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Research Article

Impact of Pharmacist-Led Medication Review on Reducing Adverse Drug Events

Dhaifalla M. Moparak Alrwili[1]*, Mohammed Tajir D Alanazi[2], Muqrin Saeed Hulayyil Almutairi[3], Alharbi Waleed Abdullah M[4], Salam Saud Alanazi[5], Mohammed Hassan Almuntashiri[6], Hussein Fallah Khadran Alrashidi[7], Saleh Abdulkarim A Alkuraya[8], Ahlam Salem Bin Binyah Alanaz[9], Waleed Saud AbdulAziz AlShdokhy[10], Hamdi Ayidh Qidan Albaqami[11]

[1]Pharmacy Technician – Assistant Administration for Performance and Compliance, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Kingdom of Saudi Arabia
*** Corresponding Author Email:** dalrwili@moh.gov.sa - **ORCID:** 0000-0002-5777-9050

[2]Pharmacy Technician – Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Kingdom of Saudi Arabia
Email: mtalanazi@moh.gov.sa- **ORCID:** 0000-0002-5777-1150

[3]Pharmacy – Qassim Health Cluster, Ministry of Health, Riyadh Al-Khabra, Qassim Region, Kingdom of Saudi Arabia
Email: muqrinsa@moh.gov.sa- **ORCID:** 0000-0002-5777-2250

[4]Pharmacy Technician – Al-Quwayiyah General Hospital, Riyadh First Health Cluster, Ministry of Health, Al-Quwayiyah, Riyadh Region, Kingdom of Saudi Arabia
Email: Waabalharbi@moh.gov.sa - **ORCID:** 0000-0002-5777-3350

[5]Pharmacist (Bachelor of Pharmacy) – Mental Health Hospital, Al-Jouf Health Cluster, Ministry of Health, Al-Qurayyat, Al-Jouf Region, Kingdom of Saudi Arabia
Email: salaamsa@moh.gov.sa - **ORCID:** 0000-0002-5777-4450

[6]Pharmacist – Children's Hospital, Taif Health Cluster, Ministry of Health, Taif, Makkah Region, Kingdom of Saudi Arabia
Email: Malmontashri1407@gmail.com - **ORCID:** 0000-0002-5777-5550

[7]Pharmacy Technician – Safit Primary Health Care Center, Hail Health Cluster, Ministry of Health, Hail, Hail Region, Kingdom of Saudi Arabia
Email: hfalrashidi@moh.gov.sa - **ORCID:** 0000-0002-5777-6650

[8]Pharmacy Technician – King Abdulaziz Specialist Hospital, Al-Jouf Health Cluster, Ministry of Health, Sakaka, Al-Jouf Region, Kingdom of Saudi Arabia
Email: Salkraia@moh.gov.sa- **ORCID:** 0000-0002-5777-7750

[9]Pharmacy Technician – Ministry of Health Branch, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Kingdom of Saudi Arabia
Email: ahsalanazi@moh.gov.sa- **ORCID:** 0000-0002-5777-8850

[10]Pharmacy Assistant – Hail General Hospital, Hail Health Cluster, Ministry of Health, Hail, Hail Region, Kingdom of Saudi Arabia
Email: walshdokhy@moh.gov.sa- **ORCID:** 0000-0002-5777-9950

[11]Pharmacist – Shaer Primary Health Care Center, Taif Health Cluster, Ministry of Health, Turbah, Makkah Region, Kingdom of Saudi Arabia
Email: haaalbaqami@moh.gov.sa - **ORCID:** 0000-0002-5777-0850

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Abstract:

Pharmacist-led medication reviews play a critical role in optimizing patient safety and minimizing the risk of adverse drug events (ADEs). In a healthcare environment where polypharmacy is prevalent, especially among elderly patients or those with chronic conditions, pharmacists possess the expertise to evaluate medication regimens comprehensively. Through systematic reviews, pharmacists can identify potential drug interactions, duplicate therapies, and inappropriate medication usage, ensuring that patients receive safe and effective treatments. By collaborating with healthcare teams and educating patients about their medications, pharmacists not only mitigate the risk of ADEs but also enhance overall adherence to therapeutic plans, ultimately improving health outcomes. The implementation of pharmacist-led medication reviews has demonstrated tangible reductions in the frequency and severity of ADEs across various healthcare settings. Studies show that when pharmacists conduct thorough medication reconciliations and provide follow-up consultations, patients experience fewer hospitalizations and emergency department visits due to medication-related complications. Furthermore, these reviews contribute to a culture of safety within healthcare systems by fostering communication among healthcare providers and empowering patients to take an active role in their medication management. As such, integrating pharmacist-led initiatives into routine patient care is a strategic approach to enhancing medication safety and achieving better pharmacotherapy outcomes.

