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Pharmaceutical care services for people living with HIV/AIDS in Brazil: a scoping review of health-related outcomes

Servicios de atención farmacéutica para personas que viven con VIH/SIDA en Brasil: una revisión de alcance de los resultados relacionados con la salud

Información

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Corresponding author :

Prof. Dra. Marcela Forgerini
marcela.forgerini@unesp.br

Author Contributions

A.E.P.G. was responsible for investigation, data curation, formal analysis, writing - original draft, and writing - review and editing. B.C.B. and A.L.S.S. contributed to formal analysis, data discussion, and writing - original draft. N.P. participated in investigation, data curation, formal analysis and writing - review and editing. M.F. was responsible for conceptualization, methodology, supervision, validation, investigation, data curation, visualization, writing - original draft, and writing - review and editing. All authors approved the final version of the manuscript.

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Autorías

Ana Elisa Palha Guerra¹  0009-0005-2393-3801

Beatriz Cristina Betarelli²  0009-0005-7788-4160

Ana Luiza da Silva Selani³  0009-0007-4183-983X

Natan Piran Soares⁴  0009-0004-6005-8658

Marcela Forgerini⁵  0000-0002-2905-8519

¹Master's Student. São Paulo State University (UNESP), School of Pharmaceutical Sciences, Department of Drugs and Medicines, Araraquara, Brazil.

²Undergraduate Pharmacy Student. São Paulo State University (UNESP), School of Pharmaceutical Sciences, Department of Drugs and Medicines, Araraquara, Brazil.

³Undergraduate Pharmacy Student. São Paulo State University (UNESP), School of Pharmaceutical Sciences, Department of Drugs and Medicines, Araraquara, Brazil.

⁴Undergraduate Pharmacy Student. São Paulo State University (UNESP), School of Pharmaceutical Sciences, Department of Drugs and Medicines, Araraquara, Brazil.

⁵Ph.D. Assistant Professor. São Paulo State University (UNESP), School of Pharmaceutical Sciences, Department of Drugs and Medicines, Araraquara, Brazil.

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ABSTRACT

Objective: To identify pharmaceutical care services provided to individuals living with HIV/AIDS in Brazil and their associated outcomes.

Methods: A scoping review was conducted using PubMed, Scopus, and LILACS. Studies were eligible if they reported at least one pharmaceutical care service for individuals living with HIV/AIDS. Two reviewers independently screened studies and extracted data. Extracted variables included city, setting, study design, inclusion and exclusion criteria, type of pharmaceutical services, outcomes assessed, measurement methods, sample size, sex, age, and main findings.

Results: Twelve studies (15 publications) were included, with a total of 1,962 participants, most of whom were male (n = 1,321). Cross-sectional (n = 4) and cohort (n = 4) designs predominated, and most studies were conducted in specialized HIV/AIDS care services (n = 8). The pharmaceutical care services consisted of pharmacotherapeutic follow-up (n = 12), medication review (n = 5), and health education (n = 2). Reported outcomes comprised clinical improvements, such as increased CD4+ cell count and reduced viral load, as well as process outcomes, including improved treatment adherence and fewer drug-related problems following pharmacist-led interventions. Humanistic and economic outcomes were less frequently assessed and included participant satisfaction and empowerment, quality of life, and reduction of healthcare costs. Formal integration of pharmacists into multidisciplinary teams was reported in one study.

Conclusions: In Brazil, pharmacotherapeutic follow-up was the most frequently reported pharmaceutical care service for individuals living with HIV/AIDS. These services were associated with improvements in clinical and process outcomes. Evidence on humanistic and economic outcomes remains limited, highlighting an important gap for future research.

Keywords: Drug-related problem; Evaluation of Results; Evidence-Based Pharmacy Practice; Human Immunodeficiency Virus; Pharmaceutical Services; Treatment Adherence.

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Acrônimos:

AIDS: Acquired Immunodeficiency Syndrome.

DRPs: Drug-Related Problems.

HIV: Human Immunodeficiency Virus.

RESUMEN

Objetivo: Identificar los servicios de atención farmacéutica proporcionados a personas que viven con VIH/SIDA en Brasil y sus resultados asociados.

Métodos: Se realizó una revisión de alcance utilizando las bases de datos PubMed, Scopus y LILACS. Los estudios fueron elegibles si reportaban al menos un servicio de atención farmacéutica dirigido a personas que viven con VIH/SIDA. Dos revisores evaluaron de forma independiente los estudios y extrajeron los datos. Las variables extraídas incluyeron diseño del estudio, criterios de elegibilidad, servicios farmacéuticos proporcionados, resultados evaluados, instrumentos de medición, tamaño de la muestra, sexo, edad y hallazgos principales.

Resultados: Se incluyeron doce estudios (15 publicaciones), con un total de 1.962 participantes, la mayoría de los cuales eran hombres ($n = 1,321$). Predominaron los diseños transversales ($n = 4$) y de cohorte ($n = 4$), y la mayoría de los estudios se realizaron en servicios especializados en VIH/SIDA ($n = 8$). Los servicios de atención farmacéutica consistieron en seguimiento farmacoterapéutico ($n = 12$), revisión de la medicación ($n = 5$) y educación en salud ($n = 2$). Los resultados reportados comprendieron mejoras clínicas, como el aumento del recuento de células CD4+ y la reducción de la carga viral, así como resultados relacionados con el proceso asistencial, incluidos la mejora de la adherencia al tratamiento y un menor número de problemas relacionados con medicamentos tras intervenciones dirigidas por farmacéuticos. Los resultados humanísticos y económicos se evaluaron con menor frecuencia e incluyeron satisfacción y empoderamiento de los participantes, calidad de vida y resultados relacionados con costos. La integración formal de farmacéuticos en equipos multidisciplinarios se reportó en un estudio.

