



Electronic Prescription Systems and Medication Adherence in Schizophrenia: A Systematic Review of Digital Integration and Implementation Evidence

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Revised: 22 July 2026 Accepted: 22 September 2026 Published: 30 September 2026 How to cite : Handayani, T. S., Ghozali, M. T., & Harimurti, S. (2026). Electronic Prescription Systems and Medication Adherence in Schizophrenia: A Systematic Review of Digital Integration and Implementation Evidence. <i>Contagion : Scientific Periodical of Public Health and Coastal Health</i>, 8(3), 405–418.	<i>Medication non-adherence among patients with schizophrenia ranges from 40% to 60% and is a major factor contributing to relapse and rehospitalization. Objective assessment of medication adherence was facilitated through an electronic prescription system (SRE), although evidence regarding its effectiveness and implementation remains limited. This study aimed to evaluate the effectiveness of SRE in improving medication adherence among patients with schizophrenia and to identify factors influencing its implementation. A literature search was conducted in PubMed, Scopus, PsycINFO, Embase, and Web of Science for studies published between 2015–2025. Study was assessed using the RoB-2, ROBINS-I, CASP, and GRADE instruments. Data were synthesized using a thematic approach and a random effects model. A total of 501 studies were identified, of which eligible studies were included in the final synthesis. The findings indicated that SRE (Schizophine Recognition Elements) improved the objective identification of medication non-adherence, with measured medication adherence ($p=0.001$) and may contribute to relapse prevention among patients with schizophrenia. The use of long-acting antipsychotics (LAIs) was also associated with better adherence, with adherence rates ranging from 46% to 61%. The main barriers to implementation included poor internet connectivity, resistant among healthcare professionals, non-user-friendly interfaces, and limited digital literacy. Overall, SRE appears to be an effective strategy for improving medication adherence among patients with schizophrenia, particularly when supported by healthcare interventions and the use of LAIs. Successful implementation requires institutional commitment, standardized performance metrics, and effective integration into routine clinical practice.</i> Keywords: <i>Electronic prescribing, medication adherence, schizophrenia</i>

INTRODUCTION

Patients who are non-adherent to their prescribed medication regimens may experience serious health consequences, particularly those with severe mental illnesses. Up to 65% of individuals with severe mental illnesses fail to adhere to their prescribed medications, which can exacerbate their condition and lead to poorer treatment outcomes.

Non-adherence is associated with adverse consequences, including increased relapse rates, more frequent rehospitalizations, prolonged recovery periods, and higher overall healthcare costs (Zwide et al., 2025). Conventional methods for assessing medication adherence, such as subjective patient self-reports, prescription refill records, manual pill counts, and healthcare provider evaluations, have several limitations, including recall bias,

social desirability bias, and low reliability. Consequently, these approaches often overestimate actual adherence rates (Yaegashi et al., 2020).

Objective medication adherence data can now be viewed through Electronic Prescribing Systems (EPS) and other digital technologies, including electronic monitoring devices, digital medication management systems, and integrated pharmacy databases, which enable routine and accessible adherence monitoring (Fowler et al., 2019).

These developments are supported by theoretical frameworks, such as the Theory of Planned Behavior (TPB) (Seppälä et al., 2025) and the Technology Acceptance Model (TAM), both of which emphasize the influence of perceived usefulness and ease of use on the adoption of digital health technologies. In addition, Normalization Process Theory (NPT) provides a conceptual framework for examining the implementation challenges associated with complex healthcare interventions, from development to evaluation (Sunaryanto & Priyono, 2025). Although randomized controlled trials (RCTs) remain the gold standard for evaluating intervention efficacy, critics have argued that they often failed to adequately address real-world implementation factors. By focusing on the cognitive and social processes required to embed new practices into routine workflows, NPT offers a valuable framework for addressing this limitation. Despite its increasingly widespread application in healthcare research and RCTs, further investigation is needed to clarify the role of NPT in supporting the planning, implementation, and operationalization of such trials (Williams et al., 2023). Higher adherence rates have been reported among patients receiving clozapine than among those receiving standard treatment regimens ($P = 0.02$), with adherence influenced by factors such as system usability, behavioral intentions, peer support, and the level of healthcare system integration (Cahaya et al., 2022).

