Clinical Pharmacy Connect
ISSN: 3079-2525
2025, Article ID. …, Cite as: https://www.doi.org/10.69709/xxx

SCIFINITI PUBLISHING

OPEN ACCESS

Review Article

The Role of Pharmacists in Public Health and Disease Prevention: What Do We Know?

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Abstract

Background: Non-communicable diseases and persistent infectious threats continue to cause substantial premature mortality. Over 85 % of the global population lives within walking distance of a pharmacy, positioning pharmacists as highly accessible primary-health providers. **Aims**: To review evidence on pharmacists' public-health activities, propose a four-domain service framework, and identify barriers limiting scale-up, particularly in low- and middle-income settings. **Methods**: A conventional narrative review was conducted. Targeted manual searches of PubMed, Scopus, Web of Science, Google Scholar, professional-association websites and reference lists retrieved English-language publications from January 2015 to April 2025. Extracted data on context, interventions and outcomes were narratively synthesised across preventive, diagnostic, therapeutic and digital domains. **Results**: Preventive programmes led by pharmacists increased vaccination coverage by 51% and achieved 20–43 % verified quit rates in smoking-cessation trials according to 97 studies. Pharmacy point-of-care testing reduced inappropriate antibiotic use by up to 65 % and accelerated triage for malaria, influenza and streptococcal infections. Chronic-disease services consistently lowered systolic blood pressure by ≈6 mmHg, reduced HbA1c by 0.6–1.0 % and cut 30-day readmissions (hazard ratio 0.62). Major barriers comprised restrictive scope-of-practice regulations, limited reimbursement pathways, insufficient public-health training and under-developed digital infrastructure. **Conclusions**: Robust evidence confirms that pharmacists enhance immunisation uptake, medication safety and chronic-disease outcomes; however, fragmented policy and financing environments constrain reach. Harmonised legislation, sustainable payment models and competency-based education are essential to convert pharmacists' unparalleled accessibility into equitable population-health gains.

Keywords; pharmacists, public health, preventive services, therapeutic services, disease prevention, non-communicable diseases

1. Introduction

Non-communicable diseases (NCDs) now cause 43 million deaths a year, which is 75% of all deaths around the world. They also kill 18 million people prematurely (<70 years), 82% of whom live in low- and middle-income countries (LMICs). Cardiovascular disease, cancer, chronic respiratory disease, and diabetes alone account for 19 million, 10 million, 4 million, and >2 million deaths, respectively [1]. In 2019, 85 different pathogens caused an estimated 704 million disability-adjusted life-years (DALYs) globally. This included 309 million (250–377; 43.9% of the burden) among children younger than 5 years old [2]. Immunisation is still one of the best ways to fight disease, saving 4–5 million lives per year.

However, in 2023, 14.5 million children received no vaccines at all, showing that vaccine-preventable illnesses are still a problem [3]. In light of these enormous challenges and staggering numbers, the 2018 Astana Declaration on Primary Health Care and WHO's Immunization Agenda 2030 urge countries to embed prevention services at the community level within people-centred primary care systems [4,5].

Pharmacists can help ease the burden of chronic disorders and improve public health. Geospatial analyses suggest that 88.9% of people in the U.S. live within 5 miles (about 8 km) of a pharmacy, and 89.2% of people in England live within a 20-minute walk of one [6,7]. This makes pharmacies more accessible than many other primary-care providers [6,7]. A 2025 systematic review of 97 studies found that pharmacist-led interventions increase vaccination uptake by 51% compared to routine care (RR 1.51, 95% CI 1.28–1.77). The biggest improvements happen when pharmacists also teach, immunise, and advocate for older individuals [8]. According to data from 25 countries, pharmacy point-of-care testing (POCT) for C-reactive protein, influenza, and Streptococcus A speeds up triage and reduces unnecessary antibiotic use by 20–65% [9].

However, several barriers constrain scale-up. Multicountry surveys show that unclear rules, restricted immunisation authority, and low pay for pharmacists mean that fewer than half are legally allowed or compensated to give vaccinations, notably in Ethiopia and Nigeria[10, 11]. Another gap is digital integration. A 2025 scoping review revealed that telepharmacy adoption was uneven and slowed down by a lack of digital literacy [12]. A concurrent systematic review pointed out problems with interoperability and infrastructure [13].

