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Medication reconciliation and its essentiality in the geriatric population: A comprehensive review

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ABSTRACT

Medication reconciliation (MedRec) is a dedicated, patient-centered process with inter-professional collaboration that contributes to optimal medication management. However, evidence on the impact of MedRec in geriatric population is inadequate. This narrative review aims to comprehensively explain the MedRec process, its effectiveness in the geriatric population, and the barriers associated with its implementation, also focusing on practical questions associated with effective MedRec: when and where it should occur, contribution of healthcare providers in conducting it, and its implementation in hospitals. A comprehensive literature search was performed using appropriate keywords in MEDLINE, EMBASE, Scopus, Google Scholar, and Web of Science databases to identify relevant clinical studies, systematic reviews, and narrative reviews from 1993 to 2024. The studies were screened based on their title or abstract, and the most relevant papers were included. Polypharmacy was found to be very common among elderly patients with multiple comorbidities which lead to inappropriate prescriptions, adverse drug effects (ADEs), increased duration of hospitalization, decreased quality of life, and increased healthcare costs. MedRec prevents these errors and in turn enhances the quality of care. MedRec was found to reduce ADEs, duration of stay, hospital admissions and readmissions, or fatality. Significant clinical outcomes were also observed in terms of increased overall survival, lower death rate, fewer falls, and enhanced social interaction, mood, and attentiveness. MedRec is required at interfaces of care and transitions between facilities such as acute hospital care, community, or long-term care where patients are prone to higher risk for medication discrepancies. MedRec has shown significant results but its large-scale implementation is still challenging due to barriers such as obtaining an insufficient best possible medication history, lack of inter-professional collaboration, inadequate staffing, lack of resources, or complications in workflow. The collaboration of healthcare providers (especially pharmacists and geriatricians) is crucial for its effective implementation among geriatric population for improved management of medication risks.

1. INTRODUCTION

Medication management for elderly individuals, particularly those with frailty, can be challenging. The occurrence of numerous comorbidities indicates that polypharmacy is common among older persons. This gives rise to prescription errors, adverse medication events, and increased expenditure [1]. Adverse drug events (ADEs) constitute one of the most common causes of patient injury and mortality. According to a pharmacovigilance memo issued by the European Commission, it was estimated that nearly 5% of all hospital admissions were caused by ADEs, which were responsible for 197,000 deaths annually in Europe [2]. According to the US National Electronic Injury Surveillance System Cooperative ADE Surveillance

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(NEISS-CADES) project, there were an estimated 4.0 ED visits for ADEs per 1,000 individuals annually in the United States. About 34.5% of ED visits for ADEs occurred in older adults (aged ≥65 years). Of note, 27.3% of ED visits for ADEs resulted in hospitalization. Hospitalization rates were highest for older adults (aged ≥65 years), of whom 43.6% were hospitalized. The hospitalization rate for ADEs among older adults was 7 times greater than for the younger individuals [2]. Data from the Annual Report for China's National Adverse Drug Reaction (ADR) monitoring showed that it received a total of 1.676 million ADR/ADE reports in 2020, of which 506,000 were new and serious ADRs. Mortality and ADE-related trends are associated with longer hospital stays, a threefold increased risk of death, and increased overall costs, particularly in the geriatric population [3]. The reported incidence of ADRs in India ranges from 3.7% to 32.7%. The rate of ADRs during hospitalization was 8.8%, and the patient admission due to ADRs and death rates due to adverse reactions were 1.7% and 0.32%, respectively, determined using the intensive monitoring pharmacovigilance method. The average cost of ADR treatment per patient is ₹3,367 [4].

Previous studies have shown that most ADRs are preventable and that medication reconciliation (MedRec) is very efficacious in reducing these drug-related injuries [1, 5]. Many institutions around the world, such as The Joint Commission (TJC), recognize drug coordination as a key element in improving drug safety. As the population ages, the number of patients with various chronic diseases is increasing, and providing care for these patients causes an extensive challenge to healthcare systems [6]. Knowing what all medications geriatric patients are consuming is crucial, as aging changes the metabolism of medications in the body. MedRec is essential to avoid overdoses, drug errors, and adverse events [7]. However, the implementation of MedRec in geriatric patients remains unclear as there is insufficient evidence to comprehensively summarize the application of MedRec for geriatric patients. The challenges associated with the steps in MedRec need to be considered to implement MedRec to truly optimize drug prescribing for elderly patients [1]. The existing evidence on the MedRec process in geriatric patients is sparse, and there is no research that cumulatively describes the point of occurrence of MedRec, timing, priority patients, healthcare professionals involved, the implementation process, use of electronic tools, associated barriers, and its effect on health outcomes solely with regard to geriatric patients. Therefore, this narrative review aims to comprehensively explain the MedRec process, its effectiveness in the geriatric population, and the barriers associated with its implementation, also focusing on the appropriate timing, setting, priority group of patients, healthcare professionals involved, and the implementation process of MedRec.

