York Health Economics Consortium

NATIONAL PHARMACY ASSOCIATION

Economic Analysis of Expanding the Role of Community Pharmacy Services in Medicines Optimisation

Final Report

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Executive Summary

1. INTRODUCTION

Population growth, increasing morbidity and developments in medicines are contributing to increasing usage and cost of medicines. More people than ever before are reliant on medicines. It is vitally important that medicines use is optimised through shared decision-making conversations to maximise benefit, reduce harm and minimise costs. Community pharmacists are experts in medicines and the National Pharmacy Association (NPA) believe that the NHS must harness this expertise, alongside others in neighbourhood teams to support people taking the 1.2 billion prescriptions they dispense each year.

Medicines optimisation involves ensuring that people get the right choice of medicines, at the right time, and are part of the decision-making process [1]. Overprescribing can put a burden on people to take and manage their medicines, leading to medicines not being taken as intended, with some people stopping taking their medicine altogether in response to this burden [2]. Harm from medicines account for around 6.5% of hospital admissions each year [3].

The NPA commissioned York Health Economics Consortium to conduct an economic analysis of expanding the role of community pharmacy in medicines optimisation in the UK.

2. EVIDENCE REVIEW

An evidence review was conducted to identify studies exploring the costs and benefits associated with medicines optimisation interventions in primary and community care in the UK. The evidence review included a rapid, pragmatic search of literature and a targeted search for selected grey literature. Following deduplication and screening against eligibility criteria, 25 studies (reported in 27 papers) were prioritised for data extraction.

The evidence review concluded that there are benefits to pharmacist-led interventions for medicines optimisation, including improvements in medicines optimisation and a reduction in harm from prescribing, often translating into savings in healthcare resource use. Studies were selected for subsequent data analysis based on several criteria. The studies selected included two papers for existing interventions, and three pilot/suggested new interventions. Two other new interventions were included in our analysis but were conducted as ‘what-if’ analysis rather than taken from existing studies. This means that we considered the potential cost-saving implications if a certain level of increased uptake were achieved.

3. DATA ANALYSIS

Two existing interventions and five new interventions were included in our analysis. A breakdown of costs and resource use associated with medicines optimisation interventions and current practice was included to calculate the incremental change in costs to the healthcare system.

The results for existing interventions are summarised below:

- New Medicines Service: Community pharmacies are currently estimated to provide £661 million of cost savings per year and 204,982 lifetime QALYs. If (participating) community pharmacies in England increased their NMS activity by 10%, this is estimated to result in an additional £66.1 million cost saving and 20,498 additional QALYs, compared with current activity levels. These QALY gains would be valued at around £410 million using the NICE willingness-to-pay threshold of £20,000 per QALY gained. If (participating) community pharmacies in England all met their cap on NMS activity, this is estimated to result in an additional £371.6 million cost saving and an additional 115,236 QALYs. These QALY gains would be valued at around £2.3 billion using the NICE willingness-to-pay threshold.

- Discharge Medicines Service: Having all areas across England delivering to the same potential as the highest delivering area in the UK could result in an additional annual cost saving of £26.3 million and generate an additional 12,494 QALYs. These QALY gains would be valued at around £250 million using the NICE willingness-to-pay threshold. This could also result in a reduction of 963,216 hospital bed days.

The results for new interventions are summarised below:

- Structured medication reviews (SMRs): SMRs cost £34.06 when carried out by a community pharmacist, compared with £34.16 and £147.00 for practice-based pharmacists and GPs, respectively. Practices are currently not providing SMRs for all who would benefit and community pharmacies, with access to the clinical record, are well placed to meet unmet demand.

- Polypharmacy clinics for people taking 10 or more medicines: £619 million net cost savings, including intervention costs, drug cost savings and hospital admission savings.

- Community pharmacists providing personalised asthma action plans: If uptake was increased to 70%, 80%, and 90% of total UK need, this could generate additional cost savings of £33.7 million, £52.7 million, and £71.6 million, respectively.

- Chronic obstructive pulmonary disease education and advice: £100 million cost savings if rolled out across the UK, with an additional £7.8 million worth of avoided productivity loss. Additionally, it was estimated that around 7,280 QALYs would be produced over a six-month time horizon. These QALY gains would be valued at around £146 million using the NICE willingness-to-pay threshold.

- PINCER: The total cost savings over a five-year period would be £20.8 million, generating around 5,084 QALYs. These QALY gains would be valued at around £102 million using the NICE willingness-to-pay threshold.

4. DISCUSSION

This analysis suggests that expanding the role of community pharmacy in medicines optimisation to introduce these new interventions or expand the use of existing interventions could generate substantial opportunity cost savings to the UK NHS and improve health outcomes by helping people to use their medicines more effectively and stopping medicines that are no longer required. This will help to address pressures highlighted by Lord Darzi's independent investigation of the NHS and work towards improving the service [4].

There will need to be a focus on increasing integration of community pharmacies into the rest of the healthcare system (including access to shared electronic health records and full integration into neighbourhood teams, working collaboratively with the wider NHS multidisciplinary teams), adequate funding directed towards capacity to implement interventions, and encouraging engagement from patients.

Acknowledgements

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Abbreviations

ADHD	Attention deficit hyperactivity disorder
CAMHS	Child and Adolescent Mental Health Services
COPD	Chronic obstructive pulmonary syndrome
DES	Directed Enhanced Service
DMR	Discharge medicines review
DMS	Discharge Medicines Service
ICER	Incremental cost-effectiveness ratio
MUR	Medicines use review
NICE	National Institute for Health and Care Excellence
NMB	Net monetary benefit
NMS	New Medicines Service
NPA	National Pharmacy Association
OTC	Over the counter
PAAPS	Personalised asthma action plans
PCN	Primary Care Network
PHE	Public Health England
PICO	Population, intervention, comparator(s), outcomes
PSSRU	Personal Social Services Research Unit
QALY	Quality-adjusted life year
QOL	Quality of life
RCGP	Royal College of General Practitioners
RPS	Royal Pharmaceutical Society
SMD	Standardised mean difference
SMR	Structure medication review
WHO	World Health Organization

1 Introduction

1.1 Background

Population growth, increasing morbidity because of an aging population, and developments in medicines are contributing to the increasing usage of medications [2, 5]. This is an issue facing not just the UK, but the global population [5]. Polypharmacy (the concurrent use of multiple (generally accepted as five or more) medications), as well as transfer of care have been identified by the World Health Organization (WHO) as two main areas where work should be targeted to improve medication safety and avoid adverse events [6, 7].

Medicines optimisation involves ensuring that people get the right choice of medicines, at the right time, and are part of the decision-making process [1]. Overprescribing can put a burden on people to take and manage their medicines, leading to medicines not being taken as intended, with some people stopping taking their medicine altogether in response to this burden. The National Overprescribing Review estimates that it is possible that at least 10% of the total number of prescription items in primary care need not have been issued [2]. It has previously been estimated that between 30% and 50% of medicines prescribed for long-term conditions are not taken as intended [8]. Medicines optimisation considers systems for managing and improving patient safety, shared decision-making on medicine regimens, support for patients when they move care settings, medicines reconciliation, and medication review.

In the UK, spending on medicines is increasing [9]. Lord Darzi's report on the state of the NHS in England raised serious concerns on the performance of the NHS. The report found the health of the nation to have deteriorated, people are struggling to see their GP or be seen in A&E, there are long waits for hospital procedures, care for cardiac conditions is worsening, and there is insufficient budget allocation in community care [4]. Given this, the healthcare system cannot afford for medicines not to be used optimally, to be wasted, or to cause harm and result in additional use of healthcare resources.

Evidence suggests that shared decision making, medicines optimisation including deprescribing and appropriate monitoring, medication reviews, patient support, and interventions at transfers of care are needed to safely and optimally deliver these results [2, 6, 7]. However, Lord Darzi's report demonstrates the current lack of capacity for GP practices to deliver this [4]. Similarly, the workforce of clinical pharmacists provided by Primary Care Networks (PCNs) to deliver structured medication reviews (SMRs) to those who need them also cannot meet current patient demand [10].

Community pharmacy represents a workforce that specialises in pharmaceutical management and care, with regular contact with people on medication. As medicines experts, they are well-placed to deliver these interventions. Current policy, including the new NHS 10 Year Health Plan [11] and the Plan for Recovering Access to Primary Care (PCARP) [12], recognise the integral role that community pharmacy has to play in improving the delivery of clinical services. There is an opportunity to use the skills of community pharmacy in medicines optimisation.

The National Pharmacy Association (NPA) commissioned York Health Economics Consortium (YHEC) to conduct an economic analysis of the potential of expanding the role of community pharmacy in medicines optimisation. This included analysing the potential costs and benefits of expanding current services and commissioning new services from pilot studies identified in literature evidence. This report sets out the methods and results from the analysis and discusses the potential implications of these findings as well as barriers to implementation.

1.2 Objectives

The specific objectives of this project were:

- To conduct an evidence review to identify studies exploring the costs and benefits associated with medicines optimisation interventions in primary and community care in the UK.
- To use the results from the evidence review for medicines optimisation interventions and national data sources to analyse the potential economic benefit of expanding current community pharmacy services and of introducing new services on a national scale.
- To identify potential current barriers to implementation and expansion of such services and how these could be overcome.

2 Evidence Review

2.1 Methods

For the evidence review, a rapid, pragmatic search of literature evidence using MEDLINE (OvidSP) and a targeted search for selected grey literature was conducted, which focused on the following specific aspects of medicines optimisation:

- (Problematic) polypharmacy and medicines safety.
- Medication reviews and deprescribing.
- Staff costs and time.
- Adherence to medication, including the impact on waste, healthcare resource use, and health outcomes.

A PICO (population, intervention, comparator, outcomes) was developed to identify the key elements that would inform the eligibility criteria for the review. The eligibility criteria are set out in Table 2.1.

Table 2.1: Eligibility criteria

Analysis element	Description
Population	People in the UK who use community pharmacies to access prescription medication.
Intervention	Expanded role of community pharmacies in medicines optimisation – through regular review and check-in with patients. Moving some structured medication reviews (SMRs) from GP to community pharmacy.
Comparator	Current practices in primary care and community pharmacies.
Outcomes	Medicines safety: ▪ Incremental change in healthcare resource use, broken down into medication use and use associated with adverse events (including hospitalisations). ▪ Incremental costs of healthcare resource. Deprescribing: ▪ Incremental change in healthcare resource use, broken down into medication use and use associated with adverse events (including hospitalisations). ▪ Incremental costs of healthcare resource. Adherence: ▪ Incremental cost of waste medication disposal. ▪ Incremental cost of healthcare resource use. ▪ Incremental cost of changes in health outcomes. Staff time: ▪ Incremental number of GP appointments. ▪ Incremental staff costs. ▪ Change in unmet need of SMRs.
Time horizon	One year.
Perspective	UK NHS.
Limits	▪ Date limit of 2014 to date. ▪ Published in the English language. ▪ UK setting only.

2.1.1 Search methods

A MEDLINE search strategy was designed which identified studies of monetary costs and non-monetary resource use associated with medicines optimisation and community pharmacies in the UK. The full search strategy is presented in Appendix A. The search strategy was designed to be targeted and pragmatic to suit the project resources and context. The search was not designed to be exhaustive, but to capture as much relevant evidence as possible whilst keeping numbers manageable.

The strategy comprised five concepts:

- Community pharmacies (search lines 1 to 8).
- Medicines optimisation (search lines 9 to 29).
- Monetary costs (search lines 31 to 61).
- Non-monetary resource use (search lines 62 to 79).
- UK (search lines 82 to 92).

The concepts were combined as follows: (community pharmacies) AND medicines optimisation AND (monetary costs OR non-monetary resource use) AND UK.

Given that the search was highly pragmatic and designed to target relevant records in a rapid review context, the text search terms for the pharmacies and medicines optimisation concepts were restricted to the title and author-assigned keywords fields only.

The final Ovid MEDLINE strategy was peer-reviewed before execution by a second Information Specialist. Peer review considered the appropriateness of the strategy for the review scope and eligibility criteria, inclusion of key search terms, errors in spelling, syntax and line combinations, and application of exclusions.

Given the pragmatic nature of the database searches, some supplementary searching was also conducted. A search for selected grey literature published by organisations such as the Royal Pharmaceutical Society, the King's Fund, and the Health Foundation was undertaken. Relevant guidelines were also sought from websites such as NICE and literature already known to the NPA was also considered.

2.1.2 Record screening and data extraction

Search results were downloaded to an EndNote Library, deduplicated and uploaded to Covidence for screening. A single researcher assessed the search results according to their relevance to the eligibility criteria. The titles, abstracts and summaries were reviewed as appropriate, to develop a suitable list of relevant documents. Search outputs and initial assessment of eligibility for inclusion were recorded in a PRISMA flow diagram (Appendix B).

The final short list of documents was discussed by the project team and the NPA to prioritise studies for data extraction. These studies were prioritised based on critical judgement of their usefulness to the analysis. For example, whilst a study may have met the search criteria outlined in the PICO, the results may have been reported in a way that could not be used for the analysis, such as reporting qualitative results or using a metric that was not compatible with our calculations. Data extraction was pragmatic and limited to key data of relevance for the economic analysis.