Despite the abondance of studies showing how pharmacists contribute to vaccinations, screenings, antimicrobial stewardship, HIV prevention, and digital outreach, the evidence base is still somewhat fragmented, with most evaluations only looking at one intervention, site, or profession. A recent article stated that this "silo effect" makes it difficult to understand the overall public health benefit of pharmacists and hinders effective workforce planning and support [14]. This demands a broader, more comprehensive assessment, especially as national surveys continue to show persistent implementation challenges, even in high-income countries like Germany. Therefore, this review aims to (1) gather and critically evaluate the full range of pharmacists' public health activities; (2) to propose a practical classification that distinguishes preventive, diagnostic, therapeutic, and digital service roles; and (3) consolidate the many barriers hindering scale-up, particularly in resource-limited settings. This work aims to provide policymakers, educators, and professional organizations with a clear roadmap for expanding pharmacists' licensure, reimbursement, and training, transforming the profession's unique accessibility into measurable gains in population health and health equity.

2. Methodology

This article is a conventional narrative review. The first author conducted focused manual searches of PubMed, Scopus, Web of Science, and Google Scholar. These were complemented by manual searches of reference lists and the websites of major professional associations such as the International Pharmaceutical Federation and the World Health Organisation. In addition to service-specific phrases (e.g., point-of-care testing, immunisation, telepharmacy), the search strings included free-text terms such as pharmacist, public health, preventive, screening, disease management, and digital health. Peer-reviewed English-language papers, articles, and commentary published between January 1, 2015, and April 30, 2025, prioritised. Duplicate records were eliminated manually.

A single reviewer assessed the relevance of titles, abstracts, and, where necessary, full texts. No formal review methodology, risk-of-bias assessment, or reporting standard (e.g., PRISMA) was applied. Instead, a spreadsheet was used to capture key study characteristics (country, setting, design, population, intervention, and main outcomes) for descriptive comparison. To illustrate the breadth of pharmacists' contributions to public health and to identify common implementation challenges across healthcare settings, the evidence was then narratively organised into four pre-specified domains: preventive, diagnostic, therapeutic, and digital services.

3. Range of Pharmacists' Public Health Activities

In the last ten years, several studies have shown that pharmacists are involved in a wide range of public health initiatives across the world. There is substantial evidence that pharmacists have an impact on well-known areas such as immunization and the management of chronic diseases [15]. In contrast, newer responsibilities (such as certain digital health services or novel treatments in low-income areas) are generally supported by pilot studies and have less robust evidence [16]. The following sections divide these activities into four broad categories: preventative, diagnostic, therapeutic, and digital. This classification illustrates the full scope of pharmacists' contributions to public health.

3.1. Preventive Services

3.1.1. Vaccination

In many countries, community pharmacists now serve as immunizers for influenza, COVID-19, and other vaccines, dramatically expanding public access to immunization. Pharmacy-based vaccination services are currently authorized in over 50 countries worldwide, a sharp rise from just a few dozen a decade ago [11]. This global trend accelerated during the COVID-19 pandemic, with pharmacists being granted expanded vaccination authority across Europe, North America, and elsewhere to facilitate mass immunization efforts [11].

A systematic review and meta-analysis, which included 19 studies across different settings, found that adding a pharmacist intervention improved overall immunization rates by about 50% relative to usual care (pooled relative risk 1.51) [15]. The roles that pharmacists play include patient education, addressing vaccine hesitancy, and providing convenient walk-in immunizations [15]. Pharmacies were very important locations for vaccination, especially during the COVID-19 epidemic. For instance, in the United States, pharmacists and their teams administered an estimated 270 million COVID-19 vaccine doses, which is about 45% of all COVID-19 immunisations in the country [17]. At the height of distribution, the Federal Retail Pharmacy Program supplied up to 70–90% of daily doses during certain periods. This highlights how important pharmacists are in mass vaccination programs [17].

3.1.2. Smoking cessation

Community pharmacies, clinics, and hospitals around the world have implemented pharmacist-led smoking cessation programs that have shown promising results. For example, in Canada, a randomised study in Newfoundland compared two pharmacist-managed cessation programs: one that was intensive and one that was brief [18]. Both programs achieved high quit rates after six months (approximately 36% and 22% of participants, respectively), which is significantly higher than the ~7% quit rate reported in the general population without such assistance [18]. The difference between the intensive and shorter programs was not statistically significant, possibly due to the small sample size, but both were effective in helping smokers quit and were highly cost-effective. The cost per quit was significantly lower than that of other methods [18].

