

Original Research

The role of community pharmacists in screening and subsequent management of chronic respiratory diseases: a systematic review

Mariam FATHIMA, Pradnya NAIK-PANVELKAR, Bandana SAINI, Carol L. ARMOUR.

Received (first version): 1-Oct-2013

Accepted: 19-Nov-2013

ABSTRACT*

Objective: The purpose of this review was to evaluate the role of community pharmacists in provision of screening with/without subsequent management of undiagnosed chronic obstructive pulmonary disease (COPD) and uncontrolled asthma.

Methods: An extensive literature search using four databases (ie. Medline, PubMed, International Pharmaceutical Abstracts (IPA) and Scopus) with search terms pharmacy, screening, asthma or COPD was conducted. Searches were limited to the years 2003-2013, those in English and those reporting research with humans. Data retrieval, analysis and result presentation employed a scoping review method.

Results: Seventeen articles met the inclusion/exclusion criteria, of which fifteen studies were based on people with asthma and two were based on people with COPD. Only seven asthma studies and one COPD study involved screening followed by subsequent management. More than half of the people screened were found to be poorly controlled and up to 62% of people were identified at high risk for COPD by community pharmacists. The studies varied in the method and type of asthma control assessment/screening, the type of intervention provided and the outcomes measured. The limitations of the reviewed studies included varying definitions of asthma control, different study methodologies, and the lack of long-term follow-up. While many different methods were used for risk assessment and management services by the pharmacists, all the studies demonstrated that community pharmacists were capable of identifying people with poorly controlled asthma and undiagnosed COPD and providing them with suitable interventions.

Conclusion: The literature review identified that community pharmacists can play an effective role in screening of people with poorly controlled asthma and undiagnosed COPD along with delivering management interventions. However, there is very little literature available on screening for these chronic respiratory conditions. Future research should focus on development of patient care delivery model incorporating a screening protocol followed by targeted management interventions delivered by the community pharmacist.

Keywords: Mass Screening; Lung Diseases, Obstructive; Outcome Assessment (Health Care); Community Pharmacy Services; Professional Practice; Professional Role

PAPEL DE LOS FARMACÉUTICOS COMUNITARIOS EN RASTREO Y POSTERIOR MANEJO DE ENFERMEDADES CRÓNICAS RESPIRATORIAS: REVISIÓN SISTEMÁTICA

RESUMEN

Objetivo: El propósito de esta revisión fue evaluar el papel de los farmacéuticos comunitarios en la provisión de rastreos con/sin posterior manejo de enfermedad pulmonar obstructiva crónica (EPOC) no diagnosticada y asma no controlada.

Métodos: Se realizó una extensiva búsqueda bibliográfica usando cuatro bases de datos (ie. Medline, PubMed, International Pharmaceutical Abstracts (IPA) and Scopus) con términos de búsqueda farmacia, rastreo, asma o EPOC. Las búsquedas se limitaron a los años 2003-2013, a las escritas en inglés, y a las que comunicaban investigación en seres humanos. La recuperación, y análisis de datos y la presentación de resultados se realizaron mediante un método de determinación del alcance.

Resultados: 17 artículos cumplieron los criterios de inclusión/exclusión, de los cuales, 15 eran de personas con asma y 2 con EPOC. Sólo 7 de los estudios de asma y uno de los de EPOC envolvían rastreos seguidos del consiguiente manejo. Más de la mitad de las personas rastreadas estaban pobremente controladas y hasta un 62% de las personas fueron identificadas como en alto riesgo de EPOC por los farmacéuticos. Los estudios variaban en el método y tipo de evaluación/rastreo del control de asma, el tipo de intervención realizada y los resultados medidos. Las limitaciones de los estudios revisados incluyeron la diversidad de definiciones de control de asma, las diferentes

***Mariam FATHIMA.** B.Pharm., M.Clin.Pharm. Faculty of Medicine, The University of Sydney; & Woolcock Institute of Medical Research, The University of Sydney. Sydney, NSW (Australia).

Pradnya NAIK-PANVELKAR. B.Pharm., M.Pharm., Ph.D. Faculty of Medicine, The University of Sydney; & Woolcock Institute of Medical Research, The University of Sydney. Sydney, NSW (Australia).

Bandana SAINI. B.Pharm., M.Pharm., M.B.A., Ph.D., Grad. Cert. Ed. Studies (Higher Edu.). Faculty of Pharmacy, The University of Sydney. Sydney, NSW (Australia).

Carol L. ARMOUR. B.Pharm.(Hons.), Ph.D. Faculty of Medicine, The University of Sydney; & Woolcock Institute of Medical Research, The University of Sydney. Sydney, NSW (Australia).

metodologías de estudio, y la falta de seguimiento a largo plazo. Aunque se utilizaron muchos métodos diferentes de evaluación del riesgo y de servicios de manejo de la enfermedad por los farmacéuticos, todos los estudios demostraron que los farmacéuticos comunitarios eran capaces de identificar personas con asma pobremente controlada y EPOC no diagnosticada y de realizar con ellos las intervenciones apropiadas.

Conclusión: La revisión de la literatura identifico que los farmacéuticos comunitarios pueden jugar un papel efectivo en el rastreo de personas con asma pobremente controlado y EPOC no diagnosticada así como realizarles las intervenciones de manejo. Sin embargo, hay muy poca literatura disponible sobre el rastreo de estas enfermedades respiratorias crónicas. La investigación futura debería centrarse en el desarrollo de modelos de atención a pacientes que incorporen un protocolo de rastreo seguido de intervenciones de manejo de la enfermedad proporcionadas por los farmacéuticos comunitarios.

Palabras clave: Rastreo Masivo; Enfermedades Pulmonares Obstructivas; Evaluación de Procesos y Resultados (Atención de Salud); Servicios de Farmacia comunitaria; Práctica Profesional; Rol Profesional

INTRODUCTION

Screening and case detection are a part of prevention strategies that seek to identify and limit the disability associated with chronic diseases by early detection and appropriate treatment.¹ Screening may not only save lives but also improve quality of life by preventing the onset or reducing complications of chronic disease.² In most developed nations, primary health care practitioners are encouraged to engage in early intervention through appropriate screening, and provide patient centred care and self-management.² Conventionally, physicians located within primary care health settings (family physicians, general practitioners) have been central in conducting health screening and case detection. However, many people are unaware of the risks of chronic disease or early signs of the disease and so do not present to primary care health services.²

Chronic respiratory diseases, such as asthma and chronic obstructive pulmonary disease (COPD), kill more than four million people every year world-wide and affect hundreds of millions more.³ Asthma is a common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm. Globally the economic burden of asthma has been estimated to be the highest among chronic diseases and includes both direct (e.g., hospital admissions and costs of medications) and indirect costs (e.g., days away from work).⁴ Despite the presence of widely disseminated guidelines and policies, asthma management is still sub-optimal, leading to poor symptom control, poor quality of life, and significant morbidity.⁵

Complicating the problem of asthma control is non-adherence to long-term controller medications⁶, maintenance of inhaler technique⁷, lack of asthma knowledge^{8,9}, co-morbidities and concern about adverse effects.¹⁰ COPD on the other hand, is characterised by a slow progression of airflow limitation caused by chronic inflammation of the lung to noxious particles or gases.¹¹ COPD is also accompanied by a major burden of symptoms, health care utilization, loss of productivity and cost of medications on the individual and the society. Further, many people suffer from this disease for years and die prematurely from it or from its complications.³ Early-stage COPD is often asymptomatic and so is often ignored¹², although coughing with sputum production is common.¹² Smoking is by far the most important risk factor, accounting for 85-90% of all cases.¹³ Smoking cessation does not restore lost lung function but slows the rate of decline to that of a healthy, non-smoking individual and is the most effective intervention.¹³ Early detection of COPD is crucial for promoting smoking cessation and instituting pharmacological and non-pharmacological therapy before patients reach symptomatic and costly stages of disease¹³ which in turn can let individuals with COPD achieve a better quality of life.¹¹

Community pharmacists are a valuable component of the primary healthcare team. Given their skills and expertise, community pharmacists can play a vital role in offering opportunistic screening, referring the at-risk individuals to their general practitioners and can also provide ongoing support and management services to patients with chronic conditions such as asthma and COPD. Community pharmacy based screening and management services offer several advantages. Firstly, they are the first point of contact between patients and the healthcare system and they are suitably equipped to target people less likely to self-refer to other health services. Secondly, pharmacies are conveniently located, are open for long hours and offer consultations without any appointment.