1.1. MedRec Process

MedRec identifies the most accurate list of all medications that a patient is taking, including name, dosage, frequency, and route of administration, and uses this list to deliver the correct medication to the patient throughout the health system [8]. When conducted as intended, MedRec is a professional, patient-centred process that contributes to optimize medications for effectiveness and safety [9]. A standardized MedRec process presents a substantial opportunity to minimize preventable medication-related harm. Several randomized controlled trials, systematic reviews, and meta-analyses that involved pharmacist-led MedRec interventions have reported significant reductions in drug-related problems such as medication discrepancies, potential adverse effects, hospital readmissions, and emergency visits.

The three main steps of MedRec are (1) establishing the best possible medication history (BPMH); (2) comparing BPMH to existing prescriptions to detect and rectify discrepancies; (3) communicating with the concerned healthcare providers and thereby making relevant clinical decisions [1]. The BPMH is the foundation of MedRec. It differs from a conventional medication history in that it includes an organized process of interviewing the patient and/or family, and reviewing a minimum of two sources of information (e.g., patient, caregivers, prescription, medical records, checking medication bottles, or communicating with the community pharmacy) [1, 10].

MedRec should be conducted at every transition of care to prevent medication discrepancies. MedRec is not only a process to minimize medication errors, but it is also the cornerstone for almost any medication management or optimization procedure [11]. Therefore, the implementation of MedRec is mandatory, and the focus should now be to ensure the comprehensive implementation of MedRec rather than contemplating on whether it is needed or not [1]. The MedRec process has been illustrated as a flowchart in Figure 1.

There are a number of international guidelines for implementing MedRec, including those from the World Health Organization, Institute for Healthcare Improvement, and the UK's National Institute for Health and Care Excellence (NICE) [12]. Additionally, many national pharmaceutical societies provide guidelines, practical tools, and educational support for implementing MedRec [1]. However, in practice, accurate drug history is challenging; MedRec is time-consuming and requires pharmaceutical care expertise. The entire MedRec process requires teamwork between hospital pharmacists, treating physicians, and patients. Therefore, widespread adoption of MedRec raises questions about the adequacy of organizational tasks and human resources for the required steps [1].

MedRec processes have proven to be difficult to implement across the continuum of care, due to some barriers such as time constraints, lack of resources, lack of staff, or inadequate inter-professional collaboration [1]. With the rapid and large-scale electronic prescription data, information technology (IT) can assist a healthcare professional in implementing MedRec. However, because MedRec is a process that involves multiple medical professionals, it creates organizational problems that cannot be solved with IT tools alone and will require detailed policies to ensure its successful implementation.

MedRec may have an impact on complex systems that usually differ between and even within organizations. One example of variations within an institution is when the admitting doctors occasionally issue orders in the ED prior to other healthcare professionals, and occasionally they may do so after other clinical staff (such as ward nurses) have obtained