Community pharmacies in the UK have been supporting smoking cessation for a long time through the National Health Service [19]. The STOP study, which included 60 pharmacies in England and Wales, was a recent cluster-randomized trial that assessed an intervention aimed at increasing service uptake and retention. The additional training intervention did not significantly improve the number of smokers enrolling or the quit success rate beyond usual care, but the study demonstrated that both trial arms achieved high levels of engagement and quit rates. More than 600 smokers in each group used the pharmacy service, and 42–43% of them successfully quit smoking for four weeks, as confirmed by biochemical verification. Patient retention was high (around 70% at four weeks), and both staff and customers reported positive experiences [19]. These findings indicate that standard pharmacy-based cessation services in the UK achieve high short-term quit rates (around 40% at one month), comparable to those seen with intensive behavioral support combined with pharmacotherapy.

A multicenter randomized controlled trial in Thailand evaluated a cessation service provided by pharmacists, with and without the support of a mobile app. All participants received counseling and medication from community pharmacists over a six-month period. The intervention group also used a smartphone app. During follow-up, both groups reported reduced cigarette consumption and higher

abstinence rates ($p < 0.05$), underscoring the value of pharmacist support [20]. Notably, the final quit rates were not significantly different between the two groups, suggesting that counseling alone was just as effective as counseling plus the app in this setting. The app modestly improved program adherence (74 days vs. 60 days), but the key takeaway was that pharmacist-delivered support led to meaningful quit outcomes in a middle-income country context. Pharmacists supporting smoking cessation have demonstrated quit rates that are equal to or better than those achieved by other healthcare professionals across various studies and settings. This success is attributed to their expertise in medications, frequent patient interactions, and ability to deliver personalized behavioral support.

In a prospective, randomised controlled study conducted across eight ambulatory pharmacies in Qatar, 314 adult smokers were assigned to either a structured pharmacist-led cessation program (comprising four counselling sessions over 2–4 weeks) or unstructured brief counselling [21]. At 12 months, the intervention group had a higher rate of continuous abstinence (23.9% vs. 16.9%; $p = 0.257$), although this difference was not statistically significant. However, participants who relapsed in the intervention group smoked significantly fewer cigarettes per day at 3 months (–4.7; $p = 0.041$) and at 6 months (–5.6; $p = 0.018$). Multinomial logistic regression analysis revealed that the only significant predictors of continued smoking after one year were a longer history of smoking and a higher baseline cigarette consumption [21]. Pharmacists in southern Portugal helped 135 smokers quit between 2009 and 2019 by combining motivational and behavioural counselling with pharmacotherapy, primarily nicotine replacement therapy [22]. The participants had an average age of 47.9 years, and 58.5% were male. At one month, 43.7% of participants remained abstinent, but this rate declined to 32.6%, 28.1%, and 20.7% at 3, 6, and 12 months, respectively. A multivariate analysis showed that the use of pharmacological aids and a higher number of face-to-face and phone follow-up sessions were both strongly associated with successful quitting ($p < 0.001$). [22].

3.1.3. Dietary Counselling

As part of their preventative services, community pharmacists have piloted initiatives to help people lose weight, eat healthier, and become more physically active. For example, an independent pharmacy in Virginia, USA, implemented a six-month pharmacist-led weight loss program focused on a high-protein, calorie-controlled diet combined with lifestyle coaching [23]. Alhomoud et al. systematically searched the literature to identify 29 retrospective or prospective studies (n = 6,423; mean BMI 27–46 kg/m²) evaluating pharmacist-led weight-management interventions, primarily educational counseling, with medication recommendations in five studies, and extracted changes in body weight, BMI, or waist circumference [24]. Twenty-six studies reported significant weight-loss outcomes (most over periods < 6 months), but multidisciplinary collaboration was infrequent and study quality was generally poor. In a cross-sectional survey of Saudi community pharmacists reported that although 73% of respondents acknowledged obesity as a critical health issue and 76%–83% routinely counseled on diet and physical activity, only 31% had formal weight-management training and just 33% regularly dispensed weight-loss products; key barriers included inadequate staffing (39%), lack of private consultation areas (37%), and absence of dedicated remuneration (49%) [25].

