

Systematic review on safe prescribing training for medical students.

Revisión sistemática sobre la formación en prescripción segura para estudiantes de medicina.

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Abstract:

Introduction: Medication errors present a significant challenge to patient safety, stemming from inaccuracies in prescribing, dispensing, administration, and monitoring. These errors emphasise the urgent need to enhance safe prescribing training for medical students. This systematic review evaluates educational interventions aimed at improving prescribing competencies among medical undergraduates. **Methods:** A comprehensive search across Scopus, PubMed, Web of Science, ScienceDirect, and Google Scholar identified 16 primary studies that met the inclusion criteria. The interventions examined included case-based workshops, simulation-based training, e-learning platforms, interprofessional education, and pharmacist-led initiatives. **Results:** Findings consistently indicated that structured, longitudinal teaching, particularly when it integrates clinical relevance, decision-support tools, and hands-on practice, significantly enhanced students' prescribing accuracy and confidence. Additionally, effective training in obtaining patient histories, identifying treatment goals, and recognising contraindications, drug interactions, and comorbidities was deemed critical for reducing medication errors. However, inconsistencies were observed in training content, duration, and delivery methods across institutions. **Conclusion:** The review highlights the importance of integrating a standardised, evidence-based safe prescribing curriculum that incorporates digital innovations, real-time feedback, and collaborative learning. This will equip future healthcare professionals with the necessary competencies to minimise prescribing errors and uphold patient safety.

Keywords: Safe prescribing, medical students, medication errors, patient safety, prescribing education

Resumen

Introducción: Los errores de medicación representan un desafío significativo para la seguridad del paciente, debido a imprecisiones en la prescripción, dispensación, administración y monitorización. Estos errores enfatizan la urgente necesidad de mejorar la capacitación en prescripción segura para estudiantes de medicina. Esta revisión sistemática evalúa intervenciones educativas dirigidas a mejorar las competencias de prescripción entre los estudiantes de medicina. **Métodos:** Una búsqueda exhaustiva en Scopus, PubMed, Web of Science, ScienceDirect y Google Scholar identificó 16 estudios primarios que cumplieron con los criterios de inclusión. Las intervenciones examinadas incluyeron talleres basados en casos, capacitación basada en simulación, plataformas de aprendizaje electrónico, educación interprofesional e iniciativas dirigidas por farmacéuticos. **Resultados:** Los hallazgos

indicaron consistentemente que la enseñanza longitudinal estructurada, particularmente cuando integra relevancia clínica, herramientas de apoyo a la toma de decisiones y práctica, mejoró significativamente la precisión y la confianza de los estudiantes en la prescripción. Además, una capacitación efectiva en la obtención de historiales clínicos, la identificación de objetivos terapéuticos y el reconocimiento de contraindicaciones, interacciones farmacológicas y comorbilidades se consideró crucial para reducir los errores de medicación. Sin embargo, se observaron inconsistencias en el contenido, la duración y los métodos de impartición de la capacitación en las distintas instituciones. **Conclusión:** La revisión destaca la importancia de integrar un currículo de prescripción segura estandarizado y basado en la evidencia que incorpore innovaciones digitales, retroalimentación en tiempo real y aprendizaje colaborativo. Esto dotará a los futuros profesionales de la salud de las competencias necesarias para minimizar los errores de prescripción y garantizar la seguridad del paciente.

Palabras clave: Prescripción segura, estudiantes de medicina, errores de medicación, seguridad del paciente, educación en prescripción

1. Introduction

Medication errors pose a significant threat to patient safety and are defined as preventable events that may result in inappropriate medication use or patient harm (1). They frequently occur during the prescribing, dispensing, administration, or monitoring of drugs, and are often associated with individual, team-based, or systemic failures (2). Among these, prescribing errors constitute a considerable proportion of incidents, with studies indicating a high prevalence, particularly among newly graduated doctors and interns (3-4).

The ability to prescribe safely and effectively is a fundamental skill for medical practitioners, yet prescribing errors remain a prevalent challenge in clinical practice (3, 5-6). Numerous studies have emphasised the importance of structured educational interventions in improving prescribing competencies among medical students and junior doctors (7-8). Traditional pharmacology lectures, although foundational, often fall short in equipping future prescribers with the necessary skills to navigate complex clinical scenarios (9).

