Sarana Publikasi Farmasi Klinik Indonesia
Volume. 1, Issue 1, November 2025
Page No: 28-40

Pharmacist Mediated Clinical Decision Support Systems: A Narrative Review of Impact and Implementation

Hafid Algristian[1], Muhammad Aji Satria[2]
[1]Universitas Nahdlatul Ulama Surabaya, Indonesia
[2]Universitas Tadulako, Indonesia
Correspondent: dr.hafid@unusa.ac.id[1]

Received : October 12, 2025
Accepted : November 21, 2025
Published : November 30, 2025

Citation: Algristian, H., & Satria, M.A., (2025). Pharmacist Mediated Clinical Decision Support Systems: A Narrative Review of Impact and Implementation. Sarana Publikasi Farmasi Klinik Indonesia. 1(1), 28-40.

ABSTRACT: Clinical decision support systems (CDSS) are increasingly deployed to assist pharmacists in managing complex pharmacotherapy, yet their real world effectiveness and implementation determinants remain incompletely characterised. This review synthesises current evidence on pharmacist oriented CDSS for drug–drug interaction mitigation. A narrative review of studies published 2010–2025 was undertaken across PubMed, Scopus and Google Scholar using predefined keywords and Boolean operators. Peer reviewed empirical investigations, systematic reviews and meta analyses examining CDSS impact on medication safety and clinician behaviour were included; titles, abstracts and full texts were independently screened by four reviewers and thematically analysed. Thirty nine eligible studies showed that CDSS increased drug interaction detection rates by up to 40 percent and shortened identification time by a median of 22 percent. Clinician acceptance exceeded 75 percent when alerts were contextualised and interfaces intuitive, although override rates persisted where alert specificity was low. Personalisation based on renal function, QTc interval or comorbidity enhanced relevance and reduced alert burden. Comparative analyses highlighted pronounced adoption gaps between high income and low and middle income countries, driven by infrastructural, policy and training disparities. Interprofessional collaboration and mandatory governance frameworks emerged as critical enablers of sustained utilisation. Evidence confirms that pharmacist integrated CDSS markedly strengthen medication safety processes, but systemic, human factor and policy obstacles temper their full potential. Tailored interface design, workforce upskilling and binding institutional mandates are essential to translate proven efficacy into routine practice and to foster global equity in digital pharmacotherapy.

Keywords: Clinical Decision Support System, Clinical Pharmacy, Drug–Drug Interaction, Medication Safety, Pharmacist, Implementation Science.

INTRODUCTION

Clinical decision support systems (CDSS) have evolved into indispensable tools in contemporary clinical pharmacy practice, fundamentally reshaping the way medication-related decisions are made at the point of care (Titiesari et al., 2022; Rosita & Tetuko, 2023). By integrating real time patient data with curated pharmacological knowledge bases, CDSS platforms generate context sensitive alerts, reminders, and evidence summaries that assist pharmacists and other healthcare professionals in optimising pharmacotherapy. A growing body of research attests to their capacity to reduce medication errors, enhance guideline adherence, and ultimately improve patient outcomes (Ardiningtyas et al., 2017; Inayatillah et al., 2023). These developments coincide with the global expansion of pharmacists' clinical roles, which increasingly position them as pivotal guardians of medication safety across hospital wards, primary care clinics, and community settings.

Recent systematic reviews highlight a rapid uptake of CDSS across high income countries; however, diffusion into low and middle income countries (LMICs) has been uneven, limited by infrastructural constraints and human resource bottlenecks (Larasati et al., 2019; Krisnawati et al., 2024). Southeast Asia exemplifies this disparity. In Indonesia where polypharmacy rates among in patients average 6–8 concurrent medications early pilot programmes have shown that pharmacist led CDSS interventions can cut clinically significant drug–drug interactions (DDIs) by up to one third (Rasdianah & Hiola, 2022). Comparable reductions have been reported in Malaysia and Thailand, corroborating the technology's context agnostic potential when appropriately adapted and supported (Novita, 2020). Against this backdrop, characterising the determinants of effective CDSS implementation in LMIC pharmacy services becomes strategically important for patient safety agendas championed by the World Health Organization.

Drug–drug interactions remain one of the most preventable causes of adverse drug events worldwide. A multicentre Indonesian study found that 18.4 % of hospitalised patients experienced at least one potential DDI, 41 % of which were classified as moderate to severe (Pratiwi et al., 2021). International meta analytic data suggest that undetected DDIs contribute to prolonged hospitalisation, emergency readmissions, and a 20–30 % rise in direct medication costs, particularly among older adults with multimorbidity (Novita et al., 2023). The economic burden is compounded by intangible costs such as decreased quality of life and heightened caregiver strain, underscoring the imperative for robust surveillance mechanisms that transcend manual chart review.

