

Development of a primary care pharmacy outcomes framework: an umbrella literature review

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Abstract

Background

An aging population and rising multi-morbidity has shifted healthcare provision from secondary to primary care. Pharmacy-led services have been introduced to support this. The development of an outcomes framework for these services would facilitate conclusions to be drawn on their effectiveness.

Objectives

To identify outcomes used to evaluate pharmacy-led medication therapy and disease management services within primary care settings to develop an outcomes framework for future studies.

Methods

An umbrella literature review was conducted. MEDLINE, EMBASE, The Cochrane Library and PsycINFO were searched in June 2020 to identify relevant articles. Eligible reviews were those including studies published from 2010 onwards which reported on the outcomes of pharmacy-led medication therapy and disease management services within primary care, excluding community pharmacy settings. Data were extracted and a content analysis, guided by the ECHO model, stratified the outcomes into four areas: economic, clinical, humanistic and service.

Results

Twenty-four reviews covering 52 unique studies were identified. Pharmacy-led services included: medication reviews (n=24, 46.2%), disease and therapy management (n=17, 32.7%), educational services (n=6, 11.5%), medicines reconciliation (n=3, 5.8%), and medication compliance support (n=1, 1.9%). Services were commonly targeted towards endocrine (n=23, 44.2%) or cardiovascular diseases (n=20, 38.5%). Outcomes most commonly explored were clinical (n=38, 73.1%) and service outcomes (n=37, 71.2%), followed by humanistic (n=23, 44.2%) and economic outcomes (n=13, 25.0%). Overall, 17 sub-categories of outcomes were identified; common sub-categories were: disease indicators [clinical]; medication use and healthcare utilisation [service]; adherence to medicines [humanistic]; and healthcare costs [economic].

Conclusions

The findings informed the development of an outcomes framework to guide the evaluation of medication therapy and disease management services, and facilitate international standardised outcome measures within primary care pharmacy to be developed. This could help offer vital evidence on the effectiveness of these services to ensure the pharmacy workforce is working optimally to support primary care.

Highlights

- Pharmacy-led services support primary care but lack systematic outcomes evaluation
- Common services include medication reviews and disease / therapy management
- Clinical and service outcomes are most commonly evaluated
- A framework of 17 clinical, humanistic, service and economic outcomes was created
- The framework will guide evaluations and development of standardised outcomes

Manuscript

Introduction

Historically pharmacists were considered dispensers, participating in the sale and distribution of medicines.¹ However, since the 1980s, pharmacists have increasingly been involved in providing direct patient care and adopting clinical responsibilities.² These pharmacy roles primarily involve the provision of medication therapy and disease management services such as disease-related clinics, in-depth medication reviews and prescribing medicines.^{3,4} The current evidence-base of pharmacists' clinical roles exemplifies their benefit. Within hospital settings, pharmacists play a key role in identifying issues, reducing medication errors, offer cost-saving benefits,⁵ and can positively affect patient's medication use.⁶ Furthermore, the involvement of pharmacists in hospital settings also results in benefits within primary care, as pharmacist-led medication reconciliation at hospital discharge facilitates the transition to primary care through the reduction of medication discrepancies.⁷ Within the community pharmacy setting, recent umbrella reviews highlight the effectiveness of pharmacy-led services. Jokanovic et al (2017) found that medication reviews improve several health-care conditions, for example through positive impacts on cholesterol and

blood pressure levels,⁸ and in 2018 San-Juan-Rodríguez et al evidenced that disease preventative services improve patient outcomes and increase immunization rates.⁹

Whilst there is a broad evidence base on the benefit of pharmacy-led services in hospital and community pharmacy settings, there is a paucity of research within the primary care setting - such as general practices, health centres and clinics - whereby pharmacists work alongside other primary care clinicians such as physicians and nurses.¹⁰ This is an evolving area of pharmacy practice, and is driven by the international burden associated with aging populations, the rise in multi-morbidity, and a general shift in healthcare provision from secondary to primary care.^{11, 12} Research suggests this pharmacy role can support general practitioners¹³⁻¹⁵ and may aid patient understanding of their medicines¹⁶; however, when compared to other areas of pharmacy practice, there is less compelling evidence on the benefit of pharmacists working within this setting. Systematic reviews have attempted to identify the effectiveness of primary care based pharmacy services but repeated efforts to conduct meta-analyses and offer general conclusions on effectiveness have been unsuccessful.¹⁷⁻¹⁹ This has been linked to the heterogeneity of the studies and the outcome measures which has complicated cross-comparison,¹⁷⁻¹⁹ and researchers have strongly advocated for the development of standardised outcomes to facilitate future cross-comparison of findings.¹⁸⁻²⁰ The paucity of key conclusion on effectiveness may have a negative influence on the overall adoption of primary care based pharmacy services.¹⁷ Furthermore, the International Consortium for Health Outcome Measures (ICHOM) strongly advocates for standardisation of health-related outcome measures to facilitate cross comparisons and improve clinical decision making.²¹ Standardised outcome measures have been successfully developed for areas such as cancer care²² and mental health care.²³

To address this, the development of an outcomes framework detailing outcome areas of interest would enable outcomes to be measured in a planned and systematic way.^{18, 19} This would facilitate appropriate evaluations to inform stakeholders (e.g. strategists, pharmacists, and patients) on the effectiveness of pharmacy-led services within primary care. The aim of this literature review was to identify outcomes used to evaluate pharmacy-led medication therapy and disease management services within primary care settings in order to develop an outcomes framework that can be utilised by future studies.

Methods

An umbrella literature review was conducted to identify systematic reviews, narrative reviews, and literature reviews which explored the outcomes associated with medication therapy and disease management services within primary care pharmacy settings.

Eligibility criteria

Eligible reviews were those which included studies reporting on any types of outcomes of pharmacy-led medication therapy and disease management services conducted within primary care settings (such as general practices, health centres and primary care clinics). Studies published in the last 10 years (from 2010 onwards) were included. Review articles with a wider scope than pharmacy – for example, if they explored nursing-led services alongside pharmacy-led services – were included providing it was possible to extract data pertaining to the pharmacy-led services. Reviews were included if they stratified studies to ensure only outcomes associated with medication therapy and disease management services were extracted. Studies were excluded if they focused solely on:

adoption and/or implementation of a service; patient-reported experience measures (e.g. satisfaction); dispensing medications; health promotion activities; settings outside of primary care (e.g. hospital settings); or the community pharmacy setting. Studies of services which were not pharmacy-led, and therefore had equal or greater contribution of other health care professionals, were also excluded as it would not have been possible to distinguish clearly the contribution of the pharmacy staff members and associated outcomes.

Search strategy

The databases MEDLINE, EMBASE, The Cochrane Library and PsycINFO were searched in June 2020. Search terms for 'primary care' and 'pharmacy services' were used with various synonyms, truncation codes and Boolean operators (see Appendix 1 for search strategy). The search was limited to the English language and for review articles. A supplementary search involved screening articles identified from a preliminary scoping review. When full texts were not obtainable the first authors were contacted up to two times to request full texts.

Article selection

Article selection was conducted using Covidence software.²⁴ To ensure consistency in the study selection process 10% of the articles' titles/abstracts and full texts were randomly selected and screened independently by two researchers (NW and KP). Within reviews only a sub-set of studies might be relevant therefore, for 10% of reviews, NW and KP conducted an independent screen of eligible studies. The percentage of agreement was calculated for all independent validation, with >80% considered adequate.^{25, 26} Where dubiety arose over an article's eligibility another reviewer was consulted (MB or RN).

Data extraction

Data were extracted from the reviews and any supplementary material using Microsoft Excel. A data extraction template was piloted with 10% of reviews by NW and agreed for use by all authors. 10% of reviews were randomly selected and underwent independent data extraction by NW, KP and RN; the percentage of agreement was calculated. Again, agreement >80% was considered adequate.^{25, 26} Where dubiety arose over data extraction a second reviewer was consulted (NW, KP or RN). Data extracted from the reviews included: title; authors; year published; review type; search sources; date of search; aim of review; number of included studies in review; and number of studies of relevance. Data extracted from the relevant studies within the reviews included: geographical location of study; study type (e.g. randomised controlled trial); pharmacy setting; description of medication therapy and disease management service; patient eligibility criteria; therapeutic area(s); and outcomes(s). If specific study details were not presented on study type, pharmacy setting, target population or therapeutic area this was inferred from the review-level inclusion criteria where possible.

Data synthesis

A narrative synthesis method was used to present the characteristics of the reviews and studies identified.²⁷ If a study was reported by more than one review the data presented were selected from the review offering the most comprehensive details, and if reviews reported differing study information the data were collated. The medication therapy and disease management services were categorised by definitions used to describe pharmacy-led services offered within Scotland's primary

care setting.^{28,29} Thereafter, terminology considered most meaningful to an international audience were used.

A deductive content analysis was conducted using the ECHO model. The ECHO model encompasses Economic, Clinical and Humanistic outcomes³⁰ and explores patient-orientated outcomes.³¹ An initial scope of the literature identified that service-related outcomes were also of relevance to pharmacy-led services.³² Therefore the ECHO stratification of outcomes was supplemented by the inclusion of a “service” outcome category to allow for extraction of service outcomes of relevance to pharmacy-led services, such as health service utilisation and medication use.^{9, 32-34} We were also open to the inclusion of other emergent outcome areas, however none emerged. Therefore, four outcome categories directed the analysis (Table 1). 10% of the studies underwent initial content analysis by NW to develop a coding framework which was approved for use by all authors. NW and KP applied the coding framework to three reviews independently to ensure consistency in coding. The remaining coding was conducted by one reviewer KP and a second opinion sought where required.

Table 1. Outcome categories [as adapted from ^{9,31}]

Results

Included reviews and studies

A total of 24 reviews were included within this umbrella review³⁵⁻⁵⁸; see Figure 1 for the selection process. The 24 reviews included a total of 90 eligible studies, of which 38 (42.2%) appeared in more than one review. Therefore, 52 unique studies were identified.⁵⁹⁻¹¹⁰

Figure 1. PRISMA flow diagram of review selection process

Review characteristics

Of the 24 reviews, the majority (n=18, 75.0%) were described as ‘systematic reviews’.^{35, 36, 38, 39, 41-44, 46-49, 51-53, 55, 56, 58} Twenty-three reviews (95.8%) reported the bibliographic and trial databases searched, and one review did not report this.⁵⁷ Six (25.0%) of the reviews conducted a grey literature search.^{38-40, 42, 46, 53} Further details of the reviews are presented in Appendix 3.

Study characteristics

Of the 52 studies, most were conducted within North America (n=22, 42.3%),^{59, 66, 68-70, 72-75, 77, 80-82, 86, 88, 89, 96, 99, 101-103, 108} followed by Europe (n=9, 17.3%),^{60, 63, 65, 78, 83, 84, 92, 98, 100} Asia (n=6, 11.5%),^{61, 71, 87, 107, 109, 110} South America (n=4, 7.7%),^{91, 93, 94, 97} and Australia (n=1, 1.9%).⁶⁴ For 10 studies (19.2%) the geographical location was not reported on.^{62, 67, 76, 79, 85, 90, 95, 104-106} Grouping of the medication therapy and disease management services identified five types (Table 2), with the most common service being medication reviews (n=24, 46.2%).^{60-66, 71, 73, 76-78, 80, 83, 84, 91-94, 98, 102-104, 107} Within the category of medication reviews, there were sub-categories depending on if they involved communication with a patient/carer and if drug therapy adjustments were initiated. For one study (1.9%) the service was referred to as ‘Pharmaceutical care’ which did not offer enough detail for categorisation to a specific service type.⁸⁷ Most services were targeted towards patients with cardiovascular diseases (n=20, 38.5%)^{66, 69, 73, 74, 78, 81, 84-86, 88, 89, 93, 94, 96, 105-110} or endocrine diseases (n=23, 44.2%),^{61, 66, 67, 70, 71, 73, 75, 77, 80-82, 87, 90, 91, 93-95, 97, 101-104, 106} and the most common mode of service delivery was solely face-to-face communication (n=21, 40.4%).^{59, 60, 63, 65, 67, 71, 72, 74, 75, 78, 81, 91-93, 95, 100, 103, 105-108} For the majority of the studies the outcomes of the services were evaluated in a trial-based

setting (n=38, 73.1%).^{60, 61, 63-75, 77, 78, 80, 82-89, 91-94, 96, 97, 100, 102, 103, 107-109} Full details of the studies and their services is presented in Appendix 4.

Table 2. Medication therapy and disease management services

Outcomes

The content analysis of the outcomes identified 17 types of outcomes spanning across clinical, humanistic, economic and service outcomes (Table 3). Clinical outcomes were the most common outcomes reported by 38 studies out of 52 (73.1%).^{61, 63, 65-69, 71, 73-78, 81, 82, 84-91, 93-97, 100, 101, 103-105, 107-110} Of these, the majority were related to disease indicators such as blood pressure or lipid profile (n=26, 68.4%),^{61, 66, 68, 69, 71, 73-78, 85-88, 90, 91, 93, 94, 97, 101, 103, 105, 107, 109, 110} followed by patients achieving specific monitoring targets (n=16, 42.1%).^{66-68, 74, 75, 77, 81, 85, 86, 88, 95, 96, 101, 105, 107, 108} Clinical outcomes were closely followed by service outcomes (n=37, 71.2%).^{59, 60, 62, 64-68, 70, 72-77, 79, 80, 83-86, 88-93, 95, 96, 98, 99, 101-103, 105-107} Within this area, the most common outcomes were related to medication optimisation, such as changes to medication regimes including discontinuation (n=30, 81.1%)^{59, 60, 62, 64-68, 70, 73-77, 79, 83, 85, 86, 88, 89, 91-93, 95, 96, 98, 99, 101, 103, 105} and healthcare utilisation (n=15, 40.5%) such as hospital and/or primary care visits.^{65, 67, 72, 73, 79, 83, 84, 86, 88, 90, 92, 102, 103, 105, 106} Humanistic outcomes were presented in 23 studies (44.2%).^{59, 61-65, 67, 68, 73, 74, 85, 86, 88, 89, 91-94, 98, 100, 104, 106, 107} Of these, patients' adherence to medicines was the most predominant outcome explored (n=18, 78.3%)^{59, 61, 63, 65, 67, 68, 73, 74, 85, 86, 88, 89, 91, 93, 100, 104, 106, 107} while both generic^{62, 64, 65, 88, 93, 98} and health-related quality of life^{63, 67, 68, 88, 94, 100} were the next most common (n=6, 26.1%). The economic outcomes were least reported (n=13, 25.0%).^{62, 68, 88, 90, 92-94, 98, 100-103, 106} Two types of economic outcomes were identified: cost of healthcare (n=11, 84.6%)^{62, 68, 88, 90, 92, 94, 98, 101-103, 106} and cost-effectiveness (n= 5, 38.5%).^{92-94, 100, 102} 'Undefined outcomes' were those which provided insufficient detail for categorisation (n=12, 23.1%).^{64, 66, 75, 77, 86, 88, 92, 94, 96-98, 102}

Table 3. Full presentation of clinical, humanistic, service and economic outcomes

Discussion

This umbrella literature review drew upon the international literature to identify outcomes associated with pharmacy-led medication therapy and disease management services delivered in primary care settings. The findings reflect the level of interest in outcomes of these services in the last 10 years, and highlights that such services have been delivered worldwide across North America, Europe, Asia, South America, and Australia. Most services were clinical, evaluated in a trial-based setting, and occurred face-to-face. Disease-specific services predominately focused on cardiovascular or endocrine diseases. Clinical and service outcomes were most commonly explored; the least common was economic outcomes. Recurrent areas within these outcomes were: indicators of disease and achievement of specific monitoring targets [clinical]; medication use and healthcare utilisation [service]; patient adherence to medicines [humanistic]; and healthcare costs [economic].