1. Introduction

The modern healthcare landscape is characterized by an aging global population, a rising prevalence of multi-morbidity, and an increasingly complex pharmacological arsenal. While medications are indispensable for treating acute conditions and managing chronic diseases, their use is a double-edged sword, carrying an inherent risk of harm. Adverse Drug Events (ADEs), defined as any injury resulting from medical intervention related to a drug, represent a major public health challenge of staggering proportions [1]. These events encompass a wide spectrum, from predictable side effects and allergic reactions to more severe consequences like therapeutic failures, drug-drug interactions, and medication errors occurring at any point in the prescribing, dispensing, or administration process. The human toll of ADEs is immense, contributing significantly to patient morbidity, mortality, reduced quality of life, and eroding trust in healthcare systems. Beyond the profound human cost, ADEs impose a crippling economic burden on healthcare infrastructures worldwide, consuming billions annually through prolonged hospital stays, emergency department visits, additional diagnostic tests, and further treatments required to manage the complications [2].

The scale of the problem is both alarming and well-documented. The World Health Organization (WHO) has repeatedly highlighted medication safety as a global priority, noting that unsafe medication practices and errors are a leading cause of avoidable harm in healthcare [1]. Studies across different healthcare settings consistently reveal that a significant proportion of hospital admissions, particularly among the elderly, are drug-related. It is estimated that ADEs may account for nearly 10% of all hospital admissions in developed nations, with figures potentially higher in less regulated environments [3]. Furthermore, ADEs are not confined to the hospital setting; they are a pervasive issue in primary care and community practice, often going undetected until they precipitate a clinical crisis. The problem is compounded by factors such as polypharmacy—the concurrent use of multiple medications—which is now commonplace, especially in managing chronic conditions like diabetes, cardiovascular disease, and mental health disorders. Polypharmacy exponentially increases the risk of drug-drug and drug-disease interactions, often leading to a prescribing cascade where new medications are introduced to treat side effects of existing ones, thereby escalating complexity and risk [4].

Historically, the responsibility for medication safety was viewed primarily through the lens of the prescribing physician. However, the limitations of this siloed approach have become painfully evident. Physicians, often operating under significant time constraints and facing an overwhelming volume of new pharmacological information, may inadvertently prescribe potentially inappropriate medications, miss critical interactions, or fail to adequately reconcile medications across care transitions. The traditional model of pharmacy, focused almost exclusively on the accurate dispensing of medications, also proved insufficient in intercepting these system-wide failures. This recognition catalyzed a paradigm shift in the profession of pharmacy over the past three decades, moving it from a product-centered to a patient-centered discipline. The pharmacist's role has evolved from a dispenser of medicines to an

essential clinical partner in the therapeutic process—an expert in pharmacotherapy tasked with ensuring the optimal, safe, and effective use of medications [5].

This evolution was formally endorsed and propelled by landmark reports from institutions like the Institute of Medicine (IOM, now the National Academy of Medicine), which, in its seminal report "To Err is Human," identified medication errors as a leading cause of patient harm and called for a systemic, multidisciplinary approach to safety [6]. In this new patient-centered model, the pharmacist's unique expertise is leveraged not as a redundancy but as a critical check within the medication-use system. Pharmacists possess specialized knowledge in pharmacology, pharmacokinetics, pharmacodynamics, and pharmacogenomics. They are trained to identify subtle signs of drug toxicity, recognize inappropriate dosing for specific patient demographics (like renal or hepatic impairment), and evaluate the clinical appropriateness of a therapeutic regimen against evidence-based guidelines [7].

The most structured and impactful manifestation of this clinical role is the Pharmacist-Led Medication Review (PLMR). A medication review is a systematic, critical assessment of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimizing the impact of medicines, minimizing the number of medication-related problems, and reducing waste. When led by a pharmacist, this process becomes a powerful, structured intervention. A comprehensive PLMR is not a cursory check for interactions but a deep dive into a patient's complete pharmacotherapy. It involves obtaining a best possible medication history (BPMH), assessing each medication for clinical appropriateness (indication, effectiveness, dosage), safety (contraindications, interactions, adverse effects), and patient adherence and understanding. The pharmacist then collaborates with the prescriber and the patient to develop a personalized care plan, which may include recommendations for deprescribing unnecessary medications, switching to safer or more effective alternatives, adjusting doses, or implementing monitoring strategies [8].