Conclusiones: En Brasil, el seguimiento farmacoterapéutico fue el servicio de atención farmacéutica identificado con mayor frecuencia para las personas que viven con VIH/SIDA. Estos servicios se asociaron con mejoras en los resultados clínicos y en los procesos de atención. La evidencia sobre resultados humanísticos y económicos sigue siendo limitada, lo que señala una importante brecha para futuras investigaciones.

Palabras clave: Adherencia al Tratamiento; Evaluación de Resultados; Práctica Farmacéutica Basada en la Evidencia; Problemas relacionados con la medicación; Servicios Farmacéuticos; Virus de inmunodeficiencia humana.

Introduction

An estimated 40.8 million people worldwide were living with human immunodeficiency virus (HIV) in 2024, including approximately 1,100,000 individuals in Brazil ⁽¹⁾. In the same year, about 630,000 deaths were attributed to HIV-related causes globally ⁽¹⁾.

Despite advances in antiretroviral therapy, HIV remains a major public health challenge. Delayed diagnosis, treatment discontinuation, and poor adherence to therapy continue to contribute to preventable morbidity and mortality ⁽²⁾. These challenges are often exacerbated by adverse drug events and the complexity of lifelong treatment regimens ⁽²⁾.

In response, the Brazilian health system has implemented strategies to reduce stigma, expand access to care, and strengthen treatment monitoring. These efforts include strengthening multidisciplinary care teams and expanding the role of pharmacists in patient care ⁽³⁾.

Pharmaceutical care has increasingly been recognized as an important approach to optimizing pharmacotherapy and improving patient outcomes ^(4,5). By identifying and preventing drug-related problems (DRPs), pharmacists can support individualized treatment and enhance adherence to antiretroviral therapy ⁽⁴⁾. Pharmacist involvement has also been associated with improved clinical outcomes and reduced medication-related mortality ⁽⁴⁾.

Previous reviews have examined pharmaceutical services in HIV care. One review evaluated outcomes such as antiretroviral therapy adherence, viral load suppression, and immunologic response ⁽⁶⁾. Another focused on pharmacotherapeutic follow-up and included studies from PubMed and LILACS up to 2019 ⁽⁷⁾. Since then, additional studies on pharmaceutical care among people living with HIV have been published, highlighting the need for an updated synthesis of the evidence.

In Brazil, pharmaceutical care has previously been synthesized in a scoping review that mapped pharmaceutical services and examined outcomes across different health conditions ⁽⁸⁾. However, quantitative synthesis focused on cardiometabolic diseases due to their high prevalence, and studies involving people living with HIV were not specifically examined ⁽⁸⁾. Therefore, this scoping review aimed to map available pharmaceutical care services for people living with HIV/AIDS in Brazil and to identify their clinical, humanistic, economic, and process outcomes ^(7,8).

Methods

Study design and review questions

This scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines ⁽⁹⁾.

The review addressed two research questions: (1) which pharmaceutical care services are provided to individuals living with HIV/AIDS in Brazil and (2) which outcomes has been reported in association with these services?

Eligibility criteria

Eligibility criteria were defined using the PCC framework (Population, Concept, and Context).

Studies were eligible if they reported pharmaceutical care services provided to individuals living with HIV/AIDS in Brazil, regardless of age, sex, comorbidities, or concomitant medication use. Pharmaceutical services considered in this review were those defined by the Brazilian Federal Pharmacy Council and included medication reconciliation, health condition management, therapeutic drug monitoring, medication therapy review, health screening, medication dispensing, management of self-limiting conditions, health education, and pharmacotherapeutic follow-up. Studies conducted in any health care setting in Brazil were considered eligible.

Reviews, thesis, dissertations, conference abstracts, editorials, or commentaries were excluded.

Search strategy

Electronic searches were conducted in the Scopus, PubMed, and LILACS databases on December 5, 2024, with no restrictions on publication date or language.

The search strategy was developed using terms from the Medical Subject Headings (MeSH) and Health Sciences Descriptors (DeCS), combined with free-text terms related to HIV infection, pharmaceutical services, and Brazil.

The search included the following terms: ("HIV" OR "Human Immunodeficiency Virus" OR "HIV-1" OR "Human immunodeficiency virus 1" OR "Human Immunodeficiency Virus Type 1" OR "HIV-2" OR "Human immunodeficiency virus 2" OR "Human Immunodeficiency Virus Type 2" OR "AIDS" OR "HIV infection" OR "HIV-1 infection" OR "HIV infected patients" OR "HIV positive" OR "HIV/AIDS" OR "Antiretroviral Agent*" OR "Combination Antiretroviral Therapy" OR "Highly Active Antiretroviral Therapy") AND ("Pharmaceutic* Service*" OR "Pharmaceutical Care" OR "Pharmaceutical Service" OR "Pharmacy Service*")

OR "Evidence Based Pharmacy Practice" OR "Evidence-Based Pharmacy" OR "Evidence-Based Pharmaceutical Care" OR "Pharmaceutical intervention*") AND ("Brazil" OR "Brazilian*").

Study selection and data extraction

Titles and abstracts were independently screened by three reviewers (author 1, author 4, and author 5). Studies meeting the inclusion criteria were subsequently assessed through full-text review. Reference lists of included studies and relevant reviews were also manually screened to identify additional eligible articles.

Data extraction was performed independently by two reviewers (author 1 and author 4). Extracted data included authors, year of publication, city, setting, study design, inclusion and exclusion criteria, type of pharmaceutical service, outcomes assessed, measurement instruments, number of participants, sex, age, and main findings.