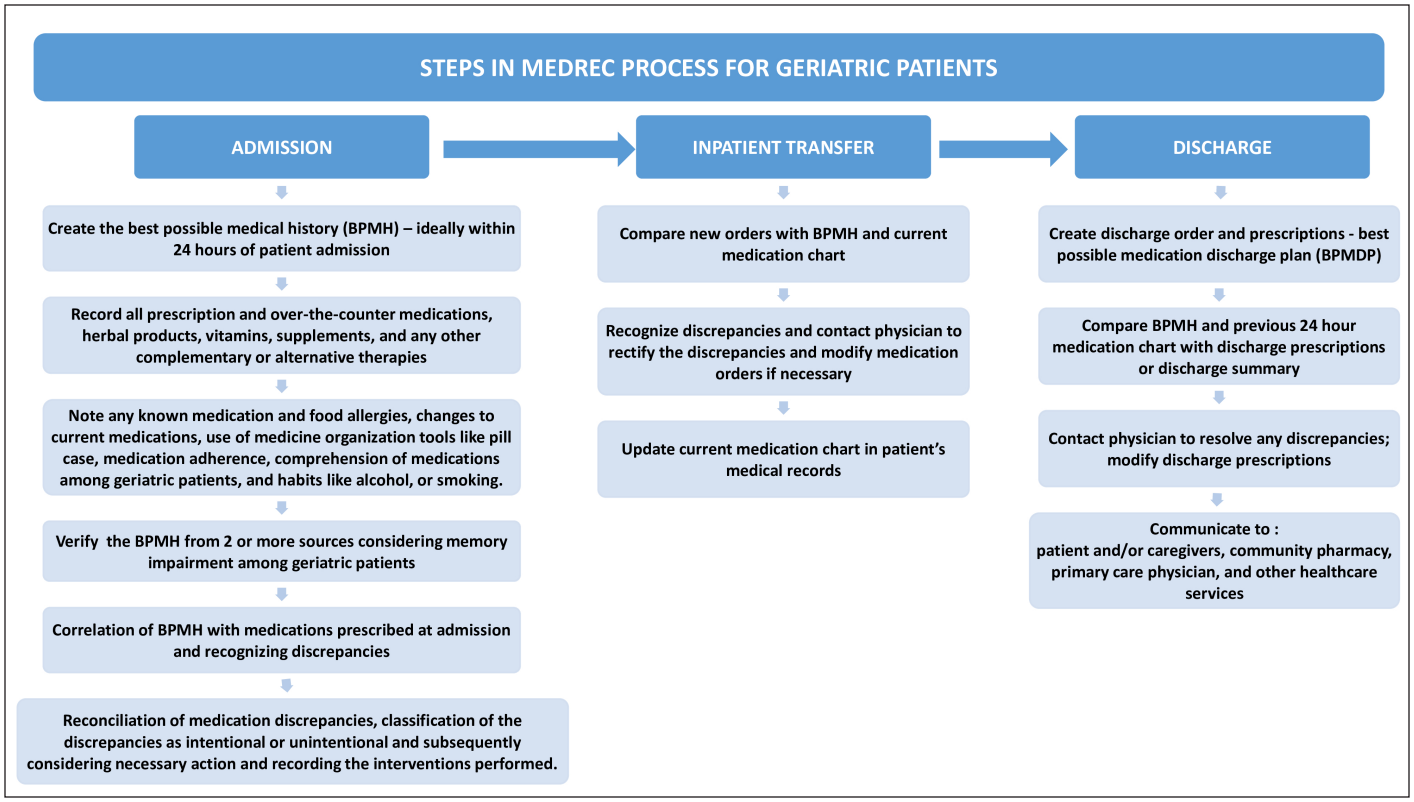

Figure 1. Steps in MedRec Process for Geriatric Patients.

the medication history. Another example of variations across health care institutions is of the instances when medication histories are obtained in the outpatient department by healthcare assistants who lack pharmacology training. Since EHRs permit the transfer of medication history along with its errors between different institutions, healthcare providers must understand that procedural differences may result in significant differences in the quality of medication history. Nevertheless, the amount of resources needed to execute MedRec effectively is a significant barrier to extrapolating interventions from the literature to the majority of institutions. Hence, it is often restricted and targeted typically towards patients at high risk and for the convenience of the clinician because few organizations have the resources to get the best possible medication histories at the beginning of each inpatient encounter. Organizational leaders are tasked with tough compromises in the context of costly opportunities and unclear estimations of positive outcomes at the institutional and literature levels.

2. METHODS

The narrative review is reported in accordance with the Scale for the Assessment of Narrative Review Articles (SANRA) [13]. This scale is based on formal criteria used to assist readers in evaluating the quality of a narrative review article. SANRA comprises of six eligibility points which include: (1) reasoning for the significance of an article for its readership; (2) statement of aims or formulation of questions; (3) sources of information on which the text is based must be described transparently along with a precise description of search methods; (4) presence of key statements with sufficient referencing provided for the statements; (5) stating of suitable arguments with scientific justification; and (6) suitable presentation of data [13]. A comprehensive literature search was performed in electronic databases such as Google Scholar, MEDLINE, Scopus, Embase, Cochrane Library, and Web of Science using the keywords "MedRec," "geriatrics population," "ADR," "medication safety," "polypharmacy," and "health outcomes." The eligibility of all the potential articles was evaluated in two steps. The studies were screened based on their title or abstract in the first step of assessment. In the second step, the studies were filtered based on the results and discussion, and the most relevant papers related to the topic were included. Original articles on MedRec and medication discrepancies in the geriatric population published in reputable journals, such as Scopus or Web of Science in the English language between 1994 and 2024 were included in the study. Articles which addressed the implementation of the MedRec process and the identification of medication discrepancies in geriatric population were included. Articles that did not comply with the inclusion criteria, presented as duplication, or were not relevant were excluded. Data extraction was carried out by collecting the names of the authors, year of publication, and the implementation of the MedRec process in the geriatric population. Medication discrepancies and other information such as source of BPMH, point of conducting MedRec and the use of any electronic tools were extracted independently. All data were presented in summary tables and narratives.

2.1. Essentiality of MedRec In Geriatric Population

The presence of various chronic diseases, often accompanied by polypharmacy, poses significant risk to health, especially for geriatric patients [9]. It can be difficult for elderly patients to recall their medication names, duration, and dosages forms, mainly if they do not live with their caregivers or missed to bring all their medication strips or bottles along with them to hospital visits. Physicians require precise past medication history details to avoid overdoses, drug errors, and adverse events. Knowing what all medications geriatric patients are consuming is crucial, as aging changes how a medication works in the body. It includes variation in the classic ADME system—absorption, distribution, metabolism, and excretion (clearance)—that can prolong the half-life of drugs, elevate the potential for drug toxicity, and also increase the likelihood of ADEs. A 25%–35% decrease in liver size and a 40% decrease in liver blood flow are common in healthy elderly patients, leading to drug withdrawal that may alter the effectiveness of the prescribed medications [10, 11].

Clinical pharmacists often contribute to MedRec implementation in geriatric units due to the high rate of polypharmacy, the frequency of medication discrepancies in geriatric care settings, and the high risk of adverse events, as mentioned in Table 1. In a systematic review, Cameli *et al*. suggested that pharmacist-led MedRec can prevent medication errors among older adults. Pharmacists were successful in the detection of medication errors and in providing recommendations to physicians [14]. In particular, increasing awareness among geriatricians about the importance of medication management will facilitate collaboration with pharmacists. Additionally, national and international initiatives have been initiated to promote widespread dissemination and implementation of MedRec in geriatric care settings [15].

