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Impact of medication reconciliation by pharmacists and nurses in preventing adverse drug events

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***Abstract*---Background:** Medication reconciliation is a crucial process aimed at identifying and rectifying discrepancies in medication lists to prevent adverse drug events. Pharmacists play a significant role in this process, especially during transitions of care, impacting patient

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outcomes and reducing hospital readmissions. **Methods:** A comprehensive literature review was conducted focusing on studies between 2012 and 2018 related to medication reconciliation and the involvement of pharmacists in both inpatient and outpatient settings. Studies were sourced from MEDLINE, PubMed, and Web of Science using specific search criteria. **Results:** Findings revealed that pharmacist-led interventions, including medication reconciliation and comprehensive medication reviews, significantly reduced hospital readmission rates and adverse drug events. Pharmacist interventions post-discharge, such as medication counseling and follow-up calls, were effective in resolving medication discrepancies and improving patient medication regimens. Cost analyses demonstrated potential cost savings associated with pharmacist interventions in medication management. **Conclusion:** Pharmacists play a crucial role in enhancing patient safety and healthcare outcomes through medication reconciliation processes. Their involvement in medication management during transitions of care can lead to reduced readmission rates, improved medication adherence, and decreased adverse drug events. Collaborative efforts among patients, pharmacists, and healthcare providers are essential for optimizing patient care and mitigating medication-related errors.

***Keywords*---**Medication reconciliation, Pharmacists, Transition of care, Hospital readmissions, Adverse drug events.

1. Introduction

Adverse drug events (ADEs) are among the leading causes of injury and death in patients worldwide (1, 2). In Europe, roughly 5% of hospital admissions are attributed to adverse drug events (ADEs), leading to over 197,000 fatalities annually (3). In the United States, adverse drug events result in about 1.3 million emergency department visits and 350,000 hospitalizations each year (4). A pivotal study by the Institute of Medicine (IOM) in 2007, entitled Preventing Medication Errors: Quality Chasm Series, projected that adverse drug events (ADEs) inflict an annual cost impact of around $3.5 billion on the U.S. healthcare system (1, 5). Research indicates that a substantial percentage of adverse drug events (ADEs) are avoidable, and that medication reconciliation is an effective technique for mitigating these medication-related injuries (6–9). Numerous global organizations, including The Joint Commission (TJC), recognize the significance of medication reconciliation in improving pharmaceutical safety (2, 5). Although pharmacists and pharmacy personnel are optimally situated to provide patient-centered medication management and perform prescription reconciliations, the execution of this procedure across the healthcare continuum has been difficult (10).

Medication reconciliation is a comprehensive procedure designed to discover and rectify medication inconsistencies before their potential to have expensive and detrimental consequences. Definitions of medication reconciliation have varied across the literature, but the fundamental concept is the act of compiling the most precise list of a patient's current medications (11). The Joint Commission

(TJC) has outlined five primary steps for medication reconciliation: compile a list of the patient's current medications; create a list of prescribed medications; compare the two medication lists; make clinical decisions based on the comparison; and convey the updated medication list to the patient, caregivers, and healthcare providers (12,14). Medication reconciliation is an essential process in both inpatient and outpatient environments and should engage various healthcare professionals across different settings. Medication reconciliation must be conducted when patients move across healthcare facilities or if a drug is altered or terminated. The objective of medication reconciliation is to establish a current list of drugs that is preserved and directs the patient's care (13-16).

Over the last two decades, several research studies have investigated the function of pharmacists in the medication reconciliation process. However, many of these studies were limited in size and poorly structured (12). We examine extensive, recently published studies and reviews that have documented the clinical and economic outcomes of pharmacists' influence on the medication reconciliation process, the prospective roles of pharmacists in this process, and the obstacles pharmacy personnel may encounter while reconciling medications.

2. Methods

For this research, we focused on studies about medication reconciliation and the involvement of pharmacy team members in both outpatient and inpatient settings. We did not impose restrictions on research from the United States. Studies not authored in English or disseminated as conference abstracts were omitted from the review. An exhaustive literature search was performed in MEDLINE, PubMed, and Web of Science, restricting the timeframe to 2012 through 2018. Search criteria encompassed: medication reconciliation OR medication reconciliations OR medication history OR medication histories OR medication discrepancy OR medication discrepancies AND pharmacy OR pharmacist.

