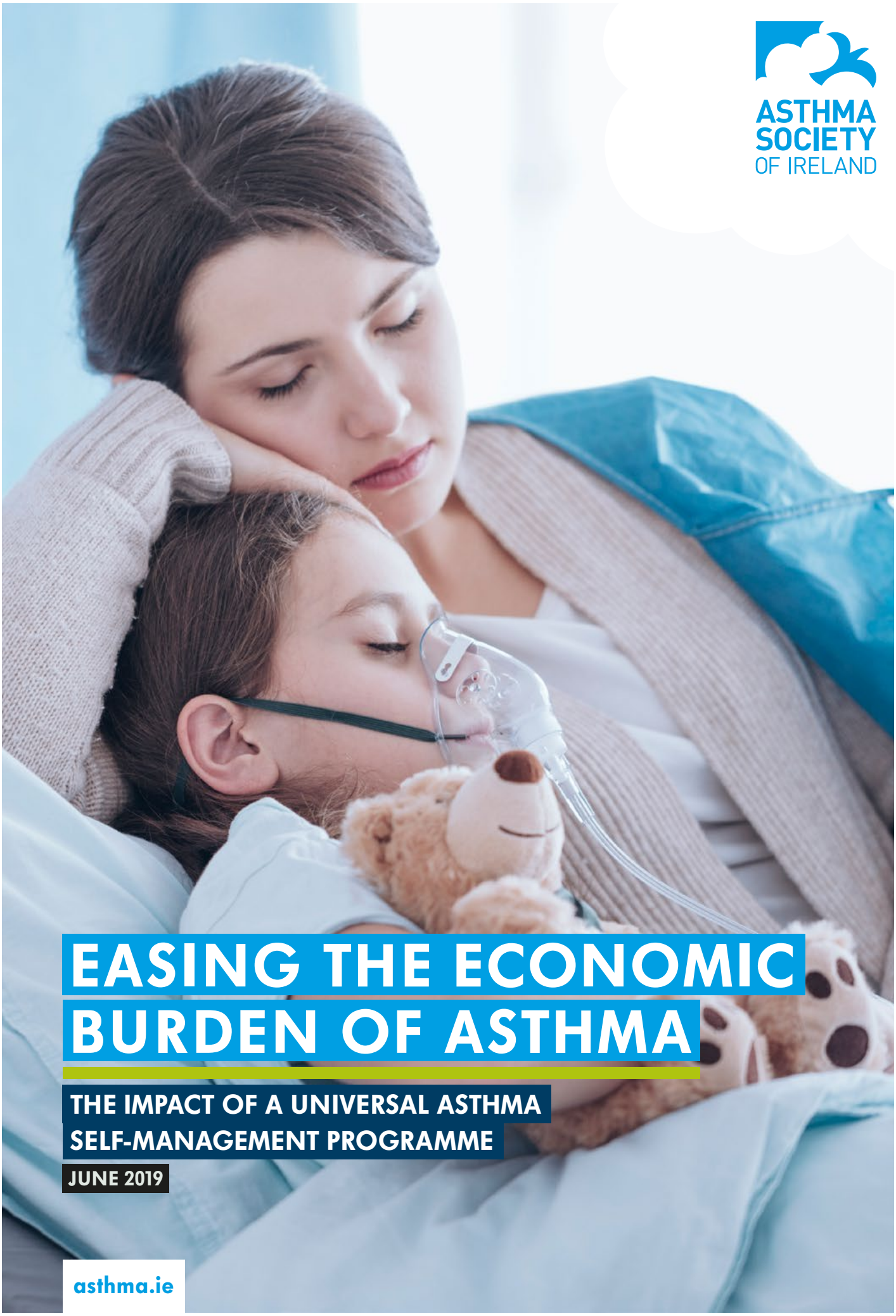

ASTHMA SOCIETY OF IRELAND

EASING THE ECONOMIC BURDEN OF ASTHMA

THE IMPACT OF A UNIVERSAL ASTHMA SELF-MANAGEMENT PROGRAMME

JUNE 2019

asthma.ie

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FOREWORD

When I started working with the Asthma Society of Ireland in February 2018, I was astonished at the lack of information about asthma in Ireland – the nuts and bolts, real life, actuality of asthma in Ireland. I found myself dismayed. How could asthma be taken seriously as a health system challenge, as a quality of life and personal healthcare challenge, if we did not understand how it actually materialised in Ireland?

This research goes a long way towards answering those questions. We can now understand how many people currently have asthma and how many experience it during their lifetime. We can quantify how many GP and nurse consultations are involved at primary care level. We can see Emergency Department visits and hospital admissions. We, sadly, also have to factor in how many people die as a result of their asthma. The reality of asthma for our health system and our patients is clearer from this research and it tells us that we have a lot of work to do to fix and improve asthma management in Ireland.

However, what follows in this research is not merely an updating of the prevalence and healthcare utilisation by people with asthma in Ireland, this research also helps us to understand the greater cost of managing – or mismanaging asthma. The work done here to assess how much asthma costs the state as a whole and where those costs lie will serve clinicians, those working in health policy and planning and our own work for a long time to come.

There are **40,593** children currently registered under the Asthma Cycle of Care programme.

This research highlights the value of a universal asthma self-management programme at the macro-level, showing the benefits for the healthcare system, the cost savings and efficiencies, the potential impact of the measure as a whole. Research shows that 60% of Irish people with asthma do not have it controlled. Uncontrolled asthma costs the individual and the state. A universal asthma self-management programme can transform asthma control and management in Ireland. The key elements of asthma self-management programmes are written action plans, patient education and regular medical review.

For us in the Asthma Society of Ireland, we also want to shout out loud the potential impact for people with asthma and their families. As an asthma patient myself, I can testify that my own asthma and allergy management fundamentally altered when I had a life-changing self management review with my GP over three years ago.

