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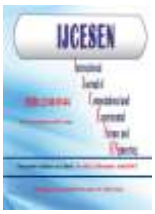

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Research Article

Medication Reconciliation Practices in Clinical Settings: A Review of Nursing and Pharmacy Roles

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Abstract:

Medication reconciliation is a critical process in clinical settings aimed at ensuring patient safety by minimizing medication discrepancies and preventing adverse drug events. This practice involves the systematic review and comparison of a patient's medication orders with the medications they have been taking, particularly during transitions of care such as hospital admission, transfer, and discharge. Nurses play a vital role in this process by collecting accurate medication histories, confirming patient adherence, and educating patients about their prescribed medications. Their direct interaction with patients allows them to identify potential issues such as omitted medications or incorrect dosages. Furthermore, nurses serve as advocates for patients, ensuring that their medication needs are effectively communicated to the healthcare team. On the other hand, pharmacists contribute significantly to medication reconciliation through their expertise in pharmacotherapy and medication management. They often conduct detailed medication reviews, evaluating possible drug interactions, contraindications, and therapeutic substitutions. In collaborative healthcare settings, pharmacists work closely with nursing staff and physicians to develop comprehensive medication plans tailored to individual patient needs. By conducting follow-up consultations and providing medication counseling, pharmacists help ensure that patients understand their regimens, which ultimately enhances adherence and improves overall health outcomes. The integration of both nursing and pharmacy roles in medication reconciliation processes fosters a holistic approach to patient care, minimizing the risk of medication errors and enhancing continuity of care.

1. Introduction

The modern healthcare landscape is characterized by increasing complexity, with patients often navigating multiple care settings, providers, and medication regimens. Within this intricate system, the potential for medication errors poses a significant threat to patient safety, leading to adverse drug events (ADEs), increased morbidity and mortality, and substantial economic burdens on healthcare systems [1]. A critical process designed to mitigate this risk is medication reconciliation, a formal, systematic procedure of creating the most accurate list possible of all medications a patient is taking—including drug name, dosage, frequency, and route—and comparing that list against the physician's admission, transfer, and/or discharge orders [2]. The primary goal is to identify and resolve discrepancies—unintentional changes in medication therapy—to ensure continuity and accuracy of pharmacotherapy across transitions of care, such as hospital admission, transfer between units, and discharge to home or another facility [3]. The importance of this process cannot be overstated; studies have consistently shown that unintentional medication discrepancies are common, occurring in a substantial proportion of patients at care transitions, and a significant number have the potential to cause harm [4].

The Joint Commission, recognizing its critical role in patient safety, established medication reconciliation as a National Patient Safety Goal (NPSG.03.06.01) in 2005, mandating its implementation in accredited healthcare organizations [5]. Despite this mandate and widespread recognition of its value, the consistent, accurate, and efficient execution of medication reconciliation remains a formidable challenge in clinical practice. Barriers are multifactorial, including time constraints, fragmented health information systems, inadequate patient knowledge, and unclear delineation of responsibilities among healthcare professionals [6]. The success of medication reconciliation is inherently interprofessional, relying heavily on the collaborative efforts of physicians, nurses, and pharmacists. Each discipline brings unique expertise and perspective to the process. This review provide a comprehensive analysis of medication reconciliation practices, with a focused examination of the distinct yet complementary roles of nursing and pharmacy.

2. The Medication Reconciliation Process:

A thorough understanding of medication reconciliation requires familiarity with its core steps. While models may vary slightly by institution, the process universally encompasses five key stages: verification, clarification, reconciliation, documentation, and transmission [7]. The verification phase involves collecting a comprehensive and accurate list of the patient's pre-admission or pre-transfer medications. This Best Possible Medication History (BPMH) is considered the gold standard and should be obtained using multiple sources, moving beyond simply asking the patient or family. Critical sources include patient and caregiver interview, reviewing medication bottles, contacting community pharmacies and

primary care physicians, and utilizing available health information exchange networks [8]. The BPMH includes all prescription medications, over-the-counter drugs, herbal supplements, vitamins, and recreational substances.

