

Review Article

Pharmacist's role in the management of patients on oral anticancer therapies: A systematic review

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Abstract

Purpose: To compile evidence on pharmacists' roles in managing adult cancer patients receiving Oral anticancer therapies (OATs).

Methods: This systematic review followed PRISMA guidelines. A comprehensive search of PubMed, MEDLINE, EMBASE, ScienceDirect, and Google Scholar identified English-language studies published between 2005 and 2025. Eligible studies examined pharmacist involvement in adult cancer patients receiving OATs. Studies underwent screening, full-text review, quality assessment, data extraction, and thematic analysis.

Results: Of 557 records identified, 19 studies met inclusion criteria. Five key pharmacist roles emerged: medication reconciliation and review, patient education and counseling, adherence support, pharmacovigilance and safety monitoring, and therapy follow-up. Pharmacist involvement was associated with reduced medication errors, improved adherence, greater patient knowledge and satisfaction, stronger patient-pharmacist relationships, and potential cost savings.

Conclusion: Pharmacists play a vital role in optimizing OAT management, improving clinical, economic, and humanistic outcomes. Integration into multidisciplinary oncology teams is strongly supported.

Keywords: Management, Medication adherence, Oncology pharmacist, Oral anticancer therapies, Patient education, Pharmacovigilance

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INTRODUCTION

Cancer remains one of the leading causes of morbidity and mortality worldwide (1). The burden of cancer is currently on the rise, with about 20 million new cases and nearly 10 million deaths recorded in 2022. The global burden of cancer is expected to further increase in the future, considering the rate of population growth, ageing, and urbanization [1]. The estimates suggest that about one in five men or women would develop cancer in their lifetime, and this would lead to death in approximately one in nine

men and one in 12 women [1]. Over the years, cancer has been managed using various chemotherapeutic agents, especially intravenously administered anticancer medications [2]. Moreover, the growing popularity of oral anticancer therapies (OATs) has changed the narrative in the treatment of cancer. Currently, it appears that more and more patients prefer OATs to intravenously administered chemotherapies in oncology clinics [3].

Targeted therapies, hormonal agents, tyrosine kinase inhibitors, and certain cytotoxic drugs are

among the currently used classes of OATs [4]. The use of OATs allows patients to take charge of their drug administration at the convenience of their home rather than frequently visiting oncology clinics to receive intravenous chemotherapy [3,5]. The responsibilities of patients using OATs are higher compared to those on intravenous chemotherapy because the success of OATs in cancer management is largely dependent on the ability of the user to follow instructions and the prescribed treatment plan [3, 5]. This implies that patients on OATs should be able to strictly adhere to their medications, correctly administer them, promptly identify any side effects, and communicate with the clinician promptly [3, 6, 7]. Despite the advantages of OATs over intravenously administered chemotherapy, there are a few concerns regarding their use in managing cancer [8]. These concerns are primarily focused on treatment adherence, adverse effects, and potential drug interactions. Without appropriate education, it would be increasingly difficult for cancer patients to safely and effectively use OATs [9]. OATs have narrow therapeutic windows and complicated dosing schedules that may make it harder for patients to comply with the recommended treatment plan [10–13]. Furthermore, some OATs necessitate periodic laboratory testing, dosage modifications, and supportive care from a clinician [9]. There is, therefore, a need for structured support systems and multidisciplinary collaboration involving pharmacists and other healthcare providers in managing patients on OATs.

Pharmacists are in a position to support patients receiving OATs by providing services such as patient education, medication reconciliation and review, and drug monitoring [14, 15]. Additionally, pharmacists can work together with various health professionals, including oncologists, nurses, and laboratory scientists, in ensuring continuity of care and optimal therapeutic outcomes [16,17]. They are also charged with the responsibility of teaching patients how to make good use of their medications and how to identify and safely handle adverse events [15]. According to previous studies, some positive effects have been recorded when pharmacists are involved in managing patients on chemotherapy. These reported benefits include improved medication adherence, understanding of cancer and its treatment, satisfaction, quality of life, and cost savings, and reduced medication errors and hospitalisation [18–22]. Although pharmacists are increasingly recognized as an important member of the multidisciplinary healthcare team in cancer management, their specific roles, impact, and

effectiveness vary across available primary studies. Variations in practice models, healthcare policies, and pharmacist training contribute to differences in service delivery and outcomes. Thus, a systematic review is warranted to synthesize available evidence and provide a comprehensive understanding of the pharmacist's role in OATs. A review of pharmacists' roles and outcomes would provide evidence-based insights to guide clinical practice, policy development, and future research in optimizing OAT management. Therefore, this systematic review aimed to synthesize published evidence on the roles of pharmacists in the management of patients on OATs.

METHODS

This review was registered in PROSPERO with registration number CRD420251148551. The conduct and reporting of this review followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [23]. The PRISMA guideline was used in conducting this review because it provides a standardized, transparent, and evidence-based framework that enhances the quality, consistency, and reproducibility of systematic reviews and meta-analyses (Figure 1).