2.2. Setting of MedRec

A comprehensive MedRec process is crucial for patient safety as it identifies unintended medication discrepancies and ADEs, especially at care transitions [16].

Although there is growing literature on MedRec in the outpatient department, most studies still focus on the hospital setting [17, 18]. MedRec occurs at interfaces of care (admission, internal transfer in the hospital, discharge) and at transitions between healthcare settings such as acute hospital care, community, or long-term care, where the patient is prone to higher risk for medication discrepancies [19].

Various strategies for the effective implementation of MedRec are needed, which include a standardized MedRec process throughout the hospitals, surveillance of the implementation process, effective methods of communication for all hospital staff involved in the MedRec process, regular monitoring systems, participation of patients and families, and use of IT [20].

Table 1. Literature related to the need for MedRec in the geriatric population.

Authors	Source of BPMH	Type and frequency of medication discrepancies
Chabane Sari-Benzengli [56]	Medical records, interviews with the patients or caregivers, evaluation of previous prescriptions, and communication with physicians and pharmacists.	Forty-four geriatric patients were included in 2012, with 349 prescriptions and 406 discrepancies. These included additions (36.9%), interruptions (31.5%), substitutions (19.5%), and incorrect dosages (12%). These included both intentional and unintentional discrepancies, and 5 (1.23%) of them were observed to be potentially serious.
		Forty-seven geriatric patients were included in 2022, with 564 prescriptions and 148 discrepancies, of which 119 were intentional and 29 were unintentional. Five (3.38%) of them were observed to be potentially serious.
Hadzic *et al.* [57]	Patient/carer interview, community pharmacy	A total of 114 geriatric patients were included, of which 85 additional medication discrepancies were detected, i.e., 1–6 per MedRec. Drug omissions constituted about half of these discrepancies (49.4%), and majority of them were found to have "low" potential clinical significance (59%).
Fétique *et al.* [58]	Computerized patient file, prescriptions, systematic telephone call from community pharmacies, interview with the patient and / or with the family or private nurses, the medications brought by the patient, letter from the attending physician or a specialist, the call from the attending physician, etc.	Among 213 geriatric patients, 287 medication errors were detected, i.e., 1.3 medication errors per patient. Pharmacists and doctors rated the severity of medication errors and qualified 3.8% of medication errors as major, 29.3% as significant and 66.9% as minor. Medication errors mainly concerned 3 pharmacological classes. Medication errors of cardiovascular class appear to be at higher risk (58.7% at least significant) than digestive tract class and metabolism (minor at 82.9%) or the nervous system class (minor at 53.2%).
Vargas *et al.* [59]	Medical files, records from earlier hospital admissions, review of "brown bag," prescriptions from community care, and patient interviews.	MedRec errors were detected in 102 (49.5%) patients out of a total of 206 geriatricpatients.1996 medications were evaluated, and 56.0% had unintentional discrepancies. Drug omission was the most commonly found type of discrepancy (65.1 %).
Vouri *et al.* [60]	MedRec Review of Systems Subject (MR ROSS) tool	Thirty-one (77.5%) out of 40 geriatric patients were observed to have≥1 omission errors.
Koehler *et al.* [61]	Personal health record (PHR), patient interview.	Readmission and ED visit rates were reduced in the intervention group (MedRec) at 30 days compared to the control group. The time interval for readmission/ ED visit post-discharge was longer in the intervention group compared to usual care.

Implementing MedRec in home healthcare also benefits patients. Preventing harm from drug use is crucial for patients and caregivers**,** as well as keeping patients out of hospitals and long-term care facilities [21]. Der *et al.* [22] investigated the potential benefits of pharmacist conducting home medication assessments for 20 frail older adults. It was found that in-home pharmacy evaluation revealed various problems associated with the administration of medications, which were not otherwise detected easily. Additionally, a reduction in medication discrepancies and their issues was recorded three to four weeks later than in-home pharmacist visit. Setter *et al.* [23] initiated collaboration between the pharmacist and nurses to identify and resolve medication discrepancies in patients aged 50 years and older during transition from hospital to home care and observed significant improvements in resolving medication discrepancies. Pherson *et al.* [24] implemented a post-discharge, pharmacist-provided home-based medication management service and found that it enhanced the continuity of patient care during the transition from hospital to home. As they have the potential to identify and resolve drug discrepancies, give necessary education to the patients related to their medicines, and provide a complete and reconciled medication list to primary care providers and community pharmacies [25].

2.3. Timing of MedRec

Most hospitals first aim for MedRec upon admission or discharge. Both options have implementation problems, making it difficult to determine which option is best for a particular hospital [18].

Incorporation of discharge reconciliation into the overall discharge process is a major obstacle as it requires additional work by doctors, nurses, pharmacists, and other health professionals. Although reconciliation at admission prevents complications in the discharge process, the obtaining of BPMH is currently hindered by time pressure at admission, especially in the case of critically ill patients. The term "on admission" has been expanded to include the time span within 24–48 hours of hospital admission to address this concern of time pressure. While this addresses the time pressure issue, it lacks MedRec functionality to assist in the process of creating medication orders at the time of admission [18].