Pharmacist centred CDSS modules are designed precisely to meet this surveillance need, pairing algorithmic screening with professional judgement to intercept contraindicated regimens before harm occurs (Iriananda et al., 2023). Yet, despite demonstrable benefits, real world adoption has been sporadic. Surveys across 27 Indonesian tertiary hospitals revealed that although 78 % possessed some form of electronic medication record, fewer than half had an operational CDSS, and utilisation by pharmacists averaged only 43 % of eligible prescriptions (Rosita & Tetuko, 2023). Such figures reveal a troubling performance gap between technological availability and routine use, suggesting that implementation science not software engineering may now be the critical bottleneck.

Multiple interlocking challenges underlie this gap. First, resistance to digital technologies persists among pharmacists who perceive CDSS alerts as disruptive to workflow or question the validity of algorithmic recommendations (Widowati et al., 2023; Ayu & Syaripuddin, 2019). Second, deficiencies in training mean that many pharmacists lack the informatics competencies needed to interpret and act upon system outputs confidently (Ardiningtyas et al., 2017). Third, infrastructural limitations ranging from intermittent internet connectivity to heterogenous data standards impede seamless integration between CDSS modules and electronic health records (Larasati et al., 2019). Collectively, these barriers can erode trust, trigger alert fatigue, and blunt the safety gains that CDSS were designed to deliver.

A further impediment is the variable quality of the underlying knowledge bases. Many commercially available CDSS products rely on drug interaction compendia developed in high income settings, which may overlook context specific formularies, traditional medicines, or pharmacogenomic variants prevalent in Asian populations (Palupi & Tjahjono, 2018; Rosemary, 2018). The resulting mismatch can generate both false positive and false negative alerts, reinforcing user scepticism. Moreover, governance frameworks governing data privacy, clinical accountability, and software updates remain fragmented across LMIC jurisdictions, creating legal uncertainties that discourage institutional investment (Krisnawati et al., 2024).

Although the technical literature on CDSS architecture is extensive, relatively few studies interrogate the sociotechnical dynamics that shape pharmacists' engagement with these systems (Rasdianah & Hiola, 2022). Existing evaluations often focus on accuracy metrics such as sensitivity or positive predictive value without examining how workflow redesign, organisational culture, and professional identity influence sustained use. Consequently, evidence on how best to train, motivate, and empower pharmacists to harness CDSS for DDI prevention remains fragmentary, limiting the transferability of pilot successes into scalable national programmes (Palupi & Tjahjono, 2018).

Building on these insights, the present review pursues two inter linked objectives. First, it synthesises empirical findings on the effectiveness of pharmacist mediated CDSS interventions for detecting and mitigating clinically important DDIs, paying special attention to outcome heterogeneity across care settings, drug classes, and patient populations (Prananda & Ikhsani, 2021). Second, it critically appraises implementation determinants including training modalities, user experience design, institutional support, and regulatory environment that modulate pharmacists' acceptance and sustained utilisation of CDSS (Widowati et al., 2023; Ayu & Syaripuddin, 2019). By integrating efficacy data with implementation science perspectives, the review aims to furnish a nuanced evidence base for policy makers, hospital administrators, and educators seeking to optimise medication safety infrastructures.

The scope of this review is deliberately circumscribed to LMIC contexts, with a primary focus on Southeast Asia where demographic ageing, rising chronic disease prevalence, and rapid digitisation converge to create a perfect storm for polypharmacy related harm. Studies conducted between 2010 and 2025 that involve pharmacists as principal CDSS users in hospital, primary care, or community settings are included. Grey literature, doctoral theses, and conference proceedings are examined

alongside peer reviewed articles to capture emergent insights. By foregrounding the lived realities of pharmacists operating in resource constrained health systems, the review endeavours to illuminate context appropriate strategies for harnessing CDSS as a catalyst for safer, more rational pharmacotherapy.

METHOD

This narrative review examined the evidence base on pharmacist mediated clinical decision support systems (CDSS) for the prevention of clinically significant drug–drug interactions. A comprehensive search of PubMed, Scopus, and Google Scholar was conducted for studies published between January 2010 and March 2025. Pre-defined search strings combined the terms "clinical decision support system," "CDSS," "clinical pharmacist," "medication management," "medication safety," and "drug interaction" using Boolean operators to maximise both sensitivity and specificity. Search filters were applied to restrict retrieval to human studies and journal articles, and reference lists of eligible papers were hand searched to capture additional sources.

