The management of asthma in adult patients in the community pharmacy setting: literature review

Abstract

Background: Asthma poses a public health concern, with an estimated 235 million people currently living with the condition globally. The provision of evidence-based, patient-centred services for adult asthma patients in community pharmacy which involves collaboration across the multidisciplinary team could improve their asthma control.
Objectives: A literature review was conducted to examine the evidence of asthma management in community pharmacy setting.
Methods: Five databases were searched to identify relevant articles published before February 2021. Screening of the potential studies was performed to remove articles that did not comply with the inclusion criteria. Relevant data from all included studies was collected using a data extraction form to ensure consistency throughout the review.
Results: Twenty studies were included in the review; all were conducted in community pharmacy settings in the period of 2001-2020, in different countries. The studies included randomised controlled trials, controlled trials and observational studies. Several successful community pharmacy-based services that were provided to asthma patients to improve their asthma management were highlighted in this review. These interventions consisted of one or more components and included: patient education, inhaler technique improvement, patient counselling, self-management plans, development and provision of asthma action plans and referral to other health care practitioners. None of the studies involved medication or dosage changes by community pharmacy.
Conclusions: The evidence discussed in this review showed that community pharmacists are well-placed to deliver services to asthma patients and many studies were conducted in the community pharmacy to improve asthma control in adult patients. However, further research could be conducted to explore further opportunities for community pharmacy to improve asthma control in adult patients.

Key Words: Community pharmacy, Self-management, Asthma management, Asthma action plan, Asthma patient groups.

Introduction

Asthma is a Long Term Condition (LTC) that is characterised by breathlessness, tightness in the chest, coughing and wheezing, along with episodes of sudden worsening in symptoms (asthma attacks or exacerbations) that can prove fatal.[1] Considered an LTC due to its chronic nature, asthma poses a public health concern, with an estimated 235 million people currently living with asthma globally, according to the World Health Organisation.[2] In the UK, approximately 5.4 million people are living with asthma, affecting 1 in every 11 people.[3 4] A systematic review that was conducted in 2009 estimated asthma economic burden as the highest among other LTCs.[5] The mean cost of asthma per patient were estimated to be USD$ 1900 in Europe countries and USD$ 3100 per patient in the United States of America.[6] A major issue with asthma patients globally is poor levels of control [7,8], regardless the availability of many published guidelines and strategies for the diagnosis and management of asthma.

The Global Initiative for Asthma (GINA) publishes regular documents of the global strategy of asthma management, diagnosis and prevention on their website and updates the documents annually.[9] In the UK, There are published national guidelines for asthma management including, the British Thoracic Society (BTS)/Scottish Intercollegiate Guideline Network (SIGN) [10] and the National Institute for Health and Care Excellence (NICE) guidance [11] and the NICE Quality Standards for asthma.[4] Asthma management involves both primary and secondary care settings.[5] A variety of different healthcare professionals (HCPs), across different practice settings, are involved in the management of asthma patients.[12] In primary care, the patients will see their general practitioner (GP), practice nurse, or nurse practitioner and more recently, a practice pharmacist for the long-term management of their asthma.[12] This may include an Annual Asthma Review (AAR), which involves the monitoring and assessment of asthma control using a validated tool, such as The Royal College Of Physicians' (RCP) 3 questions,[13] lung function, asthma attacks, inhaler technique, adherence and bronchodilator reliance, as well as the development of a Personalised Asthma Action Plan (AAP).[10,14] The development and provision of an AAP that contains advice regarding how to recognise any change in asthma control (by symptoms or FEV1) and actions

(seeking for emergency, increase Inhaled Corticosteroids (ICS) use or use an oral Corticosteroids (CS)) to be taken by patient as a response to this change were recommended by GINA, BTS/SIGN and NICE guidelines for asthma.[9-11]

Community pharmacy also has an established role in supporting asthma patients, globally and in the UK.[8,15] They dispense asthma patients' prescriptions, educate them about their medications, and provide advice regarding smoking cessation.[12] As well as this, community pharmacy supports asthma patients by offering services that review their medication, including Medicine use reviews (MURs) and the New Medicine Service (NMS).[16] Current evidence shows that proactive structured reviews improve asthma clinical outcomes, reduce school or work absence, reduce asthma attacks, improve symptom control, and decrease attendance at the Accident and Emergency (A&E) department.[10] However, asthma patients may fail to attend their appointments for a number of reasons, including forgetting their appointments, poor health, mobility problems or feeling that their asthma does not require a review.[17] To ensure the provision of efficient care to patients (including those with asthma), development and improvement of an efficient delivery process is required.[18] The provision of services to asthma patients that focus on preventive care, early treatment and better utilisation of healthcare providers including community pharmacists could improve patient's access to the services and decrease the use of Emergency care.[5,6,19] This kind of services could enhance asthma patients' management and asthma management costs.[6,19] long opening hours, ease of access and flexible appointments system of community pharmacies could improve asthma patients' engagement into their appointments.[20]

Many studies have been conducted to develop and evaluate interventions that are targeted to adult asthma patients in the UK and worldwide. The findings of these studies could be utilised to inform the development of an asthma service that could be targeted to certain groups of adult asthma patients in community pharmacy based on their needs.[8] Furthermore, many researchers have performed literature and systematic reviews to discuss, describe and analyse interventions delivered by pharmacists across different healthcare settings, including community pharmacy.[21] This review aimed to examine the evidence of the

current asthma management in community pharmacy setting. The objectives were to describe asthma interventions in terms of design, feasibility, implementation and outcomes, highlight the impact of the interventions provided on the measured outcomes and to highlight pharmacists' training needs that were identified in the current evidence. A narrative review was conducted rather than systematic because the research question was too broad to fit into an explicit statement of questions regarding participants, interventions, comparisons, outcomes and study design (PICOS).[22] Additionally, studies with any research design were included in the review. A consistent approach was used to describe the core components of the interventions that were evaluated in the included study. For this purpose, the data extraction and analysis during this literature review was informed by the improved version of the Descriptive Elements of Pharmacist Intervention Characterisation Tool (DEPICT 2),[13] which was developed by Correr, et al[23] in 2015. This tool was developed to facilitate the analysis of studies in the pharmacy field and to ensure an in-depth description of pharmacy intervention.[23] DEPICT 2 consists of 142 elements related to the characterisation of the interventions that are classified under 11 domains. DEPICT 2 is a reliable tool that was developed by analysing pharmacists' interventions in 269 RCT studies that were included in 49 systematic reviews.[24] Moreover, 2 domains of DEPICT 2 were used earlier in a systematic review that was conducted in 2017 by Crespo-Gonzalez, et al.[25] The review[25] was conducted to analyse intervention provided by pharmacists in asthma management and the use of DEPICT 2 allowed the authors to extract data on the interventions' core components. In this literature review, eight domains of the tool were used and some amendments were made to the elements, to allow better characterisation of the interventions and to help the researcher to extract enough data regarding the core components of asthma interventions in community pharmacy setting. The tool was not validated in this literature review but further research will be conducted in the future by the research team to validate this tool to be used by other researcher to analyse asthma interventions in community pharmacy setting. Using the interventions characterisation tool allowed the researcher to highlight the multiple components of the interventions that interacted together to improve patient outcomes.[21]

Methods

A narrative review of asthma interventions in community pharmacy was conducted. To reduce bias of narrative reviews, the overall methodology of the review was influenced by methodological principles in the PRISMA guidelines.[22] For example, the same search strategy was used in all of the databases and the inclusion and exclusion criteria were identified and used in the screening process. Moreover, a consistent approach was used to extract data from the included studies and the study quality were assessed by comparison of the studies to each other.

Search strategy

A literature search was undertaken to identify relevant articles published before March 2018 using previously identified search terms. More recently, the search was updated to include any papers published in the period between March 2018 to Feb 2021. The search terms were identified using the PICOS and by searching 2 related systematic reviews[8,26] and PubMed MeSH terms. Subsequently, the search terms were discussed with the research team before the search was undertaken.

The following search terms were used and combined for the literature search in the following Boolean form: ((Pharm* OR Pharmacis* OR (Chemist)) AND ((Community) OR (High street) OR (Pharmacy distribution) OR (Retail)) AND (Asthma* OR Respiratory disease* OR Bronchial disease*) AND ((Medicine optimisation) OR (Medicine management) OR (Patient-centred care) OR (Patient care management) OR (medic* use review*)) AND ((Asthma management) OR (Asthma control))). The following electronic databases were searched: Cochrane Central Registers of Controlled trials, PubMed, CINAHL, SCOPUS and PsychInfo. Hand search was conducted in the Research in Social and Administrative Pharmacy (RSADP) Journal and The International Journal of Pharmacy Practice (IJPP).

Inclusion and exclusion criteria

The studies were considered eligible if they were undertaken in the community pharmacy setting, providing an intervention to improve asthma control in adult asthma patients (identified as over 17 years of age[11]), of which was provided by a community pharmacist. In this literature review, community

pharmacy was defined as a pharmacy or retail unit that allows public access to medications and pharmacy-based services, including any type or size of community pharmacy, such as large chains and small community pharmacies that are located on the high street, in supermarkets or neighbourhood centres.[27] Moreover, studies were included if they were conducted in asthma or Chronic Obstructive Pulmonary Disease (COPD) patients, or in more than one age group, as long as the results were separately outlined for asthma patients or adult patients. Further, the studies were included only if the measured outcomes were related to asthma control, quality of life, lung function, healthcare utilisation, drug-related problems, and/or symptoms improvement, practitioner related and/ or cost, either as a primary or secondary outcome. The selection of the outcomes was influenced by other systematic reviews that reviewed asthma interventions in community pharmacy and to address the aim and objectives of the review. The outcomes were selected to help the researcher to highlight any opportunities for community pharmacy to improve asthma management through intervention that could improve one or more of the selected outcomes. All types of research design and methodology were included because the review sought to examine the largest possible number of services provided by community pharmacy for managing adult asthma patients. Only original research papers that were written in English were included.

Studies were excluded if the intervention was delivered to children rather than adults, if the intervention was delivered in any setting other than community pharmacy, and if the outcomes measured were different from those mentioned earlier in the inclusion criteria. Literature and systematic reviews were not included in the review. Finally, studies were excluded if the full text or English version could not be sourced.

Study screening

Once identified, the articles were downloaded to the EndNote® referencing programme for further screening and duplicates were removed. Screening of the potential studies' titles and abstracts was performed to remove articles that did not comply with the inclusion criteria. Following this, the full texts of the potentially relevant studies were downloaded to the EndNote® referencing program for further

detailed screening. Those texts that could not be resourced directly, were obtained via the University inter-library loan system. The full-text reading was performed by the first author (AM); the inclusion and exclusion criteria were applied to identify the articles eligible for inclusion. Further discussion was conducted with the research team regarding the included studies to ensure that all the included studies were relevant and met the inclusion/exclusion criteria. Reports from the same study were linked together. Finally, articles from the citations of the included studies were included in the review if considered relevant.