2. Defining the Pharmacist's Evolving Role and the Medication Review Process

The transformation of pharmacy practice is foundational to understanding the impact of medication reviews. The contemporary pharmacist is no longer confined behind a counter but is increasingly integrated into clinical teams as a medication therapy expert. This role expansion is formalized through collaborative practice agreements (CPAs) or independent prescriber status in many jurisdictions, allowing pharmacists to initiate, modify, or discontinue therapy under specific protocols or autonomously [8]. This authority is crucial for the effective execution of medication reviews, as it enables the pharmacist to act on their recommendations promptly, rather than merely generating a report for a physician who may be delayed in responding.

A pharmacist-led medication review is a multi-step, iterative process. It begins with a comprehensive data collection phase. The pharmacist gathers information from multiple sources: patient interviews to understand their perspective, symptoms, and adherence; medical and prescribing records; laboratory results (e.g., renal function, liver enzymes, drug levels); and sometimes input from caregivers. Establishing an accurate Best Possible Medication History (BPMH) is critical, as discrepancies between what is prescribed and what the patient actually takes are a common source of error, particularly after hospital discharge [9].

The core analytical phase involves applying clinical judgment to identify Medication-Related Problems (MRPs). MRPs are categorized into several types: untreated indications, inappropriate drug selection, sub-therapeutic or excessive dosage, adverse drug reactions, drug-drug or drug-disease interactions, and non-adherence [10]. The pharmacist evaluates each medication against key principles: Is there a clear and valid indication? Is the medication effective for this condition in this specific patient? Is the dose appropriate for the patient's age, weight, and organ function? Is it safe given the patient's comorbidities and other medications? Is the patient able and willing to take it as intended?Following this analysis, the pharmacist formulates a care plan. This involves prioritizing MRPs, developing specific recommendations (e.g., discontinue drug X, reduce dose of drug Y, monitor serum creatinine monthly), and communicating these findings. Effective communication is a two-way street: discussing the plan with the patient (or caregiver) to ensure understanding and agreement (a process known as concordance), and collaborating with the prescriber(s) to implement changes. Finally, the process includes follow-up to assess outcomes, ensure recommendations were enacted, and monitor for resolution of MRPs or emergence of new ones [11]. This structured approach transforms medication use from a passive act of consumption into an actively managed therapeutic strategy.

3. Patient Populations and Settings Most Benefiting from Pharmacist-Led Reviews

While PLMRs can benefit any patient taking medications, their impact is most pronounced and cost-effective in specific high-risk populations and at critical junctures in care. The elderly, typically defined as those aged 65 and over, are arguably the most vulnerable group. Age-related physiological changes (e.g., reduced renal and hepatic function, altered body composition) alter pharmacokinetics and pharmacodynamics, increasing sensitivity to drugs. Polypharmacy is endemic in this population, often involving five or more chronic medications, which dramatically elevates the risk of interactions and adverse effects like falls, cognitive impairment, and hospitalizations [12]. Furthermore, the use of Potentially Inappropriate Medications (PIMs), as identified by tools like the Beers Criteria or the STOPP/START criteria, is a major preventable cause of harm. Pharmacist-led reviews, focusing on deprescribing unnecessary or harmful medications and ensuring appropriate preventive therapies are in place (e.g., vaccines, bone protection), have repeatedly been shown to reduce falls, delirium, and hospital admissions in the elderly [13].

Patients with multiple chronic conditions, such as diabetes, hypertension, heart failure, and chronic obstructive pulmonary disease (COPD), also derive exceptional benefit. Managing these conditions often requires complex, overlapping drug regimens from different specialists, increasing the risk of therapeutic duplication or conflicting treatments. The pharmacist serves as a central coordinator, reconciling treatments across specialties, simplifying regimens to improve adherence, and ensuring that therapies for one condition do not exacerbate another (e.g., ensuring NSAIDs for arthritis do not worsen heart failure or renal disease) [14]. The holistic view of the pharmacist is key to optimizing the entire medication portfolio rather than just individual drugs.

Care transitions, such as hospital admission and discharge, are periods of extreme vulnerability for medication errors. Admission medication histories are frequently inaccurate, and discharge summaries may be incomplete or unclear. Pharmacist involvement in medication reconciliation during these transitions—comparing the pre-admission, in-hospital, and discharge medication lists—is a high-leverage activity. Studies demonstrate that pharmacist-led reconciliation at discharge significantly reduces preventable ADEs and readmissions within 30 days, a key quality metric for healthcare systems [15]. Other high-impact settings include intensive care units, where patients are on numerous high-alert medications; oncology, with complex chemotherapeutic regimens and supportive care; and psychiatric care, where polypharmacy and metabolic side effects are common.