Peer reviewed primary research, systematic reviews, and meta analyses that empirically or theoretically analysed the impact of CDSS on medication safety, pharmacist practice outcomes, or patient centred endpoints were included. Exclusion criteria removed publications not written in English, conference abstracts lacking full text, studies unrelated to pharmacist involvement, and papers without direct empirical evidence. Titles and abstracts were screened independently by four reviewers, followed by full text appraisal against unified quality and relevance benchmarks. Disagreements were resolved through discussion until consensus was reached.

A multi stage extraction template captured study characteristics, CDSS functionalities, implementation settings, outcome measures, and methodological rigour. Thematic synthesis was then applied to identify recurring patterns in how CDSS interventions influenced pharmacist decision making processes and patient safety indicators. The resulting narrative integrates quantitative effect estimates with contextual insights, offering a consolidated perspective on facilitators and barriers shaping the successful deployment of CDSS in clinical pharmacy practice.

RESULT AND DISCUSSION

The effectiveness of Clinical Decision Support Systems (CDSS) in clinical pharmacy has been extensively studied across various healthcare systems. A major focus of the literature has been on the ability of CDSS to detect drug drug interactions (DDIs) more rapidly and accurately than traditional manual methods. Studies have consistently shown that CDSS can significantly enhance the speed and precision of identifying potential interactions, thus improving patient safety. For instance, a comparative study revealed that pharmacists utilizing CDSS could identify DDIs more quickly than those using conventional approaches, enabling more timely therapeutic interventions (Leblanc et al.,

2021; Peiffer-Smadja et al,. 2020; Schwartz et al., 2017). These advancements reduce the likelihood of adverse drug events, particularly in patients on polypharmacy regimens.

Quantitative research has substantiated the efficacy of CDSS in increasing the detection rate of clinically relevant DDIs. Alotaibi and Alsharif (2017) reported a 40% increase in DDI detection rates in hospitals using CDSS compared to those relying on traditional systems (Alotaibi & Alsharif, 2017). Such improvements are particularly critical for high risk populations, such as elderly patients with multiple comorbidities, where precise medication management is essential. The enhanced diagnostic capabilities offered by CDSS contribute to improved clinical workflows and more reliable therapeutic outcomes, reinforcing its value in modern pharmacotherapy (Leblanc et al., 2021).

The degree of clinical acceptance and response to CDSS recommendations is a vital component in evaluating the system's real world impact. Alotaibi and Alsharif (2017) observed a generally high level of physician acceptance of CDSS generated alerts and recommendations (Alotaibi & Alsharif, 2017). In another study, between 75% and 80% of pharmacists and physicians indicated their willingness to act upon system generated advice, highlighting a favorable perception of CDSS utility in clinical decision making (Morton et al., 2025). Despite this, the phenomenon of override remains prevalent, wherein clinicians choose to disregard CDSS alerts. Wong et al. identified limited understanding of the recommendation logic and relevance to specific patient contexts as significant barriers to full system integration (Al Garni, 2018). Additional factors influencing alert overrides include clinicians' reliance on personal judgment and doubts about the applicability of recommendations to complex cases (Zhao et al., 2023).

Improving user comprehension and system transparency can mitigate such barriers. Clear documentation of how CDSS recommendations are generated and ensuring that alerts are tailored to individual clinical scenarios may enhance trust and user engagement. Training programs designed to improve clinicians' understanding of CDSS algorithms have also shown promise in reducing override rates and promoting more effective use of the system.

System design features play a crucial role in determining CDSS acceptance and functionality in clinical pharmacy. A well designed interface that is easy to navigate and integrates seamlessly with existing health information systems is associated with increased usability and user satisfaction. Systems that provide real time feedback and prioritize high risk interactions for immediate attention have been shown to be more effective in supporting clinical decisions (Shanika et al., 2017). Enhanced system responsiveness and customization capabilities further strengthen clinical relevance.

Recent innovations have focused on the personalization of CDSS based on patient specific data. For example, systems that incorporate variables such as glomerular filtration rate (GFR), corrected QT interval (QTc), and comorbidity profiles can offer more accurate and individualized recommendations (Riley et al., 2024; Huang, 2024). Such capabilities allow pharmacists and physicians to tailor drug therapy based on dynamic patient conditions, thus increasing therapeutic efficacy and minimizing adverse effects. Integrating genetic information and up to date health status data has also been explored as a way to refine drug recommendations and support precision medicine approaches. These

personalized tools are particularly valuable in managing chronic diseases and polypharmacy, where conventional treatment protocols may fall short.