In the changing paradigm of practice, where pharmacists move from a product to a patient care focus, many pharmacy based studies have demonstrated the pharmacist's capacity to identify, counsel and refer patients with previously undiagnosed conditions.^{14,15} In developing nations, where the burden of disease is skewed towards infectious diseases such as tuberculosis, community pharmacies have been involved in supporting active case detection and management.^{16,17} In developed countries like the UK for example, a number of preventative health and public health programs delivered through local pharmacies (as well as through a number of other primary health care settings), including a men's health check, targeted public health campaigns, vascular checks, and lifestyle risk assessment testing have been implemented.¹⁸ Pharmacists in Switzerland and USA have successfully provided screening and early intervention services for people at risk of sleep disorders¹⁴, type 2 diabetes¹⁵ and breast cancer screening to women at risk.¹⁹ In Australia, pharmacy based screening and clinical

management programs have been successfully offered for various conditions e.g. Type 2 diabetes²⁰, osteoporosis²¹, sleep disorders²² and assessment of cardiovascular risk.^{23,24} Pharmacists have also successfully provided screening for bowel cancer²⁵ and chlamydia.^{26,27} These health screening services provided by pharmacists have also been supported by Australian consumers.^{28,29}

In the case of asthma, pharmacy-based studies have been conducted, the majority of which have demonstrated that pharmacist interventions can have a positive impact on clinical, humanistic and economic outcomes.³⁰⁻³² Further, in the case of COPD, the Global Initiative for Chronic Obstructive Lung Disease (GOLD)¹¹ report identified pharmacists as key health care professional collaborators in decreasing patient risk. The report described them as being well positioned to assist in early detection through screening of smokers, intervene by delivering smoking cessation messages, optimise medication delivery, refer patients to appropriate support services and present realistic expectations about the disease and its treatment.¹¹ As many people with undiagnosed COPD and uncontrolled asthma often approach the community pharmacy for help with smoking cessation and for regular purchase of short acting beta agonists (SABA's), community pharmacies are thus ideally placed as a suitable venue for risk assessment of uncontrolled asthma and undiagnosed COPD.

The purpose of this literature review is to scope the empirical literature and to provide a current overview of the role and the impact of community pharmacists in the screening/assessment for undiagnosed COPD and poorly controlled asthma with or without subsequent management.

METHODS

Review Type

A scoping review methodology was used for the literature review as the aim was broad and involved screening and management of two different chronic respiratory diseases by community pharmacists.

Data bases Searched and Search Strategy

The literature search was conducted to identify articles published between January 2003 and March 2013. Articles were obtained using four databases: Medline, PubMed, International Pharmaceutical Abstracts (IPA) and Scopus. Search strategies were formulated for individual databases using the following keywords: ("pharmacy" or "pharmacies" or "community pharmacy" or "pharmacist" or "pharmacy service" or "pharmaceutical service") AND ("asthma" OR "COPD") AND ("screening" OR "case detection" or "risk assessment" or "management").

Operational Definitions: For the purpose of the review

- Assessment was defined as assessing asthma control/risk of COPD using an assessment tool without screening patients at risk.

- Screening was defined as assessing asthma control/risk of COPD using a screening tool to identify patients at risk.
- Management was defined as any intervention provided by community pharmacists to manage patients with asthma/COPD.

Inclusion/exclusion criteria

Studies were included if they:

- Were published in English language and were available in full-text,
- Were conducted in humans and adults,
- Were conducted by community pharmacists.

Studies were excluded if they:

- Were review articles, grey literature, correspondence to editors and conference proceedings,
- Were conducted by other health care professionals by utilizing pharmacy dispensing records,
- Were exploring the attitudes and behaviours of pharmacists providing interventions to people with respiratory diseases.

Study selection and Analysis

The database search conducted by the primary author retrieved titles and abstracts of potential studies. Abstracts were then screened and the full-text of only those abstracts which met the inclusion/exclusion criteria was downloaded for assessing eligibility. Further application of the inclusion/exclusion criteria to these full-text articles was done to identify the included articles in this review. These articles were reviewed independently by the two authors, followed by data abstraction and analysis. Any disagreement was resolved through discussion with the third author. Critical examination of the content of the included articles was conducted and the included articles were categorized as follows:

- Asthma control assessment or COPD risk assessment studies without subsequent management
- Asthma control assessment or COPD risk assessment studies with subsequent management
- Asthma control/COPD screening studies without subsequent management
- Asthma control/COPD screening studies with subsequent management.

This categorization was conducted and tabulated separately for asthma and COPD studies. For each individual article, the study design, the number of patients studied, the type and method of screening/assessment, the method of management (if delivered), the outcome measures, key findings and any unusual features of the study were identified and reported.

RESULTS

The database search identified 939 potential articles. After elimination of duplicates and screening as per inclusion/exclusion criteria, 42 studies were retrieved. Studies which lacked a screening/assessment component (n=25) were

excluded, which resulted in the inclusion of 17 articles in this review. Of these, 15 articles³⁴⁻⁴⁸ pertained to studies conducted on people with asthma and 2 articles^{49,50} focused on studies conducted on people at risk of COPD (Figure 1).

Asthma Studies

Table 1 summarizes all the asthma studies reviewed. Of the 15 studies, five³⁴⁻³⁸ focused only on assessing asthma control, two^{39,40} involved assessment of asthma control followed by management, one⁴¹ looked at only screening for poor asthma control and the remaining seven⁴²⁻⁴⁸ focused on screening for poor control with subsequent management of those identified with poor asthma control.

Asthma control assessment studies without subsequent management:

Assessment of asthma control without subsequent management was conducted in five studies³⁴⁻³⁸, of which three were national campaigns³⁴⁻³⁶ and the other two were cross-sectional studies.^{37,38} The number of asthma patients participating in these five studies varied from 166 - 5551. The three national campaigns surveyed people with asthma to evaluate the degree of asthma control³⁶, their perception of inadequate asthma control together with the factors responsible for it³⁴, and the extent of health care utilization specifically by those with poor control.³⁵ The other two^{37,38} studies investigated the usefulness of asthma control assessment instruments in community pharmacies.

All five studies in this category assessed asthma control using validated instruments. The Asthma Control Test (ACT)⁵¹ was used by four of these studies³⁴⁻³⁷ while Nishiyama *et al.*³⁸ used the Jones Morbidity Index (JMI)⁵² for assessment of asthma control. In addition, two studies^{35,37} also used objective methods for assessing asthma control including peak expiratory flow rate (PEFR) readings and medication dispensing history.

The two national surveys from France conducted by Laforest *et al.*^{34,35} found more than 70% of the asthma population had inadequate control of asthma. In a national campaign from Portugal, Mendes *et al.*³⁶ identified that 61% of asthma patients had uncontrolled asthma. The studies conducted by Mehuys *et al.*³⁷ and Nishiyama *et al.*³⁸ found that approximately 50% of the people assessed had poor asthma control. Just one study by Nishiyama *et al.*³⁸ trained the participating pharmacists by providing information on the study procedure and aspects of inhalation technique.

Asthma control assessment studies with subsequent management:

Assessment of asthma control with subsequent management was delivered in two studies^{39,40}, one of which was an observational study involving 727 asthma patients³⁹, while the other was a randomized controlled trial involving 24 asthma patients.⁴⁰ In both studies, asthma control was assessed using validated instruments by community pharmacists followed by asthma management interventions in patients with asthma.

Giraud *et al.*³⁹ used the Asthma Control Questionnaire (ACQ6),⁵³ while Barbanel *et al.*⁴⁰ used the North of England asthma symptom scale⁵⁴ to assess asthma control. Only one study reported the percentage (51%) of assessed patients with poor control.³⁹

The management intervention by Giraud *et al.*³⁹ involved inhaler technique education and review, and provision of an individualized self-stick instruction form for the inhaler device, to asthma patients, while Barbanel *et al.*⁴⁰ provided training in self-management decision making based on PEFr readings or asthma symptoms. Both these pharmacist led management interventions resulted in significant improvement in asthma control. Training was provided to the participating pharmacists in both the studies and consisted of either a 2-hour training session on asthma treatment principles and inhaler technique review³⁹ or a 3-day multidisciplinary course on asthma care.⁴⁰

Asthma control screening study without subsequent management:

There was only one study in this category, conducted by Armour *et al.*⁴¹ which screened for people with poor asthma control and identified the contributing factors, but did not involve provision of any management intervention. This was a cross-sectional study involving 570 people with asthma. A validated screening tool, Jones Morbidity Index (JMI) was used which identified that 77% of the people who were screened had poor asthma control. Participating pharmacists were trained in recruitment, asthma management and in lung function testing using spirometry.

Asthma control screening studies with subsequent management:

Seven studies⁴²⁻⁴⁸ involved screening of patients for poor asthma control with subsequent management of those identified with poor control. The two studies conducted by Saini *et al.*^{42,43} had a parallel group design with⁴³ and without a control arm⁴², and investigated 102 and 570 participants respectively. The two studies by Bereznicki *et al.*^{44,45} were multi-site controlled trials which studied 1551 and 173 patients respectively. The study conducted by Mehuys *et al.*⁴⁶ was a randomized controlled parallel group trial with 201 participants. Armour *et al.*^{47,48} conducted two studies, one of which was a multi-site randomized controlled trial⁴⁷ and the other was a cluster-randomized trial comparing three versus four visit interventions provided by the pharmacist.⁴⁸ These studies involved 396 and 570 asthma patients respectively.