Key data for each relevant study were extracted into a searchable Excel data extraction template. The data extracted was in narrative format. We extracted the following elements from eligible studies:

- Bibliographic details: (authors, title, journal, and year of publication).
- Study region/city: (setting).
- Study design.
- Study objective.
- Description of the intervention, including the targeted group.
- Methods used.
- Outcomes measured and the metrics used to measure them.
- Summary of the results.
- Study limitations.

The results generated then informed the data analysis.

2.2 Results

This section presents the findings from the literature review. It also describes the selection of studies that were deemed suitable to use in the economic analysis.

2.2.1 Search results

728 records were retrieved from the database and grey literature searches after duplicates were removed. 600 records were excluded at title and abstract screening stage as they did not meet the eligibility criteria. The full text of 128 studies were screened, and 44 met the review eligibility criteria. 25 studies, reported in 27 papers, were prioritised for data extraction by the project team and the NPA. A flow diagram can be found in Appendix B.

2.2.2 Characteristics of included studies

2.2.2.1 Study design

Of the 25 studies included in the review, 8 were systematic reviews [13-20] with 1 of these being a “review of reviews” or an umbrella review [20]. There were 16 primary studies, including 7 service evaluations [21-27], 2 before-and-after studies [28, 29], 1 randomised controlled trial [30], 1 non-randomised controlled trial [31], 1 cohort study [32], 1 interrupted time series study [33], 1 case series [34], 1 retrospective analysis of a quality improvement programme [35] and 1 summary of pilot studies [36]. Some relevant guidance from the National Institute of Health and Care Excellence (NICE) [8] was also identified.

2.2.2.2 Study setting

14 of the studies took place or reported on studies in community pharmacies [15, 18, 22-32, 36]. 2 of the reviews included community pharmacist-led interventions alongside other pharmacist-led interventions [13, 17]. 4 studies were in other primary care settings [16, 19, 33, 34] and 2 in care homes [21, 35]. 2 of the systematic reviews looked at medicines optimisation in any pharmacy setting [14, 20].

2.2.2.3 Target populations and interventions

Various populations were targeted. 3 of the reviews [13, 15, 16] and 1 of the primary studies [22] included any type of user of the community pharmacy. 4 studies specifically targeted elderly populations [19, 21, 27, 35], 2 in residential care homes [21, 35]. In 4 of the studies, the targeted population was those taking multiple medications who might be at high risk of inappropriate prescribing [26, 28, 33, 34]. 6 studies had targeted populations who were transitioning from hospital to the community setting [17, 18, 23, 31, 32, 36]. 6 studies targeted particular conditions. These included depression [14], chronic pain [20], attention deficit hyperactivity disorder (ADHD) [25], hypertension, asthma, diabetes and chronic obstructive pulmonary disease (COPD) [24, 29, 30].

The systematic reviews explored a variety of interventions delivered by pharmacists: educational interventions, counselling, monitoring, titrating medication to patient response, deprescribing, medication review and pain assessment.

11 of the primary studies looked at medication review [21, 23, 26-28, 30-33, 35, 36], 3 of these looked at electronic referral from hospitals to community pharmacies [31, 36, 37]. The remaining 5 primary studies examined polypharmacy clinics [34], pharmacy-led tailored community care plans [24], medication monitoring [25], medication adherence as part of an educational and support programme [29], and 1 study assessed the value of pharmacy non-prescribing services [22].

2.2.3 Summary of findings

The systematic literature reviews on pharmacist-led interventions for medicines optimisation varied in their findings depending on the intervention, population and disease area.

An umbrella review conducted by Shrestha et al. [20], looking at interventions for people with chronic pain, found that the clinical outcomes for patients were largely favourable, with improvements recorded including reduced pain intensity, improved medication management such as improved adherence to prescribing regimens and appropriate use of medication, enhanced overall physical and mental wellbeing, and reduced hospital length of stay. Significant pain intensity reductions were found due to pharmacists' interventions.

A systematic literature review by Foot et al. looking at medication reviews and patient transition from hospital to a community setting [18] found that pharmacists' interventions, including various settings, led to fewer hospital admissions; however, the follow-up time was relatively short (30 days). Three systematic literature reviews [13, 15, 16] reported evidence that pharmacist-led interventions reduced medication-related adverse outcomes, and greater discontinuation of unnecessary medications, but presented a more complex picture with regards to clinical outcomes. Improvements in clinical outcomes were observed for people with diabetes and mental health conditions, but not for those with cardiac failure, osteoporosis and epilepsy. One of the systematic reviews by Chambers et al. also found that the rate of risk of falls and mortality were not significantly impacted [16]. In contrast to Shrestha et al. [20], a systematic review from de Barra et al. [17] found that pharmacists' interventions led to little or no difference in hospital admissions or attendance compared with usual care.

In a systematic review of economic evaluations from Romano et al., which considered medication reviews with or without educational support [19], cost effectiveness ranged from dominant (where the intervention both improves patient outcomes and costs less than the comparator) to an incremental cost-effectiveness ratio (ICER) of $112,932 per quality-adjusted life-year (QALY), a value above the country's (variable based on the GDP per capita of the country setting of the study) WHO threshold, i.e. not cost effective. Overall, 85% of the interventions included by Romano et al. were cost saving, dominated usual care or were considered cost effective. Cost savings were also reported for pharmacist educational interventions by one of the reviews [15].

Primary studies (studies that report original research as opposed to a review of previous studies) reported generally positive results, showing benefits relating to pharmacy-led interventions for medicines optimisation and deprescribing. Two of the studies reported significant results in terms of the number of medicines stopped [35] and the reduction in hazardous prescribing [33] as a result of medicines optimisation reviews. 19.5% of medicines were stopped in a cohort of 382 patients [35], and hazardous prescribing was reduced by 17% and 15% at 6- and 12-months post-intervention. Two studies linked pharmacist-led interventions to the improvement of clinical outcomes for patients, including improvements in blood pressure [24, 28]. One of these studies, where the intervention was implementation of a pharmacist-led tailored care plan, also reported improvements in patient quality of life (QOL), patient activation measures and body-mass index [24]. One study also linked medication review with a reduction in falls in the elderly [26]. Pharmacist-led interventions led to greater treatment adherence and follow-up in two studies. In one study, pharmacist monitoring of young people

on medication for ADHD led to significant improvements in patients attending for assessment [25], from 6% pre-intervention to 53% post-intervention. A pharmacist-led stop smoking programme, found that 68.3% changed their inhaler technique and a rise in mean medicine adherence overall [29].

2.2.4 Selecting studies for data analysis

Studies were selected for data analysis based on several criteria. The studies needed to present results in a manner that was usable for economic analysis. This included aspects such as including intervention costs when calculating cost savings and presenting health-state utility values using a measure that could be converted into QALYs. Many of the systematic reviews did not include a meta-analysis, either because there was too much heterogeneity across study arms or because it was deemed out of scope of their analysis. This made them difficult to include in our analysis. Additionally, studies were prioritised where there was the potential for an intervention to be applied to a large national population, such as COPD which is estimated to affect 1.4 million people in the UK. A combination of pilot studies that evaluated potential new interventions and current nationwide services which have the potential for further expansion were selected and are described in the following sections.

2.2.4.1 Existing interventions

Two existing interventions were selected for inclusion in our analysis. These were the New Medicines Service (NMS) and the Discharge Medicines Service (DMS).

The NMS supports people with certain long-term conditions when they receive a new medication, to ensure that they understand how and why they are taking the medication and identify potential issues as soon as they arise. Elliott et al. 2020 reports the most recent economic results of the NMS [38]. A previous paper of theirs was also included in the search results [39], as well as another older paper used in a PwC report to analyse the service [40]. However, the most recent paper with a longer (6-months) time horizon was considered most appropriate to demonstrate the potential costs and benefits of the service. Both 6-month costs and estimated lifetime costs were reported, as well as a cost-effectiveness analysis. The paper also reported an odds ratio of 1.43 for patients' MMAS-8 scores (medication adherence) in favour of NMS. On average, pharmacies are currently reaching around 52.5% to 54% of their NMS cap, if they deliver the service, so the potential impact of the service reaching more people and the current barriers to increasing patient numbers was considered.

The DMS supports people who have received medication changes in hospital by providing discharge medication reviews (DMRs). A number of studies were selected for analysing the DMS, with a report from Hodson et al. 2014 analysing the Welsh DMS used for the majority of the input values [41]. This is because it included costs other than hospital admissions, as well as QALY loss in its analysis. However, costs associated with hospital readmissions varied between sources. Therefore, the lowest estimate was used in the base case to provide a conservative analysis, This came from Thayer et al. 2023 [42], and was costed using the NHS National Cost Collection 2023/24 [43]. Readmission rates reported by Mantzourani et al. 2020 [32], Nazar et al. 2016 [23], Hodson et al. 2014 [41], and Wickware et al. 2014 [31] were also used as scenarios, (see Table 3.3 in Section 3.1.1.2). An alternative cost per readmission was also sourced, though this did not come from the literature search.

2.2.4.2 New interventions

Five pilot/suggested new interventions were included in our analysis, with three of these sources directly from our literature searches. The three interventions sourced from the literature were pharmacist-led polypharmacy clinics for people taking ten or more medicines, a support service for people with COPD, and an error checking intervention called PINCER.

Polypharmacy Clinics

The polypharmacy clinics were run by a practice-based pharmacist team and provided medication reviews to people taking ten or more medicines, with the aim of reducing inappropriate polypharmacy. This intervention was chosen because appropriate IT infrastructure and communication with GP practices could allow this to be delivered in community pharmacies. This intervention was evaluated by Bryant et al. 2019 [34]. The target population for this intervention is estimated to be 2.2 million [2] and is also a population specified in the Directed Enhanced Service (DES) as requiring a structured medication review (SMR), Additionally, evidence suggests that priority patient groups for SMR are not all receiving timely medication reviews currently, leading to high risk of harm, so this intervention was deemed important to analyse [10]. The paper reported the cost savings associated with medicines and hospital admissions, and it was possible to calculate the cost per review based on the time required for the pharmacist to conduct it. The paper mentioned that training was provided on how to conduct the reviews. However, they did not report the time or resources associated with this training. 'Virtual' hospital admissions were also excluded in the base case because these were defined as instances where inappropriate prescribing could have resulted in a hospital admission if not changed, but there was uncertainty about the actual outcome.

An intervention for a similar population was conducted by Twigg et al. 2015, though this was for people taking four or more instead of ten or more medicines [26]. The intervention was found to be cost effective but not cost saving, suggesting that the benefits of these interventions are greater for people taking more medications. This intervention was not included in the analysis because the Bryant intervention had a greater impact on costs and therefore would be a more efficient use of healthcare spending than an intervention for people taking four or more medicines. Whilst this is the case, Twigg did report some additional findings which are useful for demonstrating other potential benefits of these interventions, such as a 0.116 reduction in average falls, and a 0.513 increase in MMAS-8 (medication adherence) score.

COPD support service

The second new intervention analysed from the literature came from Wright et al. 2015 who analysed a COPD support service based in community pharmacies [29]. This service provided both advice on medication use such as inhaler technique, as well as more general lifestyle advice, including smoking cessation. Around 1.4 million people in the UK currently have COPD [44]. Exacerbations of COPD can result in an increase in healthcare resource use and may result in sick leave from work [29]. However, these exacerbations and their severity can be reduced with appropriate lifestyle changes and medication use, which can generate cost savings to the healthcare system and improved QOL for the individual.

Wright et al. reported uptake of the service evaluated, intervention costs and resource cost savings, productivity savings, and QALY gains, which can be used in economic analysis. They also reported additional benefits which imply the potential for longer term cost savings, such as a 4.1% reduction in the number who smoked (with 13.85% of smokers stopping smoking), and a 0.564 increase in MMAS-8 (medication adherence) score. However, it was not possible to monetise these longer-term impacts.

PINCER

PINCER is an intervention that has had large-scale studies conducted on its potential benefits to the healthcare system [30, 33, 45]. PINCER is a pharmacist-led information technology intervention aimed at improving prescribing safety. Computerised queries identify 'at-risk' patients on GP clinical systems who are being prescribed drugs that are commonly associated with medication errors. A pharmacist uses the system to identify patients and reviews and makes recommendations for appropriate action for the patient.

Elliott et al. 2014 conducted an economic evaluation of the PINCER intervention, analysing both cost savings per GP practice and cost effectiveness [30]. This paper was used to evaluate the potential benefits of implementing the service into all GP practices. Chambers et al. 2024 identified PINCER along with another similar intervention called SMASH in their systematic review and found both interventions to be successful [16]. Rodgers et al. 2022 also found that PINCER decreased hazardous prescribing with an odds ratio 0.85 over 12 months [33]. Given these similar findings, this suggests that the evidence base is robust.

One problem with the studies on PINCER are that they do not consider the checks already conducted in community pharmacies when they receive a prescription, which already avoid impacts to the patient i.e. some errors identified and avoided as a results of PINCER, may have been identified in the absence of the PINCER intervention once a prescription arrived at a community pharmacy. In a report analysing the benefits of community pharmacy, conducted by PwC for Community Pharmacy England, they estimate the benefits of managing prescribing errors in community pharmacy [40]. Unfortunately, there are major differences in the population considered, costs considered, and methods used in this analysis compared with Elliott et al. and so it was not possible to use this study as a comparator in the analysis. However, it does highlight that cost savings may be reduced if considering this error checking by community pharmacists. Alternatively, cost savings may increase if considering additional costs such as legal fees if an individual takes a case to court, as the PwC paper considers.