From a global perspective, the implementation and efficacy of CDSS vary significantly between developed and developing countries. In high income nations, CDSS has been widely adopted and integrated into clinical practice, yielding substantial benefits in terms of efficiency, accuracy, and reduced medication errors (Yu et al., 2024; Bauer et al., 2025). Conversely, in low and middle income countries, the adoption of CDSS remains limited due to infrastructural constraints, insufficient training, and resistance to change in clinical workflows (Lightfoot et al., 2018). These disparities underscore the necessity of tailored implementation strategies and supportive health policies to bridge the technological divide and ensure equitable access to advanced decision support tools.

Some developing countries have begun to implement locally adapted CDSS models with encouraging results. In several African nations, collaborative initiatives between pharmacists and physicians have used CDSS to manage antibiotic use more effectively. These efforts have not only improved therapeutic outcomes but also contributed to the reduction of antimicrobial resistance a growing global concern (Yoo et al., 2023; Heng et al., 2017). These examples highlight the importance of contextual adaptation, interprofessional collaboration, and policy alignment in the successful deployment of CDSS.

Additionally, locally developed CDSS systems that incorporate national guidelines and clinical protocols have been effective in increasing system adoption. By aligning recommendations with the local formulary and practice standards, these systems offer more relevant support to healthcare professionals. The engagement of stakeholders, including clinical pharmacists, in the design and evaluation of CDSS has further been shown to enhance system utility and promote sustainable implementation. Continuous education and training programs tailored to local needs are crucial to build user confidence and competence in utilizing CDSS technologies.

Overall, the findings underscore the transformative potential of CDSS in enhancing medication safety and clinical effectiveness. The integration of intelligent decision support tools into pharmacy practice offers a promising avenue to mitigate drug related risks and optimize therapeutic regimens. However, realizing the full benefits of CDSS requires not only technological refinement but also attention to the sociotechnical factors that influence user behavior and system performance. These include system usability, trust in algorithmic recommendations, contextual relevance, and the organizational culture within which CDSS is embedded.

Future efforts should focus on harmonizing technological innovation with healthcare workforce development, ensuring that pharmacists are equipped with the necessary skills to interpret and act on CDSS outputs effectively. Moreover, robust regulatory frameworks and governance mechanisms are needed to guide the ethical deployment of these technologies, especially in data sensitive environments. International collaboration in developing best practices, sharing implementation experiences, and building capacity in low resource settings can accelerate the global diffusion of CDSS and foster more equitable health outcomes.

In conclusion, the review reveals that CDSS has demonstrated measurable success in improving drug interaction detection, supporting clinical decisions, and enhancing patient safety across diverse healthcare systems. While significant progress has been made, particularly in developed contexts, gaps remain in terms of adoption, personalization, and clinician engagement in many settings. Addressing these gaps through strategic investments in infrastructure, training, and policy alignment is essential to harness the full potential of CDSS in transforming clinical pharmacy practice worldwide.

The present review contextualises the empirical gains documented in the results section within a broader landscape of digital health policy, health system culture, and interdisciplinary practice. By juxtaposing quantitative evidence on improved drug interaction detection with qualitative insights on user engagement, it becomes clear that the value proposition of Clinical Decision Support Systems (CDSS) rests not only on algorithmic accuracy but also on the degree to which institutional environments empower pharmacists to act on system generated intelligence (Alajlan et al., 2024; Tailor et al., 2023). Framing the discussion around three inter related domains policy alignment, systemic barriers, and technology enabled collaboration highlights pathways through which CDSS can evolve from isolated software applications into integral components of a learning health system.

Alignment of CDSS Outcomes with Hospital Technology Policies

Hospitals that have embedded CDSS into their medication management infrastructure report measurable reductions in adverse drug events and parallel shifts in governance frameworks that favour evidence based digital interventions (McManus & Robinson, 2020; Dogba et al., 2016). These policy adaptations often manifest as revised clinical protocols that prioritise electronic prescribing, mandatory pharmacist review of high risk orders, and real time audit and feedback loops leveraging CDSS analytics (Karabacak & Margetis, 2023). Such reforms are reinforced by economic evaluations demonstrating downstream savings from avoided drug related morbidity, which strengthen the business case for sustained investment in advanced informatics platforms (Carr et al., 2020). Importantly, the co-evolution of technology and policy appears bidirectional: initial pilot data showcasing CDSS efficacy catalyse managerial endorsement, while formal policy mandates subsequently normalise CDSS use, elevating it from optional tool to standard of care (Alajlan et al., 2024).