All seven studies in this category utilised different tools/ instruments for screening patients with poor asthma control. In one study, Saini *et al.*⁴³ screened patients using signs and symptoms of asthma control based on the National Asthma Council severity score (NAC Score)⁵⁴, but did not report the proportion of people identified at risk of poor control. Three studies^{42,47,48} used the JMI, a validated screening tool and identified 77%^{42,48} and 79%⁴⁷ of the screened patients to have poor control. Both

studies by Bereznicki *et al.*^{44,45} screened the medication dispensing records using a pre-specified algorithm. This software program generated a list of patients who had received three or more canisters of inhaled short-acting beta2-agonists in the preceding 6 months indicative of poor asthma control. Both studies did not report on the percentage of patients identified with poor control. The study conducted by Mehuys *et al.*³⁸ used ACT⁵¹, a validated screening tool which identified 61% patients with poor control.

In five studies⁴³⁻⁴⁷ from this category, patients who were screened for poor control were allocated to either intervention or control groups. Different asthma management interventions were then delivered to patients within the intervention group. In the studies by Bereznicki *et al.* community pharmacists mailed asthma educational information to intervention patients together with a letter encouraging them to see their general practitioner for review.^{44,45} Based on their asthma knowledge, intervention patients in the study conducted by Mehuys *et al.*⁴⁶ received a tailored intervention that focused on improving inhaler technique and medication adherence. Intervention pharmacists, in the study by Saini *et al.*⁴³ delivered the Australian Six Step Asthma Management Plan based on individual patient needs analysis followed by collaborative goal setting while those in the study conducted by Armour *et al.*⁴⁷ provided a comprehensive asthma care program. This program consisted of an ongoing cycle of asthma control assessments, adherence assessments, lung function testing, medication and inhaler technique review, goal setting and patient education and regular follow-up. The other two studies^{42,48}, which did not have a control arm, did a pre-post test analysis to measure the change in asthma outcomes after provision of pharmacist delivered interventions. One study provided a tailored intervention based on individual patient needs and goals⁴², while the other delivered a comprehensive individualized asthma management service focusing on medication adherence, inhaler technique, asthma knowledge/beliefs, asthma control, triggers, quality of life and action plan ownership.⁴⁸

In all the studies⁴²⁻⁴⁸ from this category, community pharmacists were trained in different aspects of asthma treatment and management. Two studies specifically trained pharmacists in the use of the data-mining software.^{44,45} Four studies^{42,43,47,48} provided comprehensive training to pharmacists consisting of asthma education, risk assessment, goal setting, adherence assessment, recruitment and motivational interventions. Additionally, in three of these studies^{42,47,48} pharmacists were also trained to measure lung function by spirometry. The training was provided through educational manuals, training sessions and workshops conducted by the research team.

All the studies involving screening and subsequent management demonstrated significant improvements in asthma control in the intervention group compared to control, or improvements in the post-test results compared to baseline, irrespective

of the type of intervention delivered by the pharmacists.

COPD studies

Table 2 summarizes the two COPD studies reviewed.^{49,50} Of the 2 studies, one involved screening for patients at risk of COPD, while the other focused on screening with subsequent management of COPD. Our search did not identify any studies in the other two categories.

COPD screening study without subsequent management:

The study conducted by Castillo *et al.*⁴⁹ was a community pharmacy-based study, which evaluated the feasibility of a COPD screening program to identify high risk patients using spirometry. This pilot cross-sectional study included 161 participants with no prior history of lung disease. The participants were initially recruited by their pharmacists based on their age, smoking status and respiratory symptoms. The validated Global Initiative for Obstructive Lung Disease (GOLD) screening questionnaire¹¹ was used for identifying the at-risk individuals and 62% of the screened participants were found to be at high risk of COPD. Pharmacists found airflow limitation in 24% of these patients using spirometry, who were then referred to the hospital for further assessment. Participating pharmacists attended a 4-day training course where they were trained in patient recruitment and spirometry testing.

COPD screening study with subsequent management:

Fuller *et al.*⁵⁰ implemented a spirometry-based COPD screening program through community pharmacies and evaluated the role of pharmacists in screening for patients at risk. This was a prospective study in which 185 people with no prior history of COPD were included. The COPD Population screener questionnaire³³, a validated screening tool was used, which identified 19% of the participants to have an increased risk of COPD. Through spirometry, pharmacists identified 9% of screened participants to have airflow obstruction indicative of obstructive lung disease. Management interventions included referral to physicians, smoking cessation advice and follow-up after two to six months. This resulted in 22% of the patients successfully quitting smoking. The participating pharmacists were provided training and were assessed in spirometry testing, analysis and interpretation of results.

Overall, both studies demonstrated that community pharmacists were successful in screening patients at high risk of COPD through spirometry testing. Castillo *et al.*⁴⁹ and Fuller *et al.*⁵⁰ found that 73% and 99% of the spirometry tests conducted by the community pharmacists, were judged acceptable after review by pulmonary experts.

DISCUSSION

This review broadly scopes the literature and provides an overview of the role of community

pharmacists in the screening/assessment of undiagnosed COPD and poorly controlled asthma with or without subsequent management. The study highlights that community pharmacists can successfully screen and manage patients with poor asthma control and those at risk of COPD. The majority of the reviewed studies used validated screening/assessment tools, which were effective in identifying poor asthma control or undiagnosed COPD. Further, all the studies in which pharmacists provided assessment/screening with subsequent management showed significant improvements in patients with asthma control or in COPD management outcomes.

Strengths and limitations

The study highlights the important role of community pharmacists in screening and/or management of the two most prevalent chronic respiratory diseases. This is one of the first reviews to evaluate this role of community pharmacists in providing screening with/without subsequent management to patients with asthma and COPD. The strength of our study was that the search strategy was extensive and covered a large number of relevant databases. To reduce the risk of selection bias and incorrect categorization all the included articles were analysed and critically examined by three reviewers independently. Further, this review gives a true representation of the value of screening, because we were able to categorise studies into those that were using the community pharmacy to screen for asthma/COPD as opposed to those studies that assessed all patients and included them.

Our study had some limitations. Only articles written in the English language were included, which might have introduced language bias. A further source of potential bias was publication bias since only published studies available in full-text were included. Also, we had limited our search to the last 10 years, which may have affected the number of articles identified. However, this was intentional as we wanted to review and document the recent developments in this area. Another limitation of our study was the exclusion of the grey literature, which may have led to some relevant papers not being included in our review.

Asthma Studies

Our preliminary search identified a number of articles on asthma studies, but several had to be excluded as they did not screen or assess patients^{7,31} although some of them claimed to be assessing/screening asthma control⁵⁷, or was a follow-up study.⁵⁶ The review also found that although all of the included studies suggested screening for poor asthma control, critical examination of the content revealed that seven of the fifteen studies were actually assessing asthma control in every one presenting to the pharmacy with a prior diagnosis of asthma and only eight of the studies involved screening. For a study to be considered as a screening study, it had to identify the patients at increased risk of poor control using a screening tool. Therefore we chose to categorize

the asthma studies into four categories depending on whether the patients were being assessed or screened for poor control and whether they were/they were not provided with subsequent management by the pharmacist.

Assessment/screening of asthma control

Early identification of poor asthma control through screening is highly important in the management of asthma as asthma control is not only reflective of the patients' clinical status but is also predictive of the patients' future risk of exacerbations and thus, it has cost and health implications.⁵ Effective screening can help reduce this mortality and morbidity, improve the quality of life as well as reduce health care costs and resources. Our review found that community pharmacies present an ideal venue for screening those with poorly controlled asthma, as often patients with poor control tend to visit their pharmacies to obtain their reliever medications. This is especially true in countries like Australia and UK, where the over-the-counter availability of reliever medications, confers a higher likelihood on community pharmacy as being a worthwhile asthma control-screening venue.

In the reviewed asthma studies, several different methods were utilised for assessment and screening of poor asthma control. These included symptom based measures such as patient questionnaires and objective tools including lung function testing and dispensed medication history. In general, it was found that patients were able to self-administer, self-assess and report their symptoms successfully irrespective of the questionnaire used. This indicates that the ACQ6/ACT5/JMI assessment tools are convenient to administer in the pharmacy setting and are sensitive to change. This is consistent with other studies in primary care where these instruments were found to be useful and practical in assessing/screening of poor asthma control.^{52,58,59}

Among the reviewed studies, the most commonly used validated questionnaire for assessing asthma control was the Asthma Control Test (ACT) while the Jones Morbidity Index (JMI) was the most commonly used asthma control screening tool. There were only three studies which measured lung function by spirometry testing along with the screening questionnaire as part of the risk assessment for asthma control.^{41,47,48} These studies showed that community pharmacists also have the capacity to provide lung function assessment and to get patients to focus on their lung health.

