Evaluation of healthcare services provided by pharmacists in Australia

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Thesis submitted in fulfilment of the requirements for the degree of Master of Pharmacy (Research) at the University of Canberra, Australian Capital Territory, Australia

Abstract

Background

Australian pharmacists deliver a range of health services which are funded by the government under the *Community Pharmacy Agreement*. The aim of this thesis is to evaluate the effectiveness of selected clinical pharmacy services and, subsequently, to derive implications for improving the outcomes of these programmes.

Methods

First, in a narrative literature review the current evidence for the services provided by community pharmacists was evaluated, after which a proposal for further enhancement of the programmes was developed. For this purpose, the previous and current Community Pharmacy Agreements were examined to develop a search strategy. In the second part of the thesis, medication review reports written by pharmacists were retrospectively analysed to assess the pharmacists' use of the pathology data provided to them by general practitioners with the referral letter. The pathology data from 580 medication review reports were extracted and the reports were analysed regarding recommendations on laboratory testing. The third part of the thesis consists of a systematic literature review investigating community pharmacists' involvement in point-of-care testing. A comprehensive literature search was conducted in six databases applying a predefined search strategy. Subsequently, the methodological quality of the included studies was assessed. Furthermore, the results of the individual studies on the analytical quality and the effectiveness of point-of-care testing were synthesised.

Results

The findings of the narrative review showed that there is sufficient evidence for the effectiveness of the healthcare services provided by community pharmacies. Well-studied examples are the *Home Medicines Review* programme and interventions for diabetes and cardiovascular disease. Based on a theoretical concept for integrated primary care, the hypothesis was developed that the outcomes of the programmes could be further enhanced by interlinking the services to ensure a coordinated care for the patient. This was further explored by, first, retrospectively evaluating the use of pathology data by pharmacists in medication review reports. The pharmacists provided general practitioners with guideline-conforming recommendations on screening and drug therapy. The recommendations, however, were not always supported by a rationale. Furthermore, for 31% of patients the pharmacists did not have pathology data, and, in 14% of the reports, the pathology results were over a year old which limits their relevance. Second, the current evidence for point-of-

care testing in community pharmacies was investigated. The results of the systematic review indicated that community pharmacies are well positioned to deliver point-of-care tests and that these have a high analytical quality.

Conclusions and recommendations

According to the narrative review, the services that are currently offered by pharmacists in Australia are effective; nevertheless, they could be further improved by better coordinating the individual interventions. A concrete example of this is the Home Medicines Review programme and point-of-care testing. In the medication review reports, pharmacists provided general practitioners with guideline-conforming recommendations on laboratory testing. A limitation of this process was that pharmacists did not have access to current laboratory reports for 45% of patients. This could be improved if pharmacists had independent access to pathology data and the authority to perform point-of-care tests in the patient's residence during the medication review. The systematic literature review lays the foundation for this proposal by demonstrating that pharmacists performed these tests accurately. To achieve integrated care, pharmacy services should be better interlinked and coordinated with the care provided by other health professions.

Zusammenfassung

(Abstract in German language)

Hintergrund

Australische Apotheken bieten verschiedene Gesundheitsdienstleistungen an, die von der Regierung auf Grundlage des *Community Pharmacy Agreement* (= Vereinbarung über öffentliche Apotheken) gefördert werden. Diese Arbeit dient dem Ziel, die unterschiedlichen pharmazeutischen Dienstleistungen auf ihre Wirksamkeit hin zu untersuchen und abschließend Implikationen zur Verbesserung der Ergebnisse für diese Programme abzuleiten.

Methoden

Zunächst wurde auf Basis einer selektiven Literaturübersicht die Evidenz für die von Apotheken angebotenen Dienstleistungen bewertet, woraufhin ein Vorschlag zur weiteren Stärkung dieser entwickelt wurde. Zu diesem Zwecke wurden Dokumente zur vorherigen sowie der aktuellen Vereinbarung für öffentliche Apotheken untersucht, um ein Studienprotokoll zu entwickeln. In dem zweiten Teil der Arbeit wurden Berichte von Apothekern untersucht, die im Anschluss an Medikationsanalysen verfasst wurden, um herauszufinden, wie die Apotheker die Pathologiedaten nutzten, die ihnen von Hausärzten mit Überweisungen zur Medikationsanalyse zur Verfügung gestellt wurden. Aus 580 Berichten wurden die Pathologieergebnisse extrahiert und anschließend auf Empfehlungen zu Laboruntersuchungen hin untersucht. Der dritte Teil der Arbeit besteht aus einer systematischen Übersicht über die Verwendung von *Point-of-Care*-Tests in öffentlichen Apotheken. Unter Anwendung zuvor definierter Ein- und Ausschlusskriterien wurde eine umfangreiche Literaturrecherche in sechs verschiedenen Datenbanken durchgeführt. Anschließend wurde die methodische Qualität der in die Übersichtsarbeit eingeschlossenen Publikationen bewertet. Des Weiteren wurden die Ergebnisse der einzelnen Studien zur analytischen Qualität und Effizienz von Point-of-Care-Tests zusammengeführt.

Ergebnisse

Die Erkenntnisse aus der selektiven Literaturübersicht belegten eine ausreichende Evidenz für die Effektivität von Apotheker-geführten Gesundheitsdienstleistungen. Beispiele, die bereits gut untersucht wurden, sind das Medikationsanalyse-Programm *Home Medicines Review* und Interventionen zur Erkennung und Behandlung von Diabetes und Herz-Kreislauf-Erkrankungen. Aufgrund der Ergebnisse der Literaturrecherche wurde die Hypothese aufgestellt, dass die Resultate der Programme durch eine sinnvolle Verknüpfung der

Dienstleistungen weiter verbessert werden könnten, um so eine koordinierte Betreuung für den Patienten zu gewährleisten. Um diese Hypothese weiter zu erforschen, wurde zuerst eine retrospektive Untersuchung von Medikationsanalyse-Berichten durchgeführt. Dabei zeigte sich, dass Apotheker die Pathologiedaten, die ihnen von den Hausärzten zur Verfügung gestellt wurden, nutzten, um Leitlinien-gerechte Empfehlungen zur Früherkennung und Pharmakotherapie zu geben; jedoch wurde nicht immer eine Begründung für diese Empfehlung hinzugefügt. Des Weiteren hatten die Apotheker für 31 % der Patienten keine Pathologieberichte erhalten und von den zur Verfügung gestellten Pathologieberichten waren 14 % bereits über ein Jahr alt; dadurch war die Relevanz dieser eingeschränkt. Als zweites wurde die aktuelle Evidenz für Point-of-Care-Tests in Apotheken in einer systematischen Übersichtsarbeit evaluiert. Aus dieser wurde die Erkenntnis erlangt, dass öffentliche Apotheken sehr gut positioniert sind, um Point-of-Care-Tests anzubieten, und dass Apotheker diese mit einer hohen analytischen Qualität durchführen können.

Schlussfolgerungen und Empfehlungen

Gemäß der selektiven Literaturübersicht sind die zurzeit von australischen Apothekern angebotenen Dienstleistungen effektiv. Nichtsdestotrotz könnten sie weiter verbessert werden, wenn die einzelnen Interventionen besser untereinander koordiniert würden. Ein konkretes Beispiel dafür sind das Medikationsanalyse-Programm Home Medicines Review und Point-of-Care-Tests. Apotheker gaben in ihren Medikationsanalyse-Berichten an die Hausärzte Leitlinien-gerechte Empfehlungen zu Laboruntersuchungen. Dieser Prozess war allerdings dadurch limitiert, dass in 45 % der untersuchten Medikationsanalysen Apotheker keinen Zugang zu aktuellen Pathologieberichten hatten. Das könnte zukünftig verbessert werden, wenn Apotheker unabhängig Zugang zu Pathologiedaten hätten und die Autorität erhielten, Point-of-Care-Tests im Zuge der Medikationsanalyse während des Hausbesuchs am Patienten durchzuführen. Die Grundlage dazu liefert die systematische Literaturübersicht; sie hat gezeigt, dass Apotheker in der Lage sind, solche Tests akkurat anzuwenden. Um integrierte Gesundheitsversorgung zu gewährleisten, sollten die Apothekerdienstleistungen untereinander verknüpft und mit den Pflegeleistungen anderer Heilberufe koordiniert werden.

Prologue

'Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution. It is, strictly speaking, a real factor in scientific research.'

~ Albert Einstein (1) ~

Acknowledgements

First, I would like to thank my supervisory panel, Alison Shield, Sam Kosari and Mark Naunton, for their support during my candidature. I am especially thankful for Alison's organisational skills and Mark's persistence to read through my drafts again and again. Without their continuous guidance and support, I would not have been able to achieve all this in the past one and a half years.

I would like to acknowledge the pharmacists who provided us with their medication review reports. Furthermore, my sincere thanks to Louise Deeks for her assistance with the systematic literature review and her constructive comments.

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My gratitude goes to my family, my parents Reinhold and Anneliese as well as my brothers Wolfram and Oliver. They have always been supportive; raising me to believe in myself and my skills and to never give up even if there may be rough patches in between.

Last but not least, I would like to express my sincere thanks to Zakaria Mhammedi. He has supported, motivated, comforted, encouraged, advised, entertained me, and still puts up with me every day.

Curriculum Vitae

Vera Helen Buβ was born in Giessen, Germany, on the 25th of October 1990. She studied pharmacy at Heidelberg University (Germany) from 2010 to 2014 and completed her internship year in the department of drug regulatory affairs at the German headquarters of Sanofi (Frankfurt, Germany) and in a community pharmacy in Giessen. After successful completion of her degree (Pharmazeutische Prüfung), she worked for one year in a community pharmacy in Munich (Germany). In 2017, she started her postgraduate studies at the University of Canberra (Australia).

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List of publications

Journal articles

Buss VH, Shield A, Kosari S, Naunton M. Quality Use of the Pathology Data in Home Medicines Reviews: A Retrospective Evaluation. Annals of Pharmacotherapy. 2018 May 1:1060028018777547.

Buss VH, Deeks L, Shield A, Kosari S, Naunton M. Analytical quality and effectiveness of point-of-care testing in community pharmacies: a systematic literature review. Research in Social Administrative Pharmacy. 2018 Jul 20.

Buss VH, Shield A, Kosari S, Naunton M. The impact of clinical services provided by community pharmacies on the Australian healthcare system: a review of the literature. Journal of Pharmaceutical Policy and Practice. 2018 Dec;11(1):22.

Conference proceedings

Buss VH, Shield A, Kosari S, Naunton M. Pharmacists' recommendations in medication reviews based on laboratory monitoring. Accepted for Tabletop Conversations Presentation to 51st AAG Conference. Melbourne 21-23 November 2018.

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Abbreviations

BMD: Bone mineral density

CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration

CI: confidence interval

CPA: Community Pharmacy Agreement

COPD: chronic obstructive pulmonary disease

CVD: cardiovascular disease

DRP: drug-related problem

eGFR: estimated glomerular filtration rate

FEV: forced expiratory volume

GP: general practitioner

HbA1c: glycated haemoglobin

HCV: hepatitis C virus

HIV: human immunodeficiency virus

HMR: Home Medicines Review

INR: International Normalized Ratio

NRT: nicotine replacement therapy

POC: point-of-care

RMMR: Residential Medication Management Review

TSH: thyroid stimulating hormone

TTR: time in therapeutic range

WHO: World Health Organization

Chapter 1:

Introduction

'Pharmacists should move from behind the counter and start serving the public by providing care instead of pills only. There is no future in the mere act of dispensing. That activity can and will be taken over by Internet, machines and/or hardly trained technicians. The fact that pharmacists have an academic training and act as health care professionals puts a burden upon them to better serve the community than they currently do.'

~ J.W.F. van Mil, M. Schulz, and Th.F.J. Trom (2) ~

1.1 Background

1.1.1 A brief history of pharmacy

The history of pharmacies and pharmaceuticals reaches far back in time. Mankind has always been using remedies for the treatment of diseases. The word *apothecary* comes from the ancient Greek, meaning "storehouse" (3). The roots of the word go back to Galen of Pergamon (129-199 AD) who was a famous Greek medical practitioner storing his medicines in his *apotheca* (3). The first apothecary shops appeared in Persia about 850 AD. These shops had some important characteristics: medicine and pharmacy were separated, the shopkeepers were highly educated and followed ethical principles, and they prepared medicines of classical, Persian, and Indian origin (3). A very important Arabic scholar was Avicenna (980-1037 AD). He wrote many books, including a *Canon of Medicine* and a pharmacopoeia. In the following centuries, scholars spread the pharmaceutical and medical sciences from the Arabic world all over Europe (3). In Sicily, the Arabs introduced the idea of separating medicine and pharmacy to the Europeans. In 1231, the German Emperor and King of Sicily, Frederick II of Hohenstaufen, concluded the Edict of Palermo, which officially manifested this separation of professions (3). Most countries adopted this principle and it is still valid until today. In Australia, however, at the beginning of the British settlement, the two professions, pharmacy and medicine, were not separated. It was usual practice for general practitioners (GP) to sell drugs (4). The first Australian pharmacy run by a trained pharmacist was opened in Launceston, Tasmania, in 1825. The pharmacy is still open today (4).

In 1841, the Royal Pharmaceutical Society of Great Britain was founded (5). The society decided to display Galen and Avicenna on their coat of arms to honour their contributions to the pharmaceutical science (3). In the following decades, the individual Australian states

started forming pharmaceutical societies as well, but it was not until 1927 and 1977, respectively, that the national bodies, the Pharmacy Guild of Australia and the Pharmaceutical Society of Australia, were established (4, 6). These are the key organisations representing pharmacists and community pharmacy owners in Australia today.

1.1.2 Public health in the 20th century

In the 20th century, health scientists made great discoveries leading to an enormous increase in life expectancy. In the first half of the century, major improvements were made in the prevention and treatment of communicable diseases (7). These achievements were triggered by a better scientific understanding of microorganisms, improvement in hygiene standards, and development of antimicrobial agents as well as vaccines (7). The next big "epidemic" was noncommunicable diseases, such as cardiovascular disease (CVD), diabetes, and cancer. This changed the focus of medical research toward chronic diseases and their risk factors (7).

In 1948, the World Health Organization (WHO) was established by the United Nations in an approach to tackle public health in a collective effort (8). The definition of *health* in the WHO's charter (9) is 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (p.1). Furthermore, the charter (9) states that 'the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human' (p.1). In 1978, at the first International Conference on Primary Health, the WHO released in the *Declaration of Alma Ata* the *Health for all by the Year 2000* strategy, calling for the development of primary healthcare systems (10). Eight years later at the first WHO conference on health promotion, five concrete actions were defined in the *Ottawa Charter for Health Promotion*: [1] build healthy public policy; [2] create supportive environments; [3] strengthen community action; [4] develop personal skills; and [5] reorient health services (11). Regardless of the great efforts made by the WHO and individual states, we as a global society are still far from *health for all* and new challenges keep emerging.

1.1.3 Community pharmacy – a health hub

A few years after the Ottawa Charter was released, the first WHO meeting on *The pharmacist in healthcare* was held in 1990 (12). An important part of the meeting was to identify the various roles of pharmacists. The following figure (figure 1) is based on the report *The role of the pharmacist in the healthcare system*, subsequently released by the WHO (12). In the same report, pharmaceutical care is described as focussing on drug therapy in the individual, but also including the pharmacist as a part of the healthcare team by delivering interventions for illness prevention and health promotion.

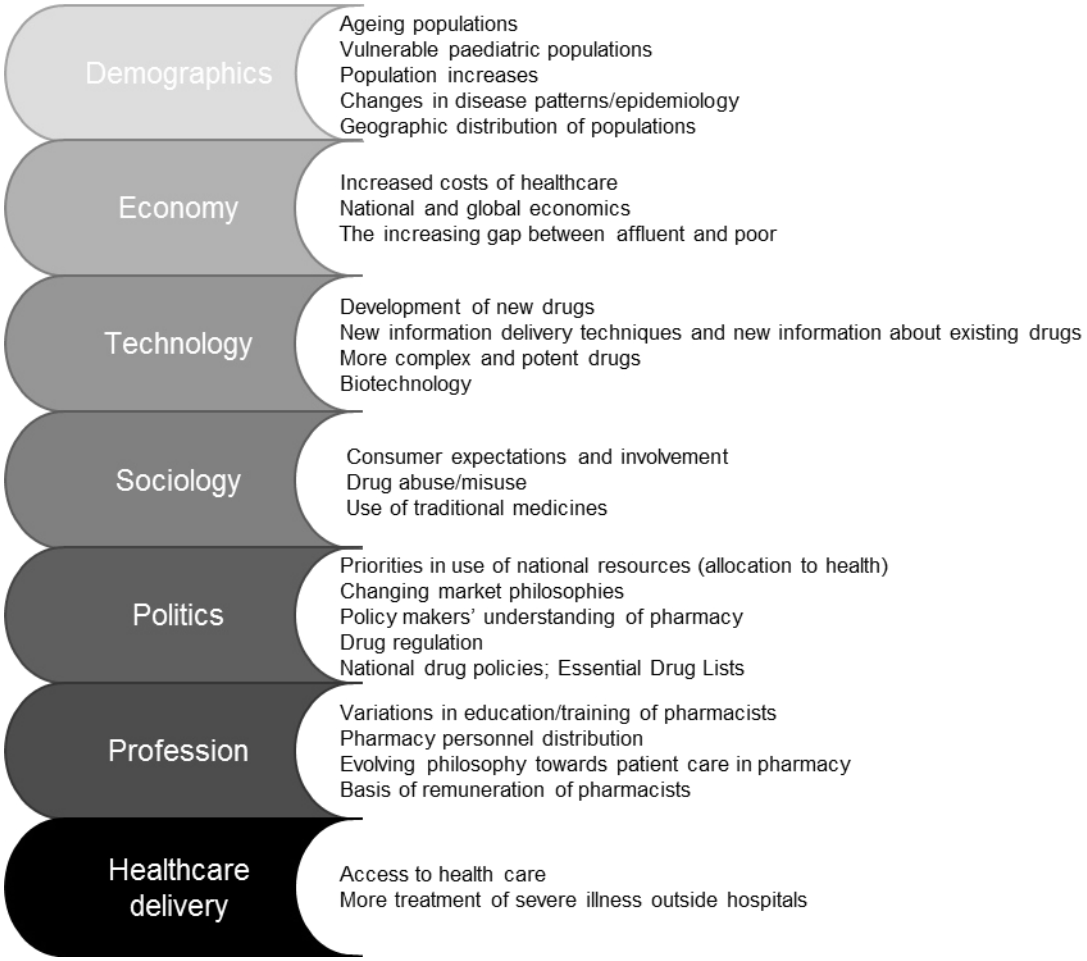

Figure 1: Factors affecting healthcare delivery, the rational use of drugs and the development of pharmaceutical care (12).

Countries such as Australia, Canada, the United Kingdom, the Netherlands, and the United States of America have recognized the potential of the pharmacy profession (13). These governments have provided pharmacists with authorities to deliver health services and, in return, they have implemented a remuneration system, so that pharmacists get compensated for the services they provide to the public (13). In Australia, the requirements for the provision of community pharmacy services and the corresponding remuneration are stated in the Community Pharmacy Agreement (CPA), which is signed by the Australian Department of Health and the Pharmacy Guild of Australia (14). In Canada, legislation and regulation differ between provinces and territories (15). For example, in Alberta a broad range of pharmacy services is offered which are all government-funded; in contrast to that, in Manitoba the scope of services in pharmacies is also comprehensive, but there is no public funding available (15). In England, the National Health Service and the Pharmaceutical Services Negotiating Committee negotiate the Community Pharmacy Contractual Framework which sets all legal requirements and the remuneration for the community pharmacy services in England (16). In

the Netherlands, the range of clinical services in community pharmacies and their reimbursement are limited and dependent on the individual's health insurance provider (13). The situation in the United States is similar to the Netherlands, the pharmacist's remuneration mainly depends on dispensing fees; there is one medication review programme which is reimbursed by some private health insurance companies, but there is only limited involvement of community pharmacies in chronic disease management (13).

1.2 Aim and research questions

There are two primary aims of this thesis: [1] to evaluate the effectiveness of pharmacist-led services in Australia, and [2] to investigate potential changes in practice to further improve the outcomes of these services. First, the gaps in the knowledge of selected clinical services provided by pharmacists in Australia were identified by reviewing clinical interventions funded under the current and the previous CPA. Subsequently, the services that were further investigated within the scope of this project were the medication review programme Home Medicines Review (HMR) and use of point-of-care (POC) tests. The focus was on how pharmacists made use of the pathology data in the medication review process and to assess the feasibility and performance of POC tests in community pharmacies. The three studies of the thesis and their connections are graphically displayed in figure 2. Potential practice changes were explored under the framework of integrated care in chapter 5.

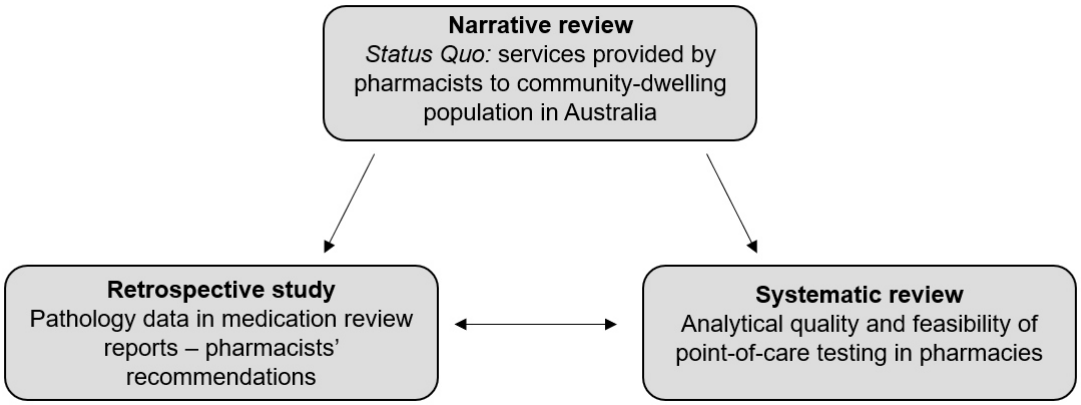

Figure 2: Graphical display of the three parts of the projects and their connections.

The project consisted of three parts: [1] a narrative review of the clinical services provided by community pharmacists in Australia, [2] a retrospective cross-sectional study identifying the role of laboratory data during the HMR process, and [3] a systematic literature review investigating the effectiveness and analytical quality of POC tests performed in community pharmacies. Table 1 shows the subprojects along with their objectives, research questions, and research designs.

Table 1: Summary of project components, their objectives, research questions, and design.

Part	*Objective(s)*	*Research questions*	*Design*
1	Evaluate the effectiveness of community pharmacy-led interventions and identify a potential approach for future improvement in the delivery of the services	How effective are community pharmacy-led clinical interventions? How could the delivery of the services be further improved in the future?	Narrative literature review
2	Evaluate pharmacists' recommendations regarding laboratory testing in the medication review process.	Are GPs providing accredited pharmacists with current pathology reports for HMRs? Are accredited pharmacists referring to the laboratory results in their reports to the GP? Are pharmacists giving guideline-conforming recommendations on laboratory tests?	Retrospective cross-sectional study
3	Assess the effectiveness and analytical quality of POC tests for screening or diagnostic purposes conducted in community pharmacies in comparison to other healthcare settings or the laboratory reference standard.	How is the analytical quality of POC tests conducted in community pharmacies? How effective is the performance of POC tests in community pharmacies?	Systematic literature review

1.3 Format of the thesis

This thesis is in the format of a compilation thesis. The experimental parts of this thesis (chapters 2, 3, and 4) are structured according to the guidelines of the journals where they were submitted for publication. Chapter 2 (titled 'The impact of clinical services provided by community pharmacies on the Australian healthcare system – a review of the literature') was submitted to the *Journal of Pharmaceutical Policy and Practice*. It was reviewed by two anonymous reviewers and the revised version of the manuscript was accepted for publication in August this year. The version found in this thesis is equivalent to the online published manuscript (17). A copy of the published article can be found in the appendix. Chapter 3 (titled

‘Quality use of the pathology report in Home Medicines Reviews – a retrospective evaluation’) was submitted to *Annals of Pharmacotherapy*. It was reviewed by four anonymous reviewers and the revised version of the manuscript was accepted for publication in May this year. The version found in this thesis is equivalent to the online published manuscript (18). Chapter 4 (titled ‘Point-of-care testing in community pharmacies – a systematic literature review’) was submitted to *Research in Social and Administrative Pharmacy*. It was reviewed by three anonymous reviewers and the revised version of the manuscript was accepted for publication in July this year. The version found in this thesis is equivalent to the online published manuscript (19).

Chapter 2:

The impact of clinical services provided by community pharmacies on the Australian healthcare system – a review of the literature

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Citation:

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2.1 Form E: Declaration of Co-Authored Publication for Thesis Chapter 2

2.1.1 Declaration by candidate

In the case of Chapter 2, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Conception and design; data acquisition, analysis and interpretation; drafted and critically revised manuscript	80

The following co-authors contributed to the work.

Name	Nature of contribution	Contributor is also a student at UC Y/N
Alison Shield	Conception and design; data interpretation; critically revised manuscript	N
Sam Kosari	Conception and design; data interpretation; critically revised manuscript	N
Mark Naunton	Conception and design; data interpretation; critically revised manuscript	N

Candidate's Signature		Date 31/05/18

2.1.2 Declaration by co-authors

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	Faculty of Health, Bruce Campus, University of Canberra

Signature 1		**Date** 31/05/18
Signature 2		31/05/18
Signature 3		31/05/18

2.2 Abstract

Background: In Australia, community pharmacists are increasingly being integrated into the healthcare system. A range of services in pharmacies are government-funded aiming to prevent chronic diseases and improve the quality use of medicines. The objective of this narrative review is to evaluate the impact of existing pharmacy services and identify opportunities to better address the patients' needs. **Methods:** A narrative review was undertaken. First, Community Pharmacy Agreement documents between the Australian government and the Pharmacy Guild of Australia were reviewed to identify relevant community pharmacy services. Based on these, a literature search was conducted via PubMed and Google Scholar. The included articles were analysed and a proposal for further improvement of the programmes was developed. **Results:** Overall, five areas of community pharmacy interventions were identified: clinical interventions, medication reviews, health promotion, screening and management of chronic diseases, and support services for drug addiction. Pharmacists' interventions have led to improved asthma control, detection of diabetes and cardiovascular risk factors, reduction in smoking rates and weight, and identification of drug-related problems. The availability of vaccination services in pharmacies has contributed to increased vaccination rates. Through support programmes for drug abusers the transmission rate of blood-borne diseases was decreased. Factors that facilitate community pharmacy interventions are skilled staff, remuneration, a designated area in the pharmacy, and good relationships between health professionals. The main barriers are patients' unawareness of existing programmes, pharmacists' lack of confidence and time, and physicians' lack of involvement. To achieve integrated care for patients, the individual services should be better combined, starting with low intensity interventions and proceeding to in-depth services if required. **Discussion:** Community pharmacies are well located to deliver healthcare services due to convenience and accessibility. The range of services offered by community pharmacies is comprehensive. Despite this, the clinical interventions provided in pharmacies currently appear not to be coordinated. This leads to the proposal that more efforts should be put into linking the individual services. **Conclusion:** There is sufficient evidence for the effectiveness of most of the pharmacy services reviewed. However, the potential of the individual services might be further enhanced by interlinking the services and better integrating them with the patient care provided by GPs and other health professionals.

Keywords: community pharmacy, healthcare services, chronic diseases, medication review, Australia.

2.3 Background

Traditionally, the role of community pharmacists was to source, manufacture, and dispense medication (20). Over the past decades, this role has shifted towards more active engagement in disease management through extended clinical roles (12). The change in policy began in the 1990s when healthcare systems were challenged by increased prevalence of chronic diseases (12). Non-communicable diseases have become the main cause of death worldwide (21). Patients suffer from chronic diseases and their co-morbidities, which in turn leads to polypharmacy (22); the term *polypharmacy* describes the intake of five or more medications per day (23). Polypharmacy has a prevalence of approximately 75% among Australian elderly (24), and independently increases the risks of non-adherence (25) and drug-related problems (DRP) (26). Both non-adherence and DRP result in poor health outcomes and increased healthcare costs (26, 27). The WHO estimates that every second person in developed countries who takes long-term medication is non-adherent (27). Drug-related problems are responsible for 2-3% of the hospital admissions in Australia causing annual costs of approximately $1.2 million Australian dollars (28). It is estimated that half of these hospitalisations is preventable (29).

The Pharmacy Guild of Australia is the professional organisation representing Australian pharmacy-owners (6). Since 1990, the Guild has negotiated with the Department of Health every five years to determine which health services are to be provided by community pharmacies and reimbursed by the Australian government; these agreements are called Community Pharmacy Agreement (CPA) (14). There is a component of research funding attached to these agreements (14). This narrative review focuses on existing community pharmacy interventions in Australia. The main aims are to evaluate the effectiveness of the interventions, to identify barriers and facilitators, and, finally, to derive implications for improving the delivery of the services.

2.4 Methods

This narrative review followed methodological consideration as outlined by Cooper (30) and Baumeister and Leary (31). Cooper introduced a taxonomy for literature reviews with six characteristics (30); these were applied to this review to provide the framework outlined in table 2.

Table 2: Taxonomy of literature review according to Cooper (30).

Characteristic	*Category*	*Explanation*
Focus	Research outcomes	Focus on studies reporting on outcomes of community pharmacy-led interventions.
Goal	Identification of central issues, integration/generalisation	Identify priority areas of community pharmacy-led interventions, synthesise the available evidence, identify potential improvements to the interventions.
Perspective	Neutral representation	Research outcomes are presented in the same format as in the original studies.
Coverage	Representative	A sample of studies is selected to represent the current body of research on the topic.
Organisation	Conceptual	Articles relating to the same priority area are presented together.
Audience	Healthcare researchers, practitioners, policy makers	Informing different stakeholders about available evidence on pharmacy-led interventions, but also about the current gap in science and practice.

First, the guidelines and rules of the 5th and 6th CPA were reviewed to identify priority areas. For the different pharmacy services, the guidelines provided by the Australian government or pharmacy organisations were reviewed. The search terms for the literature search were selected based on the identified priority areas ("clinical interventions", "medication review", "Home Medicines Review", "MedsCheck AND Australia", "health promotion", "smoking cessation", "weight management", "vaccination", "diabetes", "asthma", "cardiovascular disease", "mental health", "opioid replacement therapy", "needle and syringe") and combined via the Boolean operator "AND" with the term "community pharmacy". The literature search was conducted via the search engines PubMed and Google Scholar, with a focus on systematic literature reviews including meta analyses. The search was limited to English-language articles published between 1966 and November 2017. If several reviews on the same priority area were available, the articles of more recent date were selected. If no systematic literature review was found, original research studies were included. Further articles were identified by looking at the references of included publications. A sub-analysis focused on reported barriers and facilitators of the pharmacy services; a literature search was performed using the terms "barriers" or "facilitators" in combination with "community pharmacy services". Of all included articles, data regarding the effectiveness of the services were

extracted and synthesised. The results are presented in sub-sections, one for each priority area; at the beginning of each sub-section, a brief introduction into the underlying problem of the priority area is provided.