Results

Selection and characteristics of included studies

The search identified 67 records. After duplicate removal, 49 publications remained. Title and abstract screening identified 16 articles eligible for full text assessment. One study was identified through manual searching. Twelve studies reported in 15 publications met the inclusion criteria. **(Figure 1).**

The studies were published between 2012 and 2024 ^(10–24). Designs included cross-sectional studies (n = 4) ^(10,13,21,24), cohort studies (n = 4) ^(16,18,20,22), controlled clinical trials (n = 3) ^(11,14,17), case series (n = 1) ⁽²³⁾, and open-label randomized clinical trial (n = 1) ⁽¹²⁾.

Most studies were conducted in the state of São Paulo (n = 5) ^(10,14,17–19) and were predominantly performed in specialized HIV/AIDS care services (n = 8) ^(10–13, 15, 16, 18, 24). Study duration ranged from one month ⁽¹³⁾ to three years ⁽¹⁹⁾.

A total of 1,962 participants were included, with sample sizes ranging from 6 ⁽²³⁾ to 398 ⁽²⁴⁾ individuals. Most participants were male (n = 1,321). Detailed study characteristics are presented in **Table 1**.

Pharmaceutical services

Pharmacotherapeutic follow-up was the most frequently reported pharmaceutical service and was described in 12 studies ^(10–19,22,24). Most were conducted in specialized HIV/AIDS services (n = 8) ^(10–13,15,16,18,24) or hospital

settings ($n = 7$) (14,17,19,22). Duration of follow-up ranged from three (24) to 12 months (12,14–16,19). Participants received between two and nine consultations lasting 30 to 60 minutes.

Pharmacotherapeutic follow-up was associated with increased adherence to antiretroviral therapy, identification and reduction of DRPs, improved quality of life, and greater patient satisfaction with health services (10–19,22,24).

Medication review was the second most frequently reported service and was described in five studies conducted in hospital settings among participants with HIV/AIDS or HIV and tuberculosis coinfection (14,17,20,21,23).

A retrospective analysis of 186 prescriptions from patients admitted to an intensive care unit identified 331 drug interactions. 9% resulted in adverse events affecting 16 participants and were associated with therapeutic failure and adverse drug reactions (20).

Among participants with HIV and tuberculosis coinfection, hepatotoxicity led to discontinuation of the standard tuberculosis regimen and modification of therapy (23). Two cases of virologic failure attributed to efavirenz resistance required modification of the antiretroviral regimen (23).

Health education interventions addressed the importance of pharmacologic therapy and treatment adherence, as well as hygiene practices, laboratory monitoring, medication storage, condom use, and disease related counseling (11,19).

Characteristics of pharmaceutical services and participants are summarized in **Table 2**.

Drug related problems

Across the included studies, outcomes related to DRPs included their identification, classification, and reduction during pharmaceutical care services. DRPs comprised problems related to indication, effectiveness, safety, and adherence. Classification was performed using questionnaires developed by the study authors (10,12,13,15,16) and instruments adapted from the model proposed by Cipolle and colleagues (21,23). Drug interactions were assessed using Micromedex in two studies (19,20).

Treatment adherence was evaluated based on reductions in viral load, increases in CD4+ T-cell counts, and the number of months in which participants collected all prescribed antiretroviral medications (18,22).

The number of identified DRPs ranged from 69 (23) to 643 (11) and most frequently involved safety and indication-related problems (23). Reductions in the number of these problems were reported in studies evaluating service effectiveness (17,19). In one study, the mean number of DRPs decreased from 5.2 to 4.2 per participant ($p = 0.043$) (18).

Pharmaceutical interventions

Pharmaceutical interventions ranged from 122⁽¹⁷⁾ to 590⁽¹¹⁾. The most common interventions included dosage adjustments, adding necessary medication, discontinuing unnecessary therapy, and substituting with an alternative treatment^(11,19). In one study, the pharmacist was integrated into the multidisciplinary care team⁽¹⁸⁾, and two studies reported interventions involving pharmacist-patient and pharmacist-physician interactions^(13,19).

Factors associated with pharmacotherapeutic outcomes

Factors associated with DRPs included age, marital status, duration of diagnosis, and treatment related factors, especially medication indication and adherence⁽²¹⁾.

Higher adherence was observed among participants who presented HIV symptoms before initiation of antiretroviral therapy ($p = 0.039$), used fewer pills per day ($p = 0.003$), attended scheduled appointments regularly ($p < 0.0001$), and presented higher CD4 positive T cell count ($r = 0.237$)^(10,22).

Nonadherence to pharmacotherapeutic follow-up was associated with male sex (OR = 1.67, 95 % IC: 1.05 - 2.66), age younger than 40 years (OR = 2.21, 95 % IC: 1.42 - 3.47), and allocation to the control group (OR = 1.67, 95 % IC: 1.07 - 2.61)⁽¹²⁾.

Previous adherence to antiretroviral therapy and undetectable viral load were associated with therapeutic success⁽¹⁶⁾.

Quality of life and economic outcomes

Patient satisfaction measured at treatment initiation and after three months of follow-up increased slightly, although the change was not statistically significant ($p = 0.472$). Baseline satisfaction was associated with better physical quality of life (OR = 1.38, 95% IC: 1.11 - 1.71)⁽²⁴⁾.

Quality of life was assessed using the SF-36 Health Survey⁽¹¹⁾ and the WHO-QOL HIV BREF instrument⁽²⁴⁾.

One study evaluated the economic impact of pharmacotherapeutic follow-up using medical chart review over a one-year period⁽¹⁴⁾. At one year, the intervention group showed better clinical outcomes and lower overall costs. Expenditures were lower for medical appointments, laboratory tests, and hospitalizations, but higher for procedures and pharmacist consultations. After excluding high-cost events, the intervention group generated an estimated net saving of \$19.40 per patient per year.