Information sources and search strategy

A comprehensive literature search was conducted in the month of August, 2025 across five databases, including PubMed, ScienceDirect, Medline, EMBASE, and Google Scholar. The identified key terms were “oral”, “anticancer”, “pharmacist”, and “role”. The key terms were adapted to database-specific subject headings alongside the free-text word variants. The database subject headings were subsequently linked together using Boolean operators such as “OR” and “AND” to form a robust search string. The database search was limited to articles in the English language involving the adult population. The retrieved articles from the databases were stored, organized, and managed on the Rayyan Intelligent Systematic Review software.

Eligibility criteria

The following inclusion criteria were applied in this review: (1) Studies with designs including randomized controlled trials, quasi-experimental studies, observational and descriptive studies, retrospective and cohort studies; (2) Articles involving adult patients with cancer (aged 18 years and above);

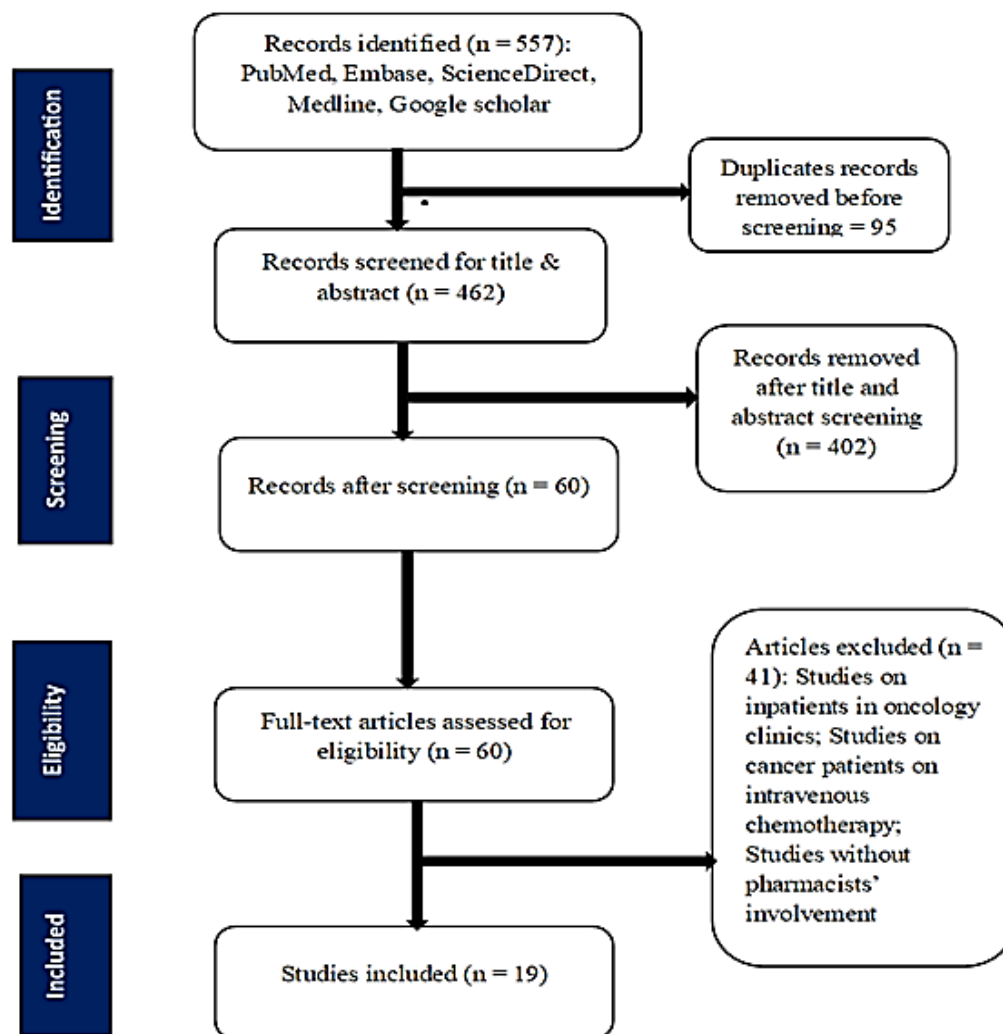


Figure 1: Flowchart of the study selection process

(3) Cancer patients receiving oral chemotherapy; (4) Studies focused on pharmacist-led or pharmacist-involved interventions; (5) Studies with usual care or standard care without pharmacists' interventions as comparator or control; and (6) Studies published in English between 2005 and 2025. However, articles reporting cancer patients receiving parenteral anticancer medications, pharmacist-led interventions unrelated to patients taking OATs, and review articles, editorials, letters, commentaries, narrative reviews, protocol-only articles, and conference abstracts were excluded (**Figure 1**).

