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Research Article

Expert Validation of a Medication Error Assessment Tool in the Integrated Medicine Management Model for Geriatric Patients with CHF

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Abstract

Geriatric patients with congestive heart failure (CHF) face an elevated risk of medication errors due to physiological changes, polypharmacy, and comorbidities. Integrated Medicine Management (IMM) is a multidisciplinary model designed to minimize drug-related problems through structured interventions during admission, hospitalization, and discharge. This study aimed to validate a medication error checklist developed for the IMM model, specifically for hospitalized older adults with CHF. A descriptive, quantitative design was applied, with expert-based content validation. A purposive sample of eight healthcare professionals, including physicians, clinical pharmacists, and senior nurses, was recruited. Each checklist item was assessed for relevance using a 4-point Likert scale. Content validity was evaluated using the Item-Level Content Validity Index (I-CVI) and the Scale-Level CVI (S-CVI/Ave). All nine items obtained I-CVI values of ⩾0.875, with seven items achieving a full consensus (I-CVI = 1.00). The overall S-CVI/Ave was 0.97, indicating excellent content validity. The checklist integrates global safety frameworks, including the STOPP/START criteria, the WHO Medication Without Harm initiative, ISMP's high-alert medication guidance, and The Joint Commission's reconciliation protocols. Core components address reconciliation, therapy duplication, high-risk drugs, and discharge education. The validated checklist demonstrates strong content validity and clinical relevance for detecting medication-related problems in hospitalized geriatric CHF patients. Integration into digital platforms such as MINE (Medicine IN gEriatric) may enhance interprofessional collaboration, reduce preventable errors, and promote safer pharmacotherapy across care transitions.

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INTRODUCTION

Older adults diagnosed with Congestive Heart Failure (CHF) exhibit a heightened susceptibility to adverse drug events due to age-related physiological alterations, extensive polypharmacy regimes, and concurrent multimorbidity. These overlapping clinical factors complicate pharmacotherapy regimens and significantly elevate the risk of medication errors, which are defined as preventable events that may lead to inappropriate medication use or patient harm, alongside drug-related problems (DRPs) that encompass actual or potential issues interfering with desired therapeutic outcomes[1]. Medication errors within the geriatric cohort are remarkably common in clinical practice, yet they are frequently unrecognized or inadequately addressed, persisting as a major source of preventable harm across global healthcare

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systems[2]. Because the physiological reserve of older heart failure patients is significantly compromised, even minor variances in drug dosing or therapeutic execution can precipitate severe clinical decompensation, making the early detection of these pharmaceutical discrepancies an urgent clinical priority.

To address these vulnerabilities, Integrated Medicine Management (IMM) has emerged as an evidence-based, multidisciplinary framework designed to optimize medication safety for patients across all stages of the continuum of care[3]. This approach emphasizes organized collaboration among nurses, physicians, and pharmacists, operating systematically through three core phases: comprehensive medication reconciliation at admission, structured clinical medication review during hospitalization, and strategic discharge planning that encompasses patient-centered education and medication supply. The existing literature demonstrates that the clinical implementation of IMM effectively reduces the incidence of DRPs, shortens hospital stays, and lowers early readmission rates among elderly patients with chronic diseases[4]. However, maximizing the effectiveness of the IMM framework requires validated screening instruments that can identify and resolve medication errors at every stage of the care process. These specialized tools must be comprehensive enough to cover inappropriate prescribing, therapeutic duplications, high-risk drug utilization, and gaps in patient discharge education, while remaining specifically tailored to the unique clinical presentation of older adults living with CHF.

Ensuring the content validity of these screening instruments represents a crucial foundational step in their clinical development. The item-level content validity index (I-CVI) is widely recognized as a robust, mathematically sound method for quantifying expert agreement regarding the relevance and clarity of individual tool components[5]. Recent empirical evidence confirms that expert-based validation significantly contributes to the ultimate reliability and practical applicability of clinical tools, particularly when deployed in high-risk patient populations[6]. Grounded in this methodological necessity, the present study aimed to validate a newly developed medication error assessment tool through rigorous expert evaluation embedded within the IMM framework for hospitalized geriatric patients with CHF. This validated instrument is intended to support early identification of medication-related risks, enhance interdisciplinary communication among ward teams, and ultimately improve clinical outcomes and reduce readmission rates for this vulnerable demographic[7].

