Commonwealth Department of Health

Initial Evaluation of Sixth Community Pharmacy Agreement Medication Management Programs: Residential Medication Management Review

Final Evaluation Report

HealthConsult Pty Ltd
ACN 1 18 337 821

Sydney Office: 3/86 Liverpool Street, Sydney, New South Wales, 2000 Phone (02) 9261 3707

Melbourne Office: 429/838 Collins Street, Docklands, Victoria, 3008 Phone (03) 9081 1640

29th March, 2017

Table of Contents

Abbreviations

ABS	Australian Bureau of Statistics
ACF	Aged care facility
ADE	Adverse drug events
AIHW	Australian Institute of Health and Welfare
APOR	Approved Pharmacist Only Review
ATSI	Aboriginal and Torres Strait Islander
BE	Business entity
CALD	Culturally and linguistically diverse people
CBA	Cost benefit analysis
CE	Cost-effective
CEA	Cost-effectiveness analysis
CI	Confidence interval
CIs	Clinical Interventions
CPA	Community Pharmacy Agreement
CRC	Campbell Research and Consulting
CUA	Cost-utility analysis
DBI	Drug Burden Index
DoHA	Department of Health and Ageing
DoN	Directors of nursing
DRP	Drug-related problem
DVA	Department of Veterans' Affairs
ED	Emergency department
GDS	Geriatric Depression Scale
GP	General practitioner
HMR	Home Medicines Review
GPPC	General Practitioner-Pharmacist Collaboration
HTA	Health technology assessment

MAI	Medication Appropriateness Index
MAP	Medication Adherence Programs
MBS	Medicare Benefits Schedule
MMP	Medication Management Program
MMSE	Mini-Mental State Examination
MPS	Multi-Purpose Service
MSAC	Medical Services Advisory Committee
NR	Not reported
OR	Odds ratio
PBS	Pharmaceutical Benefits Scheme
PPI	Pharmacy Practice Incentives
PSA	Pharmaceutical Society of Australia
PSG	Programme Specific Guidelines
PwC	Pricewaterhouse Coopers
QALY	Quality-adjusted life year
QoL	Quality of life
QUM	Quality Use of Medicines
RACF	Residential aged care facility
RCT	Randomised controlled trial
RMMR	Residential Medication Management Review
RR	Relative risk
SCRIP	Study of Cardiovascular Risk Intervention by Pharmacists
SD	Standard deviation
SS	Statistically significant
STOPP/START	Screening Tool of Older Persons' potentially inappropriate Prescriptions/Screening Tool to Alert doctors to Right Treatment
UK	United Kingdom
USA	United States of America

Executive Summary

On the 27th October 2016, the Department of Health engaged HealthConsult to undertake an evaluation to determine the clinical/cost-effectiveness of four Medication Management Programs (MMPs) funded under the Sixth Community Pharmacy Agreement (6CPA): Home Medicines Review (HMR); Residential Medication Management Review (RMMR); MedsCheck; and Diabetes MedsCheck. This report presents the initial evaluation of the RMMR Program, which has involved:

- a literature review to identify data to inform the comparative clinical and cost-effectiveness of the RMMR program and 'like' programs internationally; and
- an examination of the available Australian utilisation data from the RMMR program going back to its start under earlier Community Pharmacy Agreements (CPAs).

ES 1 BACKGROUND

The RMMR program was designed to enhance the quality use of medicines for consumers in approved Australian Government funded residential aged care facilities (RACFs), by assisting consumers and their carers to better manage their medicines through a medication review conducted by an accredited pharmacist in the RACF. The program aims to support activities that are designed to improve quality use of medicines in RACFs.

The RMMR program is part of an initiative to expand the role of community pharmacy, beyond medication dispensing to an increased primary healthcare contribution. The objectives of the RMMR program are to:

- achieve safe, effective, and appropriate use of medicines by detecting and addressing medicine related problems that interfere with desired patient outcomes;
- improve the patient's quality of life and health outcomes using a best practice approach that involves cooperation between the general practitioner (GP), pharmacist, other relevant health professionals and the patient (and where appropriate, their carer);
- improve the patient's and health professional's knowledge about medicines;
- facilitate cooperative working relationships between members of the healthcare team in the interests of patient health and wellbeing; and
- provide medication information to the patient and other healthcare providers involved in the patient's care.

The program is supported by a defined eligibility criteria that must be met by Service Providers, RACFs and patients. Currently services are payable to approved service providers for each RMMR conducted after a referral by a GP. The current payment rate for an RMMR service is $108.05.

One RMMR service can be conducted per eligible patient on referral from a GP. A subsequent RMMR service may only be conducted if more than 24 months has elapsed since the date of the most recent patient interview, or when the patient's GP specifically deems a subsequent review is clinically necessary, such as when there has been significant change to the patient's condition or medication regimen.

It is important to note that medical practitioners (e.g. GPs) are able to make an MBS claim (MBS item 903) for participation in an RMMR. Different to the RMMR service provided by a pharmacist, an item 903 can be claimed every 12 months for a referral issued by a medical practitioner under this MBS item compared to 24 months for subsequent service conducted by a pharmacists.

Although out of scope of the evaluation, it is important to note that in 2013/2014 the national medication chart (NRMC) was introduced. The NRMC is a medication chart developed for use throughout the residential aged care sector. It was designed to improve medication safety for residents, and to minimise the administrative burden of prescribers, aged care staff, and pharmacists when ordering, administering and supplying medicines. The impact of the NRMC on the RMMR is unknown and out of scope for this evaluation.

ES 2 METHODOLOGY

This section summarises the methodology used to identify the published as well as grey literature considered in this initial evaluation of the RMMR program.

ES 2.1 Literature search

A systematic literature review was undertaken in December 2016 to identify studies that provide evidence relating to the safety, effectiveness, costs and cost-effectiveness of RMMR or similar programs provided by community pharmacists to residents in aged care facilities. The grey literature was also searched, as were the reference lists of included studies. Table ES.1 presents the evidence selection criteria for inclusion in the review.

Table ES.1: Selection criteria for evidence relating to RMMR services provided by community pharmacists

Criteria	Description
Population	Patients living in a residential aged care facility who are at risk of experiencing medication misadventure. A clinical need may be one or more of the following: • discharge from hospital in the previous four weeks; • significant change to medication regimen in the past three months; • change in medical condition or abilities (including falls, cognition, physical function); • prescription of a medicine with a narrow therapeutic index or requiring therapeutic monitoring; • presentation of symptoms suggestive of an adverse drug reaction; • sub-therapeutic response to therapy; • suspected non-compliance or problems with managing medication-related devices; or • risk of, or inability to continue to self-manage medicines, due to changes in dexterity, confusion or impaired vision.
Intervention	A RMMR or any similar service consisting of a comprehensive review of a patient's medicines provided to a permanent resident of an aged care facility by an accredited pharmacist. *Interventions specifying multiple scheduled visits within a 12-month period will be excluded.*
Comparator	Aged care facility residents who did not access RMMR services.
Outcomes	Outcomes include: • changes in adherence/compliance/concordance with prescribed dose schedule (e.g. pill count, self-report); • changes in clinical outcomes (e.g. cognitive function and behavioural disturbances; BP in patients with hypertension; HbA1c in patients with diabetes); • rates of adverse drug event/reactions and medication-related problems; • changes in disability indices; • mortality rates; • health care resource use (ED attendance, hospitalisation, GP visits, specialist visits); • patient acceptance/satisfaction; • health-related quality of life; • cost of the service; • cost-effectiveness.
Study design	Comparative studies (randomised or non-randomised controlled trials, comparative cohort studies, case control studies, before/after studies) or systematic reviews of comparative studies. Applicability to the Australian context will be considered.
Publication type	Full English-language publications or reports. Conference abstracts will be excluded.

Abbreviations: blood pressure; ED, emergency department; GP, general practitioner; HBA1c, glycated haemoglobin; RMMR, Residential Medication Management Review.

The literature search identified a number of systematic reviews that did not focus on RMMR conducted by a pharmacist, but on medication reviews in any setting or medication review within a multidisciplinary model or a disease management plan, or medication reviews that were delivered by any health professional. Therefore, findings from these systematic reviews cannot be extrapolated to the evaluation of the RMMR service. For this reason, only evidence from studies that evaluated RMMR principally delivered by a pharmacist, and independent of any other intervention aiming at optimising drug regimens and patient outcomes is presented in the systematic literature review.

A total of six primary studies were identified that examined pharmacist-led RMMR impact on patient outcomes. The studies were mixed in design and included three randomised controlled trials (RCTs) (Frankenthal et al, 2014; Zermansky et al, 2006; Furniss et al, 2000), and three observational studies (McLarin et al, 2016; Nishtala et al, 2009; Stuijt et al, 2008). Two studies were conducted in Australia, two in the UK, one in the Netherlands, and one in Israel. There were no studies identified that evaluated the cost-effectiveness of RMMR.

The studies evaluated RMMRs performed by a pharmacist, aimed at checking and optimising the patients' drug regimens (i.e. ability to make recommendations on altering the regimen), and not limited simply to increasing patients' knowledge and/or adherence. Study participants were older people (mean age >80 years) and were all residents of aged care facilities. There was considerable variability in the outcomes measured, with a focus on hospitalisation, mortality, and medication costs. Quality of life (Qol) was only represented in one of the included studies. Intermediate outcomes such as drug burden and medication appropriateness were also investigated. A major limitation of the evidence was the diversity of outcome measures and the fact that they diverged in the way they were defined, collected and analysed.

The search identified three previous evaluations of the RMMR initiative funded under the 4CPA and 5CPA (Campbell Research and Consulting (2010), Stafford (2012) and PwC (2015)). These studies did not meet the inclusion criteria for the systematic review, they were non-comparative and largely took a program evaluation approach. As commented on by some of the authors, the studies provide low level evidence of the impact of RMMRs. Nonetheless, given the importance of these studies from a policy perspective and the fact that they specifically address the program being reviewed, they have been summarised in Chapter 4 of this report, and their findings have been included and referenced when drawing conclusions in this Executive Summary.

ES 2.2 Utilisation analysis

The only data available for inclusion in the utilisation analysis were claims payment data held by the Department of Human Services and the Pharmacy Guild relating to 2011 to 2016. These data have been analysed primarily on longitudinal relationships and also in the context of 'remoteness' inferred from the patient postcode. The analysis sought to assess whether the RMMR service providers were implementing the scheme in line with guidance. Key metrics in the analysis are the amount of claims paid, the number of resident RMMR services provided, the interval time between dates of service for residents who received more than one service, and summary information at person level about the age and geographic profile of service provided.

ES 3 RESULTS OF THE LITERATURE REVIEW

This section presents a summary of the findings drawn from the systematic literature review and review of the grey literature (which, in a departure from our usual practice for assessment reports prepared for the Medical Services Advisory Committee (MSAC), includes, where relevant, the low level evidence derived from the program evaluations conducted on the HMR program) funded under prior CPAs

ES 3.1 Hospitalisation and other health care resource use

Evidence from three RCTs suggests that the RMMR does not lead to fewer days in hospital. Little evidence was found evaluating the RMMR impact on other health care resource utilisation, such as GP consultations and emergency department admissions.

ES 3.2 Medication appropriateness

Evidence from one RCT and one small observational study showed that the use of RMMR by a clinical pharmacist was associated with an improvement in appropriateness of prescribing, using validated instruments. However, the link between improved medication appropriateness and patient-related outcomes is not clear, thus further clinical studies are required to demonstrate whether or not RMMR leads to improved patient outcomes.

ES 3.3 Medication-related problems

There was evidence from three RCTs and two observational studies that RMMR performed by pharmacist led to the identification of medication-related problems. The evidence also shows that GPs' acceptance rate for medicine interventions suggested by pharmacists is generally high. However, none of the studies determined whether the identification of medication-related problems through the RMMR service led to actual improvements in health outcomes, specifically reduction in adverse drug events.

Two of the RMMR program evaluations addressed the impact of RMMRs on adverse drug events and other medication-related problems. One study, based on surveys of GPs and Directors of Nursing (DoNs) reported that 76% (GPs) and 67% (DoNs) of respondents believed that RMMRs identified (and presumably dealt with) adverse drug events. The other study summarised stakeholder interview data where the perception was that patients would have improved health outcomes after medication reviews (not RMMR specific). This evidence is low level, and taken together with the fact that no RCTs specifically reported outcomes for dealing with medication-related problems, it is concluded that there is insufficient evidence to draw any robust conclusions.

ES 3.4 Falls

Two RCTs investigated the effect of RMMR by a pharmacist on reduction in rate of falls. Results from these two studies were conflicting. One trial demonstrated that a single clinical RMMR resulted in a significant reduction in falls. But, another trial showed no difference in risk of falling following RMMR.

ES 3.5 Drug burden

Evidence from one RCT and two observational study demonstrated a significant reduction in the number of prescribed drugs (specifically anticholinergic medication) following pharmacists' RMMR recommendations and GP uptake of those recommendations. Evidence from one other RCT demonstrated a reduction in the mean number of drugs in both the RMMR group and the control, with no in-between group significant difference. However, the link between reduced drug burden and patient-related outcomes (such as reduction in adverse drug effects) was not investigated in any of the included studies. Further clinical studies assessing the effect of reducing the anticholinergic burden on important outcomes such as adverse effects, hospitalisations, quality of life and mortality are required.

ES 3.6 Mortality rates

Evidence from three RCTs suggested that the RMMR has no effect on reducing deaths.

ES 3.7 Medication costs

The evidence for an effect of RMMR on medication costs was mixed, with two RCTs finding a reduction in costs and one RCT finding no difference. Therefore, it remains uncertain whether RMMR decreases medication costs.

ES 3.8 Clinical outcomes

Evidence from two RCTs indicates that RMMR performed by a pharmacist does not result in a significant improvement in cognitive, physical or behavioural functioning.

One RMMR program evaluation addressed the impact of RMMRs on clinical outcomes. Stakeholder interview data were reported, where the perception was that patients would have improved clinical outcomes from reducing hospital admissions due to medication misadventures (not RMMR specific).

ES 3.9 Health-related quality of life

There is insufficient evidence to assess the effect of pharmacist-led RMMR on quality of life.

ES 3.10 Cost-effectiveness

The systematic literature review did not identify any published studies relating to the cost and cost-effectiveness of RMMR services with reference to the PICO criteria.

The program reviews funded under CPAs by Campbell Research and Consulting (2010) and Stafford (2012) addressed the question of cost-effectiveness of RMMRs. Campbell Research and Consulting undertook a cost-effectiveness analysis and concluded that the program cost $402 per change in medications regimen, which may have not occurred in the absence of the RMMR Program; and $591 per positive health outcome, which may not have occurred in the absence of the RMMR. Costs were based on the payments made by Government to pharmacists at the time (2008) and outcomes were derived from stakeholder surveys, not from follow-up of residents. As observed by CRC, the cost-effectiveness analysis has a number of limitations. It is considered to be represent low level evidence.

Stafford made comment on the cost-effectiveness of RMMRs in the context of his work on the clinical and cost effectives of HMRs. He did not undertake any primary research on the RMMR program but referenced a number of published studies that reported mixed outcomes with respect to cost effectives. Closer investigation of the cited studies by HealthConsult revealed that they were out-of-scope (different RMMR service model). One of the original studies cited by Stafford, which was a report to the Commonwealth, could not be found. Stafford concluded that "it is possible that the RMMR program may also be less cost-effective than is assumed … there is also a need for investigation of the cost-effectiveness of the RMMR program". Again, this is considered to be low level evidence.

A prior program evaluation stated that "a reliable CBA would require a more sophisticated approach towards collection of data, linking program data (multiple datasets, including at consumer level) combined with regular auditing and reporting requirements to enable consumer health outcomes to be more effectively monitored and measured over time". This recommendation remains valid today, except that we would not suggest that a CBA would not be the most appropriate analysis rather a CEA.

ES 3.11 Other outcomes

None of the included studies specifically investigated whether the provision of RMMR is accompanied by clinically meaningful improvements in clinical outcomes or adherence to medication. None of the studies reported on changes in disability indices or patient acceptance or satisfaction with pharmacist-led RMMR. No studies were identified that evaluated the cost-effectiveness of RMMR service.

ES 3.12 Suggested program improvements

Practitioner views were sought as part of the 5CPA program evaluation on suggested improvements to the RMMR funding arrangements. Thematic analysis of the gathered views resulted in suggestions including that "funding arrangements could readjust to better facilitate programme objectives: funding could be moved out of CPA into MBS, enabling similar audit procedures; appropriate funding should be allocated to each health professional to incentivise collaboration for the benefit of the consumer".

ES 4 RESULTS OF THE UTILISATION ANALYSIS

The utilisation analysis found that claims payment policy changes (specifically, the restriction on the time interval between services, and the 30 day deadline to submit claims) had an apparent and lasting impact upon the volume of RMMR claims and participating providers. Before the changes, the uncapped scheme was servicing an increasing number of patients and attracting more providers (both community pharmacies and other business entities).

After the payment policy changes, RMMR patient and service volumes declined steeply across pharmacy and non-pharmacy providers (but mostly non-pharmacy providers). The data also suggest changes in behaviour to comply with the claiming frequency guidelines, with a greater proportion of patients receiving only one RMMR and longer claiming intervals for patients receiving multiple services. The RMMR service volumes have slowly recovered from the initial drop, although volumes have not returned to pre-policy change levels. This lower level of activity is likely to be due to provider perceptions of more stringent and enforced claims policies, previously suffered non-claimable service provision losses and reductions in access to economies of scale. Whether the change in payment policy had any impact on patients is unknown.

ES 5 CONCLUSIONS

Taken together, the systematic literature review and the lower level evidence in reviews funded as part of successive CPAs do not allow a conclusive determination to be made with regard to the clinical and cost-effectiveness of RMMRs performed by pharmacists on residents of aged care facilities.

The available studies strongly suggest that RMMRs have an impact in terms of the pharmacists identifying medication-related problems and making recommendations that the GPs are likely to implement. They also demonstrate that RMMRs have an impact in terms of improving the appropriateness of prescribing and reducing the drug burden on residents of aged care facilities. But there were no robust studies that linked these interim outcomes to improvement in end-point health outcomes for patients (i.e. reduced drug-related problems, less hospitalisations, lower use of GP services).

Further, good quality studies that address the cost and/or the cost-effectiveness of RMMRs are not available. The only available studies are low level, being largely based on stakeholder perceptions with no actual measures of consumer outcomes, nor any direct measure of service delivery cost (only payments made by Government).

The utilisation data analysis demonstrated that payment policy changes have had a significant impact on the levels of service provision and provider participation. This finding strongly suggests that underlying consumer needs are not the only driver of service provision. It may be that the current payment policy does not result in adequate remuneration for the services provided, thereby explaining the reduction in service provision levels post-policy changes. A good quality study that measures the reasonable costs of delivering a RMMR service may assist in addressing this problem. Such a study would also need to consider the role of a GP as the referrer and the subsequent cost to the MBS.

Overall, it is concluded that to make a robust assessment of the clinical and cost-effectiveness of RMMRs, further research is required. A cost measurement study would be of value as part of any program redesign activity. As would a study that collected data on clinical and perhaps patient reported outcome measures following receipt of an RMMR by a resident in an aged care facility. It is accepted that it will not be possible to conduct an RCT, but the results of cost and outcome measurement studies, when put together, would provide valuable evidence to further inform the refinement of the RMMR program.

Although this evaluation focused on presenting studies that evaluated RMMR principally delivered by a pharmacist, there is literature on alternative models (e.g. multi-disciplinary models) that could be reviewed to assess if such models are cost-effective. However this is a different research question to that asked of this evaluation and hence further research into the most appropriate model would be required to identify alternative models that are more or less cost effective than the pharmacist only intervention.

1 Introduction

On the 27th October 2016, the Department of Health engaged HealthConsult to undertake an evaluation to determine the clinical/cost-effectiveness of four Medication Management Programs (MMPs) funded under the Sixth Community Pharmacy Agreement (6CPA): Home Medicines Review (HMR); Residential Medication Management Review (RMMR); MedsCheck; and Diabetes MedsCheck. This report presents the initial evaluation of the RMMR Program, which has involved:

- a literature review to identify data to inform the comparative clinical and cost-effectiveness of the RMMR program and 'like' programs internationally; and
- an examination of the available Australian utilisation data from the RMMR program going back to its commencement under earlier Community Pharmacy Agreements (CPAs).