The decision concerning the choice of a particular screening questionnaire is best informed by considering the intended purpose and setting where the tool will be used.⁶⁰ Further, additional factors such as the content, practicality, response burden, availability of benchmark scores, and adaptability to multiple administration modes of each questionnaire should also be considered when deciding which tool to use.⁶⁰ From a content perspective, the ACT, the JMI and the ACQ6 are comparable, in that, they contain questions on activity limitations due to asthma, shortness of breath, impact of asthma symptoms on sleep, and rescue medication use.

The ACT asks respondents to rate their asthma control; the JMI categorizes the respondents into low, medium or high morbidity; while the ACQ6 has separate questions on wheezing, severity of morning asthma symptoms, and requires lung function testing. The ACQ6 was primarily designed for use in clinical research trials while the ACT and the JMI were designed for clinical use with patients.^{52,60} Irrespective of the method used for identification, all the studies showed that more than half of the population screened or assessed had poor asthma control.

In some studies^{44,45}, however, the screening questionnaires were sent home to at-risk people, which resulted in very low return rate (15%). Therefore, it would seem that 'on site' risk assessment in the pharmacies would be the more appropriate method for screening as a significant number (59-88%) of the people screened were identified by the pharmacist at risk of poor control.

Asthma management interventions

Management interventions were provided in nine of the asthma studies by the community pharmacists and varied from simple interventions like providing referral to general practitioners^{44,45} to more complex interventions like the pharmacy asthma care program.^{42,43,47} All the studies in which management was provided to people with poor asthma control showed that community pharmacist led intervention had a positive impact on asthma control. Most studies identified that asthma control was significantly affected by management interventions focusing on improving medication adherence, inhaler technique, asthma knowledge and changes in patients' perception of their disease and their behaviour.^{39,40,42,43,46,47} This is consistent with other pharmacy based asthma studies involving only management interventions (that were excluded due to lack of the screening component).^{7,31}

Duration of Interventions

Asthma is a chronic condition often influenced by seasonal variations and thus, a specific period of time may not adequately reflect symptomatic control.⁶¹ In order to highlight the effect of asthma screening and management interventions, such intervention studies need to be conducted over longer durations or need to have a control group so as to account for these seasonal variations in asthma. Our review found that most of the asthma assessment/screening, intervention and follow up studies were conducted over a short time period, ranging from a few weeks to a few months and so they did not account for the impact of seasonal variation in asthma. Only four^{40,43,46,47} of the asthma studies reviewed included a control group. Thus it would be appropriate to incorporate a control group or have proper duration of intervention when designing future studies. This would also help in evaluating long-term sustainability of the intervention, which is also important if these models are to be implemented and adopted on a wider scale.

Training of pharmacists

One of the barriers reported by pharmacists in providing interventions successfully is the lack of sufficient knowledge and confidence.^{62,63} Therefore, training program incorporating provision of asthma information and skills development may help the pharmacists in providing screening and management services more confidently. This is evident in the review as out of fifteen asthma studies analysed for the review, eleven studies³⁸⁻⁴⁸ provided training to the participating pharmacists on study protocol, screening/assessment and management of people with poorly controlled asthma. In only two studies^{41,48} pharmacists completed an accreditation assessment after training. Although in many studies, the training was not followed by an assessment of the pharmacist's performance, this could be incorporated in the planning of future asthma studies. Provision of a structured training program followed by skill assessment maintains competency of the participating pharmacists, which is in turn important for the successful implementation and maintenance of the screening and management service.

Study design

Within the included studies, a variety of study designs were evident, ranging from national surveys, cross-sectional studies to randomized controlled trials. The number of asthma patients participating in these studies varied from 24 to 5551 and a total of 12,547 asthma patients participated in the fifteen studies reviewed. Regardless of the study design or the size of the population studied all of the studies showed that community pharmacists can play an important role in identifying people at risk of poor asthma control with or without subsequent management.

It is also evident from the review that there has been a substantial increase in the number of research reports supporting pharmaceutical care in asthma patients which is consistent with the expanding role of pharmacists in this field, in different parts of the world.⁶⁴ However only seven studies were found in the last ten years that evaluated pharmacists' impact on screening for poor asthma control with subsequent management in community settings world-wide. Out of the seven studies, six were from Australia. It is also notable that similar structured services for asthma offered in other Australian primary healthcare venues have shown less objective evidence of improvement in patient management and outcomes as compared to those delivered through the community pharmacy.⁶⁵ Although a number of screening services have been provided by community pharmacies for other chronic conditions internationally, our review found that little has been done in asthma. The systematic review conducted by Ayorinde *et al.*⁶⁶ also identified a number of studies for screening of various chronic conditions like cardiovascular disease, musculoskeletal disease, diabetes, or osteoporosis, but very few for asthma.⁶⁶

COPD Studies

Similar to the asthma studies, our initial search had identified a number of COPD studies, but many had to be excluded from our review due to the fact that they exclusively focussed on management of COPD rather than screening by pharmacists.^{67,70} Ultimately only two COPD studies were included in our review, one from Spain⁴⁹ which involved screening of COPD and the other was from USA⁵⁰ which involved screening with subsequent intervention by the community pharmacist.

COPD Screening

Often, COPD remains undiagnosed especially in the mild/moderate stages and early detection through screening can help improve morbidity and slow the progression of the disease. Our review found that trained community pharmacists can have a positive impact on COPD patients, through the provision of screening to high-risk individuals. In the reviewed studies, COPD detection rates were found to be similar to those previously reported for other primary care providers, indicating that community pharmacy can provide a complementary setting for COPD case finding.⁴⁹ Further, the accuracy of pharmacist-performed spirometry was very promising compared to other care providers. In the two COPD studies included in our review, 70%⁴⁹ and 99%⁵⁰ of the spirometry tests conducted by pharmacists were judged acceptable in comparison to 46% by primary care physicians and 76% by trained nurses.⁵⁰ This thus highlights that there is an opportunity for community pharmacists to not only manage but also screen patients for undiagnosed COPD.

COPD Management

Several pharmacy-based studies (although excluded from our review due to lack of screening) which have provided COPD management interventions involving medication adherence, inhaler technique, smoking cessation and immunisations, have demonstrated significant improvements in different aspects of COPD management.^{67,70}

Our review found there was just one study that conducted screening followed by subsequent management and demonstrated the potential role of community pharmacist in COPD management. The main management intervention in this study

focussed around smoking cessation, which has been shown to be an effective strategy in other studies conducted globally.⁶⁸ Given that smoking is a major risk factor for the development of COPD, pharmacists can target patients seeking help with smoking cessation, screen for undiagnosed COPD and recommend identified at-risk individuals for COPD management.

In countries with high obstructive lung disease burden, smoking remains a problem. It has been found that the level of awareness and understanding about the disease in the general population is inadequate and many patients believe that the symptoms of COPD, particularly coughing and difficulty in exercising or daily activities because of shortness of breath, are part of the ageing process.⁶⁹ Thus there is an unmet need for targeted and effective pharmacist delivered interventions that could form part of the risk assessment and risk reduction spectrum.

CONCLUSIONS

This review identified that community pharmacists can play an effective role in screening and management of undiagnosed COPD and screening/assessment and management of poorly controlled asthma. The study also shows that whilst effort has been expended by pharmacy care researchers in pursuing management service models in people with asthma or COPD, basic risk assessment or screening followed with management has not been as intensively investigated. Our findings can be used to inform future research focusing on development of a feasible patient care delivery model in pharmacy that would involve screening to identify patients with the greatest need, that is, those with poor asthma control or patients at risk of COPD and then provide them with targeted management interventions.

CONFLICT OF INTEREST

The Authors have no conflicts of interest to disclose. The Authors alone are responsible for the content and writing of the paper.

Funding: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

References

1. Thomas R, Parikh R, Paul P, Muliylil J. Population-based screening versus case detection. *Indian J Ophthalmol.* 2002;50(3):233-237.
2. National Health Priority Action Council (NHPAC). National Chronic Disease Strategy, Australian department of health and ageing, 2006. Online ISBN: 0642828695. <http://www.health.gov.au/chronicdiseasestrategy> (Accessed June 14 2013).
3. World Health Organization. Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach. 2007. http://www.who.int/gard/publications/chronic_respiratory_diseases.pdf (Accessed July 09 2013).
4. Bahadori K, Doyle-Waters MM, Marra C, Lynd L, Alasaly K, Swiston J, FitzGerald JM. Economic burden of asthma: a systematic review. *BMC Pulm Med.* 2009;9:24. doi: 10.1186/1471-2466-9-24
5. GINA (Global Initiative for Asthma). Global strategy for asthma management and prevention 2009 (update). Bethesda, Maryland: National Institutes of Health, National Heart, Lung and Blood Institute. http://www.ginasthma.org/uploads/users/files/GINA_Report_2011.pdf. (Accessed July 09 2013).