The economic burden of managing asthma for individual patients is very real and it impacts greatly on healthcare outcomes. Patients ration their medication, they take other people's medication, they buy their medication online or abroad, they allow prescriptions to lapse, they go without. Patients avoid visiting their doctor or hospital for as long as possible to save money, they ignore medical advice. They take risks with their wellbeing and safety because they cannot afford to manage their asthma properly. We hear these stories every day and they bring a fear factor for us and for all healthcare professionals.

We want to acknowledge the kind support of GSK Ireland in funding this research and the exemplary research done by Salutem Insights and RedC to complete it. We also want to acknowledge the Asthma Society of Ireland's supporters, who channelled their real-life experiences of asthma costs and management into our survey – this has been key to the success of the research. The CSO collaborated with us, providing us with insights from their Irish Health Survey; the Department of Health collaborated with us by providing us with insights from their Healthy Ireland Survey and the Healthcare Pricing Office for HIPE data. We thank them all.

A universal asthma self-management programme is one big initiative which can reduce both the cost factor and the fear factor in asthma management in Ireland. We wholeheartedly advocate for it, along with a number of other important policy changes aiming to eliminate asthma deaths and transform the lives of people with asthma.

Sarah O'Connor
CEO of the Asthma Society of Ireland

FOREWORD

For something so common, it has always been difficult to accurately assess the rate of asthma in a given population, and to therefore work out the economic costs of the disease, largely due to a combination of factors such as variation in the definition and diagnosis of asthma, in addition to methodologic design differences in studies that quantify affected individuals. These differences also make it hard to compare asthma prevalence and costs in Ireland with asthma data collected overseas.

Asthma intrudes into most peoples' lives at some stage, either as patients or their carers.

Everyday in Ireland, children and adults are being treated in emergency departments and out-of-hours GP practices up and down the country for uncontrolled asthma symptoms, when they should instead be facilitated in getting on with their lives with minimal intrusion from what is largely a very treatable condition.

International data has suggested that there is substantial global variation in the economic burden of asthma over time, in addition to the ultimate and most tragic cost of asthma, asthma-related death, a largely preventable catastrophic event. Asthma death rates are falling in many developed countries, but alarmingly, they appear to be rising in Ireland. It is so important therefore, that efforts are made to fill in the void in our knowledge of asthma prevalence and costs. This will equip those charged with decision-making with the necessary insight into the best design and funding of our future asthma healthcare services.

The annual average cost of asthma per person is **€1,242.**

Among the key decisions to be made by healthcare policy makers is whether or not to resource self-management programmes for asthma nationally – a suite of interventions that has peer-reviewed evidence of benefit in driving down the need for asthma patients to seek out urgent care for dangerously uncontrolled disease.

As part of its mission to eliminate asthma deaths and transform the lives of people with asthma, the Asthma Society of Ireland sought to generate fresh and more relevant data to address deficits in knowledge surrounding the rate of asthma and its associated financial impact on Irish adults and children.

Our epidemiologic data for asthma in Ireland, vital to enhanced healthcare planning, has been out-dated and patchy. As part of its mission to eliminate asthma deaths and transform the lives of people with asthma, the Asthma Society of Ireland sought to generate fresh and more relevant data to address deficits in knowledge surrounding the rate of asthma and its associated financial impact on Irish adults and children. Furthermore, the Society wanted to help better understand the potential role of self-management programmes for asthma in the Irish context.

Through collaboration with Salutem Insights resulting in the current report entitled "Easing the Economic Burden of Asthma", we now have a very welcome updated resource for informing the broader community of precisely how asthma impacts upon this country. The report also makes a strong evidence-based argument for the urgent roll-out to patients of all ages of the national self-management "Asthma Cycle of Care" programme currently provided to the under-sixes. This report contends that this programme has a high likelihood of substantial cost savings, not to mention the precious safe-guarding of human life and wellbeing that underpins all of our efforts in the asthma community.

We hope you find this report to be of value in the challenges that lie ahead in grappling with this vast public health dilemma.

Marcus Butler
Medical Director of the Asthma Society of Ireland and Associate Professor, UCD/Consultant Respiratory Physician, St Vincent's University Hospital

ASTHMA IN IRELAND

2.4m
The number of asthma GP consultations annually.

€1,242
The annual average cost of asthma per patient.

1 in 5
Proportion of children who experience asthma at some stage in their life.

1 in 10
Proportion of children who currently have asthma.

1 in 13
Proportion of people in Ireland currently have asthma.

40,593
The number of children registered under the Asthma Cycle of Care programme.

2nd
Ireland had the second highest rate of asthma hospital discharges in Western Europe in 2016.

five
Average number of school days missed every year due to asthma.

seven
Average number of work days missed every year due to asthma.

890,000
The number of people in Ireland who experience asthma at some stage of their life.

14
Compared to 14 other European countries: Ireland had the highest death rate from asthma in 2015.

one every six days
The frequency at which people are dying as a result of their asthma.

Four minutes
How often someone in Ireland visits an Emergency Department with asthma.

€472 million
The amount asthma costs the state per annum.

8,000
The number of asthma admissions to hospital every year.

EXECUTIVE SUMMARY

Asthma is a chronic disease that affects the airways resulting in recurrent wheezing, breathlessness, chest tightness and coughing particularly at night or early in the morning. It is the most common chronic condition because it affects both children and adults. In this report, it is estimated that 890,000 people in Ireland have had asthma at some point in their life-time, including 380,000 people who experience asthma on an annual basis. This equates to 1 in 13 of the population experiencing asthma on an annual basis and 1 in 5 experiencing it at some point in their lifetime. Asthma is more common in children with 1 in 10 children experiencing asthma on an annual basis.

The number of deaths from asthma has been increasing in recent years. In 2016, 63 people died from asthma in Ireland. In comparison to other countries in Western Europe, Ireland has the poorest mortality outcome from asthma and one of the highest asthma hospitalisation rates. Asthma cannot be cured but the symptoms can be managed with appropriate management and treatment. When asthma is controlled, severe asthma attacks that result in a visit to the hospital or death should be rare.