Data extraction and analysis

An objective of the study was to characterise current asthma services in terms of design, implementation, feasibility and outcomes. For this purpose, relevant data from all included studies was collected using a data extraction form to ensure consistency throughout the review. The data collected was based around the study methods, intervention provided in the study, pharmacy training, outcomes measured and results summary. The interventions undertaken in community pharmacy were analysed to provide an overview of the current asthma intervention provided to adult patients in community pharmacy and highlight any opportunities for community pharmacy to improve asthma management in adult patients.

In addition, an intervention characterisation tool (see Supplementary Appendix 1) was developed by the researcher to guide the analysis of the interventions that were tested in the included studies. The development of the intervention characterisation tool was informed by DEPICT 2, using the instruction manual published on the DEPICT project website.[28] Eight domains of DEPICT 2 were used in this review, because some of the domains were not applicable to be used. For example, the setting domain was not used because all the interventions assessed in this review were conducted in community pharmacy setting. Some of the elements of DEPICT 2 were modified by the researcher as appropriate to be more specific to asthma services in the community pharmacy setting. The modifications included removal of some elements of the domains of the intervention if they were not applicable to asthma services. On the other hand, some elements were amended, for example the element of the study population domain included

different categories of asthma patients. The tool was developed and used to ensure consistent assessment of the interventions included in the literature review.

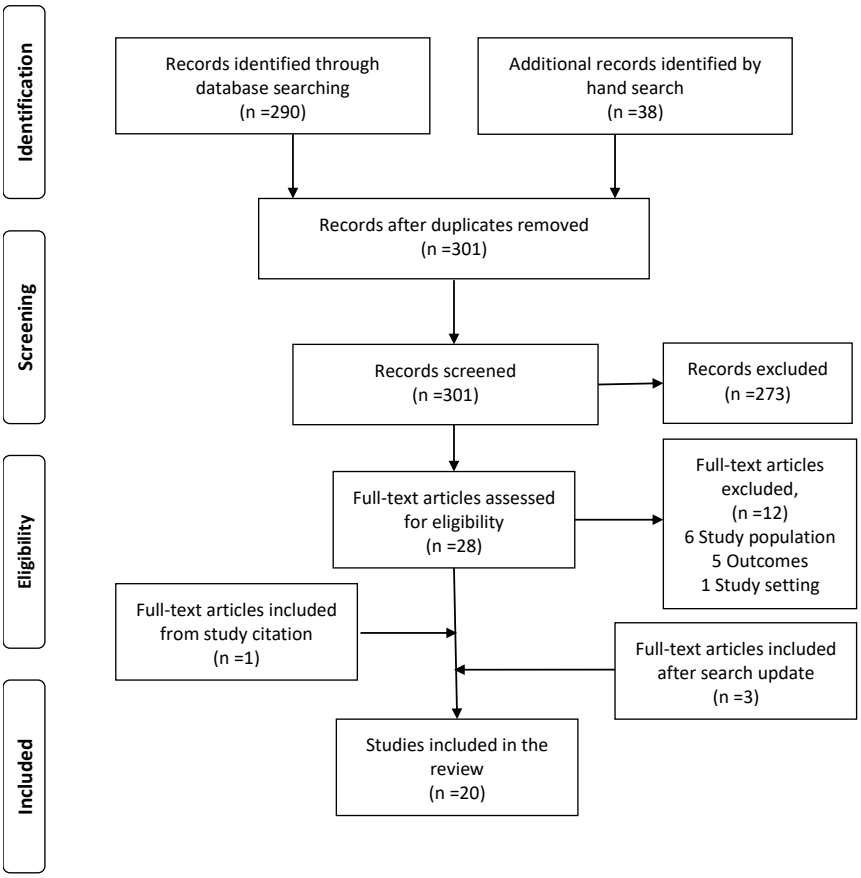
Quality assessment

The review included a variety of study designs that included randomised, controlled and observational studies. To assess the quality of the 20 included studies, a quality assessment system was developed by the first author (AM) and reviewed by the research team. The developed quality assessment system was influenced by the Newcastle-Ottawa Scale for assessing the quality of non-randomised studies in meta-analysis.[29] The assessment used a star system that assessed the quality of the studies included in terms of quality of the research and of the service provided (see Supplementary Appendix 2).

Results

The database search identified 290 potentially relevant studies which were published in peer-reviewed journals. Thirty-eight articles were identified through hand searching, which increased the total number of results to 328 articles. After duplicates were removed and the titles of the potential articles were screened for inclusion/exclusion criteria, 192 studies were retrieved for further screening. The abstracts of these 192 studies were screened and all the studies that did not meet the inclusion criteria were excluded; 45 articles were identified for the full-text screening. After the full-text screening, 28 articles were excluded and one study was included from citations in the full-text studies. Seventeen studies were considered eligible to be reviewed based on the inclusion/exclusion criteria. Recently, the search was updated and 3 more studies were included. Overall, 20 studies were included in the review. The detailed screening process and numbers of included and excluded studies are detailed in Figure 1 below and Supplementary Appendix 3.

Figure 1: Flow diagram of studies included in the review



The following sections will discuss the data extracted during the review from the included studies. The 8 domains of the intervention characterisation tool helped to extract the data and synthesise the narrative.

Study characteristics

Twenty studies[30-49] that assessed the provision of community pharmacy-based services for adult asthma patients were included in this review. A study[30] conducted in Serbia was considered eligible because the results from adults and children were clearly separated. Another study[32] was included although it was conducted on patients with asthma or COPD, because the results of the study were displayed separately for each condition.

Included studies were conducted in community pharmacy settings in the period of 2001-2017, in different countries. The studies used a range of methods to assess the interventions provided to asthma patients including 4 RCTs[37,40,42,43], 3 cluster RCTs[31,36,38], one pragmatic cluster Randomised Trial (RT)[34], one

cluster RT[35], one Controlled Trial (CT)[44], 2 parallel control design [48,50] and 8 observational studies[30,32,33,39,46,47,49], at which the study participants were not randomised to the intervention.[51] The 8 studies included 5 prospective observational intervention [30,32,39,46,47] one prospective comparative observational[49], a cross sectional study[33] and one effectiveness-implementation hybrid design[45]. The latest was considered observational because the study was conducted with no randomisation, no control group and involved testing the implementation strategy of the intervention while observing its impact on the outcomes.[45,51]

All the 20 studies were conducted in adult asthma patients, and in one[32] of the studies, COPD patients were included too. However, 13 studies[32,34-39,41-43,45,46,48] were targeted to specific groups of asthma patients. These asthma patient groups included poorly controlled asthma patients[30,32,35-37,45], patients at risk of poor asthma control[34,48], patients receiving certain ICS[38,46], patients receiving certain type of inhaler device[39], patients receiving any preventer inhaler[41-43]. There was variability in the methods used to identify patients with poorly controlled asthma among the studies. Two studies[32,45] used validated asthma control assessment tools, the Asthma Control Assessment Questionnaire (ACAQ) and the Asthma Control Test (ACT). Another study[35] identified patients with poorly controlled asthma as those who were using the reliever inhaler more than 3 times a week, had frequent attacks and/or night or day asthma symptoms. Patients with poor asthma control were only identified based on the number of reliever inhalers they had used during the last 6 or 12 months.[36,37]

An Australian study[34] in 2013 targeted patients who were at risk of poor asthma control, identifying them as patients who used the reliever inhaler more than 3 times a week, had not had an asthma review in the previous 6 months, or had 1 or more criterion from the revised Jones Morbidity Index.[52] This index is used in UK general practice and is made of 3 simple, clinically relevant questions to categorise asthma patients into low, medium, or high morbidity in relation to lung function.[52] Some studies[34,40,42,43] considered regular visits to community pharmacy as an additive inclusion criterion for the patients to be recruited into the study. Another Australian study[35] also considered patients eligible for inclusion only if

they had not visited the GP during the 6 months before the study commenced, along with the other inclusion criteria.

The details of the included studies are presented in Table 1 along with the quality assessment results.

Table 1 Included studies and results of the quality assessment

FIRST AUTHOR, YEAR AND COUNTRY	STUDY DESIGN	STAR RATING FOR STUDY DESIGN	STAR RATING FOR INCLUSION CRITERIA	STAR RATING FOR STUDY PERIOD	QUALITY OF THE RESEARCH METHOD	CONTENT OF THE INTERVENTION	OUTCOMES ASSESSMENT METHOD	QUALITY OF THE INTERVENTION
KOVACEVIC 2017, SERBIA	Prospective intervention study	★	★	★★	Fair	★★★★★	★★	Good
MANFRIN 2017, ITALY	Cluster RCT	★★★	★	★★	Moderate	★★★	★★★	Moderate
APIKOGLU-RABUS 2016, TURKEY	Prospective intervention study	★	★★★	★	Fair	★★★★	★★★	Good
WATKINS 2016, AUSTRALIA	Cross-sectional	★★★	★	★	Fair	★★	★★★	Fair
ARMOUR 2013, AUSTRALIA	Pragmatic cluster RT	★★★	★★★	★★★	Good	★★★★★★	★★★	Good
BEREZNICKI 2013, AUSTRALIA	Cluster RCT	★★★	★★★	★	Good	★★★	★	Fair
GARCIA-CARDENAS 2013, SPAIN	Cluster RCT	★★★	★★	★★★	Good	★★★★★	★★	Good
OVCHINIKOVA 2011, BELGIUM	Prospective intervention study	★	★★	★	Fair	★★★★	★★★	Good
BEREZNICKI 2008, AUSTRALIA	RCT	★★★	★★★	★	Good	★★★	★	Fair
MEHUYS 2008,	RCT	★★★	★	★★★	Good	★★★★★	★★★	Good

AUSTRALIA								
ARMOUR 2007, AUSTRALIA	Cluster RCT	★★★	★★★	★★★	Good	★★★★★★	★★★	Good
SMITH 2007, AUSTRALIA	Controlled parallel	★★	★★	★★★	Good	★★★★★★	★★	Good
BARBANEL 2003, UK	RCT	★★★	★★	★★	Good	★★★★★	★★	Good
WEINBERGER 2002, AMERICA	RCT	★★★	★★	★★★	Good	★★★★★	★★	Good
SCHULZ 2001, GERMANY	CT	★★	★	★★★	Moderate	★★★★★★	★★	Good
FULLER 2017, AUSTRALIA	Effectivness-implentation hybrid design	★	★★★	★★★	Good	★★★★★	★★	Good
GIRAUD 2011, FRANCE	Prospective intervention	★	★★	★	Fair	★★★	★★	Fair
PAOLETTI 2020, ITALY	Prospective comparative study	★	★★	★★★	Fair	★★★★★	★★★	Good
NASTARAVICIUS 2018, LITHUANIA	Parallel CT	★★	★★★	★★★	Good	★★★★★★	★★★	Good
NARHI 2002, FINLAND	Prospective intervention	★	★	★★★	Fair	★★★★★★	★★	Good

The quality of the included studies varied due to the difference in study design, service provision and evaluation. Table 1 showed the detailed rating for the quality of the research design and the overall rating of the services provided. Eleven (55%) studies showed a ‘good’ quality rating and included 8 RCTs, 2 CTs and one observational study. The limitations of the observational study compared to the RCT were strengthened by the long period of the study. Among the remaining 9 studies; 2 (10%) showed ‘moderate’

quality rating and 7 (35%) showed 'fair' quality rating. Regarding the quality of the intervention provided, 15 (75%) of them were rated as good quality, one (5%) were moderately rated and 4 (20%) showed fair quality.