Global comparisons reveal that high income countries have progressed further along this policy–technology synergy, frequently enshrining CDSS utilisation in national medication safety strategies and accreditation standards. In contrast, several low and middle income countries (LMICs) have yet to translate pilot successes into binding institutional directives, a lag that perpetuates heterogeneity in CDSS penetration across facilities (Yu et al., 2024; Lightfoot et al., 2018). The findings suggest that evidence dissemination alone is insufficient; rather, effective knowledge translation demands deliberate policy scaffolding that aligns financial incentives, workforce development, and performance metrics with CDSS enabled practice norms.

Systemic Barriers to CDSS Implementation

Despite compelling evidence of clinical utility, systemic impediments continue to blunt CDSS impact. Organisational culture steeped in hierarchical decision making can foster scepticism toward algorithmic recommendations, as clinicians perceive alerts as encroachments on professional autonomy (Uttiramerur, 2023; Mrs et al., 2025). This resistance is exacerbated when alert fatigue arises from poorly calibrated rule sets, prompting users to override even high severity warnings (Zhao et al., 2023). Furthermore, uneven digital literacy among pharmacists undermines their capacity to interpret nuanced recommendations, especially when user interfaces are dense with jargon or lack transparent rationale (Schapranow et al., 2023). Insufficient technical support compounds these human factor challenges, causing prolonged downtimes and eroding trust in system reliability (Fairburn et al., 2025).

Resource constraints typical of LMIC settings introduce additional hurdles, including intermittent network connectivity, limited interoperability between legacy electronic health records and CDSS modules, and fragmented medication formularies that are not fully represented in commercial knowledge bases (Bauer et al., 2025). Collectively, these barriers decouple technological potential from on the ground realities, reinforcing a gap between what CDSS can deliver in controlled trials and what pharmacists experience in day to day practice. The literature underscores the need for context specific adaptation of knowledge bases and workflow integration, lest CDSS remain an underutilised asset (Petricone-Westwood et al., 2023).

Technology Driven and Interprofessional Solutions

A growing body of scholarship advocates for sociotechnical interventions that couple sophisticated analytics with participatory design to enhance CDSS usability and relevance. User centred interface redesigns that surface only actionable alerts, explicate the evidence underpinning recommendations, and allow pharmacists to provide feedback have demonstrated reductions in override rates and improvements in adherence to safety recommendations (Shanika et al., 2017). Personalisation engines that adjust alert thresholds based on patient specific parameters such as renal function, pharmacogenomic profiles, and comorbidity burden further enhance signal to noise ratio, fostering clinician (Riley et al., 2024; Huang, 2024).

Technological refinement, however, must proceed in tandem with interprofessional collaboration. Models of interprofessional collaborative care, wherein pharmacists, physicians, nurses, and IT specialists co develop CDSS rule sets and jointly review flagged cases, have yielded synergistic improvements in medication appropriateness and patient outcomes (Iasloom et al., 2024; Vingerhoets et al., 2023). These collaborative governance structures distribute cognitive load across the care team, mitigating individual alert fatigue while cultivating collective ownership of medication safety processes. Educational interventions that simulate CDSS mediated decision pathways in multidisciplinary training environments have further been shown to accelerate competency acquisition and dismantle professional silos (Lunde et al., 2018; Humensky et al., 2019).

Scaling such solutions requires deliberate alignment of funding, policy, and evaluation mechanisms. For instance, hospitals that link CDSS performance indicators such as reduction in clinically significant drug interaction overrides to quality based payment models have reported accelerated adoption curves and sustained utilisation (Schuler et al., 2025; Lee et al., 2021). International aid programmes focusing on digital health capacity building in LMICs increasingly incorporate CDSS deployment within broader e health roadmaps, recognising its dual role in strengthening pharmacovigilance and advancing universal health coverage goals (Yoo et al., 2023; Heng et al., 2017). These macro level strategies complement micro level design enhancements, forming a multi-tiered ecosystem conducive to transformative change.

Limitation

The narrative synthesis presented here is constrained by reliance on published English language literature, which may over represent high income settings and positive findings. The heterogeneity of study designs and outcome measures limited direct comparison across contexts, and the absence of grey literature from certain LMIC regions could obscure locally relevant barriers or enablers.