Asthma is a huge public health challenge in Ireland. It is estimated in this report that asthma costed €472 million in 2017. This equates to a cost of €1,242 per person with asthma.

The direct cost of asthma accounted for 57% of total costs (€270 million). This includes the cost of secondary care (€116 million), primary care (€108 million) and asthma medications (€45 million). Secondary care represented the biggest proportion of direct costs. Specifically, in 2017, asthma is estimated to have resulted in 133,000 emergency department visits and almost 8,000 hospitalisations (day-case and inpatient stays) at a cost of €50 million. The remaining €66 million is a result of Specialist/Consultant visits in hospitals.

Asthma also imposes a huge burden on the primary care system with an estimated 2.4 million and 625,000 GP and Practice Nurse consultations respectively in 2017. The Healthy Ireland Survey 2016 and another survey specifically conducted for this report found that people with asthma, especially children under six years of age, visited the GP more often than those without a chronic illness. The introduction of free GP care for the under-sixes and the introduction of the Asthma Cycle of Care programmes may have contributed to the high rate of GP consultations for this age group.

Asthma accounts for **2.4 million GP consultations** annually.

The cost of asthma medication was estimated at €45 million in 2017. Combination preventer treatments and reliever inhalers represent 44% and 27% of total medication costs respectively.

Indirect costs accounted for 43% of the total cost of asthma (€202 million). This included the cost of absenteeism and premature mortality from asthma. In total, there was an estimated 1.4 million workdays lost due to asthma in 2017. On average people with asthma miss 7 work-days per year.

National and international guidelines have long recommended that all people with asthma should be provided with self-management programmes to help control their asthma and reduce the burden it imposes on health systems and patients. A key part of these programmes are written action plans, patient education, inhaler technique, adherence and regular medical review.

These guidelines are based on evidence from the literature including real life asthma self-management programmes which show strong evidence for a reduction in healthcare utilisation. Specifically, the results from a comprehensive literature review conducted for this report revealed that asthma hospitalisations could be reduced by up to 50%. This reduction occurred in Finland from the implementation of an asthma self-management programme for all people with asthma in 1994. The evidence from the literature review is also strong for reductions in emergency department (up to 46%) and GP visits (up to 32%) as a result of asthma self-management programmes being provided to all people with asthma. Studies also demonstrate improvements in quality of life and asthma control. For example, the level of uncontrolled asthma decreased from 20% to 2.5% over a 13 year period in Finland as a result of the national asthma self-management programme.

Asthma costs the state **€472 million** per annum.

There was an estimated **1.4 million workdays** lost due to asthma in 2017.

Asthma self-management programmes in other countries have also been associated with reductions in asthma deaths. The greatest reductions (from 2011-2015) were evidenced in countries with long established asthma self-management programmes that are integrated with the rest of the healthcare system e.g. Germany (-13.7%), France (-6.6%), Portugal (-10%), Finland (-33%) and Norway (-28.3%).

Steps towards improvements in asthma care have been taken in Ireland with the introduction of a national asthma self-management programme for the under-sixes in 2015. The Asthma Cycle of Care programme provides children under six years of age with asthma with a free initial and annual visit with their GP. To date, there are 40,593 children registered under the Asthma Cycle of Care programme, which represents almost 90% of children under six years of age with asthma. In contrast to other countries that have implemented national asthma self-management programmes, the Asthma Cycle of Care programme does not extend to all people with asthma.

The literature and experience from other countries have demonstrated that there are substantial benefits from the implementation of a universal asthma self-management programme. If the reductions in hospitalisations, emergency department and GP consultations experienced in other countries were to occur in Ireland, direct cost savings of up to €68 million a year could be attained. Moreover, if indirect costs were included cost savings of up to €102 million a year could be achieved from the extension of the Asthma Cycle of Care programme to all people with asthma.

In conclusion, asthma is a big public health problem.

Other European countries have applied big public health solutions by providing all people with asthma with an asthma self-management programme. They have subsequently reaped the benefits in terms of substantial reductions in healthcare utilisation and asthma mortality along with improvements in the quality of life for people with asthma. Further improvements in asthma care and cost savings could be achieved in Ireland if the Asthma Cycle of Care programme is extended to all people with asthma.

There are **8,000** asthma admissions to hospital every year.

INTRODUCTION

Asthma is a common chronic disease that affects the airways resulting in recurrent wheezing, breathlessness, chest tightness and coughing particularly at night or early in the morning [1]. In 2018, the Global Asthma Network published a report highlighting current trends in asthma incidence, morbidity and mortality citing that globally, asthma affects approximately 339 million people [2].

Asthma is a common disease because it typically arises in childhood and persists into adulthood. Previous research dating back to the late 1990s reported that Ireland had one of the highest rates of childhood asthma in the world [3]. In addition, a national survey on the prevalence of asthma in adults reports that 7-8% of adults had asthma in the previous 12 months compared to a global average of 4.3% [4, 5].

Asthma is more common in children than adults [2]. However unlike in adults, a national survey has not been conducted in children in Ireland. In addition, there is little consistency in the definition of asthma used. For example, it was reported that 21 .5% of 13-14 year olds in 2002/03 had asthma at some point in their lifetime [6] and 5.8% of 3 year olds were diagnosed with asthma in 2011[7].

In 2016, 63 people died from asthma in Ireland. A third of these deaths occurred in people under 75 years of age [8, 9]. In 2017, asthma accounted for almost 8,000 hospitalisations with over 90% of inpatients admitted through the emergency department [10]. Two thirds of asthma deaths and up to 50% of hospitalisations could be prevented with the introduction of self-management strategies such as individual asthma action plans [11, 12].

Although the economic and societal burden of asthma is considered sizable, in many countries asthma is not recognised as a health priority. Effective management of asthma through asthma self-management programmes with an emphasis on self-care, is regarded as the cornerstone of asthma prevention [13]. In Ireland, only those under six years of age with a diagnosis of asthma are enrolled in an asthma self-management programme. Other countries make these programmes available to all people with asthma [12].