Intervention characteristics

The intervention characterisation tool was used to characterise the interventions provided in community pharmacy among the included studies. The quality of the interventions on each study was presented earlier in Table 1.

A variety of interventions were provided to asthma patients by community pharmacists and assessed by the studies included in this review. The interventions that were provided among the different studies are detailed in Table 2 below.

Table 2 Interventions provided in each study

Study first author and year	Intervention / Actions taken by the community pharmacists	Frequency of the intervention	Method of delivery
Kovacevic 2017 [30]	Patient education and counselling, inhaler technique, self-management, Asthma Action Plan (AAP)	2-3 sessions (around 30 minutes each)/3 months study period	Face-to-face
Manfrin 2017 [31]	Patient education and counselling and referral to a health care practitioner	Once (around 26 minutes)/9 months study period	Face-to-face
Apikoglu-Rabus 2018 [32]	Patient education and counselling and inhaler technique	3 sessions (10-50 minutes each)/2 months study period	Face-to-face
Watkins 2016 [33]	The patients were interviewed to assess their needs	Once (duration was not mentioned)/2 weeks	Face-to-face
Armour 2013 [34]	Patient education and counselling, inhaler technique and referral to a health care practitioner	Three or 4 sessions (20-75 minutes each)/6 months study period	Face-to-face
Berezinicki 2013 [36]	Patient education and counselling and referral to a health care practitioner	Once (duration of the session was not mentioned)	Face-to-face or mail
Garcia Cardenas 2013 [38]	Patient education and counselling, inhaler technique	Three sessions (duration of the session was not mentioned)/6 months study period	Face-to-face
Ovchinikova 2011 [39]	Patient education and counselling, inhaler technique	Two visits (duration of the session was not mentioned)/1-month study period	Face-to-face
Berezinicki 2008 [37]	Patient education and counselling and referral to a health care practitioner	Once (duration of the session was not mentioned)	Mail
Mehuys 2008 [40]	Patient education and counselling, inhaler technique	Three visits (duration of the session was not mentioned)/6 months study period	Face-to-face
Armour 2007 [35]	Patient education and counselling, inhaler technique and referral to a health care practitioner	Three or four visits (duration of the session was not mentioned)/6 months study period	Face-to-face

Smith 2007 [41]	Patient education and counselling, self-management and referral to a health care practitioner	Six (20-45 minutes) visits/9 months study period	Face-to-face
Barbanel 2003 [42]	Patient education and counselling, inhaler technique, self-management and referral to a health care practitioner	One session (45-60 minutes), and then follow up of the patients by telephone for 3 months	Face-to-face and telephone
Weinberger 2002 [43]	Patient education and counselling, and referral to a health care practitioner	Three sessions (duration of the session was not mentioned)/1-year study period and follow up monthly by telephone	Face-to-face
Schulz 2001 [44]	Patient education and counselling, inhaler technique and self-management	Nine visits (duration of the session was not mentioned)/1-year study period	Face-to-face
Fuller 2017 [45]	Patient education and counselling, inhaler technique	Four visits (duration of the session was not mentioned)/6 months period	Face-to-face
Giraud 2011 [46]	Patient education and counselling, inhaler technique	Once (30 minutes)	Face-to-face
Narhi 2002 [47]	Patient education and counselling and referral to a health care practitioner.	Four visits (15-120 minutes)/1-year study period	Face-to-face
Nastaravicius 2018 [48]	Patient education, inhaler technique training and AAP.	Two visits(duration of the session was not mentioned) /6 months period	Face-to-face
Paoletti 2020 [49]	Patient education and inhaler technique training	Two visits (duration of the session was not mentioned)/6 months period	Face-to-face

One of the studies[31] evaluated interventions that were delivered as part of the Italian Medicine Use Reviews (I-MUR). The study[24] was undertaken to evaluate the I-MURs provided to asthma patients by the community pharmacy, which included a structured interview with patients to assess their asthma control, medication use and adherence. The other studies evaluated interventions that were developed and delivered for the study purposes. The following sections will discuss the interventions elements (as described earlier in the intervention characterisation tool) including the action taken by pharmacists, intervention frequency, delivery method, measured outcomes, pharmacist training, service materials and implementation.

Action taken by pharmacists

All of the interventions assessed involved an educational element as part of the intervention. Patient education was based around: asthma,[30,34-37,40,42] asthma management and monitoring, including self-management skills, for example, monitoring of peak flow readings, symptoms and exacerbations, [30,35,36,41,42,44,47] asthma medication and/or adherence [30,34-38,40,43,45] and inhaler technique.[30,32,34,35,38-40,42,44-49] Within the studies included in this review, six[30,41,42,44,47,48] assessed a patient-centred self-management interventions. During these studies,[30,41,42,44,47,48] the patient's needs were identified, and a self-management

plan was developed by the community pharmacist and the patient; this was then provided as advice or as a written plan. Barbanel's study[42] was the only one that was conducted in the UK among the included studies. In this study,[42] a self-management plan was provided to asthma patients by community pharmacy. Patients' inhaler technique was reviewed by the community pharmacist, they were then educated about their asthma, inhaler technique, non-pharmacological factors, and self-management skills.[42] As part of their self-management plan, patients were instructed to alter their ICS dose in relation to their symptoms and/or Peak Expiratory Flow Rate (PEFR) and educated on when to request an oral corticosteroid prescription or urgent intervention from their GP.[42] Patients were also followed up weekly via the telephone by the community pharmacist for 3 months.[42]

Another controlled study[34] that was conducted in Australia in 2007, involved a self-management intervention that was developed based on patients' behaviour and needs. Asthma patients involved in the study were interviewed to identify the problems they have with their asthma management, goals to be achieved and strategy to achieve the goals.[41] The findings of the study showed that the most repeated goals among patients were related to asthma triggers; this highlighted the importance of trigger identification and avoidance in asthma management .[41] In Smith's study,[41] community pharmacists motivated patients to manage their condition by helping them to identify their goals and provided them with guidance and support to choose the best method to achieve their goals.[41] The 3 studies[41,4234] provided a patient-centred self-management interventions that improved asthma patients' outcomes.

The inhaler technique education process used in the studies varied. In 6 of the studies,[38,39,45,46,48,49] community pharmacists provided asthma patients with a physical demonstration of inhalation technique along with verbal and written instructions on how to use their inhaler(s). Other studies involved physical demonstration only[30,34,35] or verbal and written instructions.[32] Assessment of the inhaler technique and correction were conducted in 3 of these studies.[40,44,47,48] On the other hand, the study that was conducted in the UK mentioned the inhaler technique education as part of the intervention provided to the patients, without explaining the technique used.[42]

One of these studies was conducted in France in 2011. [46] In this study,[46] previous training on inhaler technique was evaluated by the community pharmacist. The findings showed that 67% of the participants were educated before on how to use their inhaler by a HCP including pharmacists, however, only 35% of the participants had demonstrated their inhaler technique to a HCP.[46] Previous training on inhaler use was assessed in another study in 2010 in Australia,[39] which showed that 96% of the participants were educated before on how to use their inhaler (mostly by their GP), and physical demonstration was performed in 53% of the participants. However, reinforcement of the inhaler technique education by a HCP occurred only in 10% of the participants.[39] The variability in the provision of inhaler technique education and the findings of Giraud[46] and Ovchinikova[39] highlighted a potential to improve asthma control in patients by improving the inhaler technique education provided to them. Additionally, physical demonstration of the inhaler technique by patients during the inhaler technique review could be useful to improve inhaler technique among asthma patients.[39,46]

Furthermore, 3 of the studies[30,35,42] focused on the non-pharmacological factors that may affect asthma management, including asthma triggers, nutrition, physical activity and sleep. Asthma patients were also educated regarding smoking cessation as part of the educational interventions in 4 of the included studies.[30,32,40,42]

Edward Bartlett defined patient counselling as *"an individualised process involving guidance and collaborative problem-solving to help the patient to better manage the health problem"*[53],[p323]. In 7 of the studies,[30,31,34,35,41,45,47] patient counselling was provided regarding their condition, asthma management and/or their attitudes toward their medication to improve their adherence and/or inhaler technique.

Usually, community pharmacists in the UK check if patients have an AAP and may refer those who do not have one to their GP. [54] An expansion of the clinical role of community pharmacists in the care of asthma patients was suggested in a cross-sectional study; Watkins et al.[33] suggested that pharmacists could develop an AAP, regularly review and increase or decrease a patient's medication. In Australia, a cluster randomised control trial[35] was conducted in 2007 to evaluate an asthma pharmacy care programme for

patients with uncontrolled asthma in community pharmacy to improve their symptoms. The study[35] was conducted in 396 asthma patients from 57 community pharmacies over a 6-month period, and each patient was seen in community pharmacy 3 to 4 times. During the study period, the intervention group was provided with an educational intervention based on medication adherence and inhaler technique, and their medication was reviewed to highlight any drug-related problems.[35] Consequently, patients' management goals were identified, and some patients were referred to the GP.[35] Although the results of the study were promising and improved asthma control and patients' adherence to their treatment, 80% of patients in the intervention group were referred to the GP, most of which (90%) were referred because they did not have an AAP.[35] Although the intervention increased ownership of AAPs among asthma patients from 23% to 64% over a 6 month period,[35] not all of the patients were provided an AAP by the end of the study. The provision of an AAP by the community pharmacist was assessed by the Serbian study[30] that was conducted in 2017. In this study,[30] a counselling intervention was provided to asthma patients by community pharmacy through a systematic, structured, face-to-face interview with patients along with the development and provision of an AAP. In Lithuania, a parallel controlled study[48] conducted to evaluate a service model that involved patient education and provision of an AAP. The results of the study showed that asthma control was increased in the intervention group (who received the service) from 32.6% to 47.7%, however the improvement in asthma control was related to enhancement in inhaler technique and patient education.[48]

Another intervention that was assessed in eight[31,34-37,41-43,47] of the included studies was referral to a HCP. Patients' needs and asthma control were assessed before the pharmacists decided to refer the patient to a HCP. Referral to a HCP was undertaken as the main action of the intervention or as part of a complex intervention.

Among the 20 studies, [47]none included a change in medication, dosage, or laboratory test by the pharmacist. In one observational intervention study[47] that was conducted in Finland in 2002, the intervention provided by community pharmacists involved patient education, recommendation of dosage

or medication change by contacting a physician or nurse and/or referral to a specialist if needed.[47] The intervention consisted of 4 visits over one year study period and involved unstructured interview with the patients to assess and solve any self-management related problems perceived by the patient or identified by the pharmacist.[47] The results of the study[47] showed that 50% of the patients had no self-management problems at the end of the study period. Unfortunately, the authors of the study[47] have not mentioned explicit data regarding number of patients who needed medication or dose change and if the intervention helped to decrease this problem. However, the patients involved in the study perceived that receiving advice regarding asthma medication adjustment according to the symptoms was one of the most useful areas of the intervention.[47] This type of intervention was suggested to be undertaken to expand the role of community pharmacists by Watkins et al.[33] in their cross-sectional study.