1.1 SIXTH COMMUNITY PHARMACY AGREEMENT

In May 2015, the Australian Government and Pharmacy Guild of Australia entered into the 6CPA, which provides around $18.9 billion in remuneration for community pharmacy, as well as support to the pharmaceutical supply chain (with a further $372 million provided for chemotherapy compounding fees). Up to $1.26 billion in funding is available under the 6CPA for evidence-based, patient-focused professional pharmacy programs and services. This consists of:

- $613 million for the continuation of a number of programs and services from 5CPA;
- $50 million for a new pharmacy trial program; and
- up to $600 million for new and expanded community pharmacy programs.

The 6CPA includes three key funding elements:

- community pharmacy remuneration;
- ensuring that all Australians have timely access to the Pharmaceutical Benefits Scheme (PBS) medicines they require regardless of the cost of the medicine or where they live; and
- community pharmacy programs directed at improving consumer management of their medications and delivering primary healthcare services through community pharmacy.

1.2 CONTINUING CPA PROGRAMS

As part of the 6CPA, there are several continuing Programs directed at improving medication compliance through community pharmacies in Australia. The continuing programs include:

- Medication Adherence Programs (MAPs):
  - Dose Administration Aids (DAAs);
  - Clinical Interventions (CIs); and
  - Staged Supply (SS).
- Medication Management Programs (MMPs):
  - Home Medicines Reviews (HMR);
  - Residential Medication Management Reviews (RMMR); and
  - MedsCheck and Diabetes MedsCheck.
- Rural Support Programs:

  - Rural Pharmacy Workforce Program; and
  - Rural Pharmacy Maintenance Allowance.
- Aboriginal and Torres Strait Islander (ATSI) Programs:
  - Quality Use of Medicines Maximised for ATSI People (QUMAX);
  - S100 Pharmacy Support Allowance; and
  - ATSI Workforce Program (Pharmacy Assistant Traineeship Scheme and Pharmacy Scholarships Scheme).
- eHealth:
  - Electronic Prescription Fee.

Under 6CPA, all programs and services need to be reviewed by the Medical Services Advisory Committee (MSAC) for clinical and cost-effectiveness and the health benefits they offer to the community. This process is being used to ensure pharmacy programs and services are assessed against the same standards of evidence as for other health professions. It supports a consistent approach to informing investment that delivers the greatest benefit to consumers.

2
Overview of the RMMR Program

This Chapter briefly describes the RMMR program, as described in the Programme Specific Guidelines (PSG), which falls under the MMP within 6CPA.

2.1 RMMR INITIATIVE

The RMMR program was designed to enhance the quality use of medicines for consumers in approved Australian Government funded residential aged care facilities (RACFs), by assisting consumers and their carers to better manage their medicines. The program aims to support activities that are designed to improve quality use of medicines across approved Australian Government funded aged care facilities.

The RMMR program is part of the suite of MAPs funded under the 6CPA to support quality use of medicines services that are designed to reduce adverse events and associated hospital admissions or medical presentations.

Although out of scope of the evaluation, it is important to note that in 2013/2014 the national medication chart (NRMC) was introduced. The NRMC is a medication chart developed for use throughout the residential aged care sector. It was designed to improve medication safety for residents, and to minimise the administrative burden of prescribers, aged care staff, and pharmacists when ordering, administering and supplying medicines. The impact of the NRMC on the RMMR is unknown and out of scope for this evaluation.

2.2 OBJECTIVES OF THE RMMR PROGRAM

The RMMR program is part of an initiative to expand the role of community pharmacy, beyond medication dispensing to an increased primary healthcare contribution. The objectives of the RMMR program are to:

- achieve safe, effective, and appropriate use of medicines by detecting and addressing medicine related problems that interfere with desired patient outcomes;
- improve the patient's quality of life and health outcomes using a best practice approach that involves cooperation between the GP, pharmacist, other relevant health professionals and the patient (and where appropriate, their carer);
- improve the patient's and health professional's knowledge about medicines;
- facilitate cooperative working relationships between members of the healthcare team in the interests of patient health and wellbeing; and
- provide medication information to the patient and other healthcare providers involved in the patient's care.

2.3 PARTICIPATION IN THE RMMR INITIATIVE

To be eligible to participate in the RMMR program a Service Provider must:

- be an approved Service Provider;
- abide by the 6CPA General Terms and Conditions;

- undertake to provide RMMR Services in accordance with MMP PSGs.

In order for a RACF to participate in the RMMR program it must be either:

- an RACF which receives the residential care facility subsidy from the Australian Government in accordance with the Aged Care Act 1997; or
- an Australian Government funded transition care facility; or
- a Multi-Purpose Service (MPS) facility providing integrated health and aged care services to small rural and remote communities.

The patient must satisfy the following mandatory RMMR service eligibility criteria:

- the patient is a current Medicare/DVA card holder;
- the patient is at risk of, or currently experiencing, medication misadventure;
- the patient is a permanent resident of:
  - an Australian Government funded RACF, as defined by the Aged Care Act 1997; or
  - an MPS facility;
- the patient is a resident in an Australian Government funded transition care facility for more than 14 consecutive days; and
- the GP confirms that there is an identifiable clinical need and that the patient will benefit from an RMMR service.

Currently services are payable to approved service providers for each RMMR conducted after a referral by a general practitioner (GP). The current payment rate for an RMMR service is $108.05.

In addition, medical practitioners (e.g. GPs) are able to make an MBS claim (MBS item 903) for participation in an RMMR. Different to the RMMR service provided by a pharmacist, an item 903 can be claimed every 12 months for a referral issued by a medical practitioner under this MBS item compared to 24 months for subsequent service conducted by a pharmacists. The current MBS fee is $106.

2.4 FREQUENCY OF SERVICE

One RMMR service can be conducted per eligible patient on referral from a GP. A subsequent RMMR service may only be conducted if more than 24 months has elapsed since the date of the most recent patient interview, or when the patient's GP specifically deems a subsequent review is clinically necessary, such as when there has been significant change to the patient's condition or medication regimen.

Reasons why an additional review may be requested include:

- discharge from hospital after an unplanned admission in the previous four weeks;
- significant change to medication regimen in the past three months;
- change in medical condition or abilities (including falls, cognition, physical function);
- prescription of a medicine with a narrow therapeutic index or requiring therapeutic monitoring;
- presentation of symptoms suggestive of an adverse drug reaction;
- sub-therapeutic response to therapy; or
- suspected non-compliance or problems with managing medication-related devices.

Provision of a subsequent RMMR must not be triggered solely by an 'anniversary' date. The RMMR service is not intended to be an ongoing review cycle.

2.5 REFERRAL

The patient's GP must refer the patient for a RMMR. However the Community Pharmacy or Accredited Pharmacist, nursing staff or other member of the health care team, the patient themselves or their carer may identify the need for a RMMR and bring this to the GP's attention. The patient's GP should be contacted to initiate the review process. The patient's GP must provide a written referral, which should include reason for referral and all relevant prescribing and clinical history, to the RMMR Service Provider.

RMMR referrals are only valid if received on or before the date of the RMMR service and cannot be made retrospectively. It is the RMMR Service Provider's responsibility to ensure that appropriate patient consent has been granted to conduct the RMMR service. The patient interview must take place within 90 days of the date of the referral to be remunerated under the RMMR program.

2.6 PRIOR APPROVAL FOR PHARMCIST ONLY REVIEW

In limited circumstances, a RMMR Service Provider may seek to conduct an RMMR without a GP referral. This is known as a Pharmacist Only review and requires prior approval (APOR).

Prior approval for a pharmacist only review may only be sought when:

- A member of the patient's health care team, the patient or the carer has determined that an RMMR would benefit the resident; and
- Where repeated and reasonable attempts have been made to obtain a referral from the patients' GP.

The RMMR Service provider must submit a Prior Approval Request via email to the Guild (post 2014; previously to the Department). The prior approval form and a submission must be provided that outlines a detailed and reasonable justification for a service to be conducted without a GP's involvement.

Payment for an RMMR conducted without a GP referral will only be made when prior approval has been sought and granted.

3
Review Methodology

This Chapter describes the methodology used to identify and assess the evidence relating to RMMR, or similar pharmacist-led programs. The evaluation encompasses a systematic literature review of Australian and international evidence for the effectiveness and cost-effectiveness of pharmacist-delivered services such as those provided by RMMR to residents in aged care homes, and an analysis of available data on the utilisation of the service provided.

3.1 SYSTEMATIC LITERATURE REVIEW

This section presents the selection criteria, the search strategy used to identify the relevant evidence, and a summary of the process used to include and/or exclude identified evidence to assess the safety, effectiveness and cost-effectiveness of RMMR services.

3.1.1 PICO criteria

Table 3.1 presents the selection criteria for evidence assessing the safety, effectiveness and cost-effectiveness of RMMR services.

Table 3.1: Selection criteria for evidence relating to RMMR services provided by community pharmacists

Criteria	Description
Population	Patients living in a residential aged care facility, who are at risk of experiencing medication misadventure. A clinical need may be one or more of the following: • discharge from hospital in the previous four weeks; • significant change to medication regimen in the past three months; • change in medical condition or abilities (including falls, cognition, physical function); • prescription of a medicine with a narrow therapeutic index or requiring therapeutic monitoring; • presentation of symptoms suggestive of an adverse drug reaction; • sub-therapeutic response to therapy; • suspected non-compliance or problems with managing medication-related devices; or • risk of, or inability to continue to self-manage medicines, due to changes in dexterity, confusion or impaired vision.
Intervention	A RMMR or any similar service consisting of a comprehensive review of a patient's medicines provided to a permanent resident of an aged care facility by an accredited pharmacist. *Interventions specifying multiple scheduled visits within a 12-month period will be excluded.*
Comparator	Aged care facility residents who did not access RMMR services.
Outcomes	Outcomes include: • changes in adherence/compliance/concordance with prescribed dose schedule (e.g. pill count, self-report); • changes in clinical outcomes (e.g. cognitive function and behavioural disturbances; BP in patients with hypertension; HbA1c in patients with diabetes); • rates of adverse drug event/reactions and medication-related problems; • changes in disability indices; • mortality rates; • health care resource use (ED attendance, hospitalisation, GP visits, specialist visits); • patient acceptance/satisfaction; • health-related quality of life; • cost of the service; • cost-effectiveness.
Study design	Comparative studies (randomised or non-randomised controlled trials, comparative cohort studies, case control studies, before/after studies) or systematic reviews of comparative studies. Applicability to the Australian context will be considered.

Criteria	Description
Publication type	Full English-language publications or reports. Conference abstracts will be excluded.

Abbreviations: blood pressure; ED, emergency department; GP, general practitioner; HBA1c, glycated haemoglobin; RMMR, Residential Medication Management Review.

3.1.2 Search strategy

A comprehensive search of peer-reviewed scientific literature was conducted in December 2016 to identify studies that provide evidence relating to the effectiveness and cost-effectiveness of RMMR or similar programs provided by community pharmacists to individuals living in aged care facilities.

Three electronic databases were searched for original research papers describing relevant systematic reviews, meta-analyses or comparative studies; Embase (OVID), Medline (OVID) and the Cochrane Library of Systematic Reviews (Cochrane Database of Systematic Reviews; Database of Abstracts of Reviews of Effects; Cochrane Central Register of Controlled Trials; Health Technology Assessments Database; NHS Economic Evaluation Database). The search was conducted on 19th December 2016, and the publication date was unrestricted. A search of the Health Systems Evidence database, and the websites of health technology assessment (HTA) agencies was also conducted.

The specific search terms used to identify relevant literature are outlined in 0. The search strategy was designed to identify articles relevant to the evaluation of HMR, RMMR and also the MedsCheck and Diabetes MedsCheck programs. While the screening for evidence pertinent to each of these programs was conducted simultaneously, the evaluation of HMR, RMMR, MedsCheck and Diabetes MedsCheck is reported separately.

3.1.3 Selection of relevant evidence

The literature search outlined above identified 5,282 records from Embase, Medline and the Cochrane Library (3,670 unique citations; Table 3.2) and 373 records in the Health Systems Evidence database. The following exclusion criteria were applied:

- wrong publication or study type– excludes narrative reviews, conference abstracts and editorials, and non-comparative studies (i.e. single arm, descriptive studies);
- wrong population – excludes services for non-resident patients (e.g. hospital inpatients, residing at home, patients attending GP clinics);
- wrong intervention – excludes studies of interventions that do not align with RMMR services as described in Section 3.1.1 (e.g. provided by a health professional other than a pharmacist, multidisciplinary models, or interventions that involve other services in addition to medication review);
- wrong comparator – excludes studies that do not include a comparator group of patients for whom the service was not provided;
- wrong outcomes – excludes studies that do not assess one of the outcomes outlined in Section 3.1.1 (studies that assessed intermediate outcomes such as medication appropriateness and drug burden were included);
- not in English – excludes studies not published in English language or those that do not include at least some information (e.g. a summary) in English.

The exclusion of citations during screening of these records is presented in Table 3.2. The Health Systems Evidence search yielded an additional 32 systematic reviews or economic analyses, of which six were eligible for inclusion and 26 did not meet the inclusion criteria (e.g. focus of review too broad, including out-of-scope studies), but were checked for included studies that did meet our inclusion criteria. A further 17 citations were identified by hand searching reference lists of these and other studies, and two records were identified in targeted HTA website searches and the grey literature.

Table 3.2: Summary of the process used to identify studies and reports relevant to the evaluation of HMR service

Description	Embase	Medline	Cochrane Library
Records retrieved	3,131	1,507	644
Total number of citations	5,282		
Duplicates within and across sets removed	1,612		
Total number of citations screened	3,670		
Excluded at title/abstract review:			
Wrong publication type	238		
Wrong population	360		
Wrong intervention	2,144		
Wrong comparator	10		
Wrong outcome	81		
Not English	90		
Total citations excluded at title/abstract review	*2,923*		
Citations screened at full text review	747		
Excluded at full text review:			
Wrong publication type	26		
Wrong population	45		
Wrong intervention	656		
Wrong comparator	3		
Wrong outcome	11		
Total citations excluded at full text review	*741*		
Total included studies or reports from Embase/Medline/Cochrane	6		
Included from Health Systems Evidence database	0		
Included from HTA websites	0		
Included from hand searching reference lists	0		
Total included studies or reports: Relevant to RMMR	6		

Abbreviations; RMMR, Residential Medication Management Review

3.1.4 Previous evaluations of the RMMR program

The targeted search of the websites of relevant pharmacy organisations and the Commonwealth Department of Health identified three reports that addressed the evaluation of the RMMR program. The citations are provided in Table 3.3. A summary of the findings and conclusions of these prior evaluations, including economic evaluations, where they were conducted are reported in Chapter 4.

Table 3.3: Citation details of program evaluations of the RMMR program

Study ID	Citation
CRC (2010)	Campbell Research and Consulting - Evaluation of the Residential Medication Management Review Program: Main Findings Report; 2010.
Stafford (2012)	Stafford C. A clinical and economic evaluation of medication reviews conducted by pharmacists for community dwelling Australians; 2012
PwC (2015)	PwC – Combined Review of Fifth Community Pharmacy Agreement Medication Management Programmes: Final Report; 2015.

The study by Stafford only briefly discussed the cost-effectiveness of RMMRs. It was not a primary study, as the major focus of his work was on HMRs. Stafford referred to other studies by Roberts et

al[1] in 2001, and a report to the Commonwealth of a national evaluation of medication review services in Australian nursing conducted by the Quality of Medication Care Group in 1999[2]. The Roberts paper related to a multidisciplinary intervention (included nurse education) and was therefore excluded, and a copy of the report of the Quality of Medication Care Group could not be found (it was not published and the Department could not locate a copy). Nonetheless, given the paucity of available evidence the conclusions by Stafford in respect of RMMRs are reported in Chapter 4.

3.1.5 Systematic reviews

The literature search identified a number of systematic reviews and narrative reviews that did not focus on RMMR conducted by a pharmacist but on medication reviews in any setting, or medication review within a multidisciplinary model or a disease management plan, or medication reviews that were delivered by any health professional. Systematic reviews that presented analysis (or meta-analysis) from pharmacy interventions that included services other than the RMMR specifically performed by a pharmacist were excluded. A list of these reviews is presented in Appendix C. The reference lists of each of the excluded systematic reviews were hand-searched to identify any relevant studies not identified elsewhere.

3.1.6 Primary studies

The systematic literature search for primary studies identified six eligible publications that investigated the effect of RMMR on a number of patient outcomes. Table 3.4 presents the list of included studies.

Table 3.4: Citation details for included studies of RMMR

Study ID	Citation
McLarin (2016)	McLarin, P. E., G. M. Peterson, et al. (2016). Impact of residential medication management reviews on anticholinergic burden in aged care residents. Current Medical Research and Opinion 32(1): 123-131.
Frankenthal (2014)	Frankenthal D, Lerman Y, Kalendaryev E, Lerman Y. (2014). Intervention with the screening tool of older persons potentially inappropriate prescriptions/screening tool to alert doctors to right treatment criteria in elderly residents of a chronic geriatric facility: a randomized clinical trial. Journal of the American Geriatrics Society; 62(9): 1658–65.
Nishtala (2009)	Nishtala PS, Hilmer SN,McLachlan AJ, Hannan PJ, Chen TF. (2009). Impact of residential medication management reviews on drug burden index in aged-care homes: a retrospective analysis. Drugs Aging; 26: 677–86.
Stuijt (2008)	Stuijt CCM, Franssen EJF, Egberts ACG, Hudson SA. (2008). Appropriateness of prescribing among elderly patients in a Dutch residential home: observational study of outcomes after a pharmacist-led medication review. Drugs Aging; 25: 947–54.
Zermansky (2006)	Zermansky AG, Alldred DP, Petty DR, Raynor DK, Freemantle N, Eastaugh J, et al. (2006). Clinical medication review by a pharmacist of elderly people living in care homes - randomised controlled trial. Age and Ageing; 35:586–91.
Furniss (2000)	Furniss L, Burns A, Craig SKL, Scobie S, Cooke J,Faragher B. (2000). Effect of a pharmacist's medication review in nursing homes: randomised controlled trial. The British Journal of Psychiatry; 176:563–7.

Appendix C presents a list of other primary studies of medication reviews identified through the literature search and the reasons for their exclusion. Studies that looked at RMMR as part of a more comprehensive pharmacy care program or were part of a multidisciplinary model were excluded. Studies that evaluated RMMR performed by a healthcare professional other than a pharmacist were also excluded.

[1] Roberts M, Stokes J, King M, Lynne T, Purdie D, Glasziou P, et al. Outcomes of a randomized controlled trial of a clinical pharmacy intervention in 52 nursing homes. Br J Clin Pharmacol 2001;51:257-65

[2] National evaluation of medication review services in Australian nursing homes: final report to the Commonwealth. Brisbane, Australia: Quality of Medication Care Group; 1999

3.2 UTILISATION ANALYSIS

Utilisation of RMMR services was analysed using the claims payment data extracted from DHS systems for years 2011/12, 2012/13 and 2013/14 and Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16. The analysis is restricted to claims paid for date of service between 1st July, 2011 and 30th June, 2016 (records that do not have valid dates or have unrealistic dates were excluded from the datasets). The encryption of some key identifying fields in the DHS datasets placed some limitations on the analysis, which have been noted, where relevant.

RMMR claims payment data have been analysed with the emphasis on longitudinal relationships within the claims system extracts, especially with regard to the frequency of service stipulations (outlined in Section 2.4). The data have also been analysed to assess 'remoteness'[3], as inferred from the postcode of each aged care facility (where that information is available). Facility postcodes were provided in a separate file and relate to Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16. DHS claims systems extracts were generally not able to be categorised in this way. Postcodes were mapped to remoteness area using the Australian Bureau of Statistics (ABS) mapping table.

