviewed pharmacist interventions in managing medication-related problems in PLWHA, highlighting their efficacy and acceptance. Ibrahim et al. (2022) underscored the pivotal roles of pharmacists during the COVID-19 pandemic, emphasizing their contributions to healthcare continuity and patient education. Kozlicki et al. (2023) evaluated a dashboard to prevent treatment gaps in IBD patients, noting a decrease in treatment gaps with integrated pharmacist monitoring. Lastly, Yang et al. (2020) reported on the clinical characteristics, treatments, and prognoses of COVID-19 patients, emphasizing the importance of tailored treatment plans and psychological support.

Results

Table 4: Themes, Sub-themes, Trends and Explanation

Theme	Sub-theme(s)	Trends	Explanation
Role of Pharmacists during COVID-19 pandemic	- Community pharmacy services - Hospital pharmacy services - Patient education and support	- Increased reliance on pharmacists for essential healthcare services during the pandemic - Expansion of pharmacist roles beyond traditional responsibilities - Emphasis on patient education and support to combat misinformation	Pharmacists have played crucial roles in maintaining healthcare delivery and providing essential services during the COVID-19 pandemic, including offering point-of-care testing, vaccinations, telehealth counseling, and psychological support. They have bridged gaps in healthcare delivery and addressed public health needs amidst the pandemic.
Impact of Pharmacist-led interventions	- Chronic disease management - Medication Therapy Management (MTM) - Therapeutic Drug Monitoring (TDM) - Pharmacogenomics (PGx)	- Improved clinical outcomes across various chronic diseases - Enhanced patient adherence and medication safety - Cost savings and resource optimization - Personalized medicine through pharmacogenomics - Increased focus on medication	Pharmacist-led interventions have demonstrated significant positive impacts on patient outcomes, medication safety, and healthcare resource utilization. These interventions span across various domains, including chronic disease management, medication therapy

		optimization and monitoring	management, therapeutic drug monitoring, and pharmacogenomics, highlighting the diverse roles pharmacists play in optimizing patient care.
Pharmacy Education and Training	- Medication review competency - Pharmacogenomics education - Therapeutic drug monitoring training	- Moderate self-assessed competency in medication review among pharmacy students - Need for enhanced training in pharmacogenomics and therapeutic drug monitoring - Emphasis on integrating practical skills and patient interaction in pharmacy education	Pharmacy education and training programs need to focus on enhancing practical skills, such as medication review competency and pharmacogenomics training, to better prepare students for their roles as pharmacists. There is a growing recognition of the importance of incorporating real-world skills and patient interaction in pharmacy curricula.

Drug Supply and Pharmaceutical Care during Epidemics	- Drug supply management - Pharmaceutical care practices - Adverse reaction monitoring - Interdisciplinary collaboration	- Successful implementation of drug supply management practices - Effective pharmaceutical care strategies to ensure patient safety - Integration of pharmacists into multidisciplinary healthcare teams - Emphasis on adverse reaction monitoring and medication safety	Pharmacists have played essential roles in ensuring uninterrupted drug supply and providing pharmaceutical care during epidemics such as COVID-19. Effective management practices, interdisciplinary collaboration, and proactive monitoring are critical for optimizing patient care and safety during public health crises.
Advances in Therapeutic Drug Monitoring (TDM)	- Implementation of TDM guidelines - Optimization of β-lactam antibiotic therapy	- Adoption of TDM guidelines to improve medication optimization and dosing - Recognition of the need for personalized medicine in antibiotic therapy - Emphasis on target attainment rates and exposure thresholds in TDM practices	Therapeutic drug monitoring (TDM) guidelines and practices are evolving to optimize medication therapy, particularly in areas such as antibiotic therapy. There is a growing emphasis on personalized medicine and individualized dosing to improve clinical outcomes and minimize adverse drug events.

Pharmacists have emerged as frontline healthcare providers during the COVID-19 pandemic, expanding their roles beyond traditional responsibilities to offer essential services such as point-of-care testing, vaccinations, and patient education. Their contributions have been instrumental in maintaining healthcare delivery and addressing public health needs amidst the pandemic. Additionally, pharmacist-led interventions have shown significant positive impacts on patient outcomes, medication safety, and healthcare resource utilization, spanning across chronic disease management, medication therapy management, therapeutic drug monitoring, and pharmacogenomics. However, there is a recognized need to enhance pharmacy education and training programs to better prepare students for their evolving roles, emphasizing practical skills and patient interaction. Moreover, advancements in therapeutic drug monitoring (TDM) are driving personalized medicine approaches, particularly in optimizing antibiotic therapy, highlighting the importance of adherence to TDM guidelines and individualized dosing strategies for improving clinical outcomes and minimizing adverse drug events.

Discussion

In addition to the pivotal roles pharmacists play during crises like the COVID-19 pandemic, their contributions extend to the optimization of medication therapy across diverse patient populations. Studies such as those conducted by Meng et al. (2023) and Ahmed et al. (2023) shed light on the impact of pharmacist-led interventions, including medication therapy management (MTM) services, in ambulatory care settings and among people living with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). These interventions have not only improved clinical outcomes and medication adherence but have also resulted in significant cost savings and resource optimization. As the healthcare landscape continues to evolve, pharmacist-led initiatives are increasingly recognized as integral components of comprehensive patient care, with the potential to mitigate medication-related problems and enhance therapeutic outcomes.