Another recent effort to combat obesity at a cardiology clinic highlighted how helpful pharmacists can be in monitoring weight-loss medications and providing lifestyle advice. In a 2023 trial, clinical pharmacists led a weight management program for high-risk cardiac patients who were taking GLP-1 agonist drugs such as semaglutide or liraglutide, alongside receiving guidance on diet and exercise [26]. Out of 59 patients who enrolled, 31 completed six months of therapy. All 31 patients lost at least 5% of their body weight, with an average weight loss of 12.6%. Participants also experienced reductions in blood pressure (−9/−2 mmHg), blood lipids (LDL decreased by 18 mg/dL; triglycerides by 29 mg/dL), and improved blood glucose control (mean HbA1c reduction of 0.6%). The researchers concluded that pharmacist supervision of anti-obesity medications contributed to clinically significant weight loss and improved cardiometabolic risk factors in this high-risk population.

In a systematic review of 25 randomized controlled trials, brief physical-activity counselling interventions delivered outside of primary care were evaluated for effects on activity levels, adherence, and related outcomes. Meta-analysis showed that, at medium-term follow-up, these interventions

increased self-reported activity by an average of 34 minutes per week (95% CI 9–60 min) and daily steps by 1,541 (95% CI 433–2,649), although evidence for long-term effectiveness remains limited [27].

In a prospective quality-improvement evaluation of the VA Tennessee Valley Healthcare System's MOVE! program, 40 patients under the care of a clinical pharmacy specialist (CPS) received pharmacist-led medication assessments and telehealth follow-up over six months. These patients were compared to 29 individuals who received standard preventive care. The CPS-run clinic helped patients lose an average of 3.6 ± 5.7 kg ($p < 0.001$), with 25% of patients losing at least 5% of their total body weight. In contrast, the preventive medicine program (PMP) group lost only 1.6 ± 6.0 kg ($p = 0.15$), with 17.2% of patients achieving at least 5% weight loss. These findings indicate that the clinic significantly supported weight loss and improved access to obesity medication services [28].

3.1.4. Harm prevention

As medication experts, pharmacists have become key players in reducing medication errors and the harm they cause. Numerous high-quality studies—including RCTs, quasi-experiments, and observational studies, have evaluated pharmacist-led initiatives aimed at improving medication safety over the past decade. This section compiles evidence on how pharmacists help prevent prescribing, dispensing, and administration errors, as well as their broader harm-reduction roles, such as preventing overdoses and reducing drug misuse.

Pharmacist engagement has consistently led to significant reductions in prescribing errors and improvements in prescription quality. In primary care, the UK cluster-RCT PINCER (Pharmacist-led Information Technology Intervention for Medication Errors) demonstrated that a pharmacist-led intervention—consisting of electronic prescription review, prescriber feedback, and educational outreach—substantially improved prescribing safety. The initial study (pre-2015) revealed notable benefits, and a large-scale rollout across 343 practices (covering 3 million patients) between 2015 and 2017 confirmed its effectiveness [29]. At six months, the rate of high-risk prescriptions was approximately 17% lower than before the intervention (adjusted odds ratio ~0.83), and this reduction persisted at around 15% after 12 months. The most improved indicators were those associated with gastrointestinal bleeding risk (around 24% reduction). These findings underscore the value of pharmacist-led audit-and-feedback systems in outpatient settings to prevent potentially harmful prescribing [29].

In hospital settings, clinical pharmacists involved in care teams and medication reviews have shown measurable benefits. A Danish multicenter RCT involving 1,467 inpatients (median age 72) evaluated a complex pharmacist-led intervention during care transitions. Pharmacists conducted thorough medication reconciliation upon admission and again at discharge [30]. The 30-day readmission rate was significantly reduced (hazard ratio 0.62; 95% CI 0.46–0.84) in the intervention group compared to usual care. At 180 days, the overall number of readmissions remained lower (HR ~0.75). Although drug-related readmissions did not reach statistical significance, the combined outcome of any readmission or emergency department visit improved significantly (NNT $\approx$ 12) [30]. Targeted medication reviews by pharmacists in specialized settings have also been effective in reducing errors. For instance, a retrospective study from South Korea examined investigational cancer therapy trials, where pharmacists carefully reviewed drug orders. During the pharmacist intervention phase, the prescription error rate fell from 6.1% to 4.7%, a reduction of nearly 25% across more than 12,000 orders. In multivariate models, pharmacist involvement was associated with significantly fewer errors, even after adjusting for trial complexity [31]. Intravenous drug orders were more prone to errors than oral ones, and pharmacists were particularly valuable in identifying IV-related mistakes. Blinded trials had fewer errors than open-label ones, underscoring the need for pharmacist oversight.