4. Evidence of Impact on Clinical Outcomes and Adverse Drug Event Reduction

A substantial and growing body of evidence, encompassing randomized controlled trials (RCTs), systematic reviews, and meta-analyses, supports the efficacy of PLMRs in reducing ADEs and improving clinical outcomes across various settings. In the hospital environment, RCTs have shown that clinical pharmacist participation on medical rounds as part of a multidisciplinary team leads to a significant reduction in preventable ADEs. For example, a landmark study by Leape et al. demonstrated that having a pharmacist on rounds in an intensive care unit reduced preventable ADEs by 66% [16]. The pharmacist's real-time input on dosing, allergies, and interactions acts as a powerful in-the-moment safety check.

In the ambulatory care and primary care setting, the evidence is equally compelling. Systematic reviews consistently conclude that medication review services improve medication appropriateness and reduce the use of PIMs in the elderly. A meta-analysis by Jódar-Sánchez et al. found that pharmacist-led interventions in outpatient settings significantly reduced hospital admissions related to medication problems [17]. In the United Kingdom, the National Health Service (NHS) has implemented structured medication reviews as part of the Chronic Medication Service and Advanced Service frameworks, with evaluations showing improvements in patient understanding, adherence, and identification of MRPs [18].

Perhaps the strongest evidence comes from studies focusing on specific high-risk scenarios. For patients with heart failure, pharmacist-led reviews that optimize guideline-directed medical therapy (e.g., ensuring target doses of ACE inhibitors, beta-blockers) have been shown to reduce heart failure-related hospitalizations and mortality [19]. In diabetes management, pharmacist interventions focusing on medication titration, addressing adherence barriers, and managing cardiovascular risk factors lead to significantly better glycemic, blood pressure, and lipid control compared to usual care [20]. Furthermore, PLMRs in residential aged care facilities (nursing homes) are a gold standard in many countries. Rigorous studies, such as those employing the STOPP/START criteria, show that these reviews reduce falls, fractures, and antipsychotic use while improving prescribing appropriateness [21]. The common thread across all these settings is that the systematic application of pharmacological expertise directly identifies and

resolves the latent errors that lead to ADEs, thereby preventing harm before it occurs.

5. Economic Implications and Cost-Effectiveness of Medication Review Services

Beyond the unequivocal clinical benefits, the economic argument for investing in pharmacist-led medication review services is robust. ADEs are extraordinarily costly. A single adverse drug reaction leading to a hospital admission can cost thousands of dollars, and when multiplied across a health system, the total burden reaches hundreds of billions annually [2]. PLMRs represent a proactive, preventive investment to avoid these far greater downstream costs.Health economic analyses, including cost-benefit and cost-effectiveness studies, generally favor PLMRs. The initial cost of the pharmacist's time to conduct a review is offset by savings from avoided ADEs, reduced emergency department visits, fewer hospital admissions and readmissions, and decreased length of hospital stay. A systematic review of economic evaluations found that the majority of studies reported pharmacist-led medication reviews to be cost-effective or cost-saving, particularly when targeted at high-risk patients [22]. For instance, a study in a Canadian primary care setting demonstrated that for every dollar invested in a pharmacist-led medication management service, the healthcare system saved between $1.29 and $5.40 in direct medical costs by preventing hospitalizations and physician visits [23].The economic benefit extends beyond direct medical costs. By preventing ADEs, PLMRs also reduce indirect costs such as lost productivity for patients and caregivers. Moreover, by optimizing medication regimens—discontinuing unnecessary drugs and ensuring patients take essential ones correctly—these reviews reduce medication wastage, leading to direct savings for payers (insurance companies, national health services) and patients through lower out-of-pocket costs. This is especially important in systems with high drug expenditures. While the exact return on investment varies by setting and patient population, the preponderance of evidence indicates that well-structured PLMR programs are not a net cost but a net saving for healthcare systems, making them a financially prudent component of sustainable healthcare [24].

6. Barriers and Challenges to Widespread Implementation

Despite the compelling evidence, the universal integration of comprehensive, remunerated PLMRs into standard care remains inconsistent. Several significant barriers impede implementation. A primary challenge is the lack of sustainable funding and reimbursement models. In many healthcare systems, pharmacists are paid for dispensing products, not for providing cognitive clinical services. Without dedicated payment for the time and expertise required for a thorough review, the service is economically unviable for pharmacies and health institutions [25]. Securing funding from insurers or national health systems requires persistent advocacy and the presentation of robust local cost-saving data.