Pharmacy-led services delivered

This review identified a range of clinical pharmacy services which have been evaluated internationally within primary care, which most commonly were medication reviews or disease and therapy management services. These findings align with other research indicating that pharmacists undertake a range of clinical tasks within primary care¹¹¹ including medication reviews,^{19, 112}

medicines reconciliation,^{19, 113} polypharmacy management,¹¹³ long-term conditions management,¹¹³ and prescribing.³ However, it should be acknowledged that heterogeneous terminology used to describe pharmacy-led services made cross-comparison of our findings with previous studies difficult.^{114, 115} This may be due to the challenge of stratifying pharmacy services to a single specific category; for example, it was identified that medication review services could additionally involve educational and medication compliance support. Future primary studies may benefit from applying the Descriptive Elements of Pharmacist Interventions Characterization (DEPICT) tool which offers a framework of how to adequately describe pharmacy services, which, if consistently used, would ensure consistency in terminology and support cross-comparison between studies.¹¹⁶ When describing pharmacy services the inherent complexity and adaptability should also be acknowledged, as the exact delivery of a service can vary between patients depending on their needs and emergent issues identified during consultations.¹¹⁷ For each type of service it is likely there are core elements which are delivered unanimously to all patients (e.g. systematic assessment of prescribed medications) and additional elements which are delivered depending on the individual patient needs (e.g. physical assessment and/or prescribing). This concept is defined within the Consolidated Framework of Implementation Research (CFIR), which acknowledges that healthcare services are adaptable with “core components” and “adaptable peripheries”.¹¹⁸ The CFIR stems from the field of Implementation Science and offers an understanding of the implementation and operationalisation of health care services, and is being increasingly applied within pharmacy research.^{119, 120} Overall, future research would benefit from applying the DEPICT tool to adequately describe pharmacy services, as well as being acquainted with the CFIR to foster a clearer, more nuanced appreciation of the complexity and adaptability of pharmacy services.^{116, 118}

Outcomes

The content analysis identified 17 types of outcomes spanning across clinical, service, humanistic, and economic outcomes, with a focus on clinical and service outcomes. This focus is unsurprising in light of the need within pharmacy services to consider the efficacy of therapeutic regimes on patient’s health while also appreciating the pharmacy’s contribution within the wider primary care service.¹³⁻¹⁵ Humanistic outcomes identified focused more so on medication use rather than quality of life, which may reflect a perceived emphasis on “taking the medicine” as being an indicator of success rather than acknowledging medicines’ impact on quality of life. Economic outcomes were the least reported, and mostly focused on the healthcare costs. While they are the least reported, economic outcomes allow an understanding of the cost-effectiveness ratio of pharmacy services and their value-for-money, ultimately leading to informed decisions about the delivery of pharmacy service in times of limited resources.¹²¹

An overview of reviews from the period of 2000-2010 focusing on medication and patient-related outcomes of clinical pharmacy services identified that commonly explored outcomes related to disease indicators (e.g. blood pressure and lipid profile) and medication adherence,³⁴ which closely mirrors the current review’s findings. An umbrella review by Newman et al (2019) on community pharmacist-led chronic disease management focused on clinical, economic and service utilisation outcomes, which likewise identified that the most common clinical outcome related to disease indicators (e.g. blood pressure and glycaemic control).³² This indicates that previous umbrella reviews in a similar realm have identified comparable findings, and the findings of this review builds

upon this as it identified a broader range of outcomes used to evaluate pharmacy-led services in primary care.

Proposed outcomes framework

The outcomes identified have been developed into an outcomes framework offering an evidence-based route map through which clinical, humanistic, service and economic outcomes of primary care pharmacy services can be explored (Figure 2). This framework expands on the existing ECHO model by the inclusion of service-related outcomes, which this umbrella review identified as being one of the most commonly applied type of outcome to evaluate primary care pharmacy-led services. Additionally, despite the existence of the ECHO model, we identified ongoing heterogeneity of outcome measures, suggesting that a more detailed outcomes framework may aid standardisation to facilitate comparison of outcomes of different services and from varying contexts.

This framework draws upon established outcome definitions and contextualises them to the primary care pharmacy setting with stratification as to whether the outcomes are framed at a patient-level or health service level.^{9, 31} We pose that economic outcomes could be considered at either a patient or health service level depending on local healthcare funding models, for example if pharmacy-led service is publicly or privately funded. The outcomes framework can facilitate the planning of outcome evaluations and is a living resource which will be continually updated to reflect the ever-changing primary care landscape. Previous efforts to develop standardised outcomes measures, led by the International Consortium for Health Outcome Measures (ICHOM), have focused on developing disease-specific outcome measures.²¹ Therefore, for pharmacy services targeted towards specific disease states the selection of clinical outcomes to explore could be informed by the framework developed as well as the disease-specific ICHOM measures.

Figure 2. Proposed outcomes framework for primary care pharmacy-led services

The Primary Care Pharmacy Outcomes Framework presents the clinical, humanistic, economic and service outcomes which can be used to evaluation primary care pharmacy-led services. It is posed that clinical and humanistic outcomes are patient-level outcomes, with service outcomes a health service level outcome. Economic outcomes could be considered at either a patient or health service level depending on local healthcare funding models

The different outcomes presented in the framework may be of varying importance based on the priorities of different stakeholders – whether it be patients, pharmacists, other health care professionals, policy makers or strategists. It may be that clinical and humanistic outcomes are of greater interest to patients and pharmacists as these evidence the direct impact of care at a patient-level, whereas service and economic outcomes may be of greater importance to policy makers or strategists as these broadly relate to the benefit of pharmacy-led services to the wider health care environment. To explore the most salient outcomes there should be engagement with all stakeholders to ensure future evaluations are comprehensive and balanced.

Implications

There is international consensus that evaluating healthcare outcomes is crucial to appraise the effectiveness of healthcare.^{122, 123} This internationally-derived outcomes framework offers a route to evaluate medication and disease therapy management services in varying primary care contexts throughout the world. Internationally, pharmacists are increasingly working within general practice. Within Scotland pharmacy-led services were introduced from 2015 onwards to strengthen primary

care.^{29, 124} Similarly, within Australia pharmacists are being integrated into general practice as part of a new funding model,¹⁴ whereas in the Netherlands new clinical pharmacy training programs have been designed to prepare pharmacists for their emergent role within general practice.¹¹¹ Ultimately the collection of outcomes can be used to inform evaluations of different pharmacy-led services within primary care in different regions and their associated benefits, to ultimately inform future evidence-based service delivery. This would enable changes in practice – for example, due to the COVID-19 pandemic – to be evidence-based and targeted to meet emergent needs of local populations. Application of this outcomes framework to future research studies and systematic reviews would also allow for comparisons across contexts to be made. Additionally, this outcomes framework could be applied in both academic and real-world contexts to direct the selection of the most pertinent outcomes to evaluate primary care pharmacy services.

The outcomes framework will also aid in the development of international standardised outcome measures within clinical primary care pharmacy. Moving towards a set of standardised measures is a goal for many healthcare contexts,¹²⁵ and within this context it will overcome the heterogeneity associated with previous outcome evaluations which have hindered the ability to offer overall conclusions.¹⁷⁻²⁰ As it has been acknowledged that a paucity of key conclusions on effectiveness may impede the adoption of primary care services,¹⁷ the development of a standardised outcomes framework could ultimately support and facilitate future service development. This review is the first step in this direction, and operationalising the outcomes framework will require further work to decipher optimal outcome measurement approaches, alongside identification of the best timeframe and frequency of capturing these outcomes.¹²³ There is a global drive for outcome measurements to become a routine and ubiquitous part of health care delivery,^{123, 126, 127} therefore outcomes must be assessed outside of trial-based settings in routine, clinical practice. In real-world settings it is likely that the populations receiving pharmacy-led services will be heterogeneous, and recording patient characteristics (such as multi-morbidity, age and ethnicity) will be crucial to interpret the outcome results and understand which patients benefit most.¹²² IT solutions should therefore enable the routine extraction of key patient characteristics alongside outcome measures, ultimately ensuring the outcome measurement and interpretation is a routine part of service delivery.

Strengths and limitations

This review utilised a well-established and recognised model (ECHO) to conduct a content analysis of the outcomes, which was conducted alongside an analysis of service outcomes. This ensured that patient-focused and health service-focused outcomes were captured and enabled the validation of the ECHO model within primary care pharmacy practice. A strength of this review was the breadth of the search strategy: four databases were searched, and authors were repeatedly contacted to obtain non-accessible papers. The search terms were broad to ensure reviews exploring various pharmacy sectors were identified. Additionally, various synonyms for ‘primary care’ were used to identify international studies, ensuring the framework developed is of international relevance. A limitation was the lack of grey literature search conducted or screening of included reviews’ reference lists. Additionally, the review stages were not conducted fully independently by two researches; instead, 10% of each review stage was conducted independently and validated with good or excellent levels of agreement achieved. The search only focused on studies published within the last 10 years; however, this ensured focus on the most recent and progressive advancements in pharmacy practice. The focus of this umbrella review was on outcome measures, therefore we do not report

on experience measures such as patient satisfaction, acceptability and feasibility.^{128, 129} Whilst this was not in the scope of this review, we do believe that comprehensive evaluations should consider both outcome and experience measures. Lastly, as this review focused on the outcomes associated with pharmacy-led services specifically, it is unknown if these outcomes are applicable for services with significant multi-disciplinary input from other professionals, such as medical and social care staff.

Conclusion

This review identified the clinical, service, humanistic and economic outcomes associated with pharmacy-led clinical services delivered in primary care settings. The proposed outcomes framework could enable standardisation of outcome measures, and will guide the selection and operationalisation of outcomes to evaluate pharmacy-led services for future studies. It is anticipated that this will be a living resource and should be continually updated to reflect the ever-changing primary care context and priorities. Stakeholder engagement will be crucial in the steps moving forward so that outcomes of importance to pharmacy staff, strategists and patients are routinely collected within existing infrastructures.

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References

1. Anderson S. *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals*: Pharmaceutical Press; 2005.
2. Rueben A, Forsyth P, Thomson AH. Professional development beyond foundation training: a study of pharmacists working in Scotland. *Int J Pharm Pract*. 2020;28:165-172.
3. Benson H, Lucas C, Benrimoj SI, Williams KA. The development of a role description and competency map for pharmacists in an interprofessional care setting. *Int J Clin Pharm*. 2019;41:391-407.
4. Saavedra-Mitjans M, Ferrand É, Garin N, Bussi eres JF. Role and impact of pharmacists in Spain: a scoping review. *Int J Clin Pharm*. 2018;40:1430-1442.
5. Cohen V, Jellinek SP, Hatch A, Motov S. Effect of clinical pharmacists on care in the emergency department: A systematic review. *Am J Health-Syst Pharm*. 2009;66:1353-1361.
6. Graab ek T, Kjeldsen LJ. Medication Reviews by Clinical Pharmacists at Hospitals Lead to Improved Patient Outcomes: A Systematic Review. *Basic Clin Pharmacol Toxicol*. 2013;112:359-373.
7. Mekonnen AB, McLachlan AJ, Brien J. Pharmacy-led medication reconciliation programmes at hospital transitions: a systematic review and meta-analysis. *J Clin Pharm and Ther*. 2016;41:128-144.
8. Jokanovic N, Tan EC, Sudhakaran S, et al. Pharmacist-led medication review in community settings: An overview of systematic reviews. *Res Soc Admin Pharm*. 2017;13:661-685.
9. San-Juan-Rodriguez A, Newman TV, Hernandez I, et al. Impact of community pharmacist-provided preventive services on clinical, utilization, and economic outcomes: An umbrella review. *Prev Med*. 2018;115:145-155.
10. Institute of Medicine (US) Committee on the Future of Primary Care. Defining Primary Care. In: Donaldson M, Yordy K, Lohr K, eds. *Primary Care: America's Health in a New Era*. Washington (DC): National Academies Press (US); 1996.
11. Avery AJ. Pharmacists working in general practice: can they help tackle the current workload crisis? *Br J Genl Pract*. 2017;67:390-391.
12. Bradley F, Seston E, Mannall C, Cutts C. Evolution of the general practice pharmacist's role in England: a longitudinal study. *Br J Gen Pract*. 2018;68:e727-e734.
13. Stewart D, Maclure K, Newham R, et al. A cross-sectional survey of the pharmacy workforce in general practice in Scotland. *Fam Pract*. 2020;37:206-212.
14. Polasek TM, Rowland A, Wiese MD, Sorich MJ. Pharmacists in Australian general practice: an opportunity for expertise in precision medicine. *Ther Adv Drug Saf*. 2015;6:186-188.
15. Hazen ACM, de Groot E, de Bont AA, et al. Learning Through Boundary Crossing: Professional Identity Formation of Pharmacists Transitioning to General Practice in the Netherlands. *Acad Med*. 2018;93:1531-1538.
16. Snell R, Langran T, Donyai P. Patient views about polypharmacy medication review clinics run by clinical pharmacists in GP practices. *Int J Clin Pharm*. 2017;39:1162-1165.
17. Fish A, Watson MC, Bond CM. Practice-based pharmaceutical services: a systematic review. *Int J Pharm Pract*. 2002;10:225-233.
18. Nkansah N, Mostovetsky O, Yu C, et al. Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns. *Cochrane Database Syst Rev*. 2010;2010:Cd000336.
19. Tan EC, Stewart K, Elliott RA, George J. Pharmacist services provided in general practice clinics: a systematic review and meta-analysis. *Res Soc Admin Pharm*. 2014;10:608-622.
20. Melchior AC, Correr CJ, Venson R, Pontarolo R. An analysis of quality of systematic reviews on pharmacist health interventions. *Int J Clin Pharm*. 2012;34:32-42.
21. International Consortium on Health Care Outcomes. STANDARD SETS: Start measuring outcomes that matter most to patients. <https://www.ichom.org/>; Accessed 21.01.2021