It should also be noted that this intervention relies on access to healthcare records and integrated IT systems. This may present a barrier for implementation if this intervention were to be adopted into community pharmacy. That being said, the new NHS 10 Year Health Plan aims to join community pharmacy into a Single Patient Record to help provide a more seamless service, which would address this issue [11].

2.2.4.3 Additional studies not included in data analysis

Some studies where we extracted data were not considered in our main analysis for various reasons, but we have included some brief commentary on them to highlight other potential areas where community pharmacy could provide an impact to the healthcare system.

Pharmacy Care Plans for over 50s with diabetes/CVD

A study from Twigg et al. 2019 on a Pharmacy Care Plan service targeted at people with diabetes or CVD [46] evaluated an intervention consisting of a medication review, measuring QRISK2 score (cardiovascular risk), provision of adherence advice, development of a personalised plan with goals for their condition, and referral to appropriate services where necessary. This population is estimated to be 10.8 million.

Additionally, people with diabetes are recommended to regularly complete nine key care processes to monitor and manage their condition, with only 54.3% of people with Type 2 diabetes in England receiving all nine care processes in 2023/24 [47]. Twigg reported the incremental costs and QALYs per person, along with additional outcomes such as a 0.26 increase in mean MMAS-8 (medication adherence) score and a reduction from 51.9% to 45.5% of people with high blood pressure. This suggests that there may be additional resource savings with a longer time horizon. An additional implication of the study was that the intervention could be applied to other long-term conditions in the future.

Medication Review in Care Homes

There were two studies which focused on pharmacist-led medication reviews in care homes. The Alves et al. 2019 study evaluating the implementation of medication reviews aimed at deprescribing in care homes reported appropriate costs data as well as resource use on hospital admissions, from which costs could be estimated [21]. When calculating an average cost per person including a cost per admission from the National Cost Collection [43] and an updated pharmacist cost from the Personal Social Services Research Unit (PSSRU) 2024 [48], we estimated a cost saving of around £52 per person. In comparison, Baqir et al. 2017 did not report the costs associated with staff time to deliver the intervention [35]. However, it did provide further insight into the intervention. For example, the most common medicines to be deprescribed were laxatives and skin treatments. Additionally, Alves reported that the intervention requires the ability to communicate with GPs, hence primary care pharmacists were used. On the other hand, Baqir suggested that GP communication did not make a significant difference to the results of the intervention. The systematic review reported by Chambers et al. 2024 included Alves in their analysis [16]. They reported successful implementation of care home interventions from all three studies reporting findings for care home interventions.

However, we have not included these care home interventions in our main analysis. This is because care homes tend to be prioritised for medication reviews by general practice already, based on our general feedback from clinicians. Additionally, it would be resource-intensive for community pharmacists to make visits to care homes to carry out these reviews, which would be difficult to facilitate given current capacity constraints.

ADHD

A study from The Health Foundation that evaluated a community pharmacy intervention for children with ADHD who were taking medication and needed regular monitoring with Child and Adolescent Mental Health Services (CAMHS) [49] was also initially considered but excluded. Whilst the UK population of children taking ADHD medication is relatively small (around 140,000), NHS ADHD services currently face immense pressures, including long waiting lists for assessments [50]. Therefore, an intervention which releases staff time in the service and is cost saving was deemed important to analyse. The paper reported the incremental cost per person, as well as the number of hours for different healthcare and administrative staff required and saved per person. For the study population at Sussex Partnership NHS Foundation Trust, they estimated that around 40% of the ADHD team's resources would be released, with a cost saving of £116 per review related to staff time.

However, we excluded this study from our main analysis. This was due to the limited data included in the report, such as no costs relating to parent and child travel, clinic room rent costs, secondary resource use such as GP appointments, and no meaningful economic value that we could use relating to the child's health. That being said, we would recommend further data collection in this area given the potential beneficial impact it could have on a strained service.

2.2.5 Limitations of included studies

The evidence from systematic reviews was limited by several factors. The included studies were generally short term (from 3 months to 12 months), making it difficult to understand whether the benefits of pharmacist-led interventions in medicines optimisation were sustained [13, 15]. 4 reviews reported that the studies lacked consistency, and that there was too much heterogeneity in outcomes to compare studies and come to robust conclusions [15, 17-19]. Data was often incomplete or poorly reported [13, 14, 17, 18, 20]. 2 of the reviews also highlighted the lack of a clear definition of a community pharmacy and its role [15, 20]. Concerns were raised about the quality of the evidence [17, 20] and the lack of data on cost effectiveness [14, 20].

The most frequently reported limitation of the primary studies was limited sample sizes, due to either difficulties with recruiting participants or high levels of attrition. 9 studies reported that this was an issue [23-28, 33, 34, 38]. Several studies had limitations with their study design, as they did not have a control group [24, 26, 28-30, 32] or used unvalidated tools to measure outcomes [21]. One study reported the use of a control group, but the control group was not followed-up, and the reasons for this were unclear [31]. Some of the studies relied on self-reporting of resource use and may be subject to recall bias [26, 29]. Issues with data collection were also reported, with data being incomplete or unavailable [23, 24, 32, 38], and there were issues with access to the patient record [32]. Follow-up times and time horizons were generally short. There was a recognition that differing practices and methods of service provision may affect costs [30], and there was uncertainty around some of the results of the cost-effectiveness studies due to paucity of data [39].

These conclusions are broadly in line with the current guidance for medicines optimisation from NICE [8], which found that there was little evidence in the literature on the cost-effectiveness of medication reviews. Where there was evidence, it was usually based on short-term studies with less than 6 months of follow-up.

2.2.6 Conclusions

The evidence review shows that there are benefits to pharmacist-led interventions for medicines optimisation. The reviews and primary studies both found that there were improvements in medication management, and a reduction in hazardous prescribing. Fewer hospital admissions were reported, and hospital stays were shorter. However, the studies also showed that the benefits may be greater for some patient populations than others, with studies on epilepsy and osteoporosis showing less favourable outcomes than those with diabetes, for example. The “review of reviews” concluded that pharmacist-delivered interventions had a role in improving clinical, humanistic, and economic outcomes related to pain management. The only included review of economic evaluations [19] reported that pharmacist-led interventions, in particular deprescribing, were cost effective according to the World Health Organization threshold. However, this review also emphasised the limitations of current economic evidence and concluded that more studies are needed.

3 Data Analysis

3.1 Methods

The data analysis aimed to estimate the expected costs and benefits of expanding the role of community pharmacy services in medicines optimisation according to the PICO, compared with current practice. The primary outcome of the analysis was the incremental change in costs to the healthcare system. This included a breakdown of costs and resource use associated with medicines optimisation interventions and current practice.

Where data permitted, a summary analysis was conducted on the change in QOL associated with adverse drug reactions and/or sub-optimal medication use. This included calculating the ICERs and net monetary benefit (NMB) of these interventions. However, a more thorough analysis of patient outcomes was not conducted.

Structured Medication Reviews and Personalised Asthma Action Plans were also considered but evidence was not taken directly from the literature search. Instead, these were suggested by the NPA as other areas where there may be potential for community pharmacies to provide net benefits to the healthcare system. The nature of these interventions is expanded on in Section 3.1.2.1 and Section 3.1.2.3, respectively.

The analysis was divided into two main types of interventions:

- Existing interventions which have the potential for expansion.
    - NMS.
    - DMS.
- New/pilot interventions which have the potential to be implemented on a national scale.
    - Structured Medication Reviews (SMRs).
    - Polypharmacy clinics providing revies for people with ten or more medicines.
    - Pharmacists providing personalised asthma action plans (PAAPs) and educational advice for asthma.
    - Education and advice intervention for people with COPD.
    - PINCER intervention for error checking.

3.1.1 Existing interventions

3.1.1.1 NMS

To evaluate the NMS, we used data from Elliott et al. 2020 on the cost saving per person and cost effectiveness [38] and used dispensing data for the NHS Business Service Authority to calculate the total number of NMS performed each year [51], and the potential that could be performed given each pharmacy's monthly prescription volume and related maximum caps for payment [52]. We only included pharmacies who were currently running the NMS (with counts above zero).

Data were available to allow cost savings at six months and lifetime savings to be calculated. Analysis of costs considered both values. The six-month costs were inflated from 2012/13 to 2023 prices using the PSSRU inflation index [48]. However, the lifetime costs were not inflated as they were discounted over the patients' lifetime. Lifetime QALY gains were also available, so these were used along with the lifetime cost savings to estimate cost effectiveness, mostly replicating the calculations performed by the authors. The input values used are reported in Table 3.1.

Table 3.1: Input values for NMS calculations

Input	Value	Notes
Current number of NMSs estimated in the UK	5,124,545	Total claims from Dec 23 to Nov 24. NHS Business Services Authority 2025 [53]
Maximum number of NMSs for community pharmacies in England	8,005,440	Most recent (Nov 24) dispensing contractors data scaled up to one year. Uses only pharmacies with non-zero NMS count (assuming these are pharmacies who have 'opted in' to the service). Caps calculated using prescription counts and cap data from Community Pharmacy England. NHS Business Services Authority 2025 [51] Community Pharmacy England 2024 [52]
6-month costs in the intervention arm	£513.97	Reported as £415.84 using 2012/13 costs. Inflated to 2023 costs using PSSRU inflation index. Elliott et al. 2020 [38] PSSRU 2024 [48]
6-month costs in the normal practice arm	£642.96	Reported as £520.21 using 2012/13 costs. Inflated to 2023 costs using PSSRU inflation index. Elliott et al. 2020 [38] PSSRU 2024 [48]
Mean lifetime cost per patient – intervention	£20,482.70	Elliott et al. 2020 [38]
Mean lifetime cost per patient – normal practice	£20,596.50	Elliott et al. 2020 [38]
Incremental lifetime QALYs per patient	0.04	Elliott et al. 2020 [38]

NMS – New Medicines Service; QALY – quality-adjusted life year.

3.1.1.2 Discharge Medicines Service (DMS)

For the DMS, the costs and benefits per person receiving a review (DMR) and the potential additional population that would benefit from the service compared with current low uptake were considered, by applying the rate of the region with highest rate of referrals to the whole population of England, estimated by Thayer et al [42].

The cost of one hospital admission was calculated as the average unit cost for all admitted patient care from the NHS National Cost Collection 2023/24 [43]. This was then multiplied by the number of (90-day) readmissions avoided per DMR, calculated from Thayer et al. 2023 [42]. There were multiple sources available for the cost saving per DMR for hospital readmissions and these were also explored in scenario analysis. However, using Thayer et al. and the National Cost Collection produced the most conservative estimate, and so this was used in the base case to calculate the potential savings. The cost of each DMR, the A&E cost savings per DMR, and the medicines wastage cost savings per DMR were taken from a report from Hodson et al. 2014 evaluating the Welsh DMS [41] and were then inflated to 2023 costs using the PSSRU inflation index [48].

The Welsh DMS report also estimated the QALY loss associated with one DMR compared with standard care. This was used to consider the potential cost effectiveness of the intervention.

Additional data were available from Nazar et al. 2016 on the number of bed days per readmission [23]. There is no robust method for costing hospital bed days as costs are generally front-loaded for each admission when initial investigations are conducted. The costs also depend on the reason for the admission. Therefore, the cost savings from the change in the number of bed days per readmission were not estimated but the number of bed days saved from conducting DMRs were estimated, to demonstrate the potential for additional cost savings. To calculate bed-day reductions, readmission rates reported by Nazar et al. were used rather than Thayer et al., so that the same study conditions were used throughout the calculation. All base-case inputs are reported in Table 3.2. The scenario values used, and their associated sources, are reported in Table 3.3.

Table 3.2: Input values for DMS calculations

Input	Value	Notes
Current England population receiving DMRs	65,634	Thayer et al. 2023 [42]
Potential population that could receive DMRs if the region with the highest referral rates is matched across the country	329,785	Cheshire and Merseyside had the highest rate of referrals of 509 per 10,000 hospital admissions, giving 329,785. Thayer et al. 2023 [42]
Number of 90-day readmissions avoided per DMR	0.09	29,487 readmissions divided by 329,785 DMRs. Thayer et al. 2023 [42]
Cost of one hospital (re)admission	£1,853	Average unit cost for all admitted patient care.