MATERIALS AND METHODS

Materials

The development of the medication error evaluation instrument was grounded in the structural parameters of the IMM framework and was specifically tailored for deployment among hospitalized geriatric patients with chronic CHF. The resulting screening tool is structured as an operational checklist to evaluate therapeutic safety across the three main phases of the clinical care continuum: admission reconciliation, the acute inpatient stay, and coordinated discharge planning. To ensure international validity and clinical relevance, each checklist item was cross-referenced with and mapped to established evidence-based practices and globally accepted medical guidelines.

Characterization of pharmaceutical discrepancies was aligned with the Pharmaceutical Care Network Europe (PCNE) version 9.0 classification of drug-related problems, while age-specific prescribing safety and potential deprescribing opportunities were evaluated against the Screening Tool of Older Persons' Prescriptions and Screening Tool to Alert to the Right Treatment (STOPP/START) version 2 criteria. Global patient safety goals were integrated by incorporating directives from the World Health Organization Global Patient Safety Challenge: Medication Without Harm initiative, supplemented by the Institute for Safe Medication Practices (ISMP) guidelines for identifying and monitoring high-alert medications in acute care settings. Finally, the operational execution of drug delivery and transition care was structured around the foundational principles of the Five Rights of Medication Administration alongside the formal medication reconciliation standards established by The Joint Commission.

Methods

Study design and ethical approvals

A descriptive quantitative design was used in this study, focusing exclusively on the psychometric content validation of a newly developed medication error screening instrument. This investigation was formally reviewed and approved by the Institutional Review Board of RSUD A.W. Sjahranie Samarinda under the official designation Approval Number

135/KEPK-AWS/VIII/2022. Informed consent was obtained from all participating expert evaluators prior to the initiation of the validation process, in strict accordance with local institutional guidelines and the ethical principles enunciated in the Declaration of Helsinki. Quantitative content validation was conducted using the content validity index (CVI) framework to determine the precise relevance and clinical representativeness of each item within the proposed checklist.

Expert panel selection and eligibility criteria

The expert validation panel was assembled using a purposive sampling approach structured around predefined professional milestones, resulting in the recruitment of eight active healthcare professionals. The composition of this multidisciplinary panel included two physicians specializing in internal medicine or cardiology, three clinical pharmacists, and three senior clinical nurses. To ensure a highly qualified evaluation, the eligibility criteria required a minimum of 5 years of active clinical experience, current engagement in hands-on hospital-based practice, and a willingness to participate fully throughout the validation process.

The selection of eight experts for this investigation was grounded in established methodological considerations for optimizing the CVI. According to the classical guidelines articulated by Lynn[8], the recommended number of expert panelists for content validity evaluation ranges from three to ten individuals, an operational range that ensures an ideal balance between the statistical reliability of consensus judgments and the practical feasibility of the evaluation process. Therefore, the inclusion of eight experts is considered appropriate and methodologically rigorous.

Regarding this panel size, with eight experts, the acceptable numerical threshold for the I-CVI was set according to the psychometric criteria proposed by Polit and Beck[9]. Based on their validation framework, an instrument item is considered to have acceptable content validity if its I-CVI is 0.78 or higher. This threshold corresponds to a substantial level of consensus among the evaluators, requiring that at least 6 of the 8 panelists rate the specific item as either relevant or highly relevant. This cutoff value was strictly applied to minimize the likelihood of chance agreement among the experts, ensuring that only items demonstrating high consensus were retained, thereby strengthening the structural rigor and clinical credibility of the instrument validation process.

Research instrument development and operational checklist

The medication review checklist for hospitalized geriatric patients with heart failure was developed through a systematic, multi-step process. Initially, a comprehensive literature review identified evidence-based frameworks, including the STOPP/START criteria, the World Health Organization's patient safety initiatives, and the ISMP recommendations. Second, an initial item pool was drafted and refined through iterative discussions among the research team. Third, the preliminary checklist was formatted into a validation questionnaire aligned with the three phases of the IMM model: admission, inpatient care, and discharge.

The main instrument featured a four-point Likert scale for relevance, where 1 indicated not relevant, 2 indicated somewhat relevant, 3 indicated relevant, and 4 indicated highly relevant. The expert panelists independently rated each item, with scores of 3 or 4 categorized as content relevant. Content validity was quantified using the I-CVI, calculated as the proportion of experts rating an item as relevant, and the scale-level CVI (S-CVI/Ave), computed as the average I-CVI across all items. Modified kappa statistics were not calculated for this pilot phase and are acknowledged as an inherent methodological limitation. Items displaying lower index scores were earmarked for structural revision or elimination, resulting in the final valid instrument.

