International Journal for Equity in Health

SYSTEMATIC REVIEW

Open Access

The impact of interprofessional collaboration between pharmacists and community health workers on medication adherence: a systematic review

Carole Bandiera[1*], Ricki Ng[1], Sabuj Kanti Mistry[2], Elizabeth Harris[3], Mark F. Harris[3] and Parisa Aslani[1]

Abstract

Background There is increasing evidence to support the effectiveness of interventions involving community health workers (CHWs) in improving patient health outcomes, which reinforces their growing integration in healthcare teams. However, little is known about the interprofessional collaboration between pharmacists and CHWs. This systematic review aimed to explore the impact of interprofessional interventions involving pharmacists and CHWs on patient medication adherence.

Methods The English language scientific literature published in Embase, MEDLINE, Web of Science, CINAHL, Scopus, plus the grey literature were searched in October 2024. Using the software Covidence, two authors screened article titles and abstracts and assessed full-text articles for eligibility. Studies were included if (i) the intervention was delivered by pharmacists and CHWs and (ii) reported on medication adherence outcomes. Data were extracted using a customized template using Excel and synthetized narratively. The Effective Public Health Practice Project quality assessment tool was used to assess the studies' methodological quality.

Results Eight studies met the inclusion criteria, including a total of 1577 participants. Seven studies were conducted in the United States, and six were published since 2020. The interventions consisted of medication therapy management, medication reconciliation, and repeated education sessions. The CHW shared clinical and non-clinical patient information and ensured a culturally safe environment while the pharmacist delivered the clinical intervention. In five studies, medication adherence was evaluated solely through patient self-reported measures. One study used an objective measure (i.e., pharmacy refill records) to evaluate medication adherence. Only two studies assessed medication adherence using both self-reported and objective measures (i.e., pill count and proportion of days covered). A significant improvement in medication adherence was observed in three of the eight studies. Half of the studies were of weak quality and half of moderate quality.

Conclusions There was a small number of studies identified which focused on the impact of interprofessional collaboration between pharmacists and CHWs on medication adherence. The impact of the interprofessional

*Correspondence:
Carole Bandiera
carole.bandiera@sydney.edu.au

Full list of author information is available at the end of the article

interventions on medication adherence was limited. Further studies of higher quality are needed to better evaluate the impact of such collaboration on patient health outcomes.

Registration PROSPERO, ID CRD42024526969.

Keywords Medication adherence, Compliance, Pharmacists, Community health workers, Navigators, Community health navigators, Health coaches, Promotoras, Interprofessional collaboration, Multidisciplinary healthcare teams

Background

Medication adherence is the extent to which patients take their medication as prescribed by their healthcare providers. It is characterized by three interrelated phases: treatment initiation (i.e., first dose taken), treatment implementation (i.e., the extent to which the patient's dosing history corresponds to the prescription) and discontinuation (i.e., the patient stops taking the treatment prematurely) [1]. It is estimated that up to one third of patients never fill their first prescription, and of those who fill it, up to half of the patients are considered nonadherent [2, 3]. Within two years of the initial prescription, less than half of these patients are still taking their prescribed medications [3]. Medication nonadherence leads to treatment failure, suboptimal clinical outcomes, premature death, poor quality of life, increased health services use and health care costs [2–5]. It is thus critical to evaluate and address medication adherence barriers, and optimize patient medication adherence by supporting them in the long term [6].

Having a pivotal role in the primary health care system, pharmacists' roles are expanding globally, and the evidence of the impact of pharmacist-led interventions (such as medication reviews, medication reconciliation, medication management and medication adherence support) on patient medication adherence and health outcomes, is growing [6–12]. Community pharmacists are at the front line to identify patient medication nonadherence and support patients' medication adherence. However, several challenges may arise, such as low awareness for medication adherence in the population, healthcare professionals or policymakers [13], low workforce supply, time pressures [14], or lack of sufficient funding for pharmacists to engage in medication adherence support [13, 15].

The assessment of medication adherence and the identification of its influencing factors in each patient can be challenging. For instance, one of the major determinants of patient medication adherence are the social determinants of health (SDoH) [16, 17], which include the social and cultural background of people, their environment, income, employment status, education, and their age [18]. The SDoH influence many health outcomes and should be addressed as a major component in patient care [19]. However, health professionals often encounter challenges in identifying and managing SDoH in underserved and vulnerable populations (i.e., individuals facing disparities and experiencing barriers to access care [20]) [21, 22].

Collaborating with health workers that have a specific understanding of the patient's background would be instrumental to delivering effective care and decreasing health disparities. According to the American Public Health Association, community health workers (CHWs) are *frontline public health workers who serve as a liaison/link/intermediary between health/social services and the community* (often their own community in terms of cultural background and language) *to facilitate access to services and improve the quality and cultural competence of service delivery* [23]. CHWs can be identified by different terms, e.g., *Promotoras de Salud* who serve the Latino population [24] or aboriginal health workers who support the Aboriginal and Torres Strait Islanders people in Australia [25]. Socio-demographic characteristics of CHWs, their education and the level of pre-service training vary widely [26]. A review by the World Health Organization (WHO) and the Global Health Workforce Alliance in 2010 established that the minimum level of education to become a CHW should be completion of primary school [26]. The integration of CHWs in health systems and health care teams also varies globally. In the last decade, the implementation of CHW programs in low- and middle-income countries has been growing [26]. During the Coronavirus-2019 pandemic, CHWs were recognized as essential health workers to support communities, which may subsequently improve their integration in health care teams in the long-term [27, 28]. However, the integration of CHWs is limited in European health systems, where they are mostly project-based — CHW are more widely integrated into the United Kingdom health system [29]. CHWs have been involved in improving patients' navigation of the health system, providing health prevention services, supporting healthy behaviours, monitoring patient health and delivering specific care [30]. The evidence of the effectiveness of CHWs is growing in improving cancer screening [31], improving the management of diabetes [32], hypertension [33] or infectious diseases [30, 34], delivering HIV services [35], preventing undernutrition [36, 37] and improving maternal and child health [30, 38]. CHWs work in diverse settings, including community-based organisations, hospitals or public health departments [39]. The total number of CHWs

working in communities and healthcare settings are hard to establish owing to their diverse definition and roles. The United States Bureau of Labor Statistics estimated that 58,550 CHWs were employed across the United States of America (USA) in May 2023 [40], and that the number of CHWs is expected to grow by 13% from 2023 to 2033 (i.e., around 7,500 new CHW positions are projected each year), which is faster than the average growth rate for all occupations [39]. The integration of CHWs within healthcare teams is needed and is growing [30, 41, 42].

Working collaboratively with other healthcare professionals has become a key component of effective care, improving medication adherence and positively affecting patient health outcomes [6, 12, 43–45]. Pharmacists, especially community pharmacists and CHWs can work synergistically to modify the way in which the SDoH may act as a barrier to medication adherence in underserved populations. Current research evidence focuses on interprofessional collaboration between CHWs and physicians, nurses, dietitians and social workers in delivering interventions, programs or services that have demonstrated a positive effect on patient health outcomes and in improving patient navigation of the healthcare system [30, 46, 47]. However, little is known about the collaboration between CHWs and pharmacists [48].

Gathering the knowledge and evidence on this topic could help implement interprofessional interventions and foster the connection between pharmacists and CHWs to improve patient health outcomes. Therefore, this systematic review aims to explore the impact of interprofessional interventions involving pharmacists and CHWs on patient medication adherence.

Methods

Design and guidelines

This systematic review was conducted according to the *Preferred Reporting Items for Systematic reviews and Meta-Analyses (*PRISMA) guidelines [49]. The primary outcomes evaluated were components of medication adherence, i.e., medication initiation, implementation, discontinuation or persistence to treatment, assessed by objective or subjective measures.