To address this gap, various pedagogical approaches have been explored. These include case-based learning, hands-on training, simulation-based exercises, and interprofessional education (10, 11). World Health Organisation (WHO) initiative on constructing patient examples and the Guide to Good Prescribing have been widely adopted to foster clinical reasoning and prescription accuracy (12). Likewise, formal assessment strategies such as the Prescribing Safety Assessment (PSA) and pharmacotherapy self-assessments have demonstrated success in reinforcing theoretical knowledge and reducing error rates (13-14).

Interprofessional education (IPE) has emerged as a promising solution to enhance prescribing safety through collaboration between medical, pharmacy, and physician assistant students (11). When structured prescribing activities are conducted in a team-based setting, skills in communication, medication safety, and clinical reasoning improve (7, 14). Healthcare-led interventions such as real-time prescription audits, video-stimulated feedback, and digital modules have proven particularly effective in reducing prescribing errors (10, 14). Despite these advances, practical implementation remains challenging. Barriers such as scheduling conflicts, limited faculty availability, and resource constraints often hinder the widespread adoption of interprofessional initiatives (12). Emerging solutions like virtual platforms and interactive e-learning are increasingly being considered to address these limitations and enhance the accessibility of prescribing education

(7). The transition from medical school to clinical practice represents a critical period during which individuals are at heightened risk of medication errors (6, 13). Targeted interventions such as electronic prescribing training, simulation-based learning, and regulatory education have all shown promise in supporting safer prescribing behaviours (5, 9). However, technology-driven tools may also introduce new errors or promote over-reliance on automated decision-support systems (14-15).

A multifaceted approach is therefore essential, one that integrates foundational pharmacology education with clinically relevant, interdisciplinary, and digitally supported learning experiences. Special attention must be directed towards high-risk patient populations, such as older adults with comorbidities and polypharmacy, where the risk of medication errors is compounded (16). Given the wide range of methods available for teaching prescribing skills, it is crucial to evaluate their effectiveness systematically. This review aims to examine educational interventions designed to improve safe prescribing practices among medical students and to identify approaches most suitable for integration into undergraduate medical curricula.

2. Methods

This systematic review was conducted in accordance with the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines (17) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) (18). The review aimed to identify and evaluate published studies examining educational interventions designed to improve safe prescribing skills among medical students.

2.1 Search Strategy

A structured search strategy was developed using the PICO framework (Population, Intervention, Comparison, and Outcome) to direct the formulation of the research question (Table 1). The core objective was to explore educational interventions or training approaches that enhance safe prescribing competencies in medical undergraduates. Literature searches were conducted from December 2015 to February 2025 across the following databases: PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar. Boolean operators (AND, OR) were used to broaden the search, and filters were applied to retrieve only peer-reviewed original research articles (LIMIT-TO (DOCTYPE, "ar")). Searches were restricted to English-language publications and articles published between 2015 and 2025 to ensure relevance and currency. The search strategy utilised both Medical Subject Headings (MeSH) and free-text keywords, combining terms such as:

- "Safe prescribing" AND "medical students"
- "Prescribing training" OR "educational intervention" OR "prescribing education" OR "pharmacology teaching"

Table 1. PICO Framework

	Inclusion	Exclusion
Population	Medical students	Non-medical students, practising doctors
Intervention	Training, workshop, seminar, case-based learning, and interprofessional education on prescribing skills and errors	No intervention
Comparison	Control group vs intervention group	–
Outcome	Prescribing skills or errors	–
Study Type	Cross-sectional, pre-post study	Surveys, case reports, editorials, communications, reviews, meta-analysis

2.2 Inclusion Criteria

Studies were eligible for inclusion if they fulfilled the following criteria:

1. Published in peer-reviewed journals from December 2015 to February 2025.
2. Written in English.
3. Included an abstract and full text.
4. Described an intervention or training related to safe prescribing aimed at medical students.
5. Reported outcomes concerning prescribing competence, knowledge, skills, error rates, or prescribing confidence.

2.3 Exclusion Criteria

The following types of publications were excluded:

- Reviews or meta-analyses lacking primary data.
- Editorials, letters to the editor, commentaries, and case reports.
- Studies not focused on medical students (e.g., nurses or pharmacists only).
- Articles that do not report on educational interventions or training outcomes.
- Publications in languages other than English due to limitations in resources for translation.