6. Cochrane MG, Bala MV, Downs KE, Mauskopf J, Ben-Joseph RH. Inhaled corticosteroids for asthma therapy: patient compliance, devices, and inhalation technique. *Chest*. 2000;117(2):542-550.
7. Basheti IA, Armour CL, Bosnic-Anticevich SZ, Reddel HK. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy Clin Immunol*. 2007;119(6):1537-1538.
8. Holgate ST, Price D, Valovirta E. Asthma out of control? A structured review of recent patient surveys. *BMC Pulm Med*. 2006;6(Suppl 1):S2.
9. Vieira JW, Silva AA, Oliveira FM. Knowledge and impact on disease management by asthmatic patients. *Rev Bras Enferm*. 2008;61(6):853-857.
10. Laforest L, Van Ganse E, Devouassoux G, Osman LM, Bauguil G, Chamba G. Patient-reported adverse events under asthma therapy: a community pharmacy-based survey. *Clin Pharmacol Ther*. 2007;82(2):167-172.
11. The Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2013. <http://www.goldcopd.org/> (Accessed: July 09 2013).
12. Buist AS, McBurnie MA, Vollmer WM, Gillespie S, Burney P, Mannino DM, Menezes AM, Sullivan SD, Lee TA, Weiss KB, Jensen RL, Marks GB, Gulsvik A, Nizankowska-Mogilnicka E; BOLD Collaborative Research Group. International variation in the prevalence of COPD (The BOLD Study): a population-based prevalence study. *Lancet*. 2007;370(9589):741-750.
13. Lyngs AM, Backer V, Gottlieb V, Nybo B, Ostergaard MS, Frølich A. Early detection of COPD in primary care--the Copenhagen COPD Screening Project. *BMC Public Health*. 2010;10:524. doi: 10.1186/1471-2458-10-524
14. Hersberger KE, Renggli VP, Nirrko AC, Mathis J, Schwegler K, Bloch KE. Screening for sleep disorders in community pharmacies - evaluation of a campaign in Switzerland. *J Clin Pharm Ther*. 2006;31(1):35-41.
15. Snella KA, Canales AE, Irons BK, Sleeper-Irons RB, Villarreal MC, Levi-Derrick VE, Greene RS, Jolly JL, Nelson AA. Pharmacy- and Community-Based Screenings for Diabetes and Cardiovascular Conditions in High-Risk Individuals. *J Am Pharm Assoc* (2003). 2006;46(3):370-377.
16. Lönnroth K, Karlsson M, Lan NT, Buu TN, Dieu TT. Referring TB suspects from private pharmacies to the National Tuberculosis Programme: experiences from two districts in Ho Chi Minh City, Vietnam. *Int J Tuberc Lung Dis*. 2003;7(12):1147-1153.
17. Bell CA, Eang MT, Dareth M, Rothmony E, Duncan GJ, Saini B. Provider perceptions of pharmacy-initiated tuberculosis referral services in Cambodia, 2005-2010. *Int J Tuberc Lung Dis*. 2012;16(8):1086-1091. doi: 10.5588/ijtld.11.0669
18. Community Pharmacy at the heart of public health. Published by the Pharmaceutical Services Negotiating Committee. www.psn.org.uk. (Accessed July 09 2013).
19. Gupta S, Vij A, Cafiero E, Bloom D, Agarwal S, Donelan K, Kopans D, Saini S. Retail venue based screening mammography: assessment of women's preferences. *Acad Radiol*. 2012;19(10):1268-1272. doi: 10.1016/j.acra.2012.04.022
20. Krass I, Mitchell B, Clarke P, Brillant M, Dienaar R, Hughes J, Lau P, Peterson G, Stewart K, Taylor S, Wilkinson J, Armour C. Pharmacy Diabetes Care Program: analysis of two screening methods in Australian community pharmacy. *Diabetes Res Clin Pract*. 2007;75(3):339-347.
21. Naunton M, Peterson GM, Jones G. Pharmacist-provided quantitative heel ultrasound for rural women at risk of osteoporosis. *Ann Pharmacother*. 2006;40(1):38-44.
22. Fuller JM, Wong KK, Krass I, Grunstein R, Saini B. Sleep disorders screening, sleep health awareness, and patient follow-up by community pharmacists in Australia. *Patient Educ Couns*. 2011;83(3):325-335. doi: 10.1016/j.pec.2011.05.004
23. Peterson GM, Fitzmaurice KD, Krup H, Jackson SL, Rasiyah RL. Cardiovascular risk screening program in Australian community pharmacies. *Pharm World Sci*. 2010;32(3):373-380. doi: 10.1007/s11096-010-9379-8
24. Hourihan F, Krass I, Chen T. Rural community pharmacy: a feasible site for a health promotion and screening service for cardiovascular risk factors. *Aust J Rural Health*. 2003;11(1):28-35.
25. Howard K, Salkeld G. Home bowel cancer tests and informed choice - is current information sufficient? *Aust N Z J Public Health*. 2003;27(5):513-516.
26. Emmerton L, Buhner Skinner M, Gardiner E, Nissen L, Debattista J. A trial of the distribution of chlamydia self-collection postal specimen kits from Australian community pharmacies. *Sex Health*. 2011;8(1):130-132. doi: 10.1071/SH10068
27. Gudka S, Marshall L, Creagh A, Clifford R. To develop and pilot a best practice community pharmacy chlamydia screening model. Pharmacy Guild of Australia Research and Development Program. 2010. <http://www.guild.org.au/services-programs/research-and-development/archive---fourth-agreement/iig-003> (Accessed July 14 2013).
28. Teh R, Chen T, Krass I. Consumer perspectives of pharmacist-delivered health information and screening services. *Int J Pharm Pract*. 2001;9(4):261-267.
29. Taylor J, Krska J, Mackridge A. A community pharmacy-based cardiovascular screening service: views of service users and the public. *Int J Pharm Pract*. 2012;20(5):277-284. doi: 10.1111/j.2042-7174.2012.00190.x
30. Emmerton L, Shaw J, Kheir N. Asthma management by New Zealand pharmacists: a pharmaceutical care demonstration project. *J Clin Pharm Ther*. 2003;28(5):395-402.
31. Portlock J, Holdem M, Patel S. A community pharmacy asthma MUR project in Hampshire and the Isle of Wight. *Pharm J*. 2009;282(7537):109-112.
32. Mangiapane S, Schulz M, Mühlig S, Ihle P, Schubert I, Waldmann HC. Community pharmacy-based pharmaceutical care for asthma patients. *Ann Pharmacother*. 2005;39(11):1817-1822.
33. Martinez FJ, Raczek AE, Seifer FD, Conoscenti CS, Curtice TG, D'Eletto T, Cote C, Hawkins C, Phillips AL; COPD-PS Clinician Working Group. Development and initial validation of a self-scored COPD Population Screener Questionnaire (COPD-PS). *COPD*. 2008;5(2):85-95. doi: 10.1080/15412550801940721