Clarification follows verification, wherein the healthcare professional ensures that the medications and dosages on the BPMH are appropriate, rational, and understood by the patient. This step involves assessing for duplications, potential interactions, adherence issues, and therapeutic appropriateness [9]. The reconciliation step is the core analytical phase. Here, the BPMH is compared against the current medication orders (on admission, transfer, or discharge). Each discrepancy is identified, categorized (e.g., omission, duplication, dose change, frequency change), and its intentionality is determined. Unintentional discrepancies must be communicated to the prescribing physician for resolution [10]. Documentation is a critical and often vulnerable step. The finalized, reconciled list must be accurately recorded in the patient's permanent medical record in a clear, accessible, and standardized format. Finally, transmission involves the effective communication of the reconciled medication list to the next provider of care, whether that is an inpatient unit, a rehabilitation facility, the patient's primary care physician, or the patient themselves upon discharge [11]. A failure at any single step can compromise the entire process and introduce risk.

3. The Critical Role of Nursing in Medication Reconciliation

Nurses, by virtue of their continuous presence at the patient's bedside and their role as coordinators of care, are integral to the medication reconciliation process, particularly during care transitions. Their involvement is most pronounced during the admission and discharge phases. During hospital admission, nurses are often the first clinicians to conduct a preliminary medication history. They possess unique skills in therapeutic communication, enabling them to build rapport with patients and families to elicit crucial information about medication use, adherence patterns, and practical barriers [12]. The nursing role extends beyond mere data collection to include initial patient education, assessing functional status related to medication administration (e.g., ability to swallow pills, self-inject), and identifying potential red flags such as allergies or previous adverse reactions [13].

Upon patient discharge, the nurse's role becomes even more pivotal. They are typically responsible for ensuring that the final, reconciled discharge medication list is accurately translated into patient-friendly instructions. This involves providing clear, tailored verbal and written education, confirming the patient's or caregiver's understanding using teach-back methods, and coordinating follow-up care [14]. Nurses act as the final safety checkpoint, verifying that discharge prescriptions match the reconciled orders and that any changes from the home regimen are thoroughly explained. However, the nursing role is fraught with challenges. High nurse-to-patient ratios, competing clinical priorities, and time pressures can lead to rushed histories or the delegation of reconciliation tasks to less experienced staff without adequate support [15]. Furthermore, the lack of immediate access to comprehensive external medication records can make the verification step particularly difficult, placing undue reliance on sometimes unreliable patient recall.

4. The Essential Role of Pharmacy in Medication Reconciliation

Pharmacists contribute specialized pharmacotherapeutic knowledge that is indispensable for a high-quality medication reconciliation process. Their expertise in pharmacology, pharmacokinetics, and pharmacovigilance allows them to excel in the clarification and reconciliation phases, moving the process from a simple list-checking exercise to a clinical medication review [16]. Clinical pharmacists are trained to identify and resolve complex medication-related problems such as drug-drug interactions, therapeutic duplications, inappropriate doses for renal or hepatic function, and suboptimal therapeutic regimens. When pharmacists conduct medication reconciliation, studies have shown a significant reduction in unintentional discrepancies with a high potential for harm [17].

Pharmacist-led reconciliation often involves a more in-depth interview, focusing on indication, efficacy, and side effects for each medication. They are also adept at utilizing professional networks and databases to verify histories with community pharmacies. In many advanced practice models, pharmacists are granted prescribing authority or collaborative practice agreements that allow them to independently initiate, modify, or discontinue medications based on protocols to resolve identified discrepancies, thereby streamlining the process and reducing delay [18]. The deployment of pharmacists, however, faces systemic barriers. Resource limitations often restrict pharmacist availability to specific high-risk patient populations (e.g., geriatrics, polypharmacy, heart failure) or certain care transitions, rather than providing

universal coverage [19]. Furthermore, the full integration of pharmacists into the reconciliation workflow requires clear institutional protocols and buy-in from the entire healthcare team to define when and how pharmacy expertise is activated.

5. Interprofessional Collaboration:

The most effective medication reconciliation models are those that foster genuine interprofessional collaboration, leveraging the strengths of both nursing and pharmacy while clearly defining roles and responsibilities. A siloed approach, where each profession works independently, leads to duplication of effort, communication gaps, and process failures [20]. Successful collaborative models are built on mutual respect, open communication, and shared goals for patient safety. One evidence-based model involves a two-tiered process: nurses are responsible for obtaining the initial BPMH upon admission, leveraging their access to the patient, while pharmacists subsequently perform a more detailed clinical validation and reconciliation, focusing on high-risk medications and complex regimens [21]. Regular interprofessional team huddles or rounds can then be used to discuss and resolve any remaining discrepancies.

