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# Enhancing Pharmacists' Competency in Chronic Disease Management: A Systematic Review of Randomized Controlled Trials

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## Abstract

Robust management of chronic conditions is crucial in mitigating the burdens associated with these illnesses. To ensure pharmacists are adequately equipped for their role in chronic disease management (CDM), targeted programs that enhance their knowledge, practical abilities, and professional attitudes are necessary. As such, there is a clear need for a thorough, current review to assess the impact of such programs and explore avenues for further advancement. Classifying these programs according to the Effective Practice and Organization of Care (EPOC) framework is key to offering more effective guidance for health policy development. This systematic review aimed to pinpoint programs aimed at boosting pharmacists' abilities in CDM using the EPOC classification and to evaluate their overall impact. In line with the Cochrane Handbook protocols, searches were carried out through April 2024 across MEDLINE and Scopus databases. Studies were selected if they were English-language randomized controlled trials (RCTs) focused on interventions for pharmacists and evaluating outcomes related to knowledge, skills, or attitudes in CDM contexts. Bias risks were evaluated via the Cochrane RoB 2 instrument for individual or cluster RCTs. Results were synthesized narratively, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

A total of 11 RCTs were selected, covering diverse CDM elements in both community and hospital pharmacy settings. The programs fell into categories of implementation strategies alone or in combination with delivery arrangements. Six programs using solely implementation strategies showed reliable positive effects, with improvement scores between 0.99 and 9.17 ($p < 0.05$). Two additional implementation strategy programs, however, had variable outcomes, lacking notable gains in knowledge or skills. Combined approaches in two cases demonstrated gains, with percentage improvements from 4.5% (95% CI: 1.6%-7.4%) to 30% (95% CI: 29%-40%), while one combined program yielded no notable change. Bias risks varied considerably among the reviewed studies. Programs centered on implementation strategies, whether standalone or paired with delivery arrangements, contributed to better pharmacist performance in CDM. The bulk of these efforts produced meaningful advances in knowledge, skills, and attitudes among pharmacists. Such evidence highlights the value of customized programs focused on building competencies to strengthen pharmacists' contributions to CDM. These results can inform policymakers in formulating regulations and strategies to support lifelong learning and professional growth in pharmacy practice.

**Keywords:** Intervention, Pharmacists, Competency, Chronic disease, Disease management

## Introduction

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Non-communicable diseases play a major role in global mortality, impairment, and declines in life quality, creating substantial pressures on healthcare infrastructures worldwide [1–3]. Due to their extended timelines and gradual onset, these conditions amplify financial, social, and personal strains [1, 4, 5], demanding multifaceted and expert-led care strategies [1, 4]. Evidence points to the benefits of strong chronic disease management (CDM) approaches—encompassing promotion of health, early detection, monitoring,

ongoing oversight, patient empowerment in self-care, therapeutic interventions, supportive care, recovery services, and end-of-life support—in alleviating these problems [6–8].

Pharmacists hold a central position in CDM, commonly being patients' primary accessible healthcare professional for drug-related queries and general wellness advice [9, 10]. Their contributions include dispensing suitable treatments, promoting adherence to regimens, and advising on behavioral changes for better health [11, 12]. To deliver optimal CDM, pharmacists require solid foundational competencies encompassing knowledge, practical expertise, and appropriate mindsets [13].

Within healthcare delivery, the integration of knowledge, skills, and attitudes proves fundamental. Strong foundational understanding aids in sound clinical judgment [14]. Constructive attitudes encourage effective interprofessional cooperation and commitment to growth [15]. Skills, in turn, bridge theory to practice, enabling precise and proficient application of knowledge and attitudes in daily scenarios [16, 17]. Drawing from the theory of planned behavior, this triad shapes healthcare providers' motivations and behaviors, ultimately enhancing service quality and patient results [18]. Cultivating these areas is essential for consistent, superior care delivery.

Prior research has explored various programs designed to elevate pharmacists' abilities in handling chronic conditions [19–21]. Still, an in-depth, recent synthesis is required to examine their outcomes and opportunities for refinement. This type of analysis could aid authorities in crafting targeted, evidence-based programs to advance pharmacists' expertise in chronic illness care. Applying the Effective Practice and Organization of Care (EPOC) classification system improves policy relevance by standardizing descriptions and enabling cross-comparisons [22–24]. As far as we are aware, no equivalent broad review exists presently. Accordingly, this systematic review sought to locate and classify programs for enhancing pharmacists' CDM competencies via the EPOC system and to appraise their efficacy.

## Materials and Methods

This systematic review was performed in accordance with the Cochrane Handbook for Systematic Reviews of Interventions [25] and the guidance from the York Centre for Reviews and Dissemination [26]. Reporting adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [27]. The review protocol was not prospectively registered, as the chosen platform restricts registration to reviews with outcomes directly impacting human health, whereas our focus was on pharmacists' competency [28].