2.4.1 Theoretical concept for primary care

To develop a proposal for further improvement of the clinical services provided by pharmacists, a theoretical concept of primary care is introduced. This concept was outlined by Valentijn et al. (32) in their work about a conceptual framework of integrated care and is based on the work by Starfield (33, 34). Table 3 outlines the key elements of integrated primary care according to this concept (32).

Table 3: Integrative functions of primary care according to Valentijn et al. (32).

Care elements	*Explanation*
First contact	'Implies accessibility to and use of services for each new problem or new episode of a problem for which people seek health care.'
Continuous	'Longitudinal use of a regular source of care over time, regardless of the presence or absence of disease or injury.'
Comprehensive	'The availability of a wide range of services in and their appropriate provision across the entire spectrum of types of needs for all but the most uncommon problems in the population.'
Coordinated	'The linking of health care events and services so that the patient receives appropriate care for all his/her health problems, physical as well as mental and social.'

2.5 Results

The identified priority areas for healthcare services provided by Australian community pharmacies were: clinical interventions (DOCUMENT system), medication reviews (HMR and MedsCheck), health promotion (smoking cessation, weight management, and vaccination), screening and management of chronic diseases (asthma, CVD, mental health, and diabetes), and support services for drug addiction (opioid replacement therapy, needle and syringe programmes). For the evaluation of the services, 12 systematic literature reviews, four non-systematic reviews, and five original studies were included.

Table 4 shows an overview of the different interventions in the community funded under the 5th CPA which was in effect from 2010 to 2015 (35, 36). It included the *Pharmacy Practice Incentives* programme with the six priority areas: dose administration aid, clinical interventions, staged supply, primary healthcare, community services support and working with others (35). Pharmacies received annual payments to participate in these programmes.

Under the current CPA (2015-2020) funding for the priority areas of primary healthcare, community services support, and working with others were discontinued (14).

Table 4: Community programmes funded under the 5th CPA (35, 36).

Clinical interventions	Recommendation of change in drug treatment to improve quality use of medication (35).
Medication reviews	*MedsCheck/Diabetes MedsCheck:* In-pharmacy medication review with limited scope to improve patient's knowledge, self-management, and adherence to drug therapy (36).
	HMR: Comprehensive medication review in patient's home to identify potential DRPs and develop strategies to avoid them (36).
Primary healthcare (focusing on diabetes, respiratory tract, CVD, or mental health)	*Health promotion:* Interventions to enhance the health status of the population through education, support, and awareness (35).
	Screening and risk assessment: Identify patients at high risk of a disease or undiagnosed at present (35).
	Disease state management: Support for patients with chronic diseases to improve the quality of life and reduce long-term effects associated with the disease (35).
Community services support	*Needle and syringe programme:* Supply of sterile injecting equipment and safe disposals to reduce drug-related harm, especially transmission of HIV and HCV (35).
	Opioid substitution programme: Provision of substitute drug treatment to reduce the risk and harms associated with opioid abuse (35).
	National diabetes service scheme access point: Supply of diabetes-related devices and support for diabetes patients (35).
	Mental health first aid: Emergency support for persons with mental health issues until professional help is available (35).
	Pharmacy delivery service
	Return of unwanted medicines
	Staff training
	eHealth: use of modern software for medication dispensing (35).

Abbreviations: CVD = cardiovascular diseases, DRP = drug-related problem, HCV = hepatitis C virus, HIV = human immunodeficiency virus, HMR = Home Medicines Review.

2.5.1 Clinical interventions

Clinical interventions aim at reducing DRPs through cooperation between pharmacists and patients as well as other healthcare professionals (37). Under the 3rd and 4th CPA, a classification system for DRPs, called DOCUMENT, was developed (38). It is applied in the clinical interventions programme to assist community pharmacists in the documentation of identified DRPs (37). In figure 3, the different categories of the DOCUMENT system are outlined (38). Pharmacists have to categorise the DRP they have identified as well as the recommendation they have made (37). In a trial evaluating the usability of the DOCUMENT system the most common categories of DRPs were "Drug selection" (30.7%) and "Education or information" (23.7%); while the most frequent recommendation was "Change of therapy" (40.1%) (38). On average, 1.6 recommendations were made per clinical intervention. According to an independent expert panel, the assessment of clinical significance made by the recording pharmacist correlated with the average cost saving per DRP (38).

Category of DRP		*Category of recommendation*
Drug selection		
Over or underdose		Change of therapy
Compliance		Referral required
Undertreated	⟹	Provision of information
Monitoring		Monitoring
Education or information		Other
Not classifiable		
Toxicity or adverse reaction		

Figure 3: Categories for classification of DRPs and recommendations (38).

2.5.2 Medication reviews

In Australia, two main types of medication reviews exist in the community setting: the in-pharmacy services, MedsCheck and Diabetes MedsCheck, and HMR in the patient's residence (39). The HMR programme was introduced in 2001. General practitioners refer patients who have problems with their medication to an accredited pharmacist of their choice. The pharmacist then arranges to visit the patient at their residence and to then perform a comprehensive review of their medicines. Afterwards, the pharmacist communicates their findings to the GP who develops a medication management plan in cooperation with the patient (40). Less intensive and less time-consuming programmes are MedsCheck and Diabetes MedsCheck. These enable the review of medications without GP's referral and can take place within the pharmacy (39). This makes the programmes more easily accessible for patients (41).

One attempt to decrease the number of hospital admissions is through medication reviews (42). The review process consists of an evaluation of the medication and the patients' management of them (43). The aim is to strengthen the patient's health status and identify potential DRPs (43). Since the end of 2011, GPs can directly refer patients to accredited pharmacists for HMRs; previously, patients were first referred to a nominated community pharmacy (44). According to an evaluation by PricewaterhouseCoopers, the main outcomes and recommendations of MedsCheck are consistent with its aims (41). In 79% of the cases, patients received either training on the appropriate use of their medicines and medical devices or information about their disease and medication without further proceeding. In only 9% of the cases, pharmacists referred patients to the prescriber. Home Medicines Reviews were recommended on less than 1% of occasions, although both pharmacists and GPs stated that MedsCheck could be a good screening tool for HMR services. This allows the assumption that the potential of these programmes is not fully exhausted. In general, the MedsCheck consumers are about ten years younger than the HMR consumers (median age: 64 years vs. 75 years) (41). This shows the capacity of MedsCheck to identify high-risk patients at an early stage and prevent potential long-term effects like chronic stages of diseases or hospital admissions due to DRPs.

In a systematic review of clinical medication reviews in Australia, HMRs and similar reviews also performed in the community by pharmacists (but not including MedsCheck) have shown to be clinically effective as well as cost-effective (45). On average, 3.6 DRPs per review were identified, the hospitalisation rate decreased by 45-79 % while the adherence increased to 52-95 % (compared to 52-84 % without medication review). According to the review, exact cost savings are hard to predict as there are many studies that evaluated cost-effectiveness, but they used different approaches and hence data are not comparable. The authors of the review concluded that patients with mental health problems, chronic diseases, and high-risk medication can benefit particularly from HMRs; these are usually elderly patients with comorbidities and polypharmacy. Nevertheless, according to the systematic review there are under-represented population groups that might benefit as well; among these are indigenous, cultural and linguistically diverse people, individuals living in remote areas, patients in palliative care, patients with poor medication adherence, and patients recently released from hospital. Another population group that might benefit from HMRs consists of patients who take sedatives and anticholinergic medications because these drugs are often associated with DRPs such as falls (46). A future goal should be to find ways to better address these groups. One suggestion is to permit more healthcare providers to refer patients to pharmacists for HMRs (45). A direct referral pathway after hospitalisation is currently in the phased implementation to allow immediate arrangements of HMR after hospital discharge without the

inclusion of the GP (47). An Australian study from 2003 already showed the benefits of providing pharmaceutical care to post-hospitalisation patients living in the community (48). Different studies have demonstrated that the percentages of DRPs as well as of hospital readmissions were reduced through pharmacists who supported patients with their medication management after hospital discharge (48-50). For 2018, there are plans to change the eligibility criteria of HMRs in order to increase the percentage of Aboriginal and Torres Strait Islander patients receiving the service (51).

2.5.3 Health promotion

There are some programmes in community pharmacies that attempt to assist people to change their lifestyles towards a healthier state. Among these are smoking cessation and weight management which are already implemented services in Australian community pharmacies (13). Both programmes also serve the prevention of chronic diseases like CVD and diabetes (52). In Australia, smoking and a high body mass index are the leading behavioural risk factors for morbidity and mortality (52). Smoking cessation and weight management are effective interventions in the community pharmacy setting (53, 54).

The smoking cessation service can either be delivered in the form of simple consultations or in combination with nicotine replacement therapy (NRT). The addition of pharmacotherapy increases the beneficial outcome of the intervention (abstinence) with a relative risk of 3.46 for compared to 1.98 (53). The first available NRT product in Australia was a nicotine chewing gum in 1984, changing four years later from prescription-only to over-the-counter (55). Since 2005, NRT has also been available in supermarkets (55). Weight reduction measured in trials evaluating pharmacy services was between 0.7 and 5.6 kg, the body mass index decreased by 0.3 to 1.3 kg/m^2 and the change in the waist circumference ranged from 0 to -8 cm among different studies (54). The pharmacy services utilised a special diet and physical activity accompanied by support from the pharmacists. According to Brown et al. the evidence for alcohol reduction interventions is too weak to allow any assumptions about the effectiveness. Recently, community pharmacies started providing vaccination programmes (56). A large US-based systematic review has shown that vaccination programmes in community pharmacies improve accessibility and hence vaccination rates (57). A pilot study from Queensland and a mixed-methods study from Western Australia have confirmed these findings (58, 59). In table 5, there is an overview of systematic literature reviews evaluating the effectiveness of health promotion programmes in community pharmacies.

2.5.4 Screening and disease management

The focus of chronic disease management led by community pharmacists has been mainly asthma, CVD, and diabetes (42). The prevalence of these three diseases is 22% for CVD, 10% for asthma and 5% for type 2 diabetes among Australian adults (60, 61). The Australian

government has named them as “areas with special focus” in their national chronic disease strategy (60). Cardiovascular disease is the largest burden on the Australian heath system accounting for approximately 12% of the health expenditure (61).

A systematic review of systematic reviews showed that diabetes and CVD are the most frequently reported outcomes in community pharmacy interventions (42). In 65 studies, blood pressure control was investigated with a rate of 74% showing statistically significant results ($p<0.05$). For cardiovascular outcomes, five of seven studies showed significant improvement. Diabetes control was successful in 78% (35 studies). There are fewer studies on respiratory tract diseases, but the five studies identified all presented significant positive outcomes. In interventions, pharmacists provided information about the disease, pharmacotherapy, and lifestyle changes as well as inhalation technique training for asthma patients (62, 63). Additionally, some studies included referrals to GPs or other healthcare providers, self-management of the disease or medication reviews (62, 63). In randomised controlled trials there was an improvement in control and the severity level of asthma after intervention (64). A systematic review including CVD and diabetes interventions reported positive effects on blood pressure, glycated haemoglobin (HbA1c), blood glucose, and cholesterol levels (65). Table 6 shows an overview of systematic literature reviews assessing community pharmacist-led interventions targeting chronic disease screening and management interventions; The exact effects are summarised in table 7. Although there are attempts to involve community pharmacists in the care of mental health patients, there is a lack of practical implementation and a paucity of research in that area so far (66).

2.5.5 Addiction support services

Needle and syringe programmes as well as opioid substitution programmes have existed in Australian community pharmacies since 1986 and 1985, respectively (67, 68). In a systematic review of reviews by MacArthur et al. three reviews targeting injecting risk behaviour in the community pharmacy setting were identified, including 13 studies (69). Eight studies showed positive results for needle and syringe programmes and injecting risk behaviour. Due to the limitations in the present studies, it was not possible to assess the direct implication of HIV and HCV transmission associated with needle and syringe access points in pharmacies. Frequency and prevalence of drug injecting as well as needle sharing was reduced which led to lower HIV and HCV transmissions. Opioid substitution treatment effectively reduced injecting risk behaviour which was the most common outcome measure in studies evaluating the treatment. Since February 2016, naloxone has been available in Australian pharmacies without prescription (“Schedule 3”) (70). The decision to change the status of the drug from prescription-only to over-the-counter was based on the positive risk-benefit ratio and the easier accessibility for drug users and their relatives in case of opioid-overdosing (70).

Table 5: Systematic reviews of international studies focussing on health promotion in community pharmacies.

Author year	*No. of studies*	*Study design*	*Country*	*Type of health promotion*	*Key findings*	*Funding*
Saba 2013 (53)	5	3 RCTs 2 CBAs	3 UK, 1 each USA, Sweden	Smoking cessation	Better abstinence rates compared to control; biochemical validation increases participants' motivation.	None
Brown 2016 (54)	19	15 RCTs 2 nRCTs 2 CBAs	8 UK, 4 USA, 2 Australia, 1 each Canada, Denmark, Japan, Netherlands, Thailand	Alcohol reduction (n=2), smoking cessation (n=12), and weight management (n=5)	Limited evidence for alcohol reduction; smoking cessation effective and cost-effective; weight management with similar results compared to other settings; commercial weight loss programmes are more cost-effective.	UK government
Burson 2016 (57)	47	25 cross-sectional studies 4 cohort studies 4 experimental studies 3 modelling studies 7 singular designs	All USA	Vaccination	Accepted by patients and staff; increased vaccination rates and improved access.	USA government and University of Pennsylvania

Abbreviations: CBA = controlled before and after study, nRCT = non-randomised controlled trial, RCT = randomised controlled trial, UK = United Kingdom, USA = Unites States of America.

Table 6: Systematic reviews focussing on chronic disease screening/management in community pharmacies.

Author year	*No. of studies*	*Study design*	*Country*	*Chronic disease*	*Key findings*	*Funding*
Garcia-Cardenas 2016 (64)	21, of these 14 in pharm-acy	7 RCTs, 2 cluster RCTs, 2 cluster randomised studies, 2 cluster-controlled studies, 8 quasi-experimental studies	7 Australia, 3 USA, 2 Germany, 1 each UK, Spain, Belgium, India, Sudan, Bulgaria, Brazil, France, Finland	Asthma	Significant improvements of asthma outcomes; proportion of patients with severe asthma reduced, decrease of asthma related symptoms.	Not provided
Senna 2017 (63)	21	14 interventional studies, 7 observational studies	9 Australia, 3 France, 2 UK, 2 Spain, 2 Germany, 1 each Portugal, Belgium, USA	Asthma	Involvement of pharmacists in screening for asthma effective; increased knowledge of disease, improved inhalation technique and asthma control.	Not provided
Sabater-Hernandez 2016 (62)	14	RCTs	2 UK, 2 Spain, 2 Netherlands, 2 Belgium, 1 each USA, Portugal, Australia,	Diabetes (n=5), hypertension (n=3), dyslipidaemia/statins (n=2), heart failure/ loop-diuretics (n=1), smoking cessation	Interventions mainly target elderly for primary or secondary prevention; improvements are necessary for the implementation in other settings.	University of Technology Sydney

Author year	*No. of studies*	*Study design*	*Country*	*Chronic disease*	*Key findings*	*Funding*
			Sweden, Thailand, Canada	(n=1), dyslipidaemia /risk of coronary heart disease (n=1), CVD in general (n=1)		
Willis 2014 (71)	16	14 observational studies, 2 randomised studies	6 USA, 4 UK, 3 Australia, 1 each Canada, Thailand, Switzerland	Diabetes (n=5), CVD (n=15)	Involvement of pharmacists in screening for diabetes and CVD feasible; risk factors for CVD (hypertension, hypercholesterolemia, diabetes) identified; high number of patients at risk did not follow up with GP	UK government, University Hospitals of Leicester/ Loughborough University/ University of Leicester
Hattingh 2016 (66)	14	4 systematic reviews, 10 RCTs	RCTs: 5 USA, 1 each Netherlands, Kuwait, Australia, UK, Spain	Mental health	Lack of evidence for mental health services; information from other settings might be useful, suggesting initial conversations and ongoing monitoring	Australian government

Abbreviations: CVD = cardiovascular diseases, RCT = randomised controlled trial, UK = United Kingdom, USA = Unites States of America.

Table 7: Effects of pharmacist-led interventions on asthma, CVD, and diabetes risk factors.

Determinant	*Effect*	*Reference*
Asthma control	+8% to +12%	(64)
Asthma severity score	-0.3 (P < 0.002)	(64)
Systolic blood pressure	-6.32 mmHg (95% CI -8.8 to -3.83; P < 0.001)	(65)
Diastolic blood pressure	-3.12 mmHg (95% CI -4.57 to -1.67; P < 0.001)	(65)
HbA1c level	-0.75% (95% CI -1.41 to -0.09; P = 0.03)	(65)
Blood glucose level	-7 to -15 mg/dL	(65)
Total cholesterol level	-15 to -37 mg/dL	(65)
Triglyceride level	-50.5 mg/dL	(65)

Abbreviations: CI = confidence interval, HbA1c = glycated haemoglobin.

2.5.6 Barriers and facilitators

Important facilitating factors identified for community pharmacy services are: cooperation between pharmacists and GPs, reimbursement, private area within the pharmacy, patient's expectation that the pharmacy delivers a certain service, sufficient and skilled staff as well as external support for them (72). Among the barriers are low consumer awareness of existing programmes (45); a lack of time, resources and self-confidence on the part of pharmacists (73, 74); and that GPs show low engagement in the process (41). An approach to increase the pharmacists' self-confidence is to give them training beforehand (63). Willis et al. observed a trend towards more GP referrals being initiated by pharmacists following chronic disease screening in pharmacies; this trend could indicate that efforts to strengthen the working relationship between pharmacists and GPs have already shown some effect (71). An important facilitator is the good position that community pharmacists are in to deliver healthcare services because the population at risk usually visits a pharmacy frequently to collect their medication (62, 71).

2.5.7 Proposal for improvement

The researchers applied the theoretical concept of primary care introduced earlier in this review to the findings of the narrative review. This process has shown that the elements of first contact, continuous, and comprehensive care are provided in the community pharmacy setting. The last element, the coordinated care, seems currently not to be fully implemented. On the micro level, coordinated care refers to clinical integration, which can be split into the vertical and the horizontal integration (32). Vertical integration describes coordinated care within a single organisation, while horizontal care illustrates the coordination across organisations (75). By transferring this concept to the community pharmacy setting, coordination of care can be achieved vertically by interlinking the individual clinical services provided by the pharmacy and horizontally through interprofessional collaborations between

pharmacists and other members of the healthcare team. The lack of interprofessional collaboration has already been identified as a barrier and efforts have been made to strengthen the professional relationships between GPs and pharmacists (76-78). An approach that has been neglected is optimisation of the linkage between individual services offered by pharmacists. Improved linkage between services could lead to more coordinated care for the patient in the pharmacy: the pharmacist could apply an intervention to identify existing problems; then, the pharmacist may suggest to the patient another intervention suitable for solving the identified problem(s). A possible connection between existing services is demonstrated in figure 4. Great potential in that area might include a strengthened relationship between MedsCheck and HMR where the pharmacist could start with the less intensive MedsCheck intervention, followed by a recommendation for a HMR to resolve clinical issues that need a more in-depth medication review. Pharmacists and GPs have realised the possibility of using MedsCheck as a screening tool for HMR, but they do not appear to act on this routinely or to any great degree (41).

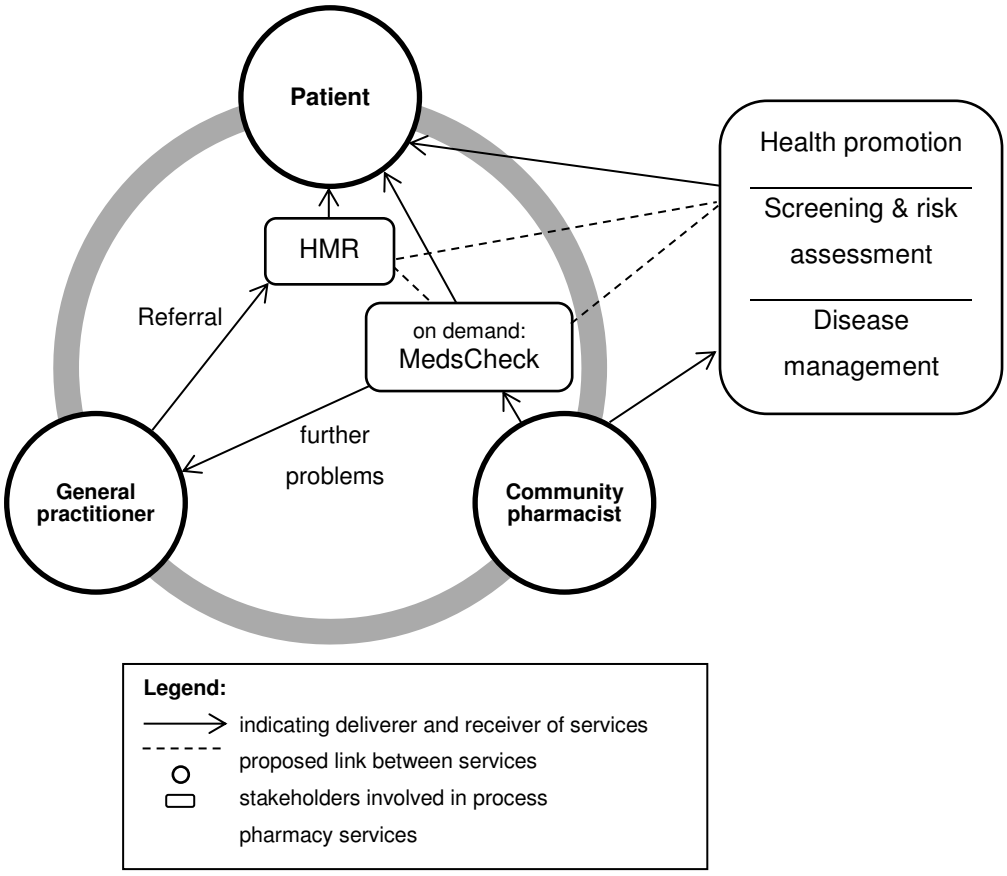

Figure 4: Proposed linkage of the services.

2.6 Discussion

2.6.1 Synthesis of the reviewed literature

The objectives of this narrative review were to evaluate the effectiveness of clinical services provided in Australian community pharmacies, to identify barriers and facilitators in that process, and to develop a proposal for improving the delivery of these services. The evidence from the included studies demonstrates the effectiveness of these pharmacist-provided healthcare services. Many studies have reported on the positive outcomes of the programmes, especially in the areas of HMR, CVD and diabetes prevention and management (41, 42, 45, 46, 62, 71, 79). Smoking cessation and weight management are already well-established in many Australian pharmacies (13). Community pharmacies are a convenient location for addressing such services because they are available for all Australians (41). Furthermore, the people who can benefit the most from these services are the ones who visit a community pharmacy regularly to collect their medication (62, 71). In spite of the great potential that arises from the convenience and easy accessibility of a pharmacy, some target groups still remain underserved, such as people living in rural and remote areas (41, 45). The proposal to strengthen the linkage between the services might help to ensure a coordinated care for the patients which does not yet seem to be realised.

2.6.2 Implications for research, policy, and practice

Without a doubt, interprofessional collaboration and interorganisational coordination, respectively, are important aspects of integrated care (32). Therefore, projects such as the integration of pharmacists into general practice are reasonable; their effectiveness has been demonstrated in various studies (80, 81). However, as defined by Leutz, there are three levels of integration: linkage, coordination, and full integration (82). Within this framework (82), *linkage* is described as allowing 'individuals with mild to moderate or new disabilities to be cared for appropriately in systems that serve the whole population without having to rely on outside systems for special relationships. Linkage begins with population screening to identify emergent needs.' (p.84). Leutz concludes that in most organisations a systematic linkage has never been completely implemented, but the approach could potentially lead to improved effectiveness (82). Hence, future research should focus on how to improve the coordination of the community pharmacy programmes so that patients receive a more integrated model of care. The proposal to strengthen the linkage between the services should be investigated in prospective studies. The knowledge from such prospective studies could provide stakeholders with a basis for negotiations on future CPAs.

For the implementation of vertical integration, specific clinical guidelines might be a helpful tool (83, 84). Additionally, the development of soft skills such as delegation, teamwork, coordination of tasks according to individual's areas of expertise, problem-solving specific

workflow, and communication might be beneficial (84, 85). At the same time, care must be taken to first remove redundant services to prevent the incorporation of interventions into the coordinated care system that are less effective or duplicative. This process ensures that efforts are focussed on successful services (84).

To facilitate the transition from traditional pharmacies to integrated health hubs, the Pharmaceutical Society of Australia initiated a project called the *Health Destination Pharmacy*. It is an evidence-based programme for community pharmacies to increase their role as healthcare providers while receiving professional support for the implementation of these changes (86); the aims are a strong relationship between pharmacist/patient and pharmacist/GP/other health professionals and the delivery of clinical pharmacy services according to local needs (87). The pilot phase ran between 2011 and 2013 with 14 community pharmacies. Although the concept has won several national and international awards, up until the beginning of 2017 only approximately 30 pharmacies had signed up to participate in the programme (88), representing approximately 0.5% of pharmacies in Australia. Future research is needed to investigate the low uptake of the programme. Understanding the barriers for pharmacists to participate in the *Health Destination Pharmacy* might also be useful for the implementation of similar projects in the future.

Additionally, further research should be undertaken to assess the impact of the expanded role of pharmacists in general practice on the community pharmacy-led services. Much research is currently being undertaken in the direction of interprofessional primary care teams, but it is unknown how this impacts the community pharmacy setting. This information would be relevant for both practitioners and policy-makers as it starts to define where the expanded role of pharmacists fit within the healthcare team.

2.6.3 Limitations

As a narrative review, this study does not provide a systematic overview of the literature. In general, the literature search is not reproducible since it did not follow a rigorously pre-defined search strategy as applied in systematic reviews. The comprehensiveness of the review was further limited by using only two search engines. The study selection was subjective and limited to a sample of the literature on the topic; therefore, there is a risk of confirmation bias. However, the authors aimed to neutrally present the available evidence. Although the authors did not formally assess the methodological quality of the included studies, where possible the

authors have included systematic literature reviews which represent the highest level in the hierarchy of evidence.

2.7 Conclusion

This narrative review has demonstrated that there is sufficient evidence for the effectiveness of most pharmacy services, especially regarding HMR, CVD, and diabetes interventions. In the areas of mental health and alcohol reduction the benefits remain uncertain due to lack of evidence. To further improve the health outcomes for patients, the individual pharmacy services could be better interlinked. In addition, the services offered at the community pharmacy should be integrated with the patient management provided by other health professionals such as general practitioners. In this way, community pharmacies can significantly contribute to the provision of integrated primary care.

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Chapter 3:

Quality use of the pathology report in Home Medicines Reviews – a retrospective evaluation

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3.1 Form E: Declaration of Co-Authored Publication for Thesis Chapter 3

3.1.1 Declaration by candidate

In the case of Chapter 3, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Conception and design; data analysis and interpretation; drafted and critically revised manuscript	80

The following co-authors contributed to the work.

Name	Nature of contribution	Contributor is also a student at UC Y/N
Alison Shield	Conception and design; data interpretation; critically revised manuscript	N
Sam Kosari	Conception and design; data acquisition and interpretation; critically revised manuscript	N
Mark Naunton	Conception and design; data interpretation; critically revised manuscript	N

Candidate's Signature		Date 31/05/18

3.1.2 Declaration by co-authors

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	Faculty of Health, Bruce Campus, University of Canberra

Signature 1		**Date** 31/05/18
Signature 2		31/05/18
Signature 3		31/05/18

3.2 Abstract

Background: Laboratory tests can be important tools for the assessment of pharmacotherapy. Nonetheless, there are no previous studies that have explicitly focused on the role of pathology data in Home Medicines Reviews (HMR), an Australian medication review program. **Objective:** Evaluate pharmacists' recommendations regarding laboratory testing in the medication review process. **Methods:** This retrospective review of HMRs assessed the prevalence of the pathology data provided by general practitioners. Additionally, the pharmacists' recommendations based on these laboratory data were compared with national and international guidelines. **Results:** In total, 580 reports were evaluated. Of these, 179 reports did not contain any pathology data. Pharmacists commented on provided laboratory values in 324 reports and recommended further testing in 473 reports. Not all suggestions were related to previous values or were in line with guidelines. Most recommendations were regarding vitamin D and lipids (69% and 62% of medication review reports, respectively). Particularly, regarding renal impairment, pharmacists used their knowledge on dose adjustments and contraindications. In relation to full blood count, vitamin B12, and thyroid function, unjustified screenings were often recommended. In 26% of all reports, the pharmacists requested an array of tests without explaining the necessity for these tests. **Conclusion and Relevance:** Pharmacists provided useful advice based on the pathology data, which was concordant with national and international guidelines; however, in some cases, there was no rationale for the test recommendations provided. The outcome of the HMR programme might be further enhanced if pharmacists had direct access to the patients' pathology data.

Keywords: drug utilization review, pathology, pharmaceutical care, aging, disease management, drug monitoring, evidence-based practice, laboratory medicine.

3.3 Background

Medication reviews consist of the assessment of the patient's medication followed by identification and problem-solving of potential issues that arise in relation to that; the aim is to improve the quality use of medicines (89). In Australia, there are two medication management review programmes funded by the government which differ in their target groups (43, 90). The HMR targets people living in the community while the Residential Medication Management Review (RMMR) is specifically for residents of aged care facilities (43, 90). The RMMR and HMR programmes commenced in 1997 and 2001, respectively (43, 90). Our current study focussed on medication reviews by pharmacists in the community setting and therefore only focus on HMRs. Briefly, the HMR process is initiated by the GP (equivalent to primary care physician in the US) who refers eligible patients to a pharmacist (43). The pharmacist then

visits the HMR recipient in their residence to review their medication (43). Patients must be at risk of experiencing medication misadventure in order to be eligible (43). Indicators for such a misadventure are co-morbidities, age, social circumstances, complexity of a particular drug or the medication regimen (43). After the visit, the pharmacist provides a written report with their findings and recommendations to the GP (43). Subsequently, the GP will meet with the patient to jointly develop a new medication plan (43). Pharmacists must be accredited by either the Australian Association of Consultant Pharmacy or the Society of Hospital Pharmacists of Australia to perform HMRs (43). Accredited pharmacists develop their own reporting template following general guidance by the Pharmaceutical Society of Australia on items that should be included (43). The reports should contain recommendations to prevent or resolve identified medication-related problems such as change of medication regimen, education, dose administration aid, or laboratory tests (43). The pharmacists' recommendations are based on clinical judgement, that should be underpinned by evidence-based guidelines.