Other countries have shown that asthma imposes a significant economic burden on the State and Society [14]. However, unlike other chronic diseases such as diabetes and heart failure [15, 16], the economic cost of asthma has not been formally evaluated to date in Ireland. As such, the Asthma Society of Ireland have commissioned Salutem Insights to conduct a study on the economic cost of asthma and how a universal asthma self-management would impact the total cost of asthma.

The economic cost approach involves identifying and calculating the total cost of treating asthma in Ireland and the economic cost of morbidity and premature mortality. The impact of asthma on quality of life was beyond the scope of the study.

The economic cost of asthma is a product of the prevalence of asthma and the direct cost of healthcare utilisation as well as other indirect costs used to manage the disease. Given the paucity of data for the prevalence of asthma in Ireland, new market research was conducted, as part of this study, to bridge the gap on the number of people with asthma in Ireland.

In relation to the impact of a universal self-management programme, a comprehensive review of the literature was conducted, from which the impact of a universal self-management programmes was estimated.

This report is structured as follows:

- **Chapter 1** contains the introduction to the report;
- **Chapter 2** describes asthma, its causes, diagnosis, symptoms and treatment;
- **Chapter 3** examines the prevalence and mortality associated with asthma. It includes new market research on the prevalence of asthma in children;
- **Chapter 4** provides estimates of the total direct and indirect cost of asthma;
- **Chapter 5** contains international evidence of the impact of national asthma management programmes;
- **Chapter 6** provides an estimate of the impact of a universal asthma management programme would have on the total cost of asthma;
- **Chapter 7** presents concluding remarks.

ASTHMA

WHAT IS ASTHMA?

Asthma is a condition that affects the airways – the small tubes that carry air in and out of the lungs. The airways become over-sensitive or inflamed, which means that they react to things that wouldn't normally cause a problem, such as cold air or dust (1).

This reaction means that muscles around the wall of the airway tighten up, making it narrow and difficult for the air to flow in and out. The lining of the airways becomes swollen (just like your nose during a cold) and sticky mucus is produced, clogging up the airways. This is known as airway obstruction.

When the airways are narrowed, it becomes difficult for air to move in and out of the airways. This results in symptoms such as recurrent wheezing, breathlessness, chest tightness and coughing particularly at night and early in the morning.

SYMPTOMS AND DIAGNOSIS

According to the Global Initiative for Asthma (GINA) guidelines, 2018 (13), the following symptoms are typical of asthma and increase the probability that a patient has asthma:

- More than one symptom (wheeze, shortness of breath, cough, chest tightness);
- Symptoms often worse at night or early in the morning;
- Symptoms very over time and in intensity; and
- Symptoms are triggered by colds, exercise, allergen exposure, changes in weather, laughter or irritants such as car exhaust fumes, smoke or strong smells.

The following features decrease the probability that respiratory symptoms are due to asthma:

- Isolated cough with no other respiratory symptoms;
- Chronic production of sputum;
- Shortness of breath associated with dizziness, light-headedness or peripheral tingling;
- Chest pain; and
- Exercise induced dyspnoea with noisy inspiration.

Asthma is a variable condition. Symptoms may resolve spontaneously or in response to medication and sometimes may be absent for weeks or months at a time. On the other hand, patients may experience occasional flare-ups (or exacerbations) which can necessitate visiting a healthcare professional or a hospital.

There is no single diagnostic test for asthma. It involves a visit to the doctor or general practitioner (GP) who will assess the following [1]:

- Whether there is a family history of asthma;
- The pattern and frequency of symptoms;
- A chest examination;
- A trial of asthma treatment;
- A peak flow/lung function test (a child must be over 5 years old).

Asthma is difficult to diagnose in children under the age of two. This is because both wheezing and respiratory infections are common in young children and can have very similar symptoms to asthma.

If a child is under 2 years of age and the symptoms are persistent or severe, the doctor may prescribe a trial of asthma medication to support a diagnosis. In many cases, children may not be officially diagnosed until the age of 5.

CAUSES AND TREATMENT

The exact cause of asthma is not known. However, it is known that there are host and environmental factors that increase the risk of asthma as described in Table . These factors are known to interact, for example, genes interact both with other genes and with environmental factors to determine asthma susceptibility [17]. Many aspects of modern lifestyles such as changes in housing, diet and a more sterile home environment may have contributed to the rise in asthma over the last few decades [17]. Reducing exposure to some of these environmental factors improves asthma control and reduces the need for drugs.

Table 1: Factors Influencing the development of asthma

Host factors	Environmental factors
Genetic e.g. genes pre-disposing to atopy, airway inflammation, airway hyper-responsiveness	Allergens e.g. mites, moulds, furred animals, pollen etc
Obesity	Occupational sensitizers and allergens e.g. flour, paints
Sex	Micro-biome
Pre-term or with small size for gestational age	Infections
	Outdoor and indoor pollutants
	Exposure to tobacco smoke
	Outdoor or indoor air pollution
	Diet
	Stress

SOURCE: Global Initiative for Asthma, 2018 (17)

Asthma cannot be prevented or cured but the clinical manifestations can be effectively controlled with appropriate treatment. When asthma is controlled, there should be no more than occasional recurrence of symptoms and severe exacerbations should be rare [1].

The goals of asthma treatment are to [13, 18]:

- Achieve and maintain control of symptoms;
- Maintain normal activity levels, including exercise;
- Maintain pulmonary function (FEV1 or PEF) as close to normal as possible;
- Prevent asthma attacks;
- Avoid adverse effects from asthma medications;
- Prevent asthma deaths.

This can be achieved by an effective partnership between the person/carer with asthma and their healthcare provider. This partnership can equip the person with asthma with the necessary skills to recognise their own asthma triggers and to take their medication properly. Self-management of asthma has been shown to reduce the morbidity associated with asthma for both adults and children [13].