34. Laforest L, Van Ganse E, Devouassoux G, Osman LM, Brice K, Massol J, Bauguil G, Chamba G. Asthmatic patients' poor awareness of inadequate disease control: a pharmacy-based survey. *Ann Allergy Asthma Immunol.* 2007;98(2):146-152.
35. Laforest L, Van Ganse E, Devouassoux G, Chretien S, Bauguil G, Pacheco Y, Chamba G. Quality of asthma care: results from a community pharmacy based survey. *Allergy.* 2005;60(12):1505-1510.
36. Mendes Z, Madeira A, Suzete C, Sonia I, Marianela V, Artur TA, Antonio SL, Mario M. Asthma Control Assessment using Asthma Control Test in Portuguese Pharmacies. *Rev Port Imunoalergologia* 2010;18(4):313-330.
37. Mehuys E, Van Bortel L, Annemans L, Remon JP, Van Tongelen I, Van Ganse E, Laforest L, Chamba G, Brusselle G. Medication use and disease control of asthmatic patients in Flanders: a cross-sectional community pharmacy study. *Respir Med.* 2006;100(8):1407-1414.
38. Nishiyama T, Chrystyn H. The Jones Morbidity Index as an aid for community pharmacists to identify poor asthma control during the dispensing process. *Int J Pharm Pract.* 2003;11(1):41-46.
39. Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: feasibility and acceptability of training by pharmacists. *Respir Med.* 2011;105(12):1815-1822. doi: 10.1016/j.rmed.2011.07.004
40. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. *Thorax.* 2003;58(10):851-854.
41. Armour CL, Lemay K, Saini B, Reddel HK, Bosnic-Anticevich SZ, Smith LD, Burton D, Song YJ, Alles MC, Stewart K, Emmerton L, Krass I. Using the Community pharmacy to identify patients at risk of poor asthma control and factors which contribute to this poor control. *J Asthma.* 2011;48(9):914-922. doi: 10.3109/02770903.2011.615431
42. Saini B, LeMay K, Emmerton L, Krass I, Smith L, Bosnic-Anticevich S, Stewart K, Burton D, Armour CL. Asthma disease management - Australian pharmacists' interventions improve patients' asthma knowledge and this is sustained. *Patient Educ Couns.* 2011;83(3):295-302. doi: 10.1016/j.pec.2011.05.001
43. Saini B, Krass I, Armour CL. Development, implementation, and evaluation of a community pharmacy-based asthma care model. *Ann Pharmacother.* 2004;38(11):1954-1960.
44. Bereznicki BJ, Peterson GM, Jackson SL, Walters EH, Fitzmaurice K, Gee PR. Pharmacist-initiated general practitioner referral of patients with suboptimal asthma management. *Pharm World Sci.* 2008;30(6):869-875. doi: 10.1007/s11096-008-9242-3
45. Bereznicki BJ, Peterson GM, Jackson SL, Walters EH, Fitzmaurice KD, Gee PR. Data-mining of medication records to improve asthma management. *Med J Aust.* 2008;189(1):21-25.
46. Mehuys E, Van Bortel L, De Bolle L, Van Tongelen I, Annemans L, Remon JP, Brusselle G. Effectiveness of pharmacist intervention for asthma control improvement. *Eur Respir J.* 2008;31(4):790-799.
47. Armour CL, Bosnic-Anticevich S, Brillant M, Burton D, Emmerton L, Krass I, Saini B, Smith L, Stewart K. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax.* 2007;62(6):496-502.
48. Armour CL, Reddel HK, LeMay KS, Saini B, Smith LD, Bosnic-Anticevich SZ, Song YJ, Alles MC, Burton DL, Emmerton L, Stewart K, Krass I. Feasibility and effectiveness of an evidence-based asthma service in Australian community pharmacies: A pragmatic cluster randomized trial. *J Asthma.* 2013;50(3):302-309. doi: 10.3109/02770903.2012.754463
49. Castillo D, Guayta R, Giner J, Burgos F, Capdevila C, Soriano JB, Barau M, Casan P; FARMAEPOC group. COPD case finding by spirometry in high-risk customers of urban community pharmacies: a pilot study. *Respir Med.* 2009;103(6):839-845. doi: 10.1016/j.rmed.2008.12.022
50. Fuller L, Conrad WF, Heaton PC, Panos R, Eschenbacher W, Frede SM. Pharmacist-managed chronic obstructive pulmonary disease screening in a community setting. *J Am Pharm Assoc (2003).* 2012;52(5):e59-e66.
51. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, Murray JJ, Pendergraft TB. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004;113(1):59-65.
52. Jones KP, Cleary R, Hyland M. Predictive value of a simple asthma morbidity index in a general practice population. *Br J Gen Pract.* 1999;49(438):23-26.
53. Juniper EF, Svensson K, Mörk AC, Ståhl E. Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. *Respir Med.* 2005;99(5):553-558.
54. Steen N, Hutchinson A, McColl E, Eccles MP, Hewison J, Meadows KA, Blades SM, Fowler P. Development of a symptom based outcome measure for asthma. *BMJ.* 1994;309(6961):1065-1068.
55. National Asthma Campaign, Asthma management handbook. National Asthma Campaign Ltd., Melbourne, Australia, 2002.
56. Bereznicki B, Peterson G, Jackson SL, Walters EH, Gee PR. The Sustainability of a community pharmacy intervention to improve the quality use of asthma medication. *J Clin Pharm Ther.* 2011;36(2):144-151. doi: 10.1111/j.1365-2710.2010.01165.x
57. Simpsom M, Gissing PM, Burton DL, Burton MA, Bowman SL. Pharmaceutical care: Impact on asthma medication use. *J Pharm Prac Res.* 2004;34(1):26-29.
58. Miedinger D, Neukomm E, Chhajed PN, Schnyder A, Naef M, Ackermann M, Leuppi JD. The use of the Asthma Control Test in general practice and its correlation with asthma control according to the GINA guidelines. *Curr Med Res Opin.* 2011;27(12):2301-2308. doi: 10.1185/03007995.2011.630722
59. Juniper EF, Bousquet J, Abetz L, Bateman ED; GOAL Committee. Identifying 'well-controlled' and 'not well-controlled' asthma using the asthma control questionnaire. *Respir Med.* 2006;100(4):616-621.
60. Wallenstein GV, Carranza-Rosenzweig J, Kosinski M, Blaisdell-Gross B, Gajria K, Jhingran P. A psychometric comparison of three patient-based measures of asthma control. *Curr Med Res Opin.* 2007;23(2):369-377.
61. Yawn BP. Factors accounting for asthma variability: achieving optimal symptom control for individual patients. *Prim Care Respir J.* 2008;17(3):138-147. doi: 10.3132/pcrj.2008.00004

62. Brown CM, Barner JC, Shepherd MD. Issues and barriers related to the provision of pharmaceutical care in community health centers and migrant health centers. *J Am Pharm Assoc* (2003). 2003;43(1):75-77. doi: 10.1331/10865800360467088
63. Emmerton L, Smith L, LeMay KS, Krass I, Saini B, Bosnic-Anticevich SZ, Reddel HK, Burton DL, Stewart K, Armour CL. Experiences of community pharmacists involved in the delivery of a specialist asthma service in Australia. *BMC Health Serv Res*. 2012;12:164. doi: 10.1186/1472-6963-12-164
64. Benavides S, Rodríguez JC, Maniscalco-Feichtl M. Pharmacist involvement in improving asthma outcomes in various healthcare settings: 1997 to present. *Ann Pharmacother*. 2009;43(1):85-97. doi: 10.1345/aph.1K612
65. Holton CH, Beilby JJ, Harris MF, Harper CE, Proudfoot JG, Ramsay EN, Ruffin RE. Systematic care for asthma in Australian general practice: a randomised controlled trial. *Med J Aust*. 2010;193(6):332-337.
66. Ayorinde AA, Porteous T, Sharma P. Screening for major diseases in community pharmacies: a systematic review. *Int J Pharm Pract*. 2013;21(6):349-361. doi: 10.1111/ijpp.12041
67. Mehuys E, Boussery K, Adriaens E, Van Bortel L, De Bolle L, Van Tongelen I, Remon JP, Brusselle G. COPD Management in Primary Care: An Observational, Community Pharmacy–Based Study. *Ann Pharmacother*. 2010;44(2):257-266. doi: 10.1345/aph.1M481
68. Sinclair HK, Bond CM, Stead LF. Community pharmacy personnel interventions for smoking cessation. *Cochrane Database Syst Rev*. 2004;(1):CD003698.
69. American Pharmacists Association Foundation. White paper on expanding the role of pharmacists in chronic obstructive pulmonary disease. *J Am Pharm Assoc* (2003). 2011;51(2):203-211. doi: 10.1331/JAPhA.2011.11513
70. Verma A, Harrison A, Torun P, Vestbo J, Edwards R, Thornton J. Are pharmacists reducing COPD'S impact through smoking cessation and assessing inhaled steroid use? *Respir Med*. 2012;106(2):230-234. doi: 10.1016/j.rmed.2011.08.011
71. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*. 2009;339:b2535. doi: 10.1136/bmj.b2535

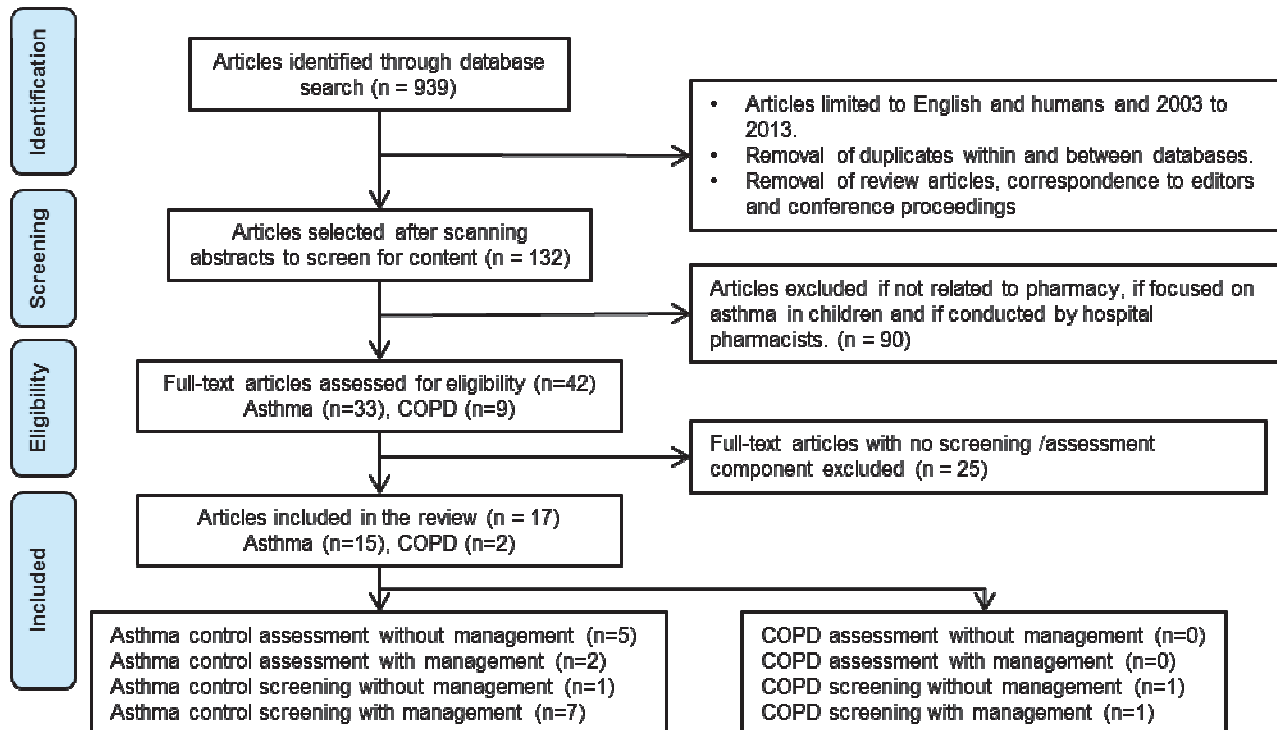


Figure 1- Flowchart describing the selection of studies that were included in the review. Adapted from the PRISMA 2009 flow diagram presented in Moher *et al.*⁷¹