2.4 Data Extraction

Data extraction was performed using a standardised data collection form by two independent reviewers (NFAH, SNK). The following information was extracted:

1. Author(s) and year of publication
2. Country of study
3. Study design and sample size
4. Objectives of the intervention
5. Type and duration of intervention
6. Delivery method (e.g. simulation, online modules, workshops)
7. Outcomes measured (e.g. error rates, prescribing confidence, knowledge retention)
8. Key findings and conclusions

2.5 Quality Assessment

The methodological quality of the included studies was assessed independently using two tools:

- The Medical Education Research Study Quality Instrument (MERSQI) (19), which evaluates domains such as study design, sampling, data analysis, and outcome validity.
- The Newcastle-Ottawa Scale (NOS) for human interventional studies, assessing selection, comparability, and outcome.

Studies rated as low quality were excluded from the synthesis, unless if their limitations were explicitly stated in the review.

2.6 Data Synthesis

Considering the diversity in study designs, interventions, and outcomes, a narrative synthesis approach was utilised. This qualitative method facilitated thematic analysis and structured comparison of findings across studies. Key information is summarised in a comparative table, enabling a clear assessment of the characteristics, methods, and outcomes reported in the reviewed literature.

2.7 Handling Missing Data

For studies with missing or incomplete data, efforts were made to contact the corresponding authors for clarification or supplementary information. If no responses were received, the study was either excluded or analysed using only the available data.

2.8 Ethical Considerations

Although this systematic review does not involve direct human or animal experimentation, ethical research guidelines were adhered to. All studies considered were peer-reviewed publications that received ethical approval for their respective experiments and clinical trials.

3. Results

3.1 Summary of Included Studies

A total of 347 articles were identified from database searches. After removing 52 duplicates, 295 records remained for title and abstract screening. Following this, 243 records were excluded, and 52 full-text articles were assessed for eligibility. Of these, 36 were excluded for not meeting inclusion criteria. Finally, 16 studies were included in the review (figure 1).

3.2 Assessment and Improvement of Prescribing Skills

The reviewed literature underscores the effectiveness of formative assessments, hands-on training, and contextual learning in enhancing prescribing safety. Kalfsvel et al. (20) showed that formative assessments with personalised feedback significantly reduced prescribing errors, although repeated assessments were needed to address persistent mistakes. Similarly, Van der Steen et al. (21) demonstrated that pharmacotherapy self-assessments led to fewer potentially harmful prescriptions among junior doctors.

Swetha et al. (6) evaluated interns in a tertiary hospital setting and found that structured training markedly improved the completeness of prescriptions, including critical data like diagnosis and prescriber identity. Kalfsvel et al. (7) further reported that continuous practice using the P-scribe e-learning platform was positively associated with higher pharmacotherapy test scores.

Meanwhile, Tichelaar et al. (22) highlighted the impact of realism in education, showing that increased exposure to clinical contexts—from studying patient records to live patient consultations—improved the ability to identify contraindications and write safe prescriptions. Bebitoglu et al. (23) also noted that students retained rational prescribing knowledge more effectively when training was provided later in their clinical years.

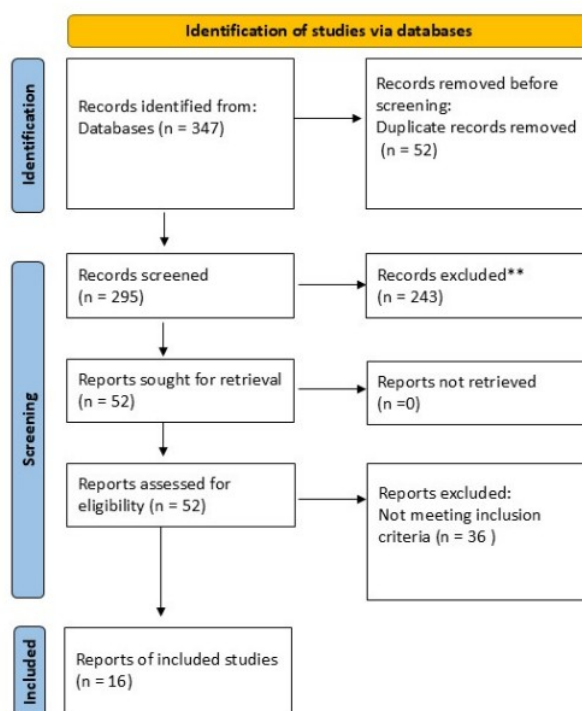


Figure 1. PRISMA Flow Diagram of Study Selection. Note: **A total of 243 articles were excluded after full-text screening as they did not meet the inclusion criteria, primarily due to irrelevance to the study objective or were review articles.