Drug monitoring is recommended at initiation and during treatment to improve effectiveness and safety (91). For some medications, specific laboratory tests are routinely recommended by guidelines and drug authorities (91). A large US trial has shown that errors in the monitoring process lead to a large proportion of preventable adverse drug reactions, especially through neglecting clinical findings or pathology results (92). Conversely, in the past decade the pathology expenditures for the Australian healthcare system have risen; not all testing that is performed is necessary (93). These two contradictory aspects outline how important it is to act in an evidence-based manner when laboratory tests are requested. Pharmacists are well-placed to assist GPs in the management of pathology data in the context of chronic diseases and drug therapy.

In some of the US states and Canadian provinces, community pharmacists already have the authority to review and order laboratory tests (15, 94). In the US, this authority is given to pharmacists through collaborative practice agreements (94); while in Australia, community pharmacists have no comparable authority. On the contrary, an attempt by a pathology provider and a pharmacy chain to implement laboratory test requests in community pharmacies was prevented in 2017 by medical practitioners. Physicians questioned pharmacists' expertise in pathology screening and monitoring. Furthermore, they criticised the costs that patients should pay for the laboratory tests in the pharmacy, although the costs for the same tests are covered by the Australian general health insurance when a GP requests them (95). For the HMR program, however, GPs are required to provide accredited pharmacists with relevant clinical information such as pathology data with each HMR referral (43). This information can help the pharmacists to assess the effectiveness and safety of the drug treatment and the necessity for monitoring.

The HMR programme has been investigated in previous studies (45). However, to the authors' knowledge, no study has explicitly focussed on the role of the pathology data in the HMR process. Therefore, this study aimed to determine how pathology data is used by HMR pharmacists. The specific objective was to investigate the characteristics of the recommendations made by pharmacists to GPs in relation to laboratory testing.

3.4 Methods

3.4.1 Study design and data sources

For this evaluation of HMRs, the researchers retrospectively assessed 580 de-identified HMR reports written by accredited pharmacists from one state in Australia. The reports were obtained directly from the service provider. Initially, four providers were contacted in this state but only one agreed to de-identify the reports and supply the de-identified data to the research team. In total, nine pharmacists conducted the HMRs between March 2011 and March 2015. All HMR reports conducted in this period were collected from the provider; there was no exclusion except in duplicates. The Human Ethics Committee of the University of Canberra approved this study (project number HREC 17-239).

3.4.2 Data collection and analysis

Data regarding patients' characteristics (age, sex, medical history, medication, height, weight, body mass index, blood pressure, pathology data) were extracted. For this purpose, a protocol for the data abstraction process and a standardised abstraction form were developed. The estimated glomerular filtration rate (eGFR) was calculated for all patients for whom data regarding serum creatinine, gender, and age were available, using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation (96). Since the researchers did not have any information on the ethnicity of the HMR recipients, the formula for non-black people was applied. These calculations allowed the researchers to classify the patients according to their renal status. The chronic medical conditions were classified according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10 Version 2016); the long-term, self-administered medication taken by the patients was classified according to the Anatomical Therapeutic Chemical Classification System (ATC Index 2017). From the relevant pathology in the reports, values regarding lipids, HbA1c, fasting blood glucose, full blood evaluation, vitamin D, kidney and thyroid function (thyroid-stimulating hormone, TSH) were analysed if provided. In some HMR reports, the specific value for a parameter was not available, but it was stated as "wnl" or "NAD" (*within normal limits* or *no abnormality detected*). These comments could not be formally evaluated and, hence, were not considered for the analysis of provided pathology data. For the analysis of the recommendations, the provided pathology information was considered regardless of whether

a specific value or “wnl”/”NAD” was stated. If numbers were obviously stated incorrectly on the reports, they were either omitted or corrected using clinical judgement in accordance with established guidelines (97-103). Reports were examined for recommendations for an *array of tests,* which was defined as a listing of at least three tests without explaining why these should be performed. The data obtained were further analysed by comparing it to national and international guidelines on pathology testing and drug therapy (97-103).

3.4.3 Statistical analysis

Statistical analyses were conducted using SPSS (IBM SPSS Statistics 23) and Microsoft Excel 2016. The Chi-square test of independence was used to test for relationships between certain patient groups and the availability of laboratory results or recommendations made by pharmacists. The level of significance was defined as 0.05. The margin of error was based on a 95% confidence level. To determine the intra-rater reliability of the data abstraction process, a random sample of 30 files was compared at two different points in time to which the same researcher abstracted the data into a standardised form.

3.5 Results

Table 7 shows the main characteristics of the HMR recipients. The average patient was 76 (±12) years old, was diagnosed with 6 (± 3) chronic diseases and took 8 (± 3) long-term medications. More than 80% of patients suffered from diseases of the circulatory system and over 90% of patients took long-term medication acting on the cardiovascular system. The most common prescribed therapeutic subgroup were agents acting on the renin-angiotensin system. The analysis for intra-rater agreement resulted in intra-class correlation coefficients (single measures for the number and categories of medication and chronic medical conditions) and Cohen’s Kappa statistics (for all other data) of greater than 0.9, indicating very good agreement.

3.5.1 Availability of pathology data

Of all reports written by pharmacists, 179 (30.9%) did not contain any pathology data. If the pharmacist’s report included details of the laboratory data (n = 390), these data were a median of 105 days old (range 4-1368). Of all reports with the date for when the pathology tests were undertaken, 13.6% (53/389) contained data that were more than a year old. Pharmacists did not recommend more frequent testing in these reports with more than a year-old pathology ($P = 0.33$). Table 8 shows the results for pathology parameters which were frequently reported in the HMR reports. For patients taking diabetes or thyroid medication, the respective parameters (HbA1c, TSH) were statistically more often stated than for patients without such drugs (both $P < 0.0001$). In contrast, taking lipid modifying agents was independent from the

provision of lipid results (P = 0.55). Females were more likely to have vitamin D values provided than males (26.4% versus 16.5%, P = 0.0045).

Table 8: Characteristics of patients (total sample = 580).[a, b]

Age, years (n = 580)	76.2 ± 12.1 (20-97)
Sex (n = 579)	
Female	385 (66.5% ± 3.8%)
Male	194 (33.5% ± 3.8%)
Body mass index [kg/m^2] (n = 493)	29.6 ± 7.1 (15.6-64.2)
Blood pressure [mmHg] (n = 431)	
Systolic	135 ± 18 (90-201)
Diastolic	74 ± 12 (40-110)
Chronic medical conditions per patient (n = 571)	6.3 ± 2.7 (1-15)
Long-term, self-administered medications per patient (n = 580)	7.8 ± 3.1 (1-20)
All discussed medications plus supplements per patient (n = 580)	15.5 ± 5.7 (4-43)
Major diagnostic category (ICD-10 codes) (n = 571)	
Patients with diseases of the circulatory system (IX)	468 (82.0% ± 3.2%)
Patients with diseases of the musculoskeletal system and connective tissue (XIII)	404 (70.8% ± 3.7%)
Patients with endocrine, nutritional, and metabolic diseases (IV)	397 (69.5% ± 3.8%)
Patients with diseases of the digestive system (XI)	269 (47.1% ± 4.1%)
Patients with mental and behavioural disorders (V)	210 (36.8% ± 4.0%)
Patients with diseases of the respiratory tract (X)	205 (36.0% ± 3.9%)
Therapeutic subgroups of long-term medications (ATC codes), (n = 580)	
Agents acting on the renin-angiotensin system (C09)	423 (72.9% ± 3.6%)
Lipid modifying agents (C10)	411 (70.9% ± 3.7%)
Antithrombotic agents (B01)	393 (67.8% ± 3.8%)
Drugs for acid related disorders (A02)	326 (56.2% ± 4.0%)
Analgesics (N02)	254 (43.8% ± 4.0%)
Psychoanaleptics (N06)	220 (37.9% ± 3.9%)
Beta blocking agents (C07)	215 (37.1% ± 3.9%)
Drugs used in diabetes (A10)	201 (34.7% ± 3.9%)
Diuretics (C03)	178 (30.7% ± 3.8%)
Calcium channel blocker (C08)	160 (27.6% ± 3.6%)

Abbreviations: ATC = Anatomical Therapeutic Chemical Classification System, ICD = International Statistical Classification of Diseases and Related Health Problems, SD = standard deviation. [a] Data are mean ± SD (range) or n (percentage ± margin of error).

[b] These are not unique patients. The number of patients with reports from several years is unknown.

Table 9: Common pathology parameters provided in the HMR reports (n = 580).

Parameter	*Mean ± SD*	*Range*	*Frequency ± MOE*
Sodium, in [mEq/L] [a]	140.5 ± 3.5	127-150	60.9% ± 4.0%
Potassium, in [mEq/L] [a]	4.5 ± 0.5	3.2-6.0	60.0% ± 4.0%
Chloride, in [mEq/L] [a, b]	102.1 ± 6.8	72.0-196.0	58.4% ± 4.0%
Bicarbonate, in [mEq/L] [a]	27.6 ± 3.5	12.8-37.0	57.6% ± 4.0%
Urea, in [mEq/L] [a, b]	7.7 ± 4.0	2.0-32.9	55.9% ± 4.0%
Creatinine, in [mg/dL] [a]	1.0 ± 0.4	0.4-3.2	60.9% ± 4.0%
Creatinine clearance (based on IBW), in [mL/min]	51.3 ± 21.4	12.6-129.0	56.7% ± 4.0%
eGFR (calculated with CKD-EPI), in [mL/min/1.73 m^2] [c]	64.0 ± 21.7	17.2-120.0	60.9% ± 4.0%
Total cholesterol, in [mg/dL] [a]	176.3 ± 47.2	88.8-339.8	30.9% ± 3.8%
Triglycerides, in [mg/dL] [a]	164.4 ± 81.5	53.1-495.6	27.6% ± 3.6%
HbA1c, in [%]	7.5 ± 1.7	5.0-14.2	23.1% ± 3.4%
Fasting blood glucose, in [mg/dL] [a, b]	122.4 ± 48.3	61.3-358.6	22.8% ± 3.4%
25(OH)-cholecalciferol, in [ng/mL] [a]	26.0 ± 11.7	3.2-91.7	22.9% ± 3.4%
TSH, in [µIU/mL] [a, b]	2.7 ± 5.6	0.01-39.40	22.1% ± 3.4%

Abbreviations: CKF-EPI = Chronic Kidney Disease Epidemiology Collaboration, eGFR = estimated glomerular filtration rate, HbA1c = haemoglobin A1c, IBW = ideal body weight, SD = standard deviation, MOE = margin of error, TSH = Thyroid-stimulating hormone. [a] Values that were not counted because they were stated as “wnl”/“NAD” instead of providing numerical values: 1 value each for electrolytes, urea, and creatinine; 6 values for 25(OH)-cholecalciferol, 8 values for fasting blood glucose, 15 values for triglycerides, 19 values for total cholesterol, and 35 values for TSH. [b] The median for these parameters: chloride = 102.0 mEq/L, urea = 6.8 mEq/L, fasting blood glucose = 108.1 mg/dL, TSH = 1.36 µIU/mL. [c] The eGFR was calculated by the researchers based on the information provided in the HMR reports.

3.5.2 Prevalence of recommendations

Table 9 provides the number of reports that contained recommendations based on laboratory data and requests for further testing by HMR pharmacists. In 80.8% (324/401) of reports with pathology, these data were used in the recommendations by pharmacists to GPs. The pharmacists assessed whether the levels were within or outside the normal range and made

suggestions, such as continuation of pharmacotherapy, lifestyle changes, commencement of a new drug, dose adjustment, withdrawal, or change in pharmacotherapy. In 81.6% (473/580) of the reports, the pharmacists suggested additional tests to GPs. If only reports with pathology data were considered, recommendations for further testing were made in 77.8% (312/401) of reports. Suggestions for laboratory testing were statistically more frequent when no pathology data were provided (P = 0.0004). Pharmacists made recommendations for further testing in 80.9% of cases where pathology data were provided by GPs. That was not statistically different (P = 0.63) to pharmacists making recommendations for new tests (82.1%) without referring to provided data or without having pathology data provided to them by GPs, respectively.

Table 10: Frequency of recommendations by pharmacists regarding pathology data in the HMR reports (n = 580).

Type of recommendation	*Frequency* [a]
Reports with comments based on laboratory data	55.9% ± 4.0%
Reports with requests for further testing	81.6% ± 3.2%
Reports with comments or requests regarding:	
25(OH)-cholecalciferol	69.3% ± 3.8%
Lipids	62.4% ± 3.9%
Renal function blood test	49.5% ± 4.1%
HbA1c or fasting blood glucose	48.2% ± 4.1%
Liver function blood test	35.0% ± 3.9%
Hydroxocobalamin	34.0% ± 3.9%
Full blood evaluation	33.6% ± 3.8%
Thyroid function blood test	31.0% ± 3.8%

Abbreviation: HbA1c = haemoglobin A1c. [a] Data are percentage ± margin of error

3.5.3 Characteristics of recommendations

In 26.0% (151/580) of the reports, the pharmacists recommended an array of tests. The prevalence of this array testing was statistically more common when the HMR report did not contain any pathology data (47.5% versus 16.5%, P < 0.0001). There were 133 HMR reports with vitamin D value; in 54.9% (73/133) of these, the pharmacists referred to that value while in 33.8% (45/133) the pharmacists recommended further monitoring of the vitamin D level. In these cases, the testing was conducted a median of 101 days (range 14-836) ago which was comparable to reports with a vitamin D level where no monitoring was suggested (107 days, range 7-1219). In comparison, in 66.9% (299/447) of reports without current serum 25(OH)-cholecalciferol concentrations, the pharmacists recommended testing. Females were more

likely to receive a recommendation by the pharmacist regarding vitamin D than males (71.9% versus 63.9%, P = 0.0481). Pharmacists were more likely to provide recommendations about lipid monitoring if the patient was on lipid-lowering therapy (67.3% vs. 50.6%, P = 0.0002). For patients (n = 27) with simultaneously high total cholesterol (≥ 193.1 mg/dL) and triglyceride values (≥ 177.0 mg/dL), the pharmacists made few recommendations to reach target levels; the most common recommendation was dietary changes (3/27). For those without lipid-modifying agents (7/27), the pharmacists suggested to commence therapy after a risk-benefit assessment by the GP.

For patients with severe kidney failure (eGFR 15-29 mL/min/1.73 m^2), pharmacists recognized the renal impairment and made recommendations based on this status for 87.0% (20/23) of patients. Among these recommendations were: dose reduction, notification of contraindication for a specific drug, referral to a renal specialist, close monitoring of renal function, risk-benefit assessment of vitamin D and calcitriol substitution, pharmacotherapy with drugs acting on the renin-angiotensin system in early chronic kidney disease but caution in severe renal impairment. There were 46 patients with eGFR below 60 mL/min/1.73 m^2 taking diabetes medication; the pharmacists made comments regarding their HbA1c levels for 82.6% (38/46) of these patients and regarding the creatinine clearance for 87.0% (40/46). If the HbA1c was not provided in these cases, the pharmacists recommended monitoring. The pharmacists always noted when HbA1c levels were 7% or above and provided recommendations on how to improve diabetes control for these patients with severe kidney failure. Of all patients, 7.8% (48/580) had reported HbA1c levels above 7.5%; in 79.2% (38/48), the pharmacists commented on the elevated value, and in 14.6% (7/48), the pharmacists suggested re-checking. In these cases, the median HbA1c measurement was 74 days ago. Pharmacists suggested to GPs in 16.7% (8/48) commencement of insulin, in 35.4% (17/48) referral to a diabetes educator, in 14.6% (7/48) referral to a dietitian, and in 16.7% (8/48) referral to an endocrinologist.

In 169 reports, a full blood evaluation was recommended. In 63.9% (108/169) of these, the pharmacists suggested routinely monitoring without stating motives; further reasons were diagnosed anaemia, (high risk of) gastrointestinal bleeding, or drugs that influence the blood count. The reasons for pharmacists requesting a vitamin B12 test are shown in table 10. These were most commonly screening suggested for patients taking proton pump inhibitors or metformin. Recommendations made by pharmacists regarding the thyroid function test were statistically dependent on patients taking thyroid medication (P < 0.0001). However, in 41.5% (22/53) of reports with recommendations for thyroid testing there was no specific reason stated. If a reason for testing was given, it was usually due to either a previous abnormal value or thyroid hormone therapy without (recent) results provided.

Table 11: Reasons why pharmacists suggested vitamin B12 testing (n = 186).

Reason for testing	*Frequency* [a]
Screening	77.4% ± 6.0%
No reason, together with range of other tests	32.8% ± 6.7%
Taking PPI, metformin or both (without further explanation)	25.8% ± 6.3%
PPI, metformin or both + at least 1 potential symptom	8.1% ± 3.9%
Potential symptom of vitamin B12 deficiency	4.3% ± 2.9%
Taking iron and/or folic acid supplementation	3.8% ± 2.7%
Full blood count outside range	2.7% ± 2.3%
Monitoring	22.6% ± 6.0%
Receiving vitamin B12 injections (no results provided)	9.7% ± 4.2%
Re-test (results provided)	4.8% ± 3.1%
Vitamin B12 injections on referral, but currently ceased	4.3% ± 2.9%
History of vitamin B12 deficiency	2.7% ± 2.3%
Taking vitamin B12 tablets (if required, change to injections)	1.1% ± 1.5%

Abbreviation: PPI = proton pump inhibitor. [a] Data are percentage ± margin of error

3.6 Discussion

Overall, it seems that the pharmacists who conducted the HMRs were familiar with pathology data and the relevance of these in relation to specific pharmacotherapy. Although GPs are asked to provide the patient's laboratory results with the HMR referral (43), in this study only 69.1% of HMR reports contained any pathology data. Additionally, 13.6% of the pathology results in the pharmacists' reports were more than a year old which limits the usefulness of those data. Pharmacists recommended in 81.6% of reports some form of laboratory testing, which is significantly more than reported in a study of Australian GPs conducting medication reviews where the proportion of pathology test orders accounted for only 26% of reviews (104).

Most of the recommendations by the HMR pharmacists appeared useful. The pharmacists gave particularly valuable advice on pharmacotherapy in patients with renal impairment; they were aware of drug classes that are contraindicated and provided guideline-conforming therapeutic guidance. These results are in line with other studies investigating pharmacist-led medication management in chronic kidney disease (105, 106). Many recommendations were made with regards to metformin; these were in accordance with the current Australian guideline for type 2 diabetes, proposing dose reductions in patients with eGFR 30-60 mL/min/1.73 m^2 and contraindication for eGFR below 30 mL/min/1.73 m^2 (97). The pharmacists calculated the creatinine clearance instead of the eGFR to determine the renal

impairment. For dose adjustments, the creatinine clearance is acceptable but then the eGFR reference values cannot be applied. However, the methods for calculations of renal impairment and dose adjustments are regularly debated; at the time of the recommendations the pharmacists' method might have been standard. An evaluation of RMMRs showed when pharmacists recommended dose reduction of metformin due to renal impairment it was usually not taken up by GPs; however, if pharmacists explained that metformin was contraindicated in patients with renal failure, GPs ceased the drug (107).

Pharmacists in this study followed current guidelines and were aware of risk factors for vitamin D deficiency. These include females and little exposure to sunlight which is often the case for the elderly (98). Since many HMR recipients were elderly females, it is not surprising that 25(OH)-cholecalciferol was among the most commonly reported pathology parameter and was commonly recommended by pharmacists. A study retrospectively evaluating RMMRs found that vitamin D supplementation was frequently recommended by pharmacists but the uptake by GPs was only 58.7%. However, a recent meta-analysis showed that while there is evidence to reduce the risk of fractures in aged care facilities using vitamin D and/or calcium supplements, there is no evidence among community-dwelling elderly (108). In view of these findings, the frequently practiced vitamin D testing requests and substitution recommendations appear questionable. Furthermore, there are potential harms associated with excessive vitamin D supplementation such as renal and cardiovascular damage (98). It was unexpected that the presence of the lipid profile was independent from patients taking lipid modifying agents. In the HMR reports, often just the two values, total cholesterol and triglycerides, were provided. Therefore, it is plausible that the pharmacists made only few comments on elevated total cholesterol and triglyceride levels since it is difficult to draw any assumptions without having the full lipid profile (103).

In a quarter of the reports, the pharmacists routinely recommended an array of pathology tests without any specific reason. Although it was significantly more common in HMR reports without pathology, this did not justify the request if no rationale for the tests was provided. According to guidelines, many of these tests are only required in specific situations (98, 99, 101, 102). Unnecessary screenings imply increased health expenditures and additional burden on patients (93). The findings for full blood count, thyroid function, and hydroxocobalamin showed that pharmacists recommended these tests without any reference to patients' symptoms or other clinical reason in 63.9%, 41.5%, and 32.6%, respectively. If the pharmacists provided a justification for the full blood count, thyroid function, or hydroxocobalamin test, these explanations were in line with guidelines (99, 102, 103). A possible explanation for the pharmacists' extensive laboratory tests requests is that they are constantly confronted with the high proportion of preventable DRPs. They learn how to prevent, identify and resolve

DRPs, for example through laboratory test requests. However, in the meantime some pharmacists might neglect that too much testing might be harmful for the patient. The pharmacists should evaluate the usefulness of laboratory tests individually for each patient.

3.6.1 Limitations

The data used in the study were retrospectively analysed which entails disadvantages. In some cases, the same person had received HMRs in consecutive years. A formal analysis of these patients over time was not possible since the data the researchers had received were de-identified. The eGFR could not be appropriately adjusted according to race because the ethnicity of the HMR recipients was unknown; however, this should not influence the results strongly because the percentage of black people in Australia is low and the CKD-EPI formula without the African-American correction factor is suitable for Aboriginal Australians (109). The investigator who performed the data abstraction was not blinded to the research question which introduced potential bias. Furthermore, the researchers did not have any follow-up information after the HMR reports had been sent to the GPs. Therefore, the practical relevance and clinical impact of the recommendations made by the pharmacists regarding the pathology testing remains unclear.

3.6.2 Future implications

Based on the findings presented in this study, there are two hypotheses for future research: [1] pharmacists contribute to unnecessary pathology testing by recommending routinely inappropriate tests to GPs, or [2] by not providing any rationale in their reports pharmacists' risk having GPs not act on these recommendations despite the recommendation being reasonable. Previous research on HMRs has shown that GPs were more likely to follow pharmacists' recommendations if they had a discussion afterwards in which the pharmacist explained the rationale for the recommendation to the GP (110). Prospective studies should be undertaken to investigate the clinical relevance and acceptance rate of the pharmacists' recommendations to clarify which of the two proposed hypotheses is more applicable. Depending on the outcomes of these prospective studies, future actions could be either the implementation of a clinical decision support system to assist pharmacists in determining which pathology tests are advisable for individual HMR recipients, or the requirement for pharmacists to provide a written rationale for their recommendations in the HMR reports.

Future research could also evaluate pharmacists' recommendations or actions if they can access pathology results directly themselves from pathology providers. In Australia, healthcare practitioners can access online health records with patients' consent (111). Through this process, accredited pharmacists can directly review patients' pathology reports if both parties are registered for the service (111). The Australian government is currently expanding the uptake of the My Health Record system (111). Consequently, pharmacists who

have access to pathology reports and do not need to rely on GPs to provide such data may make more targeted recommendations for laboratory tests. Furthermore, an increasing number of POC tests have entered the healthcare market (112). Consequently, many diagnostic tests can be performed outside the laboratory. Pharmacists have shown that they can perform such tests with an acceptable accuracy (113-115). Therefore, instead of making requests for pathology data, the pharmacists could assess, for example, HbA1c, lipid profiles, and eGFR during the HMR interview.

3.7 Conclusion and Relevance

Pathology data is a significant component in pharmacists' HMR reports with >80% of reports containing recommendations for at least one laboratory test. A quarter of all reports routinely contained recommendations for ≥3 pathology tests. Pharmacists were less likely to recommend pathology testing if they had received pathology data. More than 10% of pathology reports pharmacists were provided with from GPs were conducted over a year ago. Recommendations by pharmacists appeared to be concordant with national and international guidelines particularly in relation to renal impairment (and drug dosing) and vitamin D testing. Generally, recommendations for tests regarding full blood count, vitamin B12, and TSH did not always contain any rationale for the test. To further improve the outcome of the programme a reasonable approach might be to ensure direct access to patients' pathology data for accredited pharmacists.

Chapter 4:

Point-of-care testing in community pharmacies – a systematic literature review

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4.1 Form E: Declaration of Co-Authored Publication for Thesis Chapter 4

4.1.1 Declaration by candidate

In the case of Chapter 4, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Conception and design; data acquisition, analysis and interpretation; drafted and critically revised manuscript	70

The following co-authors contributed to the work.

Name	Nature of contribution	Contributor is also a student at UC Y/N
Louise Deeks	Data acquisition, analysis and interpretation; critically revised manuscript	N
Alison Shield	Conception and design; data interpretation; critically revised manuscript	N
Sam Kosari	Conception and design; data interpretation; critically revised manuscript	N
Mark Naunton	Conception and design; data interpretation; critically revised manuscript	N

Candidate's Signature	V.Bup	Date 31/05/18

4.1.2 Declaration by co-authors

The undersigned hereby certify that:

(1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
(2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
(3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
(4) there are no other authors of the publication according to these criteria;
(5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
(6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s)	Faculty of Health, Bruce Campus, University of Canberra

Signature 1		**Date** 07/06/18
Signature 2		31/05/18
Signature 3		31/05/18
Signature 4		31/05/18

4.2 Abstract

Background: Point-of-care tests are characterised through the ability of conducting them near the patient's side without the necessity of a laboratory. They can be applied in different healthcare settings to improve patients' access to testing. **Objective:** To evaluate the effectiveness and analytical quality of point-of-care tests performed in the community pharmacy. **Methods:** Six electronic databases were systematically searched using a predefined search strategy. Interventional studies that reported on the effectiveness of the point-of-care tests and accuracy studies that investigated their analytical quality were included. The literature search, study selection, and data extraction were performed independently by two researchers. **Results:** In total, eleven studies were identified focusing on blood glucose, cholesterol, creatinine, uric acid, liver enzymes, international normalized ratio for anticoagulation therapy, bone mineral density for osteoporosis, forced expiratory volume for chronic obstructive pulmonary disease, and infection with human immunodeficiency virus. The included studies showed that point-of-care tests that were conducted and analysed in community pharmacies had satisfactory analytical quality and that the interventions applying these tests were effective overall. **Conclusions:** Community pharmacies are well suited to deliver a wide range of point-of-care tests. In the future this will allow easier access to various screening and diagnostic tests for patients.

Keywords: point-of-care system, monitoring, community pharmacy service, systematic review.

4.3 Introduction

POC testing is increasingly used in various healthcare settings and new devices are entering the market which can be used to test for numerous health states outside the laboratory (112). The American Association for Clinical Chemistry (116) uses the following definition to distinguish POC testing from laboratory testing: 'POC testing typically refers to waived or nonwaived laboratory tests performed at remote locations by non-laboratory personnel'. One example are screening tests in community pharmacies that are performed by pharmacy staff. Community pharmacists are important members of the healthcare system and due to the increasing life expectancy of the population the pharmacists' role is gaining more importance (13, 117). POC tests have been offered in pharmacies for some time; for instance, many pharmacies conduct blood glucose and cholesterol measurements (118). Other POC tests have just entered the community pharmacy setting, such as tests for streptococcus A pharyngitis (119), coeliac disease (120), influenza (121), hepatitis C (122), and human immunodeficiency virus (HIV) infections (123). There is potential in this area to provide these screening tests in various healthcare settings. However, POC tests can only be helpful if they

are carried out correctly and deliver high-quality results (124). Under the “ASSURED” acronym the WHO defines six characteristics that every POC test should have: affordable, sensitive (avoid false negative results) and specific (avoid false positive results), user-friendly (simple to perform, non-invasive), rapid and robust, equipment-free, and deliverable (accessible to end-users) (125). With these features, POC tests can be applied in all possible settings while achieving high quality results (125). Hence, the devices used for testing could increasingly be applied in developing countries as well (125).

There are different national regulations that specify the legal requirements for POC tests and their use. In the USA, the Clinical Laboratory Improvement Amendments (CLIA) regulate diagnostic testing and certifications; this allows the Food and Drug Administration (FDA) to review requests for Waiver by Application (126). In Canada, requirements for POC tests under the standard (CAN/CSA-Z22870-07 (R2013)) are based on the International standard but there is no standardised jurisdiction for certifications (127). Similarly in the European Union, there are standardised regulations for the test devices (Regulations (EU) 2017/745 and 746), while the requirements for certifications vary between member states (128). The Australian regulatory framework for test devices is set by the Therapeutic Goods Administration and the National Pathology Accreditation Advisory Council has published guidelines for POC testing, including the requirements for staff performing the tests (129).

It is essential that POC tests assure good analytical quality, i.e. ‘achievement of analytical results with an acceptable standard of accuracy’ (130); secondly, it is important to measure the effectiveness of interventions using POC tests, i.e. the ‘extent to which an intervention does more good than harm under usual circumstances’ (131). Both aspects must be guaranteed in order to justify the delivery of POC interventions in community pharmacies. The analytical quality of tests is affected by training and qualification of staff as well as internal and external quality controls (132-135). Analytical errors can occur due to failure of the device, analytical interference, non-conformance with the testing procedure, or an undetected failure in the quality control (136). The objective of this review was to assess the effectiveness and analytical qualities of POC tests for screening or diagnostic purposes as conducted in community pharmacies in comparison to other healthcare settings or the laboratory reference standard, this being the first systematic review of this kind in the international literature to our knowledge.

4.4 Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) statement (137), and is registered with PROSPERO (registration number: CRD42017075159).

4.4.1 Search strategy

The following databases were searched to retrieve all relevant publications regarding POC tests in community pharmacies: PubMed, the Cochrane Library, MEDLINE (via Web of Science), EMBASE (via Scopus), Cumulative Index to Nursing and Allied Health Literature (CINAHL; via EBSCOhost) and PsycINFO (via EBSCOhost). The complete search strategy is shown in table 12. The search was conducted from inception until November 2017. Further studies were identified through *snowballing*, either by reviewing the references of relevant papers or by searching for further publications by relevant authors.

Table 12: Search strategy and terms.