22. Ong WL, Schouwenburg MG, van Bommel ACM, et al. A Standard Set of Value-Based Patient-Centered Outcomes for Breast Cancer: The International Consortium for Health Outcomes Measurement (ICHOM) Initiative. *JAMA Oncology*. 2017;3:677-685.
23. Obbarius A, van Maasakkers L, Baer L, et al. Standardization of health outcomes assessment for depression and anxiety: recommendations from the ICHOM Depression and Anxiety Working Group. *Qual Life Res*. 2017;26:3211-3225.
24. Covidence. Better systematic review management. <https://www.covidence.org/>; Accessed 20.01.2021.
25. Cicchetti DV. Methodological Commentary The Precision of Reliability and Validity Estimates Re-Visited: Distinguishing Between Clinical and Statistical Significance of Sample Size Requirements. *J Clin and Exp Neuropsychol*. 2001;23:695-700.
26. House AE, House BJ, Campbell MB. Measures of interobserver agreement: Calculation formulas and distribution effects. *Journal Behav Assess*. 1981;3:37-57.
27. Popay J, Roberts H, Sowden A, et al. *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme*. Lancaster University: 2006.
28. Scottish Pharmacy Practice and Prescribing Advisors Association. National Pharmacotherapy Service Specification. 2019.
29. The Scottish Government. THE 2018 GENERAL MEDICAL SERVICES CONTRACT IN SCOTLAND. <https://www.gov.scot/publications/gms-contract-scotland/>; 2017, Accessed 20.01.21.
30. Kozma CM, Reeder CE, Schulz RM. Economic, clinical, and humanistic outcomes: a planning model for pharmaco-economic research. *Clin Ther*. 1993;15:1121-1132.
31. Gunter MJ. The role of the ECHO model in outcomes research and clinical practice improvement. *Am J Manag Care*. 1999;5:S217-224.
32. Newman TV, San-Juan-Rodriguez A, Parekh N, et al. Impact of community pharmacist-led interventions in chronic disease management on clinical, utilization, and economic outcomes: An umbrella review. *Res Soc Admin Pharm*. 2020;16:1155-1165.
33. Guisado-Gil AB, Mejías-Trueba M, Alfaro-Lara ER, Sánchez-Hidalgo M, Ramírez-Duque N, Santos-Rubio MD. Impact of medication reconciliation on health outcomes: An overview of systematic reviews. *Res Soc Admin Pharm*. 2020;16:995-1002.
34. Rotta I, Salgado TM, Silva ML, Correr CJ, Fernandez-Llimos F. Effectiveness of clinical pharmacy services: an overview of systematic reviews (2000-2010). *Int J Clin Pharm*. 2015;37:687-697.
35. Alshehri AA, Jalal Z, Cheema E, Haque MS, Jenkins D, Yahyouche A. Impact of the pharmacist-led intervention on the control of medical cardiovascular risk factors for the primary prevention of cardiovascular disease in general practice: A systematic review and meta-analysis of randomised controlled trials. *Brit J Clin Pharmacol*. 2020;86:29-38.
36. Anthony BF, Surgey A, Hiscock J, Williams NH, Charles JM. General medical services by non-medical health professionals: A systematic quantitative review of economic evaluations in primary care. *Brit J Gen Pract*. 2019;69:E304-E313.
37. Babar ZUD, Kousar R, Murtaza G, Azhar S, Khan SA, Curley L. Randomized controlled trials covering pharmaceutical care and medicines management: A systematic review of literature. *Res Soc Admin Pharm*. 2018;14:521-539.
38. Bridgwood B, Lager KE, Mistri AK, Khunti K, Wilson AD, Modi P. Interventions for improving modifiable risk factor control in the secondary prevention of stroke. *Cochrane Database Syst Rev*. 2018;5:CD009103..
39. Brown JVE, Walton N, Meader N, et al. Pharmacy-based management for depression in adults. *Cochrane Database Syst Rev*. 2019;12:CD013299.
40. Chin WY, Lam CL, Lo SV. Quality of care of nurse-led and allied health personnel-led primary care clinics. *Hong Kong Med J*. 2011;17:217-230.
41. Dawoud DM, Haines A, Wonderling D, et al. Cost Effectiveness of Advanced Pharmacy Services Provided in the Community and Primary Care Settings: A Systematic Review. *Pharmacoeconomics*. 2019;37:1241-1260.

42. de Barra M, Scott CL, Scott NW, et al. Pharmacist services for non-hospitalised patients. *Cochrane Database Syst Rev.* 2018;9:CD013102.
43. Greer N, Bolduc J, Geurkink E, et al. Pharmacist-Led Chronic Disease Management: A Systematic Review of Effectiveness and Harms Compared to Usual Care. *Ann Intern Med.* 2016;165:30-40.
44. Hazen ACM, de Bont AA, Boelman L, et al. The degree of integration of non-dispensing pharmacists in primary care practice and the impact on health outcomes: A systematic review. *Res Soc Admin Pharm.*;14:228-240.
45. Kee KW, Char CWT, Yip AYF. A review on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care. *J Family Med Prim Care.* 2018;7:501-506.
46. Khalil H, Bell B, Chambers H, Sheikh A, Avery AJ. Professional, structural and organisational interventions in primary care for reducing medication errors. *Cochrane Database Syst Rev.* 2017;2017:CD003942.
47. Lehnbohm EC, Stewart MJ, Manias E, Westbrook JI. Impact of medication reconciliation and review on clinical outcomes. *Annals of Pharmacotherapy.* 2014;48:1298-1312.
48. Loh ZW, Cheen MH, Wee HL. Humanistic and economic outcomes of pharmacist-provided medication review in the community-dwelling elderly: A systematic review and meta-analysis. *J Clin Pharm Ther.* 2016;41:621-633.
49. McNab D, Bowie P, Ross A, Macwalter G, Ryan M, Morrison J. Systematic review and meta-Analysis of the effectiveness of pharmacist-led medication reconciliation in the community after hospital discharge. *BMJ Qual Saf.* 2018;27:308-320.
50. Perrot S, Cittee J, Louis P, et al. Self-medication in pain management: The state of the art of pharmacists' role for optimal Over-The-Counter analgesic use. *Eur J Pain.* 2019;23:1747-1762.
51. Pousinho S, Morgado M, Falcão A, Alves G. Pharmacist Interventions in the Management of Type 2 Diabetes Mellitus: A Systematic Review of Randomized Controlled Trials. *J Manag Care Spec Pharm.* 2016;22:493-515.
52. Rankin A, Cadogan CA, Patterson SM, et al. Interventions to improve the appropriate use of polypharmacy for older people. *Cochrane Database of Systematic Reviews. Cochrane Database Syst Rev.* 2018;9:CD008165.
53. Riordan DO, Walsh KA, Galvin R, Sinnott C, Kearney PM, Byrne S. The effect of pharmacist-led interventions in optimising prescribing in older adults in primary care: A systematic review. *SAGE Open Medicine.* 2016;4:2050312116652568.
54. Santschi V, Chiolero A, Colosimo AL, et al. Improving blood pressure control through pharmacist interventions: a meta-analysis of randomized controlled trials. *J Am Heart Assoc.* 2014;3:e000718.
55. Tan EC, Stewart K, Elliott RA, George J. Pharmacist services provided in general practice clinics: a systematic review and meta-analysis. *Res Soc Admin Pharm.* 2014;10:608-622.
56. Tecklenborg S, Byrne C, Cahir C, Brown L, Bennett K. Interventions to Reduce Adverse Drug Event-Related Outcomes in Older Adults: A Systematic Review and Meta-analysis. *Drugs Aging.* 2020;37:91-98.
57. Wagner TD, Jones MC, Salgado TM, Dixon DL. Pharmacist's role in hypertension management: a review of key randomized controlled trials. *J Hum Hypertens.* 2020;01:01.
58. Weeks G, George J, Maclure K, Stewart D. Non-medical prescribing versus medical prescribing for acute and chronic disease management in primary and secondary care. *Cochrane Database Syst Rev.* 2016; 11:CD011227.
59. Armor BL, Wight AJ, Carter SM. Evaluation of adverse drug events and medication discrepancies in transitions of care between hospital discharge and primary care follow-up. *J Pharm Pract.* 2016;29:132-137.

60. Avery AJ, Rodgers S, Cantrill JA, et al. A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. *Lancet*. 2012;379:1310-1319.
61. Ayadurai S, Sunderland VB, Tee LB, Md Said SN, Hattingh HL. Structured tool to improve clinical outcomes of type 2 diabetes mellitus patients: A randomized controlled trial. *J Diabetes*. 2018;10:965-976.
62. Bojke C, Philips Z, Sculpher M, et al. Cost-effectiveness of shared pharmaceutical care for older patients: RESPECT trial findings. *Brit J Gen Pract*. 2010;60:e20-e27.
63. Bruhn H, Bond CM, Elliott AM, et al. Pharmacist-led management of chronic pain in primary care: results from a randomised controlled exploratory trial. *BMJ open*. 2013;3:e002361.
64. Bryant LJ, Coster G, Gamble GD, McCormick RN. The General Practitioner–Pharmacist Collaboration (GPPC) study: a randomised controlled trial of clinical medication reviews in community pharmacy. *Int J Pharm Pract*. 2011;19:94-105.
65. Campins L, Serra-Prat M, Gózaló I, et al. Randomized controlled trial of an intervention to improve drug appropriateness in community-dwelling polymedicated elderly people. *Fam Pract*. 2017;34:36-42.
66. Carter BL, Coffey CS, Ardery G, et al. Cluster-randomized trial of a physician/pharmacist collaborative model to improve blood pressure control. *Circ Cardiovasc Qual Outcomes*. 2015;8:235-243.
67. Cohen LB, Taveira TH, Khatana SAM, Dooley AG, Pirraglia PA, Wu W-C. Pharmacist-led shared medical appointments for multiple cardiovascular risk reduction in patients with type 2 diabetes. *Diabetes Educ*. 2011;37:801-812.
68. Cooney D, Moon H, Liu Y, et al. A pharmacist based intervention to improve the care of patients with CKD: a pragmatic, randomized, controlled trial. *BMC Nephrol*. 2015;16:56.
69. Evans CD, Eurich DT, Taylor JG, Blackburn DF. The collaborative cardiovascular risk reduction in primary care (CCARP) study. *Pharmacotherapy*. 2010;30:766-775.
70. Gilani F, Majumdar SR, Johnson JA, et al. Adding pharmacists to primary care teams increases guideline-concordant antiplatelet use in patients with type 2 diabetes: results from a randomized trial. *Ann of Pharmacother*. 2013;47:43-48.
71. Hammad EA, Yasein N, Tahaineh L, Albsoul-Younes AM. A randomized controlled trial to assess pharmacist-physician collaborative practice in the management of metabolic syndrome in a university medical clinic in Jordan. *J Manag Care Pharm*. 2011;17:295-303.
72. Hawes EM, Maxwell WD, White SF, Mangun J, Lin F-C. Impact of an outpatient pharmacist intervention on medication discrepancies and health care resource utilization in posthospitalization care transitions. *J Prim Care Community Health*. 2014;5:14-18.
73. Heisler M, Hofer TP, Schmittiel JA, et al. Improving blood pressure control through a clinical pharmacist outreach program in patients with diabetes mellitus in 2 high-performing health systems: the adherence and intensification of medications cluster randomized, controlled pragmatic trial. *Circulation*. 2012;125:2863-2872.
74. Hirsch JD, Steers N, Adler DS, et al. Primary care–based, pharmacist–physician collaborative medication-therapy management of hypertension: a randomized, pragmatic trial. *Clinical Therapeutics*. 2014;36:1244-1254.
75. Jacobs M, Sherry PS, Taylor LM, Amato M, Tataronis GR, Cushing G. Pharmacist assisted medication program enhancing the regulation of diabetes (PAMPERED) study. *J Am Pharms Assoc*. 2012;52:613-621.
76. Jacobs SC, Son EK, Tat C, Chiao P, Dulay M, Ludwig A. Implementing an opioid risk assessment telephone clinic: Outcomes from a pharmacist-led initiative in a large Veterans Health Administration primary care clinic, December 15, 2014–March 31, 2015. *Subst Abuse*. 2016;37:15-19.
77. Jameson JP, Baty PJ. Pharmacist collaborative management of poorly controlled diabetes mellitus: a randomized controlled trial. *Am J Manag Care*. 2010;16:250-255.