3.3 Educational Strategies and Training Interventions

Structured educational interventions incorporating global frameworks such as the WHO Guide to Good Prescribing have proven effective. Sharma et al. (24) reported that integrating WHO strategies into case-based learning improved students' critical thinking and clinical reasoning. In a complementary finding, Brinkman et al. (25) demonstrated that transitioning from traditional lectures to a problem-based learning (PBL) model enhanced confidence and reduced prescribing errors among final-year students. Further supporting the value of interactive training, Ward and Wasson (9) implemented pharmacist-led workshops to improve practical prescribing and patient communication. Their results affirmed that guided workshops reduce the gap between theoretical knowledge and real-world application.

3.4 Interprofessional and Collaborative Learning Approaches

Interprofessional education (IPE) consistently emerged as an impactful strategy to improve prescribing safety. Vernon et al. (11) implemented a virtual collaborative model engaging medical, pharmacy, and physician assistant students. Their results showed significant improvements across all domains of the Interprofessional Collaborative Competency Attainment Survey (ICCAS), especially in telehealth communication. Similarly, Guilding et al. (12) reported the success of large-scale IPE conferences in promoting antimicrobial stewardship and prescribing accuracy. Mokrzecki et al. (26) confirmed that pharmacist-led tutorials improved prescription accuracy more effectively than experiential learning alone. These studies emphasise that structured interprofessional interventions enhance not only prescribing competency but also communication and teamwork—crucial elements of patient safety. IPE fosters shared understanding, builds clinical reasoning skills, and enhances learners' confidence in collaborative care settings.

3.5 Technology-Enhanced Learning and Antimicrobial Stewardship

Technology-enhanced learning (TEL) offers flexibility and consistency in delivering pharmacotherapy education. Cullinan et al. (10) evaluated the SCRIPT online module on geriatric prescribing and observed a 22% improvement in knowledge and confidence levels, sustained over 12 weeks. Likewise, Elbeddini and Tayefehchamani (27) found that a web-based medication safety module significantly boosted student performance in post-tests. Roberts et al. (28) highlighted TEL's role in antimicrobial stewardship. Their audit-feedback study at Lagos University Teaching Hospital revealed only 39.8% adherence to antimicrobial policies and 17.2% unnecessary antibiotic use. Integrating TEL tools in audit and feedback strategies helps medical students engage in real-time stewardship practices and policy compliance. TEL's asynchronous and accessible format allows learners to progress at their own pace, supports consistent feedback, and promotes long-term retention. Digital simulations, dashboards, and virtual prescribing audits empower students to apply theoretical knowledge practically, reducing errors and supporting antimicrobial stewardship goals.

3.6 Interprofessional and Pharmacist-led Approaches

Collaborative learning environments enhanced clinical reasoning and team-based decision-making. Guilding et al. (12) reported improved prescribing safety through large-scale interprofessional workshops, while Cullinan et al. (10) demonstrated the effectiveness of pharmacist-led prescription audits and video-stimulated feedback in reducing prescribing errors among students. Tables 2 summarising the characteristics of included studies.

3.7 Summary of Findings

Across the reviewed studies, the most effective strategies for safe prescribing include:

- Formative and repeated assessments
- Structured, hands-on training
- Case-based and contextual learning
- Problem-based and interactive learning
- Pharmacist-led and interprofessional collaboration
- TEL platforms and real-time feedback systems

A visual comparison of intervention effectiveness is illustrated in figure 2, the list of studies in table 2 and key information is summarised in table 3.

4. Discussion

The development of safe prescribing skills among medical students and junior doctors necessitates a multifaceted educational approach combining formative assessments, practical training, contextual learning, interprofessional collaboration, and technology-enhanced tools.

Studies have consistently shown the benefits of formative assessments in improving prescribing accuracy. Kalfsvel et al. (20) demonstrated that personalized feedback significantly reduced errors in technical aspects such as dosing, although repeated assessments were required for sustained improvement. This finding aligns with Van der Steen et al. (21), who reported that pharmacotherapy self-assessments contributed to a reduction in potentially harmful prescriptions. Similarly, Swetha et al. (6) found that structured, hands-on training addressed knowledge gaps and improved prescription completeness among medical interns, echoing Kalfsvel et al. (7)'s finding that repeated practice on the P-scribe platform enhanced pharmacotherapy test performance.