Study selection

All retrieved articles from various databases were combined, and duplicates were removed. Two investigators independently screened the titles and abstracts of the retrieved articles. Discrepancies were resolved through discussion by the two investigators. Only articles that met

the inclusion criteria were selected for full-text screening. The decisions reached for each article, as well as the reason(s) for exclusion of some studies, were properly documented. A flowchart was used to represent the number of articles selected at each stage of the screening process in compliance with the PRISMA guideline.

Data extraction

Relevant data were extracted from each database and reviewed. A data extraction form was designed in Microsoft Excel to sieve relevant data from the articles. The extraction form had columns with headings including title, author, year of publication, country of origin, study design, study setting, sample size, age range, cancer type, interventions, comparator, duration of follow-up, outcome measured, key findings, and study limitations. Discrepancies in the data extracted by the two independent investigators were resolved through discussions based on the

study protocol. Authors of eligible studies with missing information were contacted through the email address of the corresponding author for further clarification, where applicable.

Risk of bias

The Cochrane risk of bias (ROB) tool and Newcastle-Ottawa Scale were used independently by two reviewers to assess the methodological quality of each included article [24, 25]. The Cochrane ROB evaluates the quality of articles based on the following criteria: random sequence generation (selection bias), allocation concealment, blinding of participants and personnel, blinding of outcome assessment, completeness of outcome data (attrition bias), and selective reporting of results (reporting bias). The investigators rated each domain as “low risk”, “high risk”, or “unclear risk” based on the information provided by the author(s) of the article being evaluated. Cochrane ROB allows consistent and transparent assessment across studies, facilitates comparison of methodological quality, and informs the interpretation of pooled results by highlighting where confidence in the evidence may be weakened due to study limitations.

Data analysis

The extracted data were organized into evidence tables summarizing study characteristics, pharmacist-led interventions, patient populations, outcomes measured, and key findings. A narrative synthesis was used to compare and contrast the types of interventions (e.g., patient education, adherence monitoring, toxicity management, medication counselling) and their associated economic, clinical, and humanistic outcomes. The strength and certainty of the body of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, ensuring that conclusions about the roles of pharmacists in oral anticancer therapy management are evidence-based and transparent.

RESULTS

Study characteristics

A total of 19 out of 557 retrieved articles met the eligibility criteria and were included in this review. The included articles represent a diverse mix of geographical and methodological contexts. Most studies originated from the United States [26–33] and Western Europe [34–39], reflecting the advanced incorporation of pharmacists in

oncology care within high-income settings. The study design ranged from retrospective observational studies to prospective studies, with eleven studies utilizing prospective observational or randomized designs [31,33,35–43] and six studies utilizing retrospective designs [26–29,32,44]. The diversity of study settings ranged from academic medical centres to community oncology clinics [26,27,34], underscoring the pharmacists' roles in cancer management across the healthcare system.

Cancer types and oral anticancer agents

Table 2 contains the cancer types and oral anticancer medications encountered in the review. According to the findings, the cancer types reported in the reviewed articles encompass both hematologic (e.g., chronic myeloid leukaemia (CML), chronic lymphocytic leukaemia (CLL), polycythaemia vera) [27,38] and solid tumours (e.g., breast, prostate, lung cancers, kidney and ovarian tumours) [31,32,34,36,37,39,40]. In some studies, however, the specific type of cancer patients managed by pharmacists was not indicated [26,29,30]. On the other hand, orally administered anticancer agents prescribed for patients managed by pharmacists include hormonal agents [26,44] tyrosine kinase inhibitors (e.g., imitinib, sunitinib, sorafenib) [26,28,29,32,34,37,38,44], immunomodulatory drugs (e.g., lenalidomide, pomalidomide) [39] and antimetabolites (e.g., capecitabine) [29,34,41–44]. Two studies did not specify the class of anticancer medication administered to the patients [27,31].

Pharmacists' role in oncology care

The roles of pharmacists in oncology care are illustrated in Table 3. The studies reviewed identified several standout roles of pharmacists in the management of cancer patients on OATs, including medication reconciliation and review [26,29,38,39,41,42], patient education and counselling [30,32,33,37,38,40,44] medication adherence support [37, 38, 41, 43] adverse event monitoring and pharmacovigilance [32,34,39,44] and drug monitoring and follow-up [28,38,41,43,44]. Pharmacists ensured accuracy of prescribed anticancer therapy and prevention of drug duplication and potential drug interactions [36]. Patient education and counselling on oral anticancer medication was delivered through face-to-face discussions, telephone follow-ups, and digital applications (e.g., Interprofessional medication adherence program (IMAP) [30,37,41].