The systematic review protocol was registered in PROSPERO (CRD42024526969).

Study eligibility criteria

Studies were included if (i) it was a primary research article published in English (i.e., reviews, protocols, commentaries, letters to editors and conference abstracts were excluded), (ii) the study design was an intervention, a service or a program (i.e., qualitative, observational or cross-sectional studies were excluded), (iii) the intervention involved pharmacists and CHWs, (iv) the intervention involved people taking any kind of medications for a chronic or acute condition or for preventive care or contraceptive purposes and (v) the intervention aimed to improve medication adherence and one of the outcomes of the intervention delivered was a component of medication adherence (i.e., initiation, implementation, discontinuation).

Information sources and search strategy

English language literature was searched in October 2024 in Embase, MEDLINE, Web of Science, CINAHL and Scopus. Additionally, a grey literature search was conducted using similar search terms in Google Scholar and Google search engine.

The research strategy was built with a university librarian using three concepts: (i) pharmacists, (ii) community health workers and (iii) medication adherence (Additional file 1). No restriction on the publication date was applied, i.e., the search was conducted from the inception of the databases until October 2024.

Data collection process

The output references were imported into Covidence (Veritas Health Innovation, Melbourne, Australia), a web-based collaboration software platform that streamlines the production of systematic and other literature reviews [50]. Most of the duplicates were removed by the software, and the remainder was removed manually. First, two authors (CB and RN) independently excluded irrelevant articles based on the screening of their titles. Second, the remaining articles were screened based on their abstracts. Of note, while review articles were not eligible, the reference list of the review articles was also searched for any potential literature. Third, the selected articles were assessed for eligibility by CB and RN after a full-text reading. The discrepancies were discussed and resolved at each stage. To reduce any potential selection bias, any further discrepancies were discussed by another two authors (PA and SKM), until all agreed.

The data from the selected articles were extracted using a customized template for data extraction using Excel version 16 (Microsoft) developed by the authors. The variables extracted where possible as per the terminology used in the study were: intervention, setting, sample size, participant population, study design, medication adherence measure and results.

The authors of the included articles were contacted in case additional information was needed. The results were synthesized narratively.

Study quality assessment

The methodological quality of the included studies was assessed independently by two authors (CB and RN) using the Effective Public Health Practice Project quality

assessment tool [51]. Six domains were evaluated: (i) selection bias, (ii) study design, (iii) confounders, (iv) blinding, (v) data collection methods, and (vi) withdrawals and drop-outs. For every domain, a score was determined: 1 for strong, 2 for moderate, and 3 for weak quality. The scores were then used to assess the quality of the study as a whole: the study was considered of strong quality if no weak rating was assigned, of moderate quality if one weak rating was identified, and of weak quality if two or more weak ratings were assessed [52]. Discrepancies were resolved by discussion between the authors (CB and RN).

Results

The PRISMA flow diagram (Fig. 1) presents the article selection process. After duplicates were removed, 1495 articles were screened, of which 1289 were excluded based on their titles. Of the 206 articles assessed for eligibility, 147 were excluded based on their abstracts screening and 51 after a full-text reading. Finally, 8 articles met the inclusion criteria.

Study characteristics

In total, eight studies were included [53–60]. Seven studies were conducted in the USA [54–60] and six of the eight studies were published since 2020 [54, 56–60]. Three studies had a pre-post design [55, 57, 60], three were observational [53, 56, 59] and two were randomized controlled trials [54, 58]. Three studies involved interventions lasting less than 6 months [56, 57, 59], while five studies had interventions that lasted 6 months or longer [53–55, 58, 60].

Participants included

The most common group of patients included in the studies were patients with hypertension and/or diabetes [54, 55, 60]. The other studies involved patients with human immunodeficiency virus (HIV) initiating antiretroviral therapy [53], community dwelling older adults [57], patients with congestive heart failure (CHF) and/or chronic obstructive pulmonary disease (COPD) [59], patients treated with oral anticancer medications [56] and Cambodian Americans with depression and at risk of diabetes [58]. In total, the studies involved 1577 participants, ranging from 33 [60] to 517 participants [55].

Settings of the interventions

Most of the interventions (7/8) were conducted in the community (i.e., patient's home) [53–55, 57–60] and only one study was conducted in a hospital [56]. Clinical, hospital or specialty pharmacists were mostly involved (6/8) [53, 54, 56–59]; 2 studies involved academic pharmacists (i.e., pharmacist researcher affiliated with a university or an academic institution) [55, 60]. Community pharmacists were not directly involved in the intervention of any included studies.

Most of the studies defined CHWs by the same title, although CHWs were referred to as "health coaches" in one study [54], and "medication navigator" in another study [56]. In one study, "promotora" was used to refer to CHWs [55].

Data of included articles are presented in Table 1.

Interventions involving pharmacists and CHWs

Five studies reported on interventions where the pharmacist reviewed the current medication list, identified drug-related problems, developed a medication action plan or sent recommendations to healthcare providers (i.e., in most of the studies, the patients' primary care physicians) [54, 55, 57–59]. In three of these five studies, CHWs were actively involved during the intervention delivered by the pharmacist to ensure a culturally safe environment and patient understanding (i.e., translated the information in the patient's language, facilitated telehealth and introduction with pharmacists, assisted the patient during medication reconciliation) [54, 55, 58].

Two studies described how CHWs were actively involved in collecting patient information and medication records or assisted pharmacists with addressing medication adherence barriers [57, 60]. It is interesting to note that in one study, the CHW was described to be the only healthcare professional to be in direct contact with the patient during the intervention [60].

In three studies, the pharmacist delivered education sessions in addition to providing repeated medication management interventions [53, 54, 56]. These were all facilitated by the CHW who organized support group meetings [53], visited the patient at home to provide self-management education and collect clinical data (i.e., blood glucose and blood pressure levels) [54], and reinforced patient understanding regarding the medication [56]. CHWs addressed barriers to medication use, collected information regarding the medications and shared relevant information with pharmacists [54, 56–58, 60].

The training and supervision of CHWs and pharmacists was not always comprehensively described in the included studies. While in the study from Gerber et al., health coaches (term used for CHWs) received extensive study-specific training [54], in the study from Lin et al., the oncology team and the oncology specialty pharmacist provided formal training to medication navigators on medication education and triaging of medication-related problems (i.e., formal training) [56]. In the study by Meyer et al., pharmacists were required to have a geriatrics specialty designation and the staff received extensive orientation to the intervention, and frequent training in geriatrics and aging [57]. In the study from Polomoff et al., the pharmacist investigator and study coordinator