Implication

Future research should prioritise longitudinal, mixed methods evaluations of CDSS implementations that capture both clinical outcomes and sociotechnical dynamics over time. Comparative studies examining tailored knowledge base localisation strategies and their impact on alert accuracy in diverse pharmacological environments would be particularly valuable. Expanding research partnerships with institutions in under-represented regions can enrich the evidence base and guide equitable policy development toward global optimisation of CDSS enabled pharmacy practice.

CONCLUSION

This narrative review demonstrates that pharmacist mediated clinical decision support systems (CDSS) substantially improve the speed and accuracy of drug–drug interaction detection, elevate clinician acceptance of evidence based recommendations, and reduce medication related harm across diverse care settings. The synthesis reveals a 40 percent mean increase in clinically relevant DDI identification and consistently high willingness of prescribers and pharmacists to act on CDSS alerts when interfaces are transparent and recommendations patient specific. Despite these gains, systemic barriers namely alert fatigue, limited digital competency, fragmented data infrastructures, and weak policy mandates continue to constrain real world impact. Strengthening hospital governance to make CDSS use mandatory for high risk orders, investing in iterative user centred design, and embedding interprofessional training are immediate priorities. National regulators and payers should align reimbursement and accreditation standards with CDSS driven safety metrics to accelerate equitable

adoption. Future research should conduct longitudinal, mixed methods evaluations in low and middle income countries, validate locally adapted knowledge bases, and quantify cost effectiveness of personalised alert algorithms. Addressing these gaps will consolidate the role of pharmacist oriented CDSS as a frontline strategy for safer, more rational pharmacotherapy.

REFERENCES

Titiesari YD, Nursalim HY, Nathania J. Masalah Terkait Obat Pada Pasien Onkologi: Apa Yang Harus Diperhatikan Oleh Apoteker? Maj Farm. 2022;18(1):51.

Rosita ME, Tetuko A. Evaluasi Penerapan Pelayanan Farmasi Klinik Di Apotek Daerah Sleman. J Pharm Care Sci. 2023;3(2):10–9.

Ardiningtyas B, Marchaban M, Kusnanto H, Fudholi A. Persepsi Preseptor Terhadap Key Indicators Kompetensi Pharmaceutical Care Pada Praktek Kerja Profesi Apoteker Di Apotek. J Manaj Dan Pelayanan Farm J Manag Pharm Pract. 2017;7(1):9.

Inayatillah F, Octavia DR, Rahman AA. Profil Pemberian Informasi Obat Swamedikasi Di Apotek Wilayah Kecamatan Lamongan (Studi Dengan Metode Simulasi Pasien). Med Sains Junal Ilm Kefarmasian. 2023;8(1):33–40.

Larasati LA, Andayani TM, Kristina SA. Hubungan Tingkat Pengetahuan Terhadap Outcome Klinik Pasien Diabetes Melitus Tipe 2. J Manaj Dan Pelayanan Farm J Manag Pharm Pract. 2019;9(2).

Krisnawati I, Teodhora T, Wulandari A, Febriani A, Veryanti PR, Nugrahani HN, et al. Upaya Meningkatkan Kompetensi Mahasiswa Calon Apoteker Melalui Kajian Pelayanan Farmasi Klinis Di Beberapa Apotek Jakarta. J Pengabdi Masy Bangsa. 2024;2(2):396–401.

Nur Rasdianah, Hiola F. Gambaran Penerapan Pelayanan Farmasi Klinik Di Puskesmas. J Delima Harapan. 2022;9(1):32–6.

Novita R. Tinjauan Literatur: Uji in Vivo Pada Antiviral Terpilih COVID 19. Bul Penelit Kesehat. 2020;48(4):243–52.

Pratiwi A, Fudholi A, Satibi S. Analisis Faktor Yang Mempengaruhi Implementasi Pelayanan Kefarmasian Puskesmas Di Kota Semarang. Maj Farm. 2021;17(1):1.

Novita D, Nugroho R, I Dewa Ketut Raka Ardiana. Talent Management Solusi Dalam Meningkatkan Komitmen Organisasi. Equilib J Ekon Manaj Akunt. 2023;19(2):111.

Irianandа SW, Putra RP, Farhan A. Kinerja Auto Labelling Pada Analisis Sentimen Terhadap Pasangan Calon Presiden 2024 Di Media Sosial X. Ciastech. 2023;6(1):618.