[3] ABS postcode to remoteness.xls available from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.006July%202011?OpenDocument (accessed 5th October, 2016)

4
Previous evaluations of the RMMR program

This Chapter summarises the findings of evaluations of the RMMR program funded under prior CPAs. Three program evaluations were identified by PricewaterhouseCoopers (PwC), Stafford, and Campbell Research and Consulting. These summaries are offered to provide MSAC with an understanding of the approaches taken to evaluate the RMMR program in Australia, as well as present the evaluation findings in relation to the clinical and cost-effectiveness of the RMMR service. Please note that the views reported here are those of the evaluators who undertook the original evaluations and not HealthConsult's.

4.1 EVALUATION OF THE RMMR PROGRAM 2010

The RMMR program (funded under 4CPA and Medicare Benefit Schedule (MBS)) was evaluated by Campbell Research and Consulting (CRC) on behalf of the Australian Government Department of Health and Ageing (May 2009 and March 2010)[4]. The evaluation considered two types of reviews: a Pharmacist Only Review (funded by the 4CPA) and a Collaborative Review (GP funded under the MBS, and pharmacist funded under CPA) which entails an accredited pharmacist undertaking a Review for a resident in collaboration with a GP)). The evaluation objectives were to:

- gain an improved understanding of the RMMR program;
- inform the benefits of the RMMR program;
- inform broader barriers and enablers to the RMMR program – with a particular focus on the current arrangements; and
- review the current funding and service model for the RMMR program – with a particular focus on cost-effectiveness, RMMR program inputs and outputs, and informing future directions.

The evaluation used a mixed methods approach, comprising of stakeholder consultations across 53 site visits, which included discussions with Directors of Nursing (DoNs) or equivalent, Accredited Pharmacists, RMMR Providers and GPs across Australia (including in remote and rural regions); a national publicly advertised Call for Submissions; detailed diary-based case studies of Accredited Pharmacists' work; surveys of Accredited Pharmacists and GPs who had participated in an RMMR service and Aged Care Homes; and an analysis of RMMR claims data for providers in 2008. GP participation was assessed via claims for MBS Item 903.

This section presents the high level program evaluation findings, with emphasis on those specifically relating to the PICO criteria (Section 3.1.1), where they exist (including a cost-effectiveness analysis), followed by limitations of the study and their overall conclusions.

4.1.1 General findings of the evaluation

In 2008, 123,339 RMMRs were claimed, with 79 RMMRs being undertaken for every 100 residents nationally, across nearly all (97%) ACHs. The number of RMMRs per 100 residents varied by State and Territory, with the highest rate reported in Tasmania (90) and the lowest in the ACT (66).

Table 4.1 summarises the main findings, outside the PICO criteria, of the CRC evaluation of the RMMR program.

4 Campbell Research and Consulting - Evaluation of the Residential Medication Management Review Program: Main Findings Report; 2010.

Table 4.1: Main findings of the 2010 CRC RMMR Program Evaluation

Program areas	Key findings
Achievement of quality medication management	There was a consensus among the professional stakeholders that RMMRs conducted by Accredited Pharmacists were an appropriate means of achieving quality medication management for ACH residents.
Adherence to the Pharmaceutical Society of Australia Guidelines	The Guidelines suggest that assessment of the resident will optimise the identification and resolution of medication problems. However, the qualitative research identified that assessment of the resident by the accredited pharmacist was not common practice, with the amount of time required and remuneration cited as prohibitive factors. Assessment of the resident was generally done in the context of Collaborative Reviews, rather than Pharmacist Only Reviews, however this was only a small proportion. Of these, low level care residents were more likely to be seen than high level care residents.
Perceptions of Program value, ascertained via survey	**GPs:** The majority of GPs believed RMMRs were valuable to their patients and themselves as a GP. **DoNs:** The DoNs regarded the RMMR program highly and valued the Program for its benefits to patients and training of staff in relation to nurse education of medication management.
Collaborative vs. Pharmacist Only Reviews	Collaborative Reviews are more likely to result in medication changes, positive health outcomes and improved professional relationships.
Claim and payment processes	The increased administrative burden was commonly cited by RMMR providers as a problem associated with the administration of payment of RMMR. Analysis of RMMR claims identified that 3% of claims were rejected.

Source: Evaluation of the RMMR Program by Campbell Research & Consulting 2010
Abbreviations: CRC, Campbell Research & Consulting; RMMR, Residential Medication Management Review; GP, General Practitioner; DoN, Director of Nursing.
Note: Analysis was based on claims data provided by the Department for the calendar year of 2008, and may not include services rendered in which a delay between the delivery of RMMR and lodgement of a claim has occurred.

4.1.2 Adverse drug events/reactions and medication-related problems

The evaluation found that:

- Three-quarters of the GPs surveyed (76%), stated that the Accredited Pharmacists had identified adverse drug events in the previous 12 months via the RMMRs. The remaining GPs stated that the RMMRs did not identify any adverse drug events for residents.
- According to the DoNs surveyed, two-thirds (67%) of staff believed that an accredited pharmacist had identified an apparent adverse drug event in the previous 12 months. Almost half (46%) indicated that there had been an adverse drug event identified 1 to 5 times in the previous 12 months. 13% noted an apparent adverse drug event had been identified between 6 and 10 times.
- About a quarter of Accredited Pharmacists (24%) reported identifying more than 30 adverse drug events through RMMRs in the previous 12 months. Almost half (45%) indicated there had been an adverse drug event up to 10 times in the year, and about a quarter (24%) noted an adverse drug event between 11 and 30 times.

4.1.3 Cost-effectiveness

The cost-effectiveness component of the evaluation provided quantitative estimates for the chain of events that link:

- Medicare payments to RMMR Provider and GP;
- the number of RMMRs and number of changes made to residents' medication regimens (outputs);
- the desired result of the RMMR program: improvements to resident health resulting from better medication management (outcomes).

The evaluators noted that for the RMMR evaluation, no comparable program exists. Therefore the total costs associated with achieving outputs and outcomes can only be compared with a hypothetical setting where no RMMRs are conducted. A comparative measure is, however, provided between Collaborative and Pharmacist Only Reviews to determine the net cost per outcome under these two approaches.

Campbell Research drew on a number of sources to provide estimates of cost-effectiveness:

Program inputs: RMMR funding was calculated by the number of accepted claims for both the $130 payment to pharmacists, and in the case of Collaborative Reviews, the $96 paid to GPs. The RMMR claim data revealed that 38% of all reviews conducted nationally were Collaborative Reviews with the remaining 62% being Pharmacist Only Reviews. Total expenditure for all Reviews was calculated based on the 38%/62% split.

Program outputs: Analysis focused on the processes leading to outputs (a completed RMMR):

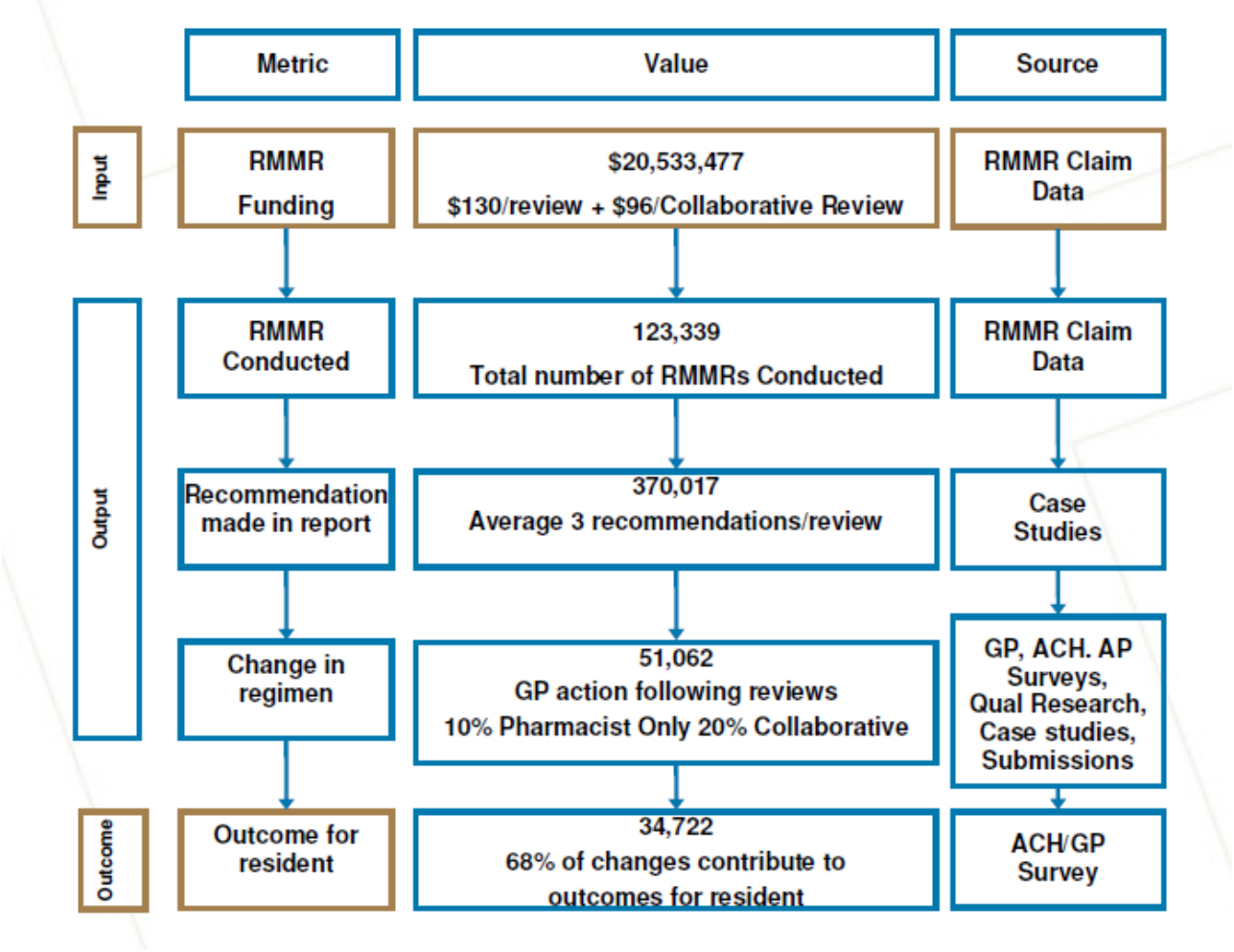
- The total number of Reviews conducted, derived from analysis of RMMR claims data.
- Medication issues, identified via the RMMR and presented in the review report for GP to review. An estimate of this output was derived from the diary-based case studies conducted for the evaluation, and used to calculate the average number of recommendations made per RMMR.
- GP actioned recommendations, effecting change to medication regimens. Two estimates were derived for this figure:
  - *For Collaborative Reviews:* 20% of GPs adopted the pharmacist's recommendations and changed a resident's medication regimen. This figure was ascertained via analysis of the GP survey, completed by GPs who had made one or more claims for Item 903 for a Collaborative Review in the previous 12 months.
  - *For Pharmacist Only Reviews:* A conservative estimate of 10% was used as the proportion of instances in which GPs adopted pharmacists' recommendations, as stated in the Pharmacist Only Review reports. This estimate was ascertained via analysis of the qualitative and quantitative research, which indicated that it was considerably less likely for GPs to follow the accredited pharmacist's recommendations when the RMMR had been conducted as a Pharmacist Only Review. Information gathered through the case studies confirmed the decreased likelihood of GPs enacting recommendations if the review was not a Collaborative Review. Further confirmation was obtained from the survey of Accredited Pharmacists, where 87% of those who had undertaken at least one Collaborative Review in the previous 12 months agreed that GP involvement made changing medication regimens easier.

The evaluation defined health outcome for the resident arising from the RMMR program as either *positive* (improved overall health, greater comfort, fewer adverse effects from medication, etc.), *negative* (the change in medication may adversely affect resident health); or *no change* in health status may be achieved. Consultation with ACH staff and GPs revealed that health outcomes resulting from the individual RMMR recommendations were impossible to estimate as the health outcomes observed were typically seen as the result of a combination of recommendations, actions and changes, rather than as a response to one specific RMMR recommendation in isolation.

The GP survey found that 60% of GPs agreed that changes made to medication as a result of reviews led to positive health outcomes for residents. The ACH survey found that three in four DoNs (75%) agreed that changes made to medication as a result of reviews led to positive health outcomes for residents, while a small minority of DoNs (7%) felt that changes to medication resulted in negative health outcomes. Almost all Accredited Pharmacists (90%) agreed that changes made to medication as result of reviews resulted in positive health outcomes for residents. From the survey results it was inferred that 68% of changes as a result of RMMRs contributed to positive health outcomes for residents.

Figure 4.1 shows the findings for the overall cost-effectiveness estimation. Note that Collaborative and Pharmacist Only Reviews are aggregated in the presented comparison.

Figure 4.1: Overall effectiveness analysis



Source: Evaluation of the RMMR Program by Campbell Research & Consulting 2010. Appendix F

Based on the consideration of RMMR claim data, surveys of stakeholders, diary-based case studies and qualitative research conducted for the purpose of this evaluation, it was estimated that:

- RMMR funding for one year (2008) amounted to $20,533,477. This number represents:
  - $130 payment only for Pharmacist Only Reviews;
  - $130 paid to RMMR Provider[5]; and $96 to the GP for Collaborative Reviews[6].
- 123,339 reviews were conducted (both Collaborative and Pharmacist only).
- The Reviews resulted in 370,017 recommendations being made by pharmacists.
- The recommendations resulted in 51,062 changes to medication regimens by GPs estimated from:
  - The GP survey, where on averages, GPs acted on an estimated 20% of recommendations made by pharmacists when the GP participated in the review; and
  - The qualitative research, where an average response to recommendations by GPs estimated to be 10%.
- In turn, based on responses to the GPs survey, where 60% of GPs agreed that the changes made to the medication as a result of the reviews had led to positive health outcomes; and the survey of ACH DoNs, where 75% of respondents agreed that the changes made arising from the reviews had led to positive outcomes, it has been estimated that 68% of changes as a result of RMMRs

[5] The Fee includes payment for the QUM component.
[6] At November 2008 the fee was $96.00 per Collaborative Review. The Medicare Benefits Schedule fee is indexed annually on 1 November.

contributed to positive health outcomes, arriving at a final figure of 34,722 positive outcomes for the year.

Overall it was estimated that 11,574 residents benefited from one or more positive health outcomes from the RMMR program (assuming an average of three positive health outcomes per review).

This equates to:

- $402 per change in regimen, presumably contributing to a positive health outcome for a resident, which may have not occurred in the absence of the RMMR program; and
- $591 per health outcome that may not have occurred in the absence of the RMMR.

The evaluators noted that for the Pharmacist Only Reviews, which may or may not involve a GP, there is no claim by the GP for the $96 MBS item in addition to the $130 claimed by the RMMR provider. This leads to a lower cost to the Australian Government for a Pharmacist Only Review.

The evaluators stated that "there is strong evidence from all components of this evaluation that GPs are considerably less likely to respond to recommendations made from Pharmacists Only Reviews. This diminished likelihood of response leads to a lower number of changes in the residents' medication regime which might have contributed to a positive health outcome for residents".

Despite the lower cost of a Pharmacist Only Review, the cost to government per positive health outcome is higher for Pharmacist Only Reviews compared with Collaborative Reviews.

In summary, it is estimated that:

- The cost per medication change for residents for Pharmacist Only Reviews is $433, compared with $377 for Collaborative Reviews; and
- The cost per health outcome for residents for Pharmacist Only Reviews is $637, compared with $554 for Collaborative Reviews.

4.1.4 Limitations

There were a number of limitations relevant to program data analysis. These included:

- The analysis was based on a number of sources of primary and secondary data to provide estimates of inputs, processes and outputs.
- The analysis provides an indicative cost-effectiveness analysis rather than a precise cost-effectiveness analysis due to the range of limitations associated with measurement of actions, changes and outcomes arising from RMMRs.
- The analysis does not include costs associated with Departmental staffing and other costs associated with the administration of the RMMR program. This implies that the analysis does not represent the total cost to Government for the RMMR program.
- The analysis relates only to the provision of RMMRs and not to the broader quality use of medicine (QUM) component included in the $130 payment to RMMR Providers.

To undertake an evaluation which included a far more comprehensive evaluation of confirmed and fully attributable health outcomes for residents and the corresponding cost-effectiveness of the RMMR Program would require identification of reduced (or increased) use of medicines, hospital admissions and other medical services that arise from adverse drug events. Such an analysis was beyond the scope of the evaluation. The focus of the evaluation was on the processes of implementation.

4.1.5 Conclusion

The evaluation found that the RMMR program has been effective in enabling RMMRs for the majority of ACH residents, at the rate of 79 RMMRs per 100 residents. The primary driver for RMMRs is the Accredited Pharmacist.

The cost-effectiveness analysis identified that Collaborative Reviews, while costing more, were more cost-effective than Pharmacist Only Reviews because of the increased likelihood of an effective change in medication regimen. Subsequently, residents are less likely to experience positive health outcomes if appropriate recommendations are not actioned. The evaluators state that to maximise potential benefits for residents, a higher proportion of Collaborative Reviews would be required.

The site visits and case studies identified that some Accredited Pharmacists seemingly focus on quality and others on throughput. Collaboration and engagement between stakeholders were identified as primary factors affecting the quality and effectiveness of outcomes for residents. To improve collaboration, it was suggested that Accredited Pharmacists provide GPs with sufficient notice to enable identification of relevant clinical issues prior to the RMMR, and that the RMMR reports be more concise and focused.

The evaluation did not support a higher payment for RMMRs or that RMMRs be remunerated at the equivalent rate of HMRs. However, as financial return for providing an RMMR service is variable, the evaluators suggest that a process of indexation of payment to the Accredited Pharmacist for Collaborative Reviews, similar to what GPs receive, be applied. The suggestion arises from the results of the cost-effectiveness and qualitative analyses, which suggest efforts by an Accredited Pharmacist to engage a GP in a Collaborative Review requires approximately an additional 15-20 minutes per RMMR.

The evaluators suggests that consideration could be given to the development of reporting and data collection tools that would provide a more objective measure of the impact of the program on resident's health. This may involve linkages to other data sources such as acute hospital admissions from residents of ACHs.

4.2 CLINICAL AND ECONOMIC EVALUATION OF MEDICATION REVIEWS 2012

As discussed, the RMMR program was briefly considered in the Clinical and Economic Evaluation of pharmacist-conducted medication reviews in home-dwelling (HMRs) Australians performed by Stafford in 2012[7]. Stafford's work aimed to investigate the clinical and cost-effectiveness of HMR, but he made comment on the implications for RMMRs of his findings about HMRs (in brief, he found that HMRs were not cost-effective, see HealthConsult's companion report on the review of the HMR program).

Specifically, Stafford noted that funding for the RMMR program was primarily based on the results of a single study by Roberts et al.[8] The Roberts study related to a multidisciplinary intervention (included nurse education) and was therefore excluded from this review (results not translatable). By way of information, Roberts found that in the intervention group that included nurse education and medication review by a pharmacist, drug use was reduced by 14.8% relative to the controls, equating to an annual drug cost saving of $64 per resident. There was no change in several morbidity indices or survival. HealthConsult notes that $64 is less than the amount paid to pharmacists to undertake the RMMR.

[7] Stafford C. A clinical and economic evaluation of medication reviews conducted by pharmacists for community dwelling Australians; 2012.
[8] Roberts M, Stokes J, King M, Lynne T, Purdie D, Glasziou P, et al. Outcomes of a randomized controlled trial of a clinical pharmacy intervention in 52 nursing homes. Br J Clin Pharmacol 2001;51:257-65.

Stafford then discusses the report to the Commonwealth of a national evaluation of medication review services in Australian nursing conducted by the Quality of Medication Care Group in 1999[9]. He notes that the evaluation associated no significant improvement in morbidity indices or mortality resulting from RMMRs, although a cost-effective analysis estimated a potential net annual cost saving of $1,151 per bed. And, he further reports that, as there was no significant difference between the RMMR and control patients in any of the variables used to generate this estimate, this was considered to be indicative only. Unfortunately, a copy of the report of the Quality of Medication Care Group could not be found (it was not published and the Department could not locate a copy), so it was not possible for analyse further.