Table 1: Study characteristics

Ref	Author(s) and year of publication	Country of origin	Study design	Study setting	Sample size
[26]	Heffner et al., 2020	USA	Retrospective study	Academic medical centre	81
[27]	Bertsch et al., 2016	USA	Retrospective study	Community-owned Cancer Clinics (3)	15
[34]	Streicher and Daulange, 2018	France	Descriptive study	Oncology unit of Brive Hospital	90
[35]	Mauro et al., 2019	England	Prospective study	Avella specialty pharmacy	40
[28]	Lam and Cheung, 2015	USA	Retrospective study	Walnut Creek and Antioch Oncology Clinics, Northern California	56
[36]	Leenhardt et al., 2021	France	Prospective clinical trial	Hospital (Cancer Clinic)	51
[29]	Looney et al., 2024	USA	Retrospective study	Tertiary medical centre Cancer Clinic (Vanderbilt University Medical Centre)	135
[40]	Bash and Rabea, 2025	Iraq	Prospective, randomized controlled study	Babylon Oncology Centre, Merjan Teaching Hospital	70
[37]	Bandiera et al., 2024	Switzerland	Prospective, randomized controlled trial	Department of Oncology, Lausanne University Hospital	118
[38]	Zerbit et al., 2022	France	Prospective observational study	Cochin Hospital	180
[30]	Crawford et al., 2019	USA	Qualitative study	Outpatient cancer centre and oncology pharmacy of an urban, Midwestern academic health system	30
[31]	Lau et al., 2019	USA	Prospective (pre-post) study	Ambulatory Oncology Clinic	87
[32]	Khrystolubova et al., 2019	USA	Retrospective observational analysis	Community-based Oncology Clinics	123
[44]	Yokoyama et al., 2018	Japan	Retrospective observational survey	Community Pharmacy	84
[33]	De Padova et al., 2016	USA	Prospective (pre-post) study	Regional Cancer Centre	195
[39]	Fornasier et al., 2018	Italy	Prospective Observational Pilot Study	National Cancer Institute	154
[41]	Byrne et al., 2018	Australia	Prospective Intervention Study (Pre-Post Design)	Oncology Outpatient Clinic	29
[42]	Almanric et al., 2023	Canada	Prospective, observational cohort study	Centre Intégré de cancérologie de Laval (CICL) Oncology Clinic	43
[43]	Eldeib et al., 2018	Egypt	Prospective, randomized trial	National Cancer Institute (NCI)	82

Table 2: Types of cancer and oral anticancer agents

Ref	Author(s) and year of publication	Cancer type	Oral anticancer agents
[26]	Heffner et al., 2020	Not specified	Capecitabine, Cobimetinib, Lenalidomide, Mercaptopurine, Midostaurin, Palbociclib, Pomalidomide, Sunitinib, Temozolamide, Trifluridine-Tipiracil
[27]	Bertsch et al., 2016	Hematologic cancer: myelodysplastic syndrome, myeloid leukaemia, Rai lymphocytic leukaemia; Solid tumour: non-small-cell lung cancer, prostate cancer, renal cell carcinoma, breast cancer, glioblastoma multiforme, pancreatic cancer	Not specified
[34]	Streicher and Daulange, 2018	Breast cancer, lung cancer, colon cancer, kidney tumour, hepatocellular carcinoma, Merkel cell carcinoma, sarcoma	Abiraterone, Capecitabine, Everolimus, Palbociclib, Erlotinib, Regorafenib, Sunitinib, Enzalutamide, Afatinib, Lomustine, Procarbazine, Ceritinib, Crizotinib, Sotoribuciclib, Gefitinib, Osimertinib, Pazopanib, Sorafenib, Topotecan, Vinorelbine, Vismodegib
[35]	Mauro et al., 2019	Multiple myeloma	Lenalidomide
[28]	Lam and Cheung, 2015	Chronic myelogenous leukaemia	Oral tyrosine kinase inhibitor (imatinib)
[36]	Leenhardt et al., 2021	Breast cancer	Palbociclib
[29]	Looney et al., 2024	Solid tumour (most), others	Temozolomide, Capecitabine, Lomustine, Palbociclib, Everolimus, Trifluridine-Tipiracil, Olaparib, Alpelisib, Ruxolitinib, Tucatinib, Regorafenib, Ribociclib
[40]	Bash and Rabea, 2025	Breast cancer	Tamoxifen
[37]	Bandiera et al., 2024	Breast cancer, gastrointestinal cancer, melanoma, sarcoma, urologic cancers, oral cancers, gynaecological cancer, and lung cancer	Oral protein kinase inhibitor
[38]	Zerbit et al., 2022	Haematological cancers: multiple myeloma, lymphocytic leukaemia, myeloid leukaemia, polycythaemia vera, diffuse large B-cell lymphoma, essential thrombocythemia	Tyrosine Kinase Inhibitors (TKI), Immunomodulatory Drugs, Venetoclax, Bruton Tyrosine Kinase Inhibitors (BTKi)
[30]	Crawford et al., 2019	Not specified	Abiraterone, Capecitabine, Dasatinib, Erlotinib, Enzalutamide, Imatinib, Lenalidomide, Pomalidomide, Sorafenib, Sunitinib, Temozolomide
[31]	Lau et al., 2019	Melanoma, Renal Cell Carcinoma	Not specified