Table1- Screening and management of poorly controlled asthma by community pharmacists						
Citation, Country	Purpose of study	Study description	Type and Method of assessment	Outcomes measures	Key findings	Comments
Asthma control assessment studies without subsequent management component						
1. Laforest et al. ³⁴ 2007. France	To investigate whether patients' ability to identify asthma control varied with personal characteristics or factors related to disease management	Design: Cross-sectional study N: 1048 Duration: 7 months	Questionnaire: Validated questionnaire (Asthma Control Test ACT) Number of visits: 2	Primary : level of asthma control Secondary: patients perception of control	> 70% of people had inadequate control. 68.5% failed to perceived inadequate control. Patients with most uncontrolled asthma have difficulty in properly perceiving their level of disease control Study suggests improving knowledge about asthma, medication adherence and identification of signs of exacerbation can improve asthma control	Convenience sampling (regular pharmacy customers), multi-site setting (nine cities), validated screening tool. Screening questionnaire sent home. The evaluation of patient perception of asthma control was based on only one question in the ACT. The study does not mention if the pharmacists were trained
2. Laforest et al. ³⁵ 2005. France	To describe the disease management and health care utilization of people with poorly controlled asthma	Design: Retrospective observational study N: 1559 Duration: 7 months	Questionnaire: Validated questionnaire (ACT), Lung function test: peak expiratory flow rate (PEFR) Medical history: pharmacy dispensing records Number of visits: 2	Primary: Level of asthma control. Secondary: measure the type of medication and doctor visits utilized	28% were adequately controlled. 89% of people were on anti-inflammatory asthma control treatments, and 59% were on combinations of long acting beta-agonists (LABA) and inhaled corticosteroids (ICS). However, asthma control therapies were not being used properly or adequately by the patients as majority of patients with asthma were poorly controlled. Therefore improvement in the management of asthma and better patient education are necessary.	Convenience sampling (regular pharmacy customers), multi-site setting (nine cities), validated screening tool. Screening questionnaire sent home. The study does not mention if the pharmacists were trained
3. Mendes et al. ³⁶ 2010. Portugal	To evaluate the prevalence of asthma control at a national level in a campaign carried out by Portuguese pharmacists.	Design: Cross-sectional National Campaign N: 5551 Duration: 1 week	Questionnaire: Validated Questionnaire (ACT)	Primary: level of asthma control Secondary: effect of age, gender and regional factors on asthma control	Pharmacists led screening identified that only 39% of the screened population had controlled asthma, higher proportion of females (58% vs 42%) and progressively lower control with age (over twice in 61-70 years). Lower control of asthma in regional areas	Convenience sampling multi-site setting (Portugal and islands of Azores and Madeira), validated screening tool. Does not mention if the pharmacists were trained.

Table1- Screening and management of poorly controlled asthma by community pharmacists							
4. Mehuys et al. ³⁷ 2006. Belgium	To assess the use of ACT to measure asthma control by community pharmacists and to describe medication use and disease management of patients with asthma	Design: Cross-sectional retrospective study N:166 Duration: 1 year	Medication history: last 12months Questionnaire: Validated Questionnaire (ACT) Lung function test: PEFR	Primary: level of asthma control Secondary: perception of control	49% were poorly controlled. 82% believed their asthma to be totally or well controlled. 63% used combination product containing corticosteroid and long-acting β -agonist. 22% consulted general practitioner (GP), 41% consulted pneumologist and 41% consulted both.	Multi-site setting. Patients were randomly selected. Convenience sampling. Pharmacists were not provided any training	
5. Nishiyama et al. ³⁸ 2003. UK	To determine if JMI can be used to identify people with poor control	Design: cross-sectional study Community pharmacies throughout UK N: 306 Duration: 3 years	Questionnaire: Jones Morbidity Index (JMI)	Primary: assessing asthma control using JMI. Secondary: relationship between control and usage of medicine, knowledge and their attitudes.	>50% were identified with poor control. More people with poor control overused reliever ($p<0.01$) and were less compliant with their preventer ($p<0.001$), less happy with their medication and had less asthma knowledge.	Convenience sampling, multi-site setting. Screening tool not validated at the time of the study. Pharmacists were trained	
Asthma control assessment studies with subsequent management component							
Citation, Country	Purpose of the study	Study description	Type and method of asthma control assessment	Type and method of management	Outcome measure	Key findings	comments
6. Giraud et al. ³⁹ 2011. France	To identify people with poorly controlled asthma and evaluate the feasibility and acceptability of education on inhaler technique in community pharmacies	Prospective observational Study N: 727 Duration: 4 month	Questionnaire: Validated Questionnaire (ACQ6)	Inhaler technique assessment and training and provision of personalized self-stick instructions for the inhaler.	Relationship between poor asthma control and inhalation technique and adherence to medication. Short-term effects of education by pharmacists on inhaler technique, asthma control and adherence to treatment	51% of people with asthma had poor control at baseline. Both ACQ ($p<0.001$) and self-reported adherence (Morisky score, $p<0.01$) were worse when inhaler technique was not optimal at baseline. Optimal inhaler technique resulted in improved ACQ score ($p<0.01$) and Morisky score ($p<0.001$).	Multi-site setting (through-out France). Convenience sampling. Pharmacist was trained. Large sample size, but high dropout rate.

Table1- Screening and management of poorly controlled asthma by community pharmacists							
7. Barbanel et al. ⁴⁰ 2003. UK	To determine if community pharmacist could improve asthma control using self-management advice	Design: randomized controlled trial N: 24 (I :12, C: 12) Duration : 3 months	Questionnaire: Validated North of England asthma symptom scale	Intervention focusing on self-management decision making based on PEFr readings. Provision of educational leaflets and personalized self-management plans Review of inhaler technique	Asthma symptom score	Significant improvement in the intervention group in the asthma symptom score (p<0.001)	Small sample size. Randomized at patient level. Single site setting. Pharmacist was trained.
Asthma control screening study without subsequent management component							
Citation, Country	Purpose of the study	Study description	Type and method of screening	Outcome measure	Key findings	comments	
8. Armour et al. ⁴¹ 2011. Australia	To describe a population recruited in community pharmacy identified by trained community pharmacists as being at risk for poor asthma outcomes and to identify factors	Cross-sectional study N: 570	Questionnaire: Validated Questionnaire (JMI)	Primary: Level of asthma control Secondary: identify factors that contribute to poor control.	77% of people were identified with severe asthma. Community pharmacists were able to identify factors that contributed to this. These were smoking, incorrect inhaler technique and low medication adherence	Cluster sampling. Multi-site setting (regional and metropolitan areas in 4 states). Pharmacists were trained and assessed. Validated screening tool.	
Asthma control screening studies with subsequent management component							
Citation, Country	Purpose of the study	Study description	Type and method of Screening	Type and method of management	Outcome measures	Key findings	comments
9. Saini et al. ⁴² 2011. Australia	To identify those with poorly controlled asthma and to assess any improvements in knowledge of these patients after a tailored education program delivered by pharmacists and measure the sustainability of any improvements	Design: parallel group design N: 570 (Group 1: 292, Group 2: 278) Duration: 6 months+12 months follow-up	Questionnaire: Validated questionnaire Jones Morbidity Index (JMI),	Interventions focusing on asthma knowledge improvement, based on individual patient's need and goals (counseling on asthma triggers, role of preventer and clarifying misunderstanding about asthma) Number of visits: 3-4	Primary: level of asthma control Secondary: level of asthma knowledge	77% of people with asthma had poor control. Asthma knowledge interventions provided by pharmacists significantly decreased from baseline to the end of the service (p<0.001). Improvements in knowledge are achievable and sustainable if pharmacists used targeted Educational interventions.	Convenience sampling, randomization of pharmacies. Multi-site (regional and metropolitan areas in 4 states). Validated screening tool. Pharmacists were trained Asthma control was not reported at the end of the study. The study does not mention clearly how improvement in asthma knowledge changes in asthma control following pharmacist intervention. No control group. Two different interventions