Another effective strategy is the implementation of standardized communication tools and shared documentation platforms within the electronic health record (EHR). When both nurses and pharmacists document in and review the same structured reconciliation module, it enhances transparency, reduces transcription errors, and ensures all team members are working from a single source of truth [22]. Clear institutional policies must delineate accountability at each step: who obtains the history, who verifies it, who reconciles, who documents, and who communicates at discharge. Without this clarity, tasks can fall through the cracks. Ultimately, a culture that values collective accountability for medication safety over individual professional autonomy is essential for sustaining an effective reconciliation process [23].

6. Technological Tools and Health Information Systems

Technology plays an increasingly dual role in both hindering and facilitating medication reconciliation. A primary historical barrier has been the fragmentation of health information across multiple, non-interoperable EHR systems. The inability to automatically access a patient's medication history from primary care, specialists, and community pharmacies forces reliance on manual entry, which is time-consuming and error-prone [24]. However, advancements in health information technology (HIT) offer promising solutions. Integrated medication history services can now aggregate data from pharmacy benefit managers (PBMs), insurance claims, and community pharmacy networks to provide a preliminary, data-driven medication list that clinicians can then verify [25]. While not a replacement for the BPMH, this serves as a valuable starting point.

Within the EHR, dedicated medication reconciliation modules have become standard. Well-designed modules guide clinicians through the process, force a side-by-side comparison of home and inpatient orders, require categorization of discrepancies, and mandate documentation of rationale for changes [26]. Clinical decision support (CDS) systems embedded within these modules can alert clinicians to potential interactions, allergies, or dosing errors at the point of reconciliation, adding a vital safety layer. Furthermore, patient-facing technologies, such as patient portals and mobile health applications, are emerging as tools for engagement. Patients can maintain and update their own medication lists, which can be imported into the EHR, empowering them as partners in their own care and improving the accuracy of the data source [27]. The future of reconciliation technology lies in greater interoperability, intelligent automation of data aggregation, and user-centered design that reduces, rather than increases, clinician burden.

7. Challenges and Barriers to Effective Implementation

Despite its conceptual simplicity, the consistent implementation of effective medication reconciliation is impeded by a multitude of persistent challenges. System-level barriers are predominant. Inadequate staffing and high workload pressures, common in both nursing and pharmacy departments, directly conflict with the time-intensive nature of conducting a proper BPMH and reconciliation, often leading to a perfunctory "check-box" exercise [28]. Process variability is another major issue; without a standardized, organization-wide protocol, the method and rigor of reconciliation can vary wildly between units, shifts, and individual clinicians, compromising reliability [29].

Human factors also play a significant role. Patients may be poor historians due to illness, cognitive impairment, or lack of knowledge about their medications. They may also use non-prescription sources or alternative therapies they do not consider "medications" [30]. On the provider side, a lack of

dedicated training in reconciliation techniques, ambiguity about professional responsibilities, and poor communication between physicians, nurses, and pharmacists can derail the process. Furthermore, the design of many EHRs remains suboptimal, with reconciliation workflows that are cumbersome, non-intuitive, and disconnected from routine clinical workflow, leading to workarounds and non-compliance [31]. Finally, a lack of strong, sustained institutional leadership and a culture that does not prioritize medication safety as a core value can doom even well-designed reconciliation initiatives to failure.

8. Special Populations and Considerations

The complexity and risk associated with medication reconciliation are magnified in specific patient populations. Elderly patients, who often present with polypharmacy (the use of five or more medications), cognitive impairment, and multiple chronic conditions, are exceptionally vulnerable. Reconciling a lengthy medication list is difficult, and these patients are at higher risk for adverse drug events from discrepancies [32]. A slower, more methodical approach involving family or caregivers and a heightened focus on deprescribing inappropriate medications is often necessary.

Pediatric patients present unique challenges, as medication doses are weight-based and change with growth. Histories depend almost entirely on caregiver recall, and formulations (e.g., liquids, suspensions) must be specified with extreme precision [33]. Patients with limited health literacy or language barriers require the use of professional interpreters (not family members) and tailored educational materials to ensure understanding and safety [34]. Furthermore, transitions to and from long-term care facilities, mental health institutions, and hospice care are particularly high-risk due to frequent communication gaps between these siloed sectors of the healthcare system, necessitating even more rigorous reconciliation protocols and direct provider-to-provider communication [35].