78. Jamieson LH, Scally A, Chrystyn H. A randomised comparison of practice pharmacist-managed hypertension providing level 3 medication review versus usual care in general practice. *J Applied Therapeut Res.* 2010;7:77-86.
79. Kilcup M, Schultz D, Carlson J, Wilson B. Postdischarge pharmacist medication reconciliation: impact on readmission rates and financial savings. *J Am Pharm Assoc.* 2013;53:78-84.
80. Kirwin JL, Cunningham RJ, Sequist TD. Pharmacist recommendations to improve the quality of diabetes care: a randomized controlled trial. *J Manage Care Pharm.* 2010;16:104-113.
81. Koenigsfeld CF, Horning KK, Logemann CD, Schmidt GA. Medication therapy management in the primary care setting: a pharmacist-based pay-for-performance project. *J Pharm Pract.* 2012;25:89-95.
82. Ladhani N, Majumdar S, Johnson J, et al. Adding pharmacists to primary care teams reduces predicted long-term risk of cardiovascular events in Type 2 diabetic patients without established cardiovascular disease: results from a randomized trial. *Diabet Med.* 2012;29:1433-1439.
83. Lenander C, Elfsson B, Danielsson B, Midlöv P, Hasselström J. Effects of a pharmacist-led structured medication review in primary care on drug-related problems and hospital admission rates: a randomized controlled trial. *Scand J Prim Health Care.* 2014;32:180-186.
84. Lowrie R, Mair FS, Greenlaw N, et al. Pharmacist intervention in primary care to improve outcomes in patients with left ventricular systolic dysfunction. *Eur Heart J.* 2012;33:314-324.
85. Magid DJ, Ho PM, Olson KL, et al. A multimodal blood pressure control intervention in 3 healthcare systems. *American J Manag Care.* 2011;17:e96-103.
86. Magid DJ, Olson KL, Billups SJ, Wagner NM, Lyons EE, Kroner BA. A pharmacist-led, American Heart Association Heart360 Web-enabled home blood pressure monitoring program. *Circ Cardiovasc Qual and Outcomes.* 2013;6:157-163.
87. Mahwi TO, Obied KA. Role of the pharmaceutical care in the management of patients with type 2 diabetes mellitus. *Int J Pharm Sci Res.* 2013;4:1363.
88. Margolis KL, Asche SE, Bergdall AR, et al. Effect of home blood pressure telemonitoring and pharmacist management on blood pressure control: a cluster randomized clinical trial. *JAMA.* 2013;310:46-56.
89. Margolis KL, Asche SE, Bergdall AR, et al. A successful multifaceted trial to improve hypertension control in primary care: why did it work? *J Gen Intern Med.* 2015;30:1665-1672.
90. McAdam-Marx C, Dahal A, Jennings B, Singhal M, Gunning K. The effect of a diabetes collaborative care management program on clinical and economic outcomes in patients with type 2 diabetes. *J Manag Care Spec Pharm.* 2015;21:452-468.
91. Mourao AOM, Ferreira WR, Martins MAP, et al. Pharmaceutical care program for type 2 diabetes patients in Brazil: a randomised controlled trial. *Int J Clin Pharm.* 2013;35:79-86.
92. Neilson AR, Bruhn H, Bond CM, et al. Pharmacist-led management of chronic pain in primary care: costs and benefits in a pilot randomised controlled trial. *BMJ open.* 2015;5:e006874.
93. Obreli-Neto PR, Guidoni CM, de Oliveira Baldoni A, et al. Effect of a 36-month pharmaceutical care program on pharmacotherapy adherence in elderly diabetic and hypertensive patients. *Int J Clin Pharm.* 2011;33:642-649.
94. Obreli-Neto PR, Marusic S, Guidoni CM, et al. Economic Evaluation of a Pharmaceutical Care Program for Elderly Diabetic and Hypertensive Patients in Primary Health Care: A 36-Month Randomized Controlled Clinical Trial. *J Manag Care Spec Pharm.* 2015;21:66-75.
95. Padiyara RS, D'Souza JJ, Rihani RS. Clinical Pharmacist Intervention and the Proportion of Diabetes Patients Attaining Prevention Objectives in a Multispecialty Medical Group. *J Manag Care Pharm.* 2011;17:456-462.
96. Pape GA, Hunt JS, Butler KL, et al. Team-Based Care Approach to Cholesterol Management in Diabetes Mellitus: Two-Year Cluster Randomized Controlled Trial. *Arch Intern Med.* 2011;171:1480-1486.

97. Plaster CP, Melo DT, Boldt V, et al. Reduction of cardiovascular risk in patients with metabolic syndrome in a community health center after a pharmaceutical care program of pharmacotherapy follow-up. *Braz J Pharm Sci.* 2012;48:435-446.
98. Richmond S, Morton V, Cross B, et al. Effectiveness of shared pharmaceutical care for older patients: RESPECT trial findings. *Brit J Gen Pract.* 2010;60:e10-e19.
99. Roth MT, Ivey JL, Esserman DA, Crisp G, Kurz J, Weinberger M. Individualized Medication Assessment and Planning: Optimizing Medication Use in Older Adults in the Primary Care Setting. *Pharmacotherapy: J Human Pharmacol Drug Ther.* 2013;33:787-797.
100. Rubio-Valera M, March Pujol M, Fernández A, et al. Evaluation of a pharmacist intervention on patients initiating pharmacological treatment for depression: A randomized controlled superiority trial. *Europ Neuropsychopharmacol.* 2013;23:1057-1066.
101. Salvo MC, Brooks AM. Glycemic Control and Preventive Care Measures of Indigent Diabetes Patients Within a Pharmacist-Managed Insulin Titration Program vs Standard Care. *Ann Pharmacother.* 2012;46:29-34.
102. Simpson SH, Lier DA, Majumdar SR, et al. Cost-effectiveness analysis of adding pharmacists to primary care teams to reduce cardiovascular risk in patients with Type 2 diabetes: results from a randomized controlled trial. *Diabet Med.* 2015;32:899-906.
103. Simpson SH, Majumdar SR, Tsuyuki RT, Lewanczuk RZ, Spooner R, Johnson JA. Effect of Adding Pharmacists to Primary Care Teams on Blood Pressure Control in Patients With Type 2 Diabetes: a randomized controlled trial. *Diabetes Care.* 2011;34:20-26.
104. Skinner JS, Poe B, Hopper R, Boyer A, Wilkins CH. Assessing the Effectiveness of Pharmacist-Directed Medication Therapy Management in Improving Diabetes Outcomes in Patients With Poorly Controlled Diabetes. *Diabetes Educ.* 2015;41:459-465.
105. Smith MC, Boldt AS, Walston CM, Zillich AJ. Effectiveness of a Pharmacy Care Management Program for Veterans with Dyslipidemia. *Pharmacotherapy.* 2013;33:736-743.
106. Spence MM, Makarem AF, Reyes SL, et al. Evaluation of an Outpatient Pharmacy Clinical Services Program on Adherence and Clinical Outcomes Among Patients with Diabetes and/or Coronary Artery Disease. *J Manag Care Spec Pharm.* 2014;20:1036-1045.
107. Tahaineh L, Albsoul-Younes A, Al-Ashqar E, Habeb A. The role of clinical pharmacist on lipid control in dyslipidemic patients in North of Jordan. *Int Journal Clin Pharm.* 2011;33:229-236.
108. Taveira TH, Wu W-C. Interventions to maintain cardiac risk control after discharge from a cardiovascular risk reduction clinic: A randomized controlled trial. *Diabetes Res Clin Pract.* 2014;105:327-335.
109. Tobari H, Arimoto T, Shimojo N, et al. Physician-Pharmacist Cooperation Program for Blood Pressure Control in Patients With Hypertension: A Randomized-Controlled Trial. *Am J Hypertens.* 2010;23:1144-1152.
110. Wong MCS, Liu KQL, Wang HHX, et al. Effectiveness of a Pharmacist-Led Drug Counseling on Enhancing Antihypertensive Adherence and Blood Pressure Control: A Randomized Controlled Trial. *J Clin Pharmacol.* 2013;53:753-761.
111. Hazen A, de Groot E, de Gier H, Damoiseaux R, Zwart D, Leendertse A. Design of a 15-month interprofessional workplace learning program to expand the added value of clinical pharmacists in primary care. *Curr Pharm Teach Learn.* 2018;10:618-626.
112. Develin A. Pharmacists in general practice – ACT pilot program: my journey so far. *J Pharm Pract Res.* 2017;47:308-312.
113. Savickas V, Foreman E, Ladva A, Bhamra SK, Sharma R, Corlett SA. Pharmacy services and role development in UK general practice: a cross-sectional survey. *Int J Pharm Pract.* 2020: ijpp12653
114. Crespo-Gonzalez C, Fernandez-Llimos F, Rotta I, Correr CJ, Benrimoj SI, Garcia-Cardenas V. Characterization of pharmacists' interventions in asthma management: A systematic review. *J Am Pharm Assoc.* 2018;58:210-219.

115. Fernandez-Llimos F, Salgado TM. Standardization of pharmacy practice terminology and the Medical Subject Headings (MeSH). *Res Soc Admin Pharm.* 2020;17:819-820.
116. Correr CJ, Melchioris AC, de Souza TT, Rotta I, Salgado TM, Fernandez-Llimos F. A tool to characterize the components of pharmacist interventions in clinical pharmacy services: the DEPICT project. *Annal Pharmacother.* 2013;47:946-952.
117. Willeboordse F, Schellevis FG, Meulendijk MC, Hugtenburg JG, Elders PJM. Implementation fidelity of a clinical medication review intervention: process evaluation. *Int J Clin Pharm.* 2018;40:550-565.
118. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci.* 2009;4:50.
119. Birken SA, Powell BJ, Presseau J, et al. Combined use of the Consolidated Framework for Implementation Research (CFIR) and the Theoretical Domains Framework (TDF): a systematic review. *Implement Sci.* 2017;12:2.
120. Nazar ZJ, Nazar H, White S, Rutter P. A systematic review of the outcome data supporting the Healthy Living Pharmacy concept and lessons from its implementation. *PLOS ONE.* 2019;14:e0213607.
121. Gammie T, Vogler S, Babar Z-U-D. Economic Evaluation of Hospital and Community Pharmacy Services. *Annal Pharmacother.* 2017;51:54-65.
122. Banfi G, Slawomirski L. The importance of evaluation of outcomes in healthcare and hospital experiences European Parliament; <https://op.europa.eu/en/publication-detail/-/publication/3c9e4bc9-bcaa-11e9-9d01-01aa75ed71a1>; 2019 Accessed 20.01.2021.
123. Porter ME. What Is Value in Health Care? *N Eng J Med.* 2010;363:2477-2481.
124. The Scottish Government. PRIMARY CARE FUNDING - ALLOCATION FOR PHARAMCISTS IN GP PRACTICES 2017-18. 2017.
125. Porter ME, Larsson S, Lee TH. Standardizing Patient Outcomes Measurement. *N Eng J Med.* 2016;374:504-506.
126. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q.* 2004;82:581-629.
127. Barker PM, Reid A, Schall MW. A framework for scaling up health interventions: lessons from large-scale improvement initiatives in Africa. *Imple Science.* 2016;11:12.
128. Proctor E, Silmere H, Raghavan R, et al. Outcomes for Implementation Research: Conceptual Distinctions, Measurement Challenges, and Research Agenda. *Adm Policy Ment Health.* 2011;38:65-76.
129. Kingsley C, Patel S. Patient-reported outcome measures and patient-reported experience measures. *BJA Education.* 2017;17:137-144.
130. Lefebvre C GJ, Briscoe S, Littlewood A, Marshall C, Metzendorf M-I, Noel-Storr A, Rader T, Shokraneh F, Thomas J, Wieland LS. Chapter 4: Searching for and selecting studies. *Cochrane Handbook for Systematic Reviews of Interventions (version 6.1)*: Cochrane; <https://training.cochrane.org/handbook/current/chapter-04>; 2020 Accessed 20.01.2021.