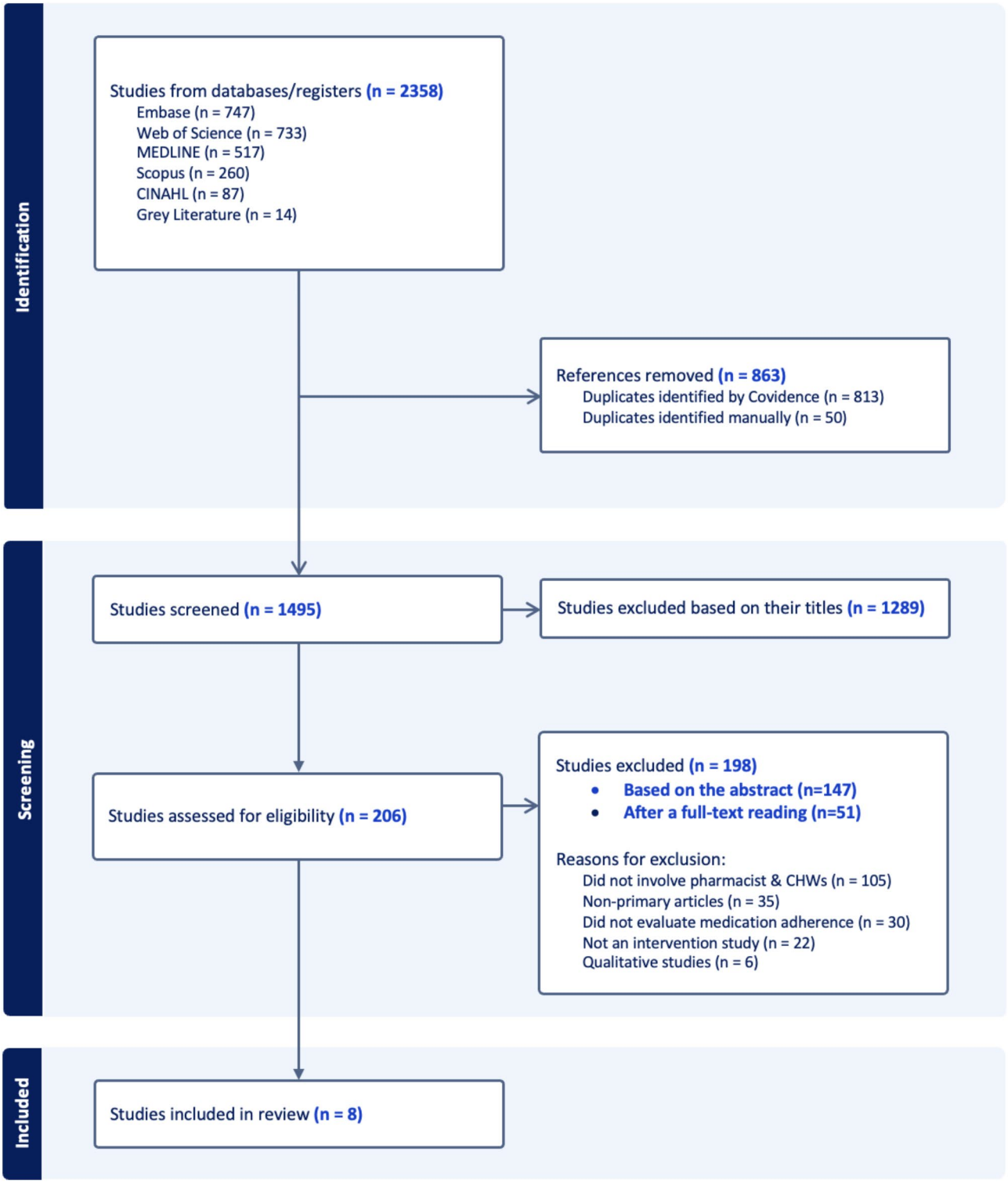

Fig. 1 Flow diagram of the article selection process. *Note.* CHWs: community health workers

trained CHWs in medication therapy management, CHWs shadowed experts who completed the medication review form and performed role play [58]. Prior to conducting the intervention independently, CHWs were supervised for some of the medication review sessions they conducted with participants [58]. In the study by Wheat et al., pharmacists and student pharmacists provided training to CHWs in medication therapy

Table 1 Included study data

Study (Country)	Study Design	Setting	Study Participants and Sample Size	Intervention and pharmacists and CHWs roles	Medication adherence measure	Results	Study Quality Assessment
Achieng et al., 2012 [53] (Kenya)	Prospective, observational cohort analysis over 6 months and follow-up at 12 months after initiation of antiretroviral therapy	Hospital (pharmacy counselling, unannounced pill counts), and community (home visit by CHWs, community based support groups)	Patients initiating antiretroviral therapy at the A.I.C. Kijabe Hospital Sample Size $n=301$ patients enrolled	During the first 6 months of antiretroviral therapy, patients received home visits by CHWs, community-based support groups, pharmacy counselling, and unannounced pill counts by clinicians. -**CHWs** visited patients in their homes and assessed barriers to care, patient adherence to medication and overall health status. -**CHWs** organized the monthly support group meetings (i.e., open discussions of both problems and successes associated with HIV therapy). -**Pharmacists** dispensed the medications at the Kijabe pharmacy -**Pharmacy counselling**: after the care provider visit, the patient met with a pharmacist to discuss any difficulties in taking medication and to further address adherence issues discovered during the provider visits.	Pharmacy refill records	-Adherence was significantly higher in those who participated in 3 or more support group meetings (90% vs. 83%, $P<0.05$), who had pill counts performed by their clinician (90% vs. 76%, $P=0.001$), and who attended all clinic visits (90% vs. 72% $P=0.001$). -Homes visits and pharmacy counselling were not associated with differences in adherence.	Weak
Gerber et al., 2023 [54] (USA)	2-arm (intervention and waitlist control) parallel randomized clinical trial (the order of the 1-year intervention was randomized)	Ambulatory and community	Urban African American or Latino adults with uncontrolled type 2 diabetes Sample Size $n=221$ patients enrolled (109 in the intervention, 112 in the waitlist control)	Patients received mobile health (mHealth) diabetes intervention for 1 year (follow-up duration: 24 months) **Pharmacists** reviewed glucose level, intensified medication via a video telehealth platform. **Health coaches** addressed barriers to medication use, assisted pharmacists in medication reconciliation and telehealth at the patient's home, via phone calls and text messaging. Usual diabetes care was routine health care from patient's primary care physicians.	Self-reported (validated): questionnaires on medication-taking behaviour (self-rating question: "Over the past month, what percent of the time did you take all your diabetes medication as prescribed?") [61, 62]	No significant effect on medication-taking behaviour.	Moderate
Johnson et al., 2018 [55] (USA)	Program evaluation project using a pre-post design	Academic / Rural Community pharmacy sites	Patients with hypertension and / or diabetes living in a rural Arizona community Sample Size $n=517$ patients participated in 5 different community pharmacy sites	-A centralized, non-rural academic-based **pharmacist** provided telephonic medication therapy management (MTM) services to patients, with special emphasis on patient laboratory results and self-monitoring, appropriateness of therapy, medication-related problems and health promotion, sending recommendations to the patient's community pharmacists and prescribers. -At one community partner site, **CHWs** served as front-line health aides. When possible, CHWs were present in the patient's home during the initial comprehensive medication review to assist the patient during the medication reconciliation, ensure patient understanding, and document any recommendations made during the call.	Self-reported (not validated): patients were asked about the frequency of missed doses at baseline and again at follow-up. Non-adherence was defined as missing a dose more than 20% of the time in a given month.	-On average, 88.7% of patients were adherent to their medication regimens -While not statistically significant, there was a decrease in nonadherent patients at the community health centre pharmacy where CHWs served as front-line health aides (13.8%-6.1%).	Weak

Table 1 (continued)