Pharmacists on multidisciplinary ward teams can intercept prescription errors in real time. A US study in an academic hospital assessed pharmacist-led discharge medication reconciliation for internal medicine patients (mean age 60; n = 31) [32]. Pharmacists identified errors in 68% of discharge summaries, averaging 1.3 errors per patient. The most common issues were therapeutic duplications and omissions due to access barriers. Errors were classified by severity, with 77.5% considered potentially serious or life-threatening if uncorrected—all of which were resolved prior to discharge. Notably, 35% of these

errors would likely have led to emergency visits or readmissions if left unaddressed. A cost-avoidance analysis estimated that this one-month intervention saved $24,784 in healthcare costs, while pharmacist labor costs were under $1,000. In Jordan, a recent RCT (2025) examined pharmacist-led medication reconciliation for elderly inpatients (n = 128). At admission, pharmacists obtained a Best Possible Medication History, corrected discrepancies, and ensured an accurate discharge list. Patients in the intervention group had approximately 70% lower odds of readmission or emergency department visits within 30 days post-discharge compared to the control group [33]. Most errors were corrected before discharge, and 94% of pharmacist recommendations were accepted by physicians. This led to significantly fewer post-discharge hospital encounters.

Pharmacists' activities in public health-oriented harm reduction have grown beyond merely dispensing and assessing medications. They are now more involved in addressing the opioid overdose crisis and pharmaceutical misuse. Community pharmacists are increasingly participating in programs aimed at preventing drug-related harm at the population level, such as naloxone distribution, syringe exchange programs, and opioid stewardship initiatives. Preventing opioid overdoses is a major area of focus. Since 2015, several jurisdictions have authorized pharmacists to dispense naloxone (the opioid overdose antidote) without a physician's prescription through collaborative practice agreements or standing orders. This policy has been shown to save lives. One study of the U.S. population in 2019 examined opioid overdose death rates in states with different naloxone access laws. It found that overdose deaths declined significantly in states where pharmacists were permitted to dispense naloxone directly. In the three years following the implementation of such laws, those states saw approximately 0.387 fewer deaths per 100,000 people compared to states without such policies [34].

Pharmacists also play a vital role in opioid use prevention and stewardship. They have implemented opioid stewardship programs in healthcare systems to ensure the safe prescribing and monitoring of opioids. A scoping review identified dozens of studies examining pharmacists' roles in managing opioid use across hospitals, primary care, and community settings. In the majority of these studies, pharmacist-led interventions improved at least one outcome related to opioid use [35]. These improvements included reductions in opioid prescriptions or dosages, increased adherence to prescribing guidelines, and fewer patients receiving dangerous combinations of opioids and benzodiazepines. Pharmacists often managed medication therapy for individuals with chronic pain, identified patients at high risk for misuse, educated prescribers on best practices, and developed opioid tapering plans. One example involved a hospital that reported substantial reductions in high-dose opioid prescribing and concurrent opioid/benzodiazepine use after integrating a clinical pharmacy specialist into its pain management team [36]. Thousands of individualized patient interventions were also documented during this period [36]. Community pharmacists are also active in harm reduction. Surveys indicate that many are willing to participate in needle and syringe exchange programs, which provide clean injection supplies and safe disposal for used needles. These programs help reduce the spread of blood-borne diseases among people who inject drugs [37].

3.2. Diagnostic Services

Increasing evidence indicates that pharmacists are capable of providing diagnostic and screening services effectively, although many studies are only observational or service evaluations [38]. Few high-quality trials exist. For example, a 2020 review found that only four of thirteen investigations on pharmacy point-of-care testing (POCT) were randomized controlled trials [38]. Overall, research demonstrates that pharmacy-based screening is feasible and improves access to testing, although study design and context frequently impede definitive proof of clinical benefit. Despite these limitations, pharmacists are increasingly becoming accessible, first-line providers of diagnostic testing, particularly for early disease detection within communities.