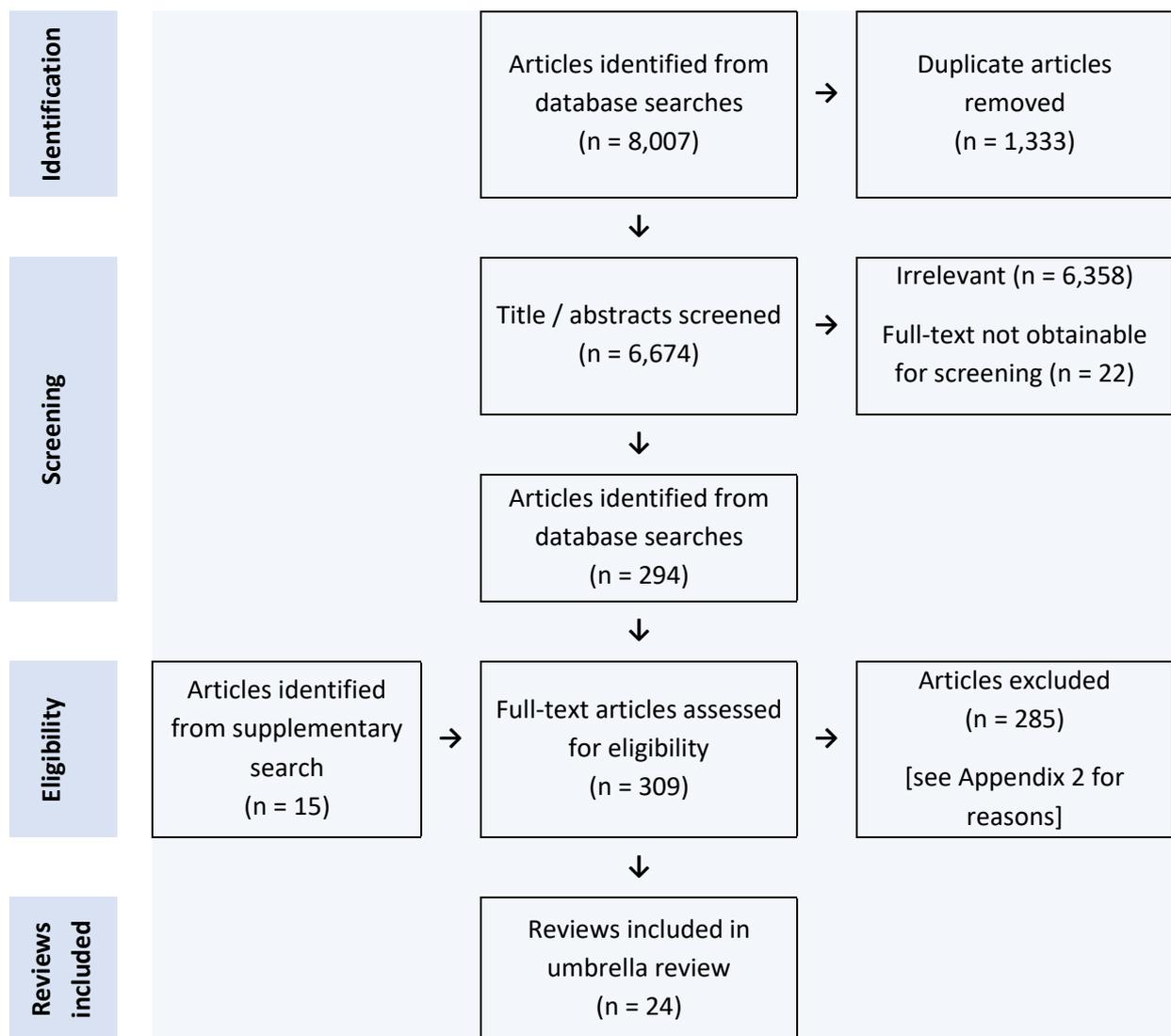


Figure 1. PRISMA flow diagram of review selection process

OUTCOMES FOR PRIMARY CARE PHARMACY-LED SERVICES

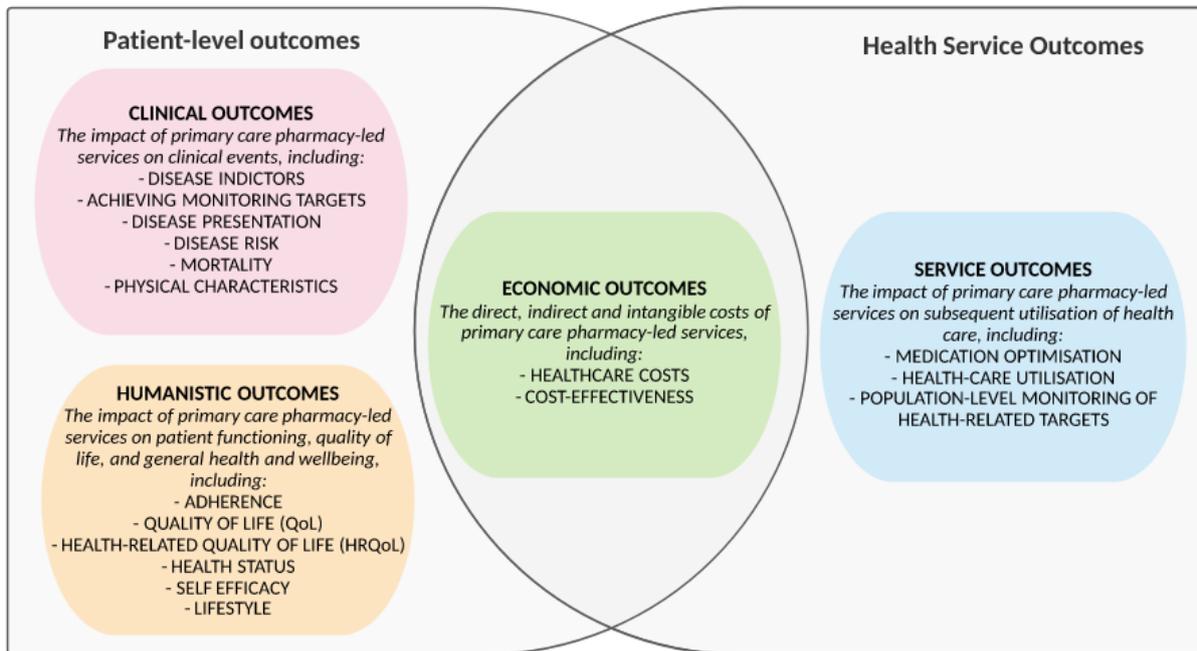


Figure 2. Proposed outcomes framework for primary care pharmacy-led services

The Primary Care Pharmacy Outcomes Framework presents the clinical, humanistic, economic and service outcomes which can be used to evaluate primary care pharmacy-led services. It is posed that clinical and humanistic outcomes are patient-level outcomes, with service outcomes a health service level outcome. Economic outcomes could be considered at either a patient or health service level depending on local healthcare funding models.

Table 1. Outcome categories [as adapted from ^{9,31}]

Outcome categories	Operational definition	Examples
Economic outcomes	The direct, indirect and intangible costs of health care.	Intervention costs; medical/pharmaceutical costs; total health care costs
Clinical outcomes	Clinical events that occur as a result of health care provision.	Incidence/rates of disease; mortality
Humanistic outcomes	The impact of healthcare on patient functioning, quality of life, and general health and wellbeing.	Medication adherence; quality of life
Services outcomes	The impact of healthcare on subsequent utilisation of health care services, including medication.	Hospital visits/admissions; number of medication; number of medication issues

Table 2. Medication therapy and disease management services

Service type	Definition	N (%)	Reference(s)
Medication review	A review of patient's medication involving patient/carer communication.	23 (44.2%)	60-66, 71, 73, 76-78, 83, 84, 91-94, 98, 102-104, 107
	- <i>with drug therapy adjustments / recommendations</i>	12 (23.1%)	63, 65, 66, 73, 76, 77, 84, 91, 92, 94, 102, 103
	- <i>without drug therapy adjustments / recommendations</i>	11 (21.2%)	60-62, 64, 71, 78, 83, 93, 98, 104, 107
	A review of patient's medication with reference to patient medication records only.	1 (1.9%)	80
Disease and therapy management	Comprehensive management of complex patients and their condition with an emphasis greater than just medicines management. Usually targeted towards patients with a specific disease (e.g. hypertension).	17 (32.7%)	67-70, 74, 75, 82, 85, 86, 88- 90, 95, 96, 101, 105, 108
Educational Service	Services which solely focus on patient education about medication and/or diseases.	6 (11.5%)	81, 97, 99, 100, 109, 110
Medicines reconciliation	Development of an accurate and up-to-date list of a patient's medicines through discussion with patient/carer following hospital discharge.	3 (5.8%)	59, 72, 79
Medication compliance support	Services which solely explore patient compliance and provision of support.	1 (1.9%)	106

Table 3. Full presentation of clinical, humanistic, service and economic outcomes

CLINICAL OUTCOMES (n=38)	
1. DISEASE INDICATORS (n=26, 68.4%)	<p>CARDIOVASCULAR SYSTEM</p> <ul style="list-style-type: none"> • Blood Pressure [n=6] ^{73, 74, 86, 88, 91, 103} <ul style="list-style-type: none"> ○ Systolic [n=17] ^{61, 66, 68, 69, 71, 73, 74, 76, 78, 86, 88, 91, 93, 94, 97, 103, 109} ○ Diastolic [n=16] ^{61, 66, 69, 71, 73-75, 78, 86, 88, 91, 93, 94, 97, 103, 109} ○ Control [n=3] ^{66, 88, 110} • Change in Blood Pressure [n=4] ^{74, 85, 88, 91} <ul style="list-style-type: none"> ○ Systolic Change [n=1] ⁸⁶ ○ Diastolic Change [n=1] ⁸⁶ • Lipid profile [n=1] ⁹¹ <ul style="list-style-type: none"> ○ Low-Density Lipoprotein [n=8] ^{61, 69, 75, 91, 93, 97, 103, 107} ○ High-Density Lipoprotein [n=7] ^{61, 69, 91, 93, 97, 103, 107} ○ Total Cholesterol [n=7] ^{61, 69, 91, 93, 97, 103, 107} ○ Triglycerides [n=7] ^{61, 69, 91, 93, 97, 103, 107} ○ Differences in lipid values [n=1] ¹⁰⁵ ○ Differences in triglycerides values [n=1] ¹⁰⁵
	<p>ENDOCRINE SYSTEM</p> <ul style="list-style-type: none"> • Hba1c [n=9] ^{61, 69, 75, 77, 87, 91, 93, 94, 103} <ul style="list-style-type: none"> ○ Changes in HbA1c [n=2] ^{77, 101} • Glycaemic control [n=1] ⁹⁰ <ul style="list-style-type: none"> ○ Fasting Blood Glucose [n=5] ^{87, 91, 93, 94, 97}
	<p>NERVOUS SYSTEM</p> <ul style="list-style-type: none"> • Loss of consciousness [n=1] ⁸⁸ • Fainting [n=1] ⁸⁸
2. ACHIEVING MONITORING TARGETS (n=16, 42.1%)	<p>CARDIO-VASCULAR SYSTEM</p> <ul style="list-style-type: none"> ○ Blood pressure [n=5] ^{74, 75, 85, 86, 88} ○ Hypertension [n=4] ^{66, 74, 85, 86} ○ Low-Density Lipoprotein [n=3] ^{75, 96, 107} ○ Dyslipidaemia [n=1] ¹⁰⁵
	<p>ENDOCRINE SYSTEM</p> <ul style="list-style-type: none"> ○ Diabetes [n=7] ^{67, 75, 77, 81, 95, 96, 101} ○ HbA1c [n=2] ^{75, 108}
	<p>RENAL SYSTEM</p> <ul style="list-style-type: none"> ○ Chronic Kidney Disease [n=1] ⁶⁸
3. DISEASE PRESENTATION (n=6, 15.8%)	<p>CARDIOVASCULAR SYSTEM</p> <ul style="list-style-type: none"> • Hypertension [n=2] ^{81, 88}
	<p>ENDOCRINE SYSTEM</p> <ul style="list-style-type: none"> • Diabetes Health Outcomes [n=1] ¹⁰⁴ • Metabolic Syndrome Status [n=1] ⁷¹
	<p>NERVOUS SYSTEM</p> <ul style="list-style-type: none"> • Pain <ul style="list-style-type: none"> ○ Severity [n=1] ⁶³ ○ Chronic Pain Intensity [n=1] ⁶³ • Anxiety [n=2] ^{63, 100} • Depression [n=1] ⁶³ <ul style="list-style-type: none"> ○ Clinical Severity [n=1] ¹⁰⁰
	<p>RESPIRATORY SYSTEM</p>

	<ul style="list-style-type: none"> • Allergic reactions [n=1]⁸⁸
4. DISEASE RISK (n=6, 15.8%)	<p>CARDIOVASCULAR SYSTEM</p> <ul style="list-style-type: none"> • Cardiovascular Risk [n=3]^{69, 82, 93} <ul style="list-style-type: none"> ○ Coronary Heart Disease Risk [n=2]^{97, 103} ○ 10-Year Cardiovascular Risk Reduction [n=1]⁶⁹ ○ Predicted 10-year risk of Cardiovascular Disease events [n=1]⁸² ○ Systolic blood pressure risk factors [n=1]⁸⁹ <p>ENDOCRINE SYSTEM</p> <ul style="list-style-type: none"> • Diabetes risk [n=1]¹⁰³
5. MORTALITY (n=4, 10.5%)	<ul style="list-style-type: none"> • Mortality rate [n=3]^{65, 67, 68} • Death <ul style="list-style-type: none"> ○ from any cause [n=1]⁸⁴ ○ from non-cardiovascular cause [n=1]⁸⁴
6. PHYSICAL CHARACTERISTICS (n=3, 7.9%)	<ul style="list-style-type: none"> • Body Mass Index [n=2]^{91, 93} • Body Weight [n=2]⁹⁷ • Waist Circumference [n=2]^{93, 97}
SERVICE OUTCOMES (n=37)	
7. MEDICATION OPTIMISATION (n=30, 81.1%)	<p>MEDICATION CHANGES</p> <ul style="list-style-type: none"> • Medication Additions [n=2]^{66, 86} <ul style="list-style-type: none"> ○ Antihypertensives [n=1]⁸⁶ • Medication Changes [n=1]^{65, 103} <ul style="list-style-type: none"> ○ Blood pressure medication [n=1]⁷³ • Medication Intensity Changes [n=1]⁸⁹ <ul style="list-style-type: none"> ○ Antihypertensives [n=2]^{66, 86} • Dose changes [n=1]⁷⁹ <ul style="list-style-type: none"> ○ Dose increases [n=2]^{66, 86} • Discontinuation <ul style="list-style-type: none"> ○ Chronic opioid therapy [n=1]⁷⁶ • Treatment Restart Ratio (after discontinuation) [n=1]⁶⁵ <p>RECOMMENDATIONS TO MEDICATION</p> <ul style="list-style-type: none"> • Recommendations of changes: chronic opioid prescriptions including decreasing quantity of opioid(s) [n=1]⁷⁶ • Patients with at least 1 recommendation (%) [n=1]⁶⁵ • Mean number of drugs per patient with recommendations [n=1]⁶⁵ <p>MEDICATION DISCREPANCIES</p> <ul style="list-style-type: none"> • Medication discrepancies [n=1]⁵⁹ <ul style="list-style-type: none"> ○ Number of medication discrepancies [n=1]⁷⁹ • Discontinued medications [n=1]⁷⁹ <ul style="list-style-type: none"> ○ Inclusion of discontinued medication [n=1]⁷⁹ • Omissions [n=1]⁷⁹ • Therapeutic duplicates [n=1]⁷⁹ <p>MEDICATION USE</p> <ul style="list-style-type: none"> • Medication Use [n=12]^{67, 68, 75, 77, 85, 86, 88, 91, 95, 96, 101, 105} <ul style="list-style-type: none"> ○ Number of medicines used [n=3]^{64, 65, 83} ○ Anti-platelets [n=1]⁷⁰ ○ Medication classes [n=1]⁸⁸ ○ Patients on asthma controller medication (%) [n=1]⁶⁵ ○ Delaying a fill [n=1]⁷⁶ • Number of Medications Prescribed [n=1]⁶⁵