9. Outcome Measures and Impact on Patient Safety

Evaluating the effectiveness of medication reconciliation programs requires tracking relevant outcomes. Process measures are commonly used and include compliance rates (the percentage of patients for whom a completed reconciliation document is present in the chart) and the time to completion of reconciliation after admission [36]. While important for auditing, these do not directly measure patient impact. Outcome measures are more meaningful but harder to capture. The primary outcome is the rate of unintentional medication discrepancies with potential for harm (often categorized as significant or serious) at care transitions. This is typically measured through pre- and post-implementation audits or as part of research studies [37].

Ultimately, the most critical downstream outcomes are the reduction in preventable adverse drug events (ADEs), emergency department visits, and unplanned hospital readmissions that are attributable to medication errors post-discharge. A growing body of evidence demonstrates that well-executed, interprofessional medication reconciliation can significantly reduce discrepancy rates and, in some studies, reduce ADEs and healthcare utilization [38]. However, the evidence for a direct impact on hard endpoints like mortality or 30-day readmission rates is mixed, likely because these outcomes are influenced by a vast array of factors beyond medication management alone [39]. Nevertheless, medication reconciliation is widely regarded as a foundational, necessary—if not always sufficient—component of a robust patient safety program.

10. Future Directions and Evolving Models of Care

The future of medication reconciliation lies in moving beyond a transactional, document-centric activity toward a continuous, patient-centered, and technology-enabled philosophy of medication management. One promising direction is the concept of "medication management" or "medication optimization" as an ongoing process, rather than a task confined to transitions. This involves periodic comprehensive medication reviews, especially for patients with complex regimens, led by pharmacists in collaboration with primary care teams [40]. Another evolution is the greater integration of patients and caregivers through health literacy-informed tools and shared decision-making, recognizing them as the ultimate stewards of their own medication regimens.

Technologically, the push for universal interoperability of health records holds the promise of a longitudinal, shareable medication record that follows the patient across all care settings, drastically reducing the data-gathering burden. Artificial intelligence and machine learning may eventually assist by flagging high-risk regimens, predicting potential discrepancies, or automatically generating patient-friendly instructions [41]. Furthermore, new care delivery models, such as accountable care organizations (ACOs) and hospital-at-home programs, which bear financial

risk for patient outcomes, have a powerful incentive to perfect reconciliation processes to avoid costly errors. The integration of pharmacy technicians into the reconciliation workflow to assist with data gathering under pharmacist supervision is another expanding model to improve efficiency and extend clinical reach.

11. Conclusion

Medication reconciliation stands as a critical defensive barrier against the pervasive threat of medication errors during vulnerable transitions of care. It is a complex, multistep process whose success is wholly dependent on the seamless integration of interprofessional expertise. Nurses provide the foundational patient engagement, continuous oversight, and crucial education, while pharmacists contribute the deep pharmacotherapeutic analysis needed to ensure appropriateness and safety. Neither role can achieve optimal results in isolation. The challenges to consistent implementation—ranging from systemic resource constraints and fragmented information technology to unclear responsibilities—are significant but not insurmountable. Overcoming them requires unwavering institutional commitment, investment in interoperable health IT and standardized workflows, and, most importantly, the cultivation of a collaborative culture where nursing, pharmacy, and medicine share accountability for medication safety. As healthcare continues to evolve, so too must reconciliation practices, moving toward more continuous, patient-involved, and technologically sophisticated models. By refining these practices and strengthening the collaboration between nursing and pharmacy, healthcare systems can make substantial strides in protecting patients from harm and ensuring the safe, effective, and reliable use of medications across the continuum of care.