3. The influence of pharmacists on medication reconciliation

The influence of pharmacists on medication reconciliation during transitions of care Numerous studies have shown the beneficial effect of pharmacists when included in the medication reconciliation process. Pharmacists frequently functioned as the medication therapy specialists within the health care team, significantly influencing patient outcomes, especially during transitions between health care settings (17,18). In a retrospective comparison and quality improvement analysis utilizing integrated healthcare records from Group Health Cooperative in Washington State, an evaluation was performed involving patients at elevated risk for hospital readmission who qualified for inclusion in the study. Patients were administered either a comprehensive intervention including medication reconciliation (n=243) or standard care (n=251) (19).

Patients in the intervention group got a phone call from the pharmacist within 3 to 7 days post-hospital discharge, during which the pharmacist conducted a thorough medication therapy evaluation to identify any drug-related issues and then performed a medication reconciliation. During these phone conversations,

the pharmacist also addressed patient inquiries that emerged after their recent hospital discharge. This pharmacist intervention was excluded from the standard care group. The primary outcomes assessed were readmission rates at 7-, 14-, and 30-days post-discharge, along with any financial advantages of the intervention. Intervention patients had reduced readmission rates, achieving statistical significance at 7 days: 0.8% against 4% (P=0.01) and at 14 days: 5% versus 9% (P=0.04). The projected financial effect of the pharmacist-led intervention was determined to be $1,518,600 in yearly net cost savings due to the prevention of hospital readmissions (20).

Ravn-Nielsen et al. (20) provided findings on the efficacy of multimodal pharmacist intervention in decreasing hospital readmissions and emergency department visits. This randomized controlled study had 1,467 patients who were assigned to receive either standard treatment, the basic intervention, or an enhanced intervention. Alongside medication reconciliation, patients in the basic intervention group had a patient-centered medication review conducted by pharmacists upon hospital admission, with requested modifications logged in the electronic medical record for physician evaluation when accessible. A medication review included pharmacists assessing the patient's prescription regimen for possible therapeutic deficiencies.

Patients in the prolonged intervention group had a medication review and a thorough medication reconciliation at discharge, which included motivational interviewing. Primary care providers, the patient's community pharmacy, nursing homes, and caregivers were also consulted for any medication-related concerns at discharge (14). Patients in the prolonged intervention group were subsequently monitored by telephone follow-up after discharge. The prolonged intervention had a statistically significant impact on the incidence of patient readmissions within 30 days compared to standard care (HR, 0.62; 95% CI, 0.46–0.84) and within 180 days (HR, 0.75; 95% CI, 0.62–0.90). Additionally, a similar impact was seen in the count of patients experiencing a composite of readmissions or emergency department visits within 180 days post-inclusion (HR, 0.77; 95% CI, 0.64–0.93). The authors found that pharmacists might significantly contribute to reducing hospital readmissions (14).

Research conducted by The Permanente Medical Group analyzed data from 18 Kaiser Permanente hospitals to investigate variables influencing 30-day all-cause readmissions. A total of 537 readmissions were examined, of which 250 (47%) were deemed possibly avoidable, with drug management identified as a primary area for improvement. The authors indicated that pharmacists might significantly influence outcomes in the emergency department. Pharmacists would possess the capability to provide medication reconciliation services for patients at admission or release, and thereafter deliver medication management services to enhance the overall quality of care for hospitalized patients (21-25).

A study at Northwestern Memorial Hospital examined the effects of a pharmacist-led medication intervention, which included medication reconciliation at admission and discharge, on 30-day patient readmission rates and adverse drug events (ADEs). Patients were randomly assigned to receive either standard care or the intervention (26). A total of 278 patients were included in the final analysis.

Eligibility included patients released home on more than three scheduled prescription medications or those on at least one high-risk medicine. Patients receiving standard care had medication reconciliation conducted by the pharmacist, followed by medication counseling delivered by the physician or nursing staff at the time of release. The intervention group also received a tailored medication plan developed by a pharmacist upon discharge, and medication inconsistencies were resolved before the patient departed from the institution (21).