	<ul style="list-style-type: none"> ○ Number of Medicines on Repeat Prescription [n=1] ⁹⁸ ● Prescribed and non-prescribed medication [n=1] ⁹²
	<p>MEDICATION-RELATED PROBLEMS</p> <ul style="list-style-type: none"> ● Medication-Related Problems [n=5] ^{59, 74, 83, 91, 93} <ul style="list-style-type: none"> ○ Drug-drug interactions [n=1] ⁷⁹ ○ Potentially harmful medication discrepancies [n=1] ⁷⁹ ● Resolved medication related problems [n=1] ⁹⁹
	<p>APPROPRIATENESS OF MEDICATIONS</p> <ul style="list-style-type: none"> ● Medication Appropriateness [n=5] ^{60, 62, 64, 65, 98}
8. HEALTH-CARE UTILISATION (n=15, 40.5%)	<p>HOSPITAL VISITS</p> <ul style="list-style-type: none"> ● Hospitalisations [n=7] ^{65, 73, 83, 84, 86, 88, 90, 102, 106} <ul style="list-style-type: none"> ○ Urgent care/emergency room department visits [n=4] ^{86, 88, 90, 102} ○ Pain-related [n=1] ⁹² ○ Heart Failure-related [n=1] ⁸⁴ ○ Cardiovascular-related [n=1] ⁸⁴ ○ Emergency Department Consultation Rate For Acute Conditions [n=1] ⁶⁵ ○ Emergency department attendance at 30 days [n=1] ⁷² ● Readmissions rate [n=2] ^{72, 79}
	<p>PRIMARY-CARE VISITS</p> <ul style="list-style-type: none"> ● Primary care visits [n=5] ^{67, 86, 88, 90, 105} <ul style="list-style-type: none"> ○ Number of visits [n=1] ⁷³ ○ Consultation Rate For Acute Conditions [n=1] ⁶⁵ ○ For chronic pain [n=1] ⁹² ○ For BP problems (same day) [n=1] ⁸⁸ ● Primary care telephone contacts <ul style="list-style-type: none"> ○ For chronic pain [n=1] ⁹²
	<p>GENERAL HEALTH-CARE USE</p> <ul style="list-style-type: none"> ● Health-Care Related Contacts [n=1] ¹⁰³ ● Telephone encounters [n=1] ⁸⁶ ● Email encounters [n=1] ⁸⁶
9. POPULATION-LEVEL MONITORING TARGETS (n=4, 10.8%)	<ul style="list-style-type: none"> ● Proportion of patients <ul style="list-style-type: none"> ○ At Target Low-Density Lipoprotein Level [n=1] ¹⁰⁷ ○ Using guideline concordant antiplatelet therapy [n=1] ⁷⁰ ○ Achieving target glycaemic [n=1] ⁶⁷ ○ Achieving cardiac risk factor goals [n=1] ⁶⁷ ● Testing rate/monitoring <ul style="list-style-type: none"> ○ Rate Of Hba1c Testing [n=1] ⁸⁰
HUMANISTIC OUTCOMES (n=23)	
10. ADHERENCE (n=18, 78.3%)	<ul style="list-style-type: none"> ● Adherence to Medication [n=18] ^{59, 61, 63, 65, 67, 68, 73, 74, 85, 86, 88, 89, 91, 93, 100, 104, 106, 107}
11. QUALITY OF LIFE (QoL) (n=6, 26.1%)	<ul style="list-style-type: none"> ● Generic QoL [n=4] ^{62, 65, 88, 98} ● Quality-adjusted life year [n=1] ⁹³ ● Improvement in emotional role [n=1] ⁶⁴ ● Social functioning [n=1] ⁶⁴ ● Mental functioning [n=1] ⁹⁸ ● Physical functioning [n=1] ⁹⁸
12. HEALTH-RELATED QUALITY	<ul style="list-style-type: none"> ● Generic HRQoL [n=6] ^{63, 67, 68, 88, 94, 100} ● Physical functioning [n=1] ⁶³

OF LIFE (HRQoL) (n=6, 26.1%)	
13. HEALTH STATUS (n=4, 17.4%)	<ul style="list-style-type: none"> • Health Utility [n=3]^{62, 92, 98} • General health and functioning [n=1]⁶³ • Health status [n=1]⁶³
14. SELF EFFICACY (n=2, 8.7%)	<ul style="list-style-type: none"> • Self-efficacy for monitoring <ul style="list-style-type: none"> ○ for Blood Pressure measuring [n=1]⁸⁸ ○ for monitoring home Blood Pressure tele-monitoring [n=1]⁸⁹
15. LIFESTYLE* (n=1, 4.3%)	<ul style="list-style-type: none"> • Physical activity [n=1]⁸⁹ • Weight management [n=1]⁸⁹ • Alcohol consummation [n=1]⁸⁹ • Reduced salt intake [n=1]⁸⁹
ECONOMIC OUTCOMES (n=13)	
16. HEALTHCARE COSTS (n=11, 84.6%)	<ul style="list-style-type: none"> • Cost of healthcare [n=6]^{62, 68, 94, 98, 101, 102} • Total Cost <ul style="list-style-type: none"> ○ Per Patient Per Year [n=2]^{90, 103} ○ Mean [n=1]⁹² • Cost of programme/intervention [n=3]^{88, 92, 102} • Direct costs of intervention [n=2]^{92, 94} • Economic cost [n=1]⁹⁴ • Other patient costs [n=1]⁹² • Cost saving [n=1]¹⁰⁶
17. COST-EFFECTIVENESS (n=5, 38.5%)	<ul style="list-style-type: none"> • Cost-effectiveness [n=4]^{92, 93, 100, 102} <ul style="list-style-type: none"> ○ The incremental cost-effectiveness ratio [n=2]^{94, 102} ○ Incremental cost - intervention vs control [n=2]^{92, 102}
UNDEFINED OUTCOMES (n=12)	
	<ul style="list-style-type: none"> • Adverse events [n=6]^{66, 75, 77, 86, 88, 98} • Health benefits / outcomes [n=3]^{92, 94, 102} • Access to care [n=2]^{88, 96} • Medication [n=1]¹⁰² • Negative Outcomes Associated With Medication [n=1]⁹⁷ • Healthcare services [n=1]¹⁰² • Discrepancy resolution [n=1]¹⁰² • Recommendations [n=1]⁶⁴ • Healthcare services [n=1]¹⁰² • Discrepancy resolution [n=1]¹⁰²

* Lifestyle-related outcomes emerged from the data even though this umbrella review did not seek to explore studies which focused on health promotion activities.

Appendix 1: Search strategy

Search terms	Medline	Cochrane database	Embase	Psycinfo
Health setting terms	Pharmacies/	Pharmacies		
	Community pharmac*	(Community NEXT pharmac*)	Community adj pharmac*	Community W0 pharmac*
	drug store*	(Drug NEXT store*)	“pharmacy (shop)”/	Drug W0 store*
	Retail pharmac*	(Retail NEXT pharmac*)		Retail W0 pharmac*
	dispensar*	(Dispensar*)	Dispensar*	dispensar*
	general practice/ or family practice/	General practice		General practice or family practice or primary care or primary health care
	Community Medicine/	(Community NEXT medicine)	Community medicine	Community W0 medicine
	General practice*	(General NEXT practice*)	General practice*	
	Family practice*	(Family NEXT practice*)	Family practice*	
	Medical practice*	(Medical NEXT practice*)	Medical practice* or medical practice/	Medical W0 practice
	doctor* surger*	(Doctor* NEXT surger*)	Doctor* surger*	Doctor* W0 surger*
	Primary Health Care/	Primary health care	Primary health care	
	Primary care*	(Primary NEXT care*)	Primary care	
	Community Health Centres/	Community health centers	Community health cent*	Community W0 health W0 cent*
	Health Cent*	(Health NEXT cent*)	Health center/ or health care facility/	Health W0 cent*
	Health care facilit*	(Health NEXT care NEXT facilit*)		Health W0 care W0 facilit*
	Home Care Agencies/	Home care agencies	Home care/	Home care services or home health care or home healthcare
	Home Care Services/	Home care services		

	Residential Facilities/	Residential facilities	Residential care/	Nursing homes or care homes or long term care or residential care or aged care facility
	Assisted Living Facilities/	Assisted living facility	Assisted living facility/	assisted living facilities or assisted care facility
	Intermediate Care Facilities/	Intermediate care facilities		
	Nursing Homes/	Nursing homes	Nursing home/	
	Care home*	(Care NEXT home*)	Care home*	care W0 home*
	Residential home*	(Residential NEXT home*)	Residential home*	Residential W0 home*
Pharmacy service terms	pharmaceutical services/ (tick-) or drug information services/ or clinical pharmacy information systems/ or prescription drug monitoring programs/ or medication therapy management/	Pharmaceutical services		
			Drug information service*	Drug W0 information W0 service*
			Clinical pharmacy information system*	Clinical W0 pharmacy W0 information W0 system*
			Prescription drug monitor*	Prescription W0 drug W0 monitor*
			Medication therapy management/	Medication W0 therapy W0 management
	(pharmac* adj3 service*)	(Pharmac* NEAR/3 service*)	(pharmac* adj3 service*)	pharmac* N3 service*
	Community Pharmacy Services/	Community pharmacy services		
	(pharmac* adj3 intervention*)	(Pharmac* NEAR/3 intervention*)	(pharmac* adj3 intervention*)	pharmac* N3 intervention*
Medication Reconciliation/	Medication Reconciliation	medication reconciliation/ or medic* reconciliation		

Medic* reconciliation	(Medic* NEXT reconciliation)		medic* W0 reconciliation
Pharmacotherapy	(Pharmacotherapy)	pharmacotherapy	Pharmacotherapy
Prescribing review*	(Prescribing NEXT review*)	Prescribing review*	prescribing W0 review*
(Pharmac* adj3 review*)	(Pharmac* NEAR/3 review*)	(Pharmac* adj3 review*)	pharmac* N3 review*
Medic* adj3 review*	(Medic* NEAR/3 review*)	Medic* adj3 review	medic* N3 review
Medic* recall*	(Medic* NEXT recall*)	Medic* recall*	medic* W0 recall*
Monito* medic*	(Monito* NEXT medic*)	Monitor* medic*	Monitor* W0 medic*
(Pharmac* adj3 Clinic*)	(Pharmac* NEAR/3 clinic*)	(Pharmac* adj3 clinic*)	pharmac* W3 clinic*
Medic* Compliance	(Medic* NEXT Compliance)	Medication compliance/ or medic* compliance	Medic* W0 compliance
Medic* Adherence	(Medic* NEXT Adherence)	Medication Adherence/ or medic* adherence	medic* W0 adherence
Medic* Concordance	(Medic* NEXT Concordance)	Medic* concordance	medic* W0 concordance
(Medic* adj3 management*)	(medic* NEAR/3 management*)	(Medic* adj3 management*)	medic* N3 management*
Medic* advice*	(Medic* NEXT advice*)	Medic* advice*	medic* W0 advice
Formulary adherence	(Formulary NEXT adherence)	Formulary adherence	Formulary W0 adherence
Guideline* adherence or Guideline Adherence/	Guideline adherence	Guideline* adherence	Guideline* W0 adherence
	(Guideline* NEXT adherence)		
Polypharmacy review*	(Polypharmacy NEXT review*)	Polypharmacy review*	polypharmacy W0 review*
(Pharmac* adj3 Triage)	(pharmac* NEAR/3 triage)	(Pharmac* adj3 triage)	Pharmac* N3 triage
pharmacy technicians/ or pharmacists/	Pharmacy technicians	Pharmacy technician/	Pharmacist W0 technician*
	Pharmacists	Clinical pharmacist/ or pharmacist	Clinical W0 pharmac*

	Clinical pharmac*	(clinical NEXT pharmac*)	Clinical pharmac*	Pharmacist
	non-dispensing pharmac*	(Non-dispensing NEXT pharmac*)	Non-dispensing pharmac*	non-dispensing W0 pharmac*
	Pharmac* staff*	(Pharmac* NEXT staff*)	Pharmac* staff*	Pharmac* W0 staff*
	(disease* management adj5 pharmac*)	(disease* management NEAR/5 pharmac*).	(disease* management adj5 pharmac*)	disease* management N5 pharmac*
Combining the search	Health setting terms AND pharmacy setting terms Limited to English language and "review articles"	Health setting terms AND pharmacy setting terms Limit it to 'Cochrane reviews'	Health setting terms AND pharmacy setting terms Limited to English language and "review articles"	Health setting terms AND pharmacy setting terms Limited to English language and systematic reviews, literature reviews and meta-analysis

Appendix 2: Reasons for excluding articles during full-text screening

Exclusion reason	n
No relevant setting(s) or setting unclear	99
No pharmacy-led service(s)	43
No medication therapy / disease management service(s)	39
Not a systematic / scoping / narrative / literature review	35
Unable to solely extract data of relevance to current review's aim	33
No relevant studies published 2010 onwards	27
No reporting of outcome(s)	8
Conference abstract	1
Total	285