The additional daily investment required by the health care system was estimated at US\$1.45, US\$1.09, US\$2.13, US\$4.35, US\$1.09, and US\$0.87 for each additional outcome of viral load <50 copies/mL, absence of coinfection, CD4+ T-cell count >200, >350, and >500/mm³, and optimal immune response, respectively.

Key results of the pharmaceutical services are summarized in **Table 3**.

Discussion

This scoping review mapped the available evidence on the impact of pharmaceutical services in the care of people living with HIV/AIDS in Brazil. Overall, the findings support the important role of pharmacists in HIV/AIDS care, especially in improving treatment adherence, identifying and resolving DRPs, and supporting patient education. Patient-reported and economic outcomes were less frequently evaluated, highlighting an important gap in the current literature ⁽⁸⁾.

Previous reviews have examined pharmaceutical services in HIV care but focused on specific interventions or outcomes ^(6–8). One review evaluated outcomes such as antiretroviral therapy adherence, viral load suppression, and immunologic response ⁽⁶⁾. Another restricted the analysis to pharmacotherapeutic follow-up services ⁽⁷⁾. A third review included studies regardless of clinical condition or outcome type, but the meta-analysis was limited to cardiometabolic diseases, and data from participants living with HIV/AIDS were not specifically analyzed ⁽⁸⁾.

Consistent with previous literature, the included studies demonstrated beneficial effects of pharmaceutical services, particularly in improving adherence to antiretroviral therapy and addressing DRPs. Prior reviews have also highlighted the need for additional studies evaluating economic, clinical, and humanistic outcomes, as well as research conducted in low- and middle-income countries ^(6,7).

Fifteen studies were included in this review, confirming the predominance of clinical endpoints while also documenting economic and humanistic outcomes, which were less frequently reported. The increasing number of publications in recent years suggests growing interest in evaluating pharmaceutical care for this population.

Participants frequently presented multiple DRPs related to advanced immunodeficiency, polypharmacy, and the use of medications for the prevention and treatment of opportunistic infections ⁽²¹⁾. Pharmacist-led interventions were associated with reductions in these problems, suggesting an important role for pharmacists in optimizing pharmacotherapy and improving treatment safety.

Despite these benefits, formal integration of pharmacists into multidisciplinary teams was reported in only one study⁽¹⁸⁾. Current guidelines recommend that people living with HIV/AIDS be managed by multidisciplinary teams including pharmacists, whose expertise in pharmacotherapy management, patient counseling, and medication safety can contribute to improved treatment outcomes⁽²⁵⁾.

The context in which pharmaceutical services are delivered may also influence patient engagement and care access. Pharmacies often represent accessible and familiar health care environments, which may be particularly important in settings affected by HIV-related stigma. Services delivered in these settings can support infectious disease testing, facilitate early diagnosis, and expand access to pre-exposure and post-exposure prophylaxis⁽²⁶⁾.

In addition to structural and workforce challenges, variability in pharmacists' knowledge of HIV/AIDS has been reported⁽²⁷⁾. Knowledge gaps may disproportionately affect vulnerable populations, including LGBTQIA+ individuals, who frequently experience barriers to care such as discrimination, family rejection, and limited access to health services⁽²⁸⁾. Notably, none of the included studies specifically evaluated pharmaceutical services for this population, highlighting an important gap in the literature. Expanding pharmaceutical services to incorporate HIV testing, counseling, and prophylaxis may reduce disparities and improve outcomes among high-risk and underserved groups⁽²⁶⁾.

Only one study in this review evaluated economic outcomes and did not identify statistically significant cost differences between groups. However, preliminary cost-effectiveness analyses from other settings suggest potential benefits. For example, pharmaceutical services have been associated with estimated savings from US\$51 to US\$166 per patient and reductions in health care utilization of approximately 18.5 hours annually⁽²⁹⁾. These findings support the potential value of integrating pharmaceutical services into national HIV/AIDS strategies⁽²⁹⁾.

Standardized quality indicators can help improve the evaluation and comparability of pharmaceutical services⁽³⁰⁾. Relevant indicators include pharmacotherapy follow-up for high-risk patients, identification and management of adverse drug reactions, medication dispensing and counseling, and accurate documentation of clinical activities⁽³⁰⁾. Patient-centered measures, completion of validated quality-of-life instruments, and engagement in HIV/AIDS surveillance programs, can provide additional insight into care quality. Indicators of professional development, such as pharmacist training in motivational interviewing, may also improve patient engagement and adherence support⁽³⁰⁾.

This review has limitations. Some relevant studies may have been missed despite comprehensive searches conducted according to PRISMA guidelines for scoping reviews⁽⁹⁾. Only studies conducted in Brazil were included, and terminology describing pharmaceutical services and outcomes varied

across studies, which may have limited comparability. Similar limitations have been reported in international reviews on pharmaceutical services. Nevertheless, the findings may provide insights relevant beyond the Brazilian context and help guide future research and service development.

A key strength of this review is the systematic mapping of evidence from Brazilian studies, capturing clinical, humanistic, economic, and process-related outcomes associated with pharmaceutical services. These findings highlight the broad contribution of pharmacists to HIV/AIDS care and may inform policy decisions and service implementation.

In summary, pharmaceutical services appear to improve clinical and care process outcomes among people living with HIV/AIDS in Brazil, although evidence on patient-reported and economic outcomes remains limited. Future research should prioritize the evaluation of economic outcomes, the inclusion of populations at higher vulnerability, and greater standardization in the terminology and reporting of pharmaceutical services and outcome measures. These efforts may support the development and implementation of pharmaceutical services capable of strengthening comprehensive care for people living with HIV/AIDS.