Intervention frequency

The duration and frequency of interventions varied among the studies included in this review. Some of the interventions, including patient counselling, written education material, referral to a HCP and/or inhaler technique training, were provided to the patient on 1 occasion during the study period. However, the other educational and self-management interventions frequency ranged from 1 to 9 visits during the study period. The length of the follow-up period in the included studies also varied from 2 weeks up to a year. In Australia, Armour, et al[34,35] assessed patients' outcomes (asthma control, inhaler technique and ownership of AAP) improvement in 2 groups of asthma patients, one received the intervention in 3 visits and the other group received the intervention in 4 visits in 6 month period. The findings showed no significant difference in the outcomes between the 2 groups and suggested that an asthma service provided in the community pharmacy consisting of 3 visits could be more feasible than 4 visits; due to the lower cost and amount of time required. [34,35]

Delivery method

A common factor in the interventions assessed in 18 of the included studies,[30-35,38-49] was the face-to-face method used to deliver the intervention. Only Bereznicki et al.[37] assessed an intervention that included

educational material that was sent to the patients by mail from community pharmacy. Later on, Bereznicki, et al[36] conducted a study in 2013 to compare face-to-face and mail methods of delivering the intervention in community pharmacy. The pharmacists delivered the intervention to 89.4% (414/463) of patients in the mail group and to 66.6% (235/353) of patients in the face-to-face group.[36] The 2 methods were assessed by comparing use of Short Acting Beta Agonist (SABA) and ICS inhalers in each group to the control group.[36] The results suggested that the largest decrease in SABA usage was in the mail intervention group, followed by the face-to-face intervention group; the lower uptake of the face-to-face intervention by the community pharmacists affected the overall outcomes.[36] More delivery methods that utilise technology could be used to improve patients' engagement with asthma services and ensure a higher uptake by community pharmacists.

Variables assessed and clinical data sources

Data was collected at baseline in all of the included studies[30-49] to assess certain patient variables that were related to asthma control, patients' knowledge, asthma management and asthma medication. Some studies [30-35,38-41,44-46,48,49] collected the data directly from patients through systematically structured interviews and/or a validated tool or questionnaire; while some studies [32,36,37,40,43] used the patient's medical records to collect the data. One of the studies used unstructured interviews with patients to collect data through the study period[47].The data collected was analysed to identify individual patient's needs in order to inform the development of an individualised intervention or education material to be provided to the patient, or to assess their baseline characteristics. [47] In a German study,[44] asthma patients were recruited through community pharmacy, but their diagnosis of asthma was assessed and confirmed by a physician before the intervention was provided to them by the community pharmacist. This collaboration between the community pharmacists and other HCPs could improve patient identification and thus, improve asthma service provision in community pharmacy.

In a 1-year study in Indiana,[43] community pharmacists strived to collect data regarding medication use and to check any hospitalisation or A&E visits that were related to asthma. The community pharmacists had

access to an integrated network linking data from Indianapolis' major hospital and/or contacting the site of care, phoning the patients monthly for updates.[43]

Measured outcomes.

A variety of outcomes were measured to evaluate the interventions provided in community pharmacy among the included studies, using different measurement tests or tools. The outcomes were asthma control lung function, occurrence of asthma exacerbation, medication use, medication adherence, inhaler technique, ownership of AAP, patient beliefs self-efficacy and knowledge, quality of life, cost-effectiveness and patient satisfaction. The outcomes measured, measurement tools and the effect of the intervention on the outcomes are presented in Table 3.and discussed below.

Table 3 Effect of the interventions on the measured outcomes

Outcomes measured	Measurement method	Effect of interventions on outcomes
Asthma control	**ACT [30-33,40,48,49] **ACQ[34,38,39,41,45,46] Tool adapted from **NAC[35] North of England asthma symptoms scale[42]	13 studies[30,31,33-35,38,40-42,45,46,48,49] measured the effect of the pharmacist's intervention on asthma control and 10 of them[30,31,34,35,38,41,42,45,46,48] reported improvement in asthma control. One study[33] showed no relation between asthma control and other patients' outcomes and the other 2 stuides[40,49] showed no significant improvement on asthma control after receiving the intervention.
Lung function	** FEV1 and/or**PEFR[43,44,49]	3 studies[43,44,49] measured lung function as an outcome. Only one study[43] reported significant improvement of lung function as a result of a pharmaceutical care programme intervention compared to usual care.
Exacerbations	Questionnaire[33] Self-reported by patients[40] A&E visits and hospital admissions from patients' medical records[43]	3 studies[33,40,43] measured the effect of the intervention on asthma exacerbations; one study[40] found no significant difference in occurrence of asthma exacerbations in the intervention group compared to the control group, the second study[43] reported a higher number of A&E visits and hospitalisation in the intervention group, finally Watkins et al,[33] highlighted a relationship between poor control and hospital admission and A&E visits in asthma patients.
Medication use	Directly from patients[31] Questionnaire[33-35] Preventer/reliever ratio was calculated from patients' medical records[36,37]	Medication use was assessed in 6 studies. [31,33-37] The studies found decrease in the number of the active ingredients used[31] or the reliever inhaler used by patients.
Medication adherence	**MMAS[30-32,46] **MARS[39,41] 4-item **MGLS[38] **BMQ[35]	9 studies[30,31,34,35,38,40,41,46,49] assessed the medication adherence in asthma patients after receiving intervention and 7 of these studies[30,31,34,35,38,46,49] found positive impact

	**TAI[49] Self-reported by patients[40,48]	of the intervention on medication adherence in asthma patients. 2 studies[40,41] found no impact of the intervention on medication adherence in asthma patients during the study period.
Medication and self-management related problems	**PCNE classification scheme[32] Structured interviews with patients[47]	Apikoglu-rabus and colleagues[32] reported decrease in medication related problems among asthma patients at the end of the study. Narhi et al,[47] reported decrease in patients with self-management related problems.
Inhaler technique	10-Step turbohaler checklist[38] 11-item inhaler device-specific checklist[39] Device-specific checklist[35,40,44-46,48] Tool not mentioned[34]	The 9 studies[34,35,38-40,44-46,48] that assessed inhaler technique reported improvement in inhaler technique after receiving the intervention.
Ownership of AAP	Questionnaire[33] Self-reported by patients[34,35]	Three studies[33-35] reported the proportion of ownership of AAP among asthma patients. One study[33] reported that less than 20% of asthma patients in the study had an AAP. 2 studies[34,35] reported an increase in AAP ownership among patients in the intervention group(s).
Patient beliefs, self-efficacy and knowledge	BMQ[30,35,38] **KASE-AQ[41] Self-efficacy scale[44] *KAM[30] **CQ[33,34] Questionnaire[40,44]	One of the studies reported improvements in patient beliefs toward their medication.[30] 2 studies[41,44] showed an improvement in asthma patients' self-efficacy. 6 studies[30,33-35,40,44] reported the impact of the pharmacist's intervention on asthma patient knowledge. Improvement in asthma patients' knowledge was reported in 4 studies. [30,34,35,44] 2 studies[33,40] showed no improvement in asthma knowledge among the study participants.
Quality of life	**AQLQ[34,35,40,41] **QoL [43,44] Questionnaire[33]	7 studies[33-35,40,41,43,44] reported the impact of the intervention on the QoL of asthma patients. 5 studies[34,35,41,43,44] reported significant improvement in QoL of patients after receiving the intervention, while one study[40] reported no impact of the intervention on the QoL. One study[33] showed that poor asthma control had negative impact on QoL.
Cost-effectiveness	Cost/ **QALY[31]	Manfarin 2017[31] study results showed a 100% probability of the Italian MURs of being more cost-effective than the usual care
Patient's satisfaction with the service	4-item global measure[43] Interview with patients[32,47]	3 studies[32,43,47] assessed in patients' satisfaction with the intervention provided to them and all showed high satisfaction with the intervention provided by the community pharmacist among asthma patients.
Service implementation, provision and/or sustainability	Systematically structured tool and patients uptake of the service[45] Developed by the researchers[34]	Fuller 2017[45] study results showed that only 7 (40%) of the involved pharmacies delivered the service and 41% of patients completed the service by the end of the study. Armour 2013[34] study reported sustainability on asthma control. Knowledge and quality of life for 12 months (follow-up period) after the service.

**ACT: Asthma Control Test, ACQ: Asthma Control Questionnaire, NAC: National Asthma Council of Australia, BMQ: Brief Medication Questionnaire, FEV1: Forced Expiratory Volume, EFR: Expiratory Flow Rate, PEFR: Peak Expiratory Flow Rate, MMAS: Morisky Medication Adherence Scale, MGLS: Morisky Green Levine Scale, MARS: Medication Adherence Rating

Scale, TAI: Test of Adherence to Inhalers, PCNE: Pharmaceutical Care Network Europe Foundation, KASE-AQ: Knowledge Attitude And Self-Efficacy Asthma Questionnaire, KAM: Knowledge Of Asthma And Asthma Medicine, CQ: Consumer Questionnaire, AQLQ: Asthma Quality Of Life Questionnaire, QoL: Quality Of Life Questionnaire, DASS: Depression Anxiety Stress Scale.

Asthma control.

Thirteen studies[30,31,33-35,38,40-42,45,46,48,49] measured the effect of the pharmacist's intervention on asthma control. Most of the studies used validated tools to measure asthma control, mainly Asthma Control Test (ACT) and Asthma Control Questionnaire (ACQ).

Four of these studies[30,31,38,48] reported significant increase in the number or proportion of patients with controlled asthma or whom asthma control was improved after receiving the intervention. In the Spanish cluster RCT,[38] the number of patients with controlled asthma increased from 28% to 58.1%, while in the Italian one[31] the proportion of patients with controlled asthma was increased by 40.2% and 45% for the two MUR intervention groups compared to the control group. The third study[48] used parallel controlled design and the results showed increase in proportion of patients with controlled asthma from 32.56% to 47.6% in the intervention group. The findings of the fourth study[30] that was a prospective intervention study showed significant increase in asthma control (measured by ACT score) in 60% of the patients. One study[46] that was conducted in France using a prospective observational study reported a significant improvement in the mean ACQ score from 1.8 to 1.4 after one month of the intervention that involved inhaler technique training in community pharmacy. Further study[34] that was conducted in Australia reported significant improvement in asthma control in both of the study groups who received 3 and 4 visits intervention. However, no significant different in the improvement in asthma control and ACQ scores between the two groups.[34] Furthermore, a RCT[42] assessed the effect of the intervention on asthma control using the North of England Asthma Symptoms score and reported a significant improvement in the mean score of asthma symptoms in the intervention group.