A systematic review of eleven studies reported that pharmacy-conducted POCT for various conditions (such as blood glucose, cholesterol, HIV, and INR) exhibited strong analytical performance and was generally effective in improving patient-care processes [39]. However, the tests yielding the most significant outcomes varied by condition. A meta-analysis revealed that pharmacy-based malaria testing significantly reduced inappropriate antimalarial prescribing (risk ratio approximately 0.34 for incorrect

therapy) [38]. In contrast, POCT for chronic disease indicators (lipids, HbA1c) had minimal impact on parameter control, and INR testing results were inconclusive [38]. These findings imply that diagnostics alone are insufficient; long-term health outcomes require follow-up with appropriate therapeutic management. The small number of randomized controlled trials in this domain highlights the need for more rigorous studies to establish sustained therapeutic benefits.

Community pharmacies have also proven effective at identifying previously undiagnosed chronic illnesses through opportunistic screening programs. For instance, an Italian pharmacy screening initiative in 2020 utilized the FINDRISC diabetes risk questionnaire to identify at-risk individuals, referring them for confirmatory testing. Of over 5,900 participants, 53 percent were classified as high risk, and one new diabetes diagnosis was confirmed for every 117 individuals screened [40]. These results suggest that community pharmacists can facilitate early detection of conditions such as type 2 diabetes, which might otherwise remain undiagnosed until complications arise [40]. However, high detection rates do not guarantee subsequent medical follow-up outside structured study environments, underscoring the importance of linking screening to care pathways [41]. Blood pressure screening efforts have similarly uncovered undiagnosed hypertension, although evidence of long-term improvements in blood pressure control remains limited.

Pharmacist-led diagnostic services have enhanced access to testing for infectious diseases, particularly in resource-constrained settings. During the COVID-19 pandemic, pharmacists worldwide assisted with sample collection and rapid testing, demonstrating their value in emergency public-health responses [42]. In low- and middle-income countries, pilot programs have shown that community pharmacies can successfully provide HIV testing and counselling; for example, a Nigerian initiative from 2019 to 2020 engaged fifty pharmacies, tested 919 individuals over three months (with a 2 percent positivity rate), and achieved over 95 percent protocol fidelity [43]. Similar programs in Kenya and Rwanda have demonstrated high feasibility and acceptability of pharmacy-distributed HIV self-test kits, markedly increasing testing uptake among populations less likely to visit clinics [44].

A narrative review used Ecological Systems Theory and papers indexed by Medline (together with free-text searches) to put together information on how community chemists used POCT and treated influenza and Group A Streptococcus [45]. It discovered that chemists' easy access allows for quick POCT and the start of the right treatment, which improves clinical outcomes, makes better use of antibiotics and antivirals, and may even lessen health inequities. However, system-level hurdles still make it hard for wider implementation. Mark A Strand wrote a commentary and highlighted that from 2000 to 2025, pharmacists expanded beyond merely dispensing prescriptions and began performing CLIA-waived point-of-care testing in community and ambulatory settings [46]. This evolution positioned them as essential providers of rapid diagnostics that advance public health objectives. Looking ahead to 2050, pharmacists are projected to integrate POCT within broader population-health initiatives—such as analytics, program design, and risk-based service delivery, to enhance access, inform public health decision-making, and improve outcomes.

3.3. Therapeutic Services

A substantial number of studies support the therapeutic services that pharmacists provide to their patients, which include direct patient care interventions centred on pharmaceutical treatment, disease management, and health counselling. Pharmacists can enhance clinical outcomes in managing chronic diseases in a variety of settings, according to numerous randomised studies and meta-analyses conducted over the past ten years [47–49]. The evidence supporting pharmacist-led treatment of conditions such as diabetes, hypertension, and hyperlipidaemia is very strong. Compared to conventional therapy, systematic reviews regularly demonstrate notable improvements (e.g., reduced blood pressure, improved glycaemic control). These studies demonstrate global applicability by spanning both high- and low-income settings. However, this review identifies some challenges: since interventions vary widely (from collaborative prescribing to medication review), it is difficult to identify the most effective components. Some studies focus on surrogate outcomes or have short follow-up periods. Additionally, results may not generalise to settings where pharmacists lack such authority, because many high-quality studies originate from health systems with supportive policies (e.g., collaborative practice agreements, funding for

pharmacist clinics). Notwithstanding these caveats, the majority of the evidence is of high quality, suggesting that pharmacists' therapeutic services are an effective and increasingly important component of healthcare teams.