Patients with schizophrenia who exhibited extrapyramidal side effects and were receiving outpatient treatment were recruited using a consecutive sampling approach. Treatment effectiveness was determined based on physician-confirmed diagnoses documented in the patients' medical records (Putrilia et al., 2025). Telenursing-based care has also been shown to improve medication adherence among individuals with schizophrenia, with both patients and caregivers benefiting from efficient and targeted care delivery that ultimately reduces nonadherence (Azni & Anisa, 2020).

The primary objective of this review was to systematically examine and evaluate the impact of digital prescribing systems, including functions for electronic prescription transmission, medication tracking, and clinical decision support, on medication adherence outcomes among patients.

The secondary objectives were threefold. First, to identify and quantify technological mediators, such as notification delivery time, dashboard usability, and inter-pharmacy interoperability; clinical mediators, including the accuracy of prescribing decision-support systems and long-acting antipsychotic (LAI) scheduling algorithms; and psychosocial mediators, such as digital literacy, therapeutic alliance, and patient-perceived distress, in the relationship between EPS and medication adherence through a meta-analytic mediation model. Second, to systematically explore barriers and facilitators to the integration of EPS into routine psychiatric practice using dual coding based on the Consolidated Framework for Implementation Research (CFIR) and the Non-adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) framework, with particular attention to issues such as notification fatigue, data security concerns, and reimbursement incentives that have emerged alongside the rapid expansion of telepsychiatry services following the COVID-19 pandemic. Third, to identify key implementation challenges, including limited internet connectivity in rural areas, cross-border data governance issues, and low levels of digital literacy among healthcare professionals.

METHODS

This systematic review was conducted in accordance with the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines, which emphasize comprehensive topic coverage and the systematic identification of all relevant studies regardless of study design.

The primary research question was formulated collaboratively by the research team and aligned with the study objectives. Key thematic areas examined included the technological, clinical, and psychosocial factors influencing adherence in schizophrenia; the facilitators and barriers to the adoption of digital prescribing in psychiatric practice; and implementation challenges and future priorities for digital prescribing technologies. Studies were eligible for conclusion if they evaluated digital prescribing systems, electronic adherence monitoring tools, or digital medication platforms; reported outcomes related to medication adherence, treatment persistence, hospitalizations, or clinical outcomes; and employed randomized controlled trial RCTs, cohort, mixed methods, qualitative, or implementation designs published within the last 15 years. Studies were excluded if they lacked a digital prescribing component or were review articles, editorials, or case reports.

The search strategy was developed by a principal investigator, who has expertise in pharmacy research and systematic review methodology. Two investigators independently

searched PubMed, Scopus, PsycINFO, Embase, and Web of Science for studies published between January 2015 and December 2025. The search used the following keyword combination: ("electronic prescribing" OR "electronic prescription" OR "digital prescription") AND ("schizophrenia" OR "psychotic disorder") AND ("medication adherence" OR "compliance" OR "persistence"), with appropriate adaptations for the indexing terms and search syntax of each database. Retrieved records were imported, screened, and deduplicated according to predefined eligibility criteria. The search process was designed to maximize the identification of relevant studies and was supplemented by gray literature searching to reduce publication bias.

Titles and abstracts identified through the systematic search were independently screened by two reviewers against the predefined eligibility criteria. Studies that did not meet the inclusion criteria were excluded. Any disagreements between reviewers were resolved through discussion and consensus, with consultation from a third reviewer when necessary. Regular meetings were conducted to monitor and review the progress of the screening process. Studies deemed potentially eligible underwent full-text assessment by the reviewers. The study selection process, including the numbers of records identified, screened, excluded, and included, is presented in a PRISMA flow diagram (Figure 1).

The data collected included research design, population characteristics, type of intervention, adherence measurement method, outcomes, and barriers or contributing factors. Researchers used Covidence software to manage the data and then conducted a narrative synthesis, supported by quantitative mapping of adherence outcomes.