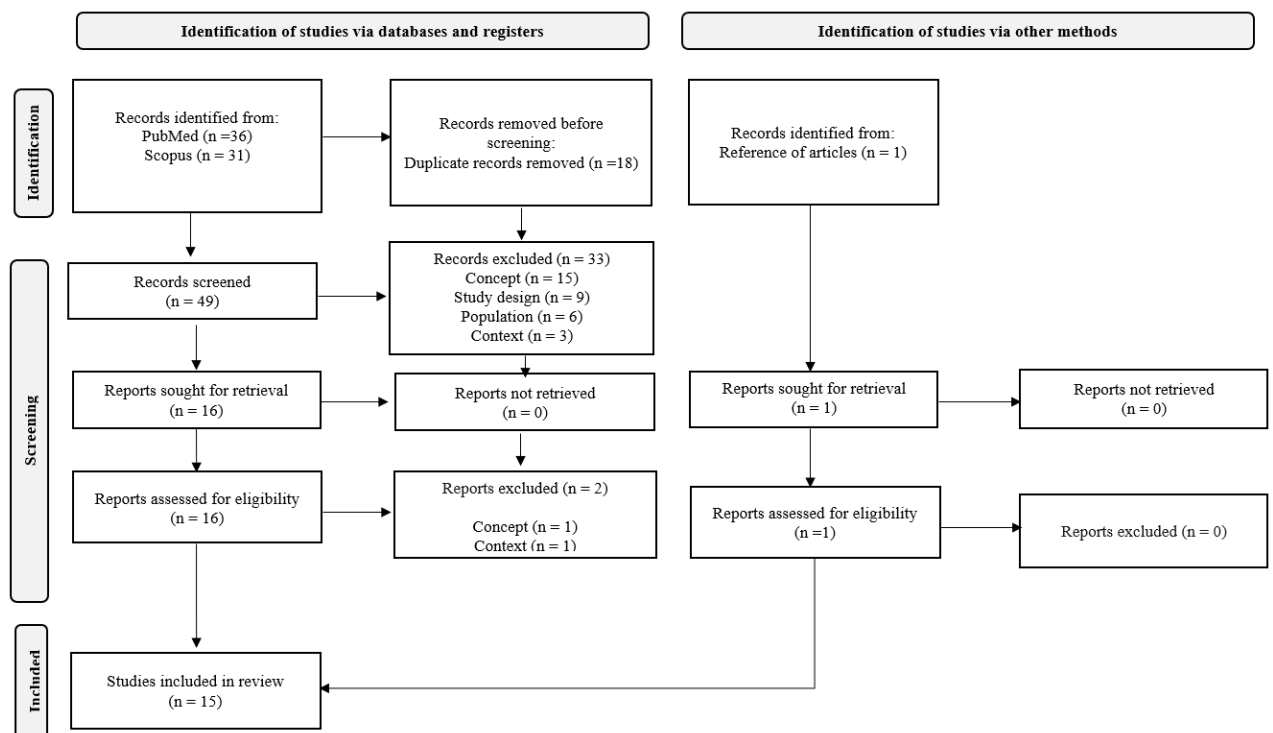
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Figure 1. PRISMA flow diagram of study selection.**Table 1.** Characteristics of the included studies by study design, location, setting, data collection period, and eligibility criteria (n = 15 publications).

First author, year	Study design	City, State	Setting	Data collection period	Inclusion criteria	Exclusion criteria
Gutierrez <i>et al.</i> , 2012 ⁽¹⁰⁾	Cross-sectional	São Paulo, SP	Public outpatient specialized in HIV/AIDS	March 2007–April 2009	Individuals aged ≥18 years with HIV/AIDS on ART for at least 6 months	Pregnant women
Loureiro <i>et al.</i> , 2012 ⁽¹¹⁾	Controlled clinical trial	Fortaleza, CE	Outpatient pharmacy at specialized medical center	November 2008–August 2010	Patients aged ≥18 years, treatment-naïve, initiated ART during study period, with no prior participation in pharmaceutical intervention studies	Pregnant women or individuals unable to participate in interviews
Silveira <i>et al.</i> , 2013 ⁽¹²⁾	Unblinded controlled clinical trial	Pelotas, RS	Specialized HIV care service	NR	Patients aged ≥18 years, HIV-positive, receiving care and ART at specialized urban clinics	Pregnant women, patients with mental health disorders, visual impairment, hospitalization, or terminal illness
Molino <i>et al.</i> , 2014 ⁽¹⁷⁾	Controlled clinical trial	Campinas, SP	University Hospital	February 2009–August 2010	Outpatients with HIV/AIDS, aged 18–60 years, BMI <30 kg/m ² , on ART without regimen changes in the preceding four weeks	Patients aged >60 years, pregnant women, individuals with obesity, incarcerated persons, those unable to return for visits or examinations, deceased participants, those with severe psychiatric illness impairing comprehension, or those who missed scheduled visits