Finally, Stafford asserts that there is little international literature that has assessed the cost-effectiveness of pharmacist-conducted MMRs in nursing home residents, with most studies being simple cost analyses.[10,11] We have examined the studies by Christensen et al and Cole et al, and found that they relate to a different intervention model to RMMR and are therefore not included. Stafford also cites a study that included a comprehensive cost-effective analysis alongside a trial of pharmaceutical care specifically targeting inappropriate prescribing of psychoactive drugs in nursing homes in Northern Ireland[12]. But, he points out that, even though the study reported a high probability of the intervention being cost-effective, this finding cannot be extrapolated to the Australian RMMR program as the MMR model used in the study was quite different to a RMMR.

Stafford concluded by questioning the cost-effectiveness of RMMR, give that his primary study found that the HMR program may not be cost-effective as was predicted by initial research. So Stafford stated that "it is possible that the RMMR program may also be less cost-effective than is assumed. Given the lack of recent research into RMMRs, it is reasonable to suggest that there is also a need for investigation of the cost-effectiveness of the RMMR program".

4.3 5CPA PROGRAM COMBINED REVIEW BY PwC 2015

The RMMR program was evaluated as part of the 5CPA Review of the MMPs performed by PwC in 2015[13]. The overall aim of the evaluation was to better inform how the 5CPA MMPs contribute to improving consumer health outcomes, in order to better inform future investment by the Australian Government in pharmacy programs and services.

PwC evaluated the three priority areas in the PPI Program: RMMR, HMR and MedsCheck/Diabetes MedsCheck. The evaluation methodology involved an analysis of the program data in order to assess the uptake and volume of services delivered over the duration of the 5CPA (between 2011 and 2014), stakeholder consultations, consumer focus groups, practitioner focus groups, a practitioner survey and a consumer survey.

This section presents the program evaluation findings against the PICO criteria (Section 3.1.1), where they exist, followed by thematic analysis of practitioner views and the evaluators views on the limitations of the study and the gathered data.

[9] National evaluation of medication review services in Australian nursing homes: final report to the Commonwealth. Brisbane, Australia: Quality of Medication Care Group; 1999

[10] Christensen D, Trygstad T, Sullivan R, Garmise J, Wegner SE. A pharmacy management intervention for optimizing drug therapy for nursing home patients. Am J Geriatr Pharmacother 2004;2:248-56.

[11] Cole M, Jacobs M, Silver B. Unnecessary medications: Cost savings resulting from interdisciplinary assessment of medication regimens. Consult Pharm 1996;11:933-36.

[12] Patterson SM, Hughes CM, Cardwell C, Lapane KL, Murray AM, Crealey GE. A cluster randomized controlled trial of an adapted US model of pharmaceutical care for nursing home residents in Northern Ireland (Fleetwood Northern Ireland study): a cost-effectiveness analysis. J Am Geriatr Soc 2011;59(4):586-93.

13-PricewaterhouseCoopers. Combined Review of Fifth Community Pharmacy Agreement Medication Management Programmes: Final Report; 2015.

4.3.1 Changes in adherence/compliance/concordance with prescribed dose schedule

All stakeholders consulted[14], commented that perceived benefits of the MMPs included educating consumers about correct medication adherence; and improving consumers' confidence/compliance in taking medicines. RMMR program specific feedback was not included in the evaluation report.

4.3.2 Changes in clinical outcomes

All stakeholders consulted commented that MMPs were contributing to improving consumer health outcomes and the benefits that were cited included: improving consumer health and reducing hospital admissions due to medication misadventures. However the majority of stakeholders also commented that impacts and outcomes of the services needed to be reviewed regularly to ensure that the budget was being well spent and cost-effective. "Due to the programs and reviews being undertaken in isolation to other initiatives within primary health care, it is often difficult to attribute health outcomes to having received a MMP". RMMR program specific feedback was not included in the evaluation report.

4.3.3 Health care resource use

Utilisation analysis showed that there were 842 service providers that participated in delivering RMMR services between 1st July 2010 and 28th February 2014. For this period, a total of 511,890 RMMR services were conducted, with a median number of 131 RMMR services conducted per pharmacist, with 50% of pharmacists conducting between 52 and 326 RMMRs each.

Approximately 33,527 GPs referred 304,510 different consumers to receive RMMRs. There were 527 consumers receiving a combination of RMMR and MedsCheck services, and 55 consumers received a combination of HMR, RMMR and MedsCheck services in the evaluation period. The average age of consumers who received RMMR services was 84.7 years.

A total of 36,789 of claims for RMMR services were rejected. Common reasons for rejection included: RMMR service already claimed on date of service (42%), service agreement was not current on date of service (11%), accredited pharmacist was not current on date of service (11%), pharmacist review within 12 months of last RMMR service (8.5%) and other reasons not stated (27.5%).

4.3.4 Patient acceptance/satisfaction

The evaluators found, as ascertained via the consumer focus group, that:

- "…no consumers in the RMMR focus group reported having received an RMMR, it is noted that they had in fact received one however were not aware that this had been performed."; and
- "Most consumers, particularly Aboriginal and Torres Strait Islander consumers, noted that there was very low awareness in the community that these programmes and services are available, how to access them and the value they provide".

The evaluators stated that more consumers could benefit from RMMR if they were appropriately advertised, and awareness was raised.

4.3.5 Pharmacist views about the RMMR program

Table 4.2 summarises the thematic analysis of data gathered from the practitioners' focus groups and survey. Briefly, a total of 767 primary health care practitioners, with the majority being pharmacists

14 41 stakeholder consultations with over 50 individuals driven by insights from sector experience

(94%), responded to the practitioner survey. About a third (33%) were involved in the RMMR program.

Table 4.2: Main findings of the 2015 5CPA combined review, 2011-2014

Measure/domain	Key findings
Practitioner focus group themes raised	
Addressing consumer need	All participants commented that, when performed well, RMMR provided the most value/benefit to the consumer in achieving positive health outcomes and providing education on medication safety and adherence, as well as providing costs savings to the health system through de-prescribing and preventing hospital admissions due to medication misadventure.
Program implementation	Many participants felt that a multidisciplinary, collaborative approach to programs/services would aid in the implementation of the programs and benefit the impacts and outcomes for consumers. It was suggested that funding should be allocated to support implementation to prevent inconsistencies in the way that the programs are delivered. It was generally noted that there was potential for investment in implementation activities to yield faster and more complete uptake of programmes, as well as more consistency in the quality of delivery of programmes. This could be interpreted to mean more resourcing, better targeted resourcing, or both. The targets might be improvement to the payment and claiming system, other administrative systems or targeting awareness of the programmes. It was suggested that the focus should be optimising uptake of various programmes and services.
Policy and strategy	Participants agreed that generally the 5CPA programs/services added value and should be part of the overall preventative strategy for consumers. Some stakeholders indicted there is opportunity for the MMPs to better support primary care services by being more widely accessible to consumers.
Unintended consequences	The majority of participants commented that MMPs, unintentionally foster business models that rely on quantity rather than quality.
Interaction between programs	The majority of participants commented that there was little interaction and that there was not a clear flow between MMPs, each program/service was seen as fulfilling a specific purpose and do not necessarily form part of a continuum.
Areas for improvement – funding arrangements	Funding arrangements could readjust to better facilitate programme objectives: funding could be moved out of CPA into MBS, enabling similar audit procedures; appropriate funding should be allocated to each health professional to incentivise collaboration for the benefit of the consumer.
Practitioners/providers survey results	
Interaction between programs	Less than half of survey respondents agreed or strongly agreed that the linkages/pathways between the programs/services were clearly identified. More than half agreed there were gaps in the services provided, resulting in unmet needs of the consumer.
Factors influencing clinical decision making (asked of pharmacists and GPs)	Among Accredited Pharmacists, the most common aspects of consumers' needs influencing clinical judgement to provide RMMR were: collaboration can occur with GP and facility staff who will be administering the medicines; to better understand other factors in the facility that may impact on the consumers' health; and to better assess the medicines the consumer is taking.
Provider satisfaction	Just over half of those involved in RMMR reported being satisfied or very satisfied. The majority reported being satisfied with the benefit their consumers received through the RMMR program.
Collaboration	GPs reported communicating with pharmacists after the service somewhat more commonly than pharmacists reported communicating with the GP. A breakdown was not available by specific program.

Source: PricewaterhouseCoopers Combined Review of 5CPA Medication Management Programmes (2015)
Abbreviations: 5CPA, Fifth Community Pharmacy Agreement; CPA, Community Pharmacy Agreement; GP, general practitioner; MBS, Medicare Benefits Scheme; MMP, Medication Management Programmes; RMMR, Residential Medication Management Review.

Overall, practitioners reported being reasonably satisfied with their involvement in the MMP. They also reported being satisfied with the benefit their consumers received through MMPs and services, and they saw clear benefit in the suite of MMPs and services as contributing towards improving the health outcomes of consumers.

However, stakeholders and practitioners indicated that 5CPA programs were difficult to access for consumers due to low consumer awareness, information on programs not being readily available to consumers, and low GP engagement and awareness to refer consumers to the relevant programs, particularly for Indigenous and culturally and linguistically diverse (CALD) peoples.

4.3.6 Limitations of the evaluation

The evaluators reported that a "cost benefit analysis (CBA) was not performed in this Review, thus direct and indirect benefits resulting from delivering MMPs, such as the RMMR program, could not be inferred". The evaluators recommended that a baseline benefits analysis be conducted in a future review to inform the health, social and economic benefits that result from programs implemented as

part of the 6CPA and evaluate the cost-benefits as a result of the 6CPA investment. "A reliable CBA would require a more sophisticated approach towards collection of data, linking program data (multiple datasets, including at consumer level) combined with regular auditing and reporting requirements to enable consumer health outcomes to be more effectively monitored and measured over time".

There were also a number of limitations reported in relation to program data analysis:

- Data collected as part of the claims process provided limited insight on uptake and volume of programs and services since multiple services could be submitted under one claim. The evaluators presented service level data where possible, merging accepted, rejected and claims datasets to conduct more accurate analyses.
- Consumer level data was de-identified and not linked to other data sources (e.g. Medicare or hospital data); therefore, it was not possible to determine the impact of participating in specific programs on consumer outcomes, outside of that particular episode of care.
- Consumer demographic data, such as age and gender, was only available for HMR, RMMR and MedsCheck/Diabetes MedsCheck, therefore data was not able to be linked across all six datasets (i.e. including DAAs, CIs and SS services). Postcode was not captured at the consumer level within any program/service dataset, therefore analysis of the data could not be performed for socioeconomic indicator (SEIFA) or remoteness (ARIA).
- The number of medicines and health conditions of consumers was not captured in the PPI Program dataset, resulting in the inability to analyse trends over time and potential investment value, including impact, for other programs and services.
- Analysis of program data beyond 28th February 2014 was not performed, resulting in failure to capture the effects of administrative changes to programs and services implemented on 1st March 2014 on the uptake and volume of programs and services.

5
Evidence for the effectiveness of the RMMR program

This Chapter presents evidence of the effectiveness and safety from primary studies (both Australian and international) that evaluated RMMR principally delivered by a pharmacist, and independent of any other intervention aiming at optimising drug regimens and patient outcomes. The evidence is presented in relation to the PICO criteria outlined in Section 3.1.1. It does not include evidence reported in previous evaluations of the RMMR program, which was summarised in Chapter 4.

In reviewing this Chapter, it should be noted that 22 systematic reviews were assessed using the eligibility criteria for studies to be included in this review against the characteristics of each previous review. It appeared that the identified systematic reviews included studies (RCT- and non-RCT evidence) that evaluated the effects of medication reviews in any setting, including the home, residential aged care facility, community pharmacy, as well as hospital, outpatient clinic, and medical centre. Further, the systematic reviews included studies that evaluated medication reviews as part of a multidisciplinary model or multifaceted pharmacy-led intervention, or medication reviews delivered by combinations of health professionals (e.g. physicians, nurses) where the pharmacist was only partly involved. Therefore, findings from these systematic reviews cannot be extrapolated to the evaluation of the RMMR service, and thus will not be discussed further.

5.1 EVIDENCE FROM PRIMARY STUDIES

The systematic literature review identified six studies with mixed design, and included three RCTs and three retrospective observational studies. Two studies were conducted in Australia, two in the UK, one in Netherlands, and one in Israel.

The studies evaluated RMMRs performed by a pharmacist, aimed at checking and optimising the patients' drug regimens (i.e. ability to make recommendations on altering the regimen), and not limited simply to increasing patients' knowledge and/or adherence. Study participants were older people (mean age >80 years) and were all residents of aged care facilities. There was considerable variability in the outcomes measured, with a focus on hospitalisation, mortality, and medication costs. Quality of life was only represented in one of the included studies. Intermediate outcomes such as drug burden and medication appropriateness were also investigated. A major limitation of the evidence was the diversity of outcome measures and the fact that they differed in the way they were defined, collected and analysed.

The characteristics and results of the six identified studies are presented in Table 5.1 and Table 5.2, respectively.

Table 5.1: Characteristics of the included studies-RMMR performed by a pharmacist

Study ID Country	Study design/total study duration	Mean age	Population	Intervention	Control	Outcomes
McLarin (2016) Australia	Retrospective observational study N=814	85.6	Residents (de-identified from RMMR reports) ≥65 years	RMMR conducted by an accredited pharmacist in collaboration with GPs.	-	Primary outcome • change in anticholinergic burden (Wilcoxon sign rank test)
Frankenthal (2014) Israel	RCT N=359 (1 chronic care geriatric facility) 12-months	82.7	Residents in a chronic care geriatric facility ≥65 years, prescribed at least 1 medication (n=183 intervention/ 176 control)	RMMR by the study pharmacist. Recommendations that the study pharmacist made were discussed with the chief physician at study opening and after six months. The chief physician decided whether to accept these recommendations and implement prescribing changes.	Usual pharmaceutical care	Primary outcome • Medication appropriateness (STOPP/START) Secondary outcomes • hospital admissions • mortality • medication cost • medication-related problems • quality of life (SF-12) • falls • functioning (Functional Independence Measure (FIM))
Nishtala (2009) Australia	Retrospective observational study N=500 (62 aged care homes) 8 months	84	Residents (de-identified from RMMR reports) ≥65 years (N=500/ no control group)	RMMR performed by accredited clinical pharmacists from a single RMMR service provider, and recommendations/RMMR report sent to the GP.	-	• Drug Burden Index (BDI)
Stuijt (2008) The Netherlands	Observational study pre- post-design N=30 (1 residential nursing home) 12 months	85.8	Residents (age not specified) of a nursing home receiving ongoing medical care from 2 GPs and 1 dispensing pharmacist n=30 (no control group)	RMMR performed by a pharmacist, with access to patients' medical records. Pharmacist's recommendations were discussed with the GP and other healthcare team members.	-	• medication appropriateness (assessed using the Medication Appropriateness Index (MAI))

Study ID Country	Study design/total study duration	Mean age	Population	Intervention	Control	Outcomes
Zermansky (2006) UK	RCT N=661 (65 care homes) 6 months	85.3	Residents of care homes ≥65 years on one or more medications (n=331 intervention /330 control)	Clinical medication review by a pharmacist. It comprised a review of the GP clinical record and a consultation with the resident and carer. The pharmacist formulated recommendations with the resident and carer and passed them on to the GP for acceptance and implementation.	No RMMR-usual care by GP	Primary outcome • number of changes in medication per participant Secondary outcomes • hospital admissions (non-elective) • mortality • medication-related problems • cost of medicines (cost of 28 days of repeat medicines per participant) • falls • number of GP consultations • cognitive and physical functioning (using Standardised Mini-Mental State Examination (SMMSE) and the Barthel Activities of Daily Living Index)
Furniss (2000) UK	Cluster RCT (randomised by care homes) N=330 (14 nursing homes; 7 matched pairs) 8 months (4-month follow-up post-RMMR preceded by 4-month observation period)	83.5	Residents in nursing homes (n=158 intervention/ 172 control)	RMMR by pharmacist: details of current medication from the patient's medicines administration record chart at the home were collected, together with a brief medical history and any current problems identified by the home staff. Three weeks after the RMMR, the homes were revisited, to ascertain whether there had been any immediate problems with the changes in medication and to see if the suggested changes had been implemented.	No RMMR-usual care	• hospital admissions (number of inpatient days • mortality • cost of medicines • medication-related problems • quality of life • use of primary and secondary care resources • number of accidents • falls • cognitive function using the Mini-Mental State Examination (MMSE) • depression using the Geriatric Depression Scale (GDS) Brief Assessment Schedule Depression Cards (BASDEC) • behavioural disturbances using the Crichton-Royal Behaviour Rating Scale (CRBRS)

Abbreviations: DBI, Drug Burden Index; GP, general practitioners; MAI, Medication Appropriateness Index; RMMR, Residential Medication Management Review; RCT, randomised controlled trial; STOPP/START, Screening Tool of Older Persons' potentially inappropriate Prescriptions/Screening Tool to Alert doctors to Right Treatment; UK, United Kingdom

Table 5.2: Summary of results of the included studies

Study ID Country	Study design/ duration	Population	Relevant comparison	Effect	Authors' conclusions
McLarin (2016) Australia	Retrospective observational study N=814	Residents (de-identified from RMMR reports) ≥65 years	n.a.	Anticholinergic burden (using each of seven assessment scales) • anticholinergic burden scores were significantly (p<0.001) lower after pharmacists' recommendations • anticholinergic burden was also significantly (p<0.001) lower after GPs' acceptance of the pharmacists' recommendations	RMMRs are effective in reducing anticholinergic medication prescribing in aged care facility residents, using a range of measures of anticholinergic burden. However, it remains unclear whether a decrease in anticholinergic burden will translate into improvement in clinical outcomes
Frankenthal (2014) Israel	RCT N=359 12-months	Residents in a chronic care geriatric facility ≥65 years, prescribed at least 1 medication (n=183 intervention/ 176 control)	RMMR vs standard care	Medication appropriateness (using STOPP-START criteria) • reduction in potentially inappropriate prescriptions (37.4% intervention vs 56% control, p<0.01) • reduction in potential prescribing omissions (9.2% intervention versus 25.2% control; p <0.01) Hospital admissions • intervention 0.5 ± 1.0 vs 0.5 ± 0.9 control (p = 0.10) Mortality • 15/183 (8.2%) vs 17/176 (9.7%) however, this was not formally analysed as an outcome measure Medicine costs • difference between the intervention group and control group at follow-up (279 ± 171.9 vs 402.3 ± 291.2, Israeli New Shekel (ILS), p< 0.01) QoL • There was no difference between groups in the physical (p=0.09) and mental (p=0.70) components of SF-12	Implementation of STOPP/START criteria reduced the number of medications, falls, and costs in a geriatric facility. Their incorporation in those and similar settings is recommended
Nishtala (2009) Australia	Retrospective observational study N=500 (62 aged care homes) 8 months	Residents (de-identified from RMMR reports) ≥65 years (N=500/ no control group)	n.a.	Median DBI score • reduced from 0.5 at baseline (equivalent to one minimum efficacious dose of an anticholinergic or sedative medication per resident) to 0.33 post-RMMR (equivalent to half a minimum efficacious dose of an anticholinergic or sedative medication per resident) (p<0.001)	RMMR performed by an accredited clinical pharmacist can reduce prescribing of sedative and anticholinergic drugs in older people, resulting in a significant decrease in the patient's drug burden