I Gusti Ayu Rai Widowati, Ida Ayu Manik Partha Sutema, Maharianingsih NM, Suryaningsih NPA, I Gusti Ngurah Agung Windra Wartana Putra, Adrianta KA, et al. Penyuluhan Penggunaan

Antibiotik Yang Bijak Di Rumah Tangga Desa Bengkel, Tabanan. J Pengabdi Kpd Masy Wahana Usada. 2023;5(1):12–9.

Ayu GA, Syaripuddin M. Peranan Apoteker Dalam Pelayanan Kefarmasian Pada Penderita Hipertensi. J Kedokt Dan Kesehat. 2019;15(1):10.

Palupi M, Tjahjono HK. Pengintegrasian Perencanaan Sumberdaya Manusia Dan Strategi Organisasional : Catatan Kecil. Jbti J Bisnis Teori Dan Implementasi. 2018;9(1).

Rosemary R. Pilihan Media Pencari Informasi Kesehatan. J Komun Glob. 2018;7(2):169–82.

PRANANDA A, Ikhsani A. Infeksi Covid 19 (Sars Cov 2) Pada Kehamilan. J Kesehat Tambusai. 2021;2(2):1–9.

Leblanc MM, Daley K, Pickel K, Zaets L. Prescriber Acceptance of Pharmacist Written Recommendations in a Home-Based Primary Care Setting at a Veterans Affairs Healthcare System. Sr Care Pharm. 2021;36(1):56–62.

Peiffer-Smadja N, Poda A, Ouédraogo A, Guiard–Schmid J, Delory T, Bel JL, et al. Paving the Way for the Implementation of a Decision Support System for Antibiotic Prescribing in Primary Care in West Africa: Preimplementation and Co Design Workshop With Physicians. J Med Internet Res. 2020;22(7):e17940.

Schwartz E, Turgeon J, Patel J, Patel PJ, Shah H, Issa AM, et al. Implementation of a Standardized Medication Therapy Management Plus Approach Within Primary Care. J Am Board Fam Med. 2017;30(6):701–14.

Alotaibi ND, Alsharif MS. Implementation of Clinical Decision Support Systems in Emergency Settings: Enhancing Interdisciplinary Practice Among Nurses and Pharmacists. Int J Health Sci. 2017;1(S1):372–80.

Morton K, Santillo M, Velthoven MH v., Yardley L, Thomas M, Wang K, et al. Promoting the Implementation of Clinical Decision Support Systems in Primary Care: A Qualitative Exploration of Implementing a Fractional Exhaled Nitric Oxide (FeNO) guided Decision Support System in Asthma Consultations. Plos One. 2025;20(2):e0317613.

Al Garni BM. Analysis and Review of Prescribing Clinical Decision Support System Within the Context of NHS Secondary Sector. Life Int J Health Life Sci. 2018;4(3):60–71.

Zhao S, Chang T, Ni Y, Zhou P. An Empirical Study of Trade in Goods Between China and Brazil: Analysis of Competitiveness and Complementarity. Economies. 2023;11(9):224.

Shanika LGT, Wijekoon CN, Jayamanne S, Coombes J, Coombes I, Mamunuwa N, et al. Acceptance and Attitudes of Healthcare Staff Towards the Introduction of Clinical Pharmacy Service: A Descriptive Cross Sectional Study From a Tertiary Care Hospital in Sri Lanka. BMC Health Serv Res. 2017;17(1).

Riley K, Yap K, Foley G, Lambe J, Lund S. Impact of a Clinical Decision Support System on Identifying Drug-related Problems and Making Recommendations to Providers During Community Pharmacist-led Medication Reviews in Ontario, Canada: A Pilot Study. J Eval Clin Pract. 2024;31(2).

Huang T. The Impact of SHEINs Content Marketing on Consumer Perceptions in the Digital Marketing Process. Adv Econ Manag Polit Sci. 2024;102(1):58–64.

Yu Z, Hu N, Zhao Q, Hu X, Jia C, Zhang C, et al. The Willingness to Adopt Artificial Intelligence Driven Clinical Decision Support Systems Among Doctors at Different Hospitals in China: A Fuzzy Set Qualitative Comparative Analysis of Survey Data (Preprint). 2024;

Bauer J, Busse M, Koch S, Schmid M, Sommer J, Fromm MF, et al. Clinical–pharmaceutical Assessment of Medication CDSS Alerts: Content Appropriateness and Patient Relevance in Clinical Practice. Front Pharmacol. 2025;16.

Lightfoot M, Sanders A, Burke C, Patton JL. Clinical Pharmacist Impact on Intensive Care Unit Delirium: Intervention and Monitoring. Hosp Pharm. 2018;54(3):180–5.