Input	Value	Notes
		NHS National Cost Collection 2023/24 [43]
Cost of one DMR	£88.90	Reported as £72.72 – including set-up cost payments, £37 per DMR paid to community pharmacies, levies, and hospital staff costs. Inflated from 2013/14 to 2023 prices using PSSRU inflation index. Hodson et al. 2014 [41] PSSRU 2024 [48]
A&E cost savings per DMR	£21.74	Reported as £17.78 (£260,400 / 14,649). Inflated from 2013/14 to 2023 prices using PSSRU inflation index. Hodson et al. 2014 [41] PSSRU 2024 [48]
Medicines wastage cost savings per DMR	£1.14	Reported as £0.93 (£13,660 / 14,649). Inflated from 2013/14 to 2023 prices using PSSRU inflation index. Hodson et al. 2014 [41] PSSRU 2024 [48]
QALY loss per DMR (with DMR)	0.001	Hodson et al. 2014 [41]
QALY loss per DMR (without DMR)	0.05	Hodson et al. 2014 [41]
Bed day calculations		
Readmission rate with DMR	12.8%	Sum of 30, 60, and 90-day admissions (additive values in the source) divided by N=501. Nazar et al. 2016 [23]
Readmission rate without DMR	34.9%	Sum of 30, 60, and 90-day admissions (additive values in the source) divided by N=885. Nazar et al. 2016 [23]
Bed days per readmission with DMR	7.23	Weighted average bed days for 30, 60, and 90-day readmissions. Nazar et al. 2016 [23]
Bed days per readmission without DMR	13.10	Weighted average bed days for 30, 60, and 90-day readmissions. Nazar et al. 2016 [23]

DMR – discharge medicines review; DMS – discharge medicines service; ONS – Office for National Statistics; QALY – quality-adjusted life year.

Table 3.3: Scenario values used for DMS

Value varied in scenario	Base-case value	Scenario value	Notes
Cost per hospital admission	£1,853	£2,635.16	Cost from 2018/19 of £2,293 per admission, specific to adverse drug reactions. Inflated to 2023 costs using PSSRU inflation index. Osanlou et al. 2022 [54] PSSRU 2024 [48]
Hospital admission cost saving per DMR	£165.68	£689.32	Base-case unit cost per admission used. 31.4%

			probability of readmission vs 68.6% without a DMR. Mantzourani et al. 2020 [32]
Hospital admission cost saving per DMR	£165.68	£418.78	Base-case unit cost per admission used. 12.3% probability of readmission vs 34.9% without a DMR. Nazar et al. 2016 [23]
Hospital admission cost saving per DMR	£165.68	£327.53	2013/14 cost of £267.91 used and inflated to 2023 costs using PSSRU inflation index. Hodson et al. 2014 [41] PSSRU 2024 [48]
Hospital admission cost saving per DMR	£165.68	£274.24	Base-case unit cost per admission used. 8.5% probability of readmission vs 23.3% without a DMR. Wickware et al. 2020 [31]

DMR – discharge medicines review; DMS – discharge medicines service.

3.1.2 New interventions

3.1.2.1 Structured Medication Reviews (SMR)

The Royal College of General Practitioners (RCGP) and Royal Pharmaceutical Society (RPS) Repeat Prescribing Toolkit commissioned as part of NHS England's work on Overprescribing defined 3 levels of medication review carried out in general practice: simple repeat medication check (clinical reauthorisation), medication review and SMR.

The NPA identified SMRs as an additional area where community pharmacy may be able to provide benefit to the healthcare system. SMRs are recommended by the NICE NG05 and are the best tested intervention to reduce polypharmacy which can lead to preventable harm from medicines and admissions [55, 56]. Reduction in preventable harm and in-hospital admissions related to medicines as well as a net reduction in cost of medicines use when people are truly engaged in decisions about their care can lead to reduced NHS costs.

From October 2020, targeted SMRs formed part of the Primary Care Network (PCN) DES specification (and guidance) incentivised practices to identify and prioritise patients who would benefit from an SMR using pharmacists employed via the Additional Roles Reimbursement Scheme [57]. The specific requirements around SMR are no longer in the Network DES.

Not all patients who would benefit from an SMR in the priority groups receive one [10]. This was the case even when this was incentivised, causing a net cost pressure to the NHS. In 2023/24, only 16% of people using potentially addictive medicines, 54% of permanent care home residents aged over 18 years, 15% of people at highest risk of harm owing to medication errors, and 33% of people living with severe frailty received an SMR [10]. It is not clear which people are receiving shorter medication reviews, and which people are receiving no review at all, but what is evident is that there is a gap in delivery which would benefit from additional clinical capacity to meet demand.

Community pharmacists are well-placed to provide this service as they have specialist pharmaceutical knowledge, frequent contact with patients, and can be an accessible option to the patient in areas where it may be more difficult to access healthcare facilities such as in rural areas. Community pharmacists can also have a better indication of a patient's use of over the counter (OTC) medication, given that they are an access point for these medications. There are still deaths being caused by medicines taken alongside acute prescriptions or OTC medications, accounting for one third of coroners' prevention of future death reports reporting medication-related deaths [58]. This does not include less severe ADRs which may result in increased healthcare resource use such as hospitalisation. In the same study, the authors found that the absence of a medication review was the most commonly linked to these medication-related deaths. Community pharmacy can be used as an opportunity to address this current absence. However, barriers such as access to clinical records must also be considered.

Cost-effectiveness/cost savings

It is very difficult to measure the impact of SMRs on an individual patient level, as explained by Matthew Boyd, Professor of Medicines Safety at University of Nottingham: "SMRs have different value depending on the patient, the disease, the medicines [and] the complexities. It would be like saying, compare the success of cardiology versus thoracic surgery' [58].

Although it is difficult to measure the specific benefits per SMR, there is a good body of evidence to suggest cost savings and cost effectiveness in a wide range of populations and scenarios. For example, the iSIMPATHY evaluation report shows how an SMR intervention to address polypharmacy can be delivered by pharmacists [59]. These reviews employed a 7-step approach to appropriate polypharmacy and resulted in cost savings and QALY gains. Whilst they could not report a total net benefit due to potential double-counting, when considering only delivery costs and savings from medication changes, there was a saving of around £5,600 per 100 reviews undertaken.

Other examples that demonstrate the benefits of SMRs include:

- The OPERAM trial, which showed cost-savings for a software-assisted SMR for older adults with multimorbidity and polypharmacy [60].
- A retrospective study from Kempen et al. 2014 which found 13,366 drug-related problems from 4,574 clinical medication reviews including 1,164 instances of ineffective drugs, 1,129 adverse effects, and 1,390 instances of the wrong medication dosage [61].
- An economic evaluation of the DREAMeR study, which found a more than 90% likelihood of clinical medication reviews for older patients with polypharmacy being cost saving compared with usual care [62].

Inputs

Our analysis considered the potential amount of primary care staff time/ PCN shared resource time that could be released if community pharmacists were to take on SMRs for a proportion of the target populations highlighted in the Network Contract DES as requiring an SMR [63]. Our populations were limited to people living in care homes, people taking ten or more medicines, people with severe frailty or housebound, and people taking potentially addictive medicines,

because data were not available for other population sizes specified in the DES contract. We also collected data on the proportion of these populations who don't currently receive an SMR.

Data were only available for England, apart from for care homes where it was possible to estimate the whole UK population. The population estimate for people with severe frailty or who were housebound should be used with caution as the housebound population uses estimates from earlier surveys and extrapolates them to 2018 population numbers. There may also be double counting with the population with severe frailty and the population who are housebound. The population sizes and sources are presented in Table 3.4.

The proportion of people not currently receiving an SMR are listed in Table 3.5. These inputs were sourced from an article from Lipanovic based on data from DES [10]. Data were not available for people taking ten or more medicines. However, we still felt it useful to discuss this population due to its size and, therefore, the implication for the number of people not receiving SMRs. Given that it is our understanding from clinical feedback that care homes are the main focus for GPs to use their clinical pharmacist resource and that only around 54% of this population is receiving the service, it is likely that the population taking ten or more medicines is receiving a much lower percentage provision of SMRs.

Table 3.4: Population sizes of those recommended to have SMRs

Population	Population size	Notes
UK care home population	441,479	carehome.co.uk 2025 [64]
People taking ten or more medicines – England only	2,200,000	Department of Health and Social Care 2021 [2]
People with severe frailty or housebound – England only	398,846	The population with severe frailty was estimated to be 58,846 in 2017. The housebound population was estimated to be 340,000 for people over 85 in 2018. Walsh et al. 2023 (Supplementary information Appendix 3) [65] Winn et al. 2023 [66]
People taking potentially addictive medicines – England only	6,250,000	11.5 million adults received potentially addictive medications in 2017 to 2018. Around half of prescriptions in March 2018 were from people taking the medication regularly for at least 12 months should therefore be receiving an annual review. Public Health England 2020 [67]

Table 3.5: Population proportions who received an SMR in 2023/2024

Population	Proportion receiving SMRs in 2023/2024	Notes
UK care home population	54%	Lipanovic 2024 [10]
People with severe frailty or housebound – England only	33%	
People taking potentially addictive medicines – England only	16%	

The hourly costs of different healthcare professionals were taken from the PSSRU [48]. The hourly costs used in the analysis are reported in Table 3.6. It was estimated that an SMR would take around 30 minutes [57, 68, 69]. We used these figures to compare the cost of provision of medication reviews among different primary care staff.

Table 3.6: Hourly costs of different healthcare professionals

Healthcare professional	Cost input	Notes
GP	£294.00	Includes direct staff costs and qualification costs. PSSRU 2024 [48]
Advanced nurse practitioner (ANP)	£64.00	Includes qualification costs. PSSRU 2024 [48]
Practice nurse (PN)	£53.00	Includes qualification costs. PSSRU 2024 [48]
Clinical pharmacist (primary care)	£68.31	Assumes Band 7 NHS pharmacist [70]. Includes qualification costs, assumed to be the same as for hospital pharmacists - £5.31 assuming 42 working weeks per year and 37.5-hour weeks. PSSRU 2024 [48]
Community pharmacist	£58.09	Assumes Band 6 pharmacist as stated in the PSSRU community-based scientific and professional staff list. Includes qualification costs, assumed to be the same as for hospital pharmacists - £5.09 assuming 42 working weeks per year and 40-hour weeks. PSSRU 2024 [48]

3.1.2.2 Polypharmacy clinics

Polypharmacy clinics for people taking ten or more medicines was analysed by Bryant et al. as discussed in the literature review [34]. The costs and benefits per person were considered and scaled for a national population. The population was taken from a report by the Department of Health and Social Care [2]. This was only available for England and not the whole of the UK. Staff costs were derived from the PSSRU [48] and applied to the time per review reported in the study of 11.7 minutes. The other cost inputs were taken directly from Bryant et al. [34]. Scenario analysis was also conducted to consider a 30-minute appointment time, similar to an SMR.

Table 3.7: Input parameters for polypharmacy clinic intervention

Input	Value	Source
People taking ten or more medicines – England only	2,200,000	Department of Health and Social Care 2021 [2]
Time per review (hours)	0.20 0.50 (scenario)	Bryant et al. 2019 [34]
Pharmacist cost per hour	£58.09	Includes qualification costs, assumed to be the same as a hospital pharmacist. £5.09 assuming 42 working weeks per year and 40-hour weeks. PSSRU 2024 [48]
Medication cost savings per review	£126.54	Bryant et al. 2019 [34]
Hospital admission cost savings per review	£166.40	Bryant et al. 2019 [34]

3.1.2.3 Personalised Asthma Action Plans (PAAPs) and asthma education

Asthma and Lung UK estimated that in 2020 around 52.2% of people with asthma had received a PAAP, similar to rates in 2019 [71]. Additionally, only around 34.7% of people had received all three key elements of basic asthma care: attending an annual asthma review, having an inhaler technique check, and having a PAAP. The NPA identified PAAPs and asthma reviews/education could provide benefit to patients and the NHS.

A lack of adequate asthma care can lead to an increase in healthcare resource use, reduced QOL, and, in the worst cases, death [72-74]. Asthma and Lung UK found that four people die every day from asthma, and tens of thousands of people are admitted to hospital with life-threatening asthma attacks each year [73]. 54 children died due to asthma between April 2019 and March 2023, with one of the common themes identified in these incidents being the lack of an action plan [74]. The National Review of Asthma Deaths reported that only 23% of people who had died from asthma had been provided with a PAAP in either primary or secondary care and the Taskforce for Lung Health highlighted than in the 10 years on people were still not receiving PAAPs [73, 75]. This lack of provision suggested that there is a ‘need for improved advice for patients on the recognition and emergency self-management of asthma attacks’ with wider use of PAAPs having ‘the potential to prevent death from asthma by increasing the number of people who take appropriate action and seek help’ [73].

A systematic review and meta-analysis from Gibson et al. 2003 found that optimal self-management including a written action plan with self-monitoring and regular review reduced the probability of hospitalisation, A&E visits, and unscheduled GP appointments relating to asthma [72]. Given that only around 34.7% of people with asthma received all the element of basic asthma care, with only 52.2% of people receiving a PAAP, more needs to be done to meet current demand. Community pharmacies are well-placed to deliver PAAPs and asthma education and reviews due to their frequent contact with people who need inhalers. We used data from Gibson et al. in our analysis of the effect of increasing the number of people with PAAPs and annual reviews/education. The review did not analyse the effect on mortality. Therefore, this has not been included in our analysis. This means that our results are more likely to be conservative and that the benefits may be bigger.

The cost of delivering the intervention, including a PAAP, support for self-monitoring, and regular review was estimated, assuming that a 30-minute consultation would be required [76], and the potential resource-use savings associated with receiving education and a PAAP were costed, as reported by Gibson et al. 2003 [72]. The UK population of people with asthma was taken from the NICE Clinical Knowledge Summary on asthma [77]. The value of the changes in resource use were estimated using costs from PSSRU and NHS National Cost Collection [43, 48]. Given that currently only around 52.2% or people with asthma have a PAAP, 'what-if' analyses were performed to calculate the potential costs and benefits of increasing delivery to 70%, 80%, and 90% of people with asthma. The input values used are reported in Table 3.8.