For clinical application, the instrument requires completion by a multidisciplinary team comprising a physician, a pharmacist, and a nurse. Each item is scored based on clinical parameters, and final aggregated assessment scores of 3 or higher indicate that the item warrants immediate formal clinical review or a specific pharmaceutical intervention. Items with an I-CVI greater than or equal to 0.78 were considered valid and retained in the final instrument. The data in **Table I** confirm that all nine items achieved an independent item-level content validity index of 1.00, indicating absolute consensus among the eight evaluating experts. The corresponding operational definitions ground each parameter in established clinical actions, ensuring that the multidisciplinary ward teams can uniformly execute admission history tracking, interaction screening, and transition reconciliation.

Table I. Medication error checklist for hospitalized geriatric patients with heart failure.

No	Item	Operational Definition	I-CVI
1	Complete medication history at admission	Document all current medications, including prescription, OTC, and supplements[10,11]	1.00
2	No duplicate therapies	Verify no therapeutic duplications exist[11,12]	1.00
3	Medication matches diagnosis	Medications are appropriate for documented diagnoses[12,13]	1.00
4	High-risk medications are monitored	Medications with high-risk potential (e.g., anticoagulants, digoxin) are actively monitored via labs or clinical parameters[13,14]	1.00
5	No significant drug interactions	Identify and prevent harmful drug–drug interactions[11,14]	1.00
6	Medication education at discharge	Patient/caregiver receives counseling on indications, dosing, and safety[10,15]	1.00
7	Patient receives a medication list	Provide written/electronic list at discharge[10]	1.00
8	STOPP/START criteria applied	Review medications according to STOPP/START for older adults[16]	1.00
9	Medication reconciliation performed	Cross-check medications at admission, transfer, and discharge for accuracy[9,10,17]	1.00

Data analysis

The statistical analysis of the validation dataset utilized two primary psychometric indices to rigorously evaluate the content validity of the developed screening instrument. First, the I-CVI was computed to determine the consensus level for each checklist item. The I-CVI for each item was calculated using a text-based mathematical formula: the number of expert panelists who assigned a relevance rating of 3 (indicating relevant) or 4 (indicating highly relevant) was divided by the total number of experts on the panel. After calculating these individual parameters, the S-CVI/Ave was computed as the arithmetic mean of all individual I-CVI values across the entire instrument. S-CVI/Ave = Sum of all individual I-CVI values divided by the total number of items in the checklist.

In accordance with established psychometric validation criteria, an individual checklist item was deemed content valid if it achieved a minimum I-CVI value of greater than or equal to 0.78, while the overarching scale was considered structurally valid if the cumulative S-CVI/Ave reached a minimum threshold of greater than or equal to 0.90. In addition to this quantitative screening, the qualitative feedback and descriptive comments submitted by the expert panelists were systematically reviewed using a narrative analysis approach. Indicators that fell below the optimal consensus mark or received specific editorial critiques were revised or reworded based on this narrative synthesis, ensuring the final, polished checklist had greater clarity, diagnostic accuracy, and practical clinical relevance for hospital workflows.

RESULTS AND DISCUSSION

The expert rating of the newly developed medication error checklist using the I-CVI indicated that all 9 items achieved a score of 0.875 or higher. These quantitative outcomes exceeded the established content validity benchmark of 0.78, indicating that each indicator was deemed highly relevant or representative by a multidisciplinary panel of eight active healthcare professionals. The expert panel, comprising two physicians specializing in internal medicine or cardiology, three clinical pharmacists, and three senior clinical nurses, evaluated the checklist independently using a four-point Likert scale. On this scale, individual ratings of 3 (relevant) or 4 (highly relevant) reflected content relevance, and the final I-CVI values were calculated as the proportion of experts who assigned these ratings relative to the total number of panelists.

Seven out of the nine items demonstrated absolute consensus among the evaluators, yielding a perfect I-CVI score of 1.00. These components included obtaining a complete medication history at admission, verifying that no duplicate therapies exist, ensuring medication appropriateness matches the documented diagnosis, providing comprehensive patient education upon discharge, creating a personalized medication list, applying the standardized STOPP/START criteria, and performing routine medication reconciliation. Conversely, two items (specifically the active monitoring of high-risk medications and the systematic identification of significant drug-drug interactions) received slightly lower scores, with an I-CVI value of 0.875, due to a single non-relevant rating on the panel. However, both indicators still comfortably met the required psychometric threshold for formal content validity.

The quantitative consensus data generated by the multidisciplinary panel are presented in **Table II**. The distribution tracks the total number of relevant scores alongside the final calculated index value for each clinical statement. The data demonstrate the high level of individual-item consensus achieved during the validation phase. Each component aligns with

a critical phase of the clinical care continuum, ensuring that the final validated screening tool provides a uniform, evidence-based method for tracking medication-related risks in acute care settings.