### *Study selection criteria*

#### *Types of studies*

Eligible studies were original English-language publications employing a randomized controlled trial (RCT) design. RCTs involve random allocation of participants to intervention or control arms, which reduces selection bias and enhances group comparability, thereby offering robust evidence on intervention efficacy [25, 29]. Excluded were gray literature (including theses and dissertations), editorials, opinion pieces, conference abstracts, case reports, protocols, review papers, and non-English articles.

#### *Types of participants*

Included studies involved pharmacists practicing in community or hospital environments. Participation was not required to be exclusive to pharmacists, provided that outcomes for pharmacists were reported separately from those of other professional groups.

#### *Types of interventions*

The review encompassed a broad spectrum of interventions aimed at improving pharmacists' competency in managing chronic diseases. Competency was conceptualized as the integration of knowledge, skills, and attitudes [30, 31]. Chronic diseases were defined as long-term conditions with prolonged impacts, necessitating continuous medical oversight or restricting daily functioning for at least one year [32]. Examples included cardiovascular disease, cancer, diabetes, arthritis, asthma, stroke, Alzheimer's disease, obesity, and substance use disorders [32–36], whether physician-diagnosed or self-reported.

Regarding chronic disease management (CDM) components, eligible studies addressed areas such as health promotion, early detection, screening, monitoring, support for self-management, treatment provision, ongoing care, rehabilitation, and palliative services [6]. No limitations were placed on intervention features, including mode of delivery, structure, intensity, or length.

Interventions were classified using the most recent Effective Practice and Organization of Care (EPOC) taxonomy [37] into four categories:

1. Delivery Arrangements: Interventions addressing the organization and provision of healthcare services, such as multidisciplinary team approaches, case management, coordination among providers, and ensuring care continuity.
2. Financial Arrangements: Interventions related to economic influences on healthcare, including funding mechanisms, reimbursement structures, and incentive schemes.
3. Governance Arrangements: Interventions concerning policy frameworks, leadership roles, and accountability systems, such as accreditation processes, regulatory standards, and oversight measures.
4. Implementation Strategies: Interventions designed to facilitate the adoption of healthcare practices, including provider education and training, audit procedures, and feedback systems.

Further information on these categories is available on the EPOC website [37].

*Types of comparators*

No restrictions were applied to the comparator or control conditions. Controls could involve no active intervention, an alternative intervention, or standard routine care.

*Types of outcomes*

Studies were required to assess competency by evaluating at least one of the following domains: knowledge, skills, or attitudes [30, 31]. Knowledge refers to the body of facts, principles, and experiences that allow understanding of a topic [38]. Skills denote the ability to execute tasks or resolve issues efficiently within given constraints of time or resources [39]. Attitudes represent predispositions to appraise entities in a consistent way—positively, negatively, or neutrally—affecting choices and actions [40].

The review concentrated exclusively on these core competencies, as they form the foundation for successful chronic disease management. Although behavioral practice in real settings is valuable, it is frequently shaped by external variables like workplace conditions, available resources, and institutional policies, which differ substantially across contexts. By limiting inclusion to interventions without practice-related outcomes, the findings enable straightforward comparisons and broader applicability. Studies measuring only the following were excluded:

- feasibility or acceptability of the intervention;
- organizational-level results, such as treatment success rates, case detection volumes, or patient satisfaction with care;
- patient-centered outcomes, encompassing clinical, humanistic, or economic indicators.

*Search methods for identifying studies*

A comprehensive literature search was performed through April 2024, employing predefined search strategies to locate pertinent studies within the MEDLINE and Scopus databases. These platforms are recognized as key resources for retrieving relevant citations and minimizing selection bias in systematic reviews of healthcare interventions [41, 42]. Through this process, original research meeting the predefined inclusion criteria was retrieved. Boolean operators were utilized, with “OR” to broaden coverage within individual concepts and “AND” to narrow the results across concepts. In addition, Medical Subject Headings (MeSH) terms were incorporated into the MEDLINE query, and the complete search strings are presented in **Table 1**.

**Table 1.** Search strategy in database searching

| Database | Search terms |
|---|---|
| MEDLINE | ("pharmacists"[MeSH Terms] OR "pharmacist*"[Title/Abstract] OR "pharmacies"[MeSH Terms] OR "pharmacy*"[Title/Abstract]) AND ("randomized controlled trials as topic"[MeSH Terms] OR "randomized controlled trial*"[Title/Abstract] OR "randomised controlled trial*"[Title/Abstract]) AND ("competency"[Title/Abstract] OR “competency-based education”[MeSH Terms] OR “knowledge"[Title/Abstract] OR "attitude"[Title/Abstract] OR "attitude of health personnel"[MeSH Terms] OR "skill*"[Title/Abstract]) |
| Scopus | (pharmacist* OR pharmacy*) AND (“randomized controlled trial*” OR “randomised controlled trial”) AND (competency OR knowledge OR attitude* OR skill*) |

Beyond the primary database searches, additional manual searches were performed in relevant healthcare journals and on Google Scholar [25, 41]. Furthermore, citation tracking was carried out through forward citation searching of the included studies and backward reviewing of their reference lists [25].