Moreover, a cluster RCT[35] reported a significant decrease in the proportion of patients with severe asthma in the intervention group from 87.9% to 52.7% and no change in the control group. Fuller et al,[45] reported a decrease in proportion of patients with poorly controlled asthma from 73% to 56% as a result of receiving the intervention. Another Australian study[41] ,that used a controlled parallel design, reported

447 significant improvement in asthma control overtime in both of the control and intervention group who
448 received a self-management intervention.
449 In one of the studies[49] , an educational intervention in community pharmacy was assessed using a
450 prospective comparative design. Asthma patients in the intervention group showed no significant
451 improvement in asthma control compared to those in the control group, however asthma control was
452 decreased only in 5% of patients in the intervention group compared to 20% in the control group.[49]
453 One study[33] assessed some factors that could affect asthma control (including: medication adherence,
454 asthma knowledge, ownership of AAP and gender) but the findings revealed no significant relation
455 between asthma control and any of these factors. Further study revealed no significant improvement in
456 asthma control in the intervention group compared to the control group (usual care).[40]

457 *Lung function*

458 Three studies[43,44,49] reported measurements of lung function as an outcome of the intervention provided,
459 these measurements included Forced Expiratory Volume 1(FEV1) and/or Expiratory Flow Rate (EFR).
460 One of the studies[44] reported 11.7% increase in FEV1 after 6 months in the intervention group but no
461 significant improvement in the lung function in the intervention group compared to the control group at
462 the end of the study. Another study in Italy[49] reported improvement in the mean FEV1 from 80% to 85%
463 and PEFR from 75.7% to 82.9% in the intervention group and no change in the control group. Finally, the
464 American study[43] results showed an increase in PEFR of patients in the pharmaceutical care programme
465 group and the peak flow monitoring group compared to the usual care group.

466 *Occurrence of asthma exacerbations*

467 Three studies[33,40,43] measured the number of exacerbations as one of the outcomes using different
468 methods. Two[33,43] of the studies reported the occurrence of asthma exacerbation by the number of visits to
469 the A&E or admissions to hospital, while Mehyus et al,[40] defined asthma exacerbation as an asthma attack
470 that required an oral CS, visit to the A&E or hospital admission. The American study[43] found that
471 occurrence of an asthma exacerbation was higher in the intervention group, which received a

pharmaceutical care program, compared to the usual care group. On the other hand, Mehuys et al,[40] study reported no effect of the intervention on occurrence of asthma exacerbations. Furthermore, Watkins et al,[33] cross-sectional study in 2016 showed a relation between poor-asthma control and occurrence of asthma exacerbations.

Medication use

Medication use was assessed in 6 studies[31,33-37] and the impact of the intervention on it was reported using different methods. Watkins et al,[33] found that 22% of asthma patients in the study were using the reliever only without ICS. The Italian RCT study[31] reported a 7.9% reduction in the number of active ingredients used by asthma patients after receiving the I-MUR and it was maintained for 6 months. A threefold increase in the preventer to reliever inhalers ratio used by patients in the intervention group compared to the control group in a RCT that was conducted in Australia.[37]

Other 3 Australian cluster RCTs[34-36] reported decrease in the reliever inhaler use in the patients after receiving the intervention. One[35] of the studies reported 5.7% decrease in the reliever inhaler use. Armour, et al[34] found a decrease in the reliever inhaler use in the two interventions groups, however no significant difference was found between the 3-visit and 4-visit interventions. A decrease in the reliever inhaler use was found in the 3 study groups in Berezniki et al,[36] study but the highest decrease was in the mailed intervention group compared to the usual care and face-to-face intervention groups.

Medication adherence

Nine studies[30,31,34,35,38,40,41,46,49] assessed the medication adherence in asthma patients after receiving intervention by pharmacists using many tools. Seven[30,31,34,35,38,46,49] of these studies found positive impact of the intervention on medication adherence in asthma patients.

An increase in percentage of patients who were adherent to their asthma medication was used to report the impact of the intervention on medication adherence in 4 studies.[30,35,38,46] One study[35] found that percentage of patients who were adherent to their preventer medication increased from 54% to 71% after receiving the intervention. Another study[38] reported 75.8% increase in proportion of patients who were

adherent to their asthma medication compared to 50% in the control group. Proportion of patients with very good to moderate adherence to their asthma medication was increased from 58% to 66.2% in one study in France.[46] As well as this, Kovacevic et al,[30] reported that number of patients with high adherence to their medication was increased after 3 months of the study.

Two Italian studies[31,49] reported improvement in overall adherence among asthma patients after receiving the intervention; Manfrin et al,[31] found that adherence to medication was improved by 40% at 6 months after receiving the I-MUR. Finally, Armour et al,[34] measured the risk of non-adherence using the Brief Medication Questionnaire (BMQ) and found that the risk of non-adherence was decreased in the two study groups with no significant difference between the 3-visit and 4-visit intervention groups.

Two studies[40,41] found no difference in medication adherence in asthma patients during the study period.

Medication and self-management related problems

One study in the review assessed the impact of the intervention provided on medication related problems including: treatment effectiveness, adverse reactions, cost and the causes for the problems using PCNE classification scheme.[32] Fifty nine medication related problems were identified at the beginning of the study, after receiving the intervention 32 (54.2%) problems were solved. Another study[47] assessed self-management related problems before and after receiving the intervention by conducting systematic interviews with the patients. After receiving the intervention, 50% of patients had no problems. Both studies used observational intervention design and conducted in a small sample number, however it showed that community pharmacist can help to identify medication related problems and support asthma patients to solve it.

Inhaler technique

Inhaler technique was assessed as an outcome in 9 studies[34,35,38-40,44-46,48] using device-specific, 10-step or 11-step checklists and improvement in inhaler technique in asthma patients after receiving the intervention was reported in the 9 studies. The impact of the intervention on the inhalation techniques was reported in one study[48] by decrease in the mean number of mistakes of the inhalation technique from 2.03 to 1.12

after receiving the intervention. The other 8 studies[34,35,38-40,44-46] used the proportion of patients with correct inhaler technique to report the impact of the intervention on the inhalation technique. The proportion of patients with correct inhaler technique increased from 17 to 33% and from 57 to 72% in the 3-vist and 4-visit intervention groups in Armour et al, study[34] and no significant difference reported between the two groups. Another Australian RCT[35] reported 48.6% increase in patients with correct inhaler technique in the intervention group but it was not measured in the control group. A 75.8% increase in proportion of patients with correct inhaler technique in the intervention group compared to 50% in the control group was reported in a Spanish study.[38] Fuller et al, study[45] results showed significant increase in patients with correct inhaler technique from 12% to 57%, Mehuys et al,[40] reported 40% increase in proportion of patients with correct inhaler technique in the intervention group and Giraud et al,[46] also found increase in proportion of patients with correct inhaler technique. Other 2 studies[39,44] assessed the inhaler technique and the maintenance of the correct inhaler technique. The first study[44] found improvement in the inhaler technique in asthma patients at 6 months and the improvement was maintained at 12 months of receiving the intervention. The second study[39] found that 100% of patients had correct inhaler technique after receiving the intervention compared to 17% at baseline. After one month of follow-up, only 61% maintained the correct inhaler technique.[39] The study found that patients used dry powder inhaler device were 2.6 times more likely to maintain correct inhaler technique.[39]

Ownership of asthma action plan

Three studies[33-35] reported the proportion of ownership of AAP among asthma patients. One cross-sectional study[33] reported that less than 20% of the 248 patients in the study had an AAP. The other 2 studies[34,35] were conducted in Australia and reported 40%[35] and 37%[34] increase in AAP ownership among patients in the intervention group(s) but it was not compared to usual care. Armour et al,[34] found no difference in the ownership of AAP between patients in the 3-visit and 4-visit intervention groups.

Patient's beliefs, self-efficacy and knowledge

The impact of the pharmacists' interventions on asthma patient's beliefs and self-efficacy was assessed in 3 of the studies.[30,41,44] Many tools were used in the assessment and included: beliefs about medicines questionnaire,[30] Knowledge Attitude and Self-Efficacy (KASE)[41] and another study[44] used Self-efficacy scale. One of the studies reported improvements in patients' attitude and beliefs toward their medication as a result of the pharmacist intervention.[30] Further two studies[41,44] showed an improvement in asthma patients' self-efficacy that was caused by the interventions provided by the community pharmacists.

Six studies[30,33-35,40,44] reported the impact of the pharmacist's intervention on asthma patient knowledge of asthma, asthma medication and/or asthma exacerbations using different tools One of the studies[30] used Knowledge of Asthma and Asthma Medication (KAM), other 3 studies[33-35] used Consumer Questionnaire (CQ) and the other 2 studies[40,44] used a questionnaire to assess patients knowledge. Improvement in asthma patients' knowledge was reported in 4 studies.[30,34,35,44] For example, in one of the studies,[30] the KAM score was increased by 15.2% in the intervention group after receiving an educational intervention. Another study[34] reported improvement in asthma patients' knowledge in the two study groups who received 3 or 4 visits intervention with no significant difference between the two.

On the other hand, Mehuys et al,[40] found no effect of the intervention on asthma patients' knowledge and the cross-sectional study that was conducted by Watkins et al,[33] showed no relation between asthma control and patient knowledge among the study participants.

Quality of life

Seven studies[33-35,40,41,43,44] reported the impact of the intervention on the Quality of Life (QoL) of asthma patients. The QoL was assessed using the asthma quality of life and QoL questionnaires. Amongst the 7 studies, a cross-sectional study[33] reported relation between poor asthma control and asthma quality of life. The study[33] showed that asthma has more negative impact on QoL in patients with poorly controlled asthma. Other 5 studies[34,35,41,43,44] reported significant improvement in QoL of patients after receiving the intervention. In one[44] of the 5 studies, the overall QoL in the intervention group increased from 58.1 to

66.6. Another 2[35,41] studies reported improvement in the QoL in the intervention group during the study period compared to the control group. Other 2 studies,[34,43] that used RCT study design, QoL was improved in all of the study groups. The American one[43] reported sustained improvement in the QoL in patients in the two interventions groups and the usual care group and the Australian study[34] reported no significant difference in QoL improvement between patients who received 3-visit and 4-vist intervention. Only one study[40] reported no impact of the intervention on the QoL of asthma patients.