Study (Country)	Study Design	Setting	Study Participants and Sample Size	Intervention and pharmacists and CHWs roles	Medication adherence measure	Results	Study Quality Assessment
Lin et al., 2021 [56] (USA)	Longitudinal pilot intervention	Hospital, a large urban academic hospital	Vulnerable patients already on an oral anticancer medication (OAM) at the Tufts MC Cancer Center, located in Boston's Chinatown, which serves a large number of non-English, Chinese-speaking patients, as well as patients of lower socio-economic status. Sample Size *N* = 54 patients enrolled	Four formalized (T1, T2, T3, T4) teaching and check-in sessions (two teaching sessions to coincide with the new oral anticancer medication start and cycle 2 refill, and two check-ins in the interim), supplemented with medication information sheets and individualized calendars. Patients were assessed on their OAM understanding and adherence. **Pharmacists** led the initial teaching sessions (T1) and re-teaching at the first refill (T3). The **medication navigator** was present in all 4 educational sessions, checked in with study participants for a booster check-in 7–10 days after the initial pharmacist-led teaching session (T2), utilizing the MOATT teach-back to reinforce understanding and identify issues. The study concluded with the medication navigator checking in with participants for a fourth and final time (T4) at any point between T3 and the start of the 2nd refill.	Self-reported (validated): Two self-adherence questions were adapted from a 3-item medication adherence measure, previously validated for patients with HIV [63].	-Most participants reported doing a "Very Good" or "Excellent" job (T2, 83.8%; T3, 81.1%; T4, 82.4%) at taking their medication in the way they were supposed to. -Most participants reported that they "Almost Always" or "Always" (T2, 94.6%; T3, 97.3%; T4, 97.1%) took their medication in the way they were supposed to.	Moderate
Meyer et al., 2021 [57] (USA)	A single sample, pre-post-test design, pilot program	Community	Community dwelling older adults Sample Size *N* = 180 enrolled	The Community Medication Education, Data, & Safety (C-MEDS) Program provided in-depth personalized medication safety, management and support, based on an in-home assessment and interventions delivered by trained geriatrics experts, including pharmacists and a CHW. The pharmacy technicians and **CHWs** collected health information and an adherence survey MedAdhIR tool. The collected data were provided to the **pharmacist** who identified medication safety concerns and developed a customized care plan using a standardized care plan checklist.	-Self-reported (validated) using the MedAdhIR tool (a 10-item scale that measures risk of medication nonadherence, higher scores indicate higher nonadherence, scores < 2 suggest no medication nonadherence) [64]. -Pill count for specific medications associated with higher rates of nonadherence (e.g., oral drugs for diabetes, statins).	-The mean MedAdhIR score for older adults at enrolment was 4.91 (standard deviation (SD) = 3.0), which fell to a mean of 1.8 (SD = 2.1) at follow-up, a significant improvement in medication nonadherence (t = 9.5, $P < 0.001$). -Similarly significant improvements in adherence via pill count -Adherence to the selected medications was 34.7% (SD = 0.29) at enrolment and increased to 75.8% (SD = 0.24) by the end of the program (t = − 14.58, $P < 0.001$), an absolute adherence increase of 41.1% from enrolment to the end of the program.	Weak

Table 1 (continued)

Study (Country)	Study Design	Setting	Study Participants and Sample Size	Intervention and pharmacists and CHWs roles	Medication adherence measure	Results	Study Quality Assessment
Polomoff et al., 2022 [58] (USA)	Randomized controlled trial with 3 treatment arms: (1) CHW-delivered lifestyle intervention called Eat, Walk, Sleep (EWS), (2) EWS plus pharmacist/CHW-delivered medication therapy management (EWS + MTM), or, (3) social services (SS) (control)	Community	Cambodian Americans with depression and at risk of diabetes Sample Size $N = 188$ participants randomized (EWS, $n = 67$; EWS + MTM, $n = 63$; SS, $n = 50$; control)	**Pharmacist** conducted MTM: they remotely connected via secure videoconferencing and reviewed medications, identified drug therapy problems number and type, determined drug therapy problems resolution status, developed and discussed a medication action plan. **CHWs** collected information regarding all prescription and nonprescription medications, optimized MTM by providing language translation, cultural interpretation, education, behaviour modification, role modelling, bureaucracy navigation, and advocacy, contributed to the MTM process by conducting the medication history-taking. CHWs helped increase participant trust and confidence regarding the pharmacist recommendations.	-Self-reported medication forgetting (not validated): one item asked about frequency of forgetting to take medications, with response options on a Likert scale from 0 = 'never' to 4 = "always". -Self-reported barriers to taking medications (not validated): the authors created an 8-item scale to assess the frequency with which structural barriers interfere with medication-taking (e.g., language, cost). Response options are 1 = yes, often, 2 = yes, sometimes, or 3 = no, never. -Specific scale of the beliefs about medicines questionnaire (BMQ) [65] (validated) with two 5-item subscales: the 'Specific Necessity' subscale and the 'Specific concerns' subscale.	-Forgetting decreased from baseline to 12 months in the EWS + MTM group while it increased in the control group. -At 12 months the difference in forgetting between EWS + MTM and other groups was marginally significant ($p = 0.094$) and at 15 months there was a significant difference ($p = 0.030$). -Barriers to medication: for all groups there was a significant decrease from baseline to 12 month ($p < 0.001$) that was maintained at 15 months but there was no difference between the EWS + MTM group and other groups at 12 months ($p = 0.668$) or 15 months ($p = 0.338$) -BMQ necessity and concern subscale: no discernible pattern is evident. The EWS + MTM group did not differ from the other groups at 12 months (necessity: $p = 0.872$, concern: $p = 0.899$) or 15 months (necessity: $p = 0.533$, concern: $p = 0.873$).	Moderate

Table 1 (continued)

Study (Country)	Study Design	Setting	Study Participants and Sample Size	Intervention and pharmacists and CHWs roles	Medication adherence measure	Results	Study Quality Assessment
Sokan et al., 2022 [59] (USA)	Retrospective cohort observational study	Transition of care after hospital discharge, between hospital and the community	Patients with congestive heart failure (CHF) and/or chronic obstructive pulmonary disease (COPD) Sample Size *n* = 83 patients included (43 in the intervention group and 40 were propensity-matched controls)	Mobile integrated health-community paramedicine program, addressed both medical (e.g., providing medication reconciliation services) and social determinants of health, including in-home visit. **Pharmacists** performed medication reconciliation, addressed adherence barriers, provided patient education and developed a patient care plan. **CHWs** enrolled patients, collected relevant patient information and scheduled home visits and coordinated and executed the wide variety of activities needed to address or mitigate social and environmental needs.	-Proportion of days covered (PDC) -Self-reported (validated): during the intervention, barriers to medication use was also assessed from a questionnaire developed from the Modified Drug Adherence Work-Up tool (a validated 13-item checklist questionnaire) [66], that was slightly modified to include other pertinent questions relevant to the patient population.	Medication adherence was higher among patients enrolled in the program during the first 30 days post-discharge among patients with CHF (8% difference in PDC, 95% confidence interval (CI), -0.12–0.28%) and COPD (14% difference, 95% CI, -0.15–0.43%), although neither result achieved statistical significance.	Moderate
Wheat et al., 2020 [60] (USA)	Pre/post pilot study, single group	Community / University	Patients diagnosed with hypertension with or without diabetes who were mainly Native American or black. Sample Size *N* = 33 patients included	Identification and addressing of medication adherence barriers encountered by hypertensive patients. **CHWs** collected patient information such as pharmacy refill data, use of self-medication such as herbals and home remedies and the patients' concerns. The CHW asked adherence barrier questions based on the Drug Adherence Workup Tool. The CHWs collaborated remotely with a **pharmacist** to identify opportunities for intervention on the basis of the adherence barriers identified, which resulted in a written "action plan" with specific steps for the patient to implement to help overcome the adherence barriers.	Self-reported (validated): a series of adherence barrier questions, based on the Drug Adherence Workup Tool [67]	By the final visits, 75.6% of the barriers related to antihypertensive medications and 63.9% of the barriers related to antidiabetic medications were resolved.	Weak

NB: BMQ = beliefs about medicines questionnaire, CHF = congestive heart failure, CHWs = community health workers, CI = confidence interval, COPD = chronic obstructive pulmonary disease, EWS = Eat, Walk, Sleep, MedAdhIR = Medication Adherence Individual Review, MOATT: Multinational Association of Supportive Care in Cancer (MASCC) Oral Agent Teaching Tool (MOATT), MTM = medication therapy management, OAM: oral anticancer medication, PDC = proportion of days covered, SD = standard deviation

management (including health disparities, cultural competency, motivational interviewing, communication skills, ways to identify adherence barriers and how to collaborate with a pharmacist) [60].