*Data collection and analysis*

*Study selection*

Search records were imported into Zotero version 6.0.13 (Corporation for Digital Scholarship, Vienna, USA), where duplicates were systematically removed. Two independent reviewers (FR and AMU) screened titles and abstracts, followed by full-text assessment of potentially eligible articles. Any disagreements were settled through consensus discussions.

*Data extraction*

Information from the selected studies was entered manually into a standardized template created in Microsoft® Excel® 2019 MSO version 2210 (Microsoft Corporation, Redmond, WA, USA). Data extraction was performed independently by two reviewers (FR and AMU), with discrepancies resolved via consultation with additional team members. Where necessary, corresponding authors were contacted by email to retrieve missing details. The collected items for each study encompassed author names, year of publication, study location, funding sources, design, participant details, sample size, specific chronic condition, CDM component addressed, intervention category, detailed intervention content, comparator or control condition, measured outcomes, assessment tools, follow-up period, and reported effectiveness.

*Risk of bias assessment*

Risk of bias was appraised independently by three reviewers (FR, WNI, and FP) using the appropriate instruments: the Revised Cochrane Risk-of-Bias tool for randomized trials (RoB 2) or the Risk-of-Bias tool for cluster-randomized trials (RoB 2 CRT) [25]. Studies were judged as low risk overall if all domains were rated low. Those raising some concerns in at least one domain—but without any high-risk ratings—were classified as having some concerns. A high-risk designation was assigned if at least one domain showed high risk or if multiple domains had some concerns that collectively weakened confidence in the findings [25]. Differences in judgments were addressed through group discussion.

*Data synthesis*

Study characteristics were summarized using descriptive approaches. Given the heterogeneity in methods across included trials, a narrative synthesis was conducted rather than a quantitative meta-analysis. The synthesis involved team discussions of key findings and followed the narrative synthesis framework recommended by the York Centre for Reviews and Dissemination for systematic reviews [26].

## Results and Discussion

*Literature search results*

The searches yielded 326 records from MEDLINE and 1,175 from Scopus. Following the elimination of 277 duplicates, 1,224 unique records underwent title and abstract screening, from which 15 were advanced to full-text review. One full text [43] remained inaccessible despite attempts to contact the authors. Three further articles [44–46] were excluded because outcomes for pharmacists were not reported separately from other healthcare professionals. No additional eligible studies emerged from hand searches in journals, Google Scholar, or citation tracking. Ultimately, 11 studies [19–21, 47–54] fulfilled the inclusion criteria and were incorporated into the review. The study selection process is illustrated in the flowchart shown in **Figure 1**.