Medication counseling was conducted, and follow-up phone conversations were arranged for days 3, 14, and 30 post-discharge. The authors documented 380 medication discrepancies (46.2%) in the intervention group, in contrast to 205 (19.9%) in the usual care group ($P<0.0001$). Regarding hospital readmissions, 55 patients (39%) in the usual care group were readmitted or visited the emergency department within 30 days post-discharge, compared to 34 patients (24.8%) in the intervention group ($P=0.001$). This research demonstrated that pharmacists were essential in correcting medication inconsistencies and improving the patient's medication regimen after discharge.

The final study examined the influence of pharmacists during hospital admission and discharge, alongside a cost analysis of the intervention. Patients aged 18 and older receiving care from medical or surgical units were included in the study over a 7-week duration. The main outcome measure was the quantity and severity of medication mistakes identified by the pharmacist for each patient per service. The secondary outcome measures were comparing the 7-day and 30-day readmission rates to a historical cohort of patients who were admitted and released from the same two units in July and August 2013. Sixty-seven individuals were evaluated for their entrance and discharge medication lists throughout the trial. A total of 84 medication mistakes were recorded, with an average of 1.25 ± 2.04 errors per patient. Six percent of these mistakes (5/84) were deemed severe; 75% (63/84) were rated as major, and 19% (16/84) as minor. The estimated total cost of avoidance was $42,400, and extrapolating these results to the entire adult population in the facility—projected at 26,000 adult discharges annually—yields an estimated cost of avoidance of $16,415,000, attributed to a hypothetical decrease in medical errors (22).

These studies emphasized the pharmacist's role in avoiding and mitigating prescription mistakes via medication reconciliation and associated treatments. These studies emphasize that medication reconciliation is a patient care service necessitating continuous contact among the patient, pharmacist, and physician. This enables the team to collaborate in delivering excellent treatment, preventing avoidable mistakes, and perhaps decreasing expenses.

Medication reconciliation is essential but insufficient for enhancing results. Historically, coordination among healthcare settings for patients with chronic conditions has been minimal. This fragmentation compromises patient safety and elevates the risk of expensive rehospitalizations (23). The Chronic Care Model (CCM) responds to the increasing demands of the contemporary healthcare system by providing an evidence-based framework for comprehensive care management. The CCM represents an organizational strategy for delivering care to

patients with multiple chronic conditions in outpatient settings, ensuring consistency of medications across various healthcare environments. It underscores the significance of a collaborative, team-oriented approach including the patient, emphasizing that the decision-maker is not just the primary care practitioner. The primary objective of the CCM is to enhance the quality and accessibility of healthcare while elevating patient understanding of health, hence improving health outcomes (24,25). The CCM delineates the essential components required to provide high-quality chronic illness management: the community, the health system, self-management assistance, delivery system design, decision support, and clinical information systems. Each component may be adjusted to enhance patient-centered chronic illness management. The CCM has been extensively used as a framework for the reformation of treatment strategies for several chronic illnesses, including diabetes and hypertension (24-27).

Medication reconciliation is an essential component of a procedure that is important but insufficient for enhancing overall results. It is a crucial element of the patient-centered care process, whereby pharmacists play a role in ensuring favorable results. Nevertheless, several methodologies are requisite to provide superior care quality. A study assessing the efficacy of a comprehensive readmission reduction initiative financed by the Center for Medicare & Medicaid Services (CMS) analyzed Medicare fee-for-service (FFS) readmissions for 10,621 patients. The quasi-experimental evaluation revealed that the readmission reduction strategy, which encompassed personalized transitional care, education, medication reconciliation, follow-up telephone calls, and connections to community resources, resulted in a 9.3% decrease in readmissions within the CMS-targeted population. Patients did not get all treatments, with a mean of 4.3 interventions administered (range 0–16), indicating that reducing readmissions requires a multifaceted approach across healthcare institutions (28).

4. Pharmacists' roles in medication reconciliation

Studies indicate that the accuracy and efficiency of medication reconciliation are enhanced when pharmacists participate directly in the process. The World Health Organization (WHO) and numerous other prominent organizations have advocated for pharmacists to conduct the medication reconciliation process, given their proficiency in drug management (29). The American Society of Health-System Pharmacists (ASHP) advocates that pharmacists play essential roles in the medication reconciliation process by designing and overseeing patient-centered medication reconciliation procedures; educating patients and their providers regarding the advantages and constraints of medication reconciliation; and advocating for patients during transitions between healthcare settings. In addition to participating in direct medication reconciliation efforts, pharmacists should supervise the formulation of policies that embed medication reconciliation procedures into the culture and daily operations of the healthcare system. Additional responsibilities, including continuous quality improvement, training, maintaining continuing competence, and therapeutic knowledge for information systems development, may also fall within the pharmacy's jurisdiction (30).