Methods to measure medication adherence

In five studies, medication adherence was evaluated subjectively solely through patient self-reported measures [54–56, 58, 60], of which four [54, 56, 58, 60] used at least one validated questionnaire (such as the BMQ [65] or the Drug Adherence Workup Tool [67]) or questions adapted from previously validated questionnaires (such as from a 3-item medication adherence measure, previously validated for patients with HIV [63]). Two studies measured adherence through self-reported measures based on the frequency of missed doses or self-reported barriers to taking medications and did not report on the validity of the questionnaire used to assess medication adherence [55, 58].

One study solely used an objective measure (i.e., pharmacy refill records) to evaluate medication adherence [53]. Only two studies assessed medication adherence using both self-reported and objective measures [57, 59]. In one study, participants completed the MedAdhIR tool and adherence was also evaluated using pill counts [57]. In another study, medication adherence was assessed through the modified Drug Adherence Work-up Tool and the proportion of days covered [59].

Study quality assessment

Using the Effective Public Health Practice Project quality assessment tool [51], none of the studies were considered to be of a strong (or high) quality. Half of the studies (4/8) were considered to be of weak methodological quality [53, 55, 57, 60] and half of moderate quality [54, 56, 58, 59]. The studies were determined to be of weak or moderate quality due to the study design (i.e., the studies were mostly observational with a pre/post design, only two studies were randomized and controlled trials), presence of confounders, lacking of blinding, and lacking of reliability in the data collection methods.

Impact of the intervention on medication adherence outcome

Table 1 summarizes medication adherence measures and results in the included studies.

Three of the eight studies showed a significant improvement in medication adherence [53, 57, 58]– the quality assessment was of weak quality in two [53, 57] and moderate in the third [58]. In these studies, adherence was evaluated with pharmacy refill records [53], the validated self-report MedAdhIR tool and pill-count [57], and the validated BMQ questionnaire and non-validated self-report measures [58]. The interventions, which showed a positive outcome, were repeated education sessions [53], medication reviews and medication therapy management [57, 58].

Three studies did not demonstrate statistically significant improvements in medication adherence [54, 55, 59], including a study which evaluated adherence with the proportion of days covered [59], one study using a validated questionnaire [54], and another study using a non-validated questionnaire [55]. The quality assessment of these studies was respectively of moderate [54], weak [55] and moderate quality [59].

Two studies using validated questionnaires to assess medication adherence were descriptive and did not conduct statistical analyses on medication adherence outcomes [56, 60]– these studies were considered as moderate quality [56] and weak quality [60].

Discussion

This is the first systematic review to evaluate the impact of interprofessional interventions involving pharmacists and CHWs on patient medication adherence. The evidence of the impact of the interventions on medication adherence is limited. While only a small number of studies were eligible for inclusion in this systematic review, there was a large degree of heterogeneity among the included studies, which used various methods to measure medication adherence. Most of these methods were subjective, relying on patient self-reported measures through different kinds of questionnaires, which were not always validated. Studies of higher quality are needed in this field of research.

A majority of the included studies relied solely on self-reported adherence measures. The use of subjective measures to evaluate medication adherence allows obtaining the patient's perspective on their medication adherence, is low cost and can be easily implemented in adherence studies [68, 69]. However, they are prone to desirability bias (i.e., patients may respond according to their perspective of a favourable answer) and memory bias, leading to an overestimation of medication adherence compared to objective measures, that provide an accurate record of medication adherence [68, 69]. Of note, when researchers modify a validated questionnaire, they should validate the instrument and its scoring [70], which has not been clearly reported in the included studies.

The variety of questionnaires in terms of question phrasing, intervals of recalls, scale formats, type of non-adherence (i.e., intentional versus non-intentional), and adherence phase (i.e., initiation, implementation and discontinuation), prevents the comparison of results between the studies [68, 71]. Based on such variations in questionnaires, the literature recommends to concomitantly use objective measures to corroborate self-reported measures [2, 69], which was reported in only

two selected studies [57, 59]. In addition to quantitative data, qualitative data should also be collected in adherence studies to better understand the factors influencing medication adherence that are addressed by the intervention [72–74].

Even if medication adherence is considered a surrogate outcome to assess the impact of the intervention on patient clinical outcomes, only one of the studies that significantly improved medication adherence reported the direct impact of the improvement of medication adherence on a clinical outcome (i.e., viral load with the number of copies of HIV-1 RNA per mL, which defined treatment failure) [53]. Considering the variety of adherence outcome measures reported in the included studies and the fact that no clinical outcomes were collected during the interventions, it is difficult to draw clear conclusions on the impact of the adherence interventions on patient clinical outcomes.

Future studies should explore the collaborative practice between CHWs and pharmacists using at least one objective method to measure medication adherence and should explore the impact of the medication adherence intervention on clinical outcomes.

While there is extended evidence of the effectiveness of pharmacist-led interventions to improve medication adherence [6, 12, 75–79], the literature reporting effective CHWs-led interventions to improve adherence is growing [80–83]. The systematic review findings demonstrate that through a collaborative approach with pharmacists, CHW-led interventions may benefit from the pharmacist's clinical expertise in medication reviews and medication management to optimize the intervention, in the same way as pharmacist-led interventions would benefit from the cultural and social expertise of the CHWs to collect relevant adherence data and provide culturally sensitive adherence interventions. Indeed, in the three studies that demonstrated significant improvements in adherence [53, 57, 58], CHWs' roles were instrumental in collecting information regarding the medication history-taking, the prescriptions and assessing patient medication adherence. The trust built between the patient and the CHW, as well as their shared cultural background may have helped the patient to explain their medication management with accuracy. The information collected by the CHW allowed pharmacists to deliver the intervention (i.e., reviewing medications, identifying drug-related problems, addressing medication barriers and providing an individual care plan), which eventually tailored the intervention to the patient's needs. In addition to collecting relevant information, the CHWs also organized support group meetings for patients, they contributed to the medication therapy management process by providing education and behaviour modification.

Segal et al. proposed a collaborative CHW-pharmacist practice model, where CHWs collect the patient medication list, uncover patient medication self-management and evaluate medication adherence barriers [16]. The CHW share the information collected with the pharmacist, and they then both collaborate on the implementation of an action plan to optimize medication adherence [16]. The CHW implements the plan with the patient and ensure follow-up [16]. The findings of this systematic review corroborate that the evaluation of patient medication adherence by the CHW provides a robust assessment of medication adherence, and the interprofessional collaboration with pharmacists to optimize medication adherence can improve the effectiveness of the interventions. CHWs and pharmacists could then synergistically work together on evaluating, maintaining and improving patient medication adherence in the long run, which may ultimately improve patient health outcomes.

Of note, the interventions included in this systematic review were delivered by clinical, hospital, specialty or academic pharmacists, and community pharmacists were not directly involved in the included interventions. This shows that the integration of community pharmacists in the interprofessional healthcare teams is still limited. Future studies should explore the integration of community pharmacists in interprofessional collaborative practices, as it could improve the recognition of their roles and expand their responsibilities, including in supporting patient medication adherence [84].

This systematic review has several strengths. The strong methodological rigour was guided by the PROSPERO protocol and PRISMA guidelines. The search strategy was comprehensive, completed in consultation with a librarian. The screening and quality assessment of the studies were conducted by two independent authors, and other authors were involved in discussions in case of discrepancies.

Some limitations are to be considered. First, the definitions and roles of the CHWs were not clearly separated out from other health professions and were rarely comprehensively described in the literature. The quality of the collaboration between pharmacists and CHWs was also not described (e.g., regarding communication, the trusted and respectful relationship); there should be more research into this topic. A contact with the study authors was often needed to confirm the study eligibility. Second, due to the heterogeneity of the methods to measure medication adherence and the different study designs in the included studies, a meta-analysis was considered unsuitable.