Database	*Search*	*Search terms*
PubMed	#1	"point-of-care systems"[MeSH Terms]
	#2	"in vitro techniques"[MeSH Terms]
	#3	"monitoring system"[All fields]
	#4	#1 OR #2 OR #3
	#5	"pharmacies"[MeSH Terms]
	#6	#4 AND #5
Cochrane Library	#1	point-of-care[Title, abstract, keywords]
	#2	in vitro diagnostic[Title, abstract, keywords]
	#3	monitoring system[Title, abstract, keywords]
	#4	#1 OR #2 OR #3
	#5	community pharmacy[Title, abstract, keywords]
	#6	community pharmacist[Title, abstract, keywords]
	#7	#5 OR #6
	#8	#4 AND #7
MEDLINE	#1	"community pharmac*"[Topic]
	#2	"in-vitro diagnos*"[Topic]
	#3	"monitoring system"[Topic]
	#4	"point-of-care"[Topic]
	#5	#2 OR #3 OR #4
	#6	#1 AND #5

Database	*Search*	*Search terms*
EMBASE	#1	“community pharmac*”[Title, abstract, keywords]
	#2	“in-vitro diagnos*”[Title, abstract, keywords]
	#3	“monitoring system”[Title, abstract, keywords]
	#4	“point-of-care”[Title, abstract, keywords]
	#5	#2 OR #3 OR #4
	#6	#1 AND #5
CINAHL	#1	“community pharmac*”
	#2	“in-vitro diagnos*”
	#3	“monitoring system”
	#4	“point-of-care”
	#5	#2 OR #3 OR #4
	#6	#1 AND #5
PsychINFO	#1	“community pharmac*”
	#2	“in-vitro diagnos*”
	#3	“monitoring system”
	#4	“point-of-care”
	#5	#2 OR #3 OR #4
	#6	#1 AND #5

4.4.2 Study selection

Primary research studies were eligible for inclusion if the intervention took place in a community pharmacy using a POC test and evaluating the effectiveness or analytical quality of the POC testing in community pharmacies. To be included, the intervention had to compare either the results of the POC device to the laboratory result or the community pharmacy to another healthcare setting. Only peer-reviewed articles published in English language were included. The definition of the International standard ISO 22870 (138) was applied for point-of-care testing: ‘testing that is performed near or at the site of a patient with the result leading to possible change in the care of the patient’. Studies that only used POC testing as an outcome measure for another intervention (e.g. to evaluate an educational programme) were excluded. Furthermore, POC tests that were not performed in the pharmacy, such as chlamydia tests that were only bought in the pharmacy and subsequently sent for analysis to the pathology (139, 140), were excluded. After removing duplicates, titles and abstracts of all identified publications were screened according to the pre-defined inclusion/exclusion criteria. The remaining full text articles were reviewed to determine eligibility for inclusion. Two

researchers (VB/LD) performed the study selection independently. If they did not reach agreement, the opinion of two other investigators (AS/MN) was obtained.

4.4.3 Data extraction and synthesis

Data extraction included: author, title, year, country, parameters measured with POC test, study objectives, intervention, POC devices, comparator, outcome measures, participants' characteristics, main findings, and willingness to pay/fee for patient. Due to the heterogeneity of the studies, especially in terms of parameters, comparators, and outcome measures, a meta-analysis was not possible.

4.4.4 Literature quality assessment

For the assessment of the risk of bias three different tools were used: the Cochrane Collaboration's tool for assessing risk of bias of randomized controlled trials (141), the Risk Of Bias In Non-randomized Studies – of Interventions (ROBINS-I) assessment tool by the Cochrane Collaboration (142), and the Cochrane Collaboration's recommended quality items for analytical tests derived from Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool (143).

4.5 Results

In total, 288 articles were identified by applying the search strategy in table 12; a further 15 articles were found through snowballing. After all duplicates were removed 173 articles remained which were screened for eligibility (see figure 5). Of these, 11 studies were finally included in the review; the outcomes measured were: International Normalized Ratio (INR) (n = 4) (144-147), blood glucose (n = 3) (113, 114, 148), cholesterol (n = 4) (114, 148, 149), bone mineral density (BMD) (n = 1) (150), forced expiratory volume (FEV) (n = 1) (151), creatinine (n = 1) (114), uric acid (n = 1) (114), liver enzymes (n = 1) (114), and HIV (n = 1) (152). The studies were conducted in Australia (n = 1) (145), Canada (n = 3) (146, 149, 150), Italy (n = 1) (114), Malta (n = 1) (147), New Zealand (n = 1) (144), Norway (n = 1) (113), Spain (n = 2) (151, 152), and South Africa (n = 1) (148); and were published between 2000 and 2016.

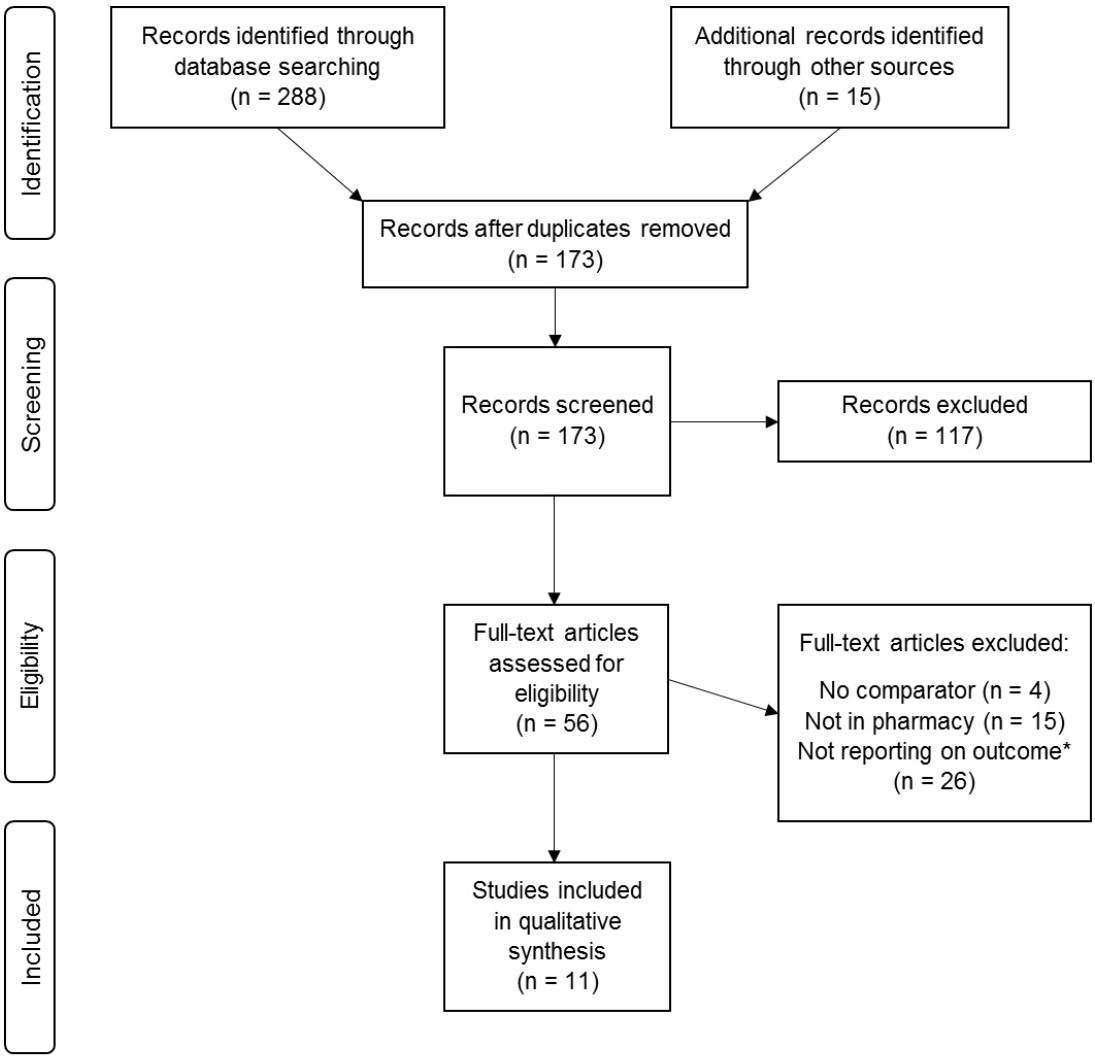


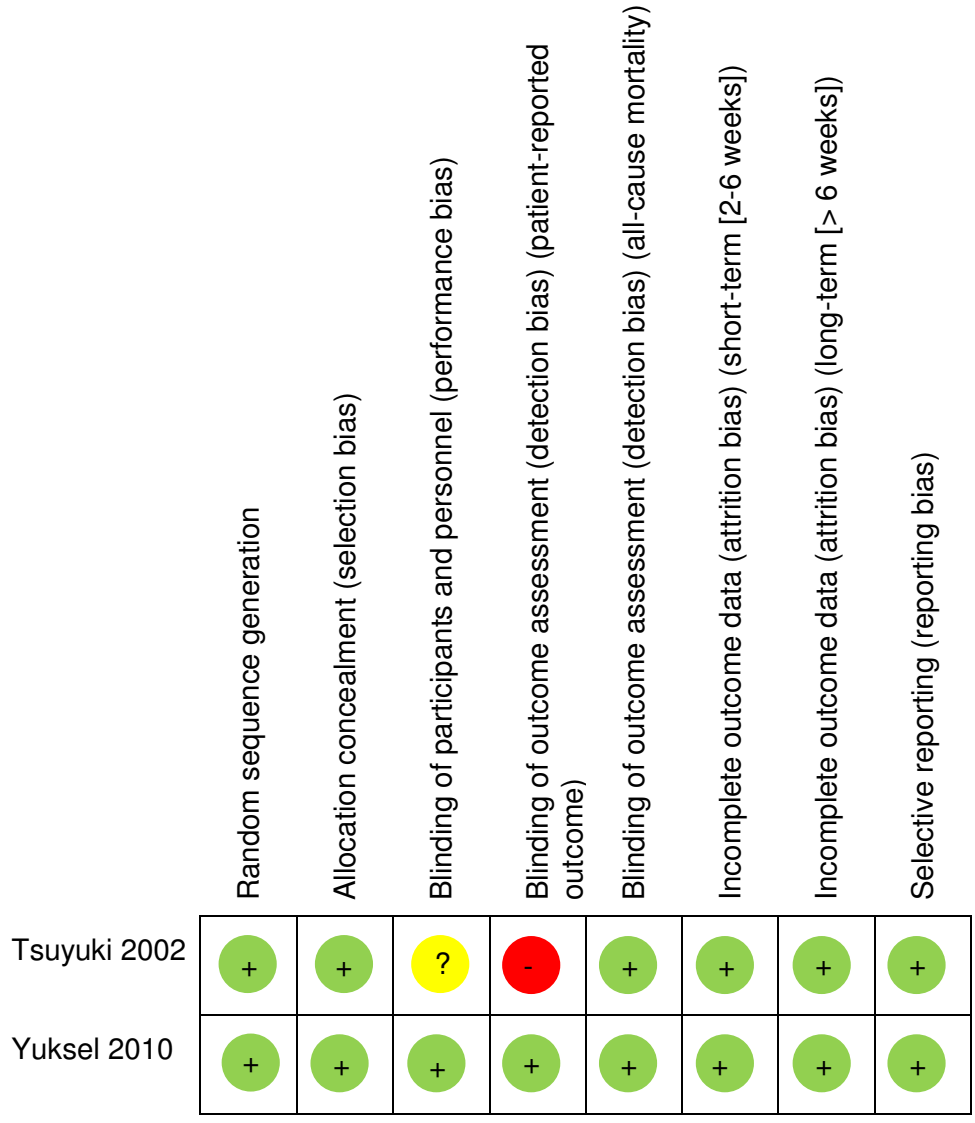
Figure 5: PRISMA flowchart displaying literature search and study selection.

4.5.1 Methodological quality of studies

The summary of the quality assessment is supplied in tables 13-15. From the six studies evaluating analytical tests, all had a representative spectrum, used acceptable reference standards, conducted both tests within an acceptable time frame, and used relevant clinical information (113, 114, 145, 147, 148, 151). Five studies avoided partial and differential verification as well as incorporation (113, 114, 147, 148, 151); while in one study only a non-random sample received the reference standard resulting in partial verification (145). The test results (i.e. index and reference standard) were either not blinded or blinding was unclear. Three studies received commercial funding (113, 145, 148). In four analytical studies, the objectives were pre-specified (113, 147, 148, 151); in the other two, it was unclear (114, 145). Four studies had pre-defined cut-off values (113, 114, 147, 151). All non-randomized intervention studies (n = 3) were of low risk of selection bias, misclassification bias, bias due to deviations from intended interventions and bias due to missing data (144, 146, 152). Thus,

for all three studies the risk of confounding cannot be determined. Two studies are of serious risk of bias in measurement of outcomes and moderate risk of bias in the selection of the reported results (144, 146). This results in an overall serious risk of bias for two studies (144, 146), and a moderate risk for the third study (152). The quality issues arise particularly due to the comparators used. The two randomized controlled trials have a low risk of bias (149, 150). For one study the risk of performance bias remains unclear (149). Uncertainties are due to the fact that the control groups received a more comprehensive care than is normally expected from “usual care”, and that the participating pharmacists might not be representative for all pharmacists (149, 150). The former fact might undermine the findings of the studies and the latter might reduce their generalisability.

Table 13: Summary of risk of bias for randomised controlled trials (141).



Explanation of the symbols: “+” low risk of bias, “-“ serious risk of bias, “?” unclear.

Table 14: Summary of risk of bias of non-randomised intervention studies (142). Modified according to Cochrane Handbook for Systematic Reviews of Interventions (141).

	Risk of confounding	Risk of selection bias	Risk of misclassification bias	Risk of bias due to deviations from intended interventions	Risk of bias due to missing data	Risk of bias in measurement outcomes	Risk of bias in the selection of the reported results	Overall predicted direction of bias for this outcome
Wilson 2004	?	+	+	+	+	-	o	-
Harrison 2015	?	+	+	+	+	-	o	-
Fernandez-Balbuena 2015	?	+	+	+	+	+	+	+

Explanation of the symbols: “+” low risk of bias, “o” moderate risk of bias, “-“ serious risk of bias, “?” unclear.

Table 15: Summary of bias for analytical test studies (143). Modified according to Cochrane Handbook for Systematic Reviews of Interventions (141).

	du Plessis 2000	Jackson 2005	Kjome 2010	Mifsud 2014	Represas-Represas	Zaninotto 2016
Representative spectrum?	+	+	+	+	+	+
Acceptable reference standard?	+	+	+	+	+	+
Reasonable time between reference and test?	+	+	+	+	+	+
Partial verification avoided?	+	-	+	+	+	+
Differential verification avoided?	+	+	+	+	+	+
Incorporation avoided?	+	+	+	+	+	+
Index test results blinded?	-	-	?	?	?	?
Reference standard results blinded?	-	-	?	?	?	?
Relevant clinical information?	+	+	+	+	+	+
Uninterpretable results reported?	-	-	-	+	-	-
Withdrawals explained?	N/A	N/A	N/A	N/A	N/A	N/A
Pre-defined cut-off values?	-	-	+	+	+	+
Technology up-to-date?	-	-	+	+	+	+
Treatment withheld until test and reference performed?	N/A	?	N/A	+	+	N/A
Pre-specified objectives?	+	?	+	+	+	?
Free of commercial funding?	-	-	-	+	+	+

Explanation of the symbols: “+” yes, “-“ no, “?” unclear, “N/A” not applicable.

4.5.2 Analytical quality

Table 16 shows a summary of the studies evaluating the analytical quality of POC tests; in table 17, the relevant results and conclusions are presented. In all three studies which investigated the analytical quality of blood glucose measurements, there was an acceptable accuracy compared to laboratory testing (113, 114, 148). Based on two studies, the cholesterol measurements in pharmacies showed good analytical performance (114, 148). While total cholesterol and HDL-cholesterol showed satisfactory correlation between laboratory and in-pharmacy measurements using the Passing-Bablok regression and Bland-Altman plot, the triglyceride values showed significantly different results between the two sites (median value for pharmacies: 1.627 mmol/L, ranging from 0.65 – 3.14 mmol/L vs. laboratory: 0.950 mmol/L, ranging from 0.86 – 2.37 mmol/L) (114). There was a significant positive bias for the pharmacies (0.6; 95% confidence interval (CI) limits of agreement: -0.8 – 1.8) (114). For the evaluation of the analytical performance, the researchers used another procedure by excluding variability due to pre- and post-analytics, showing a satisfactory conformity of the pharmacy results with the laboratory (114). In contrast to the first analysis, the blood samples were not obtained directly from patients but a lithium-heparin sample of one individual drawn from a physician and a control concentration were provided to the pharmacies and the laboratory (114). Further blood values that were investigated in the same study through POC testing were creatinine, uric acid, aspartate aminotransferase, and alanine aminotransferase levels (114). They all showed satisfactory correlation with the results obtained from the laboratory using the Passing-Bablok method (114).

Two studies determined the analytical quality of POC INR testing in community pharmacies comparing the results to a laboratory (145, 147). Both studies had almost equivalent results for the agreement between INR values obtained in the pharmacy and the laboratory: 85% of the pharmacy results, respectively, were within 0.4 and 0.5 INR units of the laboratory results, respectively (145, 147). In both studies, 15% of the obtained INR values were categorized differently between POC test and laboratory (145, 147). A portable spirometer was used in one study to identify patients with chronic obstructive pulmonary disease (COPD) (151). The proposed cut-off point for the FEV1/FEV6 ratio was 0.8.(151) In the comparison with two other settings (primary care and emergency service in a hospital), all showed comparable analytical quality (151). The percentage of positive results in the pharmacy (20%) was below the ones obtained for primary care (40%) and the emergency service (34%) (151). At the same time, the proportion of men being tested was much lower in the pharmacy (40%) compared to the other settings (70.6% and 71.6%) (151).

4.5.3 Effectiveness

The relevant results and conclusions of the studies assessing the effectiveness of POC testing are found in table 17; the characteristics of these studies are summarised in table 18. Two studies investigated the effectiveness of anticoagulation management in community pharmacies comparing it with GPs or an anticoagulation clinic, respectively (144, 146). Both studies used the Rosendaal method for linear interpolation to calculate the mean time in therapeutic range (TTR), although they used different thresholds for therapeutic range (within 0.2 vs. 0.5 INR units) (144, 146). In one study the pharmacists achieved a statistically significantly higher mean TTR compared to GPs' care ($P < 0.001$), while in the other study the pharmacists accomplished a mean TTR comparable to an anticoagulation clinic ($P = 0.58$) (146). Both studies revealed no significant differences in the number of concerning INR values between pharmacy-led care and the comparison groups (144, 146). While the study comparing to GP care could not identify any significant differences in the frequency of tests (3.4 tests/month in the pharmacy vs. 2.8 tests/month in general practice) (144), there was a difference between the pharmacy (6 per patient in 3 months; 95% CI: 4.7 – 6.5) and the anticoagulation clinic (11 per patient in 3 months; 95% CI: 10 – 12) (146).

In a randomized controlled trial investigating the effectiveness of an osteoporosis screening programme in community pharmacies, the quantitative heel ultrasound test was used to motivate patients to conduct a BMD test in a specialist clinic (150). The intervention led to 22% of participants achieving at least one of the primary endpoints (BMD test or new osteoporosis prescription) compared with 11% in usual care (relative risk (RR) = 2.1; 95% CI: 1.1 – 3.7, $P = 0.017$) (150). This result was mainly driven by the performance of a BMD test with 22% in the intervention group and 10% in the control group (RR = 2.2; 95% CI: 1.2 – 4.1, $P = 0.011$) (150). Another randomized controlled trial compared pharmacist-led care for cholesterol risk management to usual care (149). Pharmacists measured the total cholesterol and educated participants about cardiovascular risk factors (149). Subsequently the researchers investigated whether participants were more likely to receive a full cholesterol screen and new or increased cholesterol-lowering medication (149). In the pharmacy group, 57% of participants reached the primary endpoint compared to 37% with usual care (odds ratio 3.0; 95% CI 2.2 – 4.1, $P < 0.001$) (149). Hence the intervention was significantly superior to the control that led to an early termination of the study (149). The study investigating the feasibility of HIV POC testing in community pharmacies in a Spanish rural area compared the results to the local HIV registry (152). The pharmacy had a higher percentage of men sleeping with men being newly diagnosed with HIV (60.9%) compared to the local registry (40.2%) (152). On the other hand the pharmacy did not test any injecting drug users positively while in the registry 11.6% of positively tested persons were injecting drug users (152). In general only 0.2% of

participants in the pharmacy stated needle sharing as the reason for getting tested (152). Compared to other Spanish studies, the researchers reported high proportions of heterosexual men who requested HIV tests (52.8% vs. 45.1% vs. 28.7%) and who had positive test results (34.8% vs. 14.6% vs. 0%) (152-154).

4.6 Discussion

The review showed that the POC tests used in pharmacies had an acceptable analytical quality compared to the laboratory standard and were without disadvantages compared to other healthcare settings. The different blood tests conducted in pharmacies were useful to screen for abnormalities. However, due to analytical imprecision caused by errors such as wrong sample collection or false internal quality control, the testing appears not always appropriate for diagnostic and treatment purposes, for example in the treatment of hypercholesterolemia (148); this test should be used primarily for screening. Furthermore, the interpreter needs to be careful when comparing values obtained from different POC devices, as the highest variability of results was observed between different devices (148). Especially when testing triglyceride concentrations, appropriate sample collection was essential in order to obtain appropriate results (114). One common mistake observed was that the fingertip from which the sample was taken was not sufficiently cleaned in advance (114). This has led to contamination, for instance through hand creams, falsifying the results (155). In other therapeutic areas, such as anticoagulation management, pilot studies confirmed the ability of community pharmacists to check INR values and adjust medical treatment (144, 146). The testing was appreciated by patients because the finger prick tests are less invasive when compared to venepuncture (145, 147).

Screening programmes using POC testing were successfully tested in pharmacies for COPD, osteoporosis, cardiovascular disease, and HIV (149-152). The POC test results gave the pharmacists an indication whether follow-up actions were required. Furthermore, they increased the awareness for diseases and their risk factors. Results of the HIV study suggested that community pharmacies are capable of attracting other population groups for testing as compared with the usual HIV test centres (152). One possible explanation for this is that people are less concerned to be stigmatised in a pharmacy as practicing certain sexual behaviour or abusing drugs (152). That means that HIV testing in community pharmacy settings could lead to higher test rates in more conservative populations (152).

In general, patients appreciated the availability of POC tests in community pharmacies for screening or medication management purposes (145-147, 152, 156-158). Community pharmacies are convenient settings for patients to conduct POC testing since pharmacies are widely spread and easily accessible, usually no appointment is necessary and test results are

quickly available compared to laboratory tests (117, 152, 156, 158). When asked, patients usually showed a willingness to pay a small amount (approximately USD 5) to use this service (145, 146, 156-159). This might not cover the costs for the service and pharmacies might charge higher fees if the service is not covered by the patient's health insurance; careful consideration of funding models is therefore required. For a successful implementation of programmes such as the anticoagulation management, it appears beneficial if local GPs are involved and to recognize that pharmacists are intending to reduce GPs' workload and not to reduce the GPs' source of income (157, 160). Research has shown how important the role of interprofessional collaboration in the patient care process is (161). When community pharmacists deliver public health services, for example by performing POC screening tests, they need to collaborate with patients' GPs to assure continuity of care (161).

4.6.1 Strengths and limitations

A thorough literature search was conducted with the aim of identifying all relevant articles. Two researchers independently performed the search, study selection, and data extraction. The included studies were conducted in various countries with similar findings. This indicates that the results can be generally applied to developed countries. The authors' attempt was to only include studies with a high-quality study design by limiting the eligibility to studies with a comparator. However, some of the studies included in the review had quality deficiencies and, therefore, the results from these studies cannot be generalised. Two studies used POC devices that are now available in updated versions; these studies are from 2000 and 2005 (145, 148). Three studies had small sample sizes ($n \leq 50$) (146-148). Only two studies had a randomized control group that was followed-up simultaneously to the intervention group (149, 150). The other three interventional studies compared the results to patient information that was already available (144, 146, 152). In the studies, participating pharmacists might have been exceptionally motivated to conduct such interventions. Additionally, there is a range of other POC tests that can be performed in the community pharmacy, such as testing for infections with streptococcus bacteria or influenza viruses (162). Unfortunately, up to this point there have not been any studies published using such POC tests that fit the criteria of this review.

Table 16: Summary of studies evaluating analytical quality.

Author, year, country	*Parameter*	*Objective*	*Participants' characteristics*	*Intervention*	*Comparator*	*Outcome measures*
du Plessis et al. 2000, South Africa (148)	blood cholesterol and glucose	analytical quality of blood cholesterol and glucose testing in community pharmacies	12 pharmacies, 8 pathologies, 6 participants	volunteers had blood glucose and cholesterol concentrations measured in randomly selected pharmacies and pathologies	laboratory, pathology	between-pharmacy analytical variation, between-pathology analytical variation, bias for measurements, percentage of closeness to homeostatic set point
Zaninotto et al. 2016, Italy (114)	blood glucose, cholesterol panel, creatinine, uric acid, liver enzymes	analytical quality of various blood tests in community pharmacies	106 customers of 8 pharmacies (glucose + cholesterol: n = 67; triglycerides: n = 65; HDL-cholesterol: n = 50; creatinine, uric acid, and liver enzymes: n = 35)	capillary specimens collected by the pharmacist and lithium heparin samples from a female and a control sample containing high concentrations of glucose, cholesterol and triglycerides were analysed	laboratory	correlation between pharmacy and laboratory, bias for measurements, 95% limits of agreement, laboratory and pharmacy recommended level or reference interval
Kjome et al. 2010, Norway (113)	blood glucose	analytical quality of blood glucose measurements performed in community pharmacies	customers of 16 pharmacies	variation between instruments performed in laboratory; pharmacy staff performed glucose measurement and quality control	laboratory, GP	variation between instruments; external and internal quality control; comparison with GPs

Author, year, country	*Parameter*	*Objective*	*Participants' characteristics*	*Intervention*	*Comparator*	*Outcome measures*
Jackson et al. 2005, Australia (145)	INR	analytical quality of anticoagulation management by community pharmacies	16 pharmacies, n = 137; median age 72 (range 23–100); indication: 52% atrial fibrillation, 27% deep vein thrombosis, 16% mechanical heart valve	pharmacists were trained in INR monitoring and conducted testing for 3 months	laboratory	correlation between laboratory INR values and pharmacy-based INR values; dosage change; satisfaction of patients and healthcare providers
Mifsud et al. 2014, Malta (147)	INR	analytical quality of anticoagulation management by community pharmacies	n = 50; 38% men; mean age: 73 (range 26–89); indication: 68% atrial fibrillation, 16% heart valve replacement; 12% deep vein thrombosis	INR test were performed in community pharmacy on the same day as patients' venous plasma INR was monitored at outpatient clinic	laboratory	patients' perception; correlation between pharmacy and laboratory in outpatient clinic
Represas-Represas et al. 2016, Spain (151)	FEV	analytical quality of COPD screening in non-specialized healthcare settings	15 pharmacies; n = 143 (vs. GP: 167, ES: 127); 40% men (vs. 70.6% GP, 71.6% ES); mean age: 53.1 (±8.6) [vs. GP: 56.8 (±9.7), ES: 56 (±11.1)]; 77.3% active smokers (vs. 74.6% GP, 63.7% ES)	diagnostic COPD test in 3 settings (GP, ES, community pharmacy) for individuals with risk factors; subsequently conventional spirometry at hospital	hospital using conventional spirometry (gold standard), GP, ES	area under ROC curve; FEV1/FEV6 ratio; FEV1/FVC ratio

Abbreviations: COPD = chronic obstructive pulmonary disease, ES = emergency service, FEV(1/6) = forced expiratory volume (in 1 second/6 seconds), FVC = forced vital capacity, GP = general practitioner, HDL = high-density lipids, INR = international normalized ratio, ROC = receiver operating characteristic.

Table 17: Summary of results and findings.