Study ID Country	Study design/ duration	Population	Relevant comparison	Effect	Authors' conclusions
Stuijt (2008) The Netherlands	Observational study pre- post-design N=30 (1 residential nursing home) 12 months	Residents (age not specified) of a nursing home receiving ongoing medical care from 2 GPs and 1 dispensing pharmacist n=30 (no control group)	n.a.	Medication appropriateness (MAI scores) • mean overall MAI score: 16.0 (95% CI 9.48–22.6) post-RMMR vs 23.7 (95% CI 17.0–30.3) pre-RMMR (p = 0.013) • mean per medication MAI score: 2.43 (95% CI 1.75–3.11) post-RMMR vs 3.79 (95% CI 2.89–4.68) pre-RMMR (p=0.002)	RMMR performed by a clinical pharmacist was associated with an improvement in appropriateness of prescribing measured by a decrease in MAI scores. However, it remains unclear whether improved quality of prescribing translate into improvement in clinical outcomes (e.g. reduction in drug-related problems)
Zermansky (2006) UK	RCT N=661 (65 care homes) 6 months	Resident of care homes ≥65 years on one or more medications (n=331 intervention /330 control)	RMMR vs standard care	Hospital admissions • RR 0.75, 95% CI 0.52–1.07 Change in patients' medication regimens • mean number of drug changes/patient: 3.1 for intervention and 2.4 for control group (p< 0.0001) Mortality • RR 1.06, 95% CI 0.70–1.64 Falls/patient • mean of 0.8 vs 1.3 (p< 0.0001) • number of falls/patient remained unchanged in the control group compared to baseline GP consultations/patient • means 2.9 and 2.8 in 6 months (p=0.5) Medicine costs • There is little difference on the cost of 28 days' repeat medicines per resident (mean difference £ -0.70, 95% CI £-7.28– £5.71) Medication-related recommendations • 76% of pharmacist recommendations were accepted by the GP • 77% of accepted recommendations were implemented Cognitive and physical functioning • no statistically significant difference in Barthel or SMMSE score between the two groups Barthel score (9.8 and 9.3, P = 0.06), SMMSE score (13.9 and 13.8, P = 0.62	Pharmacist-led RMMR leads to substantial change in patients' medication regimens without change in drug costs. RMMR demonstrated a significant reduction in the number of falls, however, there were no significant change in GP consultation rates, hospitalisation, mortality, or cognitive and physical functioning

Study ID Country	Study design/ duration	Population	Relevant comparison	Effect	Authors' conclusions
Furniss (2000) UK	Cluster RCT (randomised by care homes) N=330 (14 nursing homes; 7 matched pairs) 8 months (4-month follow-up post-RMMR preceded by 4-month observation period)	Residents in nursing homes (n=158 intervention/ 172 control)	RMMR vs standard care	Hospital admissions • 0.55 vs 1.26; however, small numbers precluded statistical analysis Number of prescribed drugs • mean difference 0.5, 95% CI -0.04–1.0; p=0.07 Falls and accidents • no significant difference between groups Mortality • 4-month post-RMMR: 4 vs 14 (p=0.028) • 8-month study duration: 28 and 26 (p value not reported) Medication-related recommendations • 92% recommendations were accepted by the GP Medicine costs • observation phase (first 4 months of the study): £159.01/resident vs £142.53/resident • post-RMMR: £131.54/resident vs £141.24/resident • accounting for the pharmacist's time, the cost saving on medicines in the intervention group: £22/resident Cognitive functioning • MMSE score: mean difference between the two groups at 8 months 1.6 (95% CI -0.1–3.3; p=0.07) Behavioural disturbances • observed effect not attributed to RMMR Depression • no significant difference between groups	RMMR conducted by a pharmacist reduced the number of medicines prescribed to elderly people living in nursing homes, and reduced costs. However, the RMMR had no impact on health outcomes such as hospitalisation, falls, and deaths

Abbreviations: CI, confidence interval; DBI, Drug Burden Index; GP, general practitioners; MAI, Medication Appropriateness Index; MMSE, Mini-Mental State Examination; n.a., not applicable; RMMR, Residential Medication Management Review; RCT, randomised controlled trial; RR, relative risk; SMMSE, Standardised Mini-Mental State Examination; STOPP/START, Screening Tool of Older Persons' potentially inappropriate Prescriptions/Screening Tool to Alert doctors to Right Treatment; UK, United Kingdom; vs, versus

The RCT by Frankenthal et al (2014) investigated pharmacist-led RMMR versus usual care. The chief physician decided whether to accept these recommendations and implemented changes. It included 359 residents in one chronic care geriatric facility, randomised to receiving an RMMR (n=183) or usual care (n=176). The study assessed medication appropriateness as a primary outcome, using the validated Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) and Screening Tool to Alert doctors to Right Treatment (START) criteria. Other outcome measures included hospital admissions (not defined), mortality (over 12 months), quality of life (using SF-12), medication-related problems (assessed as the number of pharmacist recommendations, acceptance of recommendations by the physician, number of treatment changes), and medicine costs (per month).

The RCT by Zermansky et al. (2006) evaluated the effectiveness of a RMMR (in addition to usual care by the GP) undertaken by a pharmacist who held a post-graduate clinical pharmacy qualification versus usual care by the GP. The pharmacist reviewed the patients' medicines with the medical and care home records in conjunction with a consultation with the resident (if possible) and a nurse or carer. The study involved 661 residents in 65 nursing and residential homes for older people (331 intervention; 330 control group). The study measured the number of changes in medication per participant as the primary outcome (pharmacist's recommendations were identified, collated and classified along with GPs' acceptance of the recommendations). Other outcome measures included hospital admissions (reported the mean number of non-elective hospitalisations per resident), mortality (over six and eight months), falls per patient, GP consultations, medication-related problems, cognitive and physical functioning and medicine costs. The study reported similar baseline characteristics in the intervention and control group. The study reported that the mean number of medicines prescribed in the UK per resident was 6.9 (in 2003).

The cluster RCT by Furniss et al (2000) investigated the effect of RMMR (in addition to usual care by the GP) conducted by a pharmacist versus usual care by the GP. The intervention was a single medication review conducted by one pharmacist with access to medical and nursing home records. The pharmacist collected details of current medication from the patient's medicines administration record chart at the home, together with a brief medical history and any current problems identified by the home staff. Fourteen homes were matched into seven pairs with similar characteristics and one home in each pair was randomised to receive regular medication review by a pharmacist and the other to receive no pharmacist intervention. The study comprised of a four-month observation period, after which medication review was undertaken, followed by a further four-month observation period. Three weeks after the medication review, the homes were revisited to see if the recommended changes had been implemented. The study involved 330 residents (158 intervention; 172 control group). Outcome measures included hospital admissions (number of inpatients days), mortality (over six and eight months), medication-related problems, cognitive and behavioural functioning, depression, and medicine costs. Of note, residents in the control group were younger and there were fewer females. The study reported that the mean number of medicines prescribed in the UK per resident was 4.9 (in 1998).

A recent Australian retrospective study by McLarin et al (2016) investigated the impact of RMMRs on anticholinergic burden (drug burden). It included 814 residents of aged care facilities aged 65 years or older, who received an RMMR by an accredited pharmacist. The study assessed the change in anticholinergic burden using seven scales at three time points: at baseline, post-RMMR (after pharmacists' recommendations) and after the actual GP uptake of pharmacists' recommendations. Change in the anticholinergic burden was measured using the Wilcoxon sign rank test.

The Australian retrospective observational study by Nishtala et al (2009) examined the impact of RMMRs performed by accredited clinical pharmacists on Drug Burden Index (DBI) in older people living in aged care homes. It included a sample of 500 de-identified RMMR reports from residents who had received medication reviews conducted by accredited clinical pharmacists. DBI scores were calculated at three points in time: at baseline, after the recommendations had been made by the

pharmacist and after uptake of pharmacist recommendations by the GP. A decrease in DBI scores indicates an improvement in the use of medicines characterised by the cessation of sedative/anticholinergic drug; antipsychotic dose reduction; withdrawal of benzodiazepines.

A small observational study by Stuijt et al (2008) investigated the impact of a pharmacist-led RMMR on medication appropriateness. It included 30 nursing home residents whose medications were administered by the nursing home staff. The medication review consisted of the preparation of a patient medication profile, which combined the patient's medical records with his or her complete prescription record (current and previous medication history) and pharmaceutical record (electronic journal entries for the patient over the same period). Laboratory values were also evaluated. A pharmaceutical care plan was developed and pharmacists' recommendations were discussed with the healthcare professional team consisting of a GP and care home staff, followed by consultation with the patient. Medication appropriateness was assessed using the Medication Appropriateness Index (MAI), MAI, a comprehensive validated instrument consisting of 10 criteria for which each medication is rated according to a specified protocol. It should be noted that despite consultation with the patient following the pharmacists' recommendation, the intervention is more of a shared team approach with access to medical records, and the face-to-face encounter with the patient during the RMMR did not take place.

5.1.1 Hospital admissions

The RCT by Frankenthal et al (2014) showed no evidence of an effect on the average number of hospitalisations (intervention 0.5 ± 1.0 vs 0.5 ± 0.9 control, p = 0.10).

The RCT by Zermansky et al (2006) showed no evidence of an effect of the RMMR on the mean number of hospitalisations per resident (relative risk 0.75, 95% CI 0.52–1.07; not significant). The study also found no significant difference for GP consultations per patient in the RMMR group versus the control group (means 2.9 and 2.8 in 6 months, p= 0.5). However, the number of GP consultations per patient were lower in both groups compared to the UK's Department of Health figures for patients over 75 generally. This may reflect on the quality of care in homes, with better diet, safer environment and earlier health intervention.

The RCT by Furniss et al (2000) found fewer inpatient days per resident in the intervention group compared with the control group during the four-month intervention phase of the study (0.55 versus 1.26); however, small numbers precluded statistical analysis.

Findings: *Evidence from three RCTs suggests that the RMMR does not lead to fewer days in hospital. There is a paucity of evidence evaluating the RMMR impact on other health care resource utilisation, such as GP consultations and emergency department admissions.*

5.1.2 Medication appropriateness

The RCT by Frankenthal et al (2014) evaluated medication appropriateness using STOPP-START criteria in a random subsample of 411 residents (200 control, 211 intervention). The study found a reduction in potentially inappropriate prescriptions (37.4% intervention vs 56% control, p<0.01) and potential prescribing omissions (9.2% intervention versus 25.2% control; p <0.01) in intervention residents at six months' follow-up and this was sustained at 12 months.

The small observational study by Stuijt et al (2008) showed that the mean summed MAI score before the RMMR was 23.7 (95% CI 17.0–30.3) compared with 16.0 (95% CI 9.48–22.6) post-RMMR, thus revealing a statistically significant difference between overall pre- and post-RMMR summed MAI scores (p = 0.013). The mean per medication MAI score before RMMR for all medicines used or still in use was 3.79 (95% CI 2.89–4.68) compared with 2.43 (95% CI 1.75–3.11) post-RMMR (p=0.002).

The authors concluded that the use of a RMMR by a clinical pharmacist was associated with an improvement in appropriateness of prescribing. However, the study failed to link the effect of improved quality of prescribing on reducing drug-related problems.

Findings: *Evidence from one RCT and one small observational study showed that the use of a RMMR by a clinical pharmacist was associated with an improvement in appropriateness of prescribing, using validated instruments. However, the link between improved medication appropriateness and patient-related outcomes is not clear. One limitation of using the MAI as an instrument to measure medication appropriateness is that the MAI scores differ depending on the judgements of individual raters and the context of different types of patients and GPs, and the quality of prescribing and the number of drugs used. Therefore, changes in prescribing appropriateness as measured by the MAI should be strictly interpreted within their own context. In addition, the study by Stuijt et al (2008) included a small sample of selected, non-randomised patients thus limiting the generalisability of the study findings.*

5.1.3 Medication-related problems

In the retrospective study by McLarin et al (2016), and depending on the scale used to estimate the anticholinergic burden, the RMMR resulted in pharmacists recommending stopping between 45 and 193 anticholinergic medications prescribed at baseline, while four to 60 new anticholinergic medications were recommended to be added by the pharmacists. In addition, pharmacists recommended 114 dosage changes and recommended monitoring for anticholinergic adverse effects for 241 anticholinergic medications. Notably, in 103 instances the pharmacists' recommendation (to cease, decrease dose or monitor) was made due to possible anticholinergic adverse effects identified by the pharmacist. However, the effect of pharmacists' recommendations on reducing drug-related problems was not investigated.

The RCT by Frankenthal et al (2014) made 327 recommendations in total including 245 in 129 residents based on STOPP and 82 in 65 residents based on START. Nearly 82% of STOPP recommendations and 93% of START recommendations were accepted by the physician. However, the effect of pharmacists' recommendations on reducing drug-related problems was not investigated.

The small observational study by Stuijt et al (2010) reported a total 115 drug-related problems identified by pharmacists in a cohort of 30 nursing home residents, with nearly 68% (78) of the recommendations accepted by GPs. This study also demonstrated an improvement in medication appropriateness (refer to Section 5.1.2) following an RMMR, however the effect of this on reducing drug-related problems was not investigated.

In the study by Zermansky 2006, at least one recommendation was made in 256 (77%, 95% CI 73.1–81.7) residents, with a mean of 2.3 recommendations per resident. The pharmacists made 672 medication-related recommendations, along with an additional 75 recommendations related to the residents' conditions. The most common recommendation (30%) was technical (for example generic switching, amending quantities, removing discontinued items from the repeat prescription). Other common recommendations included performing tests to monitor therapy (22%) and to stop a medicine (13%). The GP accepted 565 (76%) of the pharmacist's recommendations and rejected 52 (7%); there was no response to the review or the resident died before the review could be actioned in the remaining cases. The GP actioned 433 (77%) of the accepted recommendations. However, the authors have not attempted to evaluate the impact of pharmacists' recommendations on reducing drug-related problems.

The RCT by Furniss et al (2000) reported a total of 261 recommendations made by pharmacists, with 239 (92%) recommendations accepted by the GP, leading to 144 actual treatment changes. The two most common interventions were related to medicines that were no longer needed by the patient and switching to more effective or safer medicine.

Findings: *There was evidence from three RCTs and two observational studies that RMMR performed by pharmacist led to the identification of medication-related problems. The evidence also shows that GPs' acceptance rate for medicine interventions suggested by pharmacists is generally high. However, none of the studies determined whether the identification of medication-related problems through the RMMR service led to actual improvements in health outcomes, specifically reduction in adverse drug events.*

5.1.4 Falls

The RCT by Zermansky et al (2006) found a statistically (and clinically) significant reduction in falls. Although noting that this was a secondary outcome measure, patients in the intervention group experienced a mean of 0.8 falls compared with 1.3 in the control group ($p< 0.0001$). Notably, the number of falls per patient remained unchanged in the control group compared to baseline. There are, however, many reasons for caution with the outcomes of this study, including a greater number of patients falling at baseline in the intervention arm and the non-random recruitment of patients. Zermansky et al. suggested that the reduction in falls seen in their study is largely attributable to stopping central nervous system drugs that are known to increase the risk of falls by causing sedation, confusion and hypotension.

The RCT by Furniss et al (2000) reported that the number of accidents and falls recorded at the nursing homes did not differ significantly throughout the study.

Findings: *Two RCTs investigated the effect of RMMR by a pharmacist on reduction in rate of falls. Results from these two studies were conflicting. One trial with a single clinical medication review resulted in a significant reduction in falls. However, another trial showed no difference in risk of falling.*

5.1.5 Drug burden

The recent Australian retrospective study by McLarin et al (2016) investigated the impact of RMMRs on the change in anticholinergic burden using seven scales at three time points: at baseline, post-RMMR (after pharmacists' recommendations) and after the actual GP uptake of pharmacists' recommendations. Change in the anticholinergic burden was measured using the Wilcoxon sign rank test. Results showed that at baseline, depending on the scale used to estimate the anticholinergic burden, between 36% and 67% of patients were prescribed at least one regular anticholinergic medication. Anticholinergic burden scores were significantly ($p<0.001$) lower after pharmacists' recommendations as determined by each of the seven scales. The reduction in anticholinergic burden was also significant ($p<0.001$) after GPs' acceptance of the pharmacists' recommendations according to all scales with the exception of one scale which reached borderline significance ($p=0.052$).

The authors noted that this is the first study to demonstrate that RMMRs are effective in reducing anticholinergic medication prescribing in aged care facility residents, using a range of measures of anticholinergic burden. However, it remains unclear whether a decrease in anticholinergic burden will translate into improvement in clinical outcomes. Therefore, further clinical studies assessing the effect of reducing the anticholinergic burden on important outcomes such as adverse effects, hospitalisations, quality of life and mortality are required. A major limitation of this study is that it is retrospective and thus although GPs may have indicated the acceptance of pharmacists' recommendations and agreed to make changes one cannot confirm the extent of accepted recommendations that were implemented.

The Australian retrospective observational study by Nishtala et al (2009) examined the impact of RMMRs performed by accredited clinical pharmacists on DBI at three points in time: at baseline, after the recommendations had been made by the pharmacist and after uptake of pharmacist recommendations by the GP. A decrease in DBI scores indicates an improvement in the use of medicines characterised by the cessation of sedative/anticholinergic drug; antipsychotic dose reduction; withdrawal of benzodiazepines. The study reported a statistically significant decrease in median DBI

score from 0.5 at baseline (equivalent to one minimum efficacious dose of an anticholinergic or sedative medication per resident) to 0.33 post-RMMR (equivalent to half a minimum efficacious dose of an anticholinergic or sedative medication per resident) ($p<0.001$) as a result of uptake of pharmacist recommendations by the GP. The mean decrease in DBI as a result of pharmacist recommendations was 0.12 (95% CI 0.09–0.14) representing a 20% decrease from baseline. When GPs implemented pharmacists' recommendations, DBI decreased by a mean of 12% from baseline (mean decrease 0.07; 95% CI 0.05– 0.08).

The authors concluded that pharmacist-conducted RMMRs can reduce prescribing of sedative and anticholinergic drugs in older people, resulting in a significant decrease in the patient's drug burden. A limitation of this study was the authors have not attempted to link the observed reduction in patients' drug burden and the improvement in medication use to improvements in health outcomes, such as drug-related problems. The authors published another study in 2011 that highlighted the prevalence and nature of drug related problems (DRPs) across drug and disease categories for the same 2009 study patient population (Nishtala et al, 2011), however, the study did not determine whether the RMMRs have resulted in a decrease in DRPs, and importantly whether the resolution of DRPs through the RMMR service led to actual improvements in health outcomes.

The RCT by Zermansky et al (2006) measured the number of changes in medication per participant as the primary outcome. Although a statistically significant difference in favour of the intervention group was found at six months (ratio of means 1.34; 95% CI 1.21–1.48), there were no statistically significant differences between groups for the total number of drugs used (ratio of means 0.98, 95% CI 0.92–1.04).

The RCT by Furniss et al (2000) reported that the mean number of drugs prescribed decreased in both the intervention and control group during the course of the eight-month study. The reduction was greater in the intervention group; however, the difference between groups was not statistically significant (mean difference 0.5 prescriptions, 95% CI -0.04–1.0; $p=0.07$).

Findings: *Evidence from one RCT and two observational study demonstrated a significant reduction in the number of prescribed drugs (specifically anticholinergic medication) following pharmacists' RMMR recommendations and GP uptake of those recommendations. Evidence from one other RCT demonstrated a reduction in the mean number of drugs in both the RMMR group and the control, with no in-between group significant difference. A large proportion of residents of aged care facilities, particularly older patients with dementia, are prescribed anticholinergic and sedative medications, which are associated with several adverse events. Anticholinergic adverse effects can be acute, and may include acute confusion or delirium which may result in increased hospitalisation and may be associated with functional and cognitive decline. Therefore, reducing the anticholinergic burden is likely to decrease the risk of a patient developing these adverse effects. However, the link between reduced drug burden and patient-related outcomes (such as adverse drug effects) was not investigated in any of the included studies. Further clinical studies assessing the effect of reducing the anticholinergic burden on important outcomes such as adverse effects, hospitalisations, quality of life and mortality are required.*

5.1.6 Mortality

Frankenthal et al (2014) reported that 15/183 (8.2%) and 17/176 (9.7%) residents died in the intervention and control groups, respectively. However, this ratio was not formally analysed as an outcome measure.

The RCT by Zermansky et al (2006) showed no evidence of an effect of the RMMR on the number of deaths (relative risk 1.06, 95% CI 0.70–1.64).

The RCT by Furniss et al (2000) found fewer deaths in the intervention group compared with the control group during the intervention phase of the study (4 versus 14, $p = 0.028$); however, when the

observation phase of the study was taken into account, the number of deaths in the control and intervention groups were 28 and 26 (p value not reported), respectively.

Findings: *Evidence from three RCTs suggested that the RMMR has no effect on reducing deaths.*

5.1.7 Medication costs

The RCT by Frankenthal et al (2014) calculated medication costs per month. The study demonstrated a reduction in the average monthly medication costs in the intervention group at follow-up compared to baseline (382.7 ± 279.3 at baseline vs 279 ± 171.9 at follow-up, Israeli New Shekel (ILS), p< 0.01), with a difference between the intervention group and control group at follow-up (279 ± 171.9 vs 402.3 ± 291.2, ILS, p< 0.01).