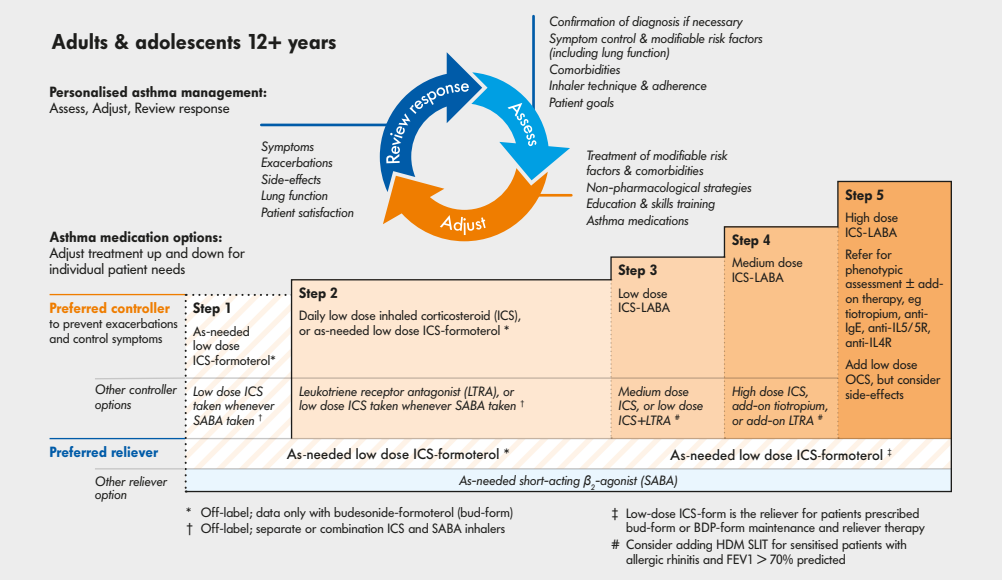
Regarding asthma treatment, inhalation is the preferred route of administration for asthma because it delivers drugs directly to the airways, resulting in potent therapeutic systemic effects with fewer side effects elsewhere in the body [13].

Asthma is a difficult disease to treat because there are numerous types of medications and inhalers. In addition, the dose has to be titrated to achieve optimal control of symptoms. In relation to the type of medications, bronchodilators containing short-acting $beta_2$ agonists (SABA) and short-acting muscarinic antagonists (SAMA) produce rapid relief from symptoms of asthma. These are known as relievers. Inhaled corticosteroids (ICS) act to prevent asthma attacks and are given with and without bronchodilators. A number of inhalers containing a combination of ICS and long-acting $beta_2$ agonist (LABA) are also available. These inhalers are known as preventers.

Not only are there numerous medications for asthma, there are also multiple different inhalers. These include metered dose inhalers (pMDI), dry powder inhalers (DPI), breath-actuated metered dose inhalers (BA MDI) and soft mist inhaler (SMI). These all have different instructions for use. As such, the type of inhaler device should be individualised for each patient to achieve optimal control of symptoms. It is advised that patients are educated on how to use their inhaler correctly and inhaler technique should be assessed regularly [13]. This is because incorrect inhaler technique is common and is associated with poor adherence to treatment [19]. In fact, adherence to asthma treatment is generally low at around 50% [20]. There are multiple other factors that contribute to poor adherence including the cost of medication, difficulty in using inhalers, misperception about the need for treatment etc.

A stepwise treatment approach is used to treat asthma. As the severity of the disease increases, the dose increases along with the type of medication (see Figure 1 for the latest guidelines for adolescents and adults with asthma).

Figure 1: Stepwise approach to asthma treatment



ABBREVIATIONS: ICS=inhaled corticosteroid, LABA= long acting beta$_2$ agonist, LAMA= long acting muscarinic antagonist, SABA= short acting beta$_2$ agonist

SOURCE: Global Initiative for Asthma (GINA) 2019 (13)

SUMMARY

Asthma is a chronic disease that affects the airways resulting in recurrent wheezing, breathlessness, chest tightness and coughing particularly at night or early in the morning.

Asthma can be a difficult disease to diagnose. As there is no single diagnostic test for asthma, a diagnosis includes: a trial of asthma medication; an assessment of whether there is a family history of the disease and severity and frequency of symptom; a chest examination; and a lung function test for those over 5 years of years. Asthma is especially difficult to diagnose in the under 5s because wheezing and coughing are common in young children and can have very similar symptoms to asthma.

Asthma cannot be prevented or cured but the clinical manifestations can be effectively controlled with appropriate treatment. When asthma is controlled, there should be no more than occasional recurrence of symptoms and severe asthma attacks that require hospitalisations should be rare (13).

The main goals of asthma treatment are to control symptoms so as to maintain normal activity levels and reduce the risk of an asthma attack (13). This can be achieved by an effective partnership between the person/carer with asthma and their healthcare provider. This partnership can equip the person with asthma (or parent) with the necessary skills to recognise their own asthma triggers and to take their medication properly. This is important because adherence to asthma treatment is low at around 50% (20). Factors that contribute to poor adherence include poor inhaler technique, the cost of inhalers, multiple different inhalers, a perception that treatment is not needed and confusion about the correct dose (13). Poor adherence for those with asthma leads to significantly higher risks of emergency hospital visits and hospitalisation, which have implications for the economic costs of asthma (21).

ASTHMA PREVALENCE AND MORTALITY

The economic burden of asthma is a function of the number of people with asthma and the direct and indirect cost of asthma. This chapter consolidates existing data on the prevalence of adult and childhood asthma in Ireland. The existing data relies on respondents to self-report their asthma via questionnaires, which is not the same as a medical diagnosis of asthma as outlined in the previous chapter, which requires a visit to the GP, who can confirm an asthma diagnosis.