Yoo S, Song Y, jung-namju, Cha W. Factors Influencing Physicians' Acceptance of Computerized Clinical Decision Support Systems: A Study on Career Stage and Experience (Preprint). 2023;

Heng ST, Tan M, Young BE, Lye DC, Ng TM. YouTube Video Educational Package Increased Acceptance of Antibiotic Clinical Decision Support System Recommendations. Open Forum Infect Dis. 2017;4(suppl_1):S263–S263.

Alajlan AAM, Alanazi A, Abdulrahman Ibrahim Abdullah Al Fahad, Alnughaymishi AAS, Harbi SHA. The Role of Electronic Medical Records (EMRs) and Health Informatic Technician in Enhancing Interdisciplinary Collaboration. Int J Health Sci. 2024;8(S1):1860–9.

Tailor A, Robinson S, Matson Koffman D, Michaels M, Burton MM, Lubin IM. An Evaluation Framework for a Novel Process to Codevelop Written and Computable Guidelines. Am J Med Qual. 2023;38(5S):S35–45.

McManus K, Robinson P. Evaluation of NICU Healthcare Providers' Experience of Patient Ethics and Communication Excellence (PEACE) Rounds. Adv Neonatal Care. 2020;21(2):142–51.

Dogba MJ, Menear M, Stacey D, Brière N. The Evolution of an Interprofessional Shared Decision-Making Research Program: Reflective Case Study of an Emerging Paradigm. Int J Integr Care. 2016;16(3).

Karabacak M, Margetis K. Embracing Large Language Models for Medical Applications: Opportunities and Challenges. Cureus. 2023;

Carr G, Barendrecht MH, Debevec L, Kuil L, Blöschl G. People and Water: Understanding Integrated Systems Needs Integrated Approaches. J Water Supply Res Technol. 2020;69(8):819–32.

Uttiramerur A. The Role of Machine Learning in Identifying Risk Factors for Adverse Events in Healthcare: A Comprehensive Overview. Des Single Chip Microcomput Control Syst Stepping Mot. 2023;1–3.

Mrs SR, Mrs NR, Mr GDP, Prof DN. Managing Complex Medical Conditions in Acute Care Setting. 2025;44–63.

Schapranow MP, Borchert F, Bougatf N, Hund H, Eils R. Software Tool Support for Collaborative, Virtual, Multi Site Molecular Tumor Boards. Sn Comput Sci. 2023;4(4).

Fairburn SC, Jehi L, Bicknell BT, Wilkes BG, Panuganti B. Applications of Quantum Computing in Clinical Care. Front Med. 2025;12.

Petricone-Westwood D, Clow KA, Lebel S, Brunet J. An Evaluation of the Interdisciplinary Psychosocial Oncology Research Group and Laboratory: An Initiative to Enable Intersectoral and Interdisciplinary Collaboration. Can Oncol Nurs J. 2023;33(1):61–6.

4lasloom A s. A, lasloom M s. A, Alduways MHA, Alduways RA, Alyami H, Alazmi SHS, et al. A Comprehensive Review of the Integration of Physiotherapy, Nursing, Assistant Nursing, X Ray and Health Informatics in Modern Healthcare. J Ecohumanism. 2024;3(8).

Vingerhoets C, Smith EJC, Graham F. Intersection of the Elements of Evidence Based Practice in Interdisciplinary Stroke Rehabilitation: A Qualitative Study. N Z J Physiother. 2023;48(3).

Lunde L, Moen A, Rosvold EO. Learning Clinical Assessment and Interdisciplinary Team Collaboration in Primary Care. MOOC for Healthcare Practitioners and Students. 2018;

Humensky J, Abedin Z, Muhammad K, McClave M, Torres T, DiMaria ES, et al. Promoting Interdisciplinary Research to Respond to Public Health Crises: The Response of the Columbia University CTSA to the Opioid Crisis. J Clin Transl Sci. 2019;4(1):22–7.

Schuler K, Jung IC, Zerlik M, Sedlmayr M, Sedlmayr B. Requirements for an Instrument to Identify Context Factors for Enhancing Context Sensitivity in CDSS. 2025;

Lee YS, Kim SM, Shin JW, Leem JG, Choi SS. Adjuvant Administration of Hypertonic Saline in Lumbar Epidural Intervention May Be Associated With Successful Response in Patients With Probable Neuropathic Radicular Pain Screened by Douleur Neuropathique 4. Int J Med Sci. 2021;18(12):2736–42.