First author, year	Study design	City, State	Setting	Data collection period	Inclusion criteria	Exclusion criteria
Reis <i>et al.</i> , 2014 ⁽¹³⁾	Cross-sectional	Fortaleza, CE	Medical Specialty Center	October–November 2008	NR	NR
Silveira <i>et al.</i> , 2014 ⁽¹⁵⁾	Unblinded controlled clinical trial	Pelotas, RS	Specialized HIV care service	NR	Patients aged ≥18 years receiving ART, and residing in urban areas	Pregnant women, history of mental illness, visual impairment, hospitalization, or terminal illness
Carnevale <i>et al.</i> , 2015 ⁽¹⁴⁾	Controlled clinical trial	NR, SP	Hospital	January 2009–June 2012	Outpatients diagnosed with HIV/AIDS, aged 18–60 years, receiving ART, and with BMI <30 kg/m ²	Pregnant women, patients with obesity or psychiatric disorders, or inability to return for follow-up
Silveira <i>et al.</i> , 2015 ⁽¹⁶⁾	Cohort	Pelotas, RS	HIV/AIDS Care Service	June 2006–July 2007	Individuals with baseline and follow-up data on viral load, CD4+ count, and treatment adherence	Pregnant women
Gerenutti <i>et al.</i> , 2017 ⁽¹⁸⁾	Prospective cohort	Sorocaba, SP	Municipal Specialized Care Service	NR	HIV-infected patients on ART registered in Digitized System of Drug Logistic Control, aged >12 years, and receiving care at specialized center	Pregnant women, deceased during study, transfer to other health services, or ART adherence shorter than study duration
Molino <i>et al.</i> , 2017 ⁽¹⁹⁾	Controlled clinical trial	Campinas, SP	University Hospital	January 2009–June 2012	Outpatients with HIV/AIDS, aged 18–65 years, BMI <30 kg/m ² , on highly active ART	Homeless or incarcerated persons, severe psychiatric illness impairing comprehension, missed visits, pregnancy, fewer than two pharmaceutical consultations, > six months between pharmaceutical visits, >1 year of pharmaceutical care, transfer to other health services, or missed medical appointments
Ramos <i>et al.</i> , 2018 ⁽²⁰⁾	Retrospective cohort	Rio de Janeiro, RJ	Intensive Care Unit	November 2006–September 2008	Adult patients with HIV/AIDS admitted to ICU requiring mechanical ventilation	ICU stay <72 hours
Resende <i>et al.</i> , 2019 ⁽²¹⁾	Cross-sectional	Belo Horizonte, MG	Hospital	September 2015–December 2016	Patients aged ≥18 years and diagnosed with TB and HIV/AIDS, initiating TB treatment from September 2015 concomitantly with HIV/AIDS diagnosis	Cognitive deficits, prior treatment abandonment, death, transfer, or diagnostic changes
Cruz <i>et al.</i> , 2020 ⁽²²⁾	Retrospective cohort	NR	University Hospital	January 2007–December 2010	HIV-positive adults aged ≥18 years with documented CD4+ counts and pharmacy record of ART initiation between 1998 and 2010	Fewer than 2 documented CD4+ or viral load measurements during the study, or only 1 documented ART refill.
Resende <i>et al.</i> , 2021 ⁽²³⁾	Series of cases	Belo Horizonte, MG	Hospital	NR	TB/HIV co-infected patients under treatment, aged ≥18 years, with ≥ 6 months follow-up	Treatment abandonment, death, transfer, cognitive deficit, or diagnostic change
Marçal <i>et al.</i> , 2024 ⁽²⁴⁾	Cross-sectional	Belo Horizonte, MG	HIV/AIDS Health Services	September 2015–July 2018	Individuals with HIV/AIDS aged ≥18 years who completed service quality perception questionnaires at ART initiation and after 3 months	NR

Abbreviations: **AIDS:** Acquired Immunodeficiency Syndrome; **ART:** Antiretroviral Therapy; **BMI:** Body Mass Index; **CE:** Ceará; **HIV:** Human Immunodeficiency Virus; **ICU:** Intensive Care Unit; **MG:** Minas Gerais; **NR:** not reported; **RJ:** Rio de Janeiro; **RS:** Rio Grande do Sul; **SP:** São Paulo; **TB:** Tuberculosis.

Table 2. Characteristics of participants and pharmaceutical services in the 12 studies included in the review (n = 15 publications).

First author, year	Sample size (N men)	Mean age $\pm$ SD (years)	Pharmaceutical service	Outcome	Measurement method
Gutierrez <i>et al.</i> , 2012 ⁽¹⁰⁾	292 (205)	44.3 $\pm$ 9.03	Pharmacotherapeutic follow-up	ART adherence, association between adherence and undetectable viral load, and identification of factors associated with adherence.	Structured questionnaire developed by the authors
Loureiro <i>et al.</i> , 2012 ⁽¹¹⁾	45 (28)	37.04 $\pm$ 11.47	Pharmacotherapeutic follow-up and health education	Quality of life	Short Form-36 Health Survey (SF-36) (Ware and Sherbourne Instrument, 1992)
Silveira <i>et al.</i> , 2013 ⁽¹²⁾	Intervention group: 166 (108) Control group: 166 (102)	Intervention group: 39.28 $\pm$ 9.4 Control group: 41.33 $\pm$ 10.7	Pharmacotherapeutic follow-up	Effectiveness of pharmacotherapeutic follow-up and adherence	Self-report questionnaire with a control sheet recording routine activities and medications taken during the 3 days before the interview
Molino <i>et al.</i> , 2014 ⁽¹⁷⁾	Intervention group: 45 (25) Control group: 45 (25)	Intervention group: 42 (NR); Control group: 41.5 (NR)	Pharmacotherapeutic follow-up and medication review	Effectiveness of pharmacotherapeutic follow-up	NR
Reis <i>et al.</i> , 2014 ⁽¹³⁾	25 (14)	37 (NR)	Pharmacotherapeutic follow-up	Drug-related problems	A data collection form developed by the authors was used to collect demographic and lifestyle information, clinical history, ART adherence profile, interview conditions, participant-pharmacy service relationship, and satisfaction with the pharmacist and the pharmaceutical care program
Silveira <i>et al.</i> , 2014 ⁽¹⁵⁾	332 (209)	39 (NR)	Pharmacotherapeutic follow-up	Nonadherence to pharmacotherapeutic follow-up	Self-report questionnaire recording routine activities and medications taken, including doses and schedules, during the three days before the interview
Carnevale <i>et al.</i> , 2015 ⁽¹⁴⁾	Intervention group: 51 (34) Control group: 51 (34)	Intervention group: 41.3 $\pm$ 8.8 Control group: 40.5 $\pm$ 9.2	Pharmacotherapeutic follow-up and medication review	Drug-related problems and costs of pharmaceutical care services	CD4+ T-cell count, viral load, absence of coinfections, and immune response. Cost analysis was conducted over a one-year period. For both groups, the number of appointments, laboratory tests, procedures, and hospitalizations at 6 and 12 months were recorded. Pharmacist appointments were additionally recorded for the intervention group
Silveira <i>et al.</i> , 2015 ⁽¹⁶⁾	136 (82)	40 $\pm$ 10	Pharmacotherapeutic follow-up	Factors associated with therapeutic success	Self-report questionnaire used to assist participants in recalling routine activities and reporting current medications, including doses and administration schedules.
Gerenutti <i>et al.</i> , 2017 ⁽¹⁸⁾	359 (182)	NR	Pharmacotherapeutic follow-up	Effectiveness of pharmacotherapeutic follow-up and association of adherence with viral load and CD4+ T-cell percentage	Pharmacy refill records over 6 months. Viral load and CD4+ T-cell counts were extracted from medical records at baseline and 6 months after the pharmacist consultation