Time constraints could also be overcome in the clinical scenario by

1. providing regular training to healthcare providers and medical assistants on conducting MedRec;
2. training elderly patients on medication basics and MedRec to enhance health literacy and ownership;
3. promoting inter-professional collaboration;
4. improvising the current electronic health records (EHR) to facilitate communication between healthcare providers, community pharmacists, patients, and care partners.

Pharmacy-led MedRec interventions have proven to be an effective strategy for reducing medication discrepancies and had a valuable impact when delivered either during admission

Table 2. Literature related to MedRec occurrence.

Author	Point of MedRec	Findings
Bajeux *et al.* [62]	Admission and discharge	Patients who were given MR both on admission (MRa) and discharge (MRd) were not observed to have lesser incidence of deaths, emergency visits associated with ADEs, or unplanned re-hospitalizations 30 days after discharge as compared with patients given MRa only. But patients who were given both MRa and MRd felt more satisfied about their discharge from the hospital and found it to be better organized and that their community pharmacist received information regarding their hospitalization.
		No effect of MRd was found on healthcare utilization in patients over 65 years, 30 days after discharge; however, the process enhanced patient experiences.
Montaleytang *et al.* [6]	Discharge	MedRec helped in the detection and rectification of 87 unintentional medication discrepancies at admission and 54 at discharge, among 112 patients. Patients were discharged to homes or nursing homes (61%), geriatric rehabilitation centers (38%) or psychiatric units (1%).
		General physicians gave the first renewal of prescription after a mean of 36 ± 23 days after discharge and were aware of the MedRec in only 24% of the cases. Consequently, there was a reduction in patients with a minimum of 1 discrepancy. About 25% of general physicians who were aware about the MedRec process agreed to the therapeutic modifications, while only 7% of those who were not aware did so ($p = 0.02$). Therefore, MedRec must be considered by community physicians to optimize the treatment of geriatric patients after discharge.
Bermejo *et al.* [63]	Emergency department	On ED admission, MedRec was performed on 553 patients for 6027 drugs; 1050 unjustified discrepancies were detected, 326 medications were potentially inappropriate, with 92 drug interactions, and 72 reconciliation errors (0.13 MedRec error per patient). Therefore, pharmacist-led MedRec in the ED is a successful method of detecting and rectifying medication errors.
Seychell *et al.* [36]	Admission	One hundred fifty-four MedRec interviews were conducted. Of note, 136 (88.31%) patients had at least 1 medication error. In total, there were 498 errors (mean of 3.23 errors/ patient); 208 (41.77%) medication errors potentially needed intervention or monitoring to prevent harm while 33 (6.63%) medication errors were potentially harmful. Therefore, MedRec by a clinical pharmacist was a successful method of detecting and rectifying medication errors.
Beckett *et al.* [37]	Admission	Pharmacists were able to detect 116 discrepancies in 81 patients which mainly included omissions (41%) and a combination of wrong route, frequency, or dose, (35%). An average of 15 minutes per patient was spent by the pharmacists, and they improved the MedRec process at admission for elderly patients.

or discharge, but were less effective across various transitions in care [24]. In general, beginning the MedRec process during or soon after admission may eventually be effective. As a result, the discharge process will be very accurate, effective, and efficient if a BPMH is in existence (Table 2).

2.4. Priority Group for MedRec

It seems reasonable to focus on patients who will gain the most from MedRec, given the scarcity of human resources and hospitals' difficulties implementing it completely throughout the continuum. According to some authors, candidates for MedRec may be filtered based on their age, as those above 65 years or those taking four or more medications [26, 27]. Other risk factors could include high-alert medications, history of hospitalizations, chronic conditions that require frequent drug changes, and patients who require excessive in-hospital medication adjustments [18]. As a result, the majority of elderly patients would fall under these parameters, giving them priority status for MedRec.

Cognitive impairment among elderly patients can also present barriers for MedRec when gathering medication histories from patients upon admission or providing medication education and counselling to patients at discharge. Therefore, healthcare providers must remember that most elderly patients may face some challenges in health information, and so they must adopt universal precautions when interacting with them. These include the use of simple language, communication tools such as multimedia, and the teach-back method (to make the patient repeat instructions to evaluate his/her understanding).

2.5. Healthcare Professionals' Responsibilities Toward MedRec Activities

Hospital pharmacists are in a unique position to assist patients and multidisciplinary groups with MedRec because of their educational background and experience. This could lead to improved accuracy as well as better clinical and financial results. Pharmacist-led reconciliation had the highest projected net savings and a likelihood of being economical by over 60%, according to a cost-effectiveness analysis by Karnon *et al.* [28].

Prior research has documented the variations in results when a pharmacist or pharmacy technician conducted MedRec as opposed to other members of the healthcare team [2]. According to Kramer *et al.* [29], nurses had considerably greater medication discrepancy rates (0.59) than did pharmacists (0.16) and pharmacy technicians (0.36) ($p < 0.001$). Conversely, compared to nurses, pharmacists rectified considerably greater discrepancies per participant (6.39 vs. 0.48; $p < 0.001$).