Table 2 Continued: Types of cancer and oral anticancer agents

Ref	Author(s) and year of publication	Cancer type	Oral anticancer agents
[32]	Khrystolubova et al., 2019	Epidermal Growth Factor Receptor mutation + Non-Small Cell Lung Cancer	Afatinib
[44]	Yokoyama et al., 2018	Colorectal, Breast, renal cell carcinoma, Prostate cancer	21 different agents (e.g., S-1, Capecitabine, Sorafenib, Sunitinib, Imatinib, Hormonal agents)
[33]	De Padova et al., 2016	Not specified	Capecitabine, Temozolomide, Pazopanib
[39]	Fornasier et al., 2018	Breast, Colorectal, Renal Cell Carcinoma, GIST, Multiple Myeloma, Lung, Liver, Ovarian, Thyroid, myeloid leukaemia, Oral Cavity, Pancreatic NET	Oral: Erlotinib, Everolimus, Gefitinib, Imatinib, Lapatinib, Lenalidomide, Sorafenib, Sunitinib
[41]	Byrne et al., 2018	Breast, Colorectal, Oesophageal, Gastric, Non-Small Cell Lung Cancer, Ovarian, Glioblastoma, Others	Capecitabine, Temozolomide, Pazopanib, Olaparib
[42]	Almanric et al., 2023	Breast, Colorectal, Kidney, Lung, chronic myeloid leukaemia	Capecitabine, Trifluridine–Tipiracil, Palbociclib, Alectinib, Cabozantinib, Imatinib, Osimertinib, Pazopanib, And Others
[43]	Eldeib et al., 2018	Metastatic Colorectal Cancer and Gastric Cancer	Capecitabine

Summary of key findings and limitations

Table 4 shows the summary of key findings and limitations of the reviewed articles. Pharmacists' interventions were associated with positive economic, clinical, and humanistic outcomes across the included studies. The reported effect of pharmacists' involvement in the care of cancer patients on OATs include decrease rate of medication errors [26,41], improved patient safety [27,32,36,38,39,43,44] improved pharmacist interaction with patients and other healthcare providers [27,44] enhanced patient support [30,34], improved medication adherence [28,35,40,41,43], increase in patient satisfaction [35,39], cost saving [29,38] and improved patient understanding of the cancer and its treatment [40–42]. On the other hand, there were some recurring limitations documented across the studies reviewed. The most frequently occurring limitations include the conduct of the research in a single centre [26,27,29,31,32,34,35,38,43,44], use of retrospective design [26,28,32,44], small sample size [27,30,31,34,39,42–44], a lack of control group [27,30,32,34,38,39,41,42], use of unvalidated study instrument and protocol [34,39,44], and the possibility of outcomes bias [32,37–39,43,44].

DISCUSSION

Pharmacists' role in the management of patients on OATs includes medication reconciliation and review [26,29,38,39,41,42] patient education and counselling [30,32,33,37,38,40,44], medication adherence support [37,38,41,43] adverse event monitoring and pharmacovigilance [32,34,39,44] and drug monitoring and follow-up [28,38,41,43,44]. The findings demonstrate that pharmacists play multiple essential roles in caring for cancer patients receiving OATs. This implies that pharmacists' contribution is beyond medication dispensing to active clinical involvement in patient care. They ensure safe and appropriate therapy and prevent drug interactions and errors by performing medication reconciliation and review [45]. They empower patients on OATs with knowledge to use medications correctly through tailored patient education and counselling [46]. Furthermore, the involvement of pharmacists in adverse event monitoring and pharmacovigilance promotes early detection of toxicity and enhanced patient safety.