This study was assessed through a comprehensive evaluation and review of credibility criteria, including its value and relevance in a specific context. Cochrane RoB 2 was used for RCTs, ROBINS-I for non-RCT studies, and CASP for qualitative data. The GRADE framework was also applied to assess the strength of available evidence and to develop credible recommendations in a transparent manner.

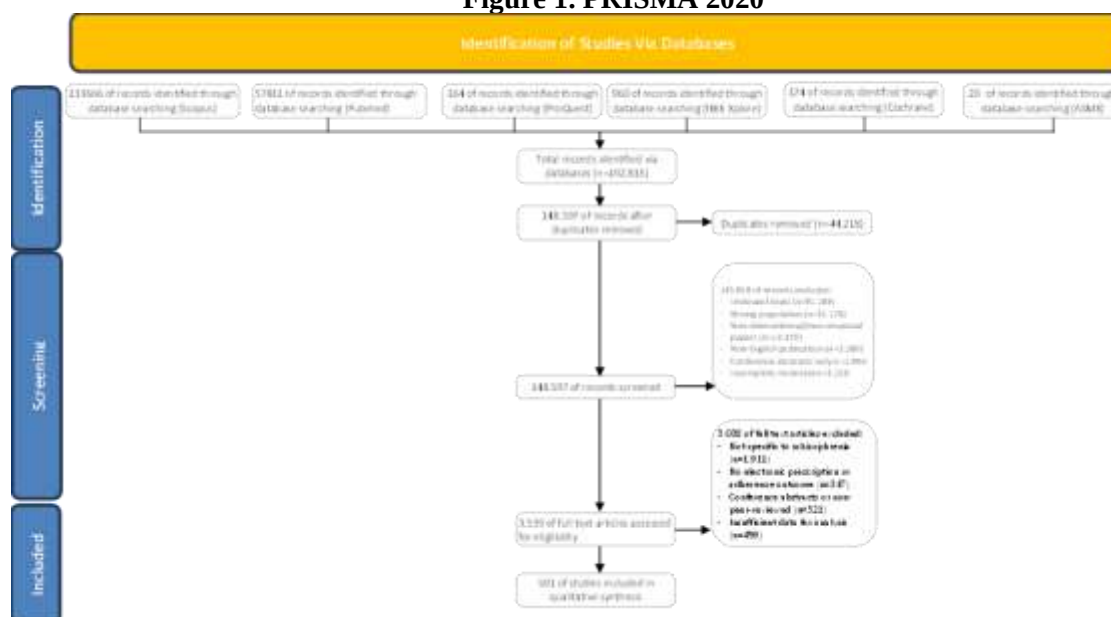
The existing data analysis process has conducted a review of various methodologies that are appropriate to the existing type of research design.

RESULTS

From the results of various data searches, approximately 133.666 searches were collected and obtained through searches in Scopus, as well as an additional 59.149 records from other sources such as PubMed, ProQuest, IEEE Explore, Cochrane, and ASME. In total, 192.815 original articles and gray literature were collected. After removing 44.218 records

suspected of duplication, 148.597 records remained. The studies were then categorized based on region, study design, and population. Of the 148.597 records screened, 145.058 articles were excluded for reasons such as: irrelevant to the topic (91.183 articles), population focus errors (35.176 articles), non-interventional or non-empirical papers (12.373 articles), conference abstracts only (1.996 articles), and incomplete metadata (2.150 articles). During the screening process, 3.539 full-text articles were assessed for eligibility. Of these, 3.038 articles were excluded for various reasons, such as not specifically addressing schizophrenia (1.911 articles), not providing data on prescribing outcomes or adherence (347 articles), being conference abstracts or non-peer-reviewed publications (321 articles), or containing insufficient data for analysis (459 articles). Thus, 501 studies were ultimately included in the qualitative synthesis.