There are gaps in the data on the prevalence of asthma in Ireland especially for children. A national prevalence study would be the most robust way to ascertain this data but was beyond the scope of this study. However, new market research was conducted by REDC on the prevalence of asthma in both adults and children, which is presented in this chapter along with data on asthma mortality.

ASTHMA IN CHILDREN

Existing data on the prevalence of childhood asthma are based on small cross sectional studies which use various definitions of asthma including ever having asthma (or life-time prevalence), annual asthma and a medical diagnosis of asthma. Data on childhood asthma also refers to specific cohorts of children e.g. 13-14 year olds, 3 year olds. All existing and new data on childhood asthma is presented in Table 2.

The International Study of Asthma and Allergies in Childhood (ISAAC) from 1995 to 2002/03 reported the prevalence of life-time asthma (or ever having asthma) in 13-14 year olds. It reported that the prevalence of life-time asthma increased from 15.2% in 1995 to 21 .6% in 2002/03 (22). The ISAAC programme allowed a worldwide comparison of asthma and reported that Ireland had the fourth highest childhood asthma prevalence rate in the world (3).

Asthma in children has been reported in other studies. The ISAAC survey design was employed in a separate and smaller cross-sectional study in 2011 in the midlands of Ireland. It reported that the prevalence of life-time asthma in 13-14 year olds was 23.5% in 2011 (23). Furthermore, the Growing up in Ireland Survey, found that 5.8% of 3 year olds had asthma that was diagnosed by a doctor (24).

Following a review of the literature and databases, it was clear that a paucity of evidence exists on the lifetime prevalence and current asthma estimates for children both in Ireland and internationally. A national prevalence study would provide robust data affording the opportunity to reduce this evidence gap. Although outside the scope of this report, such a study would be extremely beneficial in the future. For the purposes of accessing more Irish-specific information on prevalence, market research was conducted to give a better indication of the prevalence of life-time asthma and asthma in the previous 12 months in the 0-14 age group.

Market research was conducted by REDC in January and February 2019 via their online omnibus survey. In total, a representative sample of 2,009 adults over the age of 18 were interviewed about their experience of asthma and whether their children under the age of 15 had 'ever' had asthma or had asthma in the previous 12 months. In total, 995 children under the age of 15 were included in the survey.

Overall, this market research by REDC found that 179 0-14 year olds 'ever' had asthma representing 18% of that age group. It also found that 9% of 0-14 year olds experienced asthma in the previous 12 months. Asthma prevalence was higher in the 6-14 age group compared to the 0-5 age group. Specifically, 22.5% of 6-14 year olds 'ever' had asthma compared to 11 .6% of 0-5 year olds. The corresponding figures for asthma in the previous 12 months were 10.9% and 7.4% respectively (see Figure 2).

The market research conducted was broadly consistent with actual data and previous research in this area. For example, the 11 .6% figure of 0-5 year olds who 'ever' had asthma is broadly in line with the 10.3% of 0-5 year olds who have registered with Asthma Cycle of Care programme (25). In relation to the 6-14 age group, 22.5% of them 'ever' had asthma which is consistent with the later ISAAC studies of 13-14 year olds, which reported prevalence rates of 22-24% (see Table 2).

Despite the absence of a national prevalence study on childhood asthma in Ireland, the market research conducted, in combination with existing data, provides a strong understanding of the number of children with asthma at some point in their life-time and those experiencing asthma on an annual basis. Specifically, 12% of 0-5 and 22% of 6-14 year olds 'ever' had asthma. The corresponding figures for asthma in the previous 12 months are 7% and 11% respectively. Overall. 18% of children under 15 years of age have had asthma at some point in their life-time with 9% of them experiencing it on an annual basis.

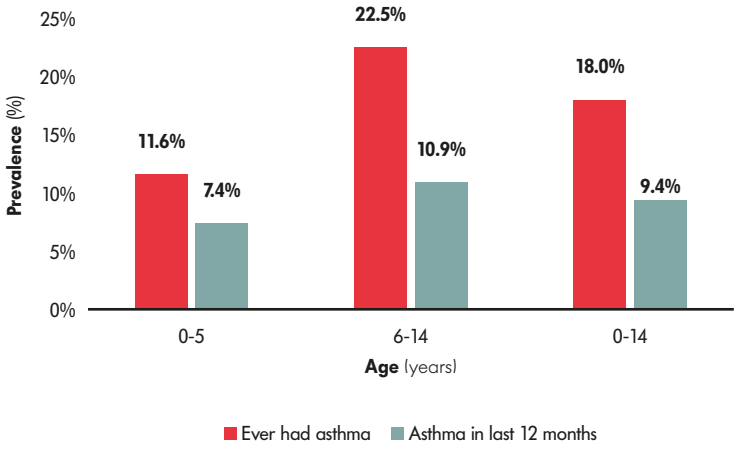
Table 2: Childhood asthma prevalence rates

Source	Asthma definition	Study size	Year	Age (years)	Prevalence rate
ISAAC[1]	Ever had asthma	3,147	1995	13-14	15.2%
ISAAC[1]	Ever had asthma	2,580	1998	13-14	18.2%
ISAAC[1]	Ever had asthma	3,089	2002/03	13-14	21 .6%
Sub-optimal asthma control in teenagers in the midland region of Ireland[2]	Ever had asthma	703	2011	13-14	23.5%
Growing up in Ireland survey[3]	Diagnosed asthma	9,793	2011	3	5.8%
REDC on-line omnibus survey[4]	Ever had asthma	995	2019	0-14	18.0%
REDC on-line omnibus survey[4]	Asthma in previous 12 months	995	2019	0-14	9.4%

ABBREVIATIONS: ISAAC= International Study of Asthma and Allergies in Childhood

SOURCES: 1. PJ Manning et al (2007) (22) 2. Fitzpatrick et al. (2011) (23) 3. Economic and Social Research Institute (2011) (7) 4. REDC Market Research (2019) (26)

Figure 2: Childhood asthma by age, 2019



SOURCE: REDC Market Research, 2019 (26).