Author	*Relevant results*	*Conclusion*
du Plessis 2000 (148)	- closeness to homeostatic set point for single BG: pharm 24.6% vs. path 16.9% - bias for BG measurements: pharm -48.1–16.2% vs. path -1.0–7.4% - closeness to homeostatic set point for single TC: pharm 23.6% vs. path 15.6% - critical difference for 2 subsequent TC: pharm 33.3% vs. path 22.1% (same site: 16.2% vs. 16.9%) - bias for TC (using reference standard): pharm -5.6–16.6% vs. path -10.6–3.7%	higher variety of TC & BG results compared to path
Zaninotto 2016 (114)	- Passing-Bablok analysis had satisfactory r (range: 1.23 for AST to 0.92 for uric acid) for all parameters, except TG [TG positive bias in pharm (0.6, 95% CI -0.8–1.8)] - TG level: pharm median = 1.627 mmol/L (range 0.65–3.14) vs. lab median = 0.950 mmol/L (0.86–2.37) - increased TG values: pharm 21% vs. lab 9% (recommended level: < 1.92 vs. < 1.69 mmol/L) - significant reduction of bias in TG by excluding variability through pre- & post-analytical phase	acceptable quality, issues in pre- & post-analytical phase
Kjome 2010 (113)	- total CV (= SD/M of duplicates) for pharm: for low BG 6.1%, for normal & high BG 1.7% - CV between pharm: for low BG 4.5%, normal BG 1.5%, high BG 1.2% - variation between sites significantly lower for pharm than GP (CI not overlapping) - trueness of results: pharm 84% good, 16% acceptable vs. GP 88% good, 10% acceptable, 1% poor - precision: pharm 100% good vs. GP 92% good, 5% acceptable, 2% poor	suitable comparison for BG home testing; equal to GPs
Jackson 2005 (145)	- r = 0.88 for INR values between pharm & lab (P < 0.0001) - in Bland-Altman plot good overall agreement, slight variation for values < 4.0 units - 84.8% within 0.5 INR units of lab results - in 85% same nominal categorization of INR, 7.5% lower & 7.5% higher placed - feedback: stakeholders mainly positive - WTP: 57% of patients (63% willing to pay 1–5 AUD, 25% 6–10 AUD, 13% 11–15 AUD)	high satisfaction with testing; monitoring feasible
Mifsud 2014 (147)	- Pearson r = 0.968 for INR values between pharm & lab (P < 0.01) - good overall agreement in Bland-Altman plot, significant differences > 3.5 units - 85% of results ± 0.4 units of lab INR value, 2 results with difference > 0.7 INR units - 7 different dose decisions required between pharm & lab - feedback: patients satisfied, 82% preferred finger-prick over venepuncture, 58% support dose adjustments by pharm - WTP: 82% of patients	POC INR testing reliable & effective, high patient satisfaction

Author	*Relevant results*	*Conclusion*
Harrison 2015 (144)	- interval between tests: median 10 days (IQR 8–21 days), increase over time - pharm with longer TTR and shorter TBR than GP (both P < 0.001), no difference for TAR (P = 0.804) (all related-samples Wilcoxon signed-rank) - comparable number of INR results falling outside efficacy & safety thresholds - interval between tests: GP median = 11 days (7–20) vs. pharms median = 9 days (7–20) (P = 0.831)	safe & effective, significant improvements in TTR
Wilson 2004 (146)	- TTR (target range ±0.2 INR units): pharm M = 84% (95% CI 75–93%) vs. control M = 82% (95% CI 78–85%) (P = 0.58) - ≥1 panic INR (≤1.5 INR units or ≥5 INR units): pharm 21% (95% CI 6–46%) vs. control 30% (95% CI 39–59%) (P = 0.59) - number of INR tests/patient: pharm M = 6 (95% CI 4.7–6.5) vs. control M = 11 (95% CI 10–12) - feedback: no difference in satisfaction between groups, most patients very satisfied - WTP: 37% > 5 CAD, 58% 5–10 CAD, 5% 16–20 CAD	feasible & with advantages compared to hospital
Represas-Represas 2015 (151)	- in pharm, 20% of participants positively tested for COPD (vs. 40% in PC vs. 31% in ES) - POC test valid for all COPD categories - with FEV1/FEV6 = 0.8, no patient with severe COPD falsely negative - FEV1/FEV6 = 0.8 in pharm: sensitivity 95.5% (in total 92.1%), specificity 51.1% (in total 52.8%), PPV 32.8% (in total 47.3%), NPV 97.8% (in total 93.6%), PLR 1.95 (in total 1.95), NLR 0.09 (in total 0.15)	POC test is suitable for COPD screening
Yuksel 2010 (150)	- 22% in intervention achieved primary endpoint (vs. 11%, RR 2.1, 95% CI 1.1–3.7, P = 0.017) - 22% with central DXA test (vs. 10%, RR 2.2, 95% CI 1.2–4.1, P = 0.011) - 5% with new prescription (vs. 2%, RR 2.1, 95% CI 0.5–8.1, P = 0.30) - no significant differences in knowledge test, and health-related or osteoporosis-specific QoL - 35% with osteoporosis specific GP appointment (vs. 17%, P < 0.001)	number of patients tested for osteoporosis doubled
Tsuyuki 2002 (149)	- 57% in intervention achieved primary endpoint (vs. 31%, OR 3.0; 95% CI 2.2–4.1, P < 0.001) - EMC recommend early study termination due to superiority of intervention - 53% with fasting chol panel (vs. 29%, OR 2.8, 95% CI 2.0–3.7, P < 0.001) - 10% with new chol-lowering medication (vs. 4%, OR 2.5, 95% CI 1.3–4.6, P < 0.003) - 3% dose increase of chol-lowering medication (vs. 1%, OR 3.0, 95% CI 0.99–8.8, P = 0.07)	cardiovascular risk management significantly improved

Author	*Relevant results*	*Conclusion*
Fernandez-Balbuena 2015 (152)	- test requests: 15.8% MSM, 52.8% MSM, 25.3% women (remaining men not classifiable) - 23 reactive results: 87% Spanish; 60.9% MSM, 34.8% HSM, 4.3% women vs. local registry: 73.1% Spanish; 35.6% MSM, 37.7% HSM, 15.1% women - age < 30 years: 52.2% (M = 32.7 years) vs. local registry 21.8% (M = 38.7 years) (P < 0.001) - 60% with reactive result 1st tested - feedback: reason for testing: 77% sexual risk exposure; reasons for pharm: 70.6% immediacy of results & convenience of setting - WTP: fee for patients: 5 EUR/test	effective in reaching HSM who are most affected by delayed diagnosis

Abbreviations: ALT = Alanine transaminase, AST = aspartate transaminase, AUD = Australian dollar, BG = blood glucose, BMD = bone mineral density, CAD = Canadian dollar, chol = cholesterol, CI = confidence interval, COPD = chronic obstructive pulmonary disease, CV = coefficient of variation, DXA = dual energy X-ray absorptiometry, EMC = external monitoring committee, ES = emergency service, EUR = euros, FEV(1/6) = forced expiratory volume (in 1 second/6 seconds), GP = general practitioner, HIV = human immunodeficiency virus, HSM = heterosexual men, INR = international normalized ratio, IQR = interquartile range, lab = laboratory, M = mean, MSM = men sleeping with men, NLR = negative likelihood ratio, NPV = negative predictive value, OR = odds ratio, PC = primary care, pharm = pharmacy/pharmacist, path = pathology, PLR = positive likelihood ratio, POC = point-of-care, PPV = positive predictive value, QC = quality control, QoL =quality of life, r = correlation, RR = relative risk, SD = standard deviation, TAR = time above therapeutic range, TBR = time below therapeutic range, TC = total cholesterol, TG = triglyceride, TTR = time in therapeutic range, WTP = willingness to pay.

Table 18: Summary of studies assessing effectiveness.

Author, year, country	*Parameter*	*Objective*	*Participants' characteristics*	*Intervention*	*Comparator*	*Outcome measures*
Harrison et al. 2015, New Zealand (144)	INR	effectiveness of anticoagulation management by community pharmacies	15 pharmacies; n = 671; 62.4% men; median age 72 (range 13–97); indication: 73.8% atrial fibrillation, 8.6% mechanical heart valve, 6% deep vein thrombosis; median duration of follow-up: 197 days (interquartile range 168-219)	anticoagulation management service using POC INR testing and computer-assisted dose adjustment	GP (before-after)	time in therapeutic range, time below and above range, number and proportion of results outside efficacy and safety thresholds
Wilson et al. 2004, Canada (146)	INR	effectiveness of anticoagulation management by community pharmacies	1 pharmacy; n = 19 (vs. 112); 68% men (vs. 62%); mean age: 61 (range 25–88) (vs. 61); indication: 42% atrial fibrillation (vs. 16%), 32% mechanical heart valve (vs. 13%), 16% deep vein thrombosis (vs. 63%); duration of follow-up: 3 months	anticoagulation management service using POC INR testing for patients receiving long-term warfarin therapy	anticoagulation clinic (historical control)(163)	proportion of time for which INR was within expanded therapeutic range; rates of thrombotic and major haemorrhagic events; patient satisfaction
Yuksel et al. 2010, Canada (150)	BMD	effectiveness of an osteoporosis intervention by community pharmacists	15 pharmacies; intervention n = 129 (vs. 133); 38% men (vs. 33%); median age: 61 (range 56–70) (vs. 63); osteoporosis risk factors: 47% family history of osteoporosis (vs. 34%), 35% menopause before age 45 (vs. 42%), 14% previous fracture as an adult (vs. 20%); duration of follow-up: 4 months	osteoporosis screening in form of quantitative ultrasound, printed material and education on disease	usual care	primary: composite endpoint of BMD with central DXA or prescription for osteoporosis mediation, secondary: individual components of primary endpoint

Author, year, country	*Parameter*	*Objective*	*Participants' characteristics*	*Intervention*	*Comparator*	*Outcome measures*
Tsuyuki et al. 2002, Canada (149)	serum total cholesterol	effectiveness of cholesterol risk management for patients at high risk of cardiovascular disease by community pharmacists	54 pharmacies, intervention n = 344 (vs. 331); 59% men (vs. 62%); mean age: 64.2 ±12.2 years (vs. 64.6 ±11.3); risk factors: 40% myocardial infarct (vs. 39%), 28% unstable angina (vs. 29%), 38% stable angina (vs. 42%), 45% diabetes mellitus + ≥1 other risk factor (vs. 42%), 16 weeks follow-up	cholesterol measurement, education on cardiovascular risk factors, advice for appointment with GP; follow-up visits, final visit measuring cholesterol and blood pressure	usual care	primary: composite endpoint of fasting cholesterol panel by GP or new/change in cholesterol-lowering medication; secondary: individual components of primary endpoint, humanistic impact of intervention
Fernandez-Balbuena et al. 2015, Spain (152)	HIV	effectiveness of HIV testing in community pharmacies	16 pharmacies; n = 2168; 74.7% men (52.8% heterosexual, 15.8% MSM, 6.1% unclassified); mean age: MSM 30.8, heterosexual men 35.4, women 31.5	HIV testing and counselling in urban pharmacies with a low prevalence of HIV infections	regional surveillance system for new HIV diagnoses	test result, reason for testing, gender, gender of sexual partner, age, ethnicity

Abbreviations: BMD = bone mineral density, DXA = dual energy X-ray absorptiometry, GP = general practitioner, HIV = human immunodeficiency virus, INR = international normalized ratio, MSM = men sleeping with men, POC = point-of-care.

The review was limited to the community pharmacy setting. Other sites in which pharmacists are employed, such as outpatient clinics, might have a higher testing volume and access to other training programmes, support mechanisms, or laboratory professionals working on the site. All these factors can influence the analytical quality (132-135). Therefore, all other settings were excluded from this review. In the evaluation of the analytical quality, errors in the pre- and post-analytical phases could have contributed to the quality of the test results. For example, some of the triglyceride results were influenced by inappropriate sample collection which refers to the pre-analytical phase (114). However, it was not possible for all studies to differentiate in which phases errors had occurred. Nonetheless, this review was set out to evaluate the analytical quality of the POC tests; the same principle was applied as stated by Westgard (164) in relation to laboratory testing: 'Quality planning and control in a laboratory must begin with analytical quality – the essential quality characteristic of any laboratory test. It is not the only quality characteristic, but unless analytical quality can be achieved, none of the other characteristics will matter.' (p.1). Issues with analytical quality are particularly relevant in immunoassays, as they are susceptible to interference, and errors can potentially lead to adverse effects on clinical care of patients and/or increased costs (136). An example of an immunoassay is the POC test used in the HIV screening study (152).

4.6.2 Implications and future directions

To achieve a constantly high level of quality in community pharmacy-based POC testing a few factors are important to consider (see table 19). If these quality and safety measures are considered, community pharmacies are ideally placed to offer POC tests. In terms of future research, some implications can be derived from the above-mentioned limitations of the studies that were included in the review. Prospective studies should have larger participant groups, longer follow-up periods and higher-quality study designs, such as randomized controlled trials, to give precise effect sizes. Between 2005 and 2007, the Australian government funded a large randomized controlled trial to assess the clinical effectiveness, cost-effectiveness, satisfaction, and safety of POC testing in general practice (165, 166). The results were satisfying; problems mainly occurred with the measurements of HbA1c and HDL-cholesterol (166). A comparable project for community pharmacies will be of value.

Table 19: Quality and safety measurements for POC testing in pharmacies.

Measurements	*Description*
Instructions for staff (113, 114, 148, 167, 168)	Correct sample collection and use of equipment.
Support by manufacturers (113, 114, 145, 167)	Comprehensive user manual and service hotline.
Internal & external controls (114, 145, 148, 167, 168)	Periodically validation of devices in pharmacy; national authorities (if not already implemented).
Reference values (114, 148, 167)	Regular updates according to newest guidelines; if required, device specific cut-off values.
Dedicated work space (145)	Guaranteed privacy, hygiene, and safety.

4.7 Conclusions

This review showed that community pharmacies can conduct POC tests with satisfactory quality and effectiveness. This should encourage policy makers to provide funding in this area to establish effective pilot programmes in community pharmacies allowing a wider range of screenings for various risk factors and diseases. Through this, patients with chronic diseases may be earlier diagnosed and treated with a potential decrease in societal costs and other healthcare practitioners could prioritise different aspects of their workload if community pharmacists conducted tasks such as anticoagulation management. POC testing by community pharmacists may allow pharmacists to share a greater responsibility for the patient's care with other health professionals and improve the continuity of care for the patient.

Chapter 5:

Overall findings and conclusions

5.1 Contribution of thesis

This thesis makes several contributions to the growing body of research indicating the immense potential of pharmacists as healthcare providers. First, the thesis provides a deeper understanding of the impact of clinical services provided by community pharmacies on the Australian healthcare system (chapter 2). Second, the thesis introduces a new approach on how to combine individual pharmacy services to achieve a more coordinated care for the patient (chapter 2). Third, to the authors' knowledge the retrospective study is the first study that specifically investigated the use of pathology data by accredited pharmacists in the medication review process (chapter 3). Fourth, this thesis provides the first systematic review of international peer-reviewed literature on point-of-care (POC) testing performed in community pharmacies (chapter 4). Overall, this thesis lays the groundwork for further research into the Australian pharmacists' engagement with screening tests and proposes how individual pharmacy services could be combined to further improve patient outcomes.

5.2 Summary of findings

This project was undertaken to design an approach for future improvement in the delivery of healthcare services by pharmacists and to investigate the potential of this approach. The results of the first experimental chapter (chapter 2) demonstrate that community pharmacists are delivering many different health services with positive patient outcomes (41, 42, 45, 62, 71, 79, 169). Pharmacists are well located to assist patients in their healthcare, particularly with medication management (42). The Home Medicines Review (HMR) programme has been shown to be a successful tool for identifying drug-related problems (DRP) and empowering people to self-manage their medication by giving them a better understanding of the drugs they are taking (45). However, the narrative review set out with the aim of identifying a potential approach for future improvement in the delivery of the services based on the theoretical concept of primary care; it was proposed that the individual programmes provided by community pharmacies could be better combined to provide patients with an integrated care system. For example, the pharmacist might notice while performing a MedsCheck medication review that the patient needs further assistance with the pharmacotherapy. Therefore, the

pharmacist could suggest consecutively to the general practitioner (GP) a more intense HMR in the patient's residence.

The following two chapters (chapters 3 & 4) investigated how services could be combined to further benefit patients. This approach was based on the idea that pharmacists could be further involved in screening and monitoring of the community-dwelling population. Pharmacists are usually the health professionals most often visited by patients; therefore, they are well-placed for such procedures. Furthermore, the hypothesis was proposed that, if pharmacists were able to directly access patients' pathology reports or perform POC tests during the medication review, they might be able to give relevant advice on the patient's health status and pharmacotherapy without first requesting those data from the GP; this could save time for all parties involved. However, before such a hypothesis can be further investigated the *status quo* was evaluated, i.e. how pathology reports are currently used during medication reviews. These considerations led to the remaining research questions.

With respect to the second study (chapter 3), it was found that accredited pharmacists referred in 56% of reports to pathology data and provided useful, guideline-conforming advice to GPs in relation to patients' laboratory testing. However, pharmacists received data only for 69% of patients and the provided pathology data were in 14% more than a year old; as a result of this, the relevance of the advice based upon those results was limited. It was also found that pharmacists did not always provide a rationale for their laboratory test requests. Therefore, in these cases it was not possible to evaluate whether the recommendations were in line with national and/or international guidelines for relevant tests. A potential danger by not providing a rationale involves the risk that GPs might not follow the recommendations if they do not receive any justification for them. This idea is supported by research showing that the GPs' uptake of recommendations was greater when pharmacists and GPs met after the HMR interview to discuss the findings and to give the pharmacists the opportunity to explain the rationale for their recommendations (110).

The third study (chapter 4) was designed to investigate the potential role of pharmacy staff to conduct POC testing. The results of the systematic review confirmed that POC testing within the community pharmacy setting seems feasible and effective. The findings indicated that pharmacists have the skills to perform screening and monitoring tests. In the future, community pharmacists could therefore play a greater role in prevention and management of chronic diseases. It is widely reported, pharmacies are easily accessible since they are widespread, and no appointments are required (170). Furthermore, if pharmacists conduct POC tests accurately in the community pharmacy, they might also be able to apply the tests in the patient's residence.

5.3 Limitations

The scope of this project was limited by the absence of a prospective study design; two studies (chapters 2 & 3) reviewed the results of prospective studies, while the third (chapter 4) evaluated medication review data retrospectively which was challenging due to guideline changes over time. Therefore, the main purpose of this research was to generate a hypothesis for future work. It was not possible to make any direct assumptions on the clinical relevance of these findings. Furthermore, there are other healthcare settings where POC tests are performed by pharmacists, for example in outpatient clinics (171, 172). These settings were beyond the scope of this project. Notwithstanding these limitations, this research lays the groundwork for potential change in policy which should be further investigated in prospective study designs before being put into practice.

5.4 Implications and future directions

5.4.1 Point-of-care testing

The findings of this thesis have a number of important implications for future research and pharmacy practice. Amongst others, this project suggests that by providing access to tests in community pharmacies that are traditionally performed in the laboratory, screening and monitoring could be improved for people living in the community. Furthermore, the findings could encourage the Australian government to authorize not only community pharmacists, but also accredited pharmacists to perform POC tests. This authority to conduct tests during the interview in the patients' residence could enable pharmacists to provide useful and relevant recommendations to drug monitoring and risk screening. This also raises the question whether the government would be willing to include such POC services in future Community Pharmacy Agreements (CPA) and reimburse pharmacists for these tests so that no additional costs for the patients arise.

Tests that might be particularly suitable for the application in the community pharmacy but also during a HMR include International Normalized Ratio (INR) and estimated glomerular filtration rate (eGFR) measurements. Both parameters can influence the drug therapy in chronically ill patients and the routinely monitoring of these levels is important in specific patient groups (100, 173). In pilot studies, anticoagulation management, including INR measurement, was successfully implemented in community pharmacies (144-147); these studies were included in the systematic literature review (chapter 4). In addition, a pilot study was conducted in Australia which investigated a warfarin management programme after hospital discharge within the HMR framework (174). Trained, accredited pharmacists visited patients on warfarin therapy in the first ten days after hospital discharge to educate the patients on warfarin treatment, to measure the INR, and to perform a mediation review (174). The

results demonstrated an improvement in clinical outcomes compared to usual care. For monitoring renal impairment, there were two pilot studies conducted in the Netherlands. In one study, community pharmacists tested the eGFR of patients over 70 years of age who were taking renally cleared drugs for diabetes and/or cardiovascular risk management and for whom no current eGFR value was available (115). If required, the pharmacists reviewed the patient's medication plan for dose adjustments and consulted the GP. At study inclusion, 44% of the participants did not have an eGFR value measured within the past 12 months (115). The authors concluded that the eGFR measurement service seemed feasible in the community pharmacy and patients were very satisfied with the intervention. The involved GPs rated the service as good or satisfactory; potentially, some GPs might have not appreciated pharmacists giving advice on dose adjustments (115). In a more recent study, the main focus was on an electronic alert system which notified community pharmacists about renally cleared antibiotics during the dispensing process (175). Pharmacists could use a POC device if they could not retrieve data on the patient's renal status from another source. Many alerts had been triggered due to either missing or not current eGFR levels; in 2.2% of the alerts, pharmacists decided to perform a POC test (175). The calculated number of POC tests needed to identify one patient with an eGFR ≤ 50 mL/min/1.73 m^2 was 11; for patients ≥ 90 years of age, the number was 3. Therefore, the authors concluded that eGFR POC testing might be particularly worthwhile in the elderly population (175). These two studies were not included in the systematic literature review due to a lack of comparator, but they show the potential for pharmacists to use POC devices for eGFR measurement in community pharmacies and during HMRs in the patients' residence.

The International Pharmaceutical Federation (FIP) released in 2004 a *Statement of Policy Point of Care Testing in Pharmacies*; in this statement, the benefits of POC testing in community pharmacies were outlined (176). Among other aspects, cost savings associated with health screening services in pharmacies were mentioned (176). However, studies demonstrating cost savings through POC testing in community pharmacies are scarce. By comparing the direct costs for a POC test with the costs for the same test in the laboratory, the laboratory test will most likely be cheaper; cost effectiveness evaluations, however, are more complex (177). A test result by itself is not of (economic) value, but it becomes valuable if it leads to improvements in patient outcomes, process of care, or resource utilisation (177). Therefore, for a cost analysis, these factors need to be assessed. This, in turn, leads back to the problem that there is a lack of high-quality studies evaluating the clinical effectiveness of POC testing in community pharmacies (chapter 4, Strengths and limitations). To develop a full picture of the effectiveness of POC testing in pharmacies, more high-quality studies, preferably using a randomised controlled design, are required to evaluate patient outcomes, process of

care, and resource utilisation. With these results, a cost-effectiveness analysis can be conducted.

5.4.2 Integrated care system

The narrative review (chapter 2) set a direction for further improvements of the clinical services provided by pharmacists. A proposal was developed to interlink the services. Two applications of this proposal were investigated in chapters 3 and 4. However, there is more research in this area required to achieve full integration of pharmacists in the primary healthcare system. In all three studies of this thesis, good working relationships between pharmacists and physicians have emerged as a facilitating factor for the effective implementation of clinical pharmacy services (72, 110, 157, 160). Despite many efforts, more research seems to be necessary which goes beyond theory and examines the concrete implementation of such approaches in practice (161).

In the WHO's *Framework on integrated, people-centred health service* (178), integrated health services are defined as: 'health services that are managed and delivered so that people receive a continuum of health promotion, disease prevention, diagnosis, treatment, disease-management, rehabilitation and palliative care services, coordinated across the different levels and sites of care within and beyond the health sector, and according to their needs throughout the life course.' (p. 2). According to the WHO's definition (178): 'People-centred care is broader than patient and person-centred care, encompassing not only clinical encounters, but also including attention to the health of people in their communities and their crucial role in shaping health policy and health services.' (p. 2). Valentijn et al. developed a conceptual framework for integrative care based on the integrative functions of primary care (32). The theoretical concept of primary care is outlined in chapter 2 of this thesis. In line with the WHO's commitment to people-centred care, it is built on the holistic vision of person- and population-based care (32). This approach acknowledges the link between health and social issues. Integration can be divided into the vertical (linking care within one organisation) and the horizontal (linking care between organisations) axes (32). Integrated care is described in three dimensions – macro (system), meso (organisational and professional), and micro (clinical). The clinical integration at the micro level is discussed in chapter 2. The meso level has two characteristics – organisational and professional integration – which can be achieved through health networks; important components are shared responsibility, collective efforts, plus respect and tolerance for differences in cultural and clinical views (32). The health networks can be either virtually (via contracts) or vertically (shared site) integrated. The macro level refers to system integration (aligning structures, processes, and techniques) to achieve common rules and policies that allow a continuum of care within a healthcare system (32). For

a full integration at all levels, functional (reimbursement, management, information) and normative (values, culture, goals) aspects need to be considered (32).

With regard to the community pharmacy setting, segregation means that the pharmacy services are delivered independently, and patients are not referred to other healthcare practitioners. This should be prevented at all means because it is neither beneficial for individual persons nor for the entire population. A more coordinated person-based care can be achieved by implementing a linkage between the services in the pharmacy (see chapter 2), and coordination of interventions in interprofessional collaboration; each profession can contribute with their expertise to achieve the best outcome for the patient. For example, pharmacists can support clinicians in the pharmacotherapy by conducting medication reviews. On the other hand, after an initial screening in the pharmacy, pharmacists can refer patients to medical practitioners to carry out appropriate examinations and potentially initiate a therapy. However, this is not enough to achieve fully integrated care (82). The last step requires the formation of networks and the inclusion of the entire outpatient care team. In this team, not only healthcare providers are included, but also social service workers, support staff, and, most of all, the patient (161). Vertical networks including pharmacists exist in the form of patient-centred medical homes and general practices which employ pharmacists. A patient-centred medical home is 'a model of practice in which a team of health professionals, coordinated by a personal physician, works collaboratively to provide high levels of care, access and communication, care coordination and integration, and care quality and safety' (179), but the individual members of the care team do not have to be located at the same site. With regard to the community pharmacy, the networks are virtual, that means that pharmacists are not located within the same setting as the other providers. Nevertheless, some features need to be present for an effective collaboration; the three core values for high functioning teams identified in the literature are effective communication, defined responsibilities, and setting clear goals (161). This highlights the importance of normative integration. In response to functional integration, close proximity, regular meetings, more support staff, and new reimbursement systems have been identified as facilitators (161, 180).

Tan et al. published in 2014 a systematic literature review evaluating the effectiveness of clinical services provided by pharmacists in general practice (80). They identified 38 studies; in nearly 90%, the pharmacists' intervention included medication reviews. Nineteen studies reported positive effects on medication use or clinical outcomes (e.g. blood pressure, HbA1c, cholesterol). Overall, the meta-analyses demonstrated favourable results for interventions involving pharmacists in general practice. Pharmacists supported GPs in the quality use of medicine and chronic disease management (80). In a 2018 published review, Hazen et al. determined the degree of integration required for effective pharmacist-provided clinical

services in primary care practice (81). They concluded that the full integration of pharmacists (organisational, informational, clinical, functional, and normative) was beneficial for patient-centred clinical services, but it might not be necessary for some specific interventions targeting chronic disease management (81).

One successful example found in the literature describes the integration of a pharmacy in a patient-centred medical home (180). The pharmacy still provides the traditional pharmaceutical services, such as dispensing, medicines delivery, and compounding. In addition, it also offers a range of clinical services, including vaccination, diabetic clinic, refill authorisations, coordinated patient visits with GP and pharmacist, pharmacist participation in shared medical appointments, medication, anticoagulation, and pain management (180). A primary goal at the beginning of the project was to relieve GPs from their workload by identifying tasks that could be executed by pharmacists, for instance refill requests. Another example for such tasks are coordinated patient visits for selected patients with a comprehensive medication review by the pharmacist prior to the GP's appointment (180). The orientation of the pharmacy was changed from prescription- to patient-focused. This was achieved through the following measures: [1] the care was coordinated between GP and pharmacist through evidence-based collaborative practice agreements and medication-related decisions were shared between GP, pharmacist, and patient; [2] open access to health services without appointments was guaranteed to patients by offering a broad range of services in the pharmacy; [3] the reimbursement system was designed, so that pharmacists were payed based on performance which was assured through third-party contracting (180).

This is just one example of integrated care, but it demonstrates which services can be well coordinated between pharmacist and GP: medication refill, medication management in combination with GP visit, therapeutic monitoring, education, hospital discharge (161, 180). Some of these aspects were also incorporated in the proposed linkage of the services in chapter 2 (see figure 4). In the selected example, however, the pharmacy was placed in the same centre as the general practice and both were owned by the same company; therefore, it is not generalisable to all community pharmacies. In Australia, the government started a Health Care Homes (HCH) trial, which is based on the model of patient-centred medical homes; the HCHs are existing general practices or Aboriginal Community Controlled Health Services (181). The first stage of the trial commenced in October 2017 and will finish in November 2019. Community pharmacists will collaborate with the HCH care team during the trial and will be jointly responsible for initial reconciliation of the patients' medications and the development of a collaborative medication management plan (181). Further services provided by community pharmacies within the trial may include dose administration aids as well as

blood pressure and blood glucose monitoring. The participating community pharmacies will receive a bundled payment for these services (181).

A good starting point for a virtual integration of community pharmacies in Australia that is already available is the online My Health Record. If the government's efforts to increase the uptake of the service succeed, data sharing between healthcare practitioners should be greatly facilitated (182). Currently, only 24% of the Australian population are using the service (183). Between July and October 2018, Australians will have the opportunity to actively opt-out of the programme, otherwise they will be offered a My Health Record (182). The online record contains information about the patient's health status, such as chronic conditions, treatments, pathology reports, allergies, medication, and previous adverse drug reactions (111). My Health Record offers the pharmacists direct access to this information, but they can also use the system to update the patient's medication plan (111). Overall, My Health Record has the potential to better connect pharmacists with patients and other healthcare providers and, thereby, might lead to improved patient care (111).

5.5 Conclusions

The evaluation of the different pharmacist-led interventions in this thesis demonstrated that most of them led to improved outcomes for patients. However, to truly improve care at the individual and the population level, these services should not be provided separately. Instead, pharmacy services should be interlinked and better coordinated with the care provided by other health practitioners. One approach is the application of POC tests, which could be increasingly performed in the community pharmacy and conducted by accredited pharmacists during the HMR residential visit.

Epilogue

„Gelassenheit kann man lernen. Man braucht dazu nur Offenheit, Motivation, ein bißchen Ausdauer und vor allem Bereitschaft, sich von den alten, eingefahrenen Bahnen zu lösen, in denen unser Denken und Handeln sich häufig bewegt.“

~ Ludwig Bechstein ~

Translated into English:

‘*Serenity can be learned. All you need is openness, motivation, a bit of perseverance, and, most of all, a willingness to break away from the old, ingrained patterns in which our thoughts and actions often move.*’

References

1. Einstein A. On science. In: George Bernhard Shaw, editor. Cosmic religion: With other opinions and aphorisms. New York, USA: Covici-Friede; 1931. p. 109.
2. van Mil JF, Schulz M, Tromp TFD. Pharmaceutical care, European developments in concepts, implementation, teaching, and research: A review. Pharm World Sci. 2004;26(6):303-11 (p. 9).
3. Anderson S. Making medicines: A brief history of pharmacy and pharmaceuticals. 1 ed. London, UK: Pharmaceutical Press; 2005. 304 p.
4. Pharmaceutical Society of Australia. The Australian scene [Internet]. Canberra: Pharmaceutical Society of Australia; 2018 [updated 2018; cited 2018 3 May]. Available from: https://www.psa.org.au/history/short-intro/chapter-7-the-australian-scene.
5. Royal Pharmaceutical Society of Great Britain. History of the society [Internet]. London, UK: Royal Pharmaceutical Society of Great Britain; 2018 [updated 2018; cited 2018 3 May]. Available from: https://www.rpharms.com/about-us/our-heritage/history-of-the-society.
6. Pharmacy Guild of Australia. About the Guild [Internet]. Canberra, Australia: Pharmacy Guild of Australia; 2017 [updated 20 June 2017; cited 2018 3 May]. Available from: https://www.guild.org.au/about-us/about-the-guild.
7. Fielding JE. Public health in the twentieth century: Advances and challenges. Annu Rev Public Health. 1999;20(1):xiii-xxx.
8. Irvine L, Elliott L, Wallace H, Crombie IK. A review of major influences on current public health policy in developed countries in the second half of the 20th century. J R Soc Promot Health. 2006;126(2):73-8.
9. World Health Organization. Constitution of the World Health Organization [Internet]. Constitution. New York, USA: World Health Organization, International Health Conference; 1946 22 July. [cited 11 May 2018]. Available from: http://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1.
10. World Health Organization. Declaration of Alma-Ata [Internet]. Declaration. Geneva, Switzerland: World Health Organization, International Conference on Primary Health Care; 1978. [cited 11 May 2018]. Available from: http://www.who.int/publications/almaata_declaration_en.pdf.

11. World Health Organization. The Ottawa Charter for health promotion [Internet]. Charter. Ottawa, Canada: World Health Organization, First International Conference on Health Promotion; 1986. [cited 11 May 2018]. Available from: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/.

12. World Health Organization. The role of the pharmacist in the health care system [Internet]. Geneva, Switzerland: World Health Organization; 1994 [updated 22 August 2017; cited 2017 6 September]. Available from: http://apps.who.int/medicinedocs/en/d/Jh2995e/.

13. Mossialos E, Courtin E, Naci H, Benrimoj S, Bouvy M, Farris K, et al. From "retailers" to health care providers: Transforming the role of community pharmacists in chronic disease management. Health Policy. 2015;119(5):628-39. Available from doi: 10.1016/j.healthpol.2015.02.007.