Contextual realism in learning environments also plays a key role. Tichelaar et al. (22) and Bebitoglu et al. (23) highlighted how realistic scenarios—such as patient consultations and exposure to patient records—significantly enhanced knowledge retention and clinical reasoning. These immersive strategies provide relevance and enhance student engagement, leading to improved clinical outcomes. Sharma et al. (24) and Brinkman et al. (25) further supported structured case-based learning and PBL models as superior to traditional lecture formats. These approaches foster critical thinking and horizontal integration of pharmacological concepts.

Meanwhile, IPE is a proven method to reduce prescribing errors and build collaborative competence. Vernon et al. (11) reported improvements in student competencies across multiple ICCAS domains following virtual collaborative activities. Guilding et al. (12) demonstrated the scalability of IPE via interprofessional conferences, while Mokrzecki et al. (26) found that pharmacist-led tutorials yielded significantly better prescribing skills than unstructured experiential learning. Beyond skills, IPE enhances communication and teamwork—two essential pillars of safe prescribing. Collectively, studies by Vernon et al. (11), Guilding et al. (12), and Mokrzecki et al. (26) support embedding structured IPE into medical curricula to foster collaborative clinical decision-making.

TEL offers scalability, flexibility, and consistent reinforcement of pharmacotherapy principles. Cullinan et al. (10) reported that the SCRIPT online module led to a 22% sustained increase in prescribing knowledge among hospital doctors. Elbeddini and Tayefehchamani (27) and Roberts et al. (28) further demonstrated how TEL modules contributed to improved adherence to antimicrobial policies and enhanced post-intervention performance. Importantly, TEL tools support real-time decision-making, simulated case-based learning, and prospective audits, especially in antimicrobial stewardship. Their integration fosters reflective practice, which is vital in reducing inappropriate prescribing and promoting safe medication use.

Table 2. Characteristics of Included Studies.