Workforce capacity and training also present hurdles. Delivering high-quality medication reviews requires pharmacists with advanced clinical skills, including physical assessment, ordering and interpreting laboratory tests, and sophisticated communication and consultation techniques. While pharmacy education has evolved, the existing workforce may need additional training and credentialing to perform at this level confidently [26]. Furthermore, there may simply be an insufficient number of clinical pharmacists to meet the demand if PLMRs were scaled up nationwide.

Interprofessional resistance, though diminishing, can still be an obstacle. Some physicians may perceive pharmacist intervention as an infringement on their clinical autonomy or a criticism of their prescribing. This underscores the importance of building trust through effective, respectful communication and demonstrating value over time. Successful models are built on clear role definition, mutual respect, and collaborative protocols [27].

From the patient perspective, awareness and accessibility can be issues. Patients may not know that such a service exists or understand its value. They may also face practical barriers like transportation to a clinic or be reluctant to question their doctor's prescribed regimen. Finally, information technology (IT) system fragmentation is a major systemic barrier. Pharmacists often cannot access a patient's full electronic health record (EHR), including hospital discharge summaries, specialist notes, and up-to-date laboratory results. This lack of a complete information picture severely hampers their ability to conduct a fully informed review [28]. Overcoming these barriers requires a multi-faceted strategy involving policy change, education, interprofessional development, and integrated health IT systems.

7. Future Directions and the Integration of Technology

The future of pharmacist-led medication reviews is likely to be shaped by technological advancement

and further role expansion. The integration of artificial intelligence (AI) and clinical decision support systems (CDSS) holds great promise. AI algorithms can rapidly screen large sets of patient data (medication lists, diagnoses, lab values) against vast databases to flag potential interactions, dosing issues, or PIMs, serving as a powerful "second check" for the pharmacist [29]. This allows the pharmacist to focus their clinical expertise on the more complex judgments that AI cannot make, such as assessing patient goals, preferences, and nuanced risk-benefit trade-offs.

The expansion of pharmacist prescribing authority, either through independent or supplementary prescribing, will streamline the implementation of review recommendations. Rather than sending a recommendation and waiting for a physician's approval, a credentialed pharmacist could make certain therapeutic changes immediately, enhancing efficiency and patient convenience [30]. Furthermore, the scope of reviews is broadening to include a stronger focus on deprescribing—the planned and supervised process of stopping inappropriate medications. This is becoming a central tenet of geriatric pharmacotherapy and sustainable healthcare [31].

Telehealth and digital health platforms are also expanding access to medication review services. Remote consultations via video link can reach patients in rural areas, those with mobility issues, or those in residential care, ensuring equitable access to expertise [32]. Finally, the movement towards fully interoperable electronic health records is critical. A future where a pharmacist can securely access a unified patient record across all care settings would revolutionize the depth and accuracy of medication reviews, closing the current information gaps that compromise patient safety [33].

8. Conclusion

The impact of pharmacist-led medication reviews on reducing adverse drug events is both profound and well-substantiated by a vast body of international evidence. ADEs represent a pervasive, costly, and often preventable form of patient harm, intricately linked to the complexities of modern polypharmacy and fragmented care systems. The clinical pharmacist, through the structured, patient-centered process of a comprehensive medication review, applies specialized pharmacotherapeutic expertise to identify and resolve medication-related problems before they result in harm. The evidence demonstrates clear benefits: reduced inappropriate prescribing, fewer medication errors, decreased hospital admissions and readmissions, improved control of chronic diseases, and enhanced patient understanding and adherence.

The economic case is equally persuasive, with studies consistently showing that the upfront investment in this service yields significant returns by averting the far greater costs associated with managing ADEs. While barriers related to funding, workforce, interprofessional relations, and health IT integration persist, the trajectory of healthcare is unmistakably moving towards greater multidisciplinary collaboration and a focus on value-based, preventive care. The pharmacist-led medication review epitomizes this shift. It is not merely a clinical intervention but a fundamental component of a safer, more effective, and more sustainable medication-use system. As populations age and therapeutic options expand, embedding this service as a standard of care for high-risk patients is no longer an optional enhancement but an ethical and practical imperative for healthcare systems worldwide. The continued expansion, evaluation, and integration of this critical pharmacist role will be central to achieving the global patient safety goal of reducing severe, avoidable medication-related harm.

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