Whenever possible, pharmacists should engage in collection/validation and/or reconciliation of the patient's medication list and comparison of the list with prescription orders. When they are unavailable, these duties should be performed by another trained healthcare professional, such as doctor, therapist, nurse, or technician, depending on their qualifications [17, 30].

Nurses can also be involved in conducting basic or full MedRec based on the clinical setting. Secondary care nurses who perform triaging may conduct basic medication reconciliation followed by full reconciliation along with a clinical pharmacist or pharmacy technician. In walk-in centers, specialist clinics, pre-assessment clinics, or urgent care centers, nurses may not have the support of pharmacists, so it is necessary that they take a similar approach, for instance by using two or more sources to gather the most precise medication list. Therefore, nurses are an untapped hospital resource who can actively participate in MedRec at discharge if they are given adequate training and motivation.

An inter-professional team approach is optimum for hospital-based MedRec, according to a new US board of stakeholders from consumer, clinical, professional, and regulatory groups [8]. Interdisciplinary health care providers should collaborate with patients and families to share responsibility for the MedRec process. A team approach involving prescribers, nurses, pharmacists, pharmacy technicians, and other healthcare providers is necessary for MedRec. Effective models vary from hospital to hospital as well as among teams within a hospital [19]. An inter-professional approach can increase productivity by eliminating redundancy in the conventional method of doctors and nurses performing separate drug histories [18].

Providing healthcare professionals with official practical training on how to carry out a BPMH methodically and effectively is crucial, irrespective of their profession [7, 8, 30]. Healthcare professionals must use a medication history interview guide when possible as part of a methodical procedure and must be diligent, accountable, and responsible when taking a medication history. They should take the time to verify that a drug is appropriately recorded (medication name, dose, and frequency) from a resource if they are uncertain regarding it [19].

Patients are also vital associates in the MedRec process. Reconciliation will barely have any benefits if patients cannot comprehend their medication list [18]. MedRec can be successful when there is active involvement of patients and their families, as they are the only factor that is constant in the process. They can provide the best information regarding their list of medications. Evaluating a patient's comprehension of their discharge medication plan is an excellent way to explain changes to the MedRec process at discharge [19].

2.6. Implementation Process of MedRec

A comprehensive and accurate medication list that is developed, maintained, and communicated across the continuum of care is essential for the successful implementation of medication reconciliation [31]. Hospitals should acknowledge that effective adoption of high-quality MedRec practices to successfully prevent adverse events necessitates careful organizational and inter-professional planning as well as effective leadership. The fundamentals of MedRec entail determining the individuals involved and the tasks that must be accomplished.

The steps given in the following outline a proposed approach for MedRec that can be utilized straight or customized according to local practices [31].

1. Creating the BPMH: The BPMH should be completed within 24 hours of patient admission, and any discrepancies must be detected and conveyed to the prescriber. MedRec conducted after 24 hours will benefit the patient, although

it is not considered to be ideal [19]. To ensure safe and appropriate prescribing in healthcare settings, an updated, accurate, and comprehensive patient medication list, which includes all prescription and over-the-counter medications, herbal products, vitamins, supplements, and any other complementary or alternative therapies the patient may be using must be obtained. Any known medication and food allergies must be noted along with changes to current medications, the patients' comprehension of their medications, use of medicine organization tools such as pill case, medication adherence, and habits such as alcohol, smoking, or drug usage. MedRec must be conducted using a structured and standardized procedure. Electronic or paper-based tools may be utilized to expedite the MedRec based on the resources available. Patients and their families must be involved to obtain accurate information and their consent must be obtained.

2. Correlation of BPMH with medications prescribed at admission, inpatient transfer, or at discharge, and recognizing discrepancies. Other allied healthcare providers, including doctors, nurses, and pharmacists, must be contacted to verify information in hospital or community settings.
3. Reconciliation of medication discrepancies, classification of the discrepancies as intentional or unintentional and subsequently considering necessary action and recording the interventions performed. Responsibilities must be shared between the healthcare professionals.
4. Analysis of MedRec practices for geriatric population in other countries or regions.
5. Analysis of the clinical and financial impact of MedRec in the geriatric population.
6. Creation of policies and guidelines relevant to MedRec in the geriatric population. National health organizations can facilitate the implementation of MedRec by promoting communication across different healthcare systems, and easy access to medication databases and medication order entries. Additionally, national policies may be created to organize standardized educational interventions delivered by experienced healthcare professionals across all hospitals.
7. Planning of action to test MedRec in the geriatric population.
8. Formation of a committee to review and monitor the service.
9. Develop the data to be collected to assess the service, which can include the number of MedRec or the number of discrepancies detected in each reconciliation.

2.7. Electronic Tools

Various organizations have recommended the utilization of IT tools in MedRec to minimize medication discrepancies. These electronic tools are computerized tools that can support the MedRec process. Such tools enable healthcare professionals to distinguish between the BPMH and medication orders, find discrepancies by presenting the medication lists, and address discrepancies by giving the following choices: continue, modify, or stop a medicine (Table 3) [5,32].