Table 3.8: Input values for asthma care

Inputs values	PAAP values	No PAAP values	Notes
Population size	3,886,879		UK prevalence of asthma in people aged 6 years and over. NICE 2025 [77]
Intervention cost	£29.05	£0.00	£58.31 per hour for community pharmacist assuming same qualification costs as for a hospital pharmacist (£5.09 for 42 working weeks per year and assuming 40-hour weeks). 30-minute appointment. PSSRU 2024 [48] Asthma and Lung UK 2024 [76]
Probability of hospitalisation in one year	6.5%	11.2%	Calculated using only 'Optimal self-management' interventions which included a written review plan and self-management education. Gibson et al. 2003 [72]
Probability of A+E visit in one year	19.3%	25.4%	Calculated using only 'Optimal self-management' interventions which included a written review plan and self-management education. Gibson et al. 2003 [72]
Probability of an unscheduled GP visit in one year	6.5%	11.5%	Calculated using only 'Optimal self-management' interventions which included a written review plan and self-management education. Gibson et al. 2003 [72]
Cost of a hospitalisation for asthma	£1,261	£1,261	Weight average unit cost for all admission types under Admitted Patient Care. The following HRG codes for asthma were included: DZ15M; DZ15N; DZ15P; DZ15Q; DZ15R. NHS National Cost Collection 2023/24 [43]
Cost of an A+E visit for asthma	£273	£273	Weighted average unit cost for all emergency care HRG codes, excluding dead on arrival and dental: VB01Z; VB02Z; VB03Z; VB04Z; VB05Z; VB06Z; VB07Z; VB08Z; VB09Z; VB11Z. NHS National Cost Collection 2023/24 [43]
Cost of a GP visit for asthma	£49	£49	Includes qualification costs and direct care staff costs. PSSRU 2024 [48]
Proportion currently receiving a PAAP	NA	52.2%	Asthma and Lung UK 2021 [71]

PAAP – personalised asthma action plan.

3.1.2.4 COPD education and advice

For the COPD intervention analysed by Wright et al. taken from the literature review, the costs and benefits per person were considered and scaled for the national population along with cost-effectiveness analysis.

Asthma and Lung UK estimates the current UK population with COPD to be around 1.4 million [44]. Wright et al. reported around 65% uptake of the COPD service. They reported intervention costs, NHS resource cost savings, the estimated value in reduction in lost productivity, and 6-month QALY gains. Costs to the healthcare system were inflated from 2011/12 to 2023 costs using the PSSRU inflation index [48]. Because this index is specific to healthcare costs, productivity values were inflated using the UK GDP deflator [78]. These input values are reported in Table 3.9.

Table 3.9: Input parameters for COPD education intervention

Input	Value	Notes
Population size	1,400,000	Asthma and Lung UK 2022 [44]
Percentage uptake of the service	65.0%	Wright et al. 2015 [29]
Intervention cost per person	£101.22	Reported as £80.53. Inflated from 2011/12 to 2023 costs using PSSRU inflation index. Wright et al. 2015 [29] PSSRU 2024 [48]
NHS resource cost savings per person	£211.40	Pre-intervention costs reported as £581.59. 6-month post-intervention costs reported as £413.41. Inflated from 2011/12 to 2023 costs using PSSRU inflation index. Wright et al. 2015 [29] PSSRU 2024 [48]
Value of reduction in lost productivity per person	£8.81	Pre-intervention costs reported as £27.47. 6-month post-intervention costs reported as £21.01. Inflated from 2011/12 to 2023/24 costs using UK Government GDP deflator (a price ratio of 1.364). Wright et al. 2015 [29] UK Government 2025
QALY gains after 6 months	0.01	Wright et al. 2015 [29]

QALY – quality-adjusted life year.

There were further results reported by Wright et al., relating to successful smoking cessation and improved medication adherence which would likely provide long-term benefits in the future. These were not possible to quantify in our analysis but are discussed further in Section 4.2.4.

3.1.2.5 PINCER

For error checking, the costs and benefits of the PINCER intervention were analysed, a pharmacist-led IT-based intervention delivered in primary care to reduce medication errors, reported by Elliott et al. 2014 [30]. The data available were only reported per GP practice. Therefore, an updated cost per practice was calculated using the PSSRU inflation index [48], and this was scaled up to all practices in England [79]. QALY gains per practice were also available, so a cost-effectiveness analysis was conducted. Inputs are reported in Table 3.10.

Table 3.10: Input parameters for PINCER intervention

Input	Value	Notes
Number of GP practices in England	6,277	Statista 2025 [79]
Intervention cost per practice	£1,253	Reported as £1,014 and inflated from 2012 to 2023 costs using PSSRU inflation index. Elliott et al. 2014 [30] PSSRU 2024 [48]
Resource cost savings per practice	£4,564	Reported as £3,693 and inflated from 2012 to 2023 costs using PSSRU inflation index. Elliott et al. 2014 [30] PSSRU 2024 [48]
QALY gains per practice	0.81	Elliott et al. 2014 [30]

QALY – quality-adjusted life year.

3.2 Results

3.2.1 Existing interventions

3.2.1.1 New Medicines Service

For a six-month time horizon, Elliott et al. 2020 estimated the NMS to cost £513.97 per person, compared with £642.96 per person under normal practice when costs are inflated to 2023 values [38]. This resulted in an estimated £128.99 cost saving per person. When extending estimates to a lifetime horizon, this reduced to £113.80 per person, and 0.04 QALYs. Using the current annual number of NMS completed in the UK, this is estimated to produce a cost saving of £661 million with an additional 204,982 QALYs.

If the NMS could increase the number of people seen each year by 10%, this would result in an additional £66.1 million cost savings, and an additional 20,498 QALYs. The NICE threshold for cost-effectiveness is £20,000 per QALY gained. This means that NICE would value these QALY gains at around £410 million. If (participating) community pharmacies all met their cap, this is estimated to result in an additional £371.6 million cost saving, and 115,236 additional QALYs, compared with current supply. NICE would value these QALY gains at around £2.3 billion. A breakdown of the results is shown in Table 3.11.

Table 3.11: Cost savings associated with increasing the number of NMS in the UK

Parameter	Current	10% more	Full
Capacity	5,124,545	5,637,000	8,005,440
Cost savings	-£661,015,060	-£727,116,566	-£1,032,621,706
Incremental cost savings		**-£66,101,506**	**-£371,606,646**
QALYs (lifetime)	204,982	225,480	320,218
Incremental QALYs		**20,498**	**115,236**

NMS – New Medicines Service; QALY – quality-adjusted life year.

3.2.1.2 Discharge Medicines Service

Evidence on the DMS indicates that it can avoid a potential 0.089 readmissions per DMR completed (Thayer et al [42]). Using an average hospital readmission cost of £1,853, this results in a cost saving of £165.68 per DMR. Other evidence indicates that there is also an associated cost saving for A&E attendance reductions (£21.74 per DMR) and medicines wastage (£1.14 per DMR).

Using the population that currently receive DMRs and the potential population that are eligible for them, it was estimated that increasing the DMS to the level of the region with highest delivery across the UK would result in an additional annual cost saving of £26.3 million and generate an additional 12,494 QALYs. This produces a dominant ICER of -£2,107, meaning it is both cost saving and produces more QALYs. These additional QALYs would be valued at around £250 million, based on the NICE willingness to pay threshold of £20,000. Table 3.12 summarises the calculations.

Table 3.12: Cost savings and QALY gains associated with the use of DMRs to the eligible population leaving hospital

Parameter	Per person	Current (n=65,634)	Potential (n=329,785)	Incremental
Intervention costs	£88.90	£5,834,863	£29,317,887	£23,483,024
A&E savings	-£21.74	-£1,426,883	-£7,169,526	-£5,742,643
Hospital readmission savings	-£165.68	-£10,874,367	-£54,639,411	-£43,765,044
Medicines wastage savings	-£1.14	-£74,823	-£375,955	-£301,132
Incremental cost/benefit	**-£99.66**	**-£6,541,210**	**-£32,867,005**	**-£26,325,795**
Incremental QALYs	**0.05**	**3,104**	**15,599**	**12,494**
ICER	**-£2,107**			

DMR – discharge medicines review; ICER – incremental cost-effectiveness ratio; QALY – quality-adjusted life year.

Using the evidence from Nazar et al. [23] on the number of bed days per person, the current number of bed days avoided from people having DMRs was estimated at 239,332. However, if this was increased to the total estimated eligible population (applying the population receiving DMRs in the highest delivery area) (329,785), it was estimated that there would be a total of 1.2 million bed days avoided. This would result in an incremental reduction in bed days of nearly 1 million annually across the UK. The results are broken down in Table 3.13.

Table 3.13: Incremental bed days associated with provision of DMRs for all eligible people leaving hospital

Parameter	Per person	Current (n=65,634)	Potential (n=329,785)
Hospital days – standard care	4.57	300,072	1,507,744
Hospital days - DMS	0.93	60,740	305,196
Incremental bed days	-3.65	-239,332	-1,202,548
Overall bed day reduction			**-963,216**

DMS – Discharge Medicines Service.

The base-case results show the most conservative estimate of the potential benefits of the DMS. However, scenario analysis using the various input parameters specified in Table 3.3 estimates that the cost savings per DMR could be up to £623.30, giving an ICER of -£13,178. This would increase the potential incremental cost savings from treating the total estimated annual eligible population feasible to review in the UK by more than six times. The full scenario results are presented in Table 3.14. Negative ICERs mean that all scenarios are both cost saving and produce more health (additional QALYs) than without the DMS.

Table 3.14: Scenario analysis results for DMS

Scenario	Base-case input parameter	Scenario input parameter	Incremental cost per DMR	ICER
Base case			-£99.66	-£2,107
Cost per hospital admission specific to ADRs [54]	£1,853.00	£2,635.00	-£169.60	-£3,586
Mantzourani et al. cost saving associated with hospital admissions per DMR [32]	£165.68	£689.32	-£623.30	-£13,178
Nazar et al. cost saving associated with hospital admissions per DMR [23]	£165.68	£418.78	-£352.76	-£7,458
Hodson et al. cost saving associated with hospital admissions per DMR [41]	£165.68	£327.53	-£261.51	-£5,529
Wickware et al. cost saving associated with hospital admissions per DMR [31]	£165.68	£274.24	-£208.22	-£4,402

ADR – adverse drug reaction; DMR – discharge medication review; ICER – incremental cost-effectiveness ratio.

3.2.2 New interventions

3.2.2.1 SMRs

The analysis of SMRs specifically considered the direct cost differences between community pharmacists delivering SMRs and different primary care staff delivering SMRs or regular 10-minute medication reviews, as well as clinical time required to review the current unmet need for SMRs.

Table 3.15 reports the number of people missed for each population. It also reports the equivalent number of clinical hours required to review them with a 10-minute appointment or as an SMR. Facilitating this clinical time in community pharmacy would mean that clinical hours are made available to patients not currently able to receive an SMR or any review at all.

Meeting this unmet need should reduce harm from medication which would reduce hospital admissions from adverse drug reactions and should reduce medication costs from waste medicines.

Table 3.15: Population not receiving SMRs and equivalent clinical hours

Population	Number missed	Clinical hours if 10-minute reviews	Clinical hours if SMRs
Care homes	203,080	33,847	101,540
Frail or housebound	267,227	44,538	133,614
People prescribed potentially addictive medications	5,250,000	875,000	2,625,000

SMR – structured medication review.

The results displayed in Table 3.16 show the costs of community pharmacists and different primary care staff delivering regular 10-minute medication reviews, and SMRs. Costs for community pharmacists and PNs include one minute of GP time per review, assuming no license to prescribe.

Table 3.16: Unit costs for carrying out regular review and SMRs

Staff	Regular reviews	SMRs
Community pharmacist		£33.95
Clinical pharmacist		£34.16
GP	£49.00	£147.00
ANP	£10.67	£32.00
PN	£13.73*	£31.40*

ANP – advanced nurse practitioner; PN – practice nurse; SMR – structured medication review.
*Note that SMRs for PNs are less costly than ANPs but regular reviews are more costly. This is because one minute of GP time is applied in both instances rather than GP time being scaled by the length of the review.

Comparing the current estimated cost of a community pharmacist with the cost of primary care staff, using salary as a proxy for SMR cost for community pharmacists, showed community pharmacists cost slightly less than clinical pharmacists for SMRs, and much less than GPs for both regular reviews and SMRs. These are the two most relevant figures as clinical pharmacists currently take on most if not all SMR work commissioned by the PCN. Limited clinical opinion elicited during our study indicated that GPs pick up a substantial number of the remaining SMR population through 10-minute appointments. However, this quantity may vary from practice to practice. There may also be a proportion of the population who do not receive a 10-minute review either. Given that community pharmacists are estimated to be able to provide SMRs at a similar cost to practice pharmacists and at a lower cost than a regular review and SMR by a GP, it would be sensible to explore using this capacity.