Conclusions

There was a small number of studies that focused on the impact of the interprofessional collaboration between pharmacists and CHWs on medication adherence. Most of the methods used to evaluate medication adherence were subjective, relying on patient self-report. Clinical, hospital, specialty or academic pharmacists led the interventions — community pharmacists were not directly involved. The evidence of the impact of the interprofessional interventions on medication adherence was limited. Future high-quality studies are needed to better evaluate the impact of such collaboration on medication adherence and patient health outcomes.

Abbreviations

BMQ	Beliefs about medicines questionnaire
CHF	Congestive heart failure
CHWs	Community health workers
CI	Confidence Interval
COPD	Chronic obstructive pulmonary disease
EWS	Eat, Walk, Sleep
HIV	Human immunodeficiency virus
mHealth	mobile health
MedAdhIR	Medication adherence individual review
MOATT	Multinational Association of Supportive Care in Cancer (MASCC) Oral Agent Teaching Tool
MTM	Medication therapy management
OAM	Oral anticancer medication
PDC	Proportion of days covered
SD	Standard deviation
USA	United Stated of America
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12939-025-02415-4.

Supplementary Material 1

Acknowledgements

The authors thank Ms Kanchana Ekanayake, librarian at the University of Sydney, for her help in building the research strategies.

Author contributions

CB, RN, SKM, EH, MH and PA built the research protocol. The research strategies were developed by CB, with the help of a university librarian. CB and RN screened and selected articles, involving SKM and PA in the discussion. CB and RN assessed the methodological quality of the studies. Analysis was performed by CB, reviewed and revised by RN and PA, and reviewed by SKM, EH and MH. CB wrote the original draft, reviewed and revised by RN and PA, and SKM, EH and MH reviewed the manuscript.

Funding

CB is supported by the Swiss National Science Foundation (Postdoc.Mobility Grant P500PM_217609). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Data availability

The datasets supporting the conclusions of this article are included within the article and its additional file.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]School of Pharmacy, The University of Sydney, Sydney, Australia
[2]School of Population Health, University of New South Wales, Sydney, Australia
[3]International Centre for Future Health Systems, University of New South Wales, Sydney, Australia

Received: 19 November 2024 / Accepted: 12 February 2025
Published online: 28 February 2025

References

1. Vrijens B, De Geest S, Hughes DA, Przemyslaw K, Demonceau J, Ruppar T, Dobbels F, Fargher E, Morrison V, Lewek P, Matyjaszczyk M, Mshelia C, Clyne W, Aronson JK, Urquhart J, Team ABCP. A new taxonomy for describing and defining adherence to medications. Br J Clin Pharmacol. 2012;73(5):691–705.
2. Sabate E. *Adherence to long-term therapies: evidence for action. Geneva: World Health Organization (WHO).* 2003.
3. Khan R, Socha-Dietrich K. Investing in medication adherence improves health outcomes and health system efficiency. Paris: OECD Publishing; 2018.
4. Eliassen FM, Blåfjelldal V, Helland T, Hjorth CF, Hølland K, Lode L, Bertelsen B-E, Janssen EAM, Mellgren G, Kvaløy JT, Søiland H, Lende TH. Importance of endocrine treatment adherence and persistence in breast cancer survivorship: a systematic review. BMC Cancer. 2023;23(1):625.
5. Glass TR, Sterne JA, Schneider MP, De Geest S, Nicca D, Furrer H, Günthard HF, Bernasconi E, Calmy A, Rickenbach M, Battegay M, Bucher HC. Self-reported nonadherence to antiretroviral therapy as a predictor of viral failure and mortality. Aids. 2015;29(16):2195–200.
6. Bandiera C, Dotta-Celio J, Locatelli I, Nobre D, Wuerzner G, Pruijm M, Lamine F, Burnier M, Zanchi A, Schneider MP. The differential impact of a 6-versus 12-month pharmacist-led interprofessional medication adherence program on medication adherence in patients with diabetic kidney disease: the randomized PANDIA-IRIS study. Front Pharmacol. 2024;15.
7. Rajiah K, Sivarasa S, Maharajan MK. Impact of pharmacists' interventions and patients' decision on health outcomes in terms of medication adherence and quality use of medicines among patients attending community pharmacies: a systematic review. Int J Environ Res Public Health. 2021;18(9).
8. Al-babtain B, Cheema E, Hadi MA. Impact of community-pharmacist-led medication review programmes on patient outcomes: a systematic review and meta-analysis of randomised controlled trials. Res Social Administrative Pharm. 2022;18(4):2559–68.
9. Alabkal RM, Medlinskiene K, Silcock J, Graham A. Impact of pharmacist-led interventions to improve clinical outcomes for adults with type 2 diabetes at risk of developing cardiovascular disease: a systematic review and meta-analysis. J Pharm Pract. 2023;36(4):888–99.
10. Milosavljevic A, Aspden T, Harrison J. Community pharmacist-led interventions and their impact on patients' medication adherence and other health outcomes: a systematic review. Int J Pharm Pract. 2018;26(5):387–97.
11. Fentie AM, Huluka SA, Gebremariam GT, Gebretekle GB, Abebe E, Fenta TG. Impact of pharmacist-led interventions on medication-related problems among patients treated for cancer: a systematic review and meta-analysis of randomized control trials. Res Social Administrative Pharm. 2024;20(5):487–97.
12. Bandiera C, Cardoso E, Locatelli I, Zaman K, Diciolla A, Digklia A, Stravodimou A, Cristina V, Aedo-Lopez V, Dolcan A, Sarivalasis A, Bouchaab H, Pasquier J, Dotta-Celio J, Peters S, Wagner D, Csajka C, Schneider MP. A pharmacist-led interprofessional medication adherence program improved adherence to oral anticancer therapies: the OpTAT randomized controlled trial. PLoS ONE. 2024;19(6):e0304573.