Furthermore, advancements in pharmacogenomics (PGx) have revolutionized the landscape of personalized medicine, offering tailored approaches to medication therapy based on individual genetic profiles. The study by Swen et al. (2023) underscores the clinical utility of pre-emptive genotyping strategies using pharmacokinetic panels in preventing adverse

drug reactions. By identifying actionable genetic variants and guiding treatment decisions accordingly, pharmacogenomics holds promise in optimizing drug therapy safety and efficacy. However, widespread implementation of pharmacogenomics testing faces challenges related to infrastructure, reimbursement, and clinician education, highlighting the need for concerted efforts to overcome barriers and realize the full potential of personalized medicine in clinical practice.

Moreover, pharmacy education and training programs play a pivotal role in shaping the future of pharmacy practice and ensuring the competency of future pharmacists. Studies such as those by Westerholm et al. (2023) emphasize the importance of enhancing medication review competency and incorporating practical skills such as patient interaction and documentation into pharmacy curricula. As the scope of pharmacy, practice expands and becomes increasingly complex, education and training programs must evolve to equip pharmacists with the necessary knowledge and skills to meet the demands of contemporary healthcare delivery.

Additionally, the integration of technology and data analytics has emerged as a transformative force in pharmacy practice, enabling pharmacists to leverage real-time data and clinical decision support tools to optimize medication therapy and improve patient outcomes. Studies such as those by Martin et al. (2022) and Kozlicki et al. (2023) highlight the role of electronic dashboards and quality measures in identifying treatment gaps, monitoring medication safety parameters, and facilitating targeted pharmacist interventions. As healthcare systems transition towards value-based care models, the integration of technology-enabled solutions holds immense potential in enhancing medication optimization, reducing adverse drug events, and improving overall healthcare quality and efficiency.

The collective evidence from these studies underscores the indispensable role of pharmacists in contemporary healthcare delivery and the need for ongoing support and investment in pharmacy practice. From addressing public health crises to optimizing medication therapy and advancing personalized medicine, pharmacists are instrumental in driving positive impacts on patient health outcomes and healthcare system sustainability. As pharmacists continue to adapt to evolving healthcare needs and technological advancements, collaboration across healthcare sectors and continued professional development will be essential

in realizing the full potential of pharmacy practice in improving patient care and population health.

Suggestion

It is recommended that politicians and healthcare organizations acknowledge the critical role that chemists play in managing chronic diseases and promoting public health, based on the results of this study. The use of healthcare resources and patient outcomes can be greatly enhanced by funding pharmacist-led initiatives like pharmacogenomics testing and medication therapy management (MTM) programs. Additionally, incorporating technology-enabled solutions can improve drug optimization and enable focused chemist interventions. Examples of these solutions are electronic dashboards and clinical decision support systems. Through utilizing chemists' expertise and expanding their scope of practice, healthcare systems may more effectively tackle the rising prevalence of chronic illnesses and enhance the overall quality and efficiency of healthcare provision.

Limitations

The current work has yielded interesting insights; however, it is important to acknowledge numerous limitations. First off, the retrospective nature of the study may have reduced the findings' generalizability and added selection bias. In addition, the breadth and depth of the evidence synthesized may have been limited by the dependence on secondary literature, such as systematic reviews and meta-analyses. Furthermore, it is possible that the diversity of interventions and results across the included studies made it difficult to do direct comparisons and meta-analyses. In order to get over these restrictions and present more solid data on the effectiveness of pharmacist-led treatments in the management of chronic illnesses, more research using prospective study designs and primary data collection techniques is required.

Recommendation

A number of suggestions for further study and application can be made in light of the constraints that have been found. Initially, to assess the efficacy of certain pharmacist-led strategies in enhancing clinical, utilization, and financial outcomes across various chronic conditions, carefully planned prospective trials are required. To aid in comparability and meta-analysis, efforts should also be undertaken to standardize outcome measures and

intervention regimens. In order to optimize pharmacists' contributions to patient care and public health, healthcare organizations should also priorities the integration of pharmacists into interdisciplinary care teams and make investments in their ongoing education and training. Finally, in order to encourage the widespread use of pharmacist-led interventions in healthcare delivery, governments ought to think about putting laws and reimbursement systems in place.

Conclusion

The current study offers insightful information about the effects of pharmacist-led interventions on the treatment of chronic illnesses and the consequences for outcomes related to clinical, utilization, and financial aspects. The evidence summarized highlights the critical role that chemists play in maximizing patient care and the sustainability of the healthcare system, notwithstanding significant constraints. Healthcare organizations can successfully handle the rising burden of chronic diseases and enhance the general quality and efficiency of healthcare by utilizing chemist expertise, incorporating technology-enabled solutions, and encouraging interdisciplinary collaboration. In the future, coordinated efforts by all parties involved in the healthcare system will be necessary to fully achieve the promise of pharmacist-led interventions in enhancing community health and patient outcomes.

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