Based on the estimated populations for various patient groups highlighted by the DES contract, and the percentage of these people not currently receiving an SMR, we estimate that around 203,000 people in care homes, 267,227 severely frail people, and 5.25 million people taking potentially addictive medicines are not currently receiving an SMR. Whilst data were not available on the number of people taking ten or more medicines who are not receiving an SMR, this population is currently around 2.2 million in England. This is much larger than the care home and severe frailty population combined and so it is sensible to assume that this constitutes another large population of people not receiving an SMR.

Looking at the potential costs savings when staff costs and NHS overheads are considered (in place of community pharmacy overheads), funding community pharmacy to deliver SMRs to meet unmet need is estimated to result in cost savings, particularly when compared with GP SMR costs. For people prescribed potentially addictive medications, delivering SMRs to a population size of 5.25 million is unfeasible with current capacity. Therefore, a population of 1 million was also considered to provide a more likely scenario. Results for each population are presented in Table 3.17.

Table 3.17: Estimated cost savings delivering SMRs to unmet population need in community pharmacy compared with clinical pharmacists and GPs

Population	Clinical pharmacist SMR	GP SMR
Care homes (N = 203,080)	-£43,018	-£3,057,369
Frail or housebound (N = 267,227)	-£56,605	-£4,023,102
People prescribed potentially addictive medications (N = 5,250,000)	-£1,112,083	-£79,038,750
N = 1,000,000	-£211,825	-£15,055,000

From September 2026, all newly qualified pharmacists will be independent prescribers [80]. This will mean that costing SMRs in the future will require less GP time to review any changes. However, there may be costs involved in infrastructure and reimbursing an additional skillset. Therefore, we believe it is reasonable to assume that the costs per SMR for a community pharmacist would remain similar to that of a clinical pharmacist in primary care.

These results also rely on community pharmacists having appropriate access to clinical records and effective communication channels with GP practices, discussed further in Section 4.2.1. These results also do not consider overhead costs such as premises and IT, also discussed further in Section 4.2.1.

3.2.2.2 Polypharmacy clinics

Evidence from Bryant et al suggested that prescribing reviews for people taking 10 or more medicines would result in cost savings in terms of medicine costs and a reduction in hospital admissions [34]. The cost of these reviews is assumed to be 11.7 minutes (GP consultation time). The reported cost savings were £126.54 for medicines and £166.40 for avoided hospital admissions.

Using the estimated population of people taking 10 or more medicines of 2.2 million in England, this would result in a net cost saving of nearly £620 million. The breakdown of results is shown in Table 3.18.

Table 3.18: Incremental costs associated with the use of polypharmacy clinics for the population prescribed 10 or more medicines (n = 2,200,000)

Parameter	Per person	England
Intervention costs	£11.33	£24,920,610
Incremental drug costs	-£126.54	-£278,388,000
Incremental hospital admission costs	-£166.40	-£366,080,000
Total incremental costs	**-£281.61**	**-£619,547,390**

Scenario analysis was conducted to estimate cost savings if this review took 30 minutes like an SMR would, rather than the 11.7 minutes used in the paper, which was the estimated average GP appointment time at the time the paper was written. Using this review time still results in a cost saving of £263.90 per person, which equates to an estimated £581 million net cost saving for the population in England. The full breakdown of results is shown in Table 3.19.

Table 3.19: Incremental costs associated with the use of polypharmacy clinics using a 30-minute appointment

Parameter	Per person	England
Intervention costs	£29.05	£63,910,000
Incremental drug costs	-£126.54	-£278,388,000
Incremental hospital admission costs	-£166.40	-£366,080,000
Total incremental costs	**-£263.90**	**-£580,569,000**

These cost savings represent the potential cost saving in an ideal scenario if there was unlimited spare capacity in community pharmacy and if activity could be switched from GPs and practice pharmacists to community pharmacists. This level of spare capacity does not exist and so a more realistic scenario would be for community pharmacists to use any spare capacity to ensure that people who are not able to access a GP-led polypharmacy clinic can access a medication review. A more realistic cost savings value could be attributed to this activity if the extent of spare community pharmacy capacity was known.

3.2.2.3 PAAPs and educational advice

The estimated cost of a 30-minute review, providing a PAAP and educational advice, including an asthma review to a person with asthma, was £29.05. Using the evidence on the change in one-year probability of a hospitalisation, A&E visit, or GP visit for asthma, and the unit costs reported in Table 3.8, we estimated an incremental cost saving of £48.87 per person. A breakdown of the incremental costs of each healthcare resource is reported in Table 3.20.

Table 3.20: Incremental costs associated with provision of education and PAAPs for people with asthma (per person)

Parameter	With intervention	Without intervention	Incremental
Intervention cost	£29.05	£0.00	£29.05
Hospitalisation cost	£82.21	£141.04	-£58.83
A&E visit cost	£52.76	£69.40	-£16.63
GP visit cost	£3.18	£5.63	-£2.45
Total	**£167.21**	**216.07**	**-£48.87**

Using these per-person figures, it was estimated that the current cost savings from PAAPs were around £98.9 million, given that around 52.2% of people with asthma have been given a PAAP (if this were provided by a community pharmacist). Increasing the provision of asthma education and PAAPs to 70%, 80%, and 90% of people with asthma with a community pharmacist is estimated to save an additional £33.8 million, £52.8 million, and £71.8 million respectively.

Table 3.21: Incremental costs associated with increasing the proportion of people with asthma receiving the intervention from 52.2% (current) to 70%, 80%, and 90%

Parameter	Current (n=2,028,951)	70% (n=2,720,815)	80% (n=3,109,503)	90% (n=3,498,191)
Intervention costs	£58,941,022	£79,039,684	£90,331,068	£101,622,451
Hospitalisation cost	-£119,369,756	-£160,074,385	-£182,942,155	-£205,809,924
A&E visit cost	-£33,746,226	-£45,253,560	-£51,718,355	-£58,183,149
GP visit cost	-£4,970,206	-£6,665,028	-£7,617,174	-£8,569,321
Total cost	**-£99,145,167**	**-£132,953,289**	**-£151,946,616**	**-£170,939,943**
Incremental change		**-£33,808,122**	**-£52,801,449**	**-£71,794,776**

3.2.2.4 COPD education and advice

When considering incremental costs to the NHS, Wright et al. estimated an (inflated) cost saving of £110.17 per person using the COPD education intervention [29]. Scaling this up to the UK population of people with COPD and applying an uptake of 65%, this intervention was estimated to produce a cost saving of £100 million to the NHS. When considering the potential additional benefit of decreasing lost productivity, the societal savings of this intervention were estimated to be £108 million.

The intervention was also estimated to produce 7,280 QALYs over six months. These additional QALYs would be valued at around £146 million, based on the NICE willingness to pay threshold of £20,000. This gave an estimated ICER for healthcare costs of -£13,772, and a societal ICER of -£14,873, because the intervention was both cost saving and produced more health benefits. A breakdown of the results is reported in Table 3.22.

Table 3.22: Cost savings and cost effectiveness of a COPD education intervention

Parameter	Per person	UK
Intervention costs	£101.22	£92,114,575
Healthcare savings	£211.40	£192,373,393
Productivity savings	£8.81	£8,017,100
QALY gains after 6 months	0.01	7,280
Incremental costs (healthcare only)	-£110.17	-£100,258,817
Incremental costs (societal)	-£118.98	-£108,275,917
ICER (healthcare only)	**-£13,772**	
ICER (societal)	**-£14,873**	

ICER – incremental cost effectiveness ratio; QALY – quality-adjusted life year.

3.2.2.5 PINCER

Elliott et al. 2014 estimated that the inflated cost per practice of implementing the PINCER intervention was £1,253 [30]. The healthcare resource savings per practice were estimated at £4,564, giving an incremental cost saving of £3,311. The QALY gains per practice were estimated to be 0.81. These figures applied to a five-year time horizon.

Based on an estimated 6,277 GP practices in England, the total estimated savings over a five-year period if the PINCER intervention was adopted would be £20.8 million, generating around 5,084 QALYs. These additional QALYs would be valued at around £102 million, based on the NICE willingness to pay threshold of £20,000. This gives an estimated ICER of -£4,088 because the intervention is both cost saving and produces more health. The results are presented in Table 3.23.

Table 3.23: Cost savings and cost effectiveness of implementation of the PINCER intervention in GP practices in England

Parameter	Result
Incremental cost per GP practice	-£3,311
Total incremental costs for England	-£20,784,214
QALY gains per GP practice	0.81
QALY gains in England	5,084
ICER	**-£4,088**

ICER – incremental cost-effectiveness ratio; QALY – quality-adjusted life year.

Implications for implementing this intervention in community pharmacy compared with GP practices are discussed in Section 4.2.5.

4 Discussion

This study analysed the potential economic benefit of expanding current community pharmacy services and of introducing new services on a national scale, based on results from the evidence review for medicines optimisation interventions and national data sources. The existing and new interventions included in this analysis are discussed in the following sections, including a description of any potential barriers to implementation and expansion of such services and how these could be overcome.

4.1 Investing in Existing Interventions

4.1.1 New Medicines Service

The current implementation of the NMS sees around 5.1 million consultations annually (according to data from December 2023 to November 2024 [53]), generating cost savings of £661 million compared with not having the NMS. It also generates nearly 205,000 QALYs. However, using data from the NHS Business Services Authority, it is estimated that pharmacies that choose to deliver the NMS, only meet around 52.5% of the maximum targets set out by the Community Pharmacy Contractual Framework [51]. It is unclear whether this is a supply or demand issue, as it was not possible to estimate the potential eligible population.

Only around 11% of community pharmacies in November 2024 delivered their maximum number of NMS reviews or more [51]. When these are removed, pharmacies on average only met about 45% of their cap. Given that the funding per NMS completed stops increasing after 40% of the maximum target is reached, this suggests that community pharmacies either try to reach their maximum target for NMS reimbursement or just aim to meet the minimum requirement to maximise their reimbursement per NMS. This implies that whilst they are not meeting the maximum number of NMS that they could be reimbursed for, community pharmacies are trying to ensure that the ones that they complete are sufficiently compensated for.

On 31st March 2025, details of the new contractual settlement with pharmacies were announced which included some changes to the NMS payment structure. Now, rather than only receiving a fee for completed NMS, the payment has been split so that half can be claimed for the initial consultation, and half for the follow-up consultation. As well as this, threshold have also been removed. This may provide better incentive for community pharmacies to conduct NMS consultations. However, it is too early to judge if this is the case.

4.1.2 Discharge Medicines Service

It was estimated that the DMS is both cost saving and produces QALY gains compared with standard care. However, using the study conducted by Thayer et al [42]. it is evident that this service is currently under-utilised by hospitals and referred patients, with the authors estimating that only around 20% of the current eligible population are accessing the service and completing reviews, and only 43% of community pharmacies in England are claiming for a DMS (complete or incomplete) in the first year. If the service reached its full potential, this could result in an additional £26.3 million in cost savings, which could be as large as £165 million when using values from Mantzourani et al. [32], with an additional 12,494 QALY gains.

Whilst it is not clear which barriers to full implementation are the biggest contributors, there are several potential areas which would benefit from further investigation to identify where funding could be invested to improve access to the service. Thayer et al. highlighted that access to the service may be caused by patient choice and from secondary care clinicians not sending referrals to the service [42]. Nazar et al. expanded on patient choice being a barrier, reporting on a study which found that patients who declined the service may not perceive any benefit from the service [23]. However, once patients were shown the benefits and availability of the service, the majority of patients were willing to participate. This suggests that the service could benefit from targeted advertising campaigns.

The DMS is also reliant on referral from hospital. Originally, there was no incentive for hospitals to generate community pharmacy referrals [42]. Whilst a Commissioning for Quality and Innovation (CQUIN) incentive, CQUIN06, was introduced in April 2023 to increase referrals, this has had limited impact on the number of DMRs completed, with the general (upward) trend of completed DMRs being similar to before the introduction of the incentive [81]. There may be a number of reasons why secondary care clinicians do not refer people for DMS reviews. The first is that hospital staff may have competing priorities [23]. Additionally, there is a disconnect between community pharmacies and the central healthcare system [23]. This includes electronic access to patient records and general communication, but also in general policy decisions which separate community pharmacy from the central healthcare system.

Another barrier to the DMS is the opportunity for engagement of community pharmacies themselves. Thayer et al. found that only 43% of community pharmacies were able to engage with DMS in the first year, although they predicted that this number should rise [42]. Many pharmacies did not receive referrals for DMS. Additionally, Nazar et al. found that 9.3% of rejected referrals were due to the pharmacy being unable to provide the review [23]. However, it is unclear why this was the case. One suggestion could be that pharmacists who have completed the training may not have the time within their current capacity to provide the service. Therefore, more funding for staff capacity may be required in community pharmacies to facilitate the DMS, given that this is stated as a mandatory essential service in the pharmacy contract.

4.2 Investing in New Interventions

4.2.1 SMRs

Moving SMRs to community pharmacy has the potential to save a large amount of primary care staff time. For example, if the population with severe frailty all received SMRs in general practice currently, this would save over 134,000 clinical hours of primary care clinician time that would otherwise need to be sourced from GPs and clinical pharmacists. However, it is more likely that many of these reviews are integrated into other 10-minute appointments. Clinicians report that there is not enough staff capacity to deliver full SMRs to all the groups recommended by NICE and specified in the DES contract. This means that this would save over 45,000 clinical hours in primary care and increase the eligible population receiving SMRs. Whilst our analysis considers specific populations where people are missed for SMRs, the concern for decision makers should be ensuring that unmet need across all priority groups is addressed, given that these people are at the most risk of harm if a detailed, structured review of their medication is not considered.