13. Bandiera C, Ribaut J, Dima AL, Allemann SS, Molesworth K, Kalumiya K, Käser F, Olson MS, Burnier M, van Boven JFM, Szucs T, Albrecht D, Wilson I, De Geest S, Schneider MP. Swiss Priority setting on implementing medication adherence interventions as part of the European ENABLE COST action. Int J Public Health. 2022;67.
14. Mansoor SM, Aslani P, Krass I. Pharmacists' attitudes and perceived barriers to provision of adherence support in Australia. Int J Clin Pharm. 2014;36(1):136–44.
15. Lelubre M, Clerc O, Grosjean M, Amighi K, De Vriese C, Bugnon O, Schneider MP. Implementation study of an interprofessional medication adherence program for HIV patients in Switzerland: quantitative and qualitative implementation results. BMC Health Serv Res. 2018;18(1):874.
16. Segal R, Angaran DM, Odedina FT, Zeigler ML, Wallace JL. Opportunities and responsibilities for pharmacists to improve their effectiveness in addressing medication adherence through culturally sensitive collaborations with community health workers. J Am Pharm Assoc (2003). 2020;60(4):e25–30.
17. Wilder ME, Kulie P, Jensen C, Levett P, Blanchard J, Dominguez LW, Portela M, Srivastava A, Li Y, McCarthy ML. The impact of social determinants of health on medication adherence: a systematic review and meta-analysis. J Gen Intern Med. 2021;36(5):1359–70.
18. World-Health-Organization. Social determinants of health. 2024 [cited 2024 23.05.2024]; Available from: https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1
19. Hood CM, Gennuso KP, Swain GR, Catlin BB. County health rankings: relationships between determinant factors and health outcomes. Am J Prev Med. 2016;50(2):129–35.
20. Kondo K, Kondo S, Kauhane D. A model for reaching vulnerable and underserved populations during public health emergencies such as COVID-19. Hawaii J Health Soc Welf. 2023;82(5):116–9.
21. Andermann A, Collaboration C. Taking action on the social determinants of health in clinical practice: a framework for health professionals. CMAJ. 2016;188(17–18):E474–83.
22. Glenn J, Kleinhenz G, Smith JMS, Chaney RA, Moxley VBA, Donoso Naranjo PG, Stone S, Hanson CL, Redelfs AH, Novilla MLB. Do healthcare providers consider the social determinants of health? Results from a nationwide cross-sectional study in the United States. BMC Health Serv Res. 2024;24(1):271.
23. American-Public-Health-Association. Community Health Workers. 2024 [cited 2024 14.08.2024]; Available from: https://www.apha.org/apha-communities/member-sections/community-health-workers
24. Rodriguez Espinosa P, Martinez Mulet Y, Chen WT, Kirk C, Tran C, Gonzalez M, Rosas LG. Community of practice of Promotoras De Salud to address health inequities during and beyond the COVID-19 pandemic. Front Public Health. 2023;11:1260369.
25. Jeyakumar R, Patel B, Coombes J, Madden T, Joshi R. We're on the ground, we know what needs to be done: exploring the role of Aboriginal Health Workers in primary health care. Front Public Health. 2022;10:1010301.
26. World-Health-Organization. What do we know about community health workers? A systematic review of existing reviews. Human Resources for Health Observer Series No 19; 2020.
27. Rodriguez NM. Community health workers in the united states: time to expand a critical workforce. Am J Public Health. 2022;112(5):697–9.
28. Dudley L, Couper I, Kannangarage NW, Naidoo S, Ribas CR, Koller TS, Young T. COVID-19 preparedness and response in rural and remote areas: a scoping review. PLOS Glob Public Health. 2023;3(11):e0002602.
29. Van Iseghem T, Jacobs I, Vanden Bossche D, Delobelle P, Willems S, Masquillier C, Decat P. The role of community health workers in primary healthcare in the WHO-EU region: a scoping review. Int J Equity Health. 2023;22(1):134.
30. World-Health-Organization. *WHO guideline on health policy and system support to optimize community health worker programmes*. 2018.
31. Okasako-Schmucker DL, Peng Y, Cobb J, Buchanan LR, Xiong KZ, Mercer SL, Sabatino SA, Melillo S, Remington PL, Kumanyika SK, Glenn B, Breslau ES, Escoffery C, Fernandez ME, Coronado GD, Glanz K, Mullen PD, Vernon SW. Community preventive services task, *Community health workers to increase cancer screening: 3 community guide systematic reviews*. Am J Prev Med. 2023;64(4):579–94.
32. Werfalli M, Raubenheimer PJ, Engel M, Musekiwa A, Bobrow K, Peer N, Hoegfeldt C, Kalula S, Kengne AP, Levitt NS. The effectiveness of peer and community health worker-led self-management support programs for improving diabetes health-related outcomes in adults in low- and-middle-income countries: a systematic review. Syst Reviews. 2020;9(1):133.
33. Mbuthia GW, Magutah K, Pellowski J. Approaches and outcomes of community health worker's interventions for hypertension management and control in low-income and middle-income countries: systematic review. BMJ Open. 2022;12(4):e053455.
34. Sinha P, Shenoi SV, Friedland GH. Opportunities for community health workers to contribute to global efforts to end tuberculosis. Glob Public Health. 2020;15(3):474–84.
35. World-Health-Organization. Optimizing community health worker programmes for HIV services: a guide for health policy and system support. Geneva; 2021.
36. Lopez-Ejeda N, Charle-Cuellar P, GBA F, Alvarez JL, Vargas A, Guerrero S. Bringing severe acute malnutrition treatment close to households through community health workers can lead to early admissions and improved discharge outcomes. PLoS ONE. 2020;15(2):e0227939.
37. Bridge R, Lin TK. Evidence on the impact of community health workers in the prevention, identification, and management of undernutrition amongst children under the age of five in conflict-affected or fragile settings: a systematic literature review. Confl Health. 2024;18(1):16.
38. Gilmore B, McAuliffe E. Effectiveness of community health workers delivering preventive interventions for maternal and child health in low- and middle-income countries: a systematic review. BMC Public Health. 2013;13(1):847.
39. U.S.-Bureau-of-labor-statistics. Community Health Workers. 2024 [cited 2024 28.05.2024]; Available from: https://www.bls.gov/ooh/community-and-social-service/community-health-workers.htm
40. U.S.-Bureau-of-labor-statistics. Occupational Employment and Wages, May 2023-21-1094 Community Health Workers. 2024 [cited 2025 07.01.2025]; Available from: https://www.bls.gov/oes/2023/may/oes211094.htm
41. Washburn DJ, Callaghan T, Schmit C, Thompson E, Martinez D, Lafleur M. Community health worker roles and their evolving interprofessional relationships in the United States. J Interprof Care. 2022;36(4):545–51.
42. Lewis CM, Gamboa-Maldonado T, Belliard JC, Nelson A, Montgomery S. Preparing for community health worker integration into clinical care teams through an understanding of patient and community health worker readiness and intent. J Ambul Care Manage. 2019;42(1):37–46.
43. WorldHealthOrganization. Framework for action on interprofessional education and collaborative practice. Switzerland: Geneva; 2010.
44. Kaiser L, Conrad S, Neugebauer EAM, Pietsch B, Pieper D. Interprofessional collaboration and patient-reported outcomes in inpatient care: a systematic review. Syst Reviews. 2022;11(1):169.
45. Schneider MP, Burnier M. Partnership between patients and interprofessional healthcare providers along the multifaceted journey to medication adherence. Br J Clin Pharmacol. 2023;89(7):1992–5. https://doi.org/10.1111/bcp.15325
46. Franklin CM, Bernhardt JM, Lopez RP, Long-Middleton ER, Davis S. Interprofessional teamwork and collaboration between community health workers and healthcare teams: an integrative review. Health Serv Res Manag Epidemiol. 2015;2:2333392815573312.
47. Mistry SK, Harris E, Li X, Harris MF. Feasibility and acceptability of involving bilingual community navigators to improve access to health and social care services in general practice setting of Australia. BMC Health Serv Res. 2023;23(1):476.
48. Bandiera C, Mistry SK, Harris E, Harris MF, Aslani P. Interprofessional collaboration between pharmacists and community health workers: a scoping review. Int J Equity Health. 2025;24(1):23.
49. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hrobjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. PLoS Med. 2021;18(3):e1003583.
50. Covidence. Covidence systematic review software. Veritas Health Innovation: Melbourne, Australia; 2024.
51. Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: a comparison of the Cochrane collaboration risk of bias tool and the effective public health practice project quality assessment tool: methodological research. J Eval Clin Pract. 2012;18(1):12–8.
52. Effective-Public-Healthcare-Panacea-Project. *Quality Assessment Tool for Quantitative Studies*. Effective Public Healthcare Panacea Project: Independent source of information about health care in Canada. 2024 [cited 2024 24.05.2024]; Available from: https://www.ephpp.ca/quality-assessment-tool-for-quantitative-studies/
53. Achieng L, Musangi H, Ong'uti S, Ombegoh E, Bryant L, Mwiindi J, Smith N, Keiser P. An observational cohort comparison of facilitators of retention in