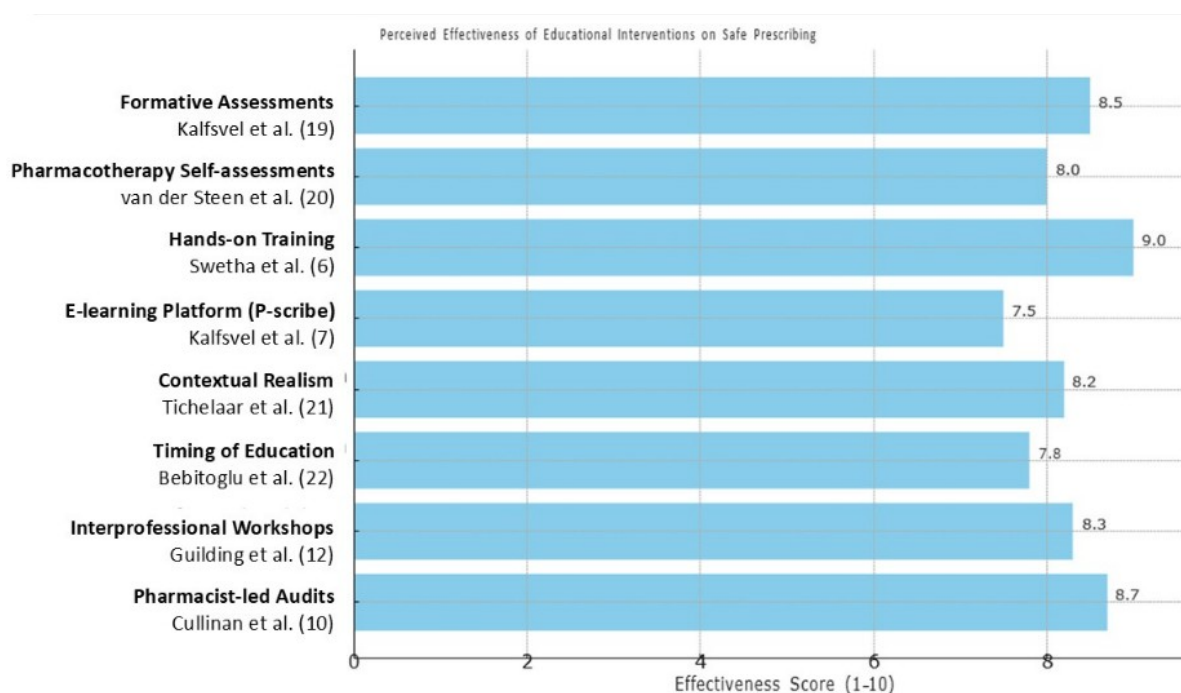
Author(s)	Type of Study	Objective	Type of Intervention	Findings	Conclusion	Quality Assessment (MERSQI and NOS)
Kalfsvel et al. (20)	Retrospective cohort	To determine if formative assessment with personalized feedback improves prescribing skills	Formative and summative skill-based prescription assessment	Errors reduced in summative assessment; most improvements in technical correctness	Formative assessment helps improve technical correctness, but single intervention is insufficient for clinical prescribing	MERSQI: 12/18 (Moderate); NOS: 5/9 (Moderate)
Van der Steen et al. (21)	Prospective cohort	To evaluate the impact of pharmacotherapy self-assessment on prescribing errors	Pharmacotherapy self-assessment with/without additional education	Self-assessment reduced prescribing errors; additional education did not have significant further impact	Self-assessment improves prescribing and patient safety, further research needed on additional education	MERSQI: 13/18 (Moderate); NOS: 6/9 (Moderate)
Swetha et al. (6)	Pre-post intervention	To assess interns' prescription writing skills before and after training	Hands-on training on prescription writing	Significant improvement in prescription completeness post-training	Hands-on training is necessary to refresh pharmacotherapeutic knowledge for interns	MERSQI: 12/18 (Moderate); NOS: 5/9 (Moderate)
Kalfsvel et al. (7)	Retrospective study	To determine if P-scribe e-learning improves pharmacotherapy assessment performance	P-scribe e-learning program	Students who spent more time on e-learning performed better on assessments	E-learning modules enhance pharmacotherapy knowledge and skills	MERSQI: 12/18 (Moderate); NOS: 5/9 (Moderate)
Tichelaar et al. (22)	Prospective exploratory	To evaluate the impact of different realism levels in context learning on prescribing competencies	Three levels of realism in prescribing tasks	Higher realism improved key prescribing competencies	Contextual learning with patient responsibility improves prescribing skills	MERSQI: 13/18 (Moderate); NOS: 6/9 (Moderate)
Bebitoglu et al. (23)	Quasi-experimental	To compare short- and long-term effects of rational pharmacotherapy training at different education stages	Rational pharmacotherapy course at different years	Later-year students retained prescribing skills better	Conducting training in later years improves long-term retention of prescribing skills	MERSQI: 15/18 (High); NOS: 7/9 (High)
Sharma et al. (24)	Experimental	To implement a WHO initiative for improving pharmacotherapeutics teaching	Case-based learning using WHO prescribing guide	90% of students found case-based learning useful for critical thinking	WHO-guided case-based learning enhances prescription-related knowledge and skills	MERSQI: 16/18 (High); NOS: 8/9 (High)
Ward and Wasson (9)	Descriptive study	Address deficiencies in prescribing skills of junior	3-hour FY0 (assistantship) workshop with simulated	Improved patient communication and	Practical workshops enhance prescribing competency in	MERSQI: 9/18 (Low); NOS: 4/9 (Low)