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References

1. Wheeler AJ, Scahill S, Hopcroft D, Stapleton H. Reducing medication errors at transitions of care is everyone's business. Aust Prescr. 2018 Jun;41(3):73-77.
2. Zaidi AS, Peterson GM, Bereznicki LRE, Curtain CM, Salahudeen M. Outcomes of Medication Misadventure Among People With Cognitive Impairment or Dementia: A Systematic Review and Meta-analysis. Ann Pharmacother. 2021 Apr;55(4):530-542.
3. Samaranayake NR, Cheung DS, Lam MP, Cheung TT, Chui WC, Wong IC, Cheung BM. The effectiveness of a 'Do Not Use' list and perceptions of healthcare professionals on error-prone abbreviations. Int J Clin Pharm. 2014 Oct;36(5):1000-6.
4. Niv Y, Chorev N, Tal Y, Manor O, Broda A, Peer T, Mamadov M. [CULTURE OF SAFETY IN THE HOSPITAL]. Harefuah. 2019 Aug;158(8):520-522.
5. Bennett G, Taing MW, Hattingh HL, La Caze A. Pharmacists' perceived responsibility for patient care when there is a risk of misadventure: a qualitative study. Int J Pharm Pract. 2020 Dec;28(6):599-607.
6. Bonetti AF, Reis WC, Lombardi NF, Mendes AM, Netto HP, Rotta I, Fernandez-Llimos F, Pontarolo R. Pharmacist-led discharge medication counselling: A scoping review. J Eval Clin Pract. 2018 Jun;24(3):570-579.
7. Almeida TA, Reis EA, Pinto IVL, Ceccato MDGB, Silveira MR, Lima MG, Reis AMM. Factors associated with the use of potentially inappropriate medications by older adults in primary health care: An analysis comparing AGS Beers, EU(7)-PIM List , and Brazilian Consensus PIM criteria. Res Social Adm Pharm. 2019 Apr;15(4):370-377.
8. Coleman JJ, Pontefract SK. Adverse drug reactions. Clin Med (Lond). 2016 Oct;16(5):481-485.
9. Cornuault L, Mouchel V, Phan Thi TT, Beaussier H, Bézie Y, Corny J. Identification of variables influencing pharmaceutical interventions to improve medication review efficiency. Int J Clin Pharm. 2018 Oct;40(5):1175-1179.
10. Oyebode F. Clinical errors and medical negligence. Med Princ Pract. 2013;22(4):323-33.
11. Cheng R, Yang YD, Chan M, Patel T. Medication Incidents Involving Antiepileptic Drugs in Canadian Hospitals: A Multi-Incident Analysis. Healthc Q. 2017;20(2):54-62.
12. Kellogg KM, Hettinger Z, Shah M, Wears RL, Sellers CR, Squires M, Fairbanks RJ. Our current approach to root cause analysis: is it contributing to