care and adherence to anti-retroviral therapy at an HIV treatment center in Kenya. PLoS ONE. 2012;7(3):e32727.
54. Gerber BS, Biggers A, Tilton JJ, Smith Marsh DE, Lane R, Mihailescu D, Lee J, Sharp LK. Mobile health intervention in patients with type 2 diabetes: a randomized clinical trial. JAMA Netw Open. 2023;6(9):e2333629.
55. Johnson M, Jastrzab R, Tate J, Johnson K, Hall-Lipsy E, Martin R, Taylor AM, Warholak T. Evaluation of an academic-community partnership to implement MTM services in rural communities to improve pharmaceutical care for patients with diabetes and/or hypertension. J Managed Care Specialty Pharm. 2018;24(2):132–41.
56. Lin M, Hackenyos D, Savidge N, Weidner RA, Murphy-Banks R, Fleckner T, Parsons SK, Rodday AM. Enhancing patients' understanding of and adherence to oral anticancer medication: results of a longitudinal pilot intervention. J Oncol Pharm Pract. 2021;27(6):1409–21.
57. Meyer M, Enguidanos S, Zhu Y, Likar D, Batra R. Community medication education, data, & safety (C-MEDS): findings from a pilot project. J Am Geriatr Soc. 2021;69(3):813–21.
58. Polomoff CM, Bermudez-Millan A, Buckley T, Buxton OM, Feinn R, Kong S, Kuoch T, Lim M, Scully M, Wagner J. Pharmacists and community health workers improve medication-related process outcomes among Cambodian Americans with depression and risk for diabetes. J Am Pharm Assoc (2003). 2022;62(2):496–504.e1.
59. Sokan O, Stryckman B, Liang Y, Osotimehin S, Gingold DB, Blakeslee WW, Moore MJ, Banas CA, Landi CT, Rodriguez M. Impact of a mobile integrated healthcare and community paramedicine program on improving medication adherence in patients with heart failure and chronic obstructive pulmonary disease after hospital discharge: a pilot study. Exploratory Res Clin Social Pharm. 2022;8:100201.
60. Wheat L, Roane TE, Connelly A, Zeigler M, Wallace J, Kim JH, Segal R. Using a pharmacist-community health worker collaboration to address medication adherence barriers. J Am Pharm Assoc (2003). 2020;60(6):1009–14.
61. Gonzalez JS, Schneider HE, Wexler DJ, Psaros C, Delahanty LM, Cagliero E, Safren SA. Validity of medication adherence self-reports in adults with type 2 diabetes. Diabetes Care. 2013;36(4):831–7.
62. Lu M, Safren SA, Skolnik PR, Rogers WH, Coady W, Hardy H, Wilson IB. Optimal recall period and response task for self-reported HIV medication adherence. AIDS Behav. 2008;12(1):86–94.
63. Wilson IB, Lee Y, Michaud J, Fowler FJ Jr., Rogers WH. Validation of a new three-item self-report measure for medication adherence. AIDS Behav. 2016;20(11):2700–8.
64. Shelton PS, Mozingo DB, Avissar PS, Karg M, Charboneau AL, Rich W. Measuring adherence in a community-based elderly population. Consult Pharm. 2012;27(11):771–81.
65. Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. J Psychosom Res. 1999;47(6):555–67.
66. Lee S, Bae YH, Worley M, Law A. Validating the modified drug adherence work-up (M-DRAW) tool to identify and address barriers to medication adherence. Pharmacy. 2017;5(3):52.
67. Doucette WR, Farris KB, Youland KM, Newland BA, Egerton SJ, Barnes JM. Development of the drug adherence work-up (DRAW) tool. J Am Pharm Assoc (2003). 2012;52(6):e199–204.
68. Stirratt MJ, Dunbar-Jacob J, Crane HM, Simoni JM, Czajkowski S, Hilliard ME, Aikens JE, Hunter CM, Velligan DI, Huntley K, Ogedegbe G, Rand CS, Schron E, Nilsen WJ. Self-report measures of medication adherence behavior: recommendations on optimal use. Transl Behav Med. 2015;5(4):470–82.
69. Lam WY, Fresco P. Medication adherence measures: an overview. Biomed Res Int. 2015;2015:217047.
70. Shah KK, Touchette DR, Marrs JC. Research and scholarly methods: measuring medication adherence. JACCP: Journal of the American College of Clinical Pharmacy. 2023;6(4):416–26.
71. Garfield S, Clifford S, Eliasson L, Barber N, Willson A. Suitability of measures of self-reported medication adherence for routine clinical use: a systematic review. BMC Med Res Methodol. 2011;11:149.
72. Sankar A, Golin C, Simoni JM, Luborsky M, Pearson C. How qualitative methods contribute to understanding combination antiretroviral therapy adherence. J Acquir Immune Defic Syndr. 2006;43(0 1):S54–68.
73. Bandiera C, Lam L, Locatelli I, Dotta-Celio J, Duarte D, Wuerzner G, Pruijm M, Zanchi A, Schneider MP. Understanding reasons and factors for participation and non-participation to a medication adherence program for patients with diabetic kidney disease in Switzerland: a mixed methods study. Diabetol Metab Syndr. 2022;14(1):140.
74. Lelubre M, Kamal S, Genre N, Celio J, Gorgerat S, Hugentobler Hampai D, Bourdin A, Berger J, Bugnon O, Schneider M. Interdisciplinary medication adherence program: the example of a university community pharmacy in Switzerland. Biomed Res Int. 2015;2015:103546.
75. Presley B, Groot W, Pavlova M. Pharmacy-led interventions to improve medication adherence among adults with diabetes: a systematic review and meta-analysis. Res Social Administrative Pharm. 2019;15(9):1057–67.
76. Conn VS, Ruppar TM. Medication adherence outcomes of 771 intervention trials: systematic review and meta-analysis. Prev Med. 2017;99:269–76.
77. Rosenberg SM, Petrie KJ, Stanton AL, Ngo L, Finnerty E, Partridge AH. Interventions to enhance adherence to oral antineoplastic agents: a scoping review. J Natl Cancer Inst. 2020;112(5):443–65.
78. Marcum ZA, Jiang S, Bacci JL, Ruppar TM. Pharmacist-led interventions to improve medication adherence in older adults: a meta-analysis. J Am Geriatr Soc. 2021;69(11):3301–11.
79. Al-Arkee S, Al-Ani O. Community pharmacist-led interventions to improve medication adherence in patients with cardiovascular disease: a systematic review of randomised controlled trials. Int J Pharm Pract. 2023;31(3):269–75.
80. Kenya S, Chida N, Symes S, Shor-Posner G. Can community health workers improve adherence to highly active antiretroviral therapy in the USA? A review of the literature. HIV Med. 2011;12(9):525–34.
81. Tolley A, Hassan R, Sanghera R, Grewal K, Kong RG, Sodhi B, Basu S. Interventions to promote medication adherence for chronic diseases in India: a systematic review. Front Public Health. 2023;11:1194919.
82. Newman PM, Franke MF, Arrieta J, Carrasco H, Elliott P, Flores H, Friedman A, Graham S, Martinez L, Palazuelos L, Savage K, Tymeson H, Palazuelos D. Community health workers improve disease control and medication adherence among patients with diabetes and/or hypertension in Chiapas, Mexico: an observational stepped-wedge study. BMJ Glob Health. 2018;3(1):e000566.
83. Xavier D, Gupta R, Kamath D, Sigamani A, Devereaux PJ, George N, Joshi R, Pogue J, Pais P, Yusuf S. Community health worker-based intervention for adherence to drugs and lifestyle change after acute coronary syndrome: a multicentre, open, randomised controlled trial. Lancet Diabetes Endocrinol. 2016;4(3):244–53.
84. Rahayu SA, Widianto S, Defi IR, Abdulah R. Role of pharmacists in the interprofessional care team for patients with chronic diseases. J Multidiscip Healthc. 2021;14:1701–10.

Publisher's note