14. Pharmacy Guild of Australia. Community Pharmacy Agreement [Internet]. Canberra, Australia: Pharmacy Guild of Australia; 2017 [updated 23 February 2017; cited 2017 15 March]. Available from: https://www.guild.org.au/migration/community-pharmacy-agreement.

15. The Conference Board of Canada. A review of pharmacy services in Canada and the health and economic evidence [Internet]. Report by Conference Board. Ottawa, Canada: Canadian Pharmacist Association; 2016. [cited 15 December 2017]. Available from: https://www.pharmacists.ca/cpha-ca/assets/File/cpha-on-the-issues/Pharmacy%20Services%20Report%201.pdf.

16. NHS England. Pharmacy [Internet]. Leeds, UK: NHS England; 2018 [updated 2018; cited 2018 21 June]. Available from: https://www.england.nhs.uk/commissioning/primary-care/pharmacy/.

17. Buss VH, Shield A, Kosari S, Naunton M. The impact of clinical services provided by community pharmacies on the Australian healthcare system: A review of the literature. Journal of Pharmaceutical Policy and Practice. 2018;11(1):22.

18. Buss VH, Shield A, Kosari S, Naunton M. Quality Use of the Pathology Data in Home Medicines Reviews: A Retrospective Evaluation. Ann Pharmacother. 2018;1(1):1060028018777547. Available from doi: 10.1177/1060028018777547.

19. Buss VH, Deeks L, Shield A, Kosari S, Naunton M. Analytical quality and effectiveness of point-of-care testing in community pharmacies: A systematic literature review. Research in Social and Administrative Pharmacy. 2018.

20. Toklu HZ, Hussain A. The changing face of pharmacy practice and the need for a new model of pharmacy education. J Young Pharm. 2013;5(2):38-40. Available from doi: 10.1016/j.jyp.2012.09.001.

21. World Health Organization. Assessing national capacity for the prevention and control of noncommunicable diseases: Report of the 2015 global survey [Internet]. Global Survey. Geneva, Switzerland: World Health Organization, Noncommunicable Diseases and Mental Health; 2016. [cited 14 March 2017]. Available from: http://www.who.int/chp/ncd-capacity/en/.

22. Stawicki S, Kalra S, Jones C, Justiniano C, Papadimos T, Galwankar S, et al. Comorbidity polypharmacy score and its clinical utility: A pragmatic practitioner's perspective. J Emerg Trauma Shock. 2015;8(4):224-31. Available from doi: 10.4103/0974-2700.161658.

23. Gnjidic D, Hilmer S, Blyth F, Naganathan V, Waite L, Seibel M, et al. Polypharmacy cutoff and outcomes: Five or more medicines were used to identify community-dwelling older men at risk of different adverse outcomes. J Clin Epidemiol. 2012;65(9):989-95. Available from doi: 10.1016/j.jclinepi.2012.02.018.

24. Hubbard R, Peel N, Scott I, Martin J, Smith A, Pillans P, et al. Polypharmacy among inpatients aged 70 years or older in Australia. Med J Aust. 2015;7(202):373-7. Available from doi: 10.5694/mja13.00172.

25. Reeve E, Wiese MD. Benefits of deprescribing on patients' adherence to medications. Int J Clin Pharm. 2014;36(1):26-9. Available from doi: 10.1007/s11096-013-9871-z.

26. Hamilton HJ, Gallagher PF, O'Mahony D. Inappropriate prescribing and adverse drug events in older people. BMC Geriatr. 2009;9(1):5. Available from doi: 10.1186/1471-2318-9-5.

27. World Health Organization. Adherence to long-term therapies: Evidence for action [Internet]. Critical Review. Geneva, Switzerland: World Health Organization, Noncommuniclable Diseases; 2003. [cited 14 March 2017]. Available from: http://apps.who.int/iris/bitstream/handle/10665/42682/9241545992.pdf;jsessionid=0AE0A0167E92B43F5C081F4941AC4061?sequence=1.

28. Roughead L, Semple S, Rosenfeld E. Literature review: Medication safety in Australia [Internet]. Literature review. Sydney, Australia: Quality Use of Medicines and Pharmacy Research Centre, Sansom Institute/University of South Australia; 2013. [cited 7 April 2018]. Available from: https://safetyandquality.gov.au/wp-content/uploads/2014/02/Literature-Review-Medication-Safety-in-Australia-2013.pdf.

29. Roughead EE, Semple SJ. Medication safety in acute care in Australia: Where are we now? Part 1: A review of the extent and causes of medication problems 2002–2008. Aust New Zealand Health Policy. 2009;6(1):18. Available from doi: 10.1186/1743-8462-6-18.

30. Cooper HM. Organizing knowledge syntheses: A taxonomy of literature reviews. Knowledge in society. 1988;1(1):104.

31. Baumeister RF, Leary MR. Writing narrative literature reviews. Rev Gen Psychol. 1997;1(3):311.

32. Valentijn PP, Schepman SM, Opheij W, Bruijnzeels MA. Understanding integrated care: A comprehensive conceptual framework based on the integrative functions of primary care. Int J Integr Care. 2013;13.

33. Starfield B. Primary care: Concept, evaluation, and policy. Oxford, UK: Oxford University Press; 1992. 280 p.

34. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank Q. 2005;83(3):457-502.

35. Pharmacy Guild of Australia. Programme specific guidelines pharmacy practice incentives (PPI) [Internet]. Guidelines. Canberra, Australia: Pharmacy Guild of Australia and Australian Government Department of Health, Australian Government; 2014. [cited 29 March 2017]. Available from: https://www.aci.health.nsw.gov.au/__data/assets/pdf_file/0003/212844/pharmacy-practice-incentives-program-specific-guidelines-october-2013.pdf.

36. Pharmaceutical Society of Australia. Guidelines for pharmacists providing medicines use review and diabetes medication management services [Internet]. Guidelines. Canberra, Australia: Pharmaceutical Society of Australia Ltd.; 2012. [cited 29 March 2017]. Available from: http://www.psa.org.au/download/ent/uploads/filebase/guidelines/3612-medscheck-guidelines-c.pdf.

37. Pharmaceutical Society of Australia. Standards and guidelines for pharmacists performing clinical interventions [Internet]. Guidelines. Canberra, Australia: Pharmaceutical Society of Australia Ltd.; 2011. [cited 29 March 2017]. Available from: https://www.psa.org.au/download/practice-guidelines/pharmacists-performing-clinical-interventions-guideline.pdf.

38. Williams M, Peterson GM, Tenni PC, Bindoff IK, Stafford AC. DOCUMENT: A system for classifying drug-related problems in community pharmacy. Int J Clin Pharm. 2012;34(1):43-52. Available from doi: 10.1007/s11096-011-9583-1.

39. The 6CPA. MedsCheck and Diabetes MedsCheck [Internet]. Canberra, Australia: The 6CPA; 2015 [updated 2017; cited 2017 15 March]. Available from: http://6cpa.com.au/medication-management-programmes/medscheck-diabetes-medscheck/.

40. Department of Health. Medication management reviews [Internet]. Canberra, Australia: Australian Government Department of Health; 2014 [updated 3 April 2014; cited 2017 15 March]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/medication_management_reviews.htm.

41. PricewaterhouseCoopers. Combined review 5CPA medication management programmes [Internet]. Review. Canberra, Australia: Australian Government; 2015. [cited 28 February 2017]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/content/6EF022DE87761986CA257EC80013198B/$File/combined-review-5cpa-medication-management-programmes-final-report-and-appendices.pdf.

42. Jokanovic N, Tan EC, Sudhakaran S, Kirkpatrick CM, Dooley MJ, Ryan-Atwood TE, et al. Pharmacist-led medication review in community settings: An overview of systematic reviews. Res Social Adm Pharm. 2017;13(4):661-85. Available from doi: 10.1016/j.sapharm.2016.08.005.

43. Pharmaceutical Society of Australia. Guidelines for pharmacists providing Home Medicines Review (HMR) services [Internet]. Guidelines. Canberra, Australia: Pharmaceutical Society of Australia Ltd.; 2011. [cited 14 November 2017]. Available from: https://www.psa.org.au/download/practice-guidelines/home-medicines-review-services.pdf.

44. Malek J. HMR and RMMR program changes. Aust Pharm. 2011;30(10):848-50.

45. Jokanovic N, Tan ECK, van den Bosch D, Kirkpatrick CM, Dooley MJ, Bell JS. Clinical medication review in Australia: A systematic review. Res Social Adm Pharm. 2016;12(3):384-418. Available from doi: 10.1016/j.sapharm.2015.06.007.

46. Chen TF. Pharmacist-led Home Medicines Review and Residential Medication Management Review: The Australian model. Drugs Aging. 2016;33(3):199-204. Available from doi: 10.1007/s40266-016-0357-2.

47. The 6CPA. Home Medicines Review [Internet]. Canberra, Australia: The 6CPA; 2015 [updated 2017; cited 2017 17 August]. Available from: http://6cpa.com.au/medication-management-programs/home-medicines-review/.

48. Naunton M, Peterson GM. Evaluation of home-based follow-up of high-risk elderly patients discharged from hospital. J Pharm Pract Res. 2003;33(3):176-82. Available from doi: 10.1002/jppr2003333176.

49. Schnipper JL, Kirwin JL, Cotugno MC, et al. Role of pharmacist counseling in preventing adverse drug events after hospitalization. Arch Intern Med. 2006;166(5):565-71. Available from doi: 10.1001/archinte.166.5.565.

50. Arnold ME, Buys L, Fullas F. Impact of pharmacist intervention in conjunction with outpatient physician follow-up visits after hospital discharge on readmission rate. Am J Health Syst Pharm. 2015;72(11 Supplement 1):S36-S42. Available from doi: 10.2146/sp150011.

51. The 6CPA. Important: 6CPA program changes from 1 July 2017 [Internet]. Canberra, Australia: The 6CPA; 2017 [updated 20 June 2017; cited 2017 18 August]. Available from: http://6cpa.com.au/2017/06/important-6cpa-program-changes-from-1-july-2017/.

52. Forouzanfar MH, Afshin A, Alexander LT, Anderson HR, Bhutta ZA, Biryukov S, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1659-724. Available from doi: 10.1016/S0140-6736(16)31679-8.

53. Saba M, Diep J, Saini B, Dhippayom T. Meta-analysis of the effectiveness of smoking cessation interventions in community pharmacy. J Clin Pharm Ther. 2014;39(3):240-7. Available from doi: 10.1111/jcpt.12131.

54. Brown TJ, Todd A, O'Malley C, Moore HJ, Husband AK, Bambra C, et al. Community pharmacy-delivered interventions for public health priorities: a systematic review of interventions for alcohol reduction, smoking cessation and weight management, including meta-analysis for smoking cessation. BMJ Open. 2016;6(2). Available from doi: 10.1136/bmjopen-2015-009828.

55. Greenhalgh E, Stillman S, Ford C. Pharmacotherapies. 2016 [cited 22 August 2017]. In: Tobacco in Australia: Facts and issues [Internet]. Melbourne, Australia: Cancer Council Australia, [cited 22 August 2017]. Available from: http://www.tobaccoinaustralia.org.au/chapter-7-cessation/7-16-pharmacotherapy

56. Pharmacy Guild of Australia. Vaccination services [Internet]. Canberra, Australia: The Pharmacy Guild of Australia; 2017 [updated 25 August 2017; cited 2017 26 August]. Available from: https://www.guild.org.au/programs/vaccination-services.

57. Burson RC, Buttenheim AM, Armstrong A, Feemster KA. Community pharmacies as sites of adult vaccination: A systematic review. Hum Vaccin Immunother. 2016;12(12):3146-59. Available from doi: 10.1080/21645515.2016.1215393.

58. Nissen L, Glass B, Lau E, Rosenthal M. Queensland pharmacist immunisation pilot phase 1 pharmacist vaccination - Influenza [Internet]. Final Report. Brisbane, Australia: Queensland University of Technology, Faculty of Health; 2015. [cited 6 April 2018]. Available from: https://eprints.qut.edu.au/91903/1/QPIP%20Final%20Report%202015%20.pdf.

59. Hattingh HL, Sim TF, Parsons R, Czarniak P, Vickery A, Ayadurai S. Evaluation of the first pharmacist-administered vaccinations in Western Australia: A mixed-methods study. BMJ Open. 2016;6(9). Available from doi: 10.1136/bmjopen-2016-011948.

60. National Health Priority Action Council. National chronic disease strategy [Internet]. National Strategy. Canberra, Australia: National Health Priority Action Council, Australian Government Department of Health and Ageing, Australian Government; 2006. [cited 15 March 2017]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/pq-ncds-strat.

61. Australian Institue of Health and Welfare. Cardiovascular disease, diabetes and chronic kidney disease - Australian facts: Prevalence and incidence [Internet]. National Report. Canberra, Australia: Australian Institue of Health and Welfare, Australian Government; 2014. Report No.: 2 [cited 15 March 2017]. Available from: https://www.aihw.gov.au/getmedia/9c59aad6-5f8d-4c31-847a-4c09b8540bad/17034-7jan2015.pdf.aspx.

62. Sabater-Hernández D, Sabater-Galindo M, Fernandez-Llimos F, Rotta I, Hossain LN, Durks D, et al. A systematic review of evidence-based community pharmacy services aimed at the prevention of cardiovascular disease. J Manag Care Spec Pharm. 2016;22(6):699-713. Available from doi: 10.18553/jmcp.2016.22.6.699.

63. Senna G, Caminati M, Bovo C, Canonica GW, Passalacqua G. The role of the pharmacy in the management of bronchial asthma: A literature-based evaluation. Ann Allergy Asthma Immunol. 2017;118(2):161-5. Available from doi: 10.1016/j.anai.2016.10.019.

64. Garcia-Cardenas V, Armour C, Benrimoj SI, Martinez-Martinez F, Rotta I, Fernandez-Llimos F. Pharmacists' interventions on clinical asthma outcomes: A systematic review. Eur Respir J. 2016;47(4):1134-43. Available from doi: 10.1183/13993003.01497-2015.

65. Nkansah N, Mostovetsky O, Yu C, Chheng T, Beney J, Bond CM, et al. Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns. Cochrane Database Syst Rev. 2010. Available from doi: 10.1002/14651858.CD000336.pub2.

66. Hattingh HL, Scahill S, Fowler JL, Wheeler AJ. Exploring an increased role for Australian community pharmacy in mental health professional service delivery: Evaluation of the literature. J Ment Health. 2016;25(6):550-9. Available from doi: 10.3109/09638237.2015.1101418.

67. Health Outcomes International Pty Ltd. Return on investment in needle and syringe programs in Australia [Internet]. Economic Effectiveness Report. Canberra, Australia: Department of Health and Ageing, Australian Government; 2002. Report No.: 3122 [cited 22 August 2017]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/content/1648E8A63A1518AFCA257BF0001B0AA4/$File/roirep.pdf.

68. Gowing L, Ali R, Dunlop A, Farrell M, Lintzeris N. National guidelines for medication-assisted treatment of opioid dependence [Internet]. National Guideline. Canberra, Australia: Department of Health, Australian Government; 2014. [cited 14 March 2017]. Available from: http://www.nationaldrugstrategy.gov.au/internet/drugstrategy/Publishing.nsf/content/AD14DA97D8EE00E8CA257CD1001E0E5D/$File/National_Guidelines_2014.pdf.

69. MacArthur GJ, van Velzen E, Palmateer N, Kimber J, Pharris A, Hope V, et al. Interventions to prevent HIV and Hepatitis C in people who inject drugs: A review of reviews to assess evidence of effectiveness. Int J Drug Policy. 2014;25(1):34-52. Available from doi: 10.1016/j.drugpo.2013.07.001.

70. Pricolo A, Nielsen S. Naloxone rescheduling in Australia: Processes, implementation and challenges with supply of naloxone as a 'pharmacist only' over-the-counter medicine. Drug Alcohol Rev. 2017. Available from doi: 10.1111/dar.12547.

71. Willis A, Rivers P, Gray LJ, Davies M, Khunti K. The effectiveness of screening for diabetes and cardiovascular disease risk factors in a community pharmacy setting. PLoS One. 2014;9(4):e91157. Available from doi: 10.1371/journal.pone.0091157.

72. Roberts A, Benrimoj S, Chen T, Williams K, Aslani P. Practice change in community pharmacy: Quantification of facilitators. Ann Pharmacother. 2008;42(6):861-8. Available from doi: 10.1345/aph.1K617.

73. Rosenthal M, Austin Z, Tsuyuki RT. Are pharmacists the ultimate barrier to pharmacy practice change? Can Pharm J (Ott). 2010;143(1):37-42. Available from doi: 10.3821/1913-701X-143.1.37.

74. Eades CE, Ferguson JS, O'Carroll RE. Public health in community pharmacy: A systematic review of pharmacist and consumer views. BMC Public Health. 2011;11:582. Available from doi: 10.1186/1471-2458-11-582.

75. Goldwater J, Yuhasz L. Considerations for clinical integration [Internet]. Insight Paper. Michigan, USA: IBM Watson Health; 2011. [cited 24 May 2018]. Available from: https://truvenhealth.com/portals/0/assets/HOSP_11363_0712_ClinicalIntegration_WP_Web.pdf.

76. Hossain LN, Fernandez-Llimos F, Luckett T, Moullin JC, Durks D, Franco-Trigo L, et al. Qualitative meta-synthesis of barriers and facilitators that influence the implementation of community pharmacy services: perspectives of patients, nurses and general medical practitioners. BMJ Open. 2017;7(9). Available from doi: 10.1136/bmjopen-2016-015471.

77. Supper I, Catala O, Lustman M, Chemla C, Bourgueil Y, Letrilliart L. Interprofessional collaboration in primary health care: A review of facilitators and barriers perceived by involved actors. J Public Health (Oxf). 2015;37(4):716-27. Available from doi: 10.1093/pubmed/fdu102.

78. Mulvale G, Embrett M, Razavi SD. 'Gearing Up' to improve interprofessional collaboration in primary care: A systematic review and conceptual framework. BMC Fam Pract. 2016;17(1):83. Available from doi: 10.1186/s12875-016-0492-1.

79. Ryan R, Santesso N, Lowe D, Hill S, Grimshaw J, Prictor M, et al. Interventions to improve safe and effective medicines use by consumers: An overview of systematic reviews. Cochrane Database Syst Rev. 2014. Available from doi: 10.1002/14651858.CD007768.pub3.

80. Tan ECK, Stewart K, Elliott RA, George J. Pharmacist services provided in general practice clinics: A systematic review and meta-analysis. Res Social Adm Pharm. 2014;10(4):608-22. Available from doi: 10.1016/j.sapharm.2013.08.006.

81. Hazen ACM, de Bont AA, Boelman L, Zwart DLM, de Gier JJ, de Wit NJ, et al. The degree of integration of non-dispensing pharmacists in primary care practice and the

impact on health outcomes: A systematic review. Res Social Adm Pharm. 2018;14(3):228-40. Available from doi: 10.1016/j.sapharm.2017.04.014.

82. Leutz WN. Five laws for integrating medical and social services: Lessons from the United States and the United Kingdom. Milbank Q. 1999;77(1):77-110. Available from doi: 10.1111/1468-0009.00125.

83. Ahgren B, Axelsson R. Evaluating integrated health care: A model for measurement. Int J Integr Care. 2005;5:e01.

84. Hernandez SR. Horizontal and vertical healthcare integration: Lessons learned from the United States. Healthc Pap. 2000;1(2):59-65.

85. Chui MA, Mott DA, Maxwell L. A qualitative assessment of a community pharmacy cognitive pharmaceutical services program, using a work system approach. Res Social Adm Pharm. 2012;8(3):206-16. Available from doi: 10.1016/j.sapharm.2011.06.001.

86. Emerson L. PSA roadshow launches health destination pharmacy. Aust Pharm. 2016;35(5):15.

87. Pharmaceutical Society of Australia. Why - Give your pharmacy the plus factor [Internet]. Canberra, Australia: Pharmaceutical Society of Australia; 2018 [updated 2018; cited 2018 12 June]. Available from: www.healthdestinationpharmacy.com.au/why/.

88. Emerson L. A ground-breaking year and exciting times ahead. Aust Pharm. 2017;36(1):8-10.

89. PCNE working group Medication Review. Position paper on the PCNE definition of medication review 2016 [Internet]. Position Paper. Zuidlaren, Netherlands: Pharmaceutical Care Network Europe, PCNE working group Medication Review; 2016. [cited 14 December 2017]. Available from: http://www.pcne.org/upload/files/149_Position_Paper_on_PCNE_Medication_Review_final.pdf.

90. Pharmaceutical Society of Australia. Guidelines for pharmacists providing Residential Medication Management Review (RMMR) and Quality Use of Medicines (QUM) services [Internet]. Guidelines. Canberra, Australia: Pharmaceutical Society of Australia Ltd.; 2011. [cited 1 February 2018]. Available from: http://www.psa.org.au/download/practice-guidelines/rmmr-and-qum-services.pdf.

91. Raebel MA, Lyons EE, Andrade SE, Chan KA, Chester EA, Davis RL, et al. Laboratory monitoring of drugs at initiation of therapy in ambulatory care. J Gen Intern Med. 2005;20(12):1120-6. Available from doi: 10.1111/j.1525-1497.2005.0257.x.

92. Gurwitz JH, Field TS, Harrold LR, et al. Incidence and preventability of adverse drug events among older persons in the ambulatory setting. JAMA. 2003;289(9):1107-16. Available from doi: 10.1001/jama.289.9.1107.

93. Bayram C. Evaluation of pathology ordering by general practitioners in Australia [Doctor of Philosophy]. Sydney, Australia: University of Sydney; 2013.

94. Weaver K. Collaborative practice agreements vary among the states [Internet]. Washington, US: American Pharmacists Association; 2013 [updated 19 February 2013; cited 2017 15 December]. Available from: http://www.pharmacist.com/collaborative-practice-agreements-vary-among-states.

95. Haggan M. Doctors cheer as Amcal pathology scrapped [Internet]. Sydney, Australia: Australian Journal of Pharmacy; 2017 [updated 7 July 2017; cited 2017 15 December]. Available from: https://ajp.com.au/news/doctors-cheer-amcal-pathology-scrapped/.

96. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, 3rd, Feldman HI, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150(9):604-12.

97. The Royal Australian College of General Practitioners. General practice management of type 2 diabetes: 2016-2018 [Internet]. Guidelines. Melbourne, Australia: The Royal Australian College of General Practitioners; 2016. [cited 4 August 2017]. Available from: https://static.diabetesaustralia.com.au/s/fileassets/diabetes-australia/5d3298b2-abf3-487e-9d5e-0558566fc242.pdf.

98. LeFevre ML, LeFevre NM. Vitamin D screening and supplementation in community-dwelling adults: Common questions and answers. Am Fam Physician. 2018;97(4):254-60.

99. Langan RC, Goodbred AJ. Vitamin B 12 deficiency: Recognition and management. Am Fam Physician. 2017;96(6):384-9.

100. Johnson DW, Atai E, Chan M, Phoon RK, Scott C, Toussaint ND, et al. KHA-CARI Guideline: Early chronic kidney disease: Detection, prevention and management. Nephrology (Carlton). 2013;18(5):340-50. Available from doi: 10.1111/nep.12052.

101. The Royal Australian College of General Practitioners. Guidelines for preventive activities in general practice 9th edition [Internet]. Guidelines Melbourne, Australia: The

Royal Australian College of General Practitioners; 2016. [cited 4 August 2017]. Available from: https://www.racgp.org.au/download/Documents/Guidelines/Redbook9/17048-Red-Book-9th-Edition.pdf.

102. The Royal College of Pathologists of Australasia. Thyroid function testing for adult diagnosis and monitoring [Internet]. Position Statement. Sydney, Australia: The Royal College of Pathologists of Australasia; 2017. Report No.: 1/2017 [cited 4 August 2017]. Available from: https://www.rcpa.edu.au/getattachment/7bed9076-bcd5-44ac-9d12-ed9a1f69852a/Thyroid-Function-Testing-for-Adult-Diagnosis-and-M.aspx.

103. Smellie W, Forth J, Smart S, Galloway M, Irving W, Bareford D, et al. Best practice in primary care pathology: Review 7. J Clin Pathol. 2007;60(5):458. Available from doi: 10.1136/jcp.2006.042994.

104. Pit SW, Byles JE, Cockburn J. Medication review: Patient selection and general practitioner's report of drug-related problems and actions taken in elderly Australians. J Am Geriatr Soc. 2007;55(6):927-34. Available from doi: 10.1111/j.1532-5415.2007.01181.x.

105. Patel HR, Pruchnicki MC, Hall LE. Assessment for chronic kidney disease service in high-risk patients at community health clinics. Ann Pharmacother. 2005;39(1):22-7. Available from doi: 10.1345/aph.1E269.

106. Barnes KD, Tayal NH, Lehman AM, Beatty SJ. Pharmacist-driven renal medication dosing intervention in a primary care patient-centered medical home. Pharmacotherapy. 2014;34(12):1330-5. Available from doi: 10.1002/phar.1508.

107. Nishtala PS, McLachlan AJ, Bell JS, Chen TF. A retrospective study of drug-related problems in Australian aged care homes: Medication reviews involving pharmacists and general practitioners. J Eval Clin Pract. 2011;17(1):97-103. Available from doi: 10.1111/j.1365-2753.2010.01374.x.

108. Zhao J, Zeng X, Wang J, Liu L. Association between calcium or vitamin d supplementation and fracture incidence in community-dwelling older adults: A systematic review and meta-analysis. JAMA. 2017;318(24):2466-82. Available from doi: 10.1001/jama.2017.19344.

109. Maple-Brown LJ, Hughes JT, Lawton PD, Jones GRD, Ellis AG, Drabsch K, et al. Accurate assessment of kidney function in Indigenous Australians: The estimated GFR study. Am J Kidney Dis. 2012;60(4):680-2. Available from doi: 10.1053/j.ajkd.2012.07.001.

110. Penrose-Wall J, Bell S, Whitehead P, Asani P, McLachlan D, Chen T. Case conferences and care plans: Collaboration between community pharmacists and GPs [Internet]. Final Report. Sydney, Australia: University of Sydney, Faculty of Pharmacy; 2004. Report No.: 2001:064 [cited 16 April 2018]. Available from: http://6cpa.com.au/wp-content/uploads/Case-conferences-and-care-planning-Collaboration-between-community-pharmacists-and-general-practitioners-final-report-.pdf.

111. Pharmacy Guild of Australia. My Health Record [Internet]. Canberra, Australia: The Pharmacy Guild of Australia; 2018 [updated 30 January 2018; cited 2018 8 February]. Available from: https://www.guild.org.au/resources/ehealth/my-health-record.

112. Luppa PB, Müller C, Schlichtiger A, Schlebusch H. Point-of-care testing (POCT): Current techniques and future perspectives. Trends Analyt Chem. 2011;30(6):887-98. Available from doi: 10.1016/j.trac.2011.01.019.

113. Kjome RLS, Nerhus K, Sandberg S. Implementation of a method for glucose measurements in community pharmacies. Int J Pharm Pract. 2010;18(1):13-9. Available from doi: 10.1211/ijpp.18.01.0004.

114. Zaninotto M, Miolo G, Guiotto A, Marton S, Plebani M. Quality performance of laboratory testing in pharmacies: A collaborative evaluation. Clin Chem Lab Med. 2016;54(11):1745-51. Available from doi: 10.1515/cclm-2016-0104.

115. Geerts AF, De Koning FH, De Vooght KM, Egberts AC, De Smet PA, van Solinge WW. Feasibility of point-of-care creatinine testing in community pharmacy to monitor drug therapy in ambulatory elderly patients. J Clin Pharm Ther. 2013;38(5):416-22. Available from doi: 10.1111/jcpt.12081.

116. Camacho-Ryan O, Bertholf RL. Monitoring point-of-care testing compliance [Internet]. Washington, USA: American Association for Clinical Chemistry; 2016 [updated 1 February 2016; cited 2017 4 August]. Available from: https://www.aacc.org/publications/cln/articles/2016/february/monitoring-point-of-care-testing-compliance.

117. St John A. The evidence to support point-of-care testing. Clin Biochem Rev. 2010;31(3):111-9.

118. Akinwale TP, Adams AJ, Dering-Anderson AM, Klepser ME. Pharmacy-based point-of-care testing for infectious diseases: Considerations for the pharmacy curriculum. Curr Pharm Teach Learn. 2015;7(1):131-6. Available from doi: 10.1016/j.cptl.2014.09.005.

119. Thornley T, Marshall G, Howard P, Wilson APR. A feasibility service evaluation of screening and treatment of group A streptococcal pharyngitis in community pharmacies. J Antimicrob Chemother. 2016;71(11):3293-9.

120. Urwin H, Wright D, Twigg M, McGough N. Early recognition of coeliac disease through community pharmacies: A proof of concept study. Int J Clin Pharm. 2016;38(5):1294-300. Available from doi: 10.1007/s11096-016-0368-4.

121. Papastergiou J, Folkins C, Li W, Young L. Community pharmacy rapid influenza A and B screening: A novel approach to expedite patient access to care and improve clinical outcomes. Can Pharm J (Ott). 2016;149(2):83-9. Available from doi: 10.1177/1715163516629157.

122. Kugelmas M, Pedicone LD, Lio I, Simon S, Pietrandoni G. Hepatitis C point-of-care screening in retail pharmacies in the United States. Gastroenterol Hepatol (N Y). 2017;13(2):98-104.

123. Weidle PJ, Lecher S, Botts LW, Jones LD, Spach DH, Alvarez J, et al. HIV testing in community pharmacies and retail clinics: A model to expand access to screening for HIV infection. J Am Pharm Assoc (2003). 2014;54(5):486-92. Available from doi: 10.1331/JAPhA.2014.14045.

124. Shaw JLV. The dark side of point-of-care testing. Clin Biochem. 2017;50(9):466-7. Available from doi: 10.1016/j.clinbiochem.2017.03.003.

125. Kettler H, White K, Hawkes SJ. Mapping the landscape of diagnostics for sexually transmitted infections: Key findings and recommendations [Internet]. Key findings. Geneva, Switzerland: World Health Organization, Special Programme for Research and Training in Tropical Diseases; 2004. Report No.: TDR/STI/IDE/04.1 [cited 4 August 2017]. Available from: http://www.who.int/tdr/publications/documents/mapping-landscape-sti.pdf.

126. U.S. Food and Drug Administration. Clinical Laboratory Improvement Amendments (CLIA) [Internet]. Silver Spring, USA: U.S. Food and Drug Administration; 2018 [updated 22 March 2018; cited 2018 24 May]. Available from: https://www.fda.gov/medicaldevices/deviceregulationandguidance/ivdregulatoryassistance/ucm124105.htm.

127. Cowling T, Dolcine B. Point-of-care testing [Internet]. Review. Ottawa, Canada: Canadian Agency for Drugs and Technologies in Health; 2017. Report No.: 65 [cited 24 May 2018]. Available from: https://cadth.ca/sites/default/files/pdf/es0308_point_of_care_testing.pdf.