Appendix 3: Characteristics of included reviews (n=24)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
Alshehri (2019) ³⁵	This review, therefore, aims to assess the impact of pharmacists' interventions focusing on the medical risk factors for the primary prevention of cardiovascular events in general practice by limiting the analysis to RCTs and by standardising the type of interventions used by pharmacists.	PubMed; MEDLINE; EMBASE; PsycINFO; Cochrane Library; CINAHL Plus; SCOPUS; Science Citation Index Expanded (WoS Core Collection)	NR	Yes	NR	12 (21)
Anthony (2019) ³⁶	The aims of this systematic review were to review economic evaluations of nurses, pharmacists, and other allied health professionals working in primary care as substitutes for some of the tasks performed by GPs.	MEDLINE; CINAHL; NICE; CRD database.	NR	Yes	2017	1 (6)
Babar (2018) ³⁷	The objective of this systematic review was to examine the effects of pharmaceutical care using patient outcomes (i.e. clinical and surrogate outcomes) in both the hospital and community setting.	MEDLINE; IPA; EMBASE.	NR	Yes	NR	2 (54)
Bridgewood (2018) ³⁸	To assess the effects of stroke service interventions for implementing secondary stroke prevention strategies on modifiable risk factor control, including patient adherence to prescribed medications, and the occurrence of secondary cardiovascular events.	Cochrane Stroke Group Trials Register; EPOC Trials Register; CENTRAL; MEDLINE; EMBASE; CINAHL; AMED; BNI; WoS; BiblioMap; US National Institutes of Health Ongoing Trials Register; ClinicalTrials.gov; ISRCTN Registry; Stroke Trials Registry; WHO International Clinical Trials Registry	Yes	Yes	2017 (updated from 2014)	2 (42)
Brown (2019) ³⁹	To examine the effects of pharmacy-based management interventions compared with active control, waiting list, or treatment as usual at improving depression outcomes in adults.	CCMD-CTR; CENTRAL, MEDLINE; EMBASE; PsycINFO (1967 onwards), ClinicalTrials.gov; ICTRP	Yes	Yes	NR	1 (12)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
Chin (2011) 40	Its aim was to provide the background for developing an evaluation strategy to assess the quality of care provided by the Nurse and Allied Health Clinic programmes offered by the Hospital Authority. Its specific focus was to identify the factors determining quality of care for nurse-led and allied health personnel-led clinics on six programmes developed by the Hospital Authority. These programmes addressed fall prevention, continence care, pulmonary rehabilitation, mental wellness, medication compliance, and wound care.	MEDLINE; Cochrane Database; RAND	Yes	NR	NR	2 (54)
Dawoud (2019) 41	This systematic review was undertaken to identify and assess the quality and applicability of the published economic evaluations of enhanced services provided by community-based pharmacists.	NHSEED; HTA; Health Economic Evaluations Database; MEDLINE; EMBASE	NR	NR	2018, updated from 2016	1 (13)
de Barra (2018) 42	To examine the effect of pharmacists' non-dispensing services on non-hospitalised patient outcomes.	CENTRAL; DARE; HTA; NHSEED; MEDLINE; EMBASE; CINAHL; (ICTRP); ClinicalTrials.gov.	Yes	Yes	NR	9 (116)
Greer (2015) 43	What are the effectiveness and harms of pharmacist-led chronic disease management compared to usual care?	MEDLINE; CINAHL; the Cochrane Library; IPA	NR	Yes	NR	16 (70)
Hazen (2018) 44	This study investigates how the degree of integration of a non-dispensing pharmacist impacts medication related health outcomes in primary care.	PubMed; EMBASE.	NR	Yes	NR	10 (60)
Kee (2018) 45	This review article aims to examine the existing evidence on interventions to reduce medication discrepancies or errors in primary or ambulatory care setting during care transition from hospital to primary care.	PubMed; EMBASE.	NR	Yes	2017	1 (6)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
Khalil (2017) ⁴⁶	To determine the effectiveness of professional, organisational and structural interventions compared to standard care to reduce preventable medication errors by primary healthcare professionals that lead to hospital admissions, emergency department visits, and mortality in adults.	CENTRAL; MEDLINE; Embase; HTA; NHSEED; CINAHL; ICTRP; ClinicalTrials.gov	Yes	Yes	2015	2 (30)
Lehnbom (2014) ⁴⁷	The aim of this review was to evaluate how effective medication reconciliation and medication review are in identifying and rectifying harmful discrepancies and medication-related problems across a broad range of settings (hospitals, RACFs, and the community) and to assess their impact on clinical outcomes, such as length of stay, readmissions, and mortality.	MEDLINE; PsycINFO; CINAHL; EMBASE; The Cochrane Library	NR	Yes	NR	1 (83)
Loh (2016) ⁴⁸	Aims to provide a timely evaluation of the evidence base for pharmacist-provided medication review in the elderly compared with usual care. Where possible, a meta-analysis of the relevant outcomes will be conducted to gain insight into the intervention's benefits by pooling the results of the included studies. This review also aims to provide methodological recommendations for future studies that seek to evaluate the outcomes of medication review.	MEDLINE; EMBASE; CINAHL; WoS; Cochrane library	NR	Yes	NR	1 (25)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
McNab (2018) 49	We aimed to focus, in depth, on medication reconciliation performed by community and primary care pharmacists after hospital discharge, by systematically reviewing published studies that compared this process with usual care. The aim was to determine the effectiveness of this intervention on overall discrepancy identification and resolution, the clinical relevance of resolved discrepancies and healthcare utilisation in terms of readmission rates, emergency department attendance and primary care workload.	MEDLINE; CINAHL; EMBASE; AMED; ERIC; NHS Evidence; Cochrane electronic databases; Scopus	NR	Yes	2017	1 (14)
Perrot (2019) 50	The main objective of this review was to analyse the state-of-the-art of pharmacists' role in pain management self-medication.	PubMed; EMBASE.	NR	NR	NR	1 (20)
Pousinho (2016) 51	The purpose of this systematic review is to give a global and comprehensive review of the effectiveness of pharmacist interventions in the management of type 2 diabetes specifically, focusing on clinical, humanistic, and economic outcomes and including only the most robust studies, that is, randomized controlled trials, without putting restrictions on the type of pharmacist interventions.	CENTRAL; PubMed; WoS.	NR	NR	2015	3 (36)
Rankin (2018) 52	To determine which interventions, alone or in combination, are effective in improving the appropriate use of polypharmacy and reducing medication-related problems in older people.	CENTRAL; MEDLINE; EMBASE; CINAHL; HTA; NHSEED.	NR	Yes	2018	1 (32)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
Riordan (2016) 53	Therefore, the aim of this review is to evaluate studies of pharmacist-led interventions on medication prescribing among community-dwelling older adults receiving primary care to identify the components of a successful intervention.	PubMed, EMBASE, CINAHL, MEDLINE; TRIP; CRD Databases; CDSR; WoS, Science Direct; clinicaltrials.gov; mRCT	Yes	Yes	2015	2 (5)
Santschi (2014) 54	Therefore, we combined and updated BP data from these 2 previous systematic reviews to assess the effect of pharmacist interventions on BP among outpatients and to identify determinants of heterogeneity.	PubMed; EMBASE; CINAHL; CENTRAL	No	NR	2013	1 (39)
Tan (2014) 55	The aim of the current systematic review was to evaluate the role of pharmacists co-located with GPs and other health professionals within primary care general practice clinics (e.g. family practice clinics, community health centers or primary health care centers).	CENTRAL; MEDLINE; EMBASE; IPA.	No	Yes	2013	13 (38)
Tecklenborg (2020) 56	This systematic review examines interventions to reduce the incidence of ADE-associated health outcomes, including hospitalisation, mortality, quality of life (QoL), mental health and physical functioning in older adults in primary care settings.	MEDLINE; EMBASE; WoS; CINAHL; CENTRAL; ClinicalTrials.gov	NR	Yes	NR	1 (7)
Wagner (2019) 57	Thus, the aim of this review is to discuss recent RCTs that support the expanding role of pharmacists in hypertension management and provide general guidance on collaborating with pharmacists.	NR	NR	NR	NR	1 (5)

Review	Review aim / objective (verbatim)	Bibliographic and trial databases searched	Grey literature search?*	Supplementary search?	Search year	No of eligible studies (total studies)
Weeks (2016) 58	We systematically identified, reviewed, and updated the evidence from controlled studies and uncontrolled studies on the clinical, patient-reported and resource use outcomes of non-medical prescribing in primary and secondary care settings. This review considered any adverse effects of nonmedical prescribing which may be clinical (e.g. deterioration in care or incidence of adverse drugs reactions), patient-reported (e.g. decreased satisfaction), or resource-related (e.g. increased treatment costs).	CENTRAL; EPOC; Cochrane Methodology Register; CDSR; DARE; HTA, NHSEED; MEDLINE; EMBASE PsycINFO; CINAHL; ICTPR; ClinicalTrials.gov	Yes	Yes	2016	3 (46)

*Grey literature was considered as reports; dissertations/theses; searching of grey literature / conference abstract databases; and sourcing unpublished data by contacting authors/institutions ¹³⁰

ADEs = adverse drug events; AMED = Allied and Complementary Medicine Database; BNI = British Nursing Index; BP = blood pressure; CCMD-CTR = Cochrane Common Mental Disorders Controlled Trials Register; CDSR = Cochrane Database of Systematic Reviews; CENTRAL = Cochrane Central Register of Controlled Trials; CINAHL = Cumulative Index to Nursing and Allied Health Literature; CRD = Centre for Reviews and Dissemination; DARE = Database of Abstracts and Reviews of Effects; EPOC = Effective Practice and Organisation of Care Register; ERIC = Education Resources Information Center; GPs = general practitioners; HTA = Health Technology Assessment Database; ICTRP = International Clinical Trials Registry Platform; IPA = International Pharmaceutical Abstracts; ISRCTN Registry = International Standard Randomised Controlled Trial Number Registry; mRCT = metaRegister of controlled trials; NHSEED = NHS Economic Evaluation Database; NICE = National Institute for Health and Care Excellence; NR = not reported; RACF = residential aged care facilities; RAND = Research and Development Corporation Health Database; RCT = randomised controlled trial; TRIP = Turning Research into Practice; WHO = World Health Organisation; WoS = Web of Science

Appendix 4: Characteristics of eligible studies (n=52) identified from the reviews

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICINES RECONCILIATION						
Armor, 2016 ⁵⁹ [cited by: ⁴⁵]	Family medicine centre	USA (Oklahoma)		NR (NR)	Face-to- face	>18 years; non-pregnant; discharged from hospital to family medicine centre
Hawes, 2014 ⁷² [cited by: ⁴⁹]	Primary care clinics	USA	Communication with other HCPs	NR (NR)	Face-to- face	Discharged from hospital and either: long-term condition, more than 3 admissions, ≥8 medications
Kilcup, 2013 ⁷⁹ [cited by: ⁴⁷]	Community setting	NR	Communication with other HCPs	NR (NR)	Telephone	Patients discharged from hospital
MEDICATION REVIEW – WITH RECORDS ONLY						
Kirwin, 2010 ⁸⁰ [cited by: ⁵⁵]	General practice clinics	USA	Communication with other HCPs	Endocrine system (Diabetes mellitus – type 1 or 2)	Review of records	≥18 years
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION						
Tahaineh, 2011 ¹⁰⁷ [cited by: ^{35, 44,} ⁵⁵]	Primary care practice / General practice clinics	Jordan	Education/counselling; Lifestyle assessment/advice; Adherence assessment; Communication with other HCPs	Cardiovascular system (Dyslipidaemia)	Face-to- face	≥18 years
Jamieson, 2010 ⁷⁸ [cited by: ⁵⁵]	General practice clinics	UK	Education/counselling; Adherence assessment; Lifestyle assessment/advice; Monitoring; Communication with other HCPs	Cardiovascular system (Hypertension)	Face-to- face	Adults; blood pressure >140/85; on treatment
Obreli-Neto, 2011 ⁹³ [cited by: ^{35, 37,} ⁵⁵]	Primary public health care unit / General Practice clinics	Brazil	Education/Counselling; Adherence assessment; Lifestyle assessment/advice; Communicating with other HCPs	Cardiovascular system (Hypertension) + Endocrine system (Diabetes)	Face-to- face	≥60 years; with diabetes and/or hypertension diagnosis and on therapy

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION (cont.)						
Hammad, 2011 ⁷¹ [cited by: ^{44, 55}]	General practice clinics / Primary care practice	Jordan	Education/Counselling; Adherence assessment; Lifestyle assessment/advice; Monitoring; Communication with other HCPs	Endocrine system (Metabolic syndrome)	Face-to- face	NR
Ayadurai, 2018 ⁶¹ [cited by: ³⁵]	Primary care clinics	Malaysia	Education/Counselling; Adherence assessment; Lifestyle assessment/advice; Physical assessment	Endocrine system (Diabetes – type 2)	NR	>18 years
Skinner, 2015 ¹⁰⁴ [cited by: ⁴³]	Community health clinic	NR	Education/Counselling; Lifestyle assessment/advice	Endocrine system (Diabetes – type 2)	NR	≥18 years; uncontrolled diabetes: ≥1 documented HbA1c>7%, a risk factor for disease-related microvascular complications
Avery, 2012 ⁶⁰ [cited by: ⁵⁵]	General practice	UK	Education/Counselling; Monitoring; Communication with other HCPs	NR (NR)	Face-to- face	Any general practice patients
Bryant, 2011 ⁶⁴ [cited by: ⁵³]	General practice	New Zealand	Education/Counselling; Communication with other HCPs	NR (NR)	NR	≥65 years; community dwelling Exclusions: nursing home populations
Lenander, 2014 ⁸³ [cited by: ⁴²]	Primary care centres	Sweden (Stock- holm)		NR (NR)	NR	Patients with drug-related problems
Richmond, 2010 ⁹⁸ [cited by: ^{40, 53}]	General practices	UK (England)	Adherence assessment; Communication with other HCPs	NR (NR)	NR	≥75 years; community dwelling (nursing home populations excluded)
Bojke, 2010 ⁶² [cited by: ⁴⁰]	General practice	NR		NR (NR)	NR	≥75 years

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICATION COMPLIANCE SUPPORT						
Spence, 2014 ¹⁰⁶ [cited by: ⁴³]	Outpatient pharmacy clinical service	NR	Referral	Cardiovascular system (Dyslipidaemia) + Endocrine system (Diabetes)	Face-to- face	age ≥18; non-adherent diabetes mellitus or CAD patients with HbA1c or LDL-C outside clinical goals
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION AND DRUG THERAPY ADJUSTMENTS						
Lowrie, 2012 ⁸⁴ [cited by: ^{46, 55}]	General practices	UK	Communication with other HCPs; Prescribing/Adjusting therapy	Cardiovascular system (Left ventricular systolic dysfunction)	NR	≥18 years
Heisler, 2012 ⁷³ [cited by: ^{35, 44,} ⁵⁵]	Outpatient primary care clinics / Primary care practice / General practice clinics	USA	Education/Counselling; Adherence assessment; Physical assessment; Monitoring; Prescribing/Adjusting therapy	Cardiovascular system (Hypertension) + Endocrine system (Diabetes mellitus)	NR	≥18 years
Obreli-Neto, 2015 ⁹⁴ [cited by: ^{35, 42,} ⁴⁸]	Primary health care unit	Brazil (Salto Grande, Sao Paulo state)	Adherence assessment; Recommendations; Lifestyle assessment/advice; Education/Counselling	Cardiovascular system (Hypertension) + Endocrine system (Diabetes)	NR	≥60 years; community dwelling