10. Saini et al. ⁴³ 2004. Australia	To measure the impact of asthma management provided by community pharmacists on clinical, humanistic, and economic outcomes of people with asthma.	Design: Parallel group controlled trial N:102 (I: 52, C: 50) Duration: 6 months	Signs and symptoms of asthma control	Three visits involving a needs analysis, intervention, collaborative goal setting and monitoring. Number of visits: 3-4	Clinical outcome: Asthma severity score, peak flow index, risk of non-adherence, inhaler technique, action plan ownership Humanistic: Quality of life, perceived level of control, asthma knowledge Economic: hospitalization, medication profile, willingness to pay	Significant improvement in asthma severity score, PEF index, use of corticosteroids, inhaler technique, perceived control and knowledge in the intervention group (p<0.001). Bronchodilator use also improved significantly (p<0.015).	Convenience sampling, pharmacists in the intervention group were trained, difficulty retaining patients in control group.
11. Bereznicki et al. ⁴⁴ 2008. Australia	To identify patients with sub-optimal asthma management using community pharmacy medication records and then implement and evaluate a multi-disciplinary educational intervention to improve asthma management	Multi-site controlled study N: 1551 (I: 702, C: 849)	Medication history: Data-mining software program	Patients identified with sub-optimal asthma management (based on the preventer to reliever ratio) in the intervention group, were referred to their GP for review. Educational material on asthma was also mailed to the patient along with asthma knowledge, asthma control and asthma-related QOL questionnaires	Primary: Preventer-to reliever ratio(P:R) (daily usage in µg) Asthma medication profile	The median P:R ratio increased significantly from 0.1 to 0.3 (p<0.001) in the post-intervention period, while it remained the same in the control group. A higher proportion of intervention patients than control patients were using ICS therapy in the post-intervention period (p<0.01)	Multi-site setting (single state, Tasmania). Pharmacist were trained in the use of data-mining software Blinding at pharmacist level. Non-validated screening tool. Does not mention what proportion of patients were identified with poor control Unclear duration of study

Table1- Screening and management of poorly controlled asthma by community pharmacists							
12. Bereznicki et al. ⁴⁵ 2008. Australia	To assess the impact of an intervention initiated by community pharmacists, involving the provision of educational material and general practitioner (GP) referral, on asthma knowledge and self-reported asthma control and asthma-related quality of life (QOL) in patients who may have suboptimal management of their asthma	Sub-study of Bereznicki et al. ³⁹ N: 173 (I: 116, C: 57) Duration: 6 months	Medication history: Data-mining software	Patients identified with sub-optimal asthma management (based on P:R ratio) in the intervention group, were referred to their GP for review. Educational material on asthma was also mailed to the patient along with asthma knowledge, asthma control and asthma-related QOL questionnaires	Asthma knowledge (Consumer Asthma Knowledge Questionnaire), asthma control(ACT) and asthma-related quality of life score (mini-AQLQ)	Asthma control and asthma-related QOL scores were significantly higher in intervention patients (p<0.001) after 6 months.(pre-post test comparison) No significant change in asthma knowledge was observed.	Follow-up from the 2008 study. ³⁹ Multi-site setting (single state, Tasmania). Pharmacists were trained in using the data-mining software. Blinding at pharmacist level. Non-validated screening tool. Does not mention what proportion of people with asthma had poor control. High drop-out rate.
13. Mehuys et al. ⁴⁶ 2008. Belgium	To assess the impact of a community pharmacist intervention in promoting optimal asthma medication use in patients identified with asthma control.	Design: Randomized controlled parallel group trial N: 201 (I: 107, C: 94) Duration: 6 months	Prescription for an asthma medication Questionnaire: Validated questionnaire (ACT)	Tailored intervention based on the asthma knowledge, inhaler device and medication use.	Primary: level of asthma control (ACT) Secondary: diary data, asthma exacerbation, adherence to controller medication, asthma quality of life, Inhaler technique and asthma knowledge	Poor asthma control improved from 61% to 46.7% following intervention. Significant decrease in rescue medication use (p=0.012). Significant improvement in adherence to controller medication (p=0.016) and inhaler technique (p=0.004) in the intervention group. No change in asthma quality of life and asthma knowledge score	Multi-site setting, randomization at patient level. Pharmacists were trained. Validated screening tool? Not clear whether the ACT was used for screening for poor control.

14. Armour et al. ⁴⁷ 2007. Australia	To investigate if pharmacist-delivered asthma care program based on national guidelines improves asthma control	Multi-site randomized intervention Vs control trial N: 396 (I: 191, C: 205) Duration: 6 months	Questionnaire: Validated Questionnaire (JMI)	Interventions focusing on ongoing cycle of assessment, goal setting, monitoring and review. Counseling and education on disease, medication, triggers and inhaler technique	Clinical outcomes: Asthma control/severity, Medication profile Daily dose of medication Inhaler technique Adherence Action plan ownership Humanistic outcomes: Asthma related quality of life Perceived control of asthma and Asthma knowledge	Overall 79% (88% in intervention and 71% in control group) were identified with severe asthma. Proportion of intervention patients with severe asthma declined from 88% to 53% (p<0.001) while control group patients remained unchanged (71% to 68%; p= 0.11). Asthma quality of life score (p=0.05), consumer asthma knowledge score (p<0.01) and perceived control of asthma score (p<0.01) improved significantly	Cluster sampling. Large national pharmacy-based service. Multi-site setting (regional and metropolitan areas in 4 states). Pharmacists were trained and assessed. Validated screening tool.
15. Armour et al. ⁴⁸ 2013. Australia	To test the feasibility, effectiveness and sustainability of a pharmacy asthma service in primary care.	Design: Cluster randomized trial N: 570 Duration: 6+12 months follow-up	Questionnaire: Validated Questionnaire (JMI)	Interventions and counseling which focused on medication use and adherence, asthma knowledge and beliefs, asthma triggers and use of an asthma action plan. Goal setting.	Level of asthma control (ACQ) Asthma quality of life (IAQLQ) Perceived control of asthma (PACQ), asthma Knowledge (CQ), drug regimen, risk of non-adherence, lung function (spirometry) and inhaler technique. Assess whether clinical and humanistic outcomes could be achieved by 3 vs 4 consultations over 6 months and assess if the service is sustainable after 12 months	77% of people were identified with poor asthma control. Overall 48% demonstrated a clinically important reduction of ≥ 0.5 in their ACQ score. Significant improvement in quality of life, perceived control, asthma knowledge, inhaler technique, adherence with no significant difference between the 2 groups. Asthma control improved in both the 3 and 4 visits. (3 visits = 29% to 61%, 4 visits = 21% to 59%; p = 0.791). Significant increase in asthma action plan possession from 19% to 56%. There was no significant decrease in asthma control even after 12 months.	Follow-up of the 2011 study. Cluster sampling. Multi-site setting (regional and metropolitan areas in 4 states). Validated screening tool. There was no control group. Pharmacists and patients were not blinded. Pharmacists were trained and assessed.

Table 2-Screening with or without subsequent management of COPD by community pharmacists							
Citation, Country	Purpose of study	Description of study	Type and method of		Outcome measure	Key findings	comments
			screening	management			
Screening for COPD without subsequent management component							
1. Castillo et al. ⁴⁹ 2008. Spain	To evaluate the feasibility of a community pharmacy program for COPD case finding in high risk customers by means of spirometry	Design: Pilot cross-sectional descriptive study N: 161 Duration: 1 month	Questionnaire: Validated GOLD screening questionnaire Lung function test: spirometry	Referral to the hospital for further assessment	Primary: identification of patients at high risk of COPD. Secondary: assess feasibility of providing spirometry by community pharmacies	62% were identified at high risk by the GOLD questionnaire and 24% had an FEV1/FVC ratio<0.7 indicative of airflow limitation. 70% of spirometries were rated as being of acceptable quality	Multi-site setting. Convenience sampling Pharmacists training provided
Screening for COPD with subsequent management							
2. Fuller et al. ⁵⁰ 2012. USA	To determine if pharmacists can accurately perform spirometry screening and interpret results	Design: prospective study N: 185 Duration: 4 months	Questionnaire: Validated COPD screener questionnaire Lung function test: spirometry	Referral of people with obstruction to their physician for review and follow-up. Lung age calculation for active smokers based on their spirometry result and counseling provided on smoking cessation. Patients were followed-up after 2-6 months by phone or email	Primary: identification of patients at high risk of COPD. Secondary: assess feasibility of providing spirometry by community pharmacies Spirometry screening improved enrolment in smoking cessation programs	9% of people screened had airflow obstruction FEV1/FVC<LLN (lower limit of Normal) indicative of obstructive lung disease. 99% of the spirometry tests were judged acceptable by pulmonary experts. 78% reported some attempt at smoking cessation and 22% had successfully quit smoking after screening. 33% of the participants with obstruction had seen their physician for treatment	Multi-site setting (4 pharmacies). Convenience sampling Pharmacists training provided