128. European Commission. Regulatory framework [Internet]. Brussels, Belgium: European Commission; 2017 [updated 24 May 2018; cited 2018 24 May]. Available from: https://ec.europa.eu/growth/sectors/medical-devices/regulatory-framework_en.

129. National Pathology Accreditation Advisory Council. Guidelines for point of care testing [Internet]. Canberra, Australia: Commonwealth of Australia, Department of Health; 2015. [cited 24 May 2018]. Available from: https://www.health.gov.au/internet/main/publishing.nsf/Content/35DE5FC4786CBB33CA257EEB007C7BF2/$File/Guidelines%20PoCT%201st%20Ed%202015.pdf.

130. Taverniers I, De Loose M, Van Bockstaele E. Trends in quality in the analytical laboratory. II. Analytical method validation and quality assurance. Trends Analyt Chem. 2004;23(8):535-52 (p.6). Available from doi: 10.1016/j.trac.2004.04.001.

131. James JE. Reviving Cochrane's contribution to evidence-based medicine: bridging the gap between evidence of efficacy and evidence of effectiveness and cost-effectiveness. Eur J Clin Invest. 2017;47(9):617-21 (p. 9). Available from doi: 10.1111/eci.12782.

132. Hurst J, Nickel K, Hilborne LH. Are physicians' office laboratory results of comparable quality to those produced in other laboratory settings? JAMA. 1998;279(6):468-71. Available from doi: 10.1001/jama.279.6.468.

133. Stull TM, Hearn TL, Hancock JS, Handsfield JH, Collins CL. Variation in proficiency testing performance by testing site. JAMA. 1998;279(6):463-7. Available from doi: 10.1001/jama.279.6.463.

134. Jenny RW, Jackson-Tarentino KY. Causes of unsatisfactory performance in proficiency testing. Clin Chem. 2000;46(1):89-99.

135. Cembrowski GS, Carey RN. Adding Value to Proficiency Testing Programs. Clin Chem. 2000;46(1):7-8.

136. Plebani M. Errors in clinical laboratories or errors in laboratory medicine? Clin Chem Lab Med. 2006;44(6):750-9. Available from doi: 10.1515/CCLM.2006.123.

137. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Med. 2009;6(7):e1000097. Available from doi: 10.1371/journal.pmed.1000097.

138. International Organization for Standardization. ISO 22870:2016(en): Point-of-care testing (POCT) - requirements for quality and competence. 2016. In: ISO Online Browsing Platform [Internet]. Geneva, Switzerland: International Organization for

Standardization. Available from: http://www.iso.org/obp/ui/#iso:std:iso:22870:ed-2:v1:en.

139. Currie MJ, Deeks LS, Cooper GM, Martin SJ, Parker RM, Del Rosario R, et al. Community pharmacy and cash reward: A winning combination for chlamydia screening? Sex Transm Infect. 2013;89(3):212-6. Available from doi: 10.1136/sextrans-2011-050357.

140. Anderson C, Thornley T. A pharmacy-based private chlamydia screening programme: Results from the first 2 years of screening and treatment. Int J Clin Pharm. 2011;33(1):88-91. Available from doi: 10.1007/s11096-010-9460-3.

141. Higgings JP, Altman DG, Sterne JA. Chapter 8: Assessing risk of bias in included studies. 2011. In: Cochrane Handbook for Systematic Reviews of Interventions, Version 510 (updated March 2011) [Internet]. London, UK: The Cochrane Collaboration. Available from: www.handbook.cochrane.org.

142. Sterne JA, Hernán MA, Reeves BC, Savović J, Berkman ND, Viswanathan M, et al. ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016;355. Available from doi: 10.1136/bmj.i4919.

143. Reitsma J, Rutjes A, Whiting P, Vlassov V, Leeflang M, Deeks J. Chapter 9: Assessing methodological quality. 2009. In: Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy, Version 100 [Internet]. London, UK: The Cochrane Collaboration. Available from: http://srdta.cochrane.org/.

144. Harrison J, Shaw JP, Harrison JE. Anticoagulation management by community pharmacists in New Zealand: An evaluation of a collaborative model in primary care. Int J Pharm Pract. 2015;23(3):173-81. Available from doi: 10.1111/ijpp.12148.

145. Jackson SL, Peterson GM, Bereznicki LR, Misan GM, Jupe ML, Vial JH. Improving the outcomes of anticoagulation in rural Australia: An evaluation of pharmacist-assisted monitoring of warfarin therapy. J Clin Pharm Ther. 2005;30(4):345-53. Available from doi: 10.1111/j.1365-2710.2005.00656.x.

146. Wilson SJA, MacLellan E, Cox JL, Meek W, Monette K, Morash T, et al. A pilot study evaluating the feasibility of monitoring oral anticoagulant therapy with point-of-care testing in a community pharmacy. Can J Hosp Pharm. 2004;57(3):158-64.

147. Mifsud EM, Azzopardi LM, Serracino-Inglott A. Proposing a framework for international normalized ratio testing and anticoagulation management in community pharmacies. Point Care. 2014;13(4):125-7. Available from doi: 10.1097/POC.0000000000000038.

148. du Plessis M, Ubbink JB, Vermaak WJ. Analytical quality of near-patient blood cholesterol and glucose determinations. Clin Chem. 2000;46(8 Pt 1):1085-90.

149. Tsuyuki R, Johnson J, Teo K, Simpson S, Ackman M, Biggs R, 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(10):1149-55. Available from doi: 10.1001/archinte.162.10.1149

150. Yuksel N, Majumdar SR, Biggs C, Tsuyuki RT. Community pharmacist-initiated screening program for osteoporosis: Randomized controlled trial. Osteoporos Int. 2010;21(3):391-8. Available from doi: 10.1007/s00198-009-0977-z.

151. Represas-Represas C, Fernandez-Villar A, Ruano-Ravina A, Priegue-Carrera A, Botana-Rial M. Screening for chronic obstructive pulmonary disease: Validity and reliability of a portable device in non-specialized healthcare settings. PLoS One. 2016;11(1):e0145571. Available from doi: 10.1371/journal.pone.0145571.

152. Fernández-Balbuena S, Marcos H, Pérez-Rubio A, Hoyos J, Belza MJ, de la Fuente L. The rapid test in Spanish pharmacies: a novel programme to reach heterosexual men? HIV Med. 2015;16(6):362-9. Available from doi: 10.1111/hiv.12224.

153. Esteban-Vasallo MD, Morán-Arribas M, García-Riolobos C, Domínguez-Berjón MF, Rico-Bermejo J, Collado-González S, et al. Targeted rapid HIV testing in public primary care services in Madrid. Are we reaching the vulnerable populations? Int J Infect Dis. 2014;19:39-45. Available from doi: 10.1016/j.ijid.2013.10.006.

154. Hoyos J, de la Fuente L, Fernández S, Gutiérrez J, Rosales ME, de Olalla PG, et al. La oferta de la prueba rápida del VIH en la calle dentro del ámbito universitario:¿ Una estrategia prioritaria? Gac Sanit. 2012;26(2):131-7. Available from doi: 10.1016/j.gaceta.2011.07.009.

155. Carey M, Markham C, Gaffney P, Boran G, Maher V. Validation of a point of care lipid analyser using a hospital based reference laboratory. Ir J Med Sci. 2006;175(4):30-5.

156. Ungaro S, Wirth F, Azzopardi LM, Serracino-Inglott A. Point-of-care testing for urine analysis and microalbuminuria for diabetic patient management. Point Care. 2015;14(3):71-2. Available from doi: 10.1097/POC.0000000000000055.

157. Shaw J, Harrison J, Harrison J. A community pharmacist-led anticoagulation management service: Attitudes towards a new collaborative model of care in New Zealand. Int J Pharm Pract. 2014;22(6):397-406. Available from doi: 10.1111/ijpp.12097.

158. Hohmeier KC, Loomis B, Gatwood J. Consumer perceptions of and willingness-to-pay for point-of-care testing services in the community pharmacy. Res Social Adm Pharm. 2017;14(4):360-6. Available from doi: 10.1016/j.sapharm.2017.04.011.

159. Agius A, Azzopardi L, Inglott SA. Faecal occult blood testing in community pharmacy. Int J Pharm Pract. 2012;20(Supplement 2):61-2.

160. Morrissey H, Ball P, Jackson D, Pilloto L, Nielsen S. Viability and sustainability of pharmacist input in chronic disease management in rural Australia. J Pharm Pract Res. 2015;45(3):262-71. Available from doi: 10.1002/jppr.1089.

161. Smith MG, Ferreri SP. A model to inform community pharmacy's collaboration in outpatient care. Res Social Adm Pharm. 2016;12(3):529-34. Available from doi: 10.1016/j.sapharm.2015.07.005.

162. Klepser DG, Klepser ME, Smith JK, Dering-Anderson AM, Nelson M, Pohren LE. Utilization of influenza and streptococcal pharyngitis point-of-care testing in the community pharmacy practice setting. Res Social Adm Pharm. 2018;14(4):356–9. Available from doi: 10.1016/j.sapharm.2017.04.012.

163. Wilson SJ-A, Wells PS, Kovacs MJ, Lewis GM, Martin J, Burton E, et al. Comparing the quality of oral anticoagulant management by anticoagulation clinics and by family physicians: A randomized controlled trial. Can Med Assoc J. 2003;169(4):293-8.

164. Westgard JO. Quality planning and control strategies [Internet]. Brønshøj, Denmark: Radiometer Medical ApS; 2001 [cited 2018 1 June]. Available from: https://acutecaretesting.org/en/articles/quality-planning-and-control-strategies.

165. Laurence C, Gialamas A, Yelland L, Bubner T, Ryan P, Willson K, et al. A pragmatic cluster randomised controlled trial to evaluate the safety, clinical effectiveness, cost effectiveness and satisfaction with point of care testing in a general practice setting – rationale, design and baseline characteristics. Trials. 2008;9(1):50. Available from doi: 10.1186/1745-6215-9-50.

166. Shephard M, Shephard A, Watkinson L, Mazzachi B, Worley P. Design, implementation and results of the quality control program for the Australian government's point of care testing in general practice trial. Ann Clin Biochem. 2009;46(5):413-9. Available from doi: 10.1258/acb.2009.009045.

167. Holt H, Freedman DB. Internal quality control in point-of-care testing: Where's the evidence? Ann Clin Biochem. 2016;53(2):233-9. Available from doi: 10.1177/0004563215615148.

168. Lippi G, Plebani M, Favaloro EJ, Trenti T. Laboratory testing in pharmacies. Clin Chem Lab Med. 2010;48(7):943-53. Available from doi: 10.1515/cclm.2010.184.

169. Latif A, Pollock K, Anderson C, Waring J, Solomon J, Chen LC, et al. Supporting underserved patients with their medicines: a study protocol for a patient/professional coproduced education intervention for community pharmacy staff to improve the provision and delivery of Medicine Use Reviews (MURs). BMJ Open. 2016;6(12):e013500. Available from doi: 10.1136/bmjopen-2016-013500.

170. McMillan SS, Wheeler AJ, Sav A, King MA, Whitty JA, Kendall E, et al. Community pharmacy in Australia: A health hub destination of the future. Res Social Adm Pharm. 2013;9(6):863-75. Available from doi: 10.1016/j.sapharm.2012.11.003.

171. Rossiter J, Soor G, Telner D, Aliarzadeh B, Lake J. A pharmacist-led point-of-care INR clinic: Optimizing care in a family health team setting. Int J Family Med. 2013;2013:4. Available from doi: 10.1155/2013/691454.

172. Gerrald KR, Dixon DL, Barnette DJ, Williams VG. Evaluation of a pharmacist-managed lipid clinic that uses point-of-care lipid testing. J Clin Lipidol. 2010;4(2):120-5. Available from doi: 10.1016/j.jacl.2010.02.001.

173. Tideman PA, Tirimacco R, St John A, Roberts GW. How to manage warfarin therapy. Aust Prescr. 2015;38(2):44.

174. Stafford L, Peterson GM, Bereznicki LR, Jackson SL, van Tienen EC, Angley MT, et al. Clinical outcomes of a collaborative, home-based postdischarge warfarin management service. Ann Pharmacother. 2011;45(3):325-34. Available from doi: 10.1345/aph.1P617.

175. Heringa M, Floor-Schreudering A, De Smet PAGM, Bouvy ML. Clinical decision support and optional point of care testing of renal function for safe use of antibiotics in elderly patients: A retrospective study in community pharmacy practice. Drugs Aging. 2017;34(11):851-8. Available from doi: 10.1007/s40266-017-0497-z.

176. International Pharmaceutical Federation. FIP statement of policy point of care testing in pharmacies [Internet]. Policy Statement. The Hague, Netherlands: International Pharmaceutical Federation; 2004. [cited 27 May 2018]. Available from: https://www.fip.org/www/uploads/database_file.php?id=161&table_id=.

177. St John A, Price CP. Economic evidence and point-of-care testing. Clin Biochem Rev. 2013;34(2):61-74.

178. World Health Organization. Framework on integrated, people-centred health services [Internet]. Report by Secretariat. Geneva, Switzerland: World Health Organization, Secretariat; 2016. [cited 3 June 2018]. Available from: http://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_39-en.pdf?ua=1.

179. American College of Physicians. Patient-centered medical home [Internet]. Philadelphia, USA: American College of Physicians; 2018 [updated 2018; cited 2018 21 June]. Available from: https://www.acponline.org/practice-resources/business-resources/payment/models/patient-centered-medical-home.

180. Erickson S, Hambleton J. A pharmacy's journey toward the patient-centered medical home. J Am Pharm Assoc (2003). 2011;51(2):156-60. Available from doi: 10.1331/JAPhA.2011.10181.

181. The 6CPA. Community pharmacy in health care homes [Internet]. Canberra, Australia: The 6CPA; 2018 [updated 2018; cited 2018 22 June]. Available from: http://6cpa.com.au/medication-management-programs/community-pharmacy-in-health-care-homes/.

182. Media release - My Health Record opt out date announced [press release]. Canberra, Australia: Australian Government Australian Digital Health Agency, 14 May 2018.

183. Australian Digital Health Agency. My Health Record statistics Canberra, Australia: Australian Government Digital Health Agency; 2018 [updated 27 May 2018; cited 2018 5 June]. Available from: https://www.myhealthrecord.gov.au/about/my-health-record-statistics.

Appendix

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REVIEW Open Access

The impact of clinical services provided by community pharmacies on the Australian healthcare system: a review of the literature

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Abstract

Background: In Australia, community pharmacists are increasingly being integrated into the healthcare system. A range of services in pharmacies are government-funded aiming to prevent chronic diseases and improve the quality use of medicines. The objective of this narrative review is to evaluate the impact of existing pharmacy services and identify opportunities to better address the patients' needs.

Methods: A narrative review was undertaken. First, Community Pharmacy Agreement documents between the Australian government and the Pharmacy Guild of Australia were reviewed to identify relevant community pharmacy services. Based on these, a literature search was conducted via PubMed and Google Scholar. The included articles were analysed and a proposal for further improvement of the programmes was developed.

Results: Overall, five areas of community pharmacy interventions were identified: clinical interventions, medication reviews, health promotion, screening and management of chronic diseases, and support services for drug addiction. Pharmacists' interventions have led to improved asthma control, detection of diabetes and cardiovascular risk factors, reduction in smoking rates and weight, and identification of drug-related problems. The availability of vaccination services in pharmacies has contributed to increased vaccination rates. Through support programmes for drug abusers the transmission rate of blood-borne diseases was decreased. Factors that facilitate community pharmacy interventions are skilled staff, remuneration, a designated area in the pharmacy, and good relationships between health professionals. The main barriers are patients' unawareness of existing programmes, pharmacists' lack of confidence and time, and physicians' lack of involvement. To achieve integrated care for patients, the individual services should be better combined, starting with low intensity interventions and proceeding to in-depth services if required.

Discussion: Community pharmacies are well located to deliver healthcare services due to convenience and accessibility. The range of services offered by community pharmacies is comprehensive. Despite this, the clinical interventions provided in pharmacies currently appear not to be coordinated. This leads to the proposal that more efforts should be put into linking the individual services.

Conclusion: There is sufficient evidence for the effectiveness of most of the pharmacy services reviewed. However, the potential of the individual services might be further enhanced by interlinking the services and better integrating them with the patient care provided by GPs and other health professionals.

Keywords: Community pharmacy, Healthcare services, Chronic diseases, Medication review, Australia

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Background

Traditionally, the role of community pharmacists was to source, manufacture, and dispense medication [1]. Over the past decades, this role has shifted towards more active engagement in disease management through extended clinical roles [2]. The change in policy began in the 1990s when healthcare systems were challenged by increased prevalence of chronic diseases [2]. Non-communicable diseases have become the main cause of death worldwide [3]. Patients suffer from chronic diseases and their co-morbidities, which in turn leads to polypharmacy [4]; the term *polypharmacy* describes the intake of five or more medications per day [5]. Polypharmacy has a prevalence of approximately 75% among Australian elderly [6], and independently increases the risks of non-adherence [7] and drug-related problems (DRP) [8]. Both non-adherence and DRP result in poor health outcomes and increased healthcare costs [8, 9]. The World Health Organization (WHO) estimates that every second person in developed countries who takes long-term medication is non-adherent [9]. Drug-related problems are responsible for 2–3% of the hospital admissions in Australia causing annual costs of approximately $1.2 million Australian dollars [10]. It is estimated that half of these hospitalisations is preventable [11].

The Pharmacy Guild of Australia is the professional organisation representing Australian pharmacy-owners [12]. Since 1990, the Guild has negotiated with the Department of Health every five years to determine which health services are to be provided by community pharmacies and reimbursed by the Australian government; these agreements are called Community Pharmacy Agreement (CPA) [13]. There is a component of research funding attached to these agreements [13]. This narrative review focuses on existing community pharmacy interventions in Australia. The main aims are to evaluate the effectiveness of the interventions, to identify barriers and facilitators, and, finally, to derive implications for improving the delivery of the services.

Methods

This narrative review followed methodological consideration as outlined by Cooper [14] and Baumeister and Leary [15]. Cooper introduced a taxonomy for literature reviews with six characteristics [14]; these were applied to this review to provide the framework outlined in Table 1.

First, the guidelines and rules of the 5th and 6th CPA were reviewed to identify priority areas. For the different pharmacy services, the guidelines provided by the Australian government or pharmacy organisations were reviewed. The search terms for the literature search were selected based on the identified priority areas ("clinical interventions", "medication review", "Home Medicines Review", "MedsCheck AND Australia", "health promotion", "smoking cessation", "weight management", "vaccination", "diabetes", "asthma", "cardiovascular disease", "mental health", "opioid replacement therapy", "needle and syringe") and combined via the Boolean operator "AND" with the term "community pharmacy". The literature search was conducted via the search engines PubMed and Google Scholar, with a focus on systematic literature reviews including meta analyses. The search was limited to English-language articles published between 1966 and November 2017. If several reviews on the same priority area were available, the articles of more recent date were selected. If no systematic literature review was found, original research studies were included. Further articles were identified by looking at the references of included publications. A sub-analysis focused on reported barriers and facilitators of the pharmacy services; a literature search was performed using the terms "barriers" or "facilitators" in combination with "community pharmacy services". Of all included articles, data regarding the effectiveness of the services were extracted and synthesised. The results are presented in sub-sections, one for each priority area; at the beginning of each sub-section, a brief introduction into the underlying problem of the priority area is provided.

Table 1 Taxonomy of literature review according to Cooper [14]

Characteristic	Category	Explanation
Focus	Research outcomes	Focus on studies reporting on outcomes of community pharmacy-led interventions
Goal	Identification of central issues, integration/ generalisation	Identify priority areas of community pharmacy-led interventions, synthesise the available evidence, identify potential improvements to the interventions
Perspective	Neutral representation	Research outcomes are presented in the same format as in the original studies
Coverage	Representative	A sample of studies is selected to represent the current body of research on the topic
Organisation	Conceptual	Articles relating to the same priority area are presented together
Audience	Healthcare researchers, practitioners, policy makers	Informing different stakeholders about available evidence on pharmacy-led interventions, but also about the current gap in science and practice

Theoretical concept for primary care

To develop a proposal for further improvement of the clinical services provided by pharmacists, a theoretical concept of primary care is introduced. This concept was outlined by Valentijn et al. [16] in their work about a conceptual framework of integrated care and is based on the work by Starfield [17, 18]. Table 2 outlines the key elements of integrated primary care according to this concept [16].

Results

The identified priority areas for healthcare services provided by Australian community pharmacies were: clinical interventions (DOCUMENT system), medication reviews (Home Medicines Review (HMR) and MedsCheck), health promotion (smoking cessation, weight management, and vaccination), screening and management of chronic diseases (asthma, cardiovascular disease (CVD), mental health, and diabetes), and support services for drug addiction (opioid replacement therapy, needle and syringe programmes). For the evaluation of the services, 12 systematic literature reviews, four non-systematic reviews, and five original studies were included.

Table 3 shows an overview of the different interventions in the community funded under the 5th CPA which was in effect from 2010 to 2015 [19, 20]. It included the "Pharmacy Practice Incentives" programme with the six priority areas: dose administration aid, clinical interventions, staged supply, primary healthcare, community services support and working with others [19]. Pharmacies received annual payments to participate in these programmes. Under the current CPA (2015–2020) funding for the priority areas of primary healthcare, community services support, and working with others were discontinued [13].

Clinical interventions

Clinical interventions aim at reducing DRPs through cooperation between pharmacists and patients as well as other healthcare professionals [21]. Under the 3rd and 4th CPA, a classification system for DRPs, called DOCUMENT, was developed [22]. It is applied in the clinical interventions programme to assist community pharmacists in the documentation of identified DRPs [21]. In Fig. 1, the different categories of the DOCUMENT system are outlined [22]. Pharmacists have to categorise the DRP they have identified as well as the recommendation they have made [21]. In a trial evaluating the usability of the DOCUMENT system the most common categories of DRPs were "Drug selection" (30.7%) and "Education or information" (23.7%); while the most frequent recommendation was "Change of therapy" (40.1%) [22]. On average, 1.6 recommendations were made per clinical intervention. According to an independent expert panel, the assessment of clinical significance made by the recording pharmacist correlated with the average cost saving per DRP [22].

Medication reviews

In Australia, two main types of medication reviews exist in the community setting: the in-pharmacy services, MedsCheck and Diabetes MedsCheck, and HMR in the patient's residence [23]. The HMR programme was introduced in 2001. General practitioners (GP) refer patients who have problems with their medication to an accredited pharmacist of their choice. The pharmacist then arranges to visit the patient at their residence and to then perform a comprehensive review of their medicines. Afterwards, the pharmacist communicates their findings to the GP who develops a medication management plan in cooperation with the patient [24]. Less intensive and less time-consuming programmes are MedsCheck and Diabetes MedsCheck. These enable the review of medications without GP's referral and can take place within the pharmacy [23]. This makes the programmes more easily accessible for patients [25].

One attempt to decrease the number of hospital admissions is through medication reviews [26]. The review process consists of an evaluation of the medication and the patients' management of them [27]. The aim is to strengthen the patient's health status and identify potential DRPs [27]. Since the end of 2011, GPs can directly refer patients to accredited pharmacists for HMRs; previously, patients were first referred to a nominated community pharmacy [28]. According to an evaluation by PricewaterhouseCoopers, the main outcomes and recommendations of MedsCheck are consistent with its aims [25]. In 79% of the cases, patients received either

Table 2 Integrative functions of primary care according to Valentijn et al. [16]

Care elements	Explanation
First contact	"Implies accessibility to and use of services for each new problem or new episode of a problem for which people seek health care."
Continuous	"Longitudinal use of a regular source of care over time, regardless of the presence or absence of disease or injury."
Comprehensive	"The availability of a wide range of services in and their appropriate provision across the entire spectrum of types of needs for all but the most uncommon problems in the population."
Coordinated	"The linking of health care events and services so that the patient receives appropriate care for all his/her health problems, physical as well as mental and social."

Table 3 Community programmes funded under 5th CPA [19, 20]

Clinical interventions	Recommendation of change in drug treatment to improve quality use of medication [19].
Medication reviews	MedsCheck/Diabetes MedsCheck: In-pharmacy medication review with limited scope to improve patient's knowledge, self-management, and adherence to drug therapy [20].
	HMR: Comprehensive medication review in patient's home to identify potential DRPs and develop strategies to avoid them [20].
Primary healthcare (focusing on diabetes, respiratory tract, CVD, or mental health)	Health promotion: Interventions to enhance the health status of the population through education, support, and awareness [19].
	Screening and risk assessment: Identify patients at high risk of a disease or undiagnosed at present [19].
	Disease state management: Support for patients with chronic diseases to improve the quality of life and reduce long-term effects associated with the disease [19].
Community services support	Needle and syringe programme: Supply of sterile injecting equipment and safe disposals to reduce drug-related harm, especially transmission of HIV and HCV [19].
	Opioid substitution programme: Provision of substitute drug treatment to reduce the risk and harms associated with opioid abuse [19].
	National diabetes service scheme access point: Supply of diabetes-related devices and support for diabetes patients [19].
	Mental health first aid: Emergency support for persons with mental health issues until professional help is available [19].
	Pharmacy delivery service
	Return of unwanted medicines
	Staff training
	eHealth: use of modern software for medication dispensing [19].

Abbreviations: *CVD* cardiovascular diseases, *DRP* drug-related problem, *HCV* hepatitis C virus, *HIV* human immunodeficiency virus, *HMR* Home Medicines Review

training on the appropriate use of their medicines and medical devices or information about their disease and medication without further proceeding. In only 9% of the cases, pharmacists referred patients to the prescriber. Home Medicines Reviews were recommended on less than 1% of occasions, although both pharmacists and GPs stated that MedsCheck could be a good screening tool for HMR services. This allows the assumption that the potential of these programmes is not fully exhausted. In general, the MedsCheck consumers are about ten years younger than the HMR consumers (median age: 64 years vs. 75 years) [25]. This shows the capacity of MedsCheck to identify high-risk patients at an early stage and prevent potential long-term effects like chronic stages of diseases or hospital admissions due to DRPs.

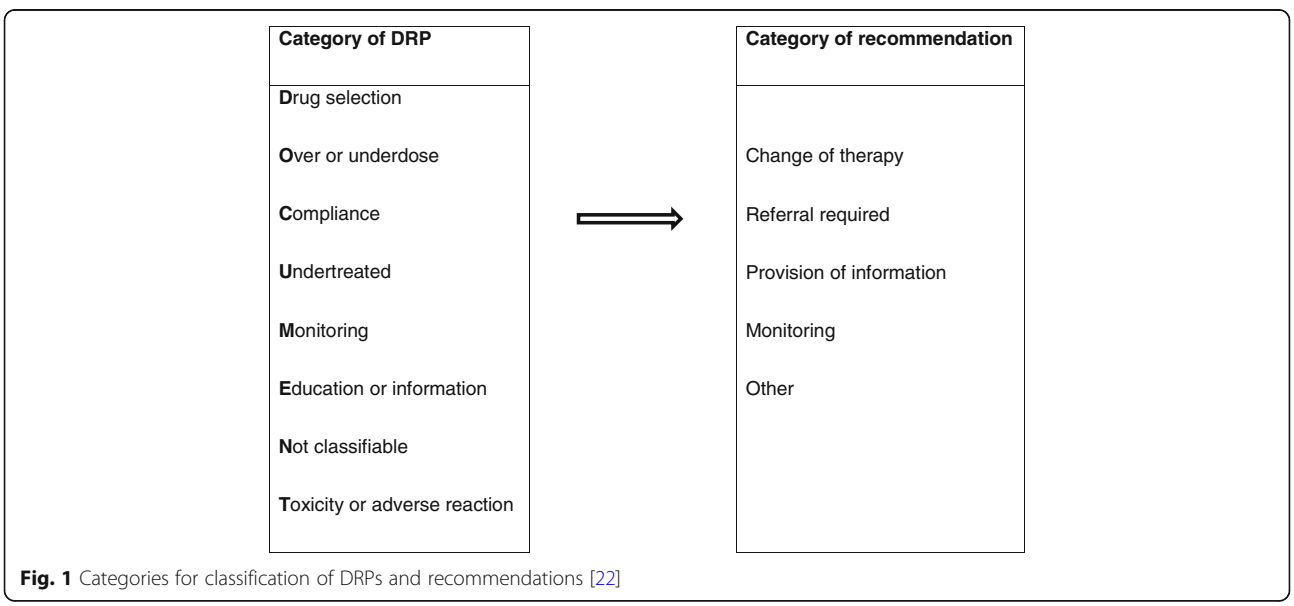

Fig. 1 Categories for classification of DRPs and recommendations [22]

In a systematic review of clinical medication reviews in Australia, HMRs and similar reviews also performed in the community by pharmacists (but not including MedsCheck) have shown to be clinically effective as well as cost-effective [29]. On average, 3.6 DRPs per review were identified, the hospitalisation rate decreased by 45–79% while the adherence increased to 52–95% (compared to 52–84% without medication review). According to the review, exact cost savings are hard to predict as there are many studies that evaluated cost-effectiveness, but they used different approaches and hence data are not comparable. The authors of the review concluded that patients with mental health problems, chronic diseases, and high-risk medication can benefit particularly from HMRs; these are usually elderly patients with co-morbidities and polypharmacy. Nevertheless, according to the systematic review there are under-represented population groups that might benefit as well; among these are indigenous, cultural and linguistically diverse people, individuals living in remote areas, patients in palliative care, patients with poor medication adherence, and patients recently released from hospital. Another population group that might benefit from HMRs consists of patients who take sedatives and anticholinergic medications because these drugs are often associated with DRPs such as falls [30]. A future goal should be to find ways to better address these groups. One suggestion is to permit more healthcare providers to refer patients to pharmacists for HMRs [29]. A direct referral pathway after hospitalisation is currently in the phased implementation to allow immediate arrangements of HMR after hospital discharge without the inclusion of the GP [31]. An Australian study from 2003 already showed the benefits of providing pharmaceutical care to post-hospitalisation patients living in the community [32]. Different studies have demonstrated that the percentages of DRPs as well as of hospital readmissions were reduced through pharmacists who supported patients with their medication management after hospital discharge [32–34]. For 2018, there are plans to change the eligibility criteria of HMRs in order to increase the percentage of Aboriginal and Torres Strait Islander patients receiving the service [35].

Health promotion

There are some programmes in community pharmacies that attempt to assist people to change their lifestyles towards a healthier state. Among these are smoking cessation and weight management which are already implemented services in Australian community pharmacies [36]. Both programmes also serve the prevention of chronic diseases like CVD and diabetes [37]. In Australia, smoking and a high body mass index are the leading behavioural risk factors for morbidity and mortality [37]. Smoking cessation and weight management are effective interventions in the community pharmacy setting [38, 39].