The RCT by Zermansky et al (2006) calculated the 28-day net ingredient cost of repeat medicines per resident. The study reported little difference on the cost of 28 days' repeat medicines per resident (mean difference £ -0.70, 95% CI £-7.28– £5.71).

Furnisss et al (2000) attempted to quantify the cost benefit of RMMR by calculating drug costs per resident throughout the observation and intervention phases of the study. The cost of medicines per resident in the observation phase (first 4 months of the study) was £159.01 in the intervention group and £142.53 in the control group. Following the intervention phase, costs were £131.54 in the intervention group versus £141.24 in the control group, thus representing a reduction in medicine costs of £27.47 per resident in the intervention group over a four-month period. Accounting for the pharmacist's time, the cost saving on medicines in the intervention group was calculated to be £22 per resident.

Findings: *The evidence for an effect of RMMR on medication costs was mixed, with two RCTs finding a reduction in costs (Furniss et al, 2000; Frankenthal et al, 2014) and one RCT finding no difference (Zermansky et al, 2006). Therefore, it remains uncertain whether RMMR decreases medication costs.*

5.1.8 Clinical outcomes

Two RCTs investigated the effect of RMMR on cognitive and physical functioning. The RCT by Zermansky et al (2006) utilised the Standardized Mini-Mental State Examination (SMMSE) to grade older people's cognitive function and the Barthel Index to assess self-care and mobility activities of daily living in geriatric patients. The study reported no statistically significant difference in Barthel score (9.8 versus 9.3; p=0.06) or SMMSE score (13.9 versus 13.8; p=0.62) between the two groups.

The RCT by Furniss et al (2000) utilised the Mini-Mental State Examination (MMSE) to grade older people's cognitive function and the Crichton-Royal Behaviour Rating Scale (CRBRS) was used to assess behavioural disturbances. The study also assessed depression using two scales: Geriatric Depression Scale (GDS) and the Brief Assessment Schedule Depression Cards (BASDEC). The study reported no statistically significant difference in MMSE score, with a mean difference between groups at eight months of 1.6 (95% CI -0.1–3.3; p=0.07). Mean CRBRS scores tended to increase in the intervention group relative to the control group, with a mean difference between groups at eight months of -2.2 (95% CI -4.1 to -0.3; p=0.02); however, the authors noted that these changes could not be attributed to the RMMR, as the increase in impairment occurred before this eight-month time point. There were no statistically significant changes observed in the depression scores between the two groups.

Findings: *Evidence from two RCTs indicates that RMMR performed by a pharmacist does not result in a significant improvement in cognitive, physical or behavioural functioning.*

5.1.9 Quality of life

Only one RCT reported on RMMR effect on quality of life. Frankenthal et al (2014) showed that the RMMR had no effect on quality of life. There was no difference between groups in the physical (p=0.09) and mental (p=0.70) components of SF-12.

Findings: *There is insufficient evidence to assess the effect of pharmacist-led RMMR on quality of life.*

5.1.10 Other outcomes

None of the included studies specifically investigated whether the provision of RMMR is accompanied by clinically meaningful improvements in adherence to medication. None of the studies reported on changes in disability indices or patient acceptance or satisfaction with pharmacist-led RMMR. No studies were identified that evaluated the cost-effectiveness of RMMR service.

6
Evidence relating to cost and cost-effectiveness

The systematic literature review did not identify any published studies relating to the cost and cost-effectiveness of RMMR services with reference to the PICO criteria outlined in Section 3.1.1. Only the study by Campbell Research and Consulting[15] and the commentary offered by Stafford[16] addressed the question of cost-effectiveness of RMMRs. This work has been summarised in Chapter 4.

No studies were found that sought to measure the costs of an RMMR. The discussion in the Campbell Research and Consulting and Stafford reports used the payment made to pharmacists as the cost, there was no attempt to measure the actual cost of the pharmacist providing the service.

[15] Campbell Research and Consulting - Evaluation of the Residential Medication Management Review Program: Main Findings Report and Appendix F; 2010.
[16] Stafford C. A clinical and economic evaluation of medication reviews conducted by pharmacists for community dwelling Australians; 2012

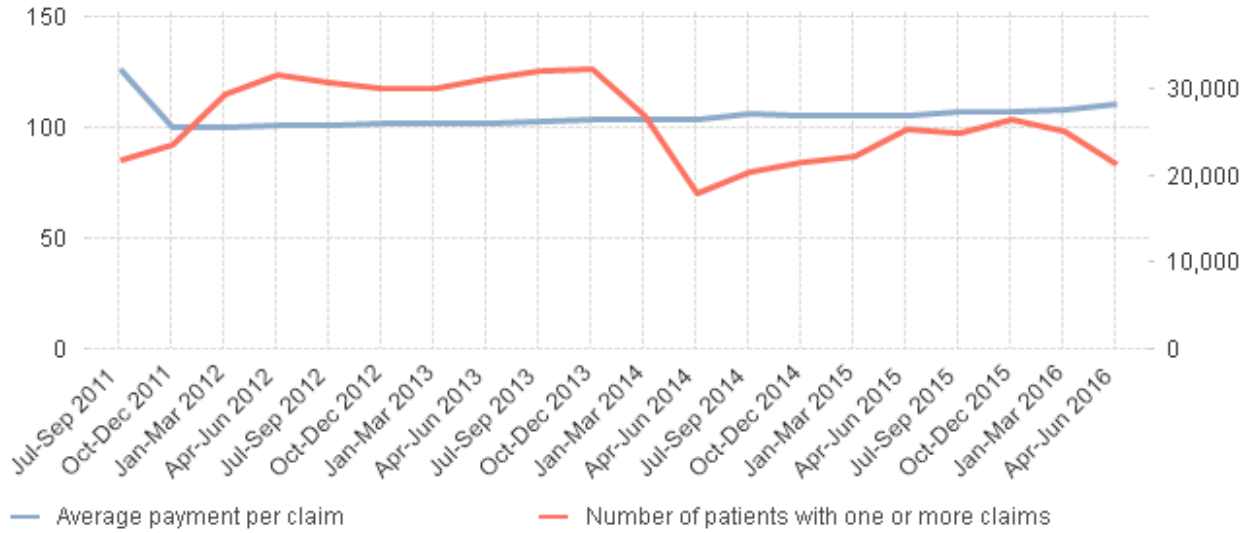
7
Utilisation Analysis

This Chapter examines the de-identified claims payment data held by the Department of Human Services and the Pharmacy Guild relating to 2011 to 2016. The data have been analysed primarily on inter-record and longitudinal relationships and also in the context of 'remoteness' inferred from the facility postcode. The analysis seeks to assess whether the RMMR service providers were implementing the scheme in line with guidance. Key metrics in the analysis are the amount of claims paid, the number of patient RMMR services provided and the interval time between dates of service for patients who received more than one service (note data on reason for referral and RMMR outcome was not available in the provided datasets).

7.1 CLAIMS MADE AND AMOUNT PER CLAIM

Figure 7.1 shows the average payment per claim (between July 2011 and June 2016 based upon the date of service) compared with the number of unique patients receiving RMMRs over the same period. It demonstrates that the average claim amount remained stable (between $100 and $105 for the period October 2011 to June 2016). It also demonstrates a significant drop in the number of patients receiving services between Quarter 4, 2013 and Quarter 2, 2014 from 32,304 to 17,389 (a reduction of 14,465 patients or 45%). This sharp reduction is likely due to the introduction of a 'deadline' of 30 days from the date of service for providers to lodge claims (in March 2014).

Figure 7.1: Movement in per patient claim value and patient volume July 2011 to Jun 2016



Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.

Prior to the introduction of the 30 day deadline the number of patients receiving an RMMR was steadily increasing. From Quarter 1, 2012 to Quarter 4, 2013 the volume of unique patients receiving services rose from 29,449 to 32,304 representing 2,855 additional patients or 9.7%. After the dip induced by the policy change, Figure 7.1 shows that patient numbers have grown steadily, but have not returned to their pre-policy change levels. Note that the underlying patient numbers are potentially understated in the RMMR claims data since rejected claims do not appear in patient counts (RMMR data do not provide details about the volume of unpaid claims). Regardless of the quantity of rejected

claims, the 30 day deadline appears to have had a sustained impact that has reduced RMMR service provision.

7.2 NUMBER OF CLAIMS BY PATIENT AGE

Figure 7.2 profiles patients by age according to how many RMMR services they have received over 10 consecutive quarters pre-policy change (i.e. with a date of service between July, 2011 and Dec, 2013). Please note that patients who have had an RMMR service in both the pre- and post-policy change periods are counted post-policy change, and that patients have been classified according to their age at the time of receiving their most recent RMMR.

Figure 7.2: Patient age by number of RMMRs between July 2011 and December 2013

Patient Age	Number of RMMR services performed												Age dist
	1	2	3	4	5	6	7	8	9	10	11	12	
0-4	4	-	-	-	-	-	-						0%
15-19	1	-	-	-	-	-	-						0%
20-24	7	1	-	-	-	-	-						0%
25-29	20	3	-	-	-	-	-						0%
30-34	21	8	2	-	-	-	-						0%
35-39	33	6	2	-	-	-	-						0%
40-44	116	37	2	-	-	-	-						0%
45-49	248	80	8	-	-	-	-						0%
50-54	479	209	21	1	-	1	-						0%
55-59	1046	408	63	4	4	-	1						1%
60-64	2046	804	97	5	2	-	-						2%
65-69	3967	1538	205	8	-	2	1						3%
70-74	6997	2401	292	9	5	-	-						5%
75-79	12958	4275	487	15	-	2	-						10%
80-84	25851	8122	891	50	7	3	1						19%
85-89	37643	12408	1245	56	18	3	-						28%
90-94	29548	10712	1203	43	12	1	3						22%
95-99	10628	4513	529	20	2	-	-						8%
100-104	1602	407	31	1	-	-	-						1%
105-109	92	37	11	-	-	-	-						0%
110-114	6	3	-	-	-	-	-						0%
% Distribution	72%	25%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.

Figure 7.2 (far right column) shows that, as expected, almost all (97%) of the patients receiving an HMR were aged 65 years or more. Somewhat surprisingly, there was at least one patient in every age cohort from 0-4 years through to 100-114 who received an RMMR. A large proportion of patients (72%) received just a single RMMR service in the two and-a-half year period, 3% of patients received three or more RMMR services. Interestingly six patients received seven services in the 30 month period (i.e. on average, at least one every six months). Overall, 28% of patients received repeat RMMRs; for this group the time between the consecutive RMMRs is relevant when considering adherence to guidelines (see Figure 7.4).

Figure 7.3 profiles patients by age according to how many RMMR services they have received over 10 continuous quarters post-policy change (i.e. with a date of service between January 2014 and June 2016). Please note again that patients who have had an RMMR service in both the pre- and post-policy change periods are counted post-policy change, and that patients have been classified according to their age at the time of receiving their most recent RMMR. Figure 7.3 (far right column) shows that post-policy change 96% of the patients receiving an HMR were aged 65 years or more (almost the same as pre-policy change), and that there was at least one patient in every age cohort from 0-4 years through to 100-114 years who received an HMR (again almost the same as pre-policy change).

Figure 7.3: Patient age by number of RMMRs between January 2014 and June 2016

Patient Age	Number of RMMR services performed												Age dist
	1	2	3	4	5	6	7	8	9	10	11	12	
0-4	86	2	-	-	-	-	-	-	-	-	-	-	0%
5-9	4	2	-	-	-	-	-	-	-	-	-	-	0%
10-14	1	-	-	-	-	-	-	-	-	-	-	-	0%
15-19	2	-	-	-	-	-	-	-	-	-	-	-	0%
20-24	7	2	1	-	-	-	-	-	-	-	-	-	0%
25-29	10	2	2	-	-	-	-	-	-	-	-	-	0%
30-34	26	4	1	1	-	-	-	-	-	-	-	-	0%
35-39	33	6	5	1	-	-	-	-	-	-	-	-	0%
40-44	121	37	13	2	-	-	-	-	-	-	-	-	0%
45-49	272	66	24	10	-	-	-	-	-	-	-	-	0%
50-54	630	162	75	14	3	-	-	-	-	-	-	-	0%
55-59	1310	382	160	42	6	2	1	-	-	-	-	-	1%
60-64	2592	732	356	76	13	-	-	-	-	-	-	-	2%
65-69	5204	1493	603	136	21	5	-	1	-	-	-	-	4%
70-74	8640	2293	945	221	27	6	1	-	1	-	-	-	6%
75-79	15268	4058	1483	335	52	5	4	-	-	-	-	1	10%
80-84	26549	7222	2591	487	91	11	4	3	2	2	1	-	18%
85-89	39135	11187	3947	806	103	13	4	3	1	-	-	-	27%
90-94	31260	9731	3921	850	99	16	5	2	3	-	1	1	22%
95-99	10117	3673	1677	398	54	7	-	1	1	-	-	-	8%
100-104	1598	207	49	7	1	-	-	-	-	-	-	-	1%
105-109	74	28	20	3	1	-	-	-	-	-	-	-	0%
110-114	12	-	-	-	-	-	-	-	-	-	-	-	0%
% Distribution	70%	20%	8%	2%	0%	0%	0%	0%	0%	0%	0%	0%	

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.

Again, as might be expected, Figure 7.3 shows that, after the policy change, the proportion of patients receiving a single RMMR service reduced by 2% to 70%, with 2% of patients receiving three or more RMMR services (compare to 3% pre-deadline). This trend is consistent with the fact that patients who received an RMMR in the pre- and post-policy change periods have been classified as post-policy change. For this reason, the maximum number of RMMRs received was 12 for two patients (i.e. an RMMR more than once every six months on average), compared to seven pre-policy change reflecting the length of the period in which some patients in aged care facilities continue to receive RMMRs. Corresponding to the decrease in the proportion of once only RMMRs, the proportion of patients that received repeat RMMRs increased from 28% to 30. These data suggest that the introduction of the claims deadline had no real impact on the propensity of service providers to determine that a repeat RMMR was required. This situation is different to HMR, where the introduction of a monthly cap of 20 claims, as well as the 30 day window in which to claim, seemed to affect the proportion of patients that received repeat HMRs.

7.3 ADHERENCE TO PROGRAM CLAIMING GUIDELINES

Figure 7.4 profiles patients that have received two or more RMMR services over 10 continuous quarters in the pre-deadline period (i.e. with a date of service between July 2011 and Dec 2013). Again, the patients have been classified according to their age at the time of receiving their most recent RMMR. The data show that 96% of patients receiving more than a single service, are aged 65 years or more, compared to 97% of patients receiving one or more RMMRs (i.e. patients receiving repeat RMMRs are on average younger than patients receiving any RMMR).

Figure 7.4 also clearly shows that most (59%) patients received their follow-up RMMRs within six months of their previous RMMR. In fact, in the period, to December, 2013, less than 1% of patients who had two or more RMMRs had a between service interval of 24 months or greater. Note that the frequency of service guidelines introduced in March, 2014 mandate that RMMR services should be no

more frequent than every two years (except where GPs are satisfied that the patient meets given clinical criteria).

Figure 7.4: Patient age by RMMR claims interval between July, 2011 and December, 2013

Patient Age	RMMR interval						Age dist
	0-6 Mths	6-12 Mths	12-18 Mths	18-24 Mths	24-30 Mths	30-36 Mths	
0-4	1	-	-	-	-		0%
5-9	1	-	-	-	-		0%
15-19	1	-	-	-	-		0%
20-24	5	-	3	-	-		0%
25-29	7	1	3	1	-		0%
30-34	13	3	6	1	-		0%
35-39	25	3	7	1	-		0%
40-44	99	11	45	2	-		0%
45-49	202	19	93	6	-		0%
50-54	534	46	244	22	5		1%
55-59	1071	116	517	37	4		1%
60-64	2104	179	1032	54	9		2%
65-69	3775	328	1923	113	12		4%
70-74	5953	479	2937	148	22		6%
75-79	10256	823	4931	313	34		11%
80-84	18479	1404	9407	531	59		19%
85-89	24891	1887	14041	787	89		27%
90-94	16926	1605	11933	728	99		20%
95-99	5215	560	4477	273	39		7%
100-104	646	75	760	54	8		1%
105-109	34	6	42	2	-		0%
110-114	3	1	2	-	-		0%
% Distribution	59%	5%	34%	2%	0%	0%	

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.

Figure 7.5 profiles patients that have received two or more RMMR services over 10 continuous quarters in the post-policy change period (i.e. with a date of service between January and June 2016). As before, the patients have been classified according to their age at the time of receiving their most recent RMMR. The data show that the patient's age distribution is very similar with, post-policy change, 96% of patients receiving more than a single service being aged 65 years or more (same as pre-policy change).

Figure 7.5: Patient age by RMMR claims interval between January, 2014 and June, 2016

Patient Age	RMMR interval						Age dist
	0-6 Mths	6-12 Mths	12-18 Mths	18-24 Mths	24-30 Mths	30-36 Mths	
0-4	15	2	2	-	-		0%
25-29	1	1	1	-	-		0%
30-34	1	-	1	-	-		0%
35-39	8	2	2	1	2		0%
40-44	17	4	17	4	2		0%
45-49	37	11	19	2	7		0%
50-54	75	25	59	14	7		0%
55-59	154	60	154	18	22		1%
60-64	297	96	294	51	41		2%
65-69	590	214	511	99	76		4%
70-74	925	332	786	126	132		6%
75-79	1700	582	1388	264	227		11%
80-84	3068	1010	2388	472	365		19%
85-89	4005	1391	3478	715	587		27%
90-94	2716	1168	3152	608	479		21%
95-99	717	374	1041	247	178		7%
100-104	94	59	174	42	41		1%
105-109	2	2	11	3	1		0%
% Distribution	38%	14%	35%	7%	6%	0%	

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.

Figure 7.5 shows a different picture post-policy change for RMMR service intervals. Only 38% of patients received their follow-up RMMRs within six months of a previous RMMR (compared to 59% pre-policy change) and 6% of patients have an RMMR service interval of 24 months or more (compared to less than 1%). The data suggest that the introduction of the claiming frequency guidelines has had an impact on provider practice. The more stringent claims policies (e.g. 30 days claims rule) and a general emphasis by the Department and Guild on the need for compliance with program guidelines have probably also contributed to a shift in provider behaviour around the frequency of RMMRs.

7.4 CLAIMS BY PROVIDER TYPE

Table 7.1 summarises the key utilisation metrics with regard to patient, provider and RMMR service volumes and average payment per claim for each half financial year, further sub-divided by the type of provider. Please note that 'Unknown Org Type' arises due to encrypted provider identifiers, we were not able to flag the provider unambiguously as a Business Entity (BE) in those instances, however because S90 registered pharmacies have a separate identifying column, we have used that to infer S90 status.