Through medication optimisation, patient education, and monitoring, pharmacists have demonstrated outstanding proficiency in managing chronic illnesses. For example, several meta-analyses of clinical trials on hypertension management indicate that pharmacist-led interventions result in significantly better blood pressure control than traditional physician-only care [50–52]. In community pharmacy hypertension programmes, pharmacist oversight reduced systolic blood pressure by an average of approximately 6–7 mmHg [53]. These reductions in blood pressure have therapeutic significance in lowering the risk of cardiovascular disease. Glycaemic control for type 2 diabetes has improved as a result of various interventions (medication therapy management, self-care counselling, etc.). In diabetic populations receiving pharmacist care, meta-analyses report substantial reductions in HbA1c levels as well as improved blood pressure and cholesterol management [47]. One sstudy found that, compared to standard care, pharmacist-led care increased medication adherence and improved blood pressure, LDL cholesterol, body mass index, and HbA1c in diabetes management [47]. These outcomes reduce the risk of complications. Studies demonstrating that pharmacist counselling decreases barriers and enhances medication utilisation in hypertension and diabetes indicate that pharmacists' chronic disease management frequently improves patients' adherence and self-management skills in addition to numerical targets.

Comprehensive medication management, including medication therapy management programmes and polypharmacy assessments, is a core therapeutic service provided by pharmacists. Pharmacist-led medication reviews can improve clinical outcomes, detect drug-related problems, and optimise regimen complexity across various settings, including community pharmacies, primary care clinics, and long-term care facilities [54]. For instance, patients at U.S. federally qualified health centres who received collaborative medication therapy management services reported higher satisfaction in managing chronic conditions such as hypertension, fewer medication-related issues, and improved self-management (increased utilisation of home monitoring devices) [42]. Similarly, in a Wisconsin initiative, pharmacists collaborated with insurers and public health agencies to achieve significant improvements in patient health behaviours and confidence in blood pressure control [55]. Studies worldwide, including those from Europe and Australia in the past ten years, associate pharmacist-led medication reviews with reductions in inappropriate medication use and potentially lower hospitalisation rates among older adults [56,57]. Patient attitudes are also positive: a comprehensive review in cardiovascular care found that ten of eleven studies including patient perceptions reported high satisfaction with pharmacist services. [58] This suggests that patients value pharmacist care beyond clinical measures.

4. Barriers to Scaling Up Pharmacists' Public Health Services

The extension and sustainability of pharmacists' public health services are hampered by a number of obstacles, according to several studies and assessments. Although most information about these obstacles is qualitative or derived from stakeholder surveys, the studies consistently identify recurrent issues. Pharmacists encounter barriers related to legislation (reimbursement, scope-of-practice limitations), workforce capacity and training, lack of professional or public awareness, and infrastructure challenges in both high-income and resource-constrained environments.

4.1. Educational and Training Barriers

The lack of education and training for pharmacists to assume more extensive public health responsibilities is a major obstacle. In many nations, public health capabilities, including epidemiology, health promotion, informatics, and programme evaluation, have not been prioritised in traditional pharmacy curricula [46]. Therefore, without further training, practising pharmacists can feel unqualified to provide services such as screenings or vaccinations. Several studies conducted in developing nations identify the absence of training opportunities in fields such as illness management and point-of-care testing as a significant barrier to service delivery [16]. For instance, pharmacy practitioners in Africa frequently need to learn new skills on the job, and information from scoping assessments indicates that this skills gap may contribute to the sluggish growth of pharmacy-led public health initiatives. Variability

in competence is further exacerbated by the lack of universal access to, or requirement for, continuing professional development (CPD) programmes and certifications for services such as vaccine training. Furthermore, without explicit instruction, pharmacists might not feel confident enough to take on tasks beyond dispensing [16]. Redesigning pharmacy schools to incorporate comprehensive public health training will be necessary to overcome this obstacle. Some progress is being made: public health and community-based care modules are being incorporated into PharmD programmes in several nations. However, to prepare pharmacists for preventive and population health activities, many authors call for a more systematic incorporation of relevant skills, ranging from digital health literacy to behavioural counselling approaches [59].