Figure 1. PRISMA 2020



No	Year, Author(s)	Country	Study Design	Electronic System/Features	Study Duration	Adherence Measure
1	(Z. Zhu et al., 2025)	USA	Post hoc analysis	AiCure app + XGBoost algorithm	28 weeks	Daily, adjusted, binary adherence (predicted)
2	(Yaegashi et al., 2020)	Japan	Observational / system evaluation	CPOE, CDSS, integrated pharmacy systems	Several months–1 year	System log-based adherence (prescriptions, workflow)
3	(X. Zhu et al., 2020)	China	RCT	WeChat-based intervention (not pure e-prescribing)	6 months	MEMS + MAQ Questionnaire
4	(Osimo et al., 2018)	UK	Retrospective observational	EHR / EPR	2013–2016	Did not measure adherence (used inflammatory markers)

No	Year, Author(s)	Country	Study Design	Electronic System/Features	Study Duration	Adherence Measure
5	(Fowler et al., 2019)	UK	Multicenter pragmatic trial	DMS (oral sensor + patch + app + dashboard)	8 weeks	Used to support adherence (pilot trial)
6	(Rohatagi et al., 2016)	UK	Phase 4 / observational	DMS (oral sensor + patch + mobile device)	16 weeks	74% of patients willing to use DMS in the future
7	(Werntz et al., 2023)	-	Qualitative meta-review	DMHI (digital mental health interventions)	-	Human support improves DMHI effectiveness
8	(Ruetsch et al., 2022)	USA	Cross-sectional	Objective adherence data (pharmacy refill, MEMS)	-	Objective data influenced clinical decisions
9	(Tham et al., 2018)	Singapore	Non-experimental cross-sectional	eIMR (Electronic Inpatient Medical Record)	Nov 2014–Mar 2015	MMAS-8 (self-report scale)
10	(Loots et al., 2021)	Europe	Systematic review & meta-analysis	Various interventions (educational, behavioral, tech)	-	No significant differences across intervention types
11	(Tessier et al., 2020)	France	Prospective observational	MEMS (smart pill bottle caps)	2 years	Mean adherence 59.8% (consistent among adherent patients)
12	(Wei et al., 2025)	Hong Kong	Population-based within-subject	CDARS (territorial EHR database)	1993–2023 (prescribing: 2004–2023)	Proxy: relapse risk (LAI vs oral)
13	(Alsabhan et al., 2023)	Saudi Arabia	Cross-sectional	EMR from KKHU	Feb 2020–Feb 2021	Did not measure adherence (assessed prescribing patterns)
14	(Berrouguet et al., 2017)	Spain	Pilot observational	MEmind (web application)	5 months	Did not measure patient adherence (assessed clinician prescribing habits)
15	(Anderson et al., 2017)	Japan	Retrospective cohort	Electronic order entry, HIS	2 years	Prescription completeness & error reduction
16	(Lin et al., 2021)	USA	Systematic review	Electronic order entry, HIS	1–2 years	Prescription completeness & error reduction
17	(Mallorquí et al., 2023)	Spain	Prospective observational	e-STAR	2 years	Treatment retention & symptom improvement (RLAI better)

Based on the study descriptions in the summary table provided, the geographic distribution of research on electronic prescribing systems and digital-based adherence monitoring is largely concentrated in high-income countries.

The majority of included studies originate from North America and Western Europe, with the United States making the largest contribution. Meanwhile, within Europe, Japan has been a major contributor from the East Asian region, with numerous observational studies and system evaluations examining electronic prescribing, CPOE, and their integration with HIS. Overall, this geographic distribution pattern indicates that research on electronic prescribing and adherence has been largely conducted in developed countries, which may limit the generalizability of the results to resource-constrained regions. This highlights a significant evidence gap and reinforces the need for more research in low- and middle-income countries, particularly to assess the feasibility, effectiveness, and contextual adaptation of electronic prescribing systems across various healthcare settings.

In patients with schizophrenia, the non-adherence rate according to electronic monitoring was 41.2%, which is lower than results obtained with other methods such as self-reporting or pill counting and traditional medication (Yujin et al., 2019). Furthermore, the use of electronic prescriptions can reduce medication errors in hospitals and improve the quality of healthcare (Putri & Dhamanti, 2025).