Table 3: Roles of pharmacists in the management of patients on oral chemotherapy

Ref	Author(s) and year of publication	Role/Intervention type
[26]	Heffner et al., 2020	Medication reconciliation
[27]	Bertsch et al., 2016	Medication Therapy Management (including oral chemotherapy education, safe handling techniques for hazardous drugs, oral chemotherapy dosage adjustments, recommendations for mitigating medication interactions and immunization
[34]	Streicher and Daulange, 2018	Multidisciplinary consultation program: Medication assessment with the realization of accurate patient medication list; Assess patients' ability to self-manage their therapy at home and provided information about new drug; completed and sent multidisciplinary report to community pharmacists with a satisfaction survey; Evaluation of possible drug interactions
[35]	Mauro et al., 2019	Risk Evaluation and Mitigation Strategy counselling; placing dispensed medication into smart pill bottles (SBP) and documenting SPB serial number for each prescription; follow-up call
[28]	Lam and Cheung, 2015	Monitoring and follow-up via routine phone calls and secure email, assessment and management of side effects, efficacy monitoring, ordering and pick-up reminder of medication refills
[36]	Leenhardt et al., 2021	Assessment of palbociclib-associated drug-drug interaction; (review of co-treatment) treatment adjustment (withdrawal, switch, dose modification) in collaboration with an oncologist; communication between hospital pharmacist and community pharmacy responsible for patients' medication refill.
[29]	Looney et al., 2024	Specialty pharmacist evaluated refill request to determine appropriateness of continued therapy; reviewed electronic health record for upcoming appointment, imaging, or laboratory monitoring.
[40]	Bash and Rabea, 2025	Patient education on their specific treatment regimen
[37]	Bandiera et al., 2024	Interprofessional medication adherence program; patient education and counselling
[38]	Zerbit et al., 2022	Medication review; Medication reconciliation; Remote telemonitoring; patient education for adverse event self-management; Modification of dosage regimen; adherence monitoring; therapeutic drug monitoring
[30]	Crawford et al., 2019	Development and testing of a customizable, tablet-based mobile app for patient education on OATs
[31]	Lau et al., 2019	A pharmacy technician was used as a process navigator to manage insurance authorization and medication access.
[32]	Khrystolubova et al., 2019	Pharmacist-led education, proactive adverse event monitoring, and management program
[44]	Yokoyama et al., 2018	Certified oncology pharmacist providing: counselling, adverse drug reaction monitoring, telephone follow-up, and collaboration with physicians
[33]	De Padova et al., 2016	Provision of a written, one-page education sheet on side-effect management by pharmacists, in addition to standard verbal counseling
[39]	Fornasier et al., 2018	Clinical pharmacist-led active pharmacovigilance: monthly structured interviews to monitor and report adverse drug reactions, patient education, and management support.
[41]	Byrne et al., 2018	Pharmacist-led OAT management clinic: initial consultation, mid-cycle and pre-cycle 2 follow-ups (phone or face-to-face). Education, adherence/symptom management, interventions.
[42]	Almanric et al., 2023	Oncology pharmacist-provided telephone education using patient information sheets.
[43]	Eldeib et al., 2018	Pharmacist-led weekly telephone follow-up for symptom assessment, management advice, and adherence reinforcement

Table 4: Summary of key findings and limitations of included articles

Ref	Author(s) and year of publication	Key findings	Study limitations
[26]	Heffner et al., 2020	Completion of medication reconciliation by pharmacists decreases the rate of medication errors among hospitalized cancer patients undergoing treatment with oral anticancer therapies.	(1) Single centre, (2) retrospective in nature
[27]	Bertsch et al., 2016	Pharmacist-led medication therapy management (MTM) program for cancer patients on oral chemotherapy improved patient care by enhancing medication reconciliation, identification of drug-related problems, and strengthening of pharmacist-patient interactions in oncology clinic.	(1) Small sample size, (2) Single institution of study, (3) Lack of intensive standardized training for pharmacists conducting MTM, (4) No control group
[34]	Streicher and Daulange, 2018	Implementation of multidisciplinary consultation program with pharmacist consultations ensured better support for patients starting new oral anticancer drug.	(1) Unvalidated study instrument, (2) Small sample size, (3) Single-centre study; (4) Lack of control or comparison group
[35]	Mauro et al., 2019	SPB interventions by pharmacists improved medication adherence and patient satisfaction	(1) Single-site study with limited generalizability of findings; (2) Adherence was assessed using the number of bottle uncappings and does not necessarily mean that the patient used the drug
[28]	Lam and Cheung, 2015	Oncology pharmacists managed oral anticancer therapy program improved tyrosine kinase inhibitor adherence rate among patients with CML.	(1) Retrospective design; (2) Intervention group was compared with usual care group published in another study; (3) Assumption that medication possession ratio equates patient compliance with drug therapy
[36]	Leenhardt et al., 2021	Pharmacist involvement in clinical trial inclusion reduced DDI associated with palbociclib and enhanced patients' safety.	(1) Single-centre oncology outpatient clinic with largely homogeneous population (solid tumour); (2) Excluded patients who did not complete scheduled follow-up or transferred care Not Reported
[29]	Looney et al., 2024	Specialty pharmacist postponement of refill request after electronic health record and identification of follow-up significantly reduced medication waste and cost avoidance	
[40]	Bash and Rabea, 2025	Targeted educational intervention by pharmacist improved patients' knowledge of their treatment regimen and adherence.	
[37]	Bandiera et al., 2024	Pharmacist-led interprofessional medication adherence program (IMAP) improved patient implementation of protein kinase inhibitors during a 12-month monitoring period. IMAP had no significant effect on patients' BAM and quality of life.	(1) Risk of contamination of the control group during intervention administration; (2) Patients in control group were contacted 72 hours after a missed appointment, which is not obtainable in standard care; (3) Pharmacists attending to patients in control group were specially trained in oncology and hence their counselling may be more tailored than usual pharmacist counsel