Table II. The result of the medication error checklist.

No	Item Statement	No. of Relevant Ratings (3/4)	I-CVI
1	Complete medication history at admission	8	1.00
2	No duplicate therapies	8	1.00
3	Medication matches diagnosis	8	1.00
4	High-risk medications are monitored	7	0.875
5	No significant drug interactions	7	0.875
6	Medication education at discharge	8	1.00
7	Patient receives a medication list	8	1.00
8	STOPP/START criteria applied	8	1.00
9	Medication reconciliation performed	8	1.00

The overall content validation results of the medication error checklist demonstrated excellent structural agreement among the evaluators, with all items achieving independent I-CVI values of 0.875 or higher and an overall S-CVI/Ave of 0.97 (**Figure 1**). These high validation metrics exceeded the globally recommended psychometric thresholds, confirming that the checklist is both highly relevant and representative of core domains in medication safety for hospitalized geriatric patients managing chronic CHF. This elevated S-CVI/Ave value of 0.97 indicates substantial professional consensus, establishing strong content validity for the checklist as a unified whole.

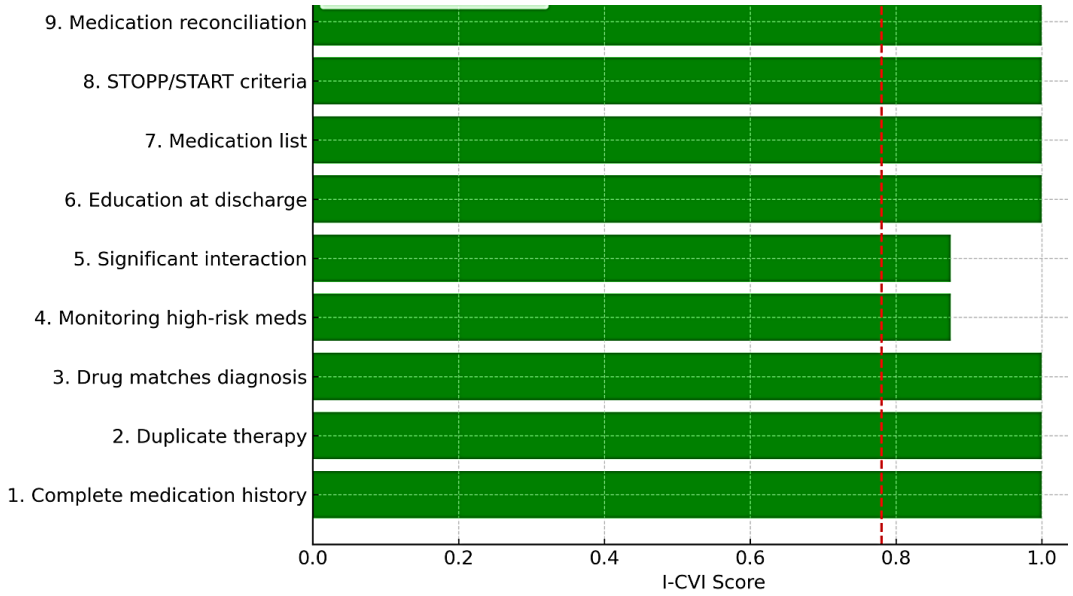

Figure 1. Total S-CVI/Ave.

The structural layout of the validated checklist successfully integrates key aspects of broadly adopted international recommendations for improving clinical medication safety, particularly within the vulnerable older adult cohort. The formal incorporation of the Older and New Medications Bar Review (ONMR) version 2 criteria enables the early detection of potentially inappropriate prescriptions, thereby supporting comprehensive medication review and structured deprescribing efforts in complex geriatric cases with multi-drug regimens[16]. This screening tool also directly aligns with global healthcare priorities established by the World Health Organization through its Medication Without Harm initiative, focusing on enhancing safety protocols during transitions of care and minimizing clinical risks associated with high-alert medications[10].

By embedding structured counseling at discharge and mandating the provision of individualized medication lists, the checklist enhances patient involvement, health literacy, and total continuity of care. Furthermore, close alignment with the ISMP's guidance ensures that the tool effectively addresses vital safety practices, such as proper handling of high-alert medications and strict adherence to the five rights of medication administration[11]. Finally, the explicit inclusion of medication

reconciliation is consistent with institutional patient safety standards established by The Joint Commission, thereby supporting the accuracy of medication information transfer across critical hospital transition points[15].