Table 7.1: Key utilisation metrics by provider type, July, 2011 to June, 2016

Year	Half	Provider type	Average payment/claim	Patient volumes	Review volume	Provider volume	Provider type split
2011-2012	H1 2011-2012	BE	$85	5,591	5,606	3	1%
		S90 Pharmacy	$98	11,121	11,216	239	58%
		Unknown Org Type	$90	28,505	28,812	170	41%
		Total	**$92**	**45,145**	**45,634**	**412**	**100%**
	H2 2011-2012	BE	$97	9,635	9,658	4	1%
		S90 Pharmacy	$100	12,890	12,956	229	57%
		Unknown Org Type	$98	38,380	38,605	170	42%
		Total	**$98**	**60,844**	**61,219**	**403**	**100%**
2012-2013	H1 2012-2013	BE	$102	9,002	9,035	3	1%
		S90 Pharmacy	$102	11,861	11,928	221	54%
		Unknown Org Type	$102	39,745	39,997	183	45%
		Total	**$102**	**60,551**	**60,960**	**407**	**100%**
	H2 2012-2013	BE	$102	9,128	9,164	11	3%
		S90 Pharmacy	$103	12,299	12,463	223	54%
		Unknown Org Type	$102	39,844	40,016	180	43%
		Total	**$103**	**61,180**	**61,643**	**414**	**100%**
2013-2014	H1 2013-2014	BE	$104	10,561	10,601	34	8%
		S90 Pharmacy	$105	11,607	11,787	214	50%
		Unknown Org Type	$104	42,130	42,260	177	42%
		Total	**$104**	**64,208**	**64,648**	**425**	**100%**
	H2 2013-2014	BE	$106	29,270	30,027	159	34%
		S90 Pharmacy	$107	8,334	8,597	200	43%
		Unknown Org Type	$103	7,191	7,192	109	23%
		Total	**$106**	**44,655**	**45,816**	**468**	**100%**
2014-2015	H1 2014-2015	BE	$107	32,694	33,318	180	45%
		S90 Pharmacy	$107	9,221	9,374	218	55%
		Unknown Org Type	$105	6	6	1	0%
		Total	**$107**	**41,869**	**42,698**	**399**	**100%**
	H2 2014-2015	BE	$106	36,382	36,741	172	46%
		S90 Pharmacy	$107	10,920	11,117	205	54%
		Unknown Org Type	$105	21	21	1	0%
		Total	**$107**	**47,277**	**47,879**	**378**	**100%**
2015-2016	H1 2015-2016	BE	$108	39,939	40,270	170	46%
		S90 Pharmacy	$107	11,315	11,398	198	54%
		Unknown Org Type	$107	8	8	4	1%
		Total	**$108**	**51,214**	**51,676**	**368**	**100%**

Year	Half	Provider type	Average payment/claim	Patient volumes	Review volume	Provider volume	Provider type split
	H2 2015-2016	BE	$113	36,607	38,812	162	45%
		S90 Pharmacy	$112	9,180	9,650	181	50%
		Unknown Org Type	$111	479	499	16	4%
		Total	**$113**	**46,229**	**48,961**	**359**	**100%**

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16.
Abbreviations: BE, Business Entity (includes sole traders)
Note 1: Provider identifiers in years 2011/12, 2012/13 and 2013/14 were supplied in encrypted form. They have been categorised in cases where the encrypted identifier was also used in the 2014/15 or in 2015/16 datasets and in cases where the S90 Pharmacy identifier was supplied.

The data show that in the first half of 2011-2012, S90 registered pharmacies represented 58% of the service providers (239 pharmacies). This number had reduced by 39 to 200 individual pharmacies by the second half of 2013-2014, representing 43% of all providers. However, total participating providers in this period grew from 412 providers to 468, an increase of 56 providers or 13.6%. From the first half of 2014-2015 and onwards S90 pharmacy and BE participants have both declined, but interestingly the decline has been more pronounced among non-pharmacy providers, suggesting that many of these providers chose to exit the market. Potentially, their exit may be due to more stringent claims policies, perceived claims processing rigour, non-claimable historical service provision losses and an implied need to improve the efficiency of back-office operations going forward.

7.5 CLAIMS BY GEPOGRAPHIC LOCATION

Table 7.2 summarises key utilisation metrics with regard to patient, provider and RMMR service volumes, further sub-divided by the ABS remoteness of the RACF in which the RMMR services were provided.

Table 7.2: Key utilisation metrics by geographic location of service, July 2011 to June 2016

Period	ABS remoteness	Patient volume	RMMR service volume	Number of providers
2011-2012	Major Cities of Australia	23,366	23,642	71
	Inner Regional Australia	5,553	5,613	70
	Outer Regional Australia	1,880	1,913	31
	Remote Australia	5	5	1
	Very Remote Australia	17	17	1
	Location unknown	73,788	75,663	340
	Total	**104,350**	**106,853**	**492**
2012-2013	Major Cities of Australia	26,910	27,223	88
	Inner Regional Australia	7,568	7,714	75
	Outer Regional Australia	2,166	2,197	40
	Remote Australia	25	26	1
	Location unknown	84,045	85,443	285
	Total	**120,343**	**122,603**	**469**
2013-2014	Major Cities of Australia	43,943	45,015	253
	Inner Regional Australia	10,576	10,751	186
	Outer Regional Australia	3,448	3,515	117
	Remote Australia	172	172	9
	Very Remote Australia	30	30	2
	Location unknown	50,665	50,981	225
	Total	**107,774**	**110,464**	**609**
2014-2015	Major Cities of Australia	63,206	65,304	223
	Inner Regional Australia	17,369	17,950	200
	Outer Regional Australia	6,028	6,199	110
	Remote Australia	314	315	19
	Very Remote Australia	137	140	7
	Location unknown	657	669	10
	Total	**87,579**	**90,577**	**451**
2015-2016	Major Cities of Australia	69,729	72,923	199
	Inner Regional Australia	18,769	19,729	185

Period	ABS remoteness	Patient volume	RMMR service volume	Number of providers
	Outer Regional Australia	6,559	6,789	114
	Remote Australia	387	394	17
	Very Remote Australia	56	56	4
	Location unknown	713	746	12
	Total	**96,114**	**100,637**	**421**

Source: DHS claims systems extracts for years 2011/12, 2012/13 and 2013/14, Pharmacy Guild claims systems extracts for years 2014/15 and 2015/16, used with ABS postcode to remoteness.xls available from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.006July%202011?OpenDocument (accessed 5th October, 2016)
Abbreviations: BE, Business Entity (includes sole traders). ABS, Australian Bureau of Statistics
Note: Provider identifiers in years 2011/12, 2012/13 and 2013/14 were supplied in encrypted form. They have been categorised in cases where the encrypted identifier was also used in the 2014/15 or in 2015/16 datasets and in cases where the S90 Pharmacy identifier was supplied and that 'Location Unknown' arises due to encrypted facility identifiers in the DHS datasets and a small number of missing facility postcodes in the data in the Pharmacy Guild datasets. In cases where the facility postcode is missing and we know the postcode of the provider, the provider's postcode is used as a proxy.

In Table 7.2, patient numbers, RMMR service volumes and provider volumes in the years 2011-2012, 2012-2013 and 2013-2014 were not able to be sufficiently mapped to ABS remoteness categories and consequently it is not possible to draw conclusions about RMMR service provision in Australian locations in those years. We note that by 2015-2016, in regional and rural areas, there were 21 providers servicing 443 patients and providing 450 RMMRs.

7.6 SUMMARY OF UTILSATION ANALYSIS FINDINGS

In summary, we found that claims payment policy changes (specifically, the restriction on the time interval between services, and the 30 day deadline to submit claims) had an apparent and lasting impact upon the volume of RMMR claims and participating providers. Before the changes, the uncapped scheme was servicing and increasing number of patients and attracting more providers (both community pharmacies and other business entities).

After the payment policy changes, RMMR patient and service volumes declined steeply across pharmacy and non-pharmacy providers (but mostly non-pharmacy providers). The data also suggest changes in behaviour to comply with the claiming frequency guidelines, with a greater proportion of patients receiving only one RMMR and longer claiming intervals for patients receiving multiple services. The RMMR service volumes have slowly recovered from the initial drop, although volumes have not returned to pre-policy change levels. This lower level of activity is likely to be due to provider perceptions of more stringent and enforced claims policies, previously suffered non-claimable service provision losses and reductions in access to economies of scale.

APPENDIX A REFERENCES

Australian Government Department of Health, The Pharmacy Guild of Australia. (2015). 6th community pharmacy agreement residential medication management review programme (RMMR) and quality use of medicines programme (QUM) programme specific guidelines.

Deloitte (2012). Evaluation of the MedsCheck and Diabetes MedsCheck Pilot Program.

Frankenthal D, Lerman Y, Kalendaryev E, Lerman Y. (2014). Intervention with the screening tool of older persons potentially inappropriate prescriptions/screening tool to alert doctors to right treatment criteria in elderly residents of a chronic geriatric facility: a randomized clinical trial. Journal of the American Geriatrics Society; 62(9): 1658–65.

Furniss L, Burns A, Craig SKL, Scobie S, Cooke J, Faragher B. (2000). Effect of a pharmacist's medication review in nursing homes: randomised controlled trial. The British Journal of Psychiatry; 176:563–7.

McLarin, P. E., G. M. Peterson, et al. (2016). Impact of residential medication management reviews on anticholinergic burden in aged care residents. Current Medical Research and Opinion 32(1): 123-131.

Nishtala PS, Hilmer SN,McLachlan AJ, Hannan PJ, Chen TF. (2009). Impact of residential medication management reviews on drug burden index in aged-care homes: a retrospective analysis. Drugs Aging; 26: 677–86.

Nishtala PS, McLachlan AJ, Bell JS, Chen TF. (2011). A retrospective study of drug-related problems in Australian aged care homes: medication reviews involving pharmacists and general practitioners. J Eval Clin Pract; 17: 97–103.

Stuijt CCM, Franssen EJF, Egberts ACG, Hudson SA. (2008). Appropriateness of prescribing among elderly patients in a Dutch residential home: observational study of outcomes after a pharmacist-led medication review. Drugs Aging; 25: 947–54.

Zermansky AG, Alldred DP, Petty DR, Raynor DK, Freemantle N, Eastaugh J, et al. (2006). Clinical medication review by a pharmacist of elderly people living in care homes - randomised controlled trial. Age and Ageing; 35:586–91.

APPENDIX B SEARCH STRATEGY

Search strategies used for Embase, Medline, Cochrane and Health systems evidence are presented in Table A-B.1, Table A-B.2, Table A-B.3 and Table A-B.4, respectively.

Table A-B.1 Embase search strategy for studies relevant to Medication Management Review services

#	Search strategy for EMBASE OVID (19 Dec 2016)	Records
1	MedsCheck.mp.	20
2	home medic$ review.mp.	130
3	residential medic$ management.mp.	14
4	(residential adj2 medic$ adj2 (review or management)).ti,ab.	14
5	(home adj2 medic$ adj2 (review or management)).ti,ab.	183
6	or/1-5	245
7	(pharmacist-led or pharmacist-run).ti,ab.	1,055
8	(review$ or assess$ or management).ti,ab.	5,483,928
9	7 and 8	840
10	((medication$ or medicine$ or drug or pharmac$) adj2 (management or review)).ti,ab,kw.	27,309
11	(pharmacy or pharmacies or pharmacist$).ti,ab,kw.	104,037
12	10 and 11	6,738
13	(home or domiciliary or community).ti,ab.	648,137
14	12 and 13	2,209
15	residential.ti,ab.	30,024
16	((aged or geriatric or elderly) adj2 (care or home$ or facility or facilities or residential)).ti,ab.	13,701
17	((care or convalescent) adj (home$ or center$ or centre$ or facility or facilities)).ti,ab.	57,085
18	home$ for the aged.ti,ab.	1,623
19	home for the aged/	11,273
20	exp nursing homes/	49,989
21	or/15-20	142,931
22	12 and 21	440
23	6 or 9 or 14 or 22	3,214
24	((medication or medicine$) adj review).ti.	565
25	((medication or medicine$) adj management review).ti.	8
26	or/23-25	3,559
27	editorial/ or erratum/ or letter/ or note/ or short survey/ or abstract report/ or letter/ or case study/ or (editorial or erratum or letter or note or short survey or conference abstract or abstract report or case study or case report).tw.	3,474,064
28	26 not 27	3,241
29	remove duplicates from 28	3,131

Table A-B.2 Medline search strategy for studies relevant to Medication Management Review services

#	Search strategy for Medline OVID (19 Dec 2016) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, OVID MEDLINE(R) Daily and OVID MEDLINE(R) 1946 to Present	Records
1	MedsCheck.mp.	9
2	home medic$ review.mp.	63
3	residential medic$ management.mp.	8
4	(residential adj2 medic$ adj2 (review or management)).ti,ab.	10
5	(home adj2 medic$ adj2 (review or management)).ti,ab.	118
6	or/1-5	137
7	(pharmacist-led or pharmacist-run).ti,ab.	481
8	(review$ or assess$ or management).ti,ab.	4,491,449
9	7 and 8	374
10	((medication$ or medicine$ or drug or pharmac$) adj2 (management or review)).ti,ab,kw.	19,306
11	(pharmacy or pharmacies or pharmacist$).ti,ab,kw.	55,772
12	10 and 11	3,402
13	(home or domiciliary or community).ti,ab.	571,338

#	Search strategy for Medline OVID (19 Dec 2016) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, OVID MEDLINE(R) Daily and OVID MEDLINE(R) 1946 to Present	Records
14	12 and 13	1,015
15	residential.ti,ab.	26,722
16	((aged or geriatric or elderly) adj2 (care or home$ or facility or facilities or residential)).ti,ab.	11,685
17	((care or convalescent) adj (home$ or center$ or centre$ or facility or facilities)).ti,ab.	44,622
18	home$ for the aged.ti,ab.	1,469
19	homes for the aged/	12,927
20	exp nursing homes/	36,659
21	or/15-20	113,285
22	12 and 21	231
23	6 or 9 or 14 or 22	1,509
24	((medication or medicine$) adj review).ti.	300
25	((medication or medicine$) adj management review).ti.	8
26	or/23-25	1,709
27	editorial/ or erratum/ or letter/ or note/ or case study/ or (editorial or erratum or letter or note or short survey or conference abstract or abstract report or case study or case report).tw.	3,362,429
28	26 not 27	1,632
29	remove duplicates from 28	1,507

Table A-B.3 Cochrane Library search strategy for studies relevant to Medication Management Review services

#	Search strategy for Cochrane Library (19 December 2016)	Records
#1	MedsCheck (Word variations have been searched)	1
#2	"home medication review" or "home medicine* review"	15
#3	(home near/2 medic* near/2 (review or management))	36
#4	"residential medication management" or "residential medicine* management"	0
#5	residential and ((medication or medicine*) near/2 (review or management))	71
#6	(pharmacist-led or pharmacist-run):ti,ab,kw	151
#7	(review* or assess* or management):ti,ab,kw	341,261
#8	#6 and #7	129
#9	((medication* or medicine* or drug or pharmac*) near/2 (management or review)):ti,ab,kw	1,947
#10	(pharmacy or pharmacies or pharmacist*):ti,ab,kw	3,434
#11	#9 and #10	472
#12	MeSH descriptor: [Medication Therapy Management] explode all trees	72
#13	MeSH descriptor: [Medication Reconciliation] explode all trees	41
#14	(#12 or #13) and #10	61
#15	(medication* next management or medication* next therapy next management or medication* next strategy or medication* next strategies or (medication* near/2 review*)):ti,ab,kw	844
#16	#15 and #10	312
#17	#1 or #2 or #3 or #4 or #5 or #8 or #11 or #14 or #16	644
	By database:	
	Cochrane Database of Systematic Reviews	67
	Database of Abstracts of Reviews of Effects (Other reviews)	19
	Cochrane Central Register of Controlled Trials	525
	Methods studies	5
	Health Technology Assessments Database	3
	NHS Economic Evaluation Database	25

Table A-B.4 Health Systems Evidence search strategy for studies relevant to Medication Management Review services

Item	Search strategy for Health Systems Evidence database (3 January 2017)	
Search terms	'medicine review' OR 'medicines review' OR 'medication review' OR 'medication management'	2116
Filter	Provider = pharmacist	373

APPENDIX C EXCLUDED SYSTEMATIC REVIEWS AND PRIMARY STUDIES

The list of excluded systematic reviews and primary studies are provided in Table A-C. 1 and Table A-C. 2, respectively.

Table A-C. 1 List of excluded systematic reviews

Citations
Alldred David, P., M.-C. Kennedy, et al. (2016) Interventions to optimise prescribing for older people in care homes. Cochrane Database of Systematic Reviews
Cheema, E., P. Sutcliffe, et al. (2014). The impact of interventions by pharmacists in community pharmacies on control of hypertension: A systematic review and meta-analysis of randomized controlled trials. British Journal of Clinical Pharmacology 78(6): 1238-1247.
Charrois TL, Zolezzi M, Koshman SL, Pearson G, Makowsky M, Durec T, Tsuyuki RT (2012). A systematic review of the evidence for pharmacist care of patients with dyslipidemia. Pharmacotherapy 32(3):222-33.
Gammie, T., S. Vogler, et al. (2016). Economic evaluation of hospital and community pharmacy services: A review of the literature (2010-2015). Annals of Pharmacotherapy 51(1): 54–65.
Geurts, M. M. E., J. Talsma, et al. (2012). Medication review and reconciliation with cooperation between pharmacist and general practitioner and the benefit for the patient: A systematic review. British Journal of Clinical Pharmacology 74(1): 16-33.
Gillespie Lesley, D., M. C. Robertson, et al. (2012) Interventions for preventing falls in older people living in the community. Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD007146.pub3
Godfrey, C. M., M. B. Harrison, et al. (2013). Homecare safety and medication management with older adults: A scoping review of the quantitative and qualitative evidence. JBI Database of Systematic Reviews and Implementation Reports 11(7): 82-130.
Hatah, E., R. Braund, et al. (2014). A systematic review and meta-analysis of pharmacist-led fee-for-services medication review. British Journal of Clinical Pharmacology 77(1): 102-115.
Hinchliffe A (2010). Pharmacist-led medication review for older people in the community setting. Available from https://www2.nphs.wales.nhs.uk/PharmaceuticalPHTDocs.nsf/
Holland R, Desborough J, Goodyer L, Hall S, Wright D, Loke YK. (2007). Does pharmacist-led medication review help to reduce hospital admissions and deaths in older people? A systematic review and meta-analysis. British Journal of Clinical Pharmacology 65(3):303–16.
Jokanovic, N., E. C. Tan, et al. (2016). "Pharmacist-led medication review in community settings: An overview of systematic reviews." Research In Social & Administrative Pharmacy 28: 28.
Loganathan, M., S. Singh, et al. (2011). Interventions to optimise prescribing in care homes: Systematic review." Age and Ageing 40(2): 150-162.
Loh, Z. W. R., M. H. H. Cheen, et al. (2016). Humanistic and economic outcomes of pharmacist-provided medication review in the community-dwelling elderly: A systematic review and meta-analysis. Journal of Clinical Pharmacy and Therapeutics 41(6): 621-633.
Nieuwlaat, R., N. Wilczynski, et al. (2014) Interventions for enhancing medication adherence. Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD000011.pub4
Nkansah N, Mostovetsky O, Yu C, Chheng T, Beney J, Bond CM, Bero L. Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns. Cochrane Database of Systematic Reviews 2010, Issue 7. Art. No.: CD000336.
Riordan, D. O., K. A. Walsh, et al. (2016). The effect of pharmacist-led interventions in optimising prescribing in older adults in primary care: A systematic review. SAGE Open Medicine 4: 2050312116652568.
Rollason V, Vogt N. Reduction of polypharmacy in the elderly. A systematic review of the role of the pharmacist. Drugs Aging 2003; 20: 817-32
Royal, S., L. Smeaton, et al. (2006). "Interventions in primary care to reduce medication-related adverse events and hospital admissions: Systematic review and meta-analysis." Quality and Safety in Health Care 15(1): 23-31.
Patterson Susan, M., A. Cadogan Cathal, et al. (2014) Interventions to improve the appropriate use of polypharmacy for older people. Cochrane Database of Systematic Reviews DOI: 10.1002/14651858.CD008165.pub3
Smith Susan, M., E. Wallace, et al. (2016) Interventions for improving outcomes in patients with multimorbidity in primary care and community settings. Cochrane Database of Systematic Reviews
Viswanathan, M., L. C. Kahwati, et al. (2014) Medication therapy management interventions in outpatient settings (Provisional abstract). Database of Abstracts of Reviews of Effects 1
Wallerstedt, S. M., J. M. Kindblom, et al. (2014). "Medication reviews for nursing home residents to reduce mortality and hospitalization: Systematic review and meta-analysis." British Journal of Clinical Pharmacology 78(3): 488-497.