our failure to improve patient safety? BMJ Qual Saf. 2017 May;26(5):381-387.
13. Keers RN, Williams SD, Cooke J, Ashcroft DM. Causes of medication administration errors in hospitals: a systematic review of quantitative and qualitative evidence. Drug Saf. 2013 Nov;36(11):1045-67.
14. Leahy IC, Lavoie M, Zurakowski D, Baier AW, Brustowicz RM. Medication errors in a pediatric anesthesia setting: Incidence, etiologies, and error reduction strategies. J Clin Anesth. 2018 Sep;49:107-111.
15. Hoyle JD, Crowe RP, Bentley MA, Beltran G, Fales W. Pediatric Prehospital Medication Dosing Errors: A National Survey of Paramedics. Prehosp Emerg Care. 2017 Mar-Apr;21(2):185-191.
16. Luetsch K, Rowett D, Twigg MJ. A realist synthesis of pharmacist-conducted medication reviews in primary care after leaving hospital: what works for whom and why? BMJ Qual Saf. 2020 Oct 30;30(5):418-30.
17. Dhawan I, Tewari A, Sehgal S, Sinha AC. Medication errors in anesthesia: unacceptable or unavoidable? Braz J Anesthesiol. 2017 Mar-Apr;67(2):184-192.
18. DeVine JG, Chutkan N, Gloystein D, Jackson K. An Update on Wrong-Site Spine Surgery. Global Spine J. 2020 Jan;10(1 Suppl):41S-44S.
19. Gillani SW, Gulam SM, Thomas D, Gebreighziabher FB, Al-Salloum J, Assadi RA, Sam KG. Role and Services of a Pharmacist in the Prevention of Medication Errors: A Systematic Review. Curr Drug Saf. 2021;16(3):322-328.
20. Institute of Medicine (US) Committee on Quality of Health Care in America. To Err is Human: Building a Safer Health System. Kohn LT, Corrigan JM, Donaldson MS, editors. National Academies Press (US); Washington (DC): 2000.
21. Radawski CA, Hammad TA, Colilla S, Coplan P, Hornbuckle K, Freeman E, Smith MY, Sobel RE, Bahri P, Arias AE, Bennett D. The utility of real-world evidence for benefit-risk assessment, communication, and evaluation of pharmaceuticals: Case studies. Pharmacoepidemiol Drug Saf. 2020 Dec;29(12):1532-1539.
22. Aljabari S, Kadhim Z. Common Barriers to Reporting Medical Errors. ScientificWorldJournal. 2021;2021:6494889.
23. Westbrook JI, Li L, Hooper TD, Raban MZ, Middleton S, Lehnbom EC. Effectiveness of a 'Do not interrupt' bundled intervention to reduce interruptions during medication administration: a cluster randomised controlled feasibility study. BMJ Qual Saf. 2017 Sep;26(9):734-742.
24. van Tilburg CM, Leistikow IP, Rademaker CM, Bierings MB, van Dijk AT. Health Care Failure Mode and Effect Analysis: a useful proactive risk analysis in a pediatric oncology ward. Qual Saf Health Care. 2006 Feb;15(1):58-63.
25. Dai HJ, Su CH, Wu CS. Adverse drug event and medication extraction in electronic health records via a cascading architecture with different sequence labeling models and word embeddings. J Am Med Inform Assoc. 2020 Jan 01;27(1):47-55.
26. Johnson M, Sanchez P, Langdon R, Manias E, Levett-Jones T, Weidemann G, Aguilar V, Everett B. The impact of interruptions on medication errors in hospitals: an observational study of nurses. J Nurs Manag. 2017 Oct;25(7):498-507.
27. Vaidotas M, Yokota PKO, Negrini NMM, Leiderman DBD, Souza VP, Santos OFPD, Wolosker N. Medication errors in emergency departments: is electronic medical record an effective barrier? Einstein (Sao Paulo). 2019 Jul 10;17(4):eGS4282.
28. McGowan J, Wojahn A, Nicolini JR. Risk Management Event Evaluation and Responsibilities. StatPearls Publishing; Treasure Island (FL): Aug 23, 2023.
29. Cohen MR, Smetzer JL. ISMP Medication Error Report Analysis. Hosp Pharm. 2017 Jun;52(6):390-393.
30. Isaacs AN, Ch'ng K, Delhiwale N, Taylor K, Kent B, Raymond A. Hospital medication errors: a cross-sectional study. Int J Qual Health Care. 2021 Feb 20;33(1)
31. Guillod O. Medical error disclosure and patient safety: legal aspects. J Public Health Res. 2013 Dec 01;2(3):e31.
32. Ciapponi A, Fernandez Nievas SE, Seijo M, Rodríguez MB, Vietto V, García-Perdomo HA, Virgilio S, Fajreldines AV, Tost J, Rose CJ, Garcia-Elorrio E. Reducing medication errors for adults in hospital settings. Cochrane Database Syst Rev. 2021 Nov 25;11(11):CD009985.
33. Karande S, Marraro GA, Spada C. Minimizing medical errors to improve patient safety: An essential mission ahead. J Postgrad Med. 2021 Jan-Mar;67(1):1-3.
34. Talebreza S, McPherson ML. Recognizing and Managing Polypharmacy in Advanced Illness. Med Clin North Am. 2020 May;104(3):405-413.
35. Yount N, Zebrak KA, Famolaro T, Sorra J, Birch R. Linking Patient Safety Culture to Quality Ratings in the Nursing Home Setting. J Appl Gerontol. 2022 Jan;41(1):73-81.
36. Mulac A, Taxis K, Hagesaether E, Gerd Granas A. Severe and fatal medication errors in hospitals: findings from the Norwegian Incident Reporting System. Eur J Hosp Pharm. 2021 Nov;28(Suppl 2):e56-e61.
37. Caleres G, Modig S, Midlöv P, Chalmers J, Bondesson Å. Medication discrepancies in discharge summaries and associated risk factors for elderly patients with many drugs. *Drugs Real World Outcomes*. 2020;7:53–62. doi: 10.1007/s40801-019-00176-5
38. Zhao M, Song JX, Zheng FF, Huang L, Feng YF. Potentially inappropriate medication and associated factors among older patients with chronic coronary syndrome at hospital discharge in Beijing, China. *Clin Interv Aging*. 2021;16:1047–1056. doi: 10.2147/CIA.S305006
39. Koehler T, Brown A. A global picture of pharmacy technician and other pharmacy support workforce

cadres. *Res Social Adm Pharm*. 2017;13:271–279. doi: 10.1016/j.sapharm.2016.12.004

40. Breuker C, Macioce V, Mura T, et al. Medication errors at hospital admission and discharge in type 1 and 2 diabetes. *Diabet Med*. 2017;34(12):1742–1746. doi: 10.1111/dme.13531
41. Fitzgibbon M, Lorenz R, Lach H. Medication reconciliation: reducing risk for medication misadventure during transition from hospital to assisted living. *J Gerontol Nurs*. 2013;39:22–29; quiz 30–1. doi: 10.3928/00989134-20130930-02