1. Computerized physician order entry (CPOE): The pharmacist can quickly receive the most up-to-date information on available medications by using this system, which guarantees that the they are brought up to date with the patient's medications in real-time [31].
2. Personal health records (PHRs): It is a computerized tool from which patients may view and manage their cumulative health data and also make parts of it available to those who need them. PHR allows patients to share all or part of their medication history, as required during the MedRec process.
3. EHR: It is an electronic medical history and an overall record of the clinical information of a patient that is managed by healthcare professionals. It is useful for medicines reconciliation in inpatient as well as outpatient settings, and also in community pharmacies [31].
4. Shared electronic medical record: This tool is used to maintain the PHRs of patients in a system, which may contain prescription drugs, laboratory test results, and imaging data. Healthcare providers in a certain jurisdiction have easy access to this information with their approval [31].
5. Smart electronic discharge summary: It is used to generate and submit a discharge report of a patient based on their medications before admission and during hospitalization. A pharmacist uses the data available in patient's electronic discharge report in medicine reconciliation [31].

Table 3. Literature related to the use of electronic tools for MedRec in geriatric population.

Author	Tool	Findings
Hung *et al.* [64]	Integrated electronic MedRec (ieMR) platform	MedRec reduced the number of duplications from 25,196 medications (pre-2.3%) to 23,413 medications (post-3.8%). Medication-related hospital revisits at 30 days were also significantly decreased in the geriatric unit.
Agud *et al.* [65]	Electronic inter-consultation request; Farmatools, (Dominion, Bilbao, Spain); Horus Information System (Madrid, Spain); Drug information at discharge sheet (DIDS) (Microsoft, Seattle, WA, USA)	Medication discrepancies were identified in 723 medications (35%), of which 105 (15%) were regarded as medication errors. A minimum of 1 error was found in 66 patients (56%), i.e., 0.9 reconciliation errors per patient. 14 medication errors (13%) were regarded as serious. Partial prescriptions (40%) and omissions (35%) were the most common errors. Therefore, electronic MedRec assists pharmacists in identifying medication errors in geriatric patients and also gives the latest and comprehensive information to minimize further errors.
Vargas *et al.* [59]	CPOE	CPOE was found to be a protective system as the occurrence of MedRec errors was reduced with CPOE in geriatric patients.

According to a systematic review of the economics of IT in medication management, most studies showed decreased costs in some areas due to the intervention such as reduction in medication costs and length of hospitalization. These changes can result in long-term cost savings and improved quality of care [33]. In another cost-effectiveness analysis of a hospital electronic medication management system (eMMS), the eMMS was observed to be less expensive and more effective than paper-based prescribing [34].

2.8. Barriers Associated with MedRec in Geriatric Population

1. Insufficient BPMH: Some patients may be unable to give accurate information about their medication history, especially geriatric patients in acute care settings, when a patient is brought in the midst of an emergency, or if their present medical conditions affect their memory or cognition. Patients could also lack sufficient knowledge of their medications which can be a barrier as the patient is the essential source of information to obtain the BPMH. Hence, it is vital to verify the BPMH from a minimum of two different sources, which includes the hospital or community pharmacist, caregivers, or family [31].
2. Inter-professional collaboration: Communicating with doctors to suggest changes in prescription orders as a response to errors in medication history can be challenging for pharmacists. They may face barriers in communicating with the responsible healthcare professional in case of patients being reviewed by various specialists in different work shifts [2,35]. When reconciling inadvertent discrepancies throughout the reconciliation process, pharmacists may encounter opposition from other healthcare providers [18]. Problems may arise when members of the team who conduct the MedRec do not have adequate knowledge of various medicines and their usage in different diseases. Therefore, it is essential for all members to be given suitable training on conducting MedRec [2].
3. Inadequate staffing: Time restrictions caused by a shortage of pharmacists may not allow for a successful medicine reconciliation process in various hospital settings, especially in smaller organizations and critical care hospitals [35].
4. Lack of resources: In some situations, restricted availability of technology can make documentation and gathering of information more difficult and time-consuming [36]. Standardization of the process of MedRec conducted by nursing students using standardized tools has shown good results in the medication list on admission in a community hospital [2]. However, there are public tools accessible to help healthcare providers establish MedRec strategies. The MARQUIS Implementation Manual: A Guide for MedRec Quality Improvement highlights the guidelines for practicing MedRec and gives sufficient details for health centers to adopt these practices based on their setting [37]. The High5s Project: Standard Operating Protocol for MedRec was issued by the WHO to aid in standardization of MedRec practices and provide guidelines to implement them in healthcare centers [19].
5. Complications in workflow: One of the main issues facing healthcare systems is the potential to transfer health records from one center to another and inadequate access to necessary information (hospitalization or discharge). Information on a patient's admission or discharge from the hospital must be promptly received and transmitted to outside providers. Pharmacies frequently lack access to healthcare information from external health systems. The adoption of EHR and easy access to the exchange of health information is required to permit healthcare professionals to enhance the accuracy of healthcare information over different electronic platforms [2].
6. Potentially hindering barriers: These include the lack of adequate compensation and the lack of an intuitive or user-friendly documentation system [38].