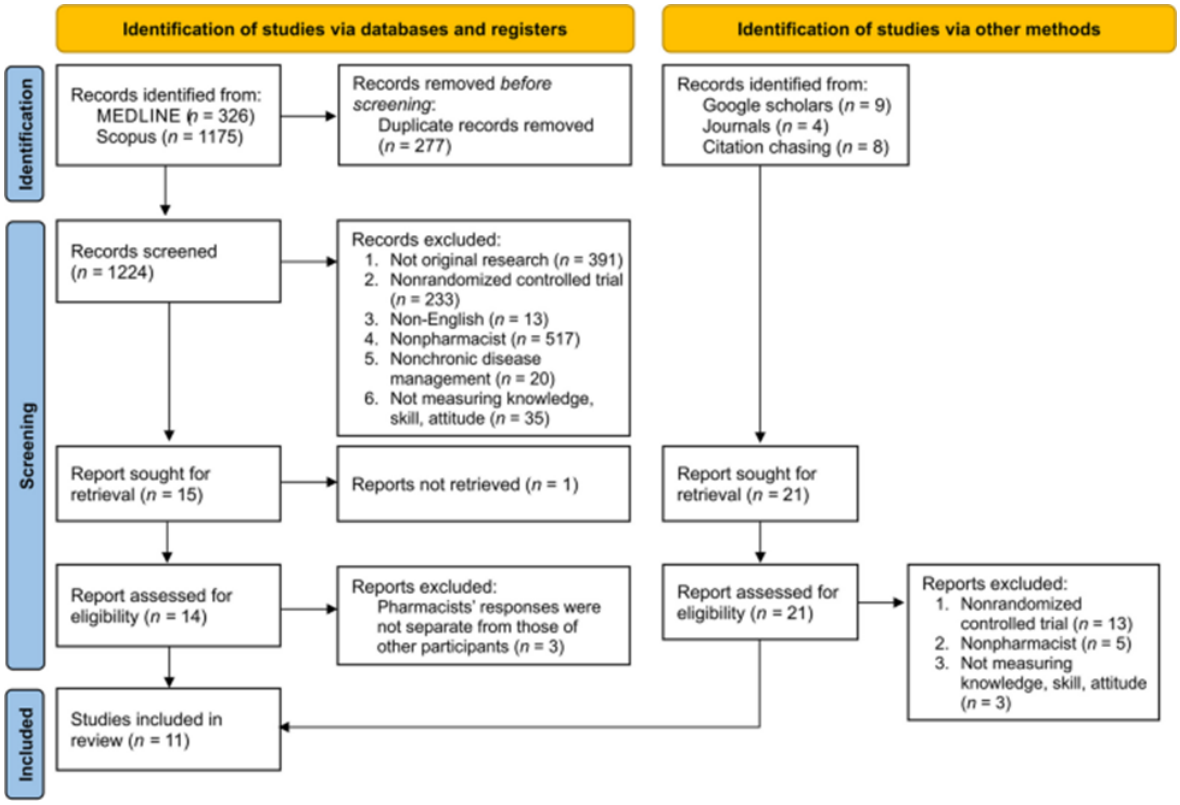


**Figure 1.** Study selection process

*Characteristics of the included studies*

The features of the studies included in this review are outlined in **Table 2**. These studies were published over a span from 1999 to 2024, with only six (54.5%) appearing in the past 10 years [19–21, 47–49]. Nine of the studies originated from high-income countries, such as Qatar, the United States, Japan, and Canada, while the remaining two were carried out in upper-middle-income countries, namely China and Iran.

**Table 2.** Characteristics of the included studies

| Country | Author, Year | Funding Source | Study Design | Sample Size | Participants | CDM Aspect | Chronic Diseases |
|---|---|---|---|---|---|---|---|
| China | Shen *et al.*, 2024 [19] | Wuhan University, Chinese Pharmaceutical Association Hospital Pharmacy Department, and Huazhong University of Science and Technology | Randomized controlled trial (RCT) | • Allocated: Intervention group = 12; Control group = 12 • Completed: Intervention group = 12; Control group = 12 | Community pharmacists | Treatment | Cardiovascular and cerebrovascular diseases, cancer, and chronic respiratory diseases |
| Qatar | El Hajj *et al.*, 2022 [20] | Qatar University Office of Research and Graduate Studies | RCT | • Allocated: Intervention group = 77; Control group = 87 • Completed: Intervention group = 54; Control group = 32 | Community pharmacists | Health promotion | Tobacco addiction |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| United States | Haga *et al*., 2021 [47] | US National Institutes of Health | Cluster-RCT | • Allocated: Intervention group = 21; Control group = 15 • Completed: Intervention group = 9; Control group = 7 | Community pharmacists | Detection | Mental health disorders, pain, and cardiovascular diseases |
| Japan | Fujii *et al*., 2021 [48] | JSPS KAKENHI | RCT | • Allocated: Intervention group = 60; Control group = 60 • Completed: Intervention group = 59; Control group = 56 | Community pharmacists | Care | Schizophrenia |
| Canada | Lalonde *et al*., 2017 [21] | Canadian Institutes of Health Research, Pfizer Canada Inc., LEO Pharma, and Amgen Inc. | Cluster-RCT | • Allocated: Intervention group = 345; Control group = 149 • Completed: Intervention group = 200; Control group = 123 | Community pharmacists | Treatment | Chronic kidney disease |
| Belgium | Liekens *et al*., 2014 [49] | No funding | Cluster-RCT | • Allocated: Intervention group = 21; Control group = 19 • Completed: Intervention group = 21; Control group = 19 | Community pharmacists | Care | Depression |
| Iran | Sarayani *et al*., 2012 [50] | No funding | RCT | • Allocated: Intervention group 1 = 60; Intervention group 2 = 60; Control group = 60 • Completed: Intervention group 1 = 35; Intervention group 2 = 40; Control group = 42 | Community pharmacists | Self-management support | Obesity |
| Canada | Legris *et al*., 2011 [51] | Cercle du Doyen of the Faculty of Pharmacy, Université de Montréal, and Amgen Canada Inc. | RCT | • Allocated: Intervention group = 52; Control group = 18 • Completed: Intervention group = 49; Control group = 18 | Community pharmacists | Treatment | Chronic kidney disease |
| Canada | Lalonde *et al*., 2008 [52] | Fonds de la recherche en santé du Québec, Bourse du Cercle du Doyen, Pfizer Canada Inc., Amgen Canada Inc., Bristol-Myers Squibb/Sanofi-Synthelabo, Hoffmann-La Roche Limitée, LEO Pharma Inc., Merck Frosst Canada & Co., Pharmaceutical Partners of Canada Inc., Pro Doc Ltée, Sabex, and Shire BioChem Inc. | Cluster-RCT | • Allocated: Intervention group = 50; Control group = 51 • Completed: Intervention group = 36; Control group = 45 | Community pharmacists | Treatment | Chronic kidney disease |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Canada | Dolovich *et al*., 2007 [53] | Merck Frosst Canada Inc. | RCT | • Allocated: Intervention group = 33; Control group = 31 • Completed: Intervention group = 29; Control group = 30 | Community pharmacists | Care | Asthma |
| Canada | Jackevicius & Chapman, 1999 [54] | Canadian Society of Hospital Pharmacists Research and Education Foundation | RCT | • Allocated: Intervention group = 25; Control group = 25 • Completed: Intervention group = 23; Control group = 19 | Hospital pharmacists | Self-management support | Asthma and chronic obstructive pulmonary disease |