Table A-C. 2 List of excluded primary studies

Citations	Reason for exclusion
Akinbosoye, O. E., M. S. Taitel, et al. (2016). Improving Medication Adherence and Health Care Outcomes in a Commercial Population through a Community Pharmacy. Population Health Management 19(6): 454-461.	Intervention comprises two counselling sessions, first 3-5 min, and second counselling session 1-2 min.
Begley S, Livingstone C, Hodges N, Williamson V. Impact of domiciliary pharmacy visits on medication management in an elderly population. Int J Pharm Pract 1997; 5: 111–21.	Home visits and counselling by a research pharmacist after hospital discharge. Comprises 3 groups: an intervention group (receiving counselling on the correct use and storage of their drugs during five domiciliary visits), a control (V) group (receiving visits but no counselling), or a control (NV) group (having no contact between an initial visit and the end of the study). (all groups received at least one home visit by the pharmacist)
Bernsten C, Björkman I, et al. Improving the well-being of elderly patients via community pharmacy-based provision of pharmaceutical care: a multicentre study in seven European countries. Drugs Aging 2001; 18: 63–77.	This study does not specify who performed the medication review.
Bond C, Matheson C, Williams S, Williams P, Donnan P. Repeat prescribing: A role for community pharmacists in controlling and monitoring repeat prescriptions. British Journal of General Practice 2000;50(453):271–5.	Wrong outcome
Borenstein JE, Graber G, Saltiel E,Wallace J, Ryu S, Archi J, et al. Physician-pharmacist co management of hypertension: A randomised, comparative trial. Pharmacotherapy 2003;23 (2):209–16.	Clinic setting/physician-pharmacist multidisciplinary intervention
Brulhart, M. I. and J. P. Wermeille (2011). Multidisciplinary medication review: Evaluation of a pharmaceutical care model for nursing homes. International Journal of Clinical Pharmacy 33(3): 549-557.	Hospital pharmacists were conducting MR however, within a multidisciplinary team that includes a GP and a nurse.
Brummel, A. R., A. M. Soliman, et al. (2013). Optimal diabetes care outcomes following face-to-face medication therapy management services. Population Health Management 16(1): 28-34.	Wrong setting-patients attended Fairview Health System Clinics staffed by medication therapy management pharmacists
Bryant, L. J. M., G. Coster, et al. (2011). The General Practitioner-Pharmacist Collaboration (GPPC) study: a randomised controlled trial of clinical medication reviews in community pharmacy. International Journal of Pharmacy Practice 19(2): 94-105	Mixed setting: HMR and MedsCheck-however, not clear what the proportion of patients received one or the other-collaborative with GP but there was high pharmacist withdrawal in the study.
Bucci C, Jackevicius C, McFarlane K, Liu P. Pharmacist's contribution in a heart function clinic: patient perception and medication appropriateness. Canadian Journal of Cardiology 2003;19(4):391–6.	Hospital clinic setting/intervention not performed solely by pharmacist - patients followed by a multidisciplinary team including a pharmacist
Cabezas CL, Salvador CF, QuadradaDC et al. Randomized clinical trial of a post-discharge pharmaceutical care program vs. regular follow-up in patients with heart failure. Farm Hosp, 2006;30:328–342.	Mixed setting (patients in hospital and followed up post-discharge). A multifaceted intervention focusing on education
Castelino RL, Bajorek BV, Chen TF. Are interventions recommended by pharmacists during Home Medicines Review evidence-based? J Eval Clin Pract 2011; 17: 104–10.	Non-comparative design and wrong outcome
Cavalieri TA, Chopra A, Gray-Miceli D, Shreve S, Waxman H, Forman LJ. Geriatric assessment teams in nursing homes: do they work? J Am Osteopath Assoc 1993; 93: 1269–72.	Intervention not performed by a pharmacist
Christensen, D., T. Trygstad, et al. (2004). A pharmacy management intervention for optimizing drug therapy for nursing home patients. American Journal Geriatric Pharmacotherapy 2(4): 248-256	Medication reviews conducted using computer generated patient drug profiles with prompts for the medication review; and a Toolkit provided to the pharmacist with screening criteria used to select drugs for attention. Cost of the medication review US$12.50

Citations	Reason for exclusion
Clifford RM, Davis WA, Batty KT, Davis TM. Effect of a pharmaceutical care program on vascular risk factors in type 2 diabetes: The Fremantle Diabetes Study. Diabetes Care 2005;28(4):771–6. Clifford RM, Batty KT, Davis TME, et al. A randomised controlled trial of a pharmaceutical care programme in high-risk diabetic patients in an outpatient clinic. Int J Pharm Pract. 2002;10(2):85- 89.	A comprehensive pharmaceutical care program that addresses all aspects of diabetes care
Crotty M, Halbert J, Rowett D, Giles L, Birks R, Williams H, Whitehead C. An outreach geriatric medication advisory service in residential aged care: a randomised controlled trial of case conferencing. Age Ageing 2004; 33: 612–7.	Multidisciplinary case conferences (GP, geriatrician, pharmacist, residential care staff and representative of the Alzheimer's Association of South Australia); responsible physician involved vs standard care
Dalleur O, Boland B, Losseau C, Henrard S, Wouters D, Speybroeck N, et al. Reduction of potentially inappropriate medications using the STOPP criteria in frail older inpatients: a randomised controlled study. Drugs & Aging 2014;31(4):291–8.	Hospital setting
Davis RG, Hepfinger CA, Sauer KA, Wilhardt MS. Retrospective evaluation of medication appropriateness and clinical pharmacist drug therapy recommendations for home-based primary care veterans. American Journal Geriatric Pharmacotherapy 2007;5(1):40-47.	Wrong intervention
Dolovich L, Gagnon A, McAiney CA, Sparrow L, Burns S. Initial pharmacist experience with the Ontario-based MedsCheck program. Can Pharm J Rev Pharm Can. 2008;141(6):339e345.e1.	Pharmacists views about MedsCheck
Dolovich L, Pottie K, Kaczorowski J, Farrell B, Austin Z, Rodriguez C et al. Integrating family medicine and pharmacy to advance primary care therapeutics. Clin Pharmacol Ther 2008; 83: 913–7.	Wrong study design, large-scale demonstration project; with pharmacists integrated within interdisciplinary healthcare team
Doucette WR, Witry MJ, Farris KB, McDonough RP. Community pharmacist-provided extended diabetes care. Ann Pharmacother 2009; 43:882–9.	Diabetes care plan-5 step process, assessment of clinical parameters
Faulkner MA, Wadibia EC, Lucas BD, Hilleman DE. Impact of pharmacy counselling on compliance and effectiveness of combination lipid-lowering therapy in patients undergoing coronary artery revascularization: a randomized, controlled trial. Pharmacotherapy 2000; 20:410–6.	A pharmacist telephoned patients at their home every week for 12 weeks.
Fornos JA, Andre´s NF, Andre´s JC, Guerra MM, Egea B. A pharmacotherapy follow-up program in patients with type-2 diabetes in community pharmacies in Spain. Pharm World Sci 2006; 28:65–72.	Pharmacotherapy follow-up/no medication review
Gallagher PF, O'Connor MN, O'Mahony D. Prevention of potentially inappropriate prescribing for elderly patients: a randomized controlled trial using STOPP/START criteria. Clinical Pharmacology and Therapeutics 2011;89(6):845–54.	Hospital setting
Garfinkel D, Zur-Gil S, Ben-Israel J. The war against polypharmacy: a new cost-effective geriatric-palliative approach for improving drug therapy in disabled elderly people. Isr Med Assoc J 2007; 9: 430–4.	Medication review performed by a physician/ unsuitable study design
Gheewala, P. A., G. M. Peterson, et al. (2014). Impact of the Pharmacist Medication Review Services on Drug-Related Problems and Potentially Inappropriate Prescribing of Renally Cleared Medications in Residents of Aged Care Facilities. Drugs and Aging 31(11): 825-835.	Non-comparative
Gilbert AL, Roughead EE, Beilby J,Mott K, Barratt JD. Collaborative medication management services: improving patient care.Med J Aust 2002; 177: 189–92.	Intervention includes a preliminary case conference component between the pharmacist and GP, and a post-visit case conference-this is non-comparative
Graffen M, Kennedy D, Simpson M. Quality use of medicines in the rural ambulant elderly: a pilot study. Rural Remote Health 2004; 4: 184.	No patient interviews were performed by the pharmacist
Hogg W, Lemelin J, Dahrouge S, Liddy C, Armstrong CD, Legault F, et al. Randomized controlled trial of Anticipatory and Preventive multidisciplinary Team Care. Canadian Family Physician December 2009; 55(12):e76–85.	Home-based multidisciplinary team approach and includes a medication review.

Citations	Reason for exclusion
Jameson J, Van Noord G, Vanderwoud K. The impact of pharmacotherapy consultation on the cost and outcome of medical therapy. J Fam Pract 1995; 41: 469–72.	Pharmacist performed the MR in the primary care clinic and with the attending GP present.
Kassam R, Farris KB, Burback L, Volume CI, Cox CE, Cave A. Pharmaceutical care research and education project: pharmacists' interventions. J Am Pharm Assoc (Wash) 2001; 41: 401–10.	Non-comparative/unsuitable study design
King MA, Roberts MS. Multidisciplinary case conference reviews: improving outcomes for nursing home residents, carers and health professionals. Pharm World Sci 2001; 23: 41–5	Multidisciplinary case conference by GPs, GP project officer, pharmacist, nurses and other health professionals
Lapane KL, Hughes CM, Daiello LA, Cameron KA, Feinberg J. Effect of a pharmacist-led multicomponent intervention focusing on the medication monitoring phase to prevent potential adverse drug events in nursing homes. J Am Geriatr Soc 2011; 59: 1238–45.	Multicomponent intervention
Lapane KL, Hughes CM, Christian JB, Daiello LA, Cameron KA, Feinberg J. Evaluation of the fleetwood model of long-term care pharmacy. J Am Med Dir Assoc 2011; 12: 355–63.	Comparing medication review by pharmacists according to the Fleetwood Model of Long-Term Care Pharmacy (responsible physician not involved) with medication review by pharmacists
Lim WS, Low HN, Chan SP, Chen HN, Ding YY, Tan TL. Impact of a pharmacist consult clinic on a hospital-based geriatric outpatient clinic in Singapore. Ann Acad Med Singapore 2004; 33: 220–7.	Relevant and interpretable data not reported for primary outcome
Lipton HL, Bero LA, Bird JA,McPhee SJ. The impact of clinical pharmacists' consultations on physicians' geriatric drug prescribing. A randomized controlled trial.Med Care 1992; 30: 646–58	Hospital setting
Lowe CJ, Raynor DK, Purvis J, Farrin A,Hudson J. Effects of a medicine review and education programme for older people in general practice. Br J Clin Pharmacol 2000; 50: 172–5.	General practice setting/also 3 home visits (1 questionnaire, 2 education, and 3 repeat questionnaire)
Mackie CA, Lawson DH,Maclaren AG, Kaczorowski J, Sellors J. A randomised controlled trial of medication review in patients receiving polypharmacy in general practice. Pharm J 1999; 263 (Suppl.): R7.	General practice setting
McMullin ST, Hennenfent JA, Ritchie DJ, Huey WY, Lonergan TP, Schaiff RA, Tonn ME, Bailey TC. A prospective, randomized trial to assess the cost impact of pharmacist-initiated interventions. Arch Intern Med 1999; 159: 2306–9.	Hospital setting
Mehuys, E., D. L. Dupon, et al. (2012). Medication management among home-dwelling older patients with chronic diseases: Possible roles for community pharmacists. Journal of Nutrition, Health and Aging 16(8): 721-726.	Non-comparative observational study (MedsCheck: Medication management included patient drug knowledge and practical drug management capacity)
Meredith S, Feldman P, Frey D, Giammarco L, Hall K, Arnold K, et al. Improving medication use in newly admitted home healthcare patients: a randomized controlled trial. Journal of the American Geriatrics Society 2002; 50(9): 1484–91.	Home health agency, collaboration between pharmacist and the agency nurse
Milos, V., E. Rekman, et al. (2013). Improving the quality of pharmacotherapy in elderly primary care patients through medication reviews: A randomised controlled study. Drugs and Aging 30(4): 235-246.	RMMR and community pts-mixed population referred to as the intervention group-proportions of which received a HMR or RMMR unknown
Naunton M, Peterson GM. Evaluation of home-based follow-up of high-risk elderly patients discharged from hospital. J Pharm Prac Res 2003; 33: 176–82.	Both intervention and control groups received MR but at different time points (control group received MR 90 days post hospital discharge vs 5 days in the intervention group)
Nazareth I, Burton A, Shulman S, Smith P, Haines A, Timberal H. Pharmacy discharge plan for hospitalized elderly patients – a randomized controlled trial. Age Ageing 2001; 30: 33–40. (Development of discharge plan by hospital pharmacist. Home visit by community pharmacist between 7 and 14 days after discharge, pts taking 4 or more medications)"	A coordinated hospital-community pharmacy discharge plan
Nola KM, Gourley DR, Portner TS, et al. Clinical and humanistic outcomes of a lipid management program in the community pharmacy setting. J Am Pharm Assoc (Wash) 2000; 40:166–73.	Collaborative-led intervention

Citations	Reason for exclusion
Peterson GM, Fitzmaurice KD, Naunton M, Vial JH, Stewart K, Krum H. Impact of pharmacist-conducted home visits on the outcomes of lipid-lowering drug therapy. Journal of Clinical Pharmacy and Therapeutics 2004;29(1): 23–30.	Total blood cholesterol measurement was determined/ home visits were repeated on monthly bases over a 6 month period
Patterson SM, Hughes CM, Crealey G, Cardwell C, Lapane KL An evaluation of an adapted U.S. model of pharmaceutical care to improve psychoactive prescribing for nursing home residents in Northern Ireland (Fleetwood Northern Ireland study). J Am Geriatr Soc 2010; 58: 44–53. Patterson SM, Hughes CM, Cardwell C, Lapane KL, Murray AM, Crealey GE. A cluster randomized controlled trial of an adapted U.S. model of pharmaceutical care for nursing home residents in Northern Ireland (Fleetwood Northern Ireland study): a cost-effectiveness analysis. J Am Geriatr Soc 2011; 59: 586–93.	Not polypharmacy focus. Appropriateness of psychoactive drugs only "pharmacists visited nursing homes monthly for 12 months and reviewed residents' clinical and prescribing information, applied an algorithm that guided them in assessing the appropriateness of psychoactive medication"
Phelan M, Blenkinsopp A, Foster NE, Thomas E, Hay EM. Pharmacist-led medication review for knee pain in older adults: Content, process and outcomes. Int J Pharm Pract 2008; 16: 347–55.	General practice setting
Pit SW, Byles JE, Henry DA, Holt L, Hansen V, Bowman DA. A Quality Use of Medicines program for general practitioners and older people: a cluster randomised controlled trial. Medical Journal of Australia 2007;187(1): 23–30.	General practice setting
Pope G, Wall N, Peters CM, O'Connor M, Saunders J, O'Sullivan C, Donnelly TM, Walsh T, Jackson S, Lyons D, Clinch D. Specialist medication review does not benefit short-term outcomes and net costs in continuing-care patients. Age Ageing 2011; 40: 307–12.	Medication review not performed by a pharmacist. Medical assessment performed by a geriatrician and medication review by a multidisciplinary expert panel including geriatricians, pharmacists and nurses
Raynor DK, Nicolson M, Nunney J, Petty D, Vail A, Davies L. The development and evaluation of an extended adherence support programme by community pharmacists for elderly patients at home. Int J Pharm Pract 2000; 8: 157–64.	Setting not clear; pharmacist-GP collaborative approach/shared-care model
Rhodes, S. A., A. E. Reynolds, et al. (2013). Evaluating the economic impact of a targeted medication intervention program. Journal of Pharmacy Practice 26(6): 562-573.	Wrong outcome-return on investment from a pharmacy perspective
Roberts MS, Stokes JA, King MA, Lynne TA, Purdie DM, Glasziou PP, Wilson DA, McCarthy ST, Brooks GE, de Looze FJ, Del Mar CB. Outcomes of a randomized controlled trial of a clinical pharmacy intervention in 52 nursing homes. Br J Clin Pharmacol 2001; 51: 257–65.	HMR: multifaceted intervention (confounded study): Three-phase intervention: introducing a new professional role to stakeholders with relationship- building; nurse education; and medication review by pharmacist
Rubio-Valera M, Bosmans J, Fernández A, et al. Cost-effectiveness of a community pharmacist intervention in patients with depression: a randomized controlled trial (PRODEFAR Study). PLoS One. 2013;8:e70588.	No MR performed, an educational intervention by the pharmacist
Schneider J, Barber N. Provision of a domiciliary service by community pharmacists. Int J Pharm Pract 1996; 4: 19–24.	Non-comparative
Sorensen L, Stokes JA, Purdie DM, Woodward M, Elliott R, Roberts MS. Medication reviews in the community: results of a randomized, controlled effectiveness trial. Br J Clin Pharmacol 2004; 58: 648–64.	RMMR: multifaceted intervention
Stafford L, Stafford A, Hughes J, Angley M, Bereznicki L, Peterson G. Drug-related problems identified in post-discharge medication reviews for patients taking warfarin. Int J Clin Pharm 2011; 33: 621–6. Stafford L, Peterson GM, Bereznicki LR, Jackson SL, van Tienen EC, Angley MT et al. Clinical outcomes of a collaborative, home-based post-discharge warfarin management service. Ann Pharmacother 2011; 45: 325–34.	Post-discharge pts were visited by the pharmacist 2-3 times in their homes within 10 days post-discharge for the management of warfarin.
Stell, R., Bonollo, M., Fiddes, K. and Dooley, M. J. (2008). Successful integration of a clinical pharmacist into a disease management unit. Journal of Pharmacy Practice and Research 38(2): 132-136.	Non-comparative
Sturgess IK, McElnay JC, Hughes CM, Crealey G. Community pharmacy based provision of pharmaceutical care to older patients. Pharm World Sci, 2003; 25: 218–226.	Mixed setting (patients were firstly seen by the pharmacist then visited at home by the pharmacist)

Citations	Reason for exclusion
Taylor CT, Byrd DC, Krueger K. Improving primary care in rural Alabama with a pharmacy initiative. American Journal of Health-System Pharmacy 2003;60(11):1123–9.	Family medicine clinic setting
Trygstad TK, Christensen DB, Wegner SE, Sullivan R, Garmise JM. Analysis of the North Carolina long-term care polypharmacy initiative: a multiple-cohort approach using propensity-score matching for both evaluation and targeting. Clin Ther 2009; 31: 2018–37.	This study compares medication review with medication therapy management program plus medication review
Tsuyuki RT, Johnson JA, Teo KK, et al. A randomized trial of the effect of community pharmacist intervention on cholesterol risk management: the Study of Cardiovascular Risk Intervention by Pharmacists (SCRIP). Arch Intern Med 2002;162:1149–55.	Laboratory tests ordered
Weber V, White A, McIlvried R. An electronic medical record (EMR)-based intervention to reduce polypharmacy and falls in an ambulatory rural elderly population. Journal of General Internal Medicine 2008; 23(4):399–404.	Medication review by pharmacist or geriatrician using electronic medical record system focusing on psychoactive medications, polypharmacy, and inappropriate dosages. Recommendations sent to primary physician via EMR. Control, usual care and no EMR
Welch EK, Delate T, Chester EA, Stubbings T. Assessment of the impact of medication therapy management delivered to home-based Medicare beneficiaries. Ann Pharmacother 2009;43(4):603-10.	MR performed through a telephone consultation with the pharmacist for people living at home
Williams ME, Pulliam CC, Hunter R, Johnson TM, Owens JE, Kincaid J, Porter C, Koch G. The short-term effect of interdisciplinary medication review on function and cost in ambulatory elderly people. J Am Geriatr Soc 2004; 52: 93–8.	Health centre ambulatory clinic setting, and medication review performed by a specialised team
Zermansky AG et al. Randomised controlled trial of clinical medication review by a pharmacist of elderly patients receiving repeat prescriptions in general practice. BMJ 2001; 323: 1340-3.	General practice setting-clinic based
Taylor, S. J., Milanova, T., Hourihan, F., Krass, I., Coleman, C., & Armour, C. L. (2005). A cost-effectiveness analysis of a community pharmacist-initiated disease state management service for type 2 diabetes mellitus. International Journal of Pharmacy Practice, 13, 33–40.	CEA-exclude mixed setting and includes hospital diabetes clinics/confounding (more pts in the control group attended the diabetes clinic)

Abbreviations: CEA, cost-effectiveness analysis; EMR, electronic medical record; MR, medication review; RMMR, residential medication management review; GP, general practitioner;