First author, year	Sample size (N men)	Mean age $\pm$ SD (years)	Pharmaceutical service	Outcome	Measurement method
Molino <i>et al.</i> , 2017 ⁽¹⁹⁾	Intervention group: 43 (28) Control group: 43 (28)	Intervention group: 41.74 $\pm$ 7.93 Control group: 41.49 $\pm$ 9.33	Pharmacotherapeutic follow-up and health education	Effectiveness of pharmacotherapeutic follow-up in reducing drug-related problems and improving CD4+ count and viral load	Two pharmacists independently identified and classified drug-related problems into four categories: indication, effectiveness, safety, and adherence. Laboratory test results and participant-reported symptoms were used to identify and monitor drug-related problems. The Micromedex and CD4+ T-cell counts supported the evaluation
Ramos <i>et al.</i> , 2018 ⁽²⁰⁾	62 (45)	37.5 (NR)	Medication review	Adverse drug events	Micromedex database 2.0.
Resende <i>et al.</i> , 2019 ⁽²¹⁾	81 (62)	40 (NR)	Medication review	Drug-related problems	Questionnaire adapted from Cipolle <i>et al.</i> and classified by the Pharmacotherapy Workup method (indication, effectiveness, safety, and adherence)
Cruz <i>et al.</i> , 2020 ⁽²²⁾	170 (121)	40.5 $\pm$ 9.38	Pharmacotherapeutic follow-up	ART adherence	Adherence rate was defined as the percentage of months during follow-up in which participants collected all prescribed ART. Total refill delay was defined as the sum of all days of ART refill delay during follow-up divided by the total number of follow-up days and multiplied by 100
Resende <i>et al.</i> , 2021 ⁽²³⁾	6 (3)	37.5 $\pm$ 9.52	Medication review	Drug-related problems	Questionnaire adapted from Cipolle <i>et al.</i> and classified by the Pharmacotherapy Workup method (indication, effectiveness, safety, and adherence)
Marçal <i>et al.</i> , 2024 ⁽²⁴⁾	398 (333)	34.2 $\pm$ 10.8	Pharmacotherapeutic follow-up	Satisfaction with health care services and quality of life at initiation of antiretroviral therapy	WHOQOL-HIV BREF Instrument

Abbreviations: ART: Antiretroviral Therapy; HIV: Human Immunodeficiency Virus; N: number; NR: Not reported; SD: Standard Deviation; WHOQOL-HIV: World Health Organization Quality of Life – HIV.

Table 3. Main findings of the 12 studies evaluating pharmaceutical services (n = 15 publications).

First author, year	Pharmaceutical service	Main findings
Gutierrez <i>et al.</i> , 2012 ⁽¹⁰⁾	Pharmacotherapeutic follow-up	Having HIV-related symptoms before initiating ART ($p = 0.039$), taking fewer ART pills per day ($p = 0.003$), and attending all scheduled medical appointments ($p < 0.0001$) were associated with better treatment adherence. Older age, HIV-related symptoms before ART initiation, baseline CD4+ T-cell count $< 350/\text{mm}^3$, and satisfaction with health services were also associated with better adherence. Depression, taking more than four ART pills per day, difficulties in taking ART, episodes of intoxication, missing medical appointments, and having HIV-positive children were associated with poor adherence.
Loureiro <i>et al.</i> , 2012 ⁽¹¹⁾	Pharmacotherapeutic follow-up and health education	A total of 643 DRPs associated with ART were identified. Most were safety-related (58.0%), followed by indication-related problems (27.4%). A total of 590 pharmaceutical interventions were performed. These interventions mainly involved to medication dose adjustment (19.6%), pharmacologic strategy (13.7%), and health education (66.7%). Comparative analysis of quality-of-life outcomes between the first and ninth follow-up visits showed statistically significant improvement across all domains (physical functioning, role limitations due to physical health, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health). Pharmacotherapy follow-up was associated with improved quality of life, particularly among symptomatic participants and those diagnosed ≥ 1 year earlier ($p < 0.05$).
Silveira <i>et al.</i> , 2013 ⁽¹²⁾	Pharmacotherapeutic follow-up	The control group had no contact with pharmacists and received medication counseling from nurses. ART adherence increased from 79.5% to 79.8% in the intervention group and from 72.3% to 73.8% in the control group ($p = 0.95$). After 12 months, viral load was undetectable in 50.3% of the intervention group and 49.8% of the control group ($p = 0.15$).