Table 4 continued: Summary of key findings and limitations of included articles

Ref	Author(s) and year of publication	Key findings	Study limitations
[38]	Zerbit et al., 2022	Pharmaceutical care integrated into a multidisciplinary approach reduces the rate of drug-related problems among patients on oral anticancer medication. Pharmacists' interventions were associated with cost avoidance and about 7 times return on investment.	(1) Possibility of outcome bias, (2) No control group, (3) Single-centre study design
[30]	Crawford et al., 2019	The feedback from usability and feasibility testing of the pharmacist-designed mobile, tablet-based app suggested potential benefits of the digital technology as a tool to help patients in managing their medications, particularly after the first months of starting new OAM regimens	(1) Small, convenience sample; (2) No control group; (3) Did not measure health literacy or long-term adherence outcomes; (4) Limited to English-speaking patients; (5) Technical issues with server connectivity during testing.
[31]	Lau et al., 2019	The program improved efficiency in terms of decreasing total time required to fill OAM prescriptions and pharmacists' involvement in this process. The program allowed pharmacists to shift their time to direct patient care activities and use of pharmacy department resources	(1) Small sample size; (2) Lack of stratification by specific medication or manufacturer; (3) Single-center study limits generalizability of findings; (4) Evolving assistance programs and medication formulary are confounding factors.
[32]	Khrystolubova et al., 2019	The study findings suggest that adverse events in patients with epidermal growth factor receptor mutation and non-small cell lung cancer receiving Afatinib can be successfully managed in a community-based, real-world setting with the help of collaborative pharmacist-led patient education, adverse event monitoring, and continuous support.	(1) Retrospective, observational design; (2) No control or comparison group; (3) Adverse event severity was not systematically evaluated or recorded; (4) Adherence to Afatinib was not systematically measured; (5) Single healthcare system (limited generalizability).
[44]	Yokoyama et al., 2018	Continued education by community pharmacists through a telephone follow-up program and systematic collaborations among community pharmacists, physicians and oncology pharmacists improved health outcomes of patients on oral chemotherapy.	(1) Retrospective, observational design; (2) Interventions performed by a single certified oncology pharmacist, limiting generalizability to regular community pharmacists; (3) No control group; (4) Small sample size for individual drug analysis; (5) Potential bias as outcomes are based on pharmacist documentation and recall; (6) Short follow-up period for a chronic therapy; (7) Lack of standardized protocol for timing/frequency of telephone follow-ups.
[33]	De Padova et al., 2016	Pharmacist-provided patient education significantly reduced the number of triage calls from patients on oral chemotherapy.	(1) Non-randomized study; (2) Different Cohorts of patients in pre- and post-intervention groups; (3) Seasonal bias, as the pre-intervention period was in autumn, while post-intervention was in spring; (4) Data relied on nursing documentation of call reasons, which may be inconsistent; (5) Only 3 drugs were included in the intervention.

Table 4 continued: Summary of key findings and limitations of included articles

Ref	Author(s) and year of publication	Key findings	Study limitations
[39]	Fornasier et al., 2018	The inclusion of pharmacists in the treatment team improved the detection and reporting of adverse drug reactions among patients receiving OAM. Patient satisfaction was improved by clinical pharmacists' monitoring of drug therapy and autonomous suspension of drugs or self-regulation, and resultant adverse effects.	(1) Observational design; (2) No control group; (3) Small sample size for some drugs; (4) Non-validated study instrument; (5) Potential bias from using SPC data as comparator; (6) Underestimation of haematological toxicities; (7) Concomitant medications or conditions could influence some adverse drug reactions.
[41]	Byrne et al., 2018	Pharmacist-led education and interventions can potentially improve patients' understanding and adherence to OAM and reduce medication errors.	(1) Small sample size; (2) No control group; (3) High exclusion of patients from culturally diverse backgrounds; (4) Insufficient data; (5) Self-reported adherence may overestimate true adherence; (6) Low community pharmacist survey response rate (20%).
[42]	Almanric et al., 2023	Pharmacist-provided education led to a significant change in activation of patients (knowledge, skills, and confidence required to successfully manage cancer) on oral anticancer medication.	(1) No control group; (2) Small sample size; (3) All interventions were administered by telephone; (4) Short-term follow-up only (first cycle); (5) Potential for social desirability bias; (6) Strict exclusion criteria may limit generalizability.
[43]	Eldeib et al., 2018	Telephone-based follow-up enhanced patients' tolerability to specific toxicities. It also improved adherence and overall survival, even though not significant. The intervention group had significantly longer passive call time compared to the control group.	(1) Small sample size; (2) Single-centre study limits generalizability; (3) Lack of blinding (potential for bias); (4) Pill count method may overestimate adherence vs. electronic monitoring; (5) Population was mostly first-line, potentially more adherent at baseline (>90%), creating a ceiling effect; (6) Intervention may not have been intensive enough compared to programs with in-person components.

Similarly, the ongoing involvement of pharmacists in drug monitoring and follow-up ensures timely adjustments in drug therapy and continuity of care. Evidently, pharmacists support safe and effective management of OATs [47]. Integrating these pharmacist-led activities into routine oncology care can improve treatment adherence, minimize medication-related risks, and enhance overall clinical outcomes.