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION AND DRUG THERAPY ADJUSTMENTS (cont.)						
Obreli-Neto, 2015 ⁹⁴ [cited by: ^{35, 42,} ⁴⁸]	Primary health care unit	Brazil (Salto Grande, Sao Paulo state)	Adherence assessment; Recommendations; Lifestyle assessment/advice; Education/Counselling	Cardiovascular system (Hypertension) + Endocrine system (Diabetes)	NR	≥60 years; community dwelling
Simpson, 2011 ¹⁰³ [cited by: ^{35, 42, 51,} ⁵⁵]	Primary care clinics / General practice clinics	Canada (Edmon- ton)	Physical assessment; Recommendations; Communication with other HCPs	Endocrine system (Diabetes – type 2)	Face-to- face	≥18 years
Mourao, 2013 ⁹¹ [cited by: ^{35, 37, 44,} ^{51, 54, 55}]	Primary health care units / Primary care practice / General practice clinics	Brazil	Education/Counselling; Lifestyle assessment/advice; Care planning; Recommendations; Communication with other HCPs	Endocrine system (Diabetes – type 2, uncontrolled)	Face-to- face	≥ 18 years; HbA1c ≥7%; post-prandial capillary glucose ≥ 180 mg/dL; taking oral antidiabetic medications for at least 6 months before beginning the study;
Jameson, 2010 ⁷⁷ [cited by: ^{43, 44,} ⁵⁵]	Community based primary care group / Primary care practice / General practice clinics	USA	Adherence assessment; Education/counselling; Prescribing/adjusting therapy	Endocrine system (Diabetes)	Face-to- face; Telephone	≥18 years; HbA1c ≥9% Exclusions: being seen by an endocrinologist; not expected to live for duration of study
Simpson, 2015 ¹⁰² [cited by: ^{35, 41}]	General Practice surgery / Primary care clinic	Canada	Physical assessment; Lifestyle advice; Recommendations	Endocrine system (Diabetes – type 2)	NR	≥18 years

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION AND DRUG THERAPY ADJUSTMENTS (cont.)						
Carter, 2015 ⁶⁶ [cited by: ^{43, 57}]	Primary care medical offices	USA	Recommendations; Education/Counselling; Adherence assessment; Care planning; Communication with other HCPs	Cardiovascular system (Hypertension – uncontrolled) + Endocrine system (Diabetes mellitus) + Renal system (Chronic Kidney Disease)	Face-to- face; Telephone	>18 years; diverse ethnic and racial backgrounds; Exclusions: acute angina; stroke, renal failure; systolic >200mmHg or diastolic >114mmHg; history of MI, stroke, or angina (past 6 months); systolic dysfunction (LVEF <35%); GFR <20mL/min, cirrhosis; hepatitis B or C infection; laboratory abnormality in past 6 months; pregnancy; pulmonary hypertension; untreated sleep apnoea; life expectancy <2 years; residence in nursing home; dementia; inability to give consent; impaired cognitive function
Jacobs, 2016 ⁷⁶ [cited by: ⁵⁰]	Primary care clinic	NR	Recommendations; Monitoring; Referral	Nervous system (Chronic non- malignant pain)	NR	Adults
Neilson, 2015 ⁹² [cited by: ^{36, 41}]	General practice	UK	Prescribing/Adjusting therapy; Communication with other HCPs	Nervous system (Chronic pain)	Face-to- face	≥ 18 years; living in their own home; receiving medication for pain

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
MEDICATION REVIEW - WITH PATIENT/CARER COMMUNICATION AND DRUG THERAPY ADJUSTMENTS (cont.)						
Bruhn, 2013 ⁶³ [cited by: ^{42, 58}]	General practice	UK (Grampian; East Anglia)	Prescribing/Adjusting therapy; Care planning; Lifestyle assessment/advice	Nervous system (Chronic pain)	Face-to- face	>18 years; living in their own house; having received 2 or more acute prescriptions and/or one repeat prescription in the last 120 days for an analgesic and/or an non-steroidal anti- inflammatory drug
Campins, 2017 ⁶⁵ [cited by: ^{46, 52,} ⁵⁶]	Primary Health Care Centres	Spain (Mataró and Argentona)	Recommendations; Communication with other HCPs	NR (NR)	Face-to- face	≥70 years; community dwelling; polypharmacy (8 or more drugs)
DISEASE AND THERAPY MANAGEMENT						
Evans, 2010 ⁶⁹ [cited by: ^{38, 44,} ⁵⁵]	Primary care medical clinic / Primary care practice / General practice clinic	Canada	Medication review; Risk assessment; Education/Counselling; Monitoring; Adherence assessment; Communication with other HCPs	Cardiovascular system (Cardiovascular disease)	Face-to- face; Telephone; Mailed letters	Framingham risk score ≥15% or coronary artery disease risk equivalent (coronary artery disease, peripheral artery disease, cerebrovascular disease, and diabetes mellitus). Exclusion: severe psychiatric conditions or dementia symptomatic heart failure; terminal illness.
Taveira, 2014 ¹⁰⁸ [cited by: ⁴²]	Primary care clinic	USA	Education/counselling; Behavioural intervention; Risk assessment; Goal setting; Adherence assessment; Monitoring	Cardiovascular system (Cardiovascular disease)	Face-to- face	Patients at cardiovascular disease risk

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
DISEASE AND THERAPY MANAGEMENT (cont.)						
Hirsch, 2014 ⁷⁴ [cited by: 42-44]	Primary care clinic / General internal medicine clinic / Primary care practice	USA (California)	Medication review; Education/counselling; Adherence assessment; Review of behaviour; Review of goals; Prescribing/Adjustment of therapy; Order tests and follow up on	Cardiovascular system (Hypertension – uncontrolled)	Face-to-face	≥18 years; continuous active status with the clinic (defined as having a record of at least 1 visit in the 6 months before); diagnosis of HTN with most recent BP measurement ≥140/≥90 mm Hg (≥130/≥80 mm Hg for DM); current treatment with ≥1 anti- HTN medication
Magid, 2011 ⁸⁵ [cited by: 43]	Health Maintenance Organisation based primary care clinic	NR	Management of disease; Education/Counselling; Monitoring; Adherence assessment; Prescribe/adjustment to therapy; Communication with other HCPs	Cardiovascular system (Hypertension)	NR	Taking ≤4 anti-HTN medicines; elevations in 2 of 3 most recent electronic BP measurements (>140/>90 mm Hg; for patients with DM/CKD, >130/80 mm Hg)
Padiyara, 2011 ⁹⁵ [cited by: 43]	Primary care clinic	NR	Education/counselling; Medication review; Prescribing/adjusting therapy; Order tests and follow up on	Endocrine system (Diabetes mellitus)	Face-to-face	≥18 years
Salvo, 2012 ¹⁰¹ [cited by: 43]	County funded health centre	USA (St Louis)	Education/counselling; Medication review; Prescribing/adjustment of therapy; Order tests and follow up on; Adherence assessment; Lifestyle assessment/advice; Referral	Endocrine system (Diabetes)	Face-to-face; Telephone	18-64 years; English speaking; using insulin; diabetes diagnosis; indigent (low-income, minority). Exclusions: seeing an endocrinologist
McAdam-Marx, 2015 ⁹⁰ [cited by: 43]	Community-based primary care clinic	NR	Prescribing/adjustment of therapy; order tests; Education/counselling; Adherence assessment; Assessing if goals met	Endocrine system (Diabetes – type 2)	Face-to-face; telephone	≥18years ;HbA1c ≥ 6%; treated at community clinic offering diabetes collaborative care management (DCCM) and referred by PCP; treated ≥180 days prior to index date

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
DISEASE AND THERAPY MANAGEMENT (cont.)						
Gilani, 2013 ⁷⁰ [cited by: ³⁵]	Primary care clinics	Canada	Medication review; Physical assessment; Lifestyle advice/assessment; Prescribing/Adjusting therapy; Management of disease.	Endocrine system (Diabetes – type 2)	NR	≥18 years
Ladhani, 2012 ⁸² [cited by: ³⁵]	Primary care clinics	Canada	Medication review; Physical assessment; Lifestyle assessment/advice; Prescribing/adjusting of therapy; Management of disease	Endocrine system (Diabetes – type 2)	NR	≥18 years
Cooney, 2015 ⁶⁸ [cited by: ⁴³]	community- based outpatient clinic	USA (Cleveland)	Medication review; Education/counselling; Lifestyle assessment/advice; Order tests and follow up on; Referral; Prescribing/adjusting therapy; Recommendations; Communication with other HCPs	Renal system (Chronic Kidney Disease – moderate to severe)	Telephone	18-85 years; Glomerular filtration rate (GFR) <60 between 90 days and 2 years prior; ≥1 primary care visit prior to study Exclusions: end-stage renal disease; if ever referred for hospice care

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
DISEASE AND THERAPY MANAGEMENT (cont.)						
Magid, 2013 ⁸⁶ [cited by: ^{42, 43,} ⁵⁸]	Health Maintenance Organisation based primary care clinic	USA (Colorado)	Education/Counselling; Monitoring; Adherence assessment; Lifestyle assessment/advice; Prescribing/adjustment of therapy; Communication with other HCPs	Cardiovascular system (Hypertension)	Face-to- face; Tele- monitoring system; Telephone; Email	18-79 years; diagnosis of hypertension from 2 most recent BP readings ≥140/≥90 mmHg (≥130/≥80 mmHg for DM or CKD); English speaking; prescribed ≤3 anti-HTN medications; had a primary care provider at one of the 10 participating clinics and had access to a computer and internet. Patients excluded if: limited life expectancy, recent MI, stroke, percutaneous coronary intervention, or coronary artery bypass graft surgery, end-stage renal disease.
Margolis, 2015 ⁸⁹ [cited by: ³⁵]	Primary health care clinics	USA	Monitoring; Education/Counselling; Prescribing/adjustment of therapy; Adherence assessment; Lifestyle assessment/advice.	Cardiovascular system (Hypertension)	Tele- monitoring system	≥18 years

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
DISEASE AND THERAPY MANAGEMENT (cont.)						
Margolis, 2013 ⁸⁸ [cited by: ^{35, 42, 43, 58}]	Health Maintenance Organisation based primary care clinic	USA (Minnesota)	Monitoring; Education/counselling; Prescribing/adjustment of therapy; Adherence assessment; Lifestyle assessment/advice; Communication with other HCPs	Cardiovascular system (Hypertension)	Tele-monitoring system; telephone;	Uncontrolled hypertension ($\geq 140/\geq 90$ mm Hg or $\geq 130/\geq 80$ mmHg for DM or CKD) at 2 most recent primary care visits in previous year. Exclusion: stage 4/5 kidney disease or ratio of albumin to creatinine of ≥ 700 mg/g; acute coronary syndrome, coronary revascularization, or stroke ≤ 3 months; known secondary causes of HTN; NYHA class III or IV CHF; known left ventricular ejection fraction $< 30\%$; pregnant.
Pape, 2011 ⁹⁶ [cited by: ⁴³]	Internal medicine family practice clinics	USA (Oregon)	Recommendations; Communication with other HCPs	Cardiovascular system (Dyslipidaemia)	Telephone	≥ 18 years; with elevated LDL-C level; problem list entry of diabetes on EMR
Smith, 2013 ¹⁰⁵ [cited by: ⁴³]	Primary care centre	NR	Prescribing/Adjusting therapy; Monitoring; Collaboration with other HCPs	Cardiovascular system (Dyslipidaemia)	Face-to-face	Patients with uncontrolled LDL cholesterol

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
DISEASE AND THERAPY MANAGEMENT (cont.)						
Jacobs, 2012 ⁷⁵ [cited by: ^{43, 55}]	Ambulatory general international medicine setting / General practice clinics	USA (Burlington, Massa- chusetts)	Physical assessment; Education/Counselling; Order tests; Prescribing/Adjustment of therapy; Lifestyle assessment/advice; referral; communication with other HCPs	Endocrine system (Diabetes – type 2)	Face-to- face	>18 years; HbA1C >8% Exclusions: receive primary care outside clinic; enrolled in another pharmacy or diabetes study; diabetes management by an outside endocrinologist; or unable to adhere to study schedule
Cohen, 2011 ⁶⁷ [cited by: ⁴³]	Primary care	NR	Education/Counselling; Behavioural intervention; Lifestyle assessment/advice; Prescribing/Adjusting therapy; Referral	Endocrine system (Diabetes – type 2)	Face-to- face	HbA1c>7%; LDL>100mg/dL or >70mg/dL if CAD; BP>130/80 mmHg; willing to discuss diabetes and cardiac risk factors in group setting. Exclusions: gestational diabetes; unable to attend sessions; condition precluding diabetes self-care
PHARMACEUTICAL CARE						
Mahwi, 2013 ⁸⁷ [cited by: ⁴²]	Diabetic centre	Iraq (Sulaimany)		Endocrine system (Diabetes – type 2)	Face-to- Face; Telephone	NR

Study; [Citing review(s)]	Primary care setting	Country (Region)	Additional tasks	Clinical system (Specific therapeutic area)	Mode of service delivery	Patient eligibility criteria
EDUCATIONAL SERVICE						
Koenigsfeld, 2012 ⁸¹ [cited by: ⁴⁴]	Primary care practice	USA	Education/Counselling; Communication with other HCPs	Cardiovascular system (Hypertension, Dyslipidaemia) + Endocrine system (Diabetes) + Respiratory system (Asthma)	Face-to-face	NR
Wong, 2013 ¹¹⁰ [cited by: ⁴⁴]	Primary care practice	Hong Kong	Education/Counselling	Cardiovascular system (Hypertension)	NR	NR
Tobari, 2010 ¹⁰⁹ [cited by: ⁵⁵]	General practice clinics	Japan	Education/Counselling; Lifestyle assessment/advice; Monitoring	Cardiovascular system (Hypertension)	NR	40–79 years; Systolic Blood Pressure 140–179 mmHg or Diastolic Blood Pressure 90–109 mm Hg; or on antihypertensives
Plaster, 2012 ⁹⁷ [cited by: ⁵¹]	Community Health Centre	Brazil	Education/Counselling; Lifestyle assessment/advice; Communication with other HCPs	Endocrine system (Diabetes – type 2)	NR	NR
Rubio-Valera, 2013 ¹⁰⁰ [cited by: ³⁹]	Primary healthcare centres	Spain (Barcelona)	Education/Counselling; Adherence assessment; Communication with other HCPs	Nervous system (Depression)	Face-to-face	18–75 years; clinical diagnosis of depression from a GP; beginning a pharmacological anti-depressant treatment
Roth, 2013 ⁹⁹ [cited by: ⁴⁴]	Primary care practice	USA	Education/Counselling; Communication with other HCPs	NR (NR)	NR	Older adults

HCPs = Health care professionals; NR = Not reported; BP = Blood pressure; CAD = Coronary artery disease; CHF = Congestive heart failure; CKD = Chronic kidney disease; DM = Diabetes mellitus; EMR = Electronic medical record; GFR = Glomerular filtration rate; HTN = Hypertension; LDL – Low density lipoprotein; LVEF = Left ventricular ejection fraction; MI = myocardial infarction; NYHA = New York Heart Association; PCP = Primary care provider