Brinkman et al. (25)	Comparative study	doctors Assess the impact of problem-based learning (PBL) on prescribing competencies	case studies Transition from traditional pharmacology teaching to PBL	practical prescribing skills PBL students had higher knowledge scores, fewer errors, and more confidence in prescribing	medical students PBL improves prescribing competency in final-year medical students	MERSQI: 16/18 (High); NOS: 8/9 (High)
Elbeddini and Tayefehchamani (27)	RCT	Assess the effectiveness of an online medication safety module	Interactive web-based learning vs. reading articles	Online module led to a significantly greater increase in medication safety knowledge	Online learning modules are effective for teaching safe prescribing	MERSQI: 17/18 (High); NOS: 9/9 (High)
Vernon et al. (11)	Educational intervention study	Develop interprofessional competencies for prescribing	Virtual interprofessional education activity	Significant increase in collaborative competencies across professional groups	Virtual interprofessional training enhances prescribing safety and collaboration	MERSQI: 13/18 (Moderate); NOS: 6/9 (Moderate)
Guilding et al. (12)	Mixed-methods study	Evaluate feasibility of large-scale interprofessional education in antimicrobial prescribing	Conference with keynote lectures and small group sessions	Conference format feasible but requires resources	Large-scale interprofessional education can be implemented successfully with adequate planning	MERSQI: 12/18 (Moderate); NOS: 5/9 (Moderate)
Mokrzecki et al. (26)	Pilot study	Assess impact of pharmacist-led education on prescribing skills	Case-based pharmacist-led tutorials	Significant improvement in prescribing accuracy in intervention group	Pharmacist-led education enhances prescribing skills in medical students	MERSQI: 10/18 (Moderate); NOS: 4/9 (Low)
Parker et al. (14)	Mixed-methods study	Develop and evaluate pharmacist-led feedback intervention	Video-stimulated feedback sessions	38% reduction in prescribing errors	Structured pharmacist-led feedback reduces prescribing errors	MERSQI: 13/18 (Moderate); NOS: 6/9 (Moderate)
Cullinan et al. (10)	RCT	Evaluate impact of an e-learning module on prescribing for older patients	Online module (SCRIPT) on geriatric pharmacotherapy	22% higher test scores in intervention group at 4 weeks	E-learning improves prescribing knowledge and confidence in geriatric pharmacotherapy	MERSQI: 16/18 (High); NOS: 8/9 (High)
Roberts et al. (28)	Retrospective Study	To audit compliance with hospital antimicrobial policy and assess the ability of medical students to conduct audits	Prospective audit, intervention, and feedback	Among 450 pediatric patients, 279 (62.0%) were prescribed antimicrobials; 214 (76.6%) had suspected or confirmed infections; compliance with guidelines was 39.8%	The use of antimicrobials was unnecessary in 17.2% of cases; poor culture collection practice was noted; medical students can feasibly conduct audits and report findings	MERSQI: 11/18 (Moderate); NOS: 5/9 (Moderate)

RCT: Randomized controlled trial

Table 3. Summary of Key Findings

Author (Year)	Outcomes Measured	Main Findings	Conclusion
Kalfsvel et al. (7)	Prescribing confidence, error rates	Improved prescribing confidence and reduced minor error rates	Interprofessional workshops enhance safe prescribing skills
Parker et al. (14)	Knowledge retention, appropriateness of prescriptions	Better appropriateness of prescriptions post-intervention	Pharmacist feedback is effective in reducing prescribing errors
Cullinan et al. (10)	Error identification and correction	Significant reduction in prescribing errors	Real-time audit is a useful training method for safe prescribing

**Figure 2.** Perceived Effectiveness of Educational Interventions on Safe Prescribing.

Given the adaptability and accessibility of TEL, these platforms are invaluable for continuous feedback and tracking learner progress. The benefits observed across various studies affirm that TEL should be prioritised as a standard component of pharmacotherapy education, particularly in resource-constrained or asynchronous learning environments.

This review has several limitations. First, only studies published in English were included, which may introduce language bias and limit the generalisability of the findings. Second, the heterogeneity of study designs, interventions, and outcome measures precluded a meta-analysis and may have influenced the synthesis of results. Third, cost and resource utilisation were rarely reported in the included studies, limiting our ability to conduct a formal economic evaluation of the interventions. Publication bias is also possible, as

studies with positive findings are more likely to be published. Despite these limitations, the review has notable strengths, including a comprehensive search strategy across multiple databases, rigorous application of PRISMA and MOOSE guidelines, and the use of validated quality-assessment tools. These measures enhance the reliability and transparency of the findings.

5. Conclusions

- Improving prescribing safety among medical students and junior doctors requires more than knowledge acquisition. It demands continuous, immersive, and collaborative learning strategies. This systematic review demonstrates that:
- Formative assessments and repeated evaluations improve accuracy and clinical reasoning.
- Structured hands-on training and realistic clinical exposure reinforce theoretical knowledge and bridge practice gaps.
- Interprofessional education fosters communication, teamwork, and shared accountability in safe prescribing.
- Technology-enhanced learning supports long-term knowledge retention, continuous feedback, and guideline adherence, particularly in antimicrobial stewardship.
- A multifaceted educational framework combining personalised feedback, practical simulation, collaborative learning, and digital tools is essential for cultivating competent, safety-conscious prescribers capable of minimising medication errors and optimising patient care. While the development of a harmonised, evidence-based framework for safe-prescribing education is desirable, its adoption and implementation must be adapted to local regulatory, political, and structural contexts.

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