The 11 studies incorporated diverse methodological approaches: seven adopted randomized controlled trials (RCTs), of which six featured a standard two-group comparison [19, 20, 48, 51, 53, 54] and one used a three-group design [50], while the remaining four employed cluster-randomized designs with two groups each [21, 47, 49, 52]. With one exception—Jackevicius and Chapman (1999), which involved hospital-based pharmacists—all investigations centered on pharmacists working in community settings. Balanced allocation between intervention and control arms was achieved in only four cases [19, 48, 50, 54]. Group sizes per arm ranged widely, from a minimum of 12 participants [19] to a maximum of 60 [50]. Where allocation was imbalanced, intervention arm enrollment spanned from 21 pharmacists [47, 49] up to 345 [21].

These investigations addressed multiple facets of chronic disease management (CDM). Treatment-oriented interventions dominated four studies [19, 21, 51, 52], targeting conditions that included cardiovascular and cerebrovascular disorders, cancer, chronic respiratory illnesses, and chronic kidney disease. One study by El Hajj *et al*. (2022) evaluated health promotion efforts aimed at tobacco dependence, and another by Haga *et al*. (2021) concentrated on screening and identification of mental health issues, pain, and cardiovascular conditions. Care delivery was the primary focus in three works [48, 49, 53], covering schizophrenia, depression, and asthma. Self-management assistance formed the core of two additional studies [50, 54], addressing obesity and asthma.

*Types of interventions and outcomes*

An overview of the interventions applied and their outcomes is provided in **Table 3**. The majority featured implementation strategies alone (eight studies) [19, 20, 48–51, 53], whereas three combined these with modifications to service delivery systems [21, 47, 52]. Educational components within implementation strategies varied widely and included provision of printed resources alongside hands-on training sessions that incorporated case-based problem solving, role-playing activities, group discussions, observational feedback, and simulated scenarios. Elements related to delivery arrangements encompassed improved inter-provider coordination, enhanced communication channels among healthcare professionals, better continuity across care episodes, and integration of digital tools and information technologies. Control conditions differed across trials: six (representing 54.5%) involved comparators with reduced-intensity or alternative approaches, four utilized standard care as the benchmark, and one applied a no-intervention comparator [53].

**Table 3.** Summary of the interventions and their effectiveness

| Author, Year | Effectiveness | Outcome | Follow-up Duration | Measurement Method | Type[a] | Intervention Description | Comparator/Control |
|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Liekens *et al*., 2014 [49] | Fujii *et al*., 2021 [48] | El Hajj *et al*., 2022 [20] | Shen *et al*., 2024 [19] |
| Better skills and attitudes in the intervention arm, with mean differences of 3.29 ($p = 0.049$) for skills and 0.99 ($p = 0.031$) for attitudes | Improved attitudes among intervention participants, effect size 0.49 ($p < 0.001$) | Clear enhancement in skills for intervention participants across every station, with adjusted mean differences of 7.2, 9.6, 7.1, 4.9, 8.2, and 4.5 (all $p < 0.001$) for the six cases | Substantial gains in knowledge and skills for the intervention arm, showing total score differences of 9.17 ($p < 0.001$) and 6.5 ($p < 0.01$) |
| Skills and attitudes | Attitudes | Skills | Knowledge and skills |
| 8 months | - | - | - |
| Follow-up ratings of seven 5-point items by trained mystery shoppers | Pre- and postassessment using eight 5-point Likert items | Postintervention evaluation through a six-station OSCE with standardized patients, graded by a blinded assessor | Postintervention assessment via single/multiple-choice items, prescription review tasks, and hands-on skills tests |
| Implementation Strategies | Implementation Strategies | Implementation Strategies | Implementation Strategies |
| Full-day program with depression-related lectures, treatment overview, communication training, consumer educator input, simulated patient role-play, and colleague observation | 60-minute session with a schizophrenia lecture, followed by group dialogue and direct patient interviews | Multi-day (four days) program on quitting smoking, blending lectures, case-based work, role-playing, and simulated scenarios | 12-hour educational session on reviewing prescriptions, appropriate medication use, and emergency aid, structured around the BOPPPS framework |
| Standard practice | Lecture-only session on schizophrenia | Lecture focused on contraception and women's health | Standard lecture on related content |