2.9. Effect of MedRec on Health Outcomes in Geriatric Population

There is insufficient data to conclude that MedRec considerably enhances patient outcomes or management in the elderly population**. A** scarce number of studies have evaluated and proved that MedRec reduced ADEs, duration of stay, hospital admissions, and readmissions, or fatality [39]. Significant clinical outcomes in terms of increased overall survival [40], lower death rate [41], fewer falls [42], and enhanced social interaction, mood, and attentiveness, were reported in four studies [43]. There is inadequate evidence in support of the intervention in terms of geriatric patient mortality, duration of stay, ED visits, unplanned prehospitalization, and utilization of healthcare [44]. Furthermore, some studies have reported no impact of MedRec on healthcare outcomes in geriatric patients. Ceschi *et al.* did not observe an impact of a MedRec intervention on ED visits and hospital readmissions within 30 days post-discharge in patients aged over 85 years [45]. In a study that included patients aged over 18 years (mean age of 70 years), pharmacist-led MedRec did not reduce the percentage of readmissions at 30 days in patients with respiratory disease [46].

Hence, research focusing on the evaluation of medication management in geriatric patients should be prioritized, as there is little evidence in support of the improvement of health outcomes in elderly individuals by MedRec [39]. In addition, a comprehensive MedRec process can correct medication-associated problems, thereby preventing significant clinical consequences which can result in considerable cost savings. However, the economic impact of MedRec on the healthcare system in the elderly population, in particular, has not been assessed and warrants further research in this area.

2.10. Geriatrics Patient Preferences

A lack of awareness about their medications is a frequent challenge among geriatric patients [47]. Previous studies observed unsatisfactory knowledge among geriatric patients regarding their prescribed medications and needed improvement [48–50]. Most patients experienced several problems with the use of their medications, such as problems reading and understanding the instructions for use, handling the packaging, preparing before use, and taking the medicine [51].

The patient has an essential role in the MedRec process and must be educated on the significance of medication information during discharge or in an outpatient setting. This education must consist of the necessity of providing a medication list to their healthcare provider, revising their list when the medicines are stopped, doses are modified, or new medications are added, and keeping their medication information with them at all times in case of emergency.

Promotion of a patient-centred strategy instead of a disease-centred one has been suggested as a necessary step toward enhancing the outcomes for elderly people with multiple medical conditions [52]. Aligning the recommendations for treatment with the patient's needs and priorities via shared decision-making (SDM) is especially crucial for minimizing the prevalence of inappropriate polypharmacy in older individuals [1]. The majority of the decisions regarding beginning, quitting, continuing, choosing, or altering medicines in elderly individuals with multiple systemic conditions are based on their preferences. SDM aids in increasing the awareness of patients who can select more prudently (e.g., to stop medications, decrease the dosage, fewer changes in medications, and start fewer medications); this assists in de-prescribing and decreases the burden of treatment significantly [1].

From the clinician's perspective, common hurdles to permitting patient choices include time restrictions, apprehensiveness to talk about preferences, and physicians assuming that many patients are unlikely to gain anything from SDM or will not choose to participate [1]. On the other hand, most elderly individuals desire to take part in SDM but are not supported in it [53]. SDM is an additional challenge for elderly individuals with cognitive disorders or inadequate health literacy. Individuals with mild-to-moderate dementia and minimal cognitive impairment can be involved in decision-making regarding medication, and tools will be created to support this process [54, 55].

3. CONCLUSION

MedRec is of great clinical significance in geriatric medicine with its involvement in the management of medication risk. It facilitates the collection of information necessary for taking the BPMH and identification and correction of medication discrepancies. A comprehensive MedRec process can correct medication-associated problems, thereby preventing significant clinical consequences that can result in considerable cost savings, for instance, by reducing medication costs and length of hospitalization. MedRec has shown positive results, but its large-scale implementation is still challenging. It is a laborious process and demands particular skills, collaboration of various healthcare providers and institutions, and availability of resources. Electronic tools can also assist healthcare providers in the execution of MedRec. They enable healthcare professionals to distinguish between the medication history and medication orders, find discrepancies by presenting the medication lists, and address those discrepancies. Nevertheless, the collaboration of healthcare providers (especially pharmacists and geriatricians) is crucial for the effective implementation of MedRec among the geriatric population for improved management of medication risks for elderly individuals.

4. AUTHOR CONTRIBUTIONS

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agree to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the International Committee of Medical Journal Editors (ICMJE) requirements/guidelines.

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6. CONFLICTS OF INTEREST

The authors report no financial or any other conflicts of interest in this work.

7. ETHICAL APPROVALS

This study does not involve experiments on animals or human subjects.

8. DATA AVAILABILITY

All the data is available with the authors and shall be provided upon request.

9. PUBLISHER'S NOTE

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10. USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that they have not used artificial intelligence (AI)-tools for writing and editing of the manuscript, and no images were manipulated using AI.

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