Pharmacists' involvement in the care of cancer patients on OATs was associated with a decreased rate of medication errors [26,41] and improved patient safety [27,32,36,38,39,43,44]. OATs often have narrow therapeutic indices, complex dosing regimens, and high toxicity risks, making patients vulnerable to dosing mistakes, drug-drug interactions, and improper administration. Pharmacists help in reducing the risks associated with the use of OATs through careful prescription verification, medication reconciliation, patient counselling, and ongoing monitoring for adverse events [48,49]. The expertise of pharmacists ensures that medication errors are detected and corrected early, thereby improving overall patient safety. This review finding supports the expanding role of pharmacists in oncology care to strengthen patient safety and optimize therapeutic outcomes. Pharmacist-driven activities may directly support cancer care in improving survival and recovery by maximizing adherence to drug regimens and proactively managing toxicities, and help improve quality of life.

The involvement of pharmacists in the care of cancer patients on OATs improved medication adherence [28,35,40,41,43], increased patient satisfaction [35,39], and improved patient understanding of the cancer and its treatment [40–42]. Pharmacists' expertise in medication counselling and side-effect management empowers patients to better understand the rationale, schedule, and potential challenges of their therapy, thereby promoting adherence to complex treatment regimens [50]. Improved knowledge of the disease and its management could alleviate patients' anxieties, contributing to higher satisfaction levels. Additionally, routine pharmacist follow-up and communication help identify barriers such as adverse effects, financial concerns, or misconceptions about therapy, allowing timely interventions that sustain adherence and engagement [34]. However, while these positive outcomes are consistently reported, variations in study design, intervention intensity, and follow-up duration may influence the extent of these benefits. Some studies reviewed relied on self-reported data, with the possibility of introducing bias. Despite this

drawback, the overall evidence highlights that pharmacists' patient-centred interventions are critical in optimizing treatment outcomes and improving the quality of cancer care, especially for those on OATs.

Pharmacists' interventions in the care of patients on OATs resulted in cost savings for both patients and the healthcare system, thus reflecting the economic value of integrating pharmacists into cancer care [29,38]. Pharmacists are able to contribute to cost savings by preventing unnecessary resource utilization and wastage of expensive OATs through patient education, improved medication adherence, medication reconciliation, and monitoring for toxicity [29,51,47,52]. Nevertheless, the level of cost savings documented in studies may be influenced by healthcare financing systems, varying intervention models, and cost-analysis methods. Although this review demonstrated that pharmacist interventions are economically beneficial, further standardized economic evaluations and cost-effectiveness analyses are required to fully quantify their value across different healthcare settings.

First, health policymakers and oncology institutions should formally incorporate pharmacists into multidisciplinary cancer care teams, assigning clear responsibilities for medication reconciliation, patient education, adherence support, adverse event monitoring, and follow-up to optimize treatment outcomes and patient safety. Secondly, standardized guidelines and continuing education programs for pharmacists on the management of OATs should be encouraged. Taking such a step would ensure consistent implementation of evidence-based interventions and enhance pharmacists' competencies in pharmacovigilance, therapeutic monitoring, and patient counselling.

Study limitations

This review had a few limitations that should be considered while interpreting its findings. First, the included studies varied widely in terms of design, scope of pharmacist-led interventions, patient populations, cancer types, and measured outcomes. This heterogeneity limited direct comparison and precluded the possibility of conducting a meta-analysis, thereby restricting the review to narrative synthesis. Secondly, several of the reviewed studies were conducted in single-centre settings, had small sample sizes, and lacked control groups, which increases vulnerability to selection bias, recall bias, and outcome measurement bias. Additionally, the use

of unvalidated tools or protocols reduces the reliability and generalizability of the findings.

Lastly, most of the included studies were conducted in high-income countries such as the United States and Western Europe, where healthcare systems, pharmacist roles, and oncology care models are advanced. This regional concentration limits the generalizability of the findings to low- and middle-income countries where pharmacist integration in oncology care may be limited or differ significantly.

CONCLUSION

The findings of this review demonstrated that pharmacists' role in managing patients on OATs includes medication reconciliation and review, patient education and counselling, medication adherence support, adverse event monitoring and pharmacovigilance, and drug monitoring and follow-up. Pharmacists' interventions were linked to decrease rate of medication errors, improved patient safety, adherence, satisfaction, cost savings, and knowledge of cancer and OATs. The review findings underscore the importance of involving pharmacists in the management of cancer patients on OATs. Additionally, developing standardized guidelines would likely ensure consistent implementation of evidence-based interventions and pharmacists' competencies in pharmacovigilance, therapeutic monitoring, and patient counselling.

DECLARATIONS

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None.

Conflict of Interest

No conflict of interest is associated with this study.

Ethical approval

Ethical approval is not applicable for this systematic review. However, it was registered in PROSPERO with registration number CRD420251148551.

Availability of data and materials

The data supporting the results of this study have been properly cited.

Use of Artificial Intelligence/large language models

I hereby declare that AI tools were not used to generate the core scientific content, research design, data analysis, or conclusions of this study. They were used only to assist with language improvement, grammar checking, and general editing during the preparation of this manuscript, at a minimal level.

Use of research reporting tool

None to be declared.

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