Additionally, SMRs delivered by community pharmacists are estimated to be cost saving compared with primary care clinical pharmacists and GPs. There is, therefore, a case to direct funding for expanding SMR services towards community pharmacy when considering direct staff costs and NHS overheads. This is before considering the benefits of receiving a medication review, which are discussed for the care home population and population taking ten or more medications from a deprescribing perspective in Section 4.2.2. Additionally, there may be other populations that would benefit from SMRs that are not prioritised currently. However, this does not consider the specific costs associated with community pharmacy overheads, potential training, or implementing referral mechanisms.

Community pharmacy has traditionally not been able to do a SMR because of lack of access to the clinical record. However, GP Connect is improving access to the patient clinical record nationally and locally some community pharmacies have access to the patient record through web-based versions of GP systems - EMIS and SystmOne.

One example evaluated the impact and feasibility of community pharmacies using an integrated clinical electronic health records system from SystmOne [82]. This allowed practices to book over 19,000 patients into community pharmacy appointments through the system, and for pharmacies to directly record over 16,000 consultations and clinical interactions. GPs and pharmacists perceived improved clinical decision-making, a more comprehensive understanding of patient history, enhanced safety and quality of care, streamlined workflows and improved communication. Patients benefited from increased access to timely consultations. There were some barriers to implementation including technical issues, staff capacity constraints, and the need for patients to consent to accessing their records [82]. These improvements in communication and integration will also facilitate general improved partnerships with multidisciplinary teams which are essential to providing an effective SMR.

It has also been highlighted in the new NHS 10 Year Health Plan that community pharmacies will be securely joined up to a Single Patient Record. Therefore, this barrier is not expected to persist if this is actioned.

There are some current capacity issues which are in the process of being addressed. The Pharmaceutical Journal's 2024 salary survey showed that only 14% of community pharmacists were independent prescribers, compared with 71% of pharmacists in general practice [83]. However, from September 2026, newly qualified pharmacists will enter the General Pharmaceutical Council register as independent prescribers [84]. Additionally, training and education initiatives are being funded through the NHS England Pharmacy Integration Fund to support existing community pharmacists to expand their scope of practice, including in independent prescribing. These all form part of the NHS Community Pharmacy Independent Prescribing Pathfinder Programme.

In terms of staff time, when the medicines use review (MUR) service was running, over 90 million MURs were completed every year [85]. These typically lasted around 15 to 25 minutes so were a little shorter than an SMR would be [86]. Assuming that they all took 15 minutes, this would translate to a possible 45 million SMRs at minimum, although other clinical services have since been introduced. There is currently critical staffing pressure in community pharmacies from recruitment and retention issues, resulting in increased workloads, delays for patients, and closures [87]. These issues need to be addressed through appropriate incentives to gain and retain staff, to be able to facilitate these potentially very beneficial services.

One limitation of the results for this intervention as mentioned previously is that salaries for community pharmacist are used with NHS overhead costs rather than the unique overhead costs that would relate to running a community pharmacy. This should be considered when interpreting the results of the study. Costs associated with training and implementing an appropriate method of referral should also be considered. Given the potential benefits highlighted in our findings, it is recommended that further studies be conducted to explore moving SMRs into community pharmacy, which account for these additional overheads and mechanisms and look at ways of targeting priority patient groups not currently receiving SMRs.

4.2.2 Polypharmacy clinics

We estimated polypharmacy clinics to be cost saving. Scaling the costs and savings per person for the intervention costs, drug cost savings, and actual hospital admission savings, a conservative estimate of £619 million of net cost savings was calculated. This figure did not include 'potential' hospital admissions recorded by the authors as it was not clear whether they had accounted for the fact that a 'potential' hospital admission may not translate into an actual admission. Additionally, the cost savings from avoided GP appointments were also excluded. This is because the authors assumed that this review would be performed by a GP if the pharmacist was not providing it. However, we cannot be certain which primary care clinician would be performing the review instead. Therefore, there are potential additional benefits to this intervention that would increase cost savings. The intervention would require one-off training costs, but it could not be discerned what the cost for the medicines optimisation team would be for the 'training packages from the Centre for Pharmacy Postgraduate Education on polypharmacy and consultation skills' specified by Bryant et al., delivered to the pharmacists at the start of their study [34]. Given that the project required 0.4 whole-time equivalent pharmacists to run the polypharmacy clinics, funding would need to be made available to facilitate this staff capacity.

Again, the results for this intervention use salaries for community pharmacist are used with NHS overhead costs rather than the unique overhead costs that would relate to running a community pharmacy, which should be considered when interpreting the results of the study.

4.2.3 Personalised Asthma Action Plans (PAAPs)

PAAPs are currently delivered to around 52.2% of the population, generating cost savings to the healthcare system [71]. However, PAAPs are recommended by NICE to be delivered to all people with asthma over the age of 5 (QS25), so there is potential to expand their delivery [88]. Having community pharmacists providing a dedicated service to PAAPs and asthma education could increase provision. If uptake was increased to 70%, 80%, and 90%, it was estimated this would generate additional cost savings of £33.7 million, £52.7 million, and £71.6 million, respectively.

These savings do not include the additional benefits of primary care staff time being released if community pharmacists take on all asthma review appointments, or QOL gains which Gibson et al. analyse (Analysis 1.14) as part of their meta-analysis, estimating a standardised mean difference (SMD) of 0.12 [72]. Given that SMD is a way of standardising effect size across different measures and not a specific QOL measure, it could not be used to conduct a cost-effectiveness analysis, but it does demonstrate that there are potential QALY gains from an intervention that provides PAAPs and patient education.

This intervention would also link to the aim outlined in the NHS 10 Year Health Plan to increase the role of community pharmacists in the management of long-term conditions [11]. As with SMRs and polypharmacy clinics, the results for this intervention use salaries for community pharmacist are used with NHS overhead, which should be considered when interpreting the results of the study.

4.2.4 COPD education and advice

The education intervention for people with COPD was estimated to save around £100 million in the healthcare system if rolled out across the UK. It was also estimated that there would be £7.8 million worth of avoided productivity loss. Additionally, it was estimated that around 7,280 QALYs would be produced over a six-month time horizon. These benefits do not account for the potential longer-term benefits of stopping smoking and increased adherence to medication. For example, Wright et al. found that 13.85% of the cohort who originally smoked had stopped smoking. Maintained over a longer period, this is associated with a 17% risk reduction in all-cause mortality for people with COPD [89]. Additionally, the probability of worsening COPD severity and incidence of lung cancer also reduces with former smokers compared with current smokers [90, 91]. COPD is estimated to cost the NHS £1.9 billion each year, with costs increasing with severity of illness [92]. The direct healthcare costs of lung cancer alone are £16,200 per case [93]. Therefore, the long-term outcomes associated with this intervention have substantial cost-saving and QALY implications. We would recommend that further studies be conducted to explore these potentially significant long-term benefits. The initial evaluation of this service demonstrated that collaborative working with GP practices is both possible and necessary to implement an effective service. Rolling this out to serve a population of 1.4 million people would require additional funding to build staff capacity.

4.2.5 PINCER

The PINCER trial demonstrated the economic benefit of implementing the error checking intervention in GP practices. If deployed across all GP practices in England, this could generate cost savings of £20.8 million, producing 5,084 QALYs over a five-year time horizon. There are several factors to consider if this intervention were to be rolled out on a wider scale. First, given that pharmacists (and pharmacy technicians) would be working with GP practices to deliver the intervention, it would be important that appropriate communication channels and IT infrastructure are implemented. This has previously been identified as a key barrier to maintaining continuity of care, with pharmacies often using standalone digital platforms [82]. However, as highlighted in the NHS 10 Year Health Plan, this barrier is expected to be addressed by linking community pharmacies up to a Single Patient Record [11].

Additionally, staff capacity in pharmacy is currently limited. To be able to provide this intervention, funding would be required for additional staff capacity to deliver the intervention, as costed by Elliott et al. in relation to training, regular meetings, and error management [30].

It should be noted that the PINCER intervention has only been run as a trial. In April 2019, GP surgeries were incentivised by the General Medical Services contract to demonstrate continuous quality improvement in relation to prescribing safety and encouraged to ‘engage with their local AHSNs to use PINCER’ [94]. However, there has been no systematic implementation of PINCER in general practice since then despite the evidence base on its effectiveness. This suggests that there may be barriers to implementation of this intervention at scale.

4.2.6 Interventions summary

A summary of the results and associated discussion for each intervention is presented in Table 4.1.

Table 4.1: Summary of results and discussion

Intervention	Costs	Savings	Health outcomes	Assumptions	Barriers to implementation
New Medicines Service	No specific intervention cost reported by the paper but we know that payment for NMS is £28 if both the initial and follow-up appointment are completed. Healthcare costs were £513.97 per person in the intervention group and £642.96 per person in the comparator group.	▪ Net saving of £128.99 per person over 6 months. ▪ Additional saving of £66.1 million with a 10% increase in NMS. ▪ Additional saving of £371 million at estimated full capacity (max cap). ▪ Savings per person reduces to £113.80 using a lifetime horizon.	▪ 0.04 additional QALYs per person. ▪ 20,498 additional QALYs with a 10% increase in NMS. ▪ 115,236 additional QALYs at estimated full capacity (max cap).	The full capacity results assume that it is feasible for pharmacies to meet their cap. This should be possible given that they are set according to their prescription volume. However, the 10% figures have been used to demonstrate another feasible scenario.	▪ Patient engagement with the service. ▪ Potentially staff capacity. ▪ Potentially incentivisation (though payment structure has recently changed). ▪ Currently within the fixed envelope of the community pharmacy contractual framework. Needs to be funded outside of this.
Discharge Medicines Service	Estimated cost of £88.90 per DMS review.	▪ Net saving of £99.66 per person from A&E, hospital admission and medicines wastage savings. ▪ Net saving of £31.1 million if service increased to its estimated potential (in line with highest current delivering region).	▪ 0.05 additional QALYs per DMR. ▪ 14,768 additional QALYs if service increased to its estimated potential. ▪ ICER of -£2,107.	All regions are capable of delivering DMS at the same rate as the region with the highest reported activity.	▪ Hospitals referring into the service. ▪ Patient engagement. ▪ Staff capacity. ▪ Disconnect between community pharmacies and the rest of the health system.

Intervention	Costs	Savings	Health outcomes	Assumptions	Barriers to implementation
Structured medication reviews delivered in community pharmacies			N/A	Results assume NHS overheads reflect community pharmacy overheads. Assumes appropriate infrastructure to facilitate SMRs in community pharmacy.	▪ Infrastructure including access to clinical records. ▪ Communication pathways with GPs and MDT. ▪ Number of community pharmacists who are independent prescribers. ▪ Staff capacity.
Pharmacist-led polypharmacy clinics	Intervention cost of £11.37 using appointment length from the paper or £29.16 per person for a 30-minute (SMR length) appointment.	▪ Net saving of £281.57 per person using reported appointment length. ▪ Translates to net saving of £619 million for England. ▪ Net saving of £263.78 per person using 30-minute appointment length. Translates to net saving of £580 million for England.	N/A	Results assume NHS overheads reflect community pharmacy overheads.	▪ Staff capacity (0.4 whole-time-equivalent pharmacist). ▪ Access to clinical records.

Intervention	Costs	Savings	Health outcomes	Assumptions	Barriers to implementation
Personalised asthma action plans and asthma reviews delivered in community pharmacies	Intervention cost per person of £29.16.	▪ Net saving of £48.76 per person from reduction in hospitalisations, A&E visits, and GP visits. ▪ Additional cost saving of £33.7 million if PAAPs delivered to 70% of the asthma population. ▪ Additional cost saving of £52.7 million if PAAPs delivered to 80% of the asthma population. ▪ Additional cost saving of £71.6 million if PAAPs delivered to 90% of the asthma population.	N/A	Results assume NHS overheads reflect community pharmacy overheads. Quality of life and mortality data were excluded as it was not reported in a form that could be translated into an economic value. Assumes appropriate infrastructure to facilitate.	▪ Infrastructure investment such as access to clinical records. ▪ Staff capacity.
COPD education and advice intervention	Intervention cost of £101.22 per person.	▪ Net healthcare savings of £110.17 per person. ▪ Net societal savings of £118.98 per person. ▪ UK net healthcare savings of £100 million. UK net societal savings of £108 million.	▪ 6-month QALY gains of 0.01 per person. ▪ UK 6-month QALY gains of 7,280. ▪ Healthcare ICER of -£13,772. Societal ICER of -£14,873.	Longer term benefits excluded due to lack of data but further benefits from smoking cessation and improved medication adherence.	▪ Staff capacity. ▪ Communication with GP practices.
PINCER trial	Intervention cost of £1,253 per GP practice.	▪ Net savings per GP practice of £3,311. ▪ Net savings across England of £20.8 million.	▪ QALY gains per GP practice of 0.81. ▪ QALY gains across England of 5,084. ▪ ICER of -£4,088.	Error checking from community pharmacists upon receipt of a prescription are not considered in the analysis. Appropriate infrastructure.	▪ Communication with GP practices. ▪ Access to clinical records and GP IT systems. ▪ Staff capacity.