| | | | |
|---|---|---|---|
| Jackevicius & Chapman, 1999 [54] | Dolovich *et al.*, 2007 [53] | Legris *et al.*, 2011 [51] | Sarayani *et al.*, 2012 [50] |
| 1. Pre-to-post gains in knowledge/skills for intervention (overall mean difference 1.38, $p < 0.001$) 2. No sustained improvement to follow-up | Skills improved significantly in the intervention group for two cases (differences of 1.17 [$p = 0.043$] for case 1 and 1.16 [$p = 0.01$] for case 3) | Intervention participants showed gains, with adjusted increases of 22% (95% CI: 16%–27%) in knowledge and 24% (95% CI: 16%–33%) in skills | 1. No notable pre-to-post changes in knowledge/attitudes across arms 2. Knowledge rise in the lecture-plus-workshop arm from baseline to follow-up (effect size 0.58; differences of 11.30 [$p = 0.002$] vs. lecture-only and 13.40 [$p = 0.001$] vs. lecture-plus-discussion) 3. No attitude shifts from baseline to |
| Knowledge and skills | Skills | Knowledge and skills | Knowledge and attitudes |
| 3 months | 3–5 weeks | - | 4 weeks |
| Pre-, post-, and follow-up assessment: six true/false items, five short answers, and blinded inhaler demonstration scoring | Follow-up simulation with three cases scored via Global Rating Scale during patient visits | Pre- and posttesting via 10 multiple-choice items and two vignettes | Pre-, post-, and follow-up testing with 18 multiple-choice items, two vignette essays, and eight 5-point statements |
| Implementation Strategies | Implementation Strategies | Implementation Strategies | Implementation Strategies |
| 60-minute interactive session with activities and inhaler practice | Single-day session mixing lectures, group tasks, and role-play on asthma treatment, monitoring, device use, and telephone follow-up | One-hour web-based interactive module using CKD vignettes to address drug-related issues | Active arms: (1) mini-lectures + case-based interactive discussions (240 min); (2) mini-lectures + resident-led small-group workshops (265 min) |
| Brief (15-min) review of package inserts | No additional training | Standard practice | Lecture-only session (240 min) on comparable topics |

| | | | | | | |
|---|---|---|---|---|---|---|
| Haga *et al.*, 2021 [47] | No notable knowledge changes in either arm | Knowledge | - | Pre- and posttesting with seven multiple-choice items | Implementation Strategies and Delivery Arrangements | Face-to-face pharmacogenetics training, MTM sessions, and PGx results incorporated into MTM within three months | Training sessions plus PGx testing (no MTM linkage) |
| Lalonde *et al.*, 2017 [21] | Intervention gains: adjusted increases of 4.5% (95% CI: 1.6%–7.4%) in knowledge and 7.4% (95% CI: 3.5%–11.3%) in skills | Knowledge and skills | - | Baseline (T0) and end (T12) testing with 10 multiple-choice items and two vignettes | Implementation Strategies and Delivery Arrangements | 90-minute online interactive module with vignettes, guide provision, and 12-month access to CKD specialist consultation (phone/forum) | Standard practice |
| Lalonde *et al.*, 2008 [52] | Mean knowledge increase of 34% (95% CI: 29–40%) in intervention participants | Knowledge | - | Pre- and immediate postworkshop testing: four pharmacotherapy items, five dosage items, and one case | Implementation Strategies and Delivery Arrangements | Three-hour session with lectures, CKD therapy discussions, specialist interaction, and six-month communication network | Standard practice |

aDerived from the Cochrane Effective Practice and Organisation of Care (EPOC) taxonomy [37].

Across the included studies, seven assessed knowledge outcomes [19, 21, 47, 50–52, 54], seven evaluated skills [19–21, 49, 51, 53, 54], and three examined attitudes [48–50]. Knowledge was typically gauged using multiple-choice questions, short-answer items, or true/false formats. Skills were assessed through hands-on demonstrations, practical tasks, clinical vignettes, Objective Structured Clinical Examinations (OSCEs), interactions with simulated patients, or evaluations by mystery shoppers. Attitudes were measured with Likert-scale statements (5-point). Outcome assessment timing varied: five studies collected data both before and after the intervention, two only immediately afterward, two solely at follow-up (one after 3–5 weeks and one after 8 months), and two at all three points (preintervention, postintervention, and follow-up—one at 4 weeks and one at 3 months). Effectiveness was predominantly reported via score changes (points or percentages) accompanied by p-values or 95% confidence intervals; effect sizes were provided in only two investigations [48, 50].

For interventions classified as pure implementation strategies, six trials [19, 20, 48, 49, 51, 53] showed consistent positive effects on pharmacists' knowledge, skills, or attitudes. Reported gains included point-score differences from 0.99 ($p = 0.031$) [49] to 9.17 ($p < 0.001$) [19], percentage improvements of 22% (95% CI: 16%–27%) for knowledge and 24% (95% CI: 16%–33%) for skills [51], and an effect size of 0.49 [48]. In contrast, two studies [50, 54] yielded mixed findings: immediate postintervention improvements in knowledge and skills were noted (point difference 1.38, $p < 0.001$) [54], along with knowledge gains at four-week follow-up (effect size 0.58) [50]. However, no sustained benefits were observed for knowledge or skills at three-month follow-up [54],

and neither immediate knowledge gains nor any attitude changes were detected [50].