First author, year	Pharmaceutical service	Main findings
Molino <i>et al.</i> , 2014 ⁽¹⁷⁾	Pharmacotherapeutic follow-up and medication review	On days when the clinical pharmacy team was absent, participants were assigned to the control group and did not receive consultations with clinical pharmacists. Following the intervention, 122 pharmaceutical interventions were performed. The mean number of DRPs decreased from 5.2 to 4.2 per participant ($p = 0.043$). A significant increase in CD4+ T-cell count was observed in the intervention group (from 260.7 to 312.0 cells/mm ³ ; $p = 0.015$). No significant change was observed in the control group.
Reis <i>et al.</i> , 2014 ⁽¹³⁾	Pharmacotherapeutic follow-up	A total of 322 DRPs were identified. Most problems were related to safety ($n = 153$, 70.5%), followed by effectiveness ($n = 33$, 15.2%), and indication ($n = 29$, 13.4%). A total of 295 pharmaceutical interventions were performed, including pharmacist-patient, pharmacist-patient-physician, and pharmacist-physician interventions.
Silveira <i>et al.</i> , 2014 ⁽¹⁵⁾	Pharmacotherapeutic follow-up	The control group had no pharmacist contact. Nonadherence to pharmaceutical follow-up was observed in 52.7% of participants. Male sex (OR = 1.67; 95% CI: 1.05 - 2.66; $p = 0.03$), age <40 years (OR = 2.21; 95% CI: 1.42 - 3.47; $p < 0.001$), and allocation to the control group (OR = 1.67; 95% CI: 1.07 - 2.61; $p = 0.02$) were significantly associated with nonadherence.
Carnevale <i>et al.</i> , 2015 ⁽¹⁴⁾	Pharmacotherapeutic follow-up and medication review	The control group received standard care without pharmacist involvement. There was a significant reduction in DRPs (from 248 to 145; $p < 0.001$). Indication-related problems decreased from 55 to 26 ($p < 0.001$). Safety-related problems decreased from 161 to 96 ($p < 0.001$). After six months, the proportion of participants without coinfections and with CD4+ T-cell count >500/mm ³ was higher in the intervention group than in the control group. This difference was not statistically significant ($p = 0.599$). The intervention group spent less on appointments, laboratory tests, and hospitalizations, but spent more on procedures and pharmacist visits.
Silveira <i>et al.</i> , 2015 ⁽¹⁶⁾	Pharmacotherapeutic follow-up	Prior ART adherence (PR: 1.34; 95% CI: 1.07 - 1.69; $p = 0.03$), CD4+ T-cell count ≥ 200 cells/mm ³ , and prior undetectable viral load (PR: 1.30; 95% CI: 1.13 - 1.49; $p < 0.001$) were associated with high treatment success (90%).
Gerenutti <i>et al.</i> , 2017 ⁽¹⁸⁾	Pharmacotherapeutic follow-up	Adherence was higher in the intervention group ($p < 0.05$). The intervention group comprised patients receiving care under a pharmaceutical care model implemented at the Specialized Municipal Assistance Service by clinical pharmacists. The non-intervention group included patients who declined participation in the intervention or had scheduling conflicts with available appointment times. Use of concomitant medicines was not associated with ART adherence ($p = 0.30$). Adherence improved among participants with undetectable viral loads ($p = 0.0004$) and among participants with higher CD4+ T-cell count ($p = 0.0024$).
Molino <i>et al.</i> , 2017 ⁽¹⁹⁾	Pharmacotherapeutic follow-up and health education	In a 1-year study without pharmaceutical services in the control group, 202 pharmaceutical interventions were proposed. Of these, 193 involved pharmacist-participant and 9 pharmacist-physicians. Pharmacist-physician interventions addressed DRPs, most commonly safety-related problems. These interventions included adding a necessary medicine, discontinuing unnecessary therapy, or substituting with an alternative therapy. All pharmacist-physician interventions were accepted. Pharmacist-participant interventions consisted of educational actions to prevent and resolve DRPs. After one year, the number of DRPs decreased by 38.43% ($p = 0.0001$).
Ramos <i>et al.</i> , 2018 ⁽²⁰⁾	Medication review	A total of 331 potential drug-drug interactions were identified. 9% resulted in adverse events in 16 participants. Most interactions were moderate (74.0%). Most were pharmacokinetic (68.3%), were well documented (65.9%), and had delayed onset (63.7%). Adverse events included treatment failure (16.7%) and adverse drug reactions (83.3%).
Resende <i>et al.</i> , 2019 ⁽²¹⁾	Medication review	80% of participants had at least one DRP. The most common were indication and adherence problems. Associated factors included age, marital status, new HIV case, ethnicity, time since HIV diagnosis, and duration of tuberculosis treatment.
Cruz <i>et al.</i> , 2020 ⁽²²⁾	Pharmacotherapeutic follow-up	Shorter delays in ART refills was positively correlated with undetectable viral load ($r = 0.407$) and higher CD4+ T-cell count ($r = 0.237$), indicating better adherence.
Resende <i>et al.</i> , 2021 ⁽²³⁾	Medication review	69 DRPs were identified. Most were related to adherence (58.0%), followed by indication (24.6%), safety (11.6%), and effectiveness (5.8%). In addition, 66.6% of participants developed hepatotoxicity during follow-up.
Marçal <i>et al.</i> , 2024 ⁽²⁴⁾	Pharmacotherapeutic follow-up	Individual satisfaction with health services increased from 95.5% at ART initiation to 96.7% after 3 months. This difference was not statistically significant ($p = 0.472$). Physical health domain scores were associated with satisfaction at ART initiation (OR, 1.38; 95% CI, 1.11 - 1.71; $p = 0.003$).

Abbreviations: ART: Antiretroviral Therapy; CI: Confidence Interval; DRP: Drug-Related Problems; HIV: Human Immunodeficiency Virus; OR: Odds Ratio; PR: Prevalence Ratio; r: Correlation Coefficient.