5 Conclusions

This study estimated that of the seven existing and potential new medicines optimisation interventions in UK primary and community care included in this analysis, all seven were cost saving. The study suggested that currently commissioned services like the NMS and DMS have substantial potential to save the NHS further money/resources if utilised more effectively. There are also additional benefits to these interventions that were not always accounted for, such as increased primary care staff time being released and cost savings from avoided GP appointments. This suggests that expanding the role of community pharmacy in medicines optimisation to introduce these new interventions or expand the use of existing interventions could be cost saving to the UK NHS and improve health outcomes. This will also support the NHS 10 Year Health Plan that promised that community pharmacies would play an integral role in delivering clinical services in the future.

There is evidence in certain populations that pharmacist-led medicines optimisation interventions are cost effective and cost saving. Currently general practice does not have the capacity to provide these services to the entire population that would benefit. With changes to legislation impacting skill mix, supervision and hub and spoke dispensing, and a rapid increase in pharmacist independent prescribers, there is an opportunity to use the clinical skills of community pharmacy professionals to meet this demand and to reduce both patient harm and NHS costs.

There are some barriers that need to be overcome to make this possible. These include improving the integration of pharmacies into the rest of the health system including access to shared electronic health records, adequate funding directed towards capacity to deliver interventions, and encouragement of patients to make use of these services.

One of the main limitations of this study is that some costs of services used community pharmacy salary with NHS overheads which may not reflect true costs of services. There are additional costs to consider relating to the running of the pharmacy itself which may differ to costs included in NHS overhead costs. General practices work on a similar independent contractor model but many of their overheads are covered directly by the NHS. This is not the case for community pharmacy. This should be kept in mind when considering the results of this study relating to SMRs, polypharmacy clinics, and asthma care. If the clinical capacity of community pharmacy in optimising medicines, improving outcomes and reducing costs, is to be released for the benefit of the NHS, future funding of community pharmacy overheads may need consideration.

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Appendix A – Medline Search Strategy

A search strategy developed for Ovid MEDLINE is presented below.

1 pharmacists/ or pharmacies/ or pharmaceutical services/ (35772)
2 community pharmacy services/ (6196)
3 (pharmacy or pharmacies or pharmaceut* or drugstore* or drug store* or chemist*).ti,kf. (182532)
4 pharmacist*.ti,kf. (21961)
5 ((independent or non-medical or nonmedical or supplementary) adj3 prescrib*).ti,kf. (321)
6 ((communit* or primary care) adj5 prescrib*).ti,kf. (1265)
7 pharmac*.jw. (890282)
8 or/1-7 (1049411)
9 inappropriate prescribing/ (5037)
10 drug utilization review/ (3887)
11 medication review/ or medication therapy management/ (3049)
12 polypharmacy/ (7346)
13 potentially inappropriate medication list/ (1211)
14 medication adherence/ or medication reconciliation/ (27792)
15 deprescriptions/ (1303)
16 ((drug* or medicat* or medicine* or pharmaceutical* or prescrib* or prescript*) adj (optimal* or optimis* or optimiz*)).ab. (1092)
17 ((drug* or medicat* or medicine* or pharmaceutical* or prescrib* or prescript*) and (optimal* or optimis* or optimiz*)).ti,kf. (8147)
18 ((drug* or medicat* or medicine* or pharmaceutical* or prescrib* or prescript*) adj3 (overus* or overutili* or over use* or over using or over usage or over utili* or under use* or under using or under usage or under utili*)).ti,kf. (1090)
19 (deprescrib* or deprescript* or de-prescrib* or de-prescript*).ti,kf. (1798)
20 (prescrib* adj behavi*).ti,kf. (424)
21 (polypharm* or polymedic* or poly-pharm* or poly-medic*).ti,kf. (6430)
22 ((drug* or medicat* or medicine* or pharmaceutical* or prescrib* or prescript*) adj3 (correct* or error* or erroneous* or fail* or inaccurat* or incorrect* or miscalculat* or mistak*)).ti,kf. (7764)
23 (Potentially Inappropriate Medication List* or Beers Criteri* or Beers Potentially Inappropriate Medications or Medication Appropriateness Index or PIM List or STOPP or "STOPP/START" or STOPPFrail* or "Screening Tool of Older Person's Potentially Inappropriate Prescription*" or "Screening Tool to Alert to Right Treatment" or START criteri* or START tool* or "Screening Tool of Older Persons Prescriptions in Frail adults" or "Screening Tool of Older Persons Prescriptions in older adults with high fall risk" or STOPPFall* or "Screening Tool of Older Persons Prescriptions").ti,kf. (778)
24 ((drug* or medicat* or medicine* or pharmaceutical* or prescrib* or prescript*) adj3 (review* or counsel*)).ti,kf. (7764)
25 (pharmacist* adj3 (counsel* or review* or intervention*)).ab. (4973)
26 (pharmacist* adj (led or leading or initiat* or instigat* or originat*) adj3 (initiative* or program* or strateg*)).ti,ab,kf. (275)
27 pharmaceutical care.ti,kf. (1893)
28 (SMR or discharge medicines review* or discharge medicines service* or DMS or DMR or "medicines care and review service*" or MCR or MUR or OSCAR or new medicines service* or NMS).ti,kf. (4473)
29 or/9-28 (81823)
30 8 and 29 (19707)
31 economics/ (27544)
32 exp "costs and cost analysis"/ (275852)
33 economics, dental/ (1922)
34 exp economics, hospital/ (26095)
35 economics, medical/ (9298)
36 economics, nursing/ (4013)
37 economics, pharmaceutical/ (3154)
38 (economic* or cost or costs or costly or costing or price or prices or pricing or pharmacoeconomic*).ti,ab,kf. (1203249)
39 expenditure*.ti,ab,kf. not energy.ti,ab. (41448)
40 value for money.ti,ab,kf. (2351)

41 budget*.ti,ab,kf. (39510)
42 or/31-41 (1362088)
43 ((energy or oxygen) adj cost).ti,ab. (5072)
44 (metabolic adj cost).ti,ab. (1843)
45 ((energy or oxygen) adj expenditure).ti,ab. (30964)
46 or/43-45 (36771)
47 42 not 46 (1353512)
48 exp budgets/ (14313)
49 exp models, economic/ (16685)
50 "value of life"/ (5834)
51 ec.fs. (451148)
52 income/ (36231)
53 remuneration/ (380)
54 "salaries and fringe benefits"/ (16698)
55 exp "fees and charges"/ (31602)
56 socioeconomic factors/ or economic factors/ or economic status/ (178180)
57 (earn* or expens* or fee or fees or financ* or fiscal* or income* or money* or monetary or paid or pay or pays or paying or payment* or remunerat* or salar* or socioeconomic* or spend or spends or spent or spending* or wage*1 or purchas*).ti,ab,kf. (953060)
58 ((resourc* or healthcare or health-care) adj4 (allocat* or consum* or ration* or usage* or use*1 or utilis* or utiliz*)).ti,ab,kf. (176348)
59 hcru.ti,ab,kf. (933)
60 or/48-59 (1524405)
61 47 or 60 (2379390)
62 health resources/ or "supply & distribution".fs. or exp resource allocation/ (101946)
63 (burden* or resourc*).ti. (113402)
64 (burden* adj3 (care or caring or disease* or healthcare or illness* or sickness* or therap* or treatment*)).ti,ab,kf. (83832)
65 ((resourc* or healthcare or health-care) adj4 (allocat* or consum* or ration* or usage* or use*1 or utilis* or utiliz*)).ti,ab,kf. (176348)
66 hcru.ti,ab,kf. (933)
67 office visits/sn, td or "facilities and services utilization"/ or "equipment and supplies utilization"/ or "procedures and techniques utilization"/ (5432)
68 (visit or visits or visited or visiting).ti,ab,kf. (325117)
69 appointment*.ti,ab,kf. (37276)
70 hospitalization/ (145275)
71 (hospitalization*1 or hospitalisation*1 or hospitalised or hospitalized).ti,ab,kf. (375907)
72 (admission*1 or readmission*1 or admitted or readmitted).ti,ab,kf. (556981)
73 "length of stay"/ (108633)
74 hospital stay*1.ti,ab,kf. (120839)
75 (bed adj3 day*1).ti,ab,kf. (4468)
76 ((days or time or length or duration*1) adj3 hospital*).ti,ab,kf. (136205)
77 ((days or time or length or duration*1) adj3 (stay or stays or stayed)).ti,ab,kf. (154326)
78 ((days or time or length or duration*1) adj3 (discharge or discharged or home or homes)).ti,ab,kf. (35651)
79 or/62-78 (1699782)
80 61 or 79 (3634849)
81 30 and 80 (8400)
82 exp Great Britain/ (401844)
83 (national health service* or nhs*).ti,ab,in. (306886)
84 (english not ((published or publication* or translat* or written or language* or speak* or literature or citation*) adj5 english)).ti,ab. (138546)
85 (gb or "g.b." or britain* or (british* not "british columbia") or uk or "u.k." or united kingdom* or (england* not "new england") or northern ireland* or northern irish* or scotland* or scottish* or ((wales or "south wales") not "new south wales") or welsh*).ti,ab,jw,in. (2632240)
86 (bath or "bath's" or ((birmingham not alabama*) or ("birmingham's" not alabama*) or bradford or "bradford's" or brighton or "brighton's" or bristol or "bristol's" or carlisle* or "carlisle's" or (cambridge not (massachusetts* or boston* or harvard*)) or ("cambridge's" not (massachusetts* or boston* or harvard*)) or (canterbury not zealand*) or ("canterbury's" not zealand*) or chelmsford or "chelmsford's" or chester or "chester's" or chichester or "chichester's" or coventry or "coventry's" or derby or "derby's" or (durham not

(carolina* or nc)) or ("durham's" not (carolina* or nc)) or ely or "ely's" or exeter or "exeter's" or gloucester or "gloucester's" or hereford or "hereford's" or hull or "hull's" or lancaster or "lancaster's" or leeds* or leicester or "leicester's" or (lincoln not nebraska*) or ("lincoln's" not nebraska*) or (liverpool not (new south wales* or nsw)) or ("liverpool's" not (new south wales* or nsw)) or ((london not (ontario* or ont or toronto*)) or ("london's" not (ontario* or ont or toronto*)) or manchester or "manchester's" or (newcastle not (new south wales* or nsw)) or ("newcastle's" not (new south wales* or nsw)) or norwich or "norwich's" or nottingham or "nottingham's" or oxford or "oxford's" or peterborough or "peterborough's" or plymouth or "plymouth's" or portsmouth or "portsmouth's" or preston or "preston's" or ripon or "ripon's" or salford or "salford's" or salisbury or "salisbury's" or sheffield or "sheffield's" or southampton or "southampton's" or st albans or stoke or "stoke's" or sunderland or "sunderland's" or truro or "truro's" or wakefield or "wakefield's" or wells or westminster or "westminster's" or winchester or "winchester's" or wolverhampton or "wolverhampton's" or (worcester not (massachusetts* or boston* or harvard*)) or ("worcester's" not (massachusetts* or boston* or harvard*)) or (york not ("new york*" or ny or ontario* or ont or toronto*)) or ("york's" not ("new york*" or ny or ontario* or ont or toronto*))))).ti,ab,in. (1909850)
87 (bangor or "bangor's" or cardiff or "cardiff's" or newport or "newport's" or st asaph or "st asaph's" or st davids or swansea or "swansea's").ti,ab,in. (77514)
88 (aberdeen or "aberdeen's" or dundee or "dundee's" or edinburgh or "edinburgh's" or glasgow or "glasgow's" or inverness or (perth not australia*) or ("perth's" not australia*) or stirling or "stirling's").ti,ab,in. (280945)
89 (armagh or "armagh's" or belfast or "belfast's" or lisburn or "lisburn's" or londonderry or "londonderry's" or derry or "derry's" or newry or "newry's").ti,ab,in. (37626)
90 or/82-89 (3377715)
91 (exp africa/ or exp americas/ or exp antarctic regions/ or exp arctic regions/ or exp asia/ or exp oceania/) not (exp great britain/ or europe/) (3521364)
92 90 not 91 (3164655)
93 81 and 92 (924)
94 exp animals/ not humans/ (5299221)
95 (news or editorial or case reports).pt. or case report.ti. (3451711)
96 93 not (94 or 95) (915)
97 limit 96 to (english language and yr="2014 -Current") (710)

Key to Ovid symbols and commands:

*	Unlimited right-hand truncation symbol
ti,ab,kf,jw,in	Searches are restricted to the Title (ti), Abstract (ab), Keyword Heading Word (kf), journal title word, institutional affiliation (in) fields.
adj	Retrieves records that contain terms next to each other (in the shown order)
adjN	Retrieves records that contain terms (in any order) within a specified number (N) of words of each other
?	Wildcard symbol
/	Searches are restricted to the Subject Heading field
exp	The subject heading is exploded
pt.	Search is restricted to the publication type field
or/1-15	Combines sets 1 to 15 using OR
.fs.	Term is searched as a floating subheading
sn, td	The subject heading is restricted to studies reporting statistical or numerical data, or trends
yr	Searches are restricted to the Year of Publication field

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Appendix B – PRISMA Diagram