Among interventions combining implementation strategies with delivery arrangements, two studies demonstrated benefits in knowledge and skills, with percentage improvements ranging from 4.5% (95% CI: 1.6%–7.4%) [21] to 34% (95% CI: 29%–40%) [52]. One study, however, found no significant knowledge changes in either arm.

*Risk of bias*

Of the seven conventional RCTs, three [19, 20, 51] were judged to have low overall risk of bias, whereas four [48, 50, 53, 54] raised some concerns. The domain most commonly affected was selection of reported results (D5), present in half of the RCTs. Risks related to missing outcome data (D3) and measurement of outcomes (D4) were consistently low across all RCTs. Among the four cluster-RCTs, one [47] showed low overall risk, two [21, 49] had some concerns, and one [52] was rated high risk. Selection of reported results (D5) was the primary issue, affecting 75% of cluster-RCTs. Domains concerning timing of identification/recruitment relative to randomization (D1b) and deviations from intended interventions (D2) were uniformly low risk.

This systematic review highlights implementation strategies—either alone or combined with delivery arrangements—as the primary approaches used to enhance pharmacists' competence in chronic disease management (CDM). The majority of studies indicated that these interventions successfully boosted pharmacists' knowledge, skills, and attitudes, evidenced by statistically significant score improvements, percentage gains, or meaningful effect sizes. Nevertheless, one investigation found no effect, while two others observed benefits that diminished or varied at follow-up.

*Implementation strategies interventions*

The predominant approach for enhancing pharmacists' abilities in managing chronic diseases involves implementation strategies. These methods have shown clear positive impacts on pharmacists' knowledge, skills, and attitudes. Such success can largely be attributed to the incorporation of hands-on, interactive educational techniques [19, 20, 48–51, 53, 54] and patient-focused elements [48], beyond mere conventional lectures.

Research by Shen *et al*. (2024) and Legris *et al*. (2011) highlighted that interactive educational formats lead to stronger knowledge gains, primarily because they foster greater participant involvement [55]. Additional hands-on techniques—such as role-playing, case-based problem solving, and simulated scenarios—played a key role in boosting skills across several trials [19, 20, 49, 51, 53]. By offering realistic practice and exposure to actual clinical situations, these methods strengthen practical competence and self-assurance [56]. Attitude enhancements noted in the work of Fujii *et al*. (2021) and Liekens *et al*. (2014) likely stemmed from group discussions, role-playing, and direct patient interactions. Prior research has similarly indicated that contact-based, patient-oriented strategies are particularly effective for attitude change [57]. In line with this, Sarayani *et al*. (2012) found that absence of patient-centered elements resulted in no attitude improvements.

Outcomes assessed shortly after interventions versus those evaluated later revealed contrasting patterns. Jackevicius and Chapman observed immediate gains that faded over time, possibly reflecting superficial retention from initial enthusiasm rather than lasting understanding [58]. In contrast, Sarayani *et al*. detected delayed benefits without early effects, potentially linked to gradual skill consolidation through repeated application [58]. Variations may also arise from distinct processes in learning and memory [58], alongside differences in program length, teaching styles (e.g., demonstrations versus extended sessions), and assessment intervals.

Overall, these results underscore the need to evaluate both immediate and sustained impacts of implementation strategies. Kim *et al*. (2013) proposed that ongoing practice and access to guides or mentors could enhance long-term outcomes by advancing skills from basic awareness to automatic proficiency, minimizing forgetting, and extending retention [58]. Consequently, supportive workplace environments, routine incorporation of new behaviors, repeated reinforcement, and continuous training are essential for maintaining benefits [59].

*Combined implementation strategies–delivery arrangements interventions*

Three investigations explored interventions that merged implementation strategies with delivery arrangements. Building on similar educational tactics as standalone implementation strategies, these added features like inter-provider coordination, improved communication,

and technology integration. Engaging multiple healthcare professionals created a broader, more cohesive framework for chronic disease care. Yet, the outcomes from these hybrid approaches were mixed.

Lalonde *et al*. (2017) documented meaningful advances in knowledge and clinical abilities, likely supported by the extended 12-month duration—the longest in the review—allowing for ongoing development. The inclusion of multidisciplinary input also enriched perspectives and promoted holistic patient management [60, 61]. Even with a shorter six-month timeframe, Lalonde *et al*. (2008) achieved over 30% knowledge gains measured right after the workshop. However, Haga *et al*. (2021) found no meaningful knowledge shifts after three months.

Inconsistent results may stem from variations in how interventions were delivered and contextual factors, including practice settings, degree of team integration, and targeted conditions [62, 63]. Additional influences could include barriers to organizational shifts, reluctance to adopt changes, or insufficient program length. Therefore, adequate resources and backing for cross-professional teamwork emerge as critical determinants of success in this category [63].