Health systems sometimes face resource limitations, necessitating the optimization and delegation of roles throughout the medication reconciliation

process to ensure the sustainability of procedures. In several healthcare environments, pharmacy teams including pharmacists, pharmacy technicians, pharmacy residents, interns (e.g., pharmacy students), and clerks may be responsible for the medication reconciliation process. Prior studies have shown that pharmacy technicians and pharmacy students have effectively participated in medication reconciliation efforts. Champion et al. (31) reviewed 32 papers to investigate the involvement of pharmacy students and technicians in medication reconciliation procedures, aiming to assess the potential for increased roles for these professionals. The authors indicated that pharmacy students and technicians with enough training could acquire medication histories, recognize differences, and implement suitable measures to rectify these disparities. Cost reductions for health systems were documented in certain studies when pharmacy technicians or students substituted pharmacists or nurses during segments of the medication reconciliation process.

In another study, Gortney et al. (32) reported on the outcomes of medication histories gathered by trained student pharmacists, evaluated by the accuracy and completeness of the ensuing discharge medication list in comparison to patients in the control group. Seventeen pharmacy student interns collected a total of 215 patient medication histories during a 12-month duration. The student pharmacists executed 76 interventions on inpatient drug regimens, impacting 25% of patients. Pevnick et al. published the findings of their three-arm randomized controlled study including 306 hospitalized patients. The first arm included standard treatment, but the second and third arms incorporated a pharmacist or pharmacy technician, respectively, in acquiring and reconciling drug information from various sources before patient admission. The involvement of a pharmacist or technician in the medication reconciliation procedure at hospital admission decreased errors in the admission medication history by almost 80% (33).

The student pharmacist's function in the institutional context is to collaborate with and learn from the pharmacist. A valuable practical experience for student pharmacists is the medication history process, which allows them to acquire and refine skills in assessing adverse drug events for risk and effectively triaging medication-related issues to the appropriate provider. The medication history method enables student pharmacists to improve their communication skills and bolster their confidence in using their theoretical knowledge in practice. This approach enables a student to strengthen their professional curriculum, possibly reduce adverse drug events stemming from erroneous prescription histories, and facilitate the student's development under the guidance of a qualified clinical pharmacist (34).

5. Obstacles to medication reconciliation

Some hospitals possess constrained resources and may encounter challenges in executing the drug reconciliation procedure. This issue is particularly evident in smaller institutions, critical access hospitals, and those catering to safety net populations. These institutions may often lack pharmacy personnel to execute medication reconciliation, or in some countries, pharmacists may not be permitted to do this procedure (35-38). The medication reconciliation procedure

may be assigned to another team member, such as doctors, nurses, or nursing assistants. Prior research has indicated the variances in outcomes when medication reconciliation is conducted by a pharmacist or pharmacy technician versus other healthcare team members. For instance, Kramer et al. found that nurses exhibited significantly higher discrepancy rates per medication (0.59) in comparison to pharmacy technicians (0.36) and pharmacists (0.16) ($P<0.001$). Pharmacists rectified a considerably greater number of inconsistencies per participant compared to nurses (6.39 vs 0.48; $P<0.001$) (37).

Challenges occur when team members conducting the medication reconciliation process lack a comprehensive understanding of various drugs and their implications for diverse illness conditions. Consequently, team members need to have enough training in conducting medication reconciliation, especially during the collection of medication history. The implementation of standardized instruments for the medication reconciliation process has yielded favorable outcomes in the admission medication lists compiled by nursing students in a community hospital (39). One study demonstrated a significant enhancement in the accuracy of medication lists during the reconciliation process among student nurses utilizing the standardized tool and receiving adequate training, compared to those who did not (87% versus 74%, $P=0.010$). Fortunately, there are publicly accessible resources to aid healthcare professionals in executing medication reconciliation practices. The MARQUIS Implementation Manual: A Guide for Medication Reconciliation Quality Improvement delineates optimal practices for medication reconciliation and offers sufficient detail for health systems to tailor these processes to their specific contexts (40). The WHO's The High5s Project – Standard Operating Protocol for Medication Reconciliation was published to facilitate the standardization of medication reconciliation procedures and to provide guiding principles for their implementation in healthcare environments (41).