ASTHMA IN ADULTS

Data on the prevalence of asthma in adolescents and adults in Ireland has been collected since 2001 in national surveys. These surveys cover the population over 18 years of age from 2001 to 2010 and over 15 years thereafter. Table 3 shows that the question asked to ascertain the prevalence of asthma has varied over the years from 'ever' having asthma to asthma in the previous 12 months to a medical diagnosis of asthma. These changes in survey design make comparing changes in the prevalence of asthma over time difficult.

The most recent data is from the Healthy Ireland Survey from the Department of Health. In 2018, it was reported that 7.5% of the adult population had doctor diagnosed asthma (5).

The REDC market research was also conducted in adults to ascertain the life-time prevalence of asthma. The online survey involved 2,009 respondents and reported a life-time prevalence rate of asthma of 18.6% and asthma in the previous 12 months of 8.6% (26).

In summary, 8% of adults on average have been reported as having asthma in the previous 12 months; with an additional 11% having asthma at some point in their life-time. This means that 1 in 13 adults have current asthma and 1 in 5 had asthma at some point in their life-time.

Table 3: Adult asthma prevalence rates

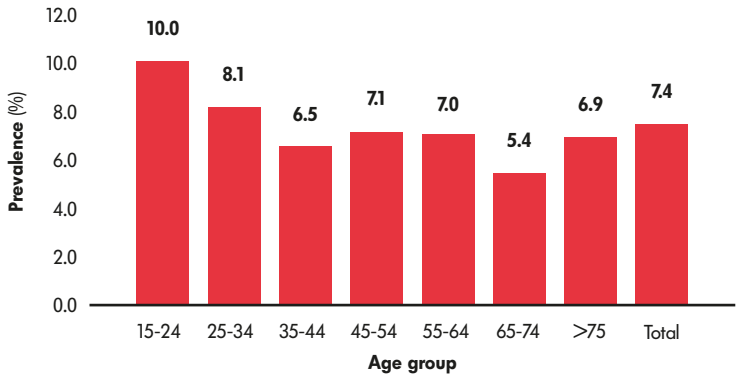
Source	Asthma definition	Survey size	Year	Age (years)	Prevalence rate
QNHS Health Module[1]	Asthma in the previous 12 months	44,844	2001	≥18	5.0%
QNHS Health Status and Health Status Utilisation[1]	Doctor diagnosed asthma	21,253	2007	≥18	6.0%
QNHS Health Status and Health Status Utilisation[1]	Doctor diagnosed asthma	15,673	2010	≥18	7.0%
Irish Health Survey[2]	Asthma in the previous 12 months	10,323	2015	≥15	9.4%
Healthy Ireland Survey[3]	Asthma in the previous 12 months	7,539	2015	≥15	7.2%
Healthy Ireland Survey[3]	Asthma in the previous 12 months	7,498	2016	≥15	7.4%
Healthy Ireland Survey[3]	Doctor diagnosed asthma	7,487	2017	≥ 15	7.5%
Healthy Ireland Survey[3]	Doctor diagnosed asthma	7,701	2018	≥ 15	7.5%
REDC market research[4]	Ever had asthma	2,009	2019	>18	18.6%
REDC market research[4]	Asthma in the previous 12 months	2,009	2019	>18	8.6%

ABBREVIATIONS: QNHS=Quarterly National Household Survey

SOURCES: 1. Central Statistics Office. Special Health Modules (27) 2. Central Statistics Office. Irish Health Survey 2015 (28) 3. Department of Health. Healthy Ireland Surveys (5). 4. REDC Market Research (2019) (26)

Figure 3 shows that asthma is also more common in the younger age cohort with a prevalence rate of 10% in the 15-24 age category compared to 6.9% in those over 75 years of age.

Figure 3: Adult asthma in the previous 12 months by age group, 2016



SOURCE: Department of Health. Healthy Ireland Survey, 2016 (5)

TOTAL NUMBERS WITH ASTHMA

The different definitions used to define asthma prevalence has a big impact on the number of people with asthma. There are three definitions used in Ireland: doctor diagnosed asthma; asthma in the previous 12 months; and 'ever' asthma. Although, there is no consensus on the correct definition, the most common definition used in the literature is doctor diagnosed asthma (29).

The Asthma Society of Ireland have previously estimated that 470,000 people have asthma in Ireland (1). This number was estimated using a combination of different definitions of asthma and old population figures. By using consistent definitions, the most up-to-date prevalence rates and the latest population figures the most accurate figures for the number of people with asthma in Ireland can be estimated. Specifically, it is estimated that there are 380,000 people with annual asthma in Ireland (Table 4). Using the life-time prevalence definition of asthma, an estimated 890,000 people currently have or had asthma at some point in their life-time (Table 5).

Asthma is more common in children than adults. Specifically, over the previous 12 months, 1 in 10 children and 1 in 13 adults experienced asthma.

In terms of estimating the annual cost that asthma imposes on the health service and on patients, asthma in the previous 12 months would provide a more relevant indicator of healthcare utilisation and therefore the cost burden of asthma. Moreover, previous studies on the cost of asthma use asthma in the previous 12 months when estimating the cost of asthma (30).

Table 4: Total number of people with asthma in last 12 months

Age group	Population[1]	Prevalence rate	Asthma in last 12 months
0-5	395,439	7.4% [2]	29,262
6-14	611,585	10.9% [2]	66,663
>15	3,785,400	7.5% [3]	283,905
Total	4,792,424		379,830

SOURCES: 1. Central Statistics Office, Population estimates for 2017 (31). 2. RedC Market Research, 2019 (26). 3. Healthy Ireland Survey 2017,2018 (5).