The smoking cessation service can either be delivered in the form of simple consultations or in combination with nicotine replacement therapy (NRT). The addition of pharmacotherapy increases the beneficial outcome of the intervention (abstinence) with a relative risk of 3.46 for compared to 1.98 [38]. The first available NRT product in Australia was a nicotine chewing gum in 1984, changing four years later from prescription-only to over-the-counter [40]. Since 2005, NRT has also been available in supermarkets [40]. Weight reduction measured in trials evaluating pharmacy services was between 0.7 and 5.6 kg, the body mass index decreased by 0.3 to 1.3 kg/m^2 and the change in the waist circumference ranged from 0 to − 8 cm among different studies [39]. The pharmacy services utilised a special diet and physical activity accompanied by support from the pharmacists. According to Brown et al. the evidence for alcohol reduction interventions is too weak to allow any assumptions about the effectiveness. Recently, community pharmacies started providing vaccination programmes [41]. A large US-based systematic review has shown that vaccination programmes in community pharmacies improve accessibility and hence vaccination rates [42]. A pilot study from Queensland and a mixed-methods study from Western Australia have confirmed these findings [43, 44]. In additional file 1, there is an overview of systematic literature reviews evaluating the effectiveness of health promotion programmes in community pharmacies.

Screening and disease management

The focus of chronic disease management led by community pharmacists has been mainly asthma, CVD, and diabetes [26]. The prevalence of these three diseases is 22% for CVD, 10% for asthma and 5% for type 2 diabetes among Australian adults [45, 46]. The Australian government has named them as “areas with special focus” in their national chronic disease strategy [45]. Cardiovascular disease is the largest burden on the Australian heath system accounting for approximately 12% of the health expenditure [46].

A systematic review of systematic reviews showed that diabetes and CVD are the most frequently reported outcomes in community pharmacy interventions [26]. In 65 studies, blood pressure control was investigated with a rate of 74% showing statistically significant results ($p < 0.05$). For cardiovascular outcomes, five of seven studies showed significant improvement. Diabetes control was successful in 78% (35 studies). There are fewer studies on respiratory tract diseases, but the five studies identified all presented significant positive outcomes. In interventions, pharmacists provided information about the

disease, pharmacotherapy, and lifestyle changes as well as inhalation technique training for asthma patients [47, 48]. Additionally, some studies included referrals to GPs or other healthcare providers, self-management of the disease or medication reviews [47, 48]. In randomised controlled trials there was an improvement in control and the severity level of asthma after intervention [49]. A systematic review including CVD and diabetes interventions reported positive effects on blood pressure, glycated haemoglobin (HbA1c), blood glucose, and cholesterol levels [50]. The exact effects are summarised in Table 4; additional file 2 shows an overview of systematic literature reviews assessing community pharmacist-led interventions targeting chronic disease screening and management interventions. Although there are attempts to involve community pharmacists in the care of mental health patients, there is a lack of practical implementation and a paucity of research in that area so far [51].

Addiction support services

Needle and syringe programmes as well as opioid substitution programmes have existed in Australian community pharmacies since 1986 and 1985, respectively [52, 53]. In a systematic review of reviews by MacArthur et al. three reviews targeting injecting risk behaviour in the community pharmacy setting were identified, including 13 studies [54]. Eight studies showed positive results for needle and syringe programmes and injecting risk behaviour. Due to the limitations in the present studies, it was not possible to assess the direct implication of HIV and HCV transmission associated with needle and syringe access points in pharmacies. Frequency and prevalence of drug injecting as well as needle sharing was reduced which led to lower HIV and HCV transmissions. Opioid substitution treatment effectively reduced injecting risk behaviour which was the most common outcome measure in studies evaluating the treatment. Since February 2016, naloxone has been available in Australian pharmacies without prescription ("Schedule 3") [55]. The decision to change the status of the drug from prescription-only to over-the-counter was based on the positive risk-benefit ratio and the easier accessibility for drug users and their relatives in case of opioid-overdosing [55].

Barriers and facilitators

Important facilitating factors identified for community pharmacy services are: cooperation between pharmacists and GPs, reimbursement, private area within the pharmacy, patient's expectation that the pharmacy delivers a certain service, sufficient and skilled staff as well as external support for them [56]. Among the barriers are low consumer awareness of existing programmes [29]; a lack of time, resources and self-confidence on the part of pharmacists [57, 58]; and that GPs show low engagement in the process [25]. An approach to increase the pharmacists' self-confidence is to give them training beforehand [48]. Willis et al. observed a trend towards more GP referrals being initiated by pharmacists following chronic disease screening in pharmacies; this trend could indicate that efforts to strengthen the working relationship between pharmacists and GPs have already shown some effect [59]. An important facilitator is the good position that community pharmacists are in to deliver healthcare services because the population at risk usually visits a pharmacy frequently to collect their medication [47, 59].

Proposal for improvement

The researchers applied the theoretical concept of primary care introduced earlier in this review to the findings of the narrative review. This process has shown that the elements of first contact, continuous, and comprehensive care are provided in the community pharmacy setting. The last element, the coordinated care, seems currently not to be fully implemented. On the micro level, coordinated care refers to clinical integration, which can be split into the vertical and the horizontal integration [16]. Vertical integration describes coordinated care within a single organisation, while horizontal care illustrates the coordination across organisations [60]. By transferring this concept to the community

Table 4 Effects of pharmacist-led interventions on asthma, CVD, and diabetes risk factors

Determinant	Effect	Reference
Asthma control	+ 8% to + 12%	[49]
Asthma severity score	−0.3 ($p < 0.002$)	[49]
Systolic blood pressure	−6.32 mmHg (95% CI −8.8 to − 3.83; $p < 0.001$)	[50]
Diastolic blood pressure	−3.12 mmHg (95% CI −4.57 to − 1.67; $p < 0.001$)	[50]
HbA1c level	−0.75% (95% CI -1.41 to − 0.09; $p = 0.03$)	[50]
Blood glucose level	−7 to − 15 mg/dL	[50]
Total cholesterol level	−15 to − 37 mg/dL	[50]
Triglyceride level	−50.5 mg/dL	[50]

Abbreviations: *CI* confidence interval, *HbA1c* glycated haemoglobin

pharmacy setting, coordination of care can be achieved vertically by interlinking the individual clinical services provided by the pharmacy and horizontally through interprofessional collaborations between pharmacists and other members of the healthcare team. The lack of interprofessional collaboration has already been identified as a barrier and efforts have been made to strengthen the professional relationships between GPs and pharmacists [61–63]. An approach that has been neglected is optimisation of the linkage between individual services offered by pharmacists. Improved linkage between services could lead to more coordinated care for the patient in the pharmacy: the pharmacist could apply an intervention to identify existing problems; then, the pharmacist may suggest to the patient another intervention suitable for solving the identified problem(s). A possible connection between existing services is demonstrated in Fig. 2. Great potential in that area might include a strengthened relationship between MedsCheck and HMR where the pharmacist could start with the less intensive MedsCheck intervention, followed by a recommendation for a HMR to resolve clinical issues that need a more in-depth medication review. Pharmacists and GPs have realised the possibility of using MedsCheck as a screening tool for HMR, but they do not appear to act on this routinely or to any great degree [25].

Discussion

Synthesis of the reviewed literature

The objectives of this narrative review were to evaluate the effectiveness of clinical services provided in Australian community pharmacies, to identify barriers and facilitators in that process, and to develop a proposal for improving the delivery of these services. The evidence from the included studies demonstrates the effectiveness of these pharmacist-provided healthcare services. Many studies have reported on the positive outcomes of the programmes, especially in the areas of HMR, CVD and diabetes prevention and management [25, 26, 29, 30, 47, 59, 64]. Smoking cessation and weight management are already well-established in many Australian pharmacies [36]. Community pharmacies are a convenient location for addressing such services because they are available for all Australians [25]. Furthermore, the people who can benefit the most from these services are the ones who visit a community pharmacy regularly to collect their medication [47, 59]. In spite of the great potential that arises from the convenience and easy accessibility of a pharmacy, some target groups still remain underserved, such as people living in rural and remote areas [25, 29]. The proposal to strengthen the linkage between the services might help to ensure a coordinated care for the patients which does not yet seem to be realised.

Implications for research, policy, and practice

Without a doubt, interprofessional collaboration and interorganisational coordination, respectively, are important aspects of integrated care [16]. Therefore, projects such as the integration of pharmacists into general practice are reasonable; their effectiveness has been demonstrated in various studies [65, 66]. However, as defined by Leutz, there are three levels of integration:

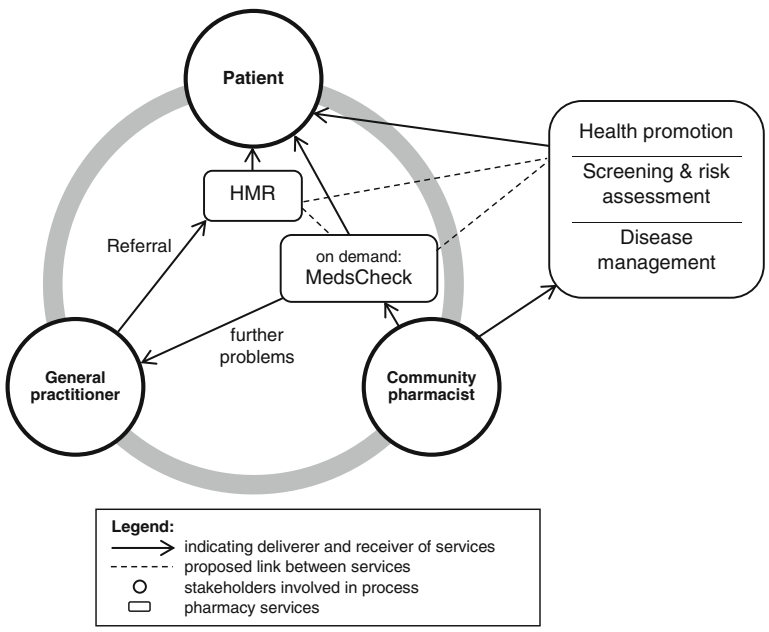

Fig. 2 Proposed linkage of the services

linkage, coordination, and full integration [67]. Within this framework, "linkage" is described as allowing "individuals with mild to moderate or new disabilities to be cared for appropriately in systems that serve the whole population without having to rely on outside systems for special relationships. Linkage begins with population screening to identify emergent needs." [67]. Leutz concludes that in most organisations a systematic linkage has never been completely implemented, but the approach could potentially lead to improved effectiveness [67]. Hence, future research should focus on how to improve the coordination of the community pharmacy programmes so that patients receive a more integrated model of care. The proposal to strengthen the linkage between the services should be investigated in prospective studies. The knowledge from such prospective studies could provide stakeholders with a basis for negotiations on future CPAs.

For the implementation of vertical integration, specific clinical guidelines might be a helpful tool [68, 69]. Additionally, the development of soft skills such as delegation, teamwork, coordination of tasks according to individual's areas of expertise, problem-solving specific workflow, and communication might be beneficial [69, 70]. At the same time, care must be taken to first remove redundant services to prevent the incorporation of interventions into the coordinated care system that are less effective or duplicative. This process ensures that efforts are focussed on successful services [69].

To facilitate the transition from traditional pharmacies to integrated health hubs, the Pharmaceutical Society of Australia initiated a project called the "Health Destination Pharmacy". It is an evidence-based programme for community pharmacies to increase their role as healthcare providers while receiving professional support for the implementation of these changes [71]; the aims are a strong relationship between pharmacist/patient and pharmacist/GP/other health professionals and the delivery of clinical pharmacy services according to local needs [72]. The pilot phase ran between 2011 and 2013 with 14 community pharmacies. Although the concept has won several national and international awards, up until the beginning of 2017 only approximately 30 pharmacies had signed up to participate in the programme [73], representing approximately 0.5% of pharmacies in Australia. Future research is needed to investigate the low uptake of the programme. Understanding the barriers for pharmacists to participate in the "Health Destination Pharmacy" might also be useful for the implementation of similar projects in the future.

Additionally, further research should be undertaken to assess the impact of the expanded role of pharmacists in general practice on the community pharmacy-led services. Much research is currently being undertaken in the direction of interprofessional primary care teams, but it is unknown how this impacts the community pharmacy setting. This information would be relevant for both practitioners and policy-makers as it starts to define where the expanded role of pharmacists fit within the healthcare team.

Limitations

As a narrative review, this study does not provide a systematic overview of the literature. In general, the literature search is not reproducible since it did not follow a rigorously pre-defined search strategy as applied in systematic reviews. The comprehensiveness of the review was further limited by using only two search engines. The study selection was subjective and limited to a sample of the literature on the topic; therefore, there is a risk of confirmation bias. However, the authors aimed to neutrally present the available evidence. Although the authors did not formally assess the methodological quality of the included studies, where possible the authors have included systematic literature reviews which represent the highest level in the hierarchy of evidence.

Conclusion

This narrative review has demonstrated that there is sufficient evidence for the effectiveness of most pharmacy services, especially regarding Home Medicines Review, cardiovascular disease, and diabetes interventions. In the areas of mental health and alcohol reduction the benefits remain uncertain due to lack of evidence. To further improve the health outcomes for patients, the individual pharmacy services could be better interlinked. In addition, the services offered at the community pharmacy should be integrated with the patient management provided by other health professionals such as general practitioners. In this way, community pharmacies can significantly contribute to the provision of integrated primary care.

Additional files

Additional file 1: Systematic reviews of international studies focussing on health promotion in community pharmacies. (DOCX 16 kb)

Additional file 2: Systematic reviews focussing on chronic disease screening/management in community pharmacies. (DOCX 18 kb)

Abbreviations

CBA: Controlled before and after study; CI: Confidence interval; CPA: Community Pharmacy Agreement; CVD: Cardiovascular diseases; DRP: Drug-related problem; GP: General practitioner; HbA1c: Glycated haemoglobin; HCV: Hepatitis C virus; HIV: Human immunodeficiency virus; HMR: Home Medicines Review; NRT: Nicotine replacement therapy; UK: United Kingdom; USA: United States of America

Availability of data and materials

The authors declare that the data supporting the findings of this study are available within the article.

Authors' contributions
All authors have participated in the drafting and revision of the manuscript. Furthermore, all authors have given approval of the final version of the manuscript for submission.

Ethics approval and consent to participate
Not applicable.

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Not applicable.

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The authors declare that they have no competing interests.

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References

1. Toklu HZ, Hussain A. The changing face of pharmacy practice and the need for a new model of pharmacy education. J Young Pharm. 2013;5(2):38–40. https://doi.org/10.1016/j.jyp.2012.09.001.
2. World Health Organization. The Role of the Pharmacist in the Health Care System. World Health Organization, Geneva. 1994. http://apps.who.int/medicinedocs/en/d/Jh2995e/. Accessed 6 Sep 2017.
3. World Health Organization. Assessing national capacity for the prevention and control of noncommunicable diseases: report of the 2015 global survey. Global Survey. Geneva: World Health Organization, Noncommunicable Diseases and Mental Health; 2016.
4. Stawicki S, Kalra S, Jones C, Justiniano C, Papadimos T, Galwankar S, et al. Comorbidity polypharmacy score and its clinical utility: a pragmatic practitioner's perspective. J Emerg Trauma Shock. 2015;8(4):224–31. https://doi.org/10.4103/0974-2700.161658.
5. Gnjidic D, Hilmer S, Blyth F, Naganathan V, Waite L, Seibel M, et al. Polypharmacy cutoff and outcomes: five or more medicines were used to identify community-dwelling older men at risk of different adverse outcomes. J Clin Epidemiol. 2012;65(9):989–95. https://doi.org/10.1016/j.jclinepi.2012.02.018.
6. Hubbard R, Peel N, Scott I, Martin J, Smith A, Pillans P, et al. Polypharmacy among inpatients aged 70 years or older in Australia. Med J Aust. 2015;7(202):373–7. https://doi.org/10.5694/mja13.00172.
7. Reeve E, Wiese MD. Benefits of deprescribing on patients' adherence to medications. Int J Clin Pharm. 2014;36(1):26–9. https://doi.org/10.1007/s11096-013-9871-z.
8. Hamilton HJ, Gallagher PF, O'Mahony D. Inappropriate prescribing and adverse drug events in older people. BMC Geriatr. 2009;9(1):5. https://doi.org/10.1186/1471-2318-9-5.
9. World Health Organization. Adherence to long-term therapies: Evidence for action. Critical Review. Geneva: World Health Organization, Noncommuniclable Diseases; 2003.
10. Roughead L, Semple S, Rosenfeld E. Literature review: medication safety in Australia. Sydney: Quality Use of Medicines and Pharmacy Research Centre, Sansom Institute University of South Australia; 2013.
11. Roughead EE, Semple SJ. Medication safety in acute care in Australia: where are we now? Part 1: a review of the extent and causes of medication problems 2002–2008. Aust New Zealand Health Policy. 2009;6(1):18. https://doi.org/10.1186/1743-8462-6-18.
12. Pharmacy Guild of Australia. About the Guild. The Pharmacy Guild of Australia. 2017. https://www.guild.org.au/about-us. Accessed 27 Mar 2018.
13. Pharmacy Guild of Australia. Community Pharmacy Agreement. Pharmacy Guild of Australia. 2017. https://www.guild.org.au/migration/community-pharmacy-agreement. Accessed 15 Mar 2017.
14. Cooper HM. Organizing knowledge syntheses: a taxonomy of literature reviews. Knowl Soc. 1988;1(1):104.
15. Baumeister RF, Leary MR. Writing narrative literature reviews. Rev Gen Psychol. 1997;1(3):311.
16. Valentijn PP, Schepman SM, Opheij W, Bruijnzeels MA. Understanding integrated care: a comprehensive conceptual framework based on the integrative functions of primary care. Int J Integr Care. 2013;13. http://doi.org/10.5334/ijic.886.
17. Starfield B. Primary care: concept, evaluation, and policy. USA: Oxford University Press; 1992.
18. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milbank Q. 2005;83(3):457–502.
19. Pharmacy Guild of Australia. Programme Specific Guidelines Pharmacy Practice Incentives (PPI). Canberra: Pharmacy Guild of Australia and Australian Government Department of Health; 2014. p. 1–15.
20. Pharmaceutical Society of Australia. Guidelines for pharmacists providing medicines use review and diabetes medication management services. Canberra: Pharmaceutical Society of Australia Ltd.; 2011. p. 1–26.
21. Pharmaceutical Society of Australia. Standards and Guidelines for pharmacists performing clinical interventions. Canberra: Pharmaceutical Society of Australia Ltd.; 2011. p. 1–32.
22. Williams M, Peterson GM, Tenni PC, Bindoff IK, Stafford AC. DOCUMENT: a system for classifying drug-related problems in community pharmacy. Int J Clin Pharm. 2012;34(1):43–52. https://doi.org/10.1007/s11096-011-9583-1.
23. The 6CPA. MedsCheck and Diabetes MedsCheck. The 6CPA. 2015. http://6cpa.com.au/medication-management-programmes/medscheck-diabetes-medscheck/. Accessed 15 Aug 2017.
24. Department of Health. Medication Management Reviews. Australian Government Department of Health. 2014. http://www.health.gov.au/internet/main/publishing.nsf/Content/medication_management_reviews.htm. Accessed 15 Mar 2017.
25. PricewaterhouseCoopers. Combined Review 5CPA Medication Management Programmes. Review. Canberra: Australian Government, Department of Health; 2015.
26. Jokanovic N, Tan EC, Sudhakaran S, Kirkpatrick CM, Dooley MJ, Ryan-Atwood TE, et al. Pharmacist-led medication review in community settings: an overview of systematic reviews. Res Social Adm Pharm. 2017;13(4):661–85. https://doi.org/10.1016/j.sapharm.2016.08.005.
27. Pharmaceutical Society of Australia. Guidelines for pharmacists providing Home Medicines Review (HMR) services. Canberra: Pharmaceutical Society of Australia Ltd.; 2011. p. 1–20.
28. Malek J. HMR and RMMR program changes. Aust Pharm. 2011;30(10):848–50.
29. Jokanovic N, Tan ECK, van den Bosch D, Kirkpatrick CM, Dooley MJ, Bell JS. Clinical medication review in Australia: a systematic review. Res Social Adm Pharm. 2016;12(3):384–418. https://doi.org/10.1016/j.sapharm.2015.06.007.
30. Chen TF. Pharmacist-led home medicines review and residential medication management review: the Australian model. Drugs Aging. 2016;33(3):199–204. https://doi.org/10.1007/s40266-016-0357-2.
31. The 6CPA. Home Medicines Review. The 6CPA. 2015. http://6cpa.com.au/medication-management-programs/home-medicines-review/. Accessed 17 Aug 2017.
32. Naunton M, Peterson GM. Evaluation of home-based follow-up of high-risk elderly patients discharged from hospital. J Pharm Pract Res. 2003;33(3):176–82. https://doi.org/10.1002/jppr2003333176.
33. Schnipper JL, Kirwin JL, Cotugno MC, et al. Role of pharmacist counseling in preventing adverse drug events after hospitalization. Arch Intern Med. 2006;166(5):565–71. https://doi.org/10.1001/archinte.166.5.565.
34. Arnold ME, Buys L, Fullas F. Impact of pharmacist intervention in conjunction with outpatient physician follow-up visits after hospital discharge on readmission rate. Am J Health Syst Pharm. 2015;72(11 Supplement 1):S36–42. https://doi.org/10.2146/sp150011.
35. The 6CPA. Important: 6CPA program changes from 1 July 2017. The 6CPA 2017. http://6cpa.com.au/2017/06/important-6cpa-program-changes-from-1-july-2017/. Accessed 18 Aug 2017.
36. Mossialos E, Courtin E, Naci H, Benrimoj S, Bouvy M, Farris K, et al. From "retailers" to health care providers: transforming the role of community pharmacists in chronic disease management. Health Policy. 2015;119(5):628–39. https://doi.org/10.1016/j.healthpol.2015.02.007.
37. Forouzanfar MH, Afshin A, Alexander LT, Anderson HR, Bhutta ZA, Biryukov S, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the global burden of disease study 2015. Lancet. 2016;388(10053):1659–724. https://doi.org/10.1016/S0140-6736(16)31679-8.
38. Saba M, Diep J, Saini B, Dhippayom T. Meta-analysis of the effectiveness of smoking cessation interventions in community pharmacy. J Clin Pharm Ther. 2014;39(3):240–7. https://doi.org/10.1111/jcpt.12131.

39. Brown TJ, Todd A, O'Malley C, Moore HJ, Husband AK, Bambra C, et al. Community pharmacy-delivered interventions for public health priorities: a systematic review of interventions for alcohol reduction, smoking cessation and weight management, including meta-analysis for smoking cessation. BMJ Open. 2016;6(2) https://doi.org/10.1136/bmjopen-2015-009828.
40. Greenhalgh E, Stillman S, Ford C. Pharmacotherapies. In: Scollo M, Winstanley M, editors. Tobacco in Australia: facts and issues. Melbourne: Cancer Council Australia; 2016.
41. Pharmacy Guild of Australia. Vaccination Services. The Pharmacy Guild of Australia. 2017. https://www.guild.org.au/programs/vaccination-services. Accessed 26 Aug 2017.
42. Burson RC, Buttenheim AM, Armstrong A, Feemster KA. Community pharmacies as sites of adult vaccination: a systematic review. Hum Vaccin Immunother. 2016; 12(12):3146–59. https://doi.org/10.1080/21645515.2016.1215393.
43. Nissen L, Glass B, Lau E, Rosenthal M. Queensland pharmacist immunisation pilot phase 1 pharmacist vaccination - influenza. Final report. Brisbane: Queensland University of Technology, Faculty of Health; 2015.
44. Hattingh HL, Sim TF, Parsons R, Czarniak P, Vickery A, Ayadurai S. Evaluation of the first pharmacist-administered vaccinations in Western Australia: a mixed-methods study. BMJ Open. 2016;6(9) https://doi.org/10.1136/bmjopen-2016-011948.
45. National Health Priority Action Council. National Chronic Disease Strategy. Canberra: National Health Priority Action Council, Australian Government Department of Health and Ageing; 2006. p. 1–6.
46. Australian Institue of Health and Welfare. Cardiovascular disease, diabetes and chronic kidney disease - Australian facts: Prevalence and Incidence. 2 ed. Canberra: Australian Institue of Health and Welfare; 2014.
47. Sabater-Hernández D, Sabater-Galindo M, Fernandez-Llimos F, Rotta I, Hossain LN, Durks D, et al. A Systematic Review of Evidence-Based Community Pharmacy Services Aimed at the Prevention of Cardiovascular Disease. J Manag Care Spec Pharm. 2016;22(6):699–713. https://doi.org/10.18553/jmcp.2016.22.6.699.
48. Senna G, Caminati M, Bovo C, Canonica GW, Passalacqua G. The role of the pharmacy in the management of bronchial asthma: a literature-based evaluation. Ann Allergy Asthma Immunol. 2017;118(2):161–5. https://doi.org/10.1016/j.anai.2016.10.019.
49. Garcia-Cardenas V, Armour C, Benrimoj SI, Martinez-Martinez F, Rotta I, Fernandez-Llimos F. Pharmacists' interventions on clinical asthma outcomes: a systematic review. Eur Respir J. 2016;47(4):1134–43. https://doi.org/10.1183/13993003.01497-2015.
50. Nkansah N, Mostovetsky O, Yu C, Chheng T, Beney J, Bond CM, et al. Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns. Cochrane Database Syst Rev. 2010; https://doi.org/10.1002/14651858.CD000336.pub2.
51. Hattingh HL, Scahill S, Fowler JL, Wheeler AJ. Exploring an increased role for Australian community pharmacy in mental health professional service delivery: evaluation of the literature. J Ment Health. 2016;25(6):550–9. https://doi.org/10.3109/09638237.2015.1101418.
52. Health Outcomes International Pty Ltd. Return on Investment in Needle and Syringe Programs in Australia. Econmic Effectiveness Report. Canberra: Commonwealth of Australia, Department of Health and Ageing; 2002.
53. Gowing L, Ali R, Dunlop A, Farrell M, Lintzeris N. National Guidelines for medication-assisted treatment of opioid dependence. National Guideline. Canberra: Australian Government, Department of Health; 2014.
54. MacArthur GJ, van Velzen E, Palmateer N, Kimber J, Pharris A, Hope V, et al. Interventions to prevent HIV and hepatitis C in people who inject drugs: a review of reviews to assess evidence of effectiveness. Int J Drug Policy. 2014;25(1):34–52. https://doi.org/10.1016/j.drugpo.2013.07.001.
55. Pricolo A, Nielsen S. Naloxone rescheduling in Australia: processes, implementation and challenges with supply of naloxone as a 'pharmacist only' over-the-counter medicine. Drug Alcohol Rev. 2017; https://doi.org/10.1111/dar.12547.
56. Roberts A, Benrimoj S, Chen T, Williams K, Aslani P. Practice change in community pharmacy: quantification of facilitators. Ann Pharmacother. 2008;42(6):861–8. https://doi.org/10.1345/aph.1K617.
57. Rosenthal M, Austin Z, Tsuyuki RT. Are pharmacists the ultimate barrier to pharmacy practice change? Can Pharm J. 2010;143(1):37–42. https://doi.org/10.3821/1913-701X-143.1.37.
58. Eades CE, Ferguson JS, O'Carroll RE. Public health in community pharmacy: a systematic review of pharmacist and consumer views. BMC Public Health. 2011;11:582. https://doi.org/10.1186/1471-2458-11-582.
59. Willis A, Rivers P, Gray LJ, Davies M, Khunti K. The effectiveness of screening for diabetes and cardiovascular disease risk factors in a community pharmacy setting. PLoS One. 2014;9(4):e91157. https://doi.org/10.1371/journal.pone.0091157.
60. Goldwater J, Yuhasz L. Considerations for clinical integration. Insight paper. Michigan: IBM Watson Health, Truven Health Analytics; 2011.
61. Hossain LN, Fernandez-Llimos F, Luckett T, Moullin JC, Durks D, Franco-Trigo L, et al. Qualitative meta-synthesis of barriers and facilitators that influence the implementation of community pharmacy services: perspectives of patients, nurses and general medical practitioners. BMJ Open. 2017;7(9) https://doi.org/10.1136/bmjopen-2016-015471.
62. Supper I, Catala O, Lustman M, Chemla C, Bourgueil Y, Letrilliart L. Interprofessional collaboration in primary health care: a review of facilitators and barriers perceived by involved actors. J Public Health. 2015;37(4):716–27. https://doi.org/10.1093/pubmed/fdu102.
63. Mulvale G, Embrett M, Razavi SD. 'Gearing Up' to improve interprofessional collaboration in primary care: a systematic review and conceptual framework. BMC Fam Pract. 2016;17(1):83. https://doi.org/10.1186/s12875-016-0492-1.
64. Ryan R, Santesso N, Lowe D, Hill S, Grimshaw J, Prictor M, et al. Interventions to improve safe and effective medicines use by consumers: an overview of systematic reviews. Cochrane Database Syst Rev. 2014; https://doi.org/10.1002/14651858.CD007768.pub3.
65. Tan ECK, Stewart K, Elliott RA, George J. Pharmacist services provided in general practice clinics: a systematic review and meta-analysis. Res Social Adm Pharm. 2014;10(4):608–22. https://doi.org/10.1016/j.sapharm.2013.08.006.
66. Hazen ACM, de Bont AA, Boelman L, Zwart DLM, de Gier JJ, de Wit NJ, et al. The degree of integration of non-dispensing pharmacists in primary care practice and the impact on health outcomes: a systematic review. Res Social Adm Pharm. 2018;14(3):228–40. https://doi.org/10.1016/j.sapharm.2017.04.014.
67. Leutz WN. Five Laws for integrating medical and social services: lessons from the United States and the United Kingdom. Milbank Q. 1999;77(1):77–110. https://doi.org/10.1111/1468-0009.00125.
68. Ahgren B, Axelsson R. Evaluating integrated health care: a model for measurement. Int J Integr Care. 2005;5:e01.
69. Hernandez SR. Horizontal and vertical healthcare integration: lessons learned from the United States. Healthc Pap. 2000;1(2):59–65.
70. Chui MA, Mott DA, Maxwell L. A qualitative assessment of a community pharmacy cognitive pharmaceutical services program, using a work system approach. Res Social Adm Pharm. 2012;8(3):206–16. https://doi.org/10.1016/j.sapharm.2011.06.001.
71. Emerson L. PSA roadshow launches health destination pharmacy. Aust Pharm. 2016;35(5):15.
72. Pharmaceutical Society of Australia. Why - Give your pharmacy the plus factor. Pharmaceutical Society of Australia, Canberra, Australia. 2018. www.healthdestinationpharmacy.com.au/why/. Accessed 12 June 2018.
73. Emerson L. A ground-breaking year and exciting times ahead. Aust Pharm. 2017;36(1):8–10.