The transmission of health records across facilities is a significant difficulty for health systems. Upon a patient's admission or release from the hospital, it is essential to convey and receive timely information to external providers. Although health information technology (IT) has the capacity to enhance service quality and facilitate continuity during patient transitions across healthcare settings, the expenses associated with the necessary infrastructure for medical record sharing are a significant obstacle (42). A study estimated that the expenditure for a typical five-physician outpatient practice to adopt an electronic health record system would amount to $162,000, with $85,500 allocated for maintenance in the first year alone. Community pharmacies frequently lack access to medical records from external health systems, despite patients often obtaining their prescription medications at these pharmacies while living in the outpatient environment. Support for the implementation of electronic health records and the subsequent facilitation of health information exchange is essential for enabling pharmacists and providers to enhance the consistency of healthcare information across various electronic platforms (43,44).

6. Summary

This study emphasized many exemplary studies that investigate the capacity of pharmacists and pharmacy personnel to enhance the medication reconciliation process and its implications for the whole care continuum, including the reduction of systemic costs. These studies indicate that the medication reconciliation procedure requires a collaborative approach, including the knowledge and time of several healthcare experts. Through continuous communication among all members of the healthcare team, unnecessary drug mistakes may be mitigated. While the challenges of escalating expenditures and injuries resulting from pharmaceutical mistakes in our healthcare system cannot be resolved only by medication reconciliation, it represents the first and perhaps most vital component of effective drug management.

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تأثير التوفيق الدوائي من قبل الصيادلة والممرضين في منع الأحداث الضائرة للأدوية

الملخص

الخلفية :التوفيق الدوائي هو عملية حاسمة تهدف إلى تحديد وتصحيح التباينات في قوائم الأدوية لمنع الأحداث الضائرة المتعلقة بالأدوية. يلعب الصيادلة دورًا بارزًا في هذه العملية، خاصة خلال انتقالات الرعاية، مما يؤثر إيجابيًا على نتائج المرضى ويقلل من إعادة دخول المستشفى.

الطرق :تم إجراء مراجعة شاملة للأدبيات ركزت على الدراسات المنشورة بين عامي 2012 و2018 المتعلقة بالتوفيق الدوائي ومشاركة الصيادلة في كل من البيئات الداخلية والخارجية. وتم الحصول على الدراسات من قاعدة بيانات MEDLINE, PubMed, Web of Scienceباستخدام معايير بحث محددة.

النتائج :أظهرت النتائج أن التدخلات التي يقودها الصيادلة، بما في ذلك التوفيق الدوائي والمراجعات الشاملة للأدوية، قللت بشكل كبير من معدلات إعادة دخول المستشفى والأحداث الضائرة المتعلقة بالأدوية. وكانت التدخلات التي يقوم بها الصيادلة بعد الخروج من المستشفى، مثل تقديم الاستشارات الدوائية وإجراء مكالمات المتابعة، فعالة في حل التباينات الدوائية وتحسين نظم الأدوية لدى المرضى. كما أظهرت تحليلات التكاليف وفورات محتملة مرتبطة بتدخلات الصيادلة في إدارة الأدوية.

الاستنتاج :يلعب الصيادلة دورًا حاسمًا في تعزيز سلامة المرضى وتحسين نتائج الرعاية الصحية من خلال عمليات التوفيق الدوائي. ويمكن أن تؤدي مشاركتهم في إدارة الأدوية خلال انتقالات الرعاية إلى تقليل معدلات إعادة دخول المستشفى، وزيادة الالتزام بالأدوية، وتقليل الأحداث الضائرة المرتبطة بالأدوية. وتعد الجهود التعاونية بين المرضى والصيادلة ومقدمي الرعاية الصحية ضرورية لتحسين الرعاية الصحية والتخفيف من أخطاء الأدوية.

الكلمات المفتاحية :التوفيق الدوائي، الصيادلة، انتقالات الرعاية، إعادة دخول المستشفى، الأحداث الضائرة للأدوية.