4.2. Policy and Regulatory Barriers

Restrictive regulations remain a major obstacle in many regions, and policy and regulatory issues determine which public health services pharmacists may offer. Pharmacists' scope of practice is still legally restricted in some countries, despite efforts elsewhere to expand it (permitting prescribing, vaccination, etc.). Laws that prohibit pharmacists from administering vaccines or performing specific tests, as well as the absence of authorizing frameworks for collaborative practice with physicians, have been identified as regulatory hurdles in the literature. For example, pharmacists cannot independently initiate preventive measures if they are not recognized as providers of those services. The implementation of legislation can also be hampered by bureaucratic obstacles and unclear guidelines. The lack of remuneration mechanisms for public health services provided by pharmacists is another significant policy-related barrier. Under current healthcare payment models in many nations, pharmacists are reimbursed primarily for dispensing prescription medications rather than for clinical or cognitive services. This misalignment creates a disincentive: pharmacists must invest time and resources in services (such as patient counseling or health screenings) without reliable compensation. Although physicians can bill for public health activities such as disease management or care coordination, there are often no comparable billing codes or payment models for pharmacists offering the same services in the United States [46].

Recent empirical work confirms that restrictive scope-of-practice rules, the absence of sustainable reimbursement pathways, and fragmented integration into national health strategies collectively reduce uptake and scale-up of pharmacist-led preventive and diagnostic services. Cross-sectional studies in Lebanon and Ethiopia found that over two-thirds of community pharmacists cite the absence of enabling regulations as the single greatest impediment to offering vaccination services [60,61]. Analyses of U.S. Medicare claims reveal no dedicated Evaluation-and-Management or preventive-service billing codes for pharmacists, forcing them to rely on low-value "incident-to" workarounds; average reimbursement is < USD 20 per visit—well below sustainability thresholds [62]. A US study demonstrated that once pharmacists were formally recognised as billable providers, annual net revenue per clinic rose by 28 %, confirming that payment reform directly drives service expansion [63]. Even where statutory authority exists, ambiguous operational guidelines and cumbersome paperwork were the leading barriers to pharmacy-based COVID-19 testing rollout in Ghana and several U.S. states [64,65].

5. Conclusion

Strong evidence has supported pharmacists' crucial role in delivering public health over the last ten years: they regularly increase vaccine uptake, enhance the management of chronic illnesses, and decrease the needless use of antibiotics through point-of-care testing. These improvements are still not uniform, though, as many countries continue to restrict the clinical authority of pharmacists, provide little or no compensation for preventive care, and fall behind in offering the training and digital infrastructure needed for contemporary practice. Three crucial steps are now required to transform pharmacists' unparalleled accessibility into population-wide health benefits: (1) integrating accredited, practice-ready training in preventive, diagnostic, therapeutic, and digital services into pre- and post-graduate curricula; (2) aligning scopes of practice and payment models to ensure pharmacists are formally recognised and fairly compensated as primary-care providers; and (3) prioritising long-term, context-specific research, particularly in low- and middle-income countries, to demonstrate cost-effectiveness and inform sustainable funding. By removing these structural obstacles, healthcare systems will be able to fully

utilise the pharmacy profession's potential for disease treatment and prevention, promoting equity and hastening the achievement of international public-health objectives.

List of Abbreviations:

NCDs – Non-communicable diseases
LMICs – Low- and Middle-Income Countries
DALYs – Disability-Adjusted Life-Years
POCT – Point-of-Care Testing
RR – Relative Risk
CI – Confidence Interval
HIV – Human Immunodeficiency Virus
RCT – Randomized Controlled Trial
IV – Intravenous
INR – International Normalized Ratio
CLIA – Clinical Laboratory Improvement Amendments
HbA1c – Hemoglobin A1c (glycated hemoglobin)
LDL – Low-Density Lipoprotein
CPS – Clinical Pharmacy Specialist
PMP – Preventive Medicine Program
BMI – Body Mass Index
CPD – Continuing Professional Development

Author contributions

The lead author of this manuscript contributed to the study design development, data extraction, manuscript drafting and reviewing.

Funding

This work did not receive any specific funding.

Conflicts of Interest

None.

Acknowledgements

The authors used Quillbot tool (https://quillbot.com/) for improving the language and correct any mistakes.

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2025, Vol. 1, Issue 1
doi: https://www.doi.org/10.69709/xxx

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