The impact of electronic prescription systems, particularly with Long-Acting Injectables (LAIs), compared with oral antipsychotics is associated with better adherence and greater effectiveness in improving clinical severity and function. LAIs also reduce the use of concomitant medications and the number and days of hospitalizations (Lin et al., 2023).

The integration of human support and technological innovation is evident in interventions that combine electronic prescription systems with motivational interviewing or psychoeducation, which produce the most robust results. Human support enhances the effectiveness of digital interventions, particularly in severe cases, while motivational interviewing, psychoeducation, and peer support improve adherence when used in conjunction with digital tools (Muhammad et al., 2016).

Factors that can influence medication adherence in schizophrenia patients include ease of use, interoperability, and fatigue due to reminders; behavioral aspects such as understanding, motivation, attitudes, and stigma; and systemic aspects such as workflow integration, clinician training, and patient literacy.

There are several factors identified into three groups: (1) Patient factors (lack of understanding of the disease, feeling cured, boredom); (2) Treatment factors (drug side effects,

duration of therapy); and (3) System and social factors (low family support, stigma, weak therapeutic relationship) (Ahmadi et al., 2026). On the other hand, additional facilitators for treatment adherence include clinician support, collaborative development with patients, decision-making support tools, and policy incentives aimed at supporting schizophrenia patients.

The use of electronic prescriptions for Long-Acting Injectables (LAIs) is one strategy used to improve medication adherence in schizophrenia patients, as LAIs have been shown to improve medication adherence, reduce hospitalization rates, and be more cost-effective than oral antipsychotics (Howard et al., 2018). Furthermore, electronic LAI monitoring has been associated with fewer relapses and improved patient functioning.

Evaluation of medication adherence in patients diagnosed with schizophrenia is hampered by a lack of standardized definitions and objective measurement instruments. Most existing studies are short to medium in duration, and research on long-term effectiveness in real-world settings is limited. Furthermore, there are significant gaps in the integration of psychosocial determinants and machine learning-based Clinical Decision Support Systems (CDSS).

DISCUSSIONS

Electronic Prescription Systems (EPS) enable early detection of patient medication non-adherence, with non-adherence rates ranging from 0.2% to 74% in various countries (Bruthans et al., 2023). The Czech Republic reported a non-adherence rate of 4.56% out of 21 million prescriptions, with rates even higher among users of psychoanalytic medications. Advantages of EPS include objective detection beyond patient self-report and integration with Clinical Decision Support Systems for better decision-making (Annisa et al., 2023; Smith et al., 2025). Disadvantages include dependence on the quality of digital infrastructure, a lack of certification standards, and the inadequacy of technical solutions without innovation from the social and health system perspectives (Kardas, 2024).

The combination of digital monitoring and human support has resulted in sustained adherence improvements, although barriers remain. Human support training, co-design, and case management reduced prescribing errors by 49.8% (Azni & Anisa, 2020; Suprayogi et al., 2026). Integrating multiple approaches has been shown to reduce user resistance and increase system acceptance (Smith et al., 2016). Challenges include slow internet connections, inflexible interfaces, habitual manual methods, resistance from senior physicians, and low digital literacy (Bani Fatemi et al., 2019; Suprayogi et al., 2026). Variations in outcomes across

departments suggest that context-specific modifications and ongoing optimization are crucial (Azni & Anisa, 2020). Successful implementation requires a balance between digital innovation, human support, and institutional commitment (Annisa et al., 2023; Kardas, 2024).

Previous reviews treated technology as a stand-alone tool (Yaegashi et al., 2020) validated electronic adherence monitoring but did not link the findings to organizational adoption (Wu et al., 2023) mapped digital interventions but still needed further validation of their effectiveness. This review overcomes these limitations by integrating three layers of analysis: individual behavior (Theory of Planned Behavior, Technology Acceptance Model), implementation systems (Normalization Process Theory, CFIR), and informatics infrastructure repositioning adherence as a sociotechnical process (Arnautovska et al., 2025). who found that digital interventions showed a trend toward positive effects only when accompanied by human support (Fulford et al., 2025) also noted that digital therapies require integration with This review uniquely addresses future directions, including the integration of AI and policy innovation (Jamil et al., 2025) and highlights aspects of equity (connectivity in rural areas, cross-border data governance) that are less addressed in the existing literature consistent with the NASSS framework (Gremyr et al., 2020).