The strong agreement among healthcare professionals from diverse clinical backgrounds supports the checklist's clinical relevance and interprofessional applicability in active ward settings. Although the two items tracking high-risk medication monitoring and drug interaction identification yielded slightly lower individual I-CVI scores of 0.875, their values remained well above acceptable thresholds, confirming their adequacy while suggesting the need for clearer operational definitions in future clinical applications. Overall, the validated checklist provides a practical, evidence-based approach for identifying medication-related problems in hospitalized geriatric patients with CHF. Its future integration into digital health platforms, such as the Medicine IN gEriatrics (MINE) system, could enhance interdisciplinary clinical decision-making, reduce preventable medication errors, and significantly improve patient safety outcomes during hospitalization and subsequent care transitions[18].

This investigation demonstrates several key methodological strengths that reinforce its clinical utility. The rigorous expert validation process, employing established psychometric indices such as I-CVI and S-CVI/Ave, enhances the methodological robustness of the final findings. The strategic inclusion of a multidisciplinary expert panel (comprising physicians, clinical pharmacists, and senior nurses) ensures a well-rounded evaluation of item relevance from multiple operational perspectives[19]. Furthermore, the systematic integration of multiple evidence-based frameworks, including the STOPP/START criteria, World Health Organization safety initiatives, and ISMP guidance, strengthens the clinical foundation of the checklist. These high content validity scores reflect a strong expert consensus, supporting its broad applicability in active clinical practice[20].

Recent empirical evidence further reinforces the methodological rigor and intended implementation pathway of this study. Contemporary research highlights that structured content validation methods, including CVI-based approaches, remain essential for developing reliable clinical instruments, particularly when dealing with complex populations such as older adults living with chronic multimorbidity[21,22]. In addition, recent studies in geriatric pharmacotherapy emphasize the critical importance of utilizing standardized tools to identify medication-related problems and optimize prescribing patterns in hospitalized older patients[20,23]. Moreover, the integration of validated tools into digital health systems has been increasingly recognized as a key strategy for improving systemic medication safety. Evidence from clinical decision support system (CDSS) implementation studies demonstrates significant reductions in prescribing errors, improved adherence to institutional guidelines, and enhanced interprofessional collaboration[24,25]. These findings align closely with the World Health Organization Global Strategy on Digital Health 2020–2025, which advocates embedding evidence-based tools into electronic health records to strengthen patient safety and quality of care, confirming that the potential integration of this checklist into digital platforms represents a critical step toward scalable and sustainable clinical implementation[26].

However, despite these strengths, certain limitations must be acknowledged within this study. The relatively small expert panel size, restricted to eight reviewers, may limit the immediate generalisability of the findings to diverse healthcare settings. The current lack of pilot testing or active clinical implementation data on the checklist's performance leaves unanswered questions about its real-world effectiveness and operational workflow integration. Focusing solely on content validity in this initial phase, without assessing other psychometric validity measures or internal reliability, provides an incomplete picture of the checklist's overall psychometric quality. There is also a potential for regional or cultural bias, as the evaluating experts were recruited from a single healthcare institution or geographic area. Furthermore, the complete absence of direct patient or caregiver input during the validation process may overlook important user-centered perspectives regarding transition education. Finally, while some checklist items that received slightly lower scores may require further operational refinement, the validation was limited strictly to content aspects, leaving other longitudinal performance metrics unexplored.

CONCLUSION

The formal validation of the newly developed medication error checklist within the scope of the IMM framework establishes robust content validity and exceptional practical relevance for identifying pharmaceutical risks in hospitalized geriatric patients with CHF. The high degree of consensus across diverse healthcare specialties confirms the instrument's clinical

utility, interprofessional applicability, and capacity to drive quality improvements in complex drug utilization practices. Through this rigorous expert evaluation, the structured checklist can be considered content valid for detecting potential medication errors and drug-related problems across the continuum of care. To maximize its operational impact, this tool is best integrated into clinical decision support architectures and electronic health record systems, such as the MINE digital platform, which enables structured, team-based medication management across all levels of hospital care for the vulnerable elderly demographic. However, despite these strong baseline psychometric outcomes, further multi-center longitudinal studies involving active pilot testing and real-world clinical implementation are necessary to fully confirm the checklist's long-term reliability, workflow usability, and direct impact on patient safety and clinical outcomes.

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AUTHORS' CONTRIBUTION

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DATA AVAILABILITY

None.

CONFLICT OF INTEREST

The authors declared no conflict of interest related to this research.

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