Cost-effectiveness

Only one study[31] measured the cost-effectiveness of the pharmacist's intervention. In this study,[31] the quality of adjusted life years was used to measure the cost-effectiveness of the Italian MURs. The findings suggested that the Italian MURs which were targeted to asthma patients in community pharmacy were effective and showed a 100% probability of being more cost-effective than the usual care. [31]

Patient satisfaction with the service

Patient satisfaction with the intervention provided to them was assessed in 3 studies.[32,43,47] Two observational intervention studies used a questionnaire to assess patients' satisfaction with the intervention. In the first study,[32] 97.4% (37 out of 38 patients) of asthma patients were satisfied with the intervention provided to them by the pharmacist, compared to 90% (25 out of 28 patients) in the second study[47]. In the third study[43] that was an RCT, patient satisfaction with the two interventions provided in the study was assessed using the 4-item global measure. The results showed that patients in the intervention groups were satisfied with the healthcare provided to them more than patients in the usual care group.[43] As well as this patients who received the pharmaceutical care program were more satisfied with their pharmacist than patients in the other intervention and usual care groups.[43]

Pharmacist training

All of the studies included in this review provided training to the pharmacists before delivering the intervention, except the Turkish[32] and Finland[47] studies. The training in general was based around asthma, medication and/or asthma control and management. Other studies also focused on asthma treatment

595 guidelines,[34,40] inhaler technique [30,38,39,46,48] and spirometry or PEFR[34,35,43]. In addition, in some of the
596 studies,[31,34,35,45] the training covered patient behaviour and clinical skills to provide the intervention to the
597 patient. However, in the17 studies,[30,31,33-46,48] the pharmacists were trained on the study protocol, resources
598 to use and software if applicable.
599 The pharmacists' training was provided face-to-face in workshops, courses, training sessions[30,33-46,48,49] or
600 via self-study material.[31,34] Moreover, in one of the studies,[31] the training included role-play or a mock
601 interview. The training duration in the studies ranged from 2 hours up to 2 days and was provided by a
602 pharmacist, respiratory specialist or more than 1 HCP. Pharmacists were provided with a protocol or
603 detailed instructions to deliver the intervention to the patients effectively. In most of the studies, the
604 instructions to deliver the interventions were included in the participant information sheet provided to the
605 pharmacist. In one of the studies,[43] intervention guidance was printed on coloured, laminated paper and
606 displayed in front of the study computers to be easily used by the pharmacists.
607 *Service materials*
608 Written material was provided to the patients in 10 of the studies,[30,32,38-41,43-46] these materials were based
609 on inhaler use, smoking cessation and specific issues related to asthma treatment. Of the 10 studies, a
610 Turkish study[32] conducted in 2016 assessed interventions provided to asthma patients by community
611 pharmacy; patients were provided with written instructions and demonstration aids on how to use their
612 inhalers, along with a smoking cessation leaflet if needed. In 2 of the studies,[39,46] a label or sticker
613 containing the inhaler use instructions was applied or attached to the patient's inhaler device.
614 Among these 10 studies, a written self-management plan was developed and provided to asthma patients
615 in the Serbian study[30] that was discussed earlier. Moreover, a diary was provided to the patients in 3 of the
616 studies [40,41,44] as part of self-management interventions, to record their asthma symptoms and peak
617 expiratory flow readings to help them monitor their condition.
618 Apart from the written materials, a peak flow meter was provided to patients in one of the studies[40] and
619 was used by the patients to monitor their lung function. In addition, pharmacists were provided with the

EasyOne® spirometer in 2 of Armour's studies[34,35] in Australia, to monitor the patient's lung function. The EasyOne® device was chosen because it could maintain calibration within routine use. [34,35] These devices were provided to ensure that all patients' readings were taken using the same device to exclude variability that could have resulted from using different devices.

Service implementation and sustainability

Most of the experimental studies were conducted to evaluate the interventions rather than to assess the implementation process or the sustainability of the interventions.[55] In this review, an Australian study[45] was conducted in 2017 to evaluate the implementation of an asthma service in community pharmacy using a systematic approach. In this study,[45] Fuller et al. used a Framework for Implementation of Services in Pharmacy model as guidance to implement the asthma service. the implementation of the service in community pharmacy was assessed using an asthma service evaluation model.[45] This is a systematic structured model that is used to assess the implementation by an evaluation of the service provision and patient outcomes.[45] The findings of the study showed variability in the implementation progress among different community pharmacies; 7 (40%) pharmacies out of 18 reached the stage of delivering the service.[45] By the end of the study period, only 3 pharmacies completed the service delivery.[45] The variability in sustainability in service delivery among community pharmacies was related to financial issues.[45]The implementation process used in the study allowed the pharmacists to overcome any identified barriers before implementation and allowed continuous assessment and identification of any barriers that arose during this process.[45] The sustainability of the service effects on asthma outcomes cannot be measured from the study because of low uptake by patients (41% of patients completed the service) and variability in implementation progress among community pharmacies. Another study[34] evaluated the sustainability of the intervention provided to asthma patients in Australia, by following up a subgroup of patients for a further 12 months. The findings showed sustainability in the improvement of asthma control, knowledge and quality of life among the subgroup of patients.[34] The limited sample number might affected the findings.[34]

Discussion

Some issues were reported to have been encountered whilst conducting systematic reviews and meta-analyses in the pharmacy field.[21] These issues arose from the variation amongst studies, the complexity of the clinical interventions provided as part of pharmacy services in some of the studies, and the interventions delivered by pharmacists were not always fully described.[21,23,56] This literature review aimed to describe asthma interventions provided to asthma patients in community pharmacy setting using a data extraction tool that was based on DEPICT 2. The development of a data extraction tool allowed a consistent data extraction regarding the core components of asthma interventions that were included in the review.

The review identified 20 studies that assessed asthma interventions in community pharmacy setting. The studies included in the review used different study designs, assessed different asthma interventions and measured a variety of outcomes. Accordingly, there was a variability in the quality of the studies in terms of the study design and intervention provided. 55% of the included studies showed a good quality rating of the study design and 75% of the studies provided a good quality rated asthma interventions. Most of the included studies had many strengths including the use of validated tools to measure the outcomes,[30-35,38-41,43-46] comparison of the intervention with usual care[31,36-42,44,46,48,49] and a study period of 6 months or more[31,34,35,38,40,41,43-45,48,49]. On the other hand, the limited sample number in some studies limited the generalisability of the result.[32,42,45,47,49]

An assessment of the patients was undertaken at the baseline of some studies to measure many variables, based around asthma control, medication use and adherence, and self-management. Some of the studies used these variables to identify patient needs in order to deliver a patient-centred intervention. These variables were assessed using data that was collected directly from patients through systematically structured interviews, use of validated tools, from patients' medical records or via the drug register in community pharmacy. Improving community pharmacy access to a patient's medical records may

facilitate patient identification to be provided with a service, consequently this could improve the provision of services in this setting; and this was highlighted in the literature.[15,57,58]

The included studies assessed their interventions using a variety of outcomes. Only the Italian study[31] evaluated the cost-effectiveness of the Italian MURs conducted in community pharmacy and reported that the service was cost-effective. Other studies were conducted to evaluate the cost-effectiveness of community pharmacy-based services for patients with COPD[59] and other LTCs[60]and the findings suggested cost-effectiveness of the services provided.

There was variability in the tools used to measure the outcomes among the studies, for example, asthma control was measured using validated tools or by counting the number of inhalers prescribed or dispensed to the patient using their medical records. Although counting the number of dispensed inhalers in patients who regularly visit the community pharmacy could help to identify patients who are overusing their SABA inhaler, patients who get their prescription from different community pharmacies may not be identified. Berezinicki, et al. study[36] showed that community pharmacy records could be used to identify patients with poorly controlled asthma. Patient medication records held in the community pharmacy setting could be used as a source of information to identify patients with LTCs who need management and patients with risk of non-adherence to their medication.[61] Moreover, such information could be utilised to facilitate the provision of new community pharmacy-based services and conduct medication reviews in patients with LTCs.[61]

Medication adherence was assessed using validated questionnaires, including the Morisky Medication Adherence Scale (MMAS), Medication Adherence Rating Scale (MARS), TAI and BMQ. Although these are validated tools, data is collected from patients and therefore relies on their memory recall. Another way to assess medication adherence is by counting SABA and ICS inhalers used by patients by collecting data from patients' medical records; this overcomes the issues with memory recall, but may not represent the real situation, because patients may not pick up all their prescriptions from one community

pharmacy.[36] This issue was highlighted in literature before and it could be addressed if the medication records of different community pharmacies were combined and linked to the GP practices.[61]

Several successful international community pharmacy-based interventions that were provided to asthma patients to improve their asthma management were highlighted in this review. These interventions consisted of 1 or more components and included: patient education that was based around inhaler technique improvement, patient counselling, patient-centred self-management plans, development and provision of AAPs and referral to other HCPs.

A patient-centred self-management intervention was assessed in 6 of the studies and had positive impacts on many of the outcomes including: improvement in asthma control,[30,42,48] medication adherence,[30] inhaler technique,[44,48] patients attitude and beliefs toward their disease and medication,[30] self-efficacy,[48] and QoL[41,44]. As well as this, 90% of patients were satisfied by the self-management intervention provided to them by the community pharmacist in one of the studies.[47]

13 studies involved inhaler technique assessment, correction and/or education as a component of the intervention provided. The effect of the intervention on the inhaler technique was reported in 9 of the studies. [34,35,38-40,44-46,48] The results showed an increase in the proportion of patients with correct inhaler technique[34,35,38-40,44-46]or decrease in the number of the mean mistakes in the inhalation by patients after receiving the intervention[48]. The results of this review showed that inhaler technique education and training in the community pharmacy setting improved inhaler technique and asthma control in adult patients. Further improvement of inhaler technique training and the provision of more frequent education on inhaler technique could improve control of asthma and medication adherence in adult patients. [30,39,46,48]

Another intervention that was provided to asthma patients in 2 of the studies[30,48] was the development and provision of an AAP. The provision of an AAP improved asthma control, self-efficacy and knowledge in asthma patients in one study.[30] Other studies[34,35] referred patients to the GP if they don't have an AAP, which resulted in increase in AAP ownership in asthma patients, but not all of them had an AAP by the end of the study. Community pharmacy could develop AAPs and review patient medications[33] instead of

referring more patients to the GP. In this way, asthma patients' control could be improved without increasing the workload on GP practices.

Also, other studies[31,34-37,41-43,47] referred asthma patients to other HCPs including GP or a specialist for review if needed. Asthma control, [31,34,35,41-43]medication adherence,[31,35] patient knowledge[34,35] and self-efficacy[41] and QoL[34,35,41,43] were improved after receiving the pharmacists' intervention. Additionally, the reliever inhaler [34-37] or total number of active ingredients[31] used by patients and risk of non-adherence to medication[34] was decreased after receiving the intervention. It was not possible to conclude the impact of referral to a HCP on these outcomes because of the complexity of the interventions provided among the studies, however the two studies that were conducted by Bereznicki and colleagues[36,37] showed improvement in the preventer to reliever used among patients after receiving education and referral to the GP practice.

None of the studies involved medication or dosage changes by community pharmacy, however in one of the studies recommendation on medication change was discussed by the community pharmacy with the GP or a nurse[47] This suggested the need to explore further opportunities to enhance community pharmacists' clinical role to support asthma patients.[15]

The interventions were delivered to the patients in community pharmacy face-to-face, over the phone or by mail. Bereznicki, et al.[36] suggested that sending study materials or recommending referral to the GP via mail, was more effective than face-to-face interventions because of the higher uptake of the mailed intervention by the pharmacists. The findings suggested that choosing an appropriate delivery method is essential to enhance the uptake of the intervention by the community pharmacists and improve patient engagement.