Objective electronic prescription systems should be used as a supporting tool, not a substitute for clinical judgment or patient engagement. To achieve sustainable improvements in adherence, it is crucial to incorporate human support mechanisms, such as case management and psychoeducation. Empirical evidence shows that EPS complements, not replaces, clinical judgment and patient engagement (Annisa et al., 2023; Suprayogi et al., 2026). The maximum effectiveness of EPS can only be achieved when integrated with human support in the form of psychoeducation and case management, which have been shown to significantly improve adherence ($p=0.001$), knowledge ($p=0.023$), attitudes ($p=0.001$), and reduce relapse and readmission rates. Patient engagement with automated interventions is often suboptimal; Therefore, the presence of human clinical support is a crucial factor in strengthening accountability and maintaining long term adherence (Mamang et al., 2025)(Santosa et al., 2025; Shaffer et al., 2022).

Furthermore, it is recommended to integrate e-prescription systems with various approaches such as long-acting injections (LAI), motivational interviewing (MI), and shared decision-making (SDM) tools to reduce hospitalization rates and improve patient outcomes. Policymakers are advised to focus on standardizing adherence metrics and incentivizing the adoption of digital tools to maximize systemic impact. Integrating EPS with LAI, MI, and SDM is recommended for patients with lower hospitalization rates and improved clinical outcomes.

LAI has been shown to increase adherence from 46% to 61% and reduce the risk of relapse by up to 30% (Dobber & Latour, 2023; Zhang et al., 2025). Meanwhile, MI and SDM play a role in addressing patient ambivalence and increasing treatment satisfaction (Zhang et al., 2025). For policymakers, there are three main priorities: standardizing compliance metrics across the service system, providing incentives for the adoption of user-friendly and operational EPS, and conducting ongoing training for medical personnel to overcome resistance and limitations in digital literacy (Suprayogi et al., 2026; Suriadi et al., 2025).

Key issues relate to workflow integration, which requires seamless connectivity with Electronic Medical Records (EHR) systems and the provision of customizable alerts to strengthen collaboration between physicians and pharmacists. To ensure clinical engagement, physicians need to be involved in the co-design process and provided with adequate training on EPS. Meanwhile, from a patient perspective, healthcare providers must support them in overcoming stigma, reducing cognitive barriers, and eliminating potential trust issues between patients and physicians.

In longitudinal studies, it is important to assess the sustainability and real-world impact of digital medicine systems and e-prescribing on patient adherence and clinical outcomes. Standardization efforts should focus on the development and validation of objective adherence metrics that are suitable for both research and routine clinical implementation. To support clinical decision-making, future research should design and evaluate operationalized machine learning-driven Clinical Decision Support Systems (CDSS) that integrate real-time adherence data with patient specific risk profiles in psychiatric care. Furthermore, cross-cultural validation of the usability and effectiveness of e-prescribing systems in supporting physicians prescribing practices is also needed.

Strengths of this review include interdisciplinary synthesis, integration of implementation evidence, and use of a peer-reviewed design. Limitations include heterogeneity in adherence measurement methods and a tendency for publication bias favoring positive findings.

CONCLUSIONS

Electronic medication use technologies are digital health tools with significant potential to improve medication adherence among patients with schizophrenia, particularly when combined with human support and the use of long-acting injectable antipsychotics (LAIs). However, several important challenges remain, including standardizing adherence measurements, integration of digital tools into clinical workflows, and management of the

complex psychosocial factors that influence adherence. Future research should prioritize longitudinal studies in real-world settings, the development of standardized adherence metrics, and the design of user-friendly, collaborative decision-support systems. Furthermore, there is an urgent need for artificial intelligence (AI)-based systems capable of integrating technology with patient-centered psychiatric care.

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