*Comparisons to other studies*

The results of this review are consistent with earlier systematic reviews [64–66], which similarly identified implementation strategies and delivery arrangements as the predominant intervention categories for building healthcare professionals' abilities in chronic disease management. One review emphasized that implementation strategies are particularly successful in strengthening providers' communication abilities for encouraging healthy behaviors, with the strongest effects appearing 6–12 months postintervention rather than immediately or after longer intervals [64]. Like the present work, it stressed the value of integrating theoretical instruction with practical components. Joshi *et al*. (2014) observed that merging implementation strategies with delivery arrangements enhanced providers' knowledge and clinical capabilities in handling hypertension and diabetes [65]. In contrast, Kok *et al*. (2015) noted that although implementation strategies boosted knowledge and skills, delivery arrangements alone showed no such effect; however, financial incentives were found to influence provider motivation in HIV/AIDS and tuberculosis care [66].

This review confirms that efforts to advance pharmacist competence in chronic disease management primarily rely on implementation strategies and delivery arrangements, both proving capable of directly elevating knowledge, skills, and attitudes in routine practice. The complete absence of financial or governance arrangements among the included studies probably reflects their typical emphasis on systemic or organizational levels—aimed at policy adherence and structural compliance—rather than individual-level skill building [67–69]. Echoing Joshi *et al*. (2014) and Kok *et al*. (2015), combining delivery or financial elements with implementation strategies often yields superior results. This points to the advantage of multifaceted approaches, potentially incorporating financial and governance components, to more robustly support pharmacist development.

*Study strengths, limitations, and implications*

This work represents the first thorough synthesis of interventions designed to elevate pharmacists' capabilities in chronic disease management. Despite diversity in intervention designs, participant groups, and assessment tools, the collective evidence provides meaningful guidance on successful methods. It underscores the reliability of implementation strategies and the promising value of integrating them with delivery arrangements for pharmacist continuing education and career growth. The granular analysis of intervention categories and their specific impacts offers deeper insight into how they influence pharmacist performance.

A major asset of this review is the lack of restrictions on publication dates, enabling the inclusion of all pertinent research and revealing evolutionary trends in educational methods over 25 years. Studies have progressively moved from knowledge-focused to competency-oriented training, prioritizing practical experiences that improve real-world application and retention. Implementation science now plays a central role in assessing teaching efficacy. Contemporary investigations increasingly employ validated instruments—like the OSCE in El Hajj *et al*. (2022)—for precise skill evaluation and to inform curriculum design. Technological advancements, including web-based modules and digital tools [21, 47], have broadened accessibility and enabled flexible, individualized learning. Recent work also shows a marked emphasis on practical training through simulations, OSCEs, and role-playing [19, 20, 48, 49]—features far less common in older studies—preparing

pharmacists more effectively for clinical demands. Although effectiveness has not clearly increased over time, modern interactive and technology-supported methods better match current educational and healthcare priorities, including emerging topics like tobacco cessation and pharmacogenetics [20, 47] that address pressing public health issues.

Several limitations warrant attention when interpreting these results. Heterogeneity in interventions and measurements, combined with a predominance of high-income settings, may limit applicability to diverse contexts. Evidence certainty varied, with some trials showing elevated risk—mainly in selective reporting—though overall quality remained moderate. The scarcity of extended follow-up periods impedes judgments about lasting benefits. Publication bias is possible, as only peer-reviewed articles were searched (excluding gray literature to maintain quality standards). Additionally, interventions with indirect effects on competence—via improved service delivery or patient results—were not captured, potentially overlooking complex, multi-component programs with substantial secondary advantages.

To overcome these constraints, upcoming studies should prioritize designs suited to low- and middle-income nations, where chronic disease burdens are rising. Rigorous methodology is needed to bolster evidence strength, alongside prolonged follow-up to gauge durability. Investigating novel options—like digital platforms and team-based training—could improve reach and impact. Further exploration of financial and governance arrangements, including cost-effectiveness analyses, would round out understanding of ways to advance pharmacist roles in chronic care.

The findings carry practical relevance for pharmacy. Educators and administrators can draw on them to create targeted, competency-driven programs incorporating proven features: blended lectures with interactive, patient-focused activities and interprofessional communication. Promoting teamwork and technology integration could increase program success and scalability. Policymakers, in turn, can develop supportive frameworks and regulations that encourage lifelong learning and multidisciplinary practice, ultimately elevating care quality.

## Conclusion

Both standalone implementation strategies and those paired with delivery arrangements enhanced pharmacists' abilities in chronic disease management. The majority of interventions produced reliable gains in knowledge, skills, and attitudes, though one showed no benefit and two displayed inconsistent follow-up outcomes. These results highlight the promise of customized, competency-focused training for strengthening pharmacist contributions to chronic care, while stressing the need to ensure enduring impact. Policymakers are well-positioned to leverage this evidence in crafting policies and guidelines that advance continuous professional growth for pharmacists.

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