None of the studies assessed video calls as a method of delivery, although it is an accessible method that could save time and cost.[62] The Royal Pharmaceutical Society's policy document[45] that was published during the COVID-19 pandemic recommended that *"pharmacists in all care settings must have access to virtual consultation tools and equipment."* [57, p3] Providing virtual care by pharmacists, including

community pharmacists, will improve patients' access to pharmacy services and their engagement by reducing the travel needed to get to a service.[57] Use of technology could allow remote patient monitoring using telepharmacy at which electronic data collection and devices can be used by pharmacists to monitor and review patient medication and provide counselling to patients remotely.[63] Telepharmacy could improve asthma patient engagement to the services and improve their condition but there is limited evidence on the impact of telepharmacy on asthma control and other outcomes in asthma patients.[64,65] Further exploration of the utilisation of technology and telepharmacy to support asthma patients could be undertaken in future research.[62,64] Furthermore, the intervention delivery was facilitated by providing patients with written educational materials to prevent reliance on memory recall. Additionally, in self-management interventions, patients were provided with a diary and/or a peak flow meter to monitor and record their symptoms and lung function. These materials and others could be utilised to improve patient outcomes and allow a better evaluation of the service provided.

All the interventions in this review were provided by community pharmacists. Training was provided to the pharmacists to improve their knowledge regarding patient education, asthma guidelines, inhaler technique, spirometry and/or AAP. To further develop their skills to deliver the intervention, some studies provided self-study materials whilst others delivered face-to-face training. Interestingly, only one study used role-play and mock interviews for the training,[31] although this may enhance the practitioner's knowledge and their adherence to research protocols.[66] Providing the pharmacists with written instructions for counselling or the inhaler technique could help to ensure the consistency of the intervention delivered.

Regardless of the outcomes assessment tools, the sustainability of the improvement in asthma control, medication adherence, inhaler technique or other outcomes cannot be assessed unless patients were followed-up for longer than 6 months. Fuller, et al[45] discussed earlier, attempted to test the sustainability of an asthma service in community pharmacy, but the variation in patient outcomes over the six months made it difficult to evaluate if the service was sustainable or not. On the other hand, Armour, et al[34] provided an intervention over a 6-month period and followed up 31% of patients for 12 months to test the

sustainability of the service. The findings showed sustainability of the improvements in asthma control, quality of life and knowledge, however, the small sample size limited the generalisability of the results.[34]

The review suggested that asthma management could be improved in adult patients and identified the need for development of asthma interventions that based on asthma patients individualised needs.[30,33]

The evidence showed that community pharmacy is well-placed to support the management and control of asthma in adult patients. In this review, asthma intervention provided in community pharmacy had a positive impact mainly on asthma control and inhaler technique. Moreover, the studies showed a potential role for community pharmacy to identify and solve medication and self-management problems in asthma patients. Such interventions showed improvement in medication use and adherence, patient knowledge and self-efficacy and QoL. Interestingly, no decrease in A&E visits or hospitalisation were reported in any of the studies.

The review highlighted many enablers for improvement that need to be explored. Firstly, improvement of patient identification in the community pharmacy setting was highlighted by 3 RCTs, 2 of which were rated as good quality in terms of research design. This could be completed by improving the communication and cooperation between community pharmacists and other HCPs in different healthcare settings and improving community pharmacy's access to patients' medical records.[42-44] Moreover, the provision of regular reviews in the community pharmacy for asthma patients may help to improve patient outcomes and improve the partnership between patients and community pharmacists.[35,38,42] For example, in the Spanish RCT,[38] the control group showed improvement in the measured outcomes due to regular visits to the community pharmacy. However, more research on the feasibility and cost-effectiveness of the frequency of the pharmacist's intervention and follow-up period could be conducted. Finally, enhancing the role of community pharmacists in the support of asthma patients could be achieved through the provision of patient-centred interventions, especially when delivering self-management and educational

interventions.[30,33,42] For example, the development and provision of a personalised AAP[30,33,42] and regular inhaler technique trainig[30,38].

Strength and limitations of the review

An extensive search strategy of the literature was performed, covering a large number of databases. The review aimed to answer a question that was too broad to fit into an explicit statement of questions regarding participants, interventions, comparisons, outcomes and study design (PICOS).[22] Additionally, the study design and type of the intervention was not limited in order to review a larger number of studies examining a community pharmacy-based intervention. Accordingly, the review cannot be considered a systematic review, despite using a systematic approach to searching and screening of studies.

Although the review was not a systematic review, it included many elements of the systematic review according to the PRISMA 2009 checklist[22] and PROSPERO register for systematic reviews.[67] Firstly, the search method outlined the search strategy clearly and the review method used eligibility criteria to select studies for inclusion in the review. Secondly, a structured approach was not only used for study selection, but also for data collection. Using the interventions characterisation tool allowed the researcher to highlight the multiple components of the complex health interventions that interacted together to improve patient outcomes.[21] The intervention characterisation tool used 8 domains of the DEPICT 2 tool and some domains was amended to be more specific for asthma interventions. Although the tool was not validated, it allowed consistent assessment of the interventions in all of the studies. The tool we developed could be utilised in future research.

The variability in the interventions provided and measured outcomes among the included studies made it impossible to run a quantitative analysis of the findings. A narrative synthesis of the findings from the included studies was conducted and was based around intervention, target population, outcomes measured and intervention components.

The study identification and data extraction were undertaken by the first author only, however the selection of the studies was based on inclusion and exclusion criteria and was further discussed by the

research team to decrease the selection bias. Additionally, the intervention characterisation tool, quality assessment tool and consistent review of the findings by the researcher and the research team helped to decrease the bias in the findings as much as possible for a narrative review. Finally, the studies included in the review were assessed and compared to each other. The methodological heterogeneity of the included studies made it impossible to apply a single validated or published tool to assess the quality of the included studies. Because no satisfactory published method exists for the combined quality assessment of randomised and nonrandomised studies, the quality of studies was assessed using a quality assessment tool that was developed by the first author. The tool was influenced by the Newcastle-Ottawa Scale[22] and reviewed by the research team. The developed tool allowed a combined quality assessment of the included studies that could be of use to other pharmacy researchers. Future work will be conducted by the research team to validate the tool.

Conclusion

This review identified many studies that included community pharmacy-based interventions and highlighted a potential role for community pharmacy in the management of adult asthma patients. The review showed that community pharmacists contributed to the improvement in asthma control, inhaler technique, medication adherence, AAP ownership and other outcomes by delivering asthma interventions to adult patients. Moreover, a high satisfaction was reported by asthma patients with the self-management interventions provided to them. Community pharmacy could provide such interventions to asthma patients and patients with other LTCs effectively. Research could be completed to explore further opportunities to provide a patient-centred interventions in community pharmacy to support asthma patients, identify the needs of asthma patients, and suggest solutions to improve the communication between community pharmacy and other healthcare settings. Finally, innovative methods of delivery for interventions by community pharmacy including technology, could be utilised to improve patients' engagement among patients with asthma and other LTCs.

The review found limited evidence regarding the implementation, sustainability and cost-effectiveness of asthma interventions in community pharmacy. Further research could be completed to explore further opportunities to provide a patient-centred interventions in community pharmacy to support asthma patients and identify the needs of asthma patients, and suggest solutions to improve the communication between community pharmacy and other healthcare settings. Additionally, there is a need to explore the use of technology in the delivery of asthma interventions in the community pharmacy setting.

Funding

This review was funded by Isra University as part of a PhD project funding and scholarship. The funders had no role conducting the review or preparation of the manuscript.

References

1. Royal College of Physicians. Why asthma still kills: The National Review of Asthma Deaths (NRAD)Confidential Enquiry report. RCP. https://www.rcplondon.ac.uk/projects/outputs/why-asthma-still-kills. Published 2015. Accessed 2.10.2018.
2. World Health Organisation. Asthma Fact Sheet. WHO. http://www.who.int/mediacentre/factsheets/fs307/en/. Published 2017. Updated April 2017. Accessed 23.08.2018, 2018.
3. Asthma UK's press office. Asthma facts and statistics. www.asthmauk.org. https://www.asthma.org.uk/about/media/facts-and-statistics/. Accessed 20.8.2017.
4. NICE. Asthma Quality standard (QS25). www.nice.org.uk. https://www.nice.org.uk/guidance/qs25. Published 2013. Updated Septemebr 2018. Accessed.
5. Bahadori K, Doyle-Waters MM, Marra C, et al. Economic burden of asthma: a systematic review. *BMC Pulm Med.* 2009;9:24.
6. Nunes C, Pereira AM, Morais-Almeida M. Asthma costs and social impact. *Asthma Research and Practice.* 2017;3(1):1.
7. Thomas M. Why aren't we doing better in asthma: time for personalised medicine? *NPJ Primary Care Respiratory Medicine.* 2015;25:15004.
8. Fathima M, Naik-Panvelkar P, Saini B, Armour CL. The role of community pharmacists in screening and subsequent management of chronic respiratory diseases: a systematic review. *Pharmacy Practice (Granada).* 2013;11(4):228-245.
9. GINA. Global Intiative for Asthma. Accessed 02/03/2021.
10. British Thoracic Society and Scottish Intercollegiate Guidelines Network. British guideline on the management of asthma; A national clinical guideline. In: Vol 2020. Edinburgh BTS and SIGN; 2019.
11. National institute for Health and Care Excellence. Asthma: diagnosis,monitoring and chronic asthma management NICE. https://www.nice.org.uk/guidance/ng80/resources/asthma-diagnosis-monitoring-and-chronic-asthma-management-pdf-1837687975621. Published 2017. Updated 2020. Accessed 15.08.2020.
12. Asthma UK. Meet your asthma healthcare team. ww.asthmauk.org. https://www.asthma.org.uk/advice/nhs-care/healthcare-team/#GP. Accessed 26.02.2018.

13. National Institute for Health and Care Excellence. Clinical knowledge Summaries (CKS): Asthma. https://cks.nice.org.uk/topics/asthma/management/follow-up/#the-royal-college-of-physicians-3-questions. Accessed 11.09.2020.
14. UK PCRS. A Quick Guide to the Routine Management of Asthma in Primary Care. The Primary Care Respiratory Society UK. https://www.healthylondon.org/wp-content/uploads/2017/10/PCRS-Quick-guide-to-asthma-management.pdf. Published 2008. Updated Aug 2015. Accessed 1.11.2018.
15. Murray R. Community Pharmacy Clinical Services Review. NHS England. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/12/community-pharm-clncl-serv-rev.pdf. Published 2016. Updated Accessed 11.07.2018.
16. Ogunbayo OJ, Schafheutle EI, Cutts C, Noyce PR. Self-care of long-term conditions: patients' perspectives and their (limited) use of community pharmacies. *International journal of clinical pharmacy.* 2017;39(2):433-442.
17. Mault S, McDonough B, Currie P, Burhan H. Reasons Proffered For Non-Attendance at a Difficult Asthma Clinic. *Thorax.* 2012;67(Suppl 2):A187-A187.
18. Angela C, Sue R, Anna D. The King's Fund: Delivering better services for people with long term conditions: Building the house of care. The King's Fund. Ideas that change health care Web site. https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/delivering-better-services-for-people-with-long-term-conditions.pdf. Published 2013. Accessed 05.02.2018.
19. Wright D. A rapid review of evidence regarding clinical services commissioned from community pharmacies www.england.nhs.uk. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/12/rapid-evdnc-rev-dec-16.pdf. Published 2016. Accessed.
20. Pharmaceutical Services Negotiating Comittee. About community pharmacy. www.psnc.org.uk. https://psnc.org.uk/psncs-work/about-community-pharmacy/. Accessed.
21. Rotta I, Salgado TM, Felix DC, Souza TT, Correr CJ, Fernandez-Llimos F. Ensuring consistent reporting of clinical pharmacy services to enhance reproducibility in practice: an improved version of DEPICT. *Journal of evaluation in clinical practice.* 2015;21(4):584-590.
22. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) website. PRISMA Chicklist,. http://www.prisma-statement.org/. Accessed 12.09.2020.
23. Correr CJ, Melchiors AC, de Souza TT, Rotta I, Salgado TM, Fernandez-Llimos F. A tool to characterize the components of pharmacist interventions in clinical pharmacy services: the DEPICT project. *The Annals of pharmacotherapy.* 2013;47(7-8):946-952.
24. Rotta I, Salgado TM, Felix DC, Souza TT, Correr CJ, Fernandez-Llimos F. Ensuring consistent reporting of clinical pharmacy services to enhance reproducibility in practice: an improved version of DEPICT. *Journal of evaluation in clinical practice.* 2015;21(4):584-590.
25. Crespo-Gonzalez C, Fernandez-Llimos F, Rotta I, Correr CJ, Benrimoj SI, Garcia-Cardenas V. Characterization of pharmacists' interventions in asthma management: A systematic review. *Journal of the American Pharmacists Association.* 2018;58(2):210-219.
26. 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):1134-1143.
27. Pharmaceutical Services Negotiating Committee. Services Database: Emergency Supply Service. www.psnc.org.uk. https://psnc.org.uk/?our-services=urgent-repeat-medicines-service-via-pgd. Accessed 27.07.2018.
28. DEPICT Project. DEPICT 2 Manual. www.depictproject.org. http://depictproject.org/downloads.htm. Published 2015. Accessed 09.07.2019.
29. Wells GA, Tugwell P, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. 2015.
30. Kovacevic M, Culafic M, Jovanovic M, Vucicevic K, Kovacevic SV, Miljkovic B. Impact of community pharmacists' interventions on asthma self-management care. *Research in Social and Adminstrative Pharmacy.* 2017;14(6):603-611.

31. Manfrin A, Tinelli M, Thomas T, Krska J. A cluster randomised control trial to evaluate the effectiveness and cost-effectiveness of the Italian medicines use review (I-MUR) for asthma patients. *BMC Health Services Research.* 2017;17:1-13.
32. Apikoglu-Rabus S, Yesilyaprak G, Izzettin FV. Drug-related problems and pharmacist interventions in a cohort of patients with asthma and chronic obstructive pulmonary disease. *Respir Medicine.* 2016;120:109-115.
33. Watkins K, Bourdin A, Trevenen M, et al. Opportunities to develop the professional role of community pharmacists in the care of patients with asthma: a cross-sectional study. *NPJ Prim Care Respir Med.* 2016;26:16082.
34. Armour CL, Reddel HK, LeMay KS, et al. Feasibility and effectiveness of an evidence-based asthma service in Australian community pharmacies: a pragmatic cluster randomized trial. *Journal of Asthma.* 2013;50(3):302-309.
35. Armour C, Bosnic-Anticevich S, Brillant M, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community [Comparative Study; Multicenter Study; Randomized Controlled Trial; Research Support, Non-U.S. Gov't]. *Thorax.* 2007;62(6):496-502. doi:10.1136/thx.2006.064709.
36. Bereznicki B, Peterson G, Jackson S, et al. Uptake and effectiveness of a community pharmacy intervention programme to improve asthma management [Multicenter Study; Randomized Controlled Trial; Research Support, Non-U.S. Gov't]. *Journal of clinical pharmacy and therapeutics.* 2013;38(3):212-218. doi:10.1111/jcpt.12017.
37. Bereznicki B, Peterson G, Jackson S, Walters E, Fitzmaurice K, Gee P. Data-mining of medication records to improve asthma management [Multicenter Study; Randomized Controlled Trial; Research Support, Non-U.S. Gov't]. *Medical journal of Australia.* 2008;189(1):21-25. doi:https://doi.org/10.5694/j.1326-5377.2008.tb01889.x.
38. García-Cárdenas V, Sabater-Hernández D, Kenny P, Martínez-Martínez F, Faus M, Benrimoj S. Effect of a pharmacist intervention on asthma control. A cluster randomised trial [Multicenter Study; Randomized Controlled Trial; Research Support, Non-U.S. Gov't]. *Respiratory medicine.* 2013;107(9):1346-1355. doi:10.1016/j.rmed.2013.05.014.
39. Ovchinikova L, Smith L, Bosnic-Anticevich S. Inhaler technique maintenance: Gaining an understanding from the patient's perspective. *Journal of Asthma.* 2011;48(6):616-624.
40. Mehuys E, Bortel L, Bolle L, et al. Effectiveness of pharmacist intervention for asthma control improvement [Randomized Controlled Trial]. *The European Respiratory Journal.* 2008;31(4):790-799. doi:10.1183/09031936.00112007.
41. Smith L, Bosnic-Anticevich S, Mitchell B, Saini B, Krass I, Armour C. Treating asthma with a self-management model of illness behaviour in an Australian community pharmacy setting. *Social science & medicine.* 2007;64(7):1501-1511. doi:https://doi.org/10.1016/j.socscimed.2006.11.006.
42. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial [Clinical Trial; Randomized Controlled Trial]. *Thorax.* 2003;58(10):851-854. doi:http://dx.doi.org/10.1136/thorax.58.10.851.
43. Weinberger M, Murray MD, Marrero DG, et al. Effectiveness of pharmacist care for patients with reactive airways disease: a randomized controlled trial. *Journal of American Medical Association.* 2002;288(13):1594-1602.
44. Schulz M, Verheyen F, Mühlig S, et al. Pharmaceutical care services for asthma patients: a controlled intervention study [Clinical Trial; Controlled Clinical Trial; Research Support, Non-U.S. Gov't]. *Journal of Clinical Pharmacology.* 2001;41(6):668-676.
45. Fuller JM, Saini B, Bosnic-Anticevich S, Cardenas VG, Benrimoj SI, Armour C. Testing evidence routine practice: Using an implementation framework to embed a clinically proven asthma service in Australian community pharmacy. *Research in Social and Administrative Pharmacy.* 2017.
46. Giraud V, Allaert F-A, Roche N. Inhaler technique and asthma: Feasability and acceptability of training by pharmacists. *Respiratory medicine.* 2011;105(12):1815-1822.

47. NÄRHI U, AIRAKSINEN M, ENLUND H. Pharmacists solving problems in asthma management — experiences from a one-year intervention programme in Finland. *International Journal of Pharmacy Practice.* 2002;10(1):55-59.
48. Nastaravičius A, Ramanauskiene K. Role of a Community Pharmacy Service in Care of Bronchial Asthma Patients in Lithuania. *Canadian Respiratory Journal.* 2018;2018.
49. Paoletti G, Keber E, Heffler E, et al. Effect of an educational intervention delivered by pharmacists on adherence to treatment, disease control and lung function in patients with asthma. *Respiratory medicine.* 2020;174:106199.
50. Smith F. Research Methods in Pharmacy Practice. In: second ed. London: Pharmaceutical Press; 2005.
51. Berger ML, Dreyer N, Anderson F, Towse A, Sedrakyan A, Normand S-L. Prospective Observational Studies to Assess Comparative Effectiveness: The ISPOR Good Research Practices Task Force Report. *Value in Health.* 2012;15(2):217-230.
52. Unwin D, Jones K, Hargreaves C, Gray J. Using a revised asthma morbidity index to identify varying patterns of morbidity in U.K. general practices. *Respir Medicine.* 2001;95(12):1006-1011.
53. Bartlett EE. At last, a definition. *Patient education and counseling.* 1985;7(4):323-324.
54. Pharmaceutical Services Negotiating Committee. PSNC Briefing 042/19: Pharmacy Quality Scheme – Asthma referrals https://psnc.org.uk/wp-content/uploads/2019/10/PSNC-Briefing-042.19-Pharmacy-Quality-Scheme-Asthma-referrals.pdf. Published 2019. Accessed 28.01.2020.
55. Hasson H. Systematic evaluation of implementation fidelity of complex interventions in health and social care. *Implementation Science.* 2010;5(1):67.
56. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *British Medical Journal.* 2008;337:a1655.
57. Royal Pharmaceutical Society. The future of pharmacy in a sustainable NHS: Key Principles for Transformation and Growth. https://www.rpharms.com/recognition/all-our-campaigns/policy-a-z/future-of-pharmacy. Published 2020. Accessed 12.09.2020.
58. Goundrey-Smith S. The Connected Community Pharmacy: Benefits for Healthcare and Implications for Health Policy. *Front Pharmacol.* 2018;9:1352.
59. Wright D, Twigg M, Barton G, Thornley T, Kerr C. An evaluation of a multi-site community pharmacy–based chronic obstructive pulmonary disease support service. *International Journal of Pharmacy Practice.* 2015;23(1):36-43.
60. Twigg MJ, Wright D, Barton G, Kirkdale CL, Thornley T. The pharmacy care plan service: Evaluation and estimate of cost-effectiveness. *Research in social & administrative pharmacy : RSAP.* 2019;15(1):84-92.
61. Wright DJ, Twigg MJ. Community pharmacy: an untapped patient data resource. *Integr Pharm Res Pract.* 2016;5:19-25.
62. McLean S, Chandler D, Nurmatov U, et al. Telehealthcare for Asthma. *Cochrane Database of Systematic Reviews.* 2010(10).
63. Angaran DM. Telemedicine and telepharmacy: Current status and future implications. *American Journal of Health-System Pharmacy.* 1999;56(14):1405-1426.
64. Littauer SL, Dixon DL, Mishra VK, Sisson EM, Salgado TM. Pharmacists providing care in the outpatient setting through telemedicine models: a narrative review. *Pharm Pract (Granada).* 2017;15(4):1134.
65. Melissa E. Badowski SM, Michael Robles. Examining the implications of analytical and remote monitoring in pharmacy practice. *The Pharmaceutical Journal.* 2017.
66. de Almeida Neto AC, Benrimoj SI, Kavanagh DJ, Boakes RA. Novel educational training program for community pharmacists. *American Journal of Pharmaceutical Education.* 2000;64(3):302-306.
67. PROSPERO. International prospective register of systematic reviews. https://www.crd.york.ac.uk/PROSPERO/. Accessed 15.09.2020.

1029