Table 5: Total number of people with life-time asthma

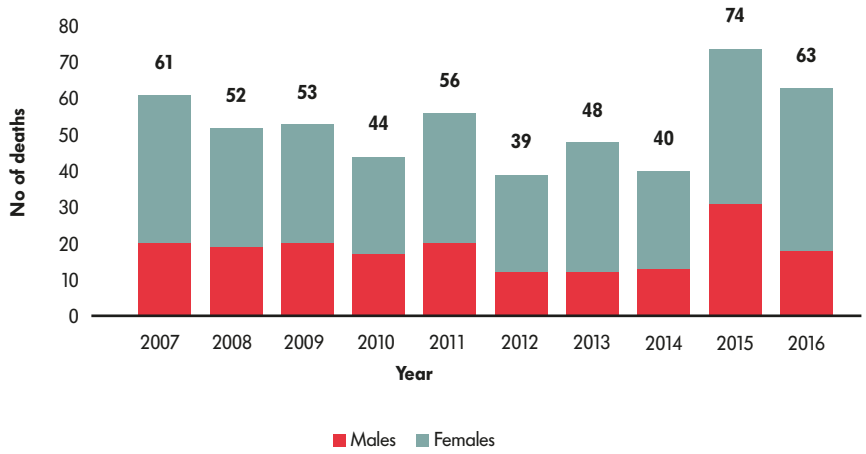
Age group	Population[1]	Prevalence rate[2]	Life-time asthma
0-5	395,439	11 .6%	45,871
6-14	611,585	22.5%	137,607
>15	3,785,400	18.6%	704,084
Total	4,792,424		887,562

SOURCES: 1. Central Statistics Office, Population estimates for 2017 (31). 2. RedC Market Research, 2019 (26)

ASTHMA MORTALITY

Following a decline in the number of asthma deaths from 2007 to 2014, the number of deaths increased to 74 in 2015. There were 63 deaths due to asthma in 2016 (see Figure 1) (9). Figure 1 shows that the majority of asthma deaths are female (63% in 2016) and occur in those over 75 years of age. This combined with the fact that women live longer than men suggests there is a significant loss of potential life years (see Table 6).

Figure 4: Number of deaths from asthma, 2007-2016



SOURCE: Central Statistics Office, Statbank, Table VSA08: Deaths Occuring by Sex, Cause of Death, Age at Death and Year (9)

Table 6: Asthma deaths by gender

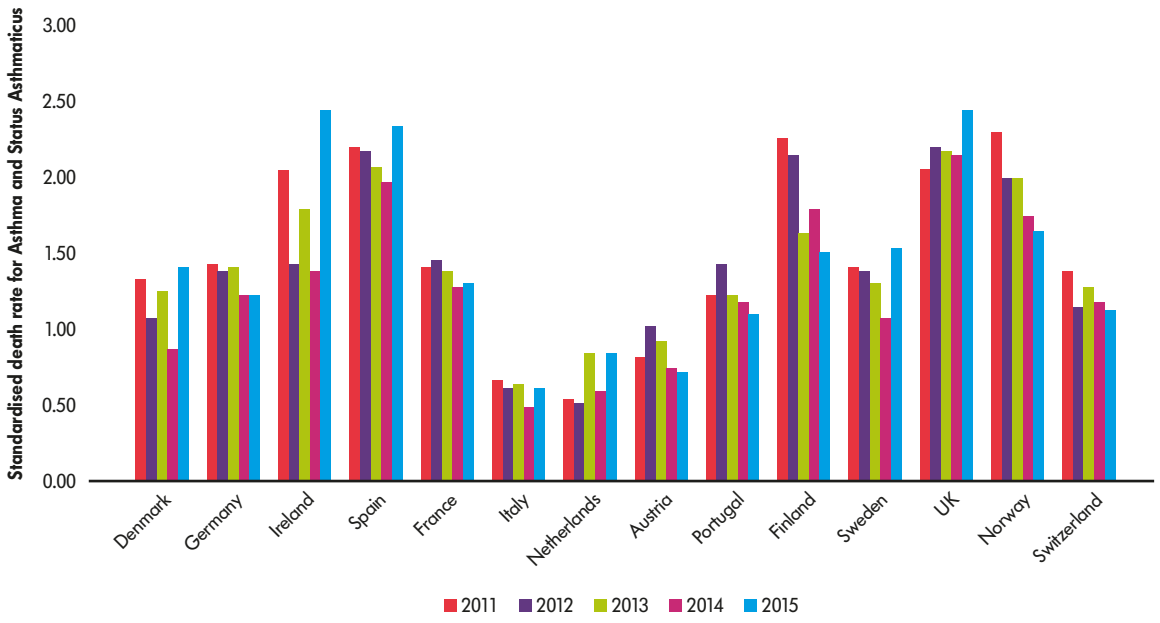
Year	Total deaths		PYLL [life expectancy]
	Male	Female	
2007	20	41	574
2008	19	33	670
2009	20	33	387
2010	16	28	470
2011	20	36	672
2012	13	26	470
2013	13	35	398
2014	16	24	489
2015	32	42	896
2016	17	46	446

ABBREVIATIONS: PYLL [life expectancy by age and gender] = potential life years lost with age and gender specific life expectancy

SOURCE: Central Statistics Office, (9) (32)

Figure 5 presents standardised asthma mortality rates across Europe from 2011 to 2015. It shows that the death rate from asthma in Ireland in 2015 was the highest in 14 European countries. Furthermore, the death rate decreased in 7 of the 14 countries over the 2011-2015 period whereas it increased in Ireland over this period.

Figure 5: Asthma mortality in Europe, 2011-2015



SOURCE: Eurostat (33)

One person dies every 6 days as a result of their asthma.

SUMMARY

Asthma is one of the most common chronic conditions in Ireland. It starts in childhood and persists into adulthood. Estimates on the number of people with asthma are based on epidemiological studies that rely on people to self-report their asthma via questionnaires. This is different to a clinical diagnosis of asthma as described in chapter 2, which requires a visit to the GP, who can confirm an asthma diagnosis.

These epidemiological studies use different definitions of asthma prevalence which has a big impact on estimates of the number of people with asthma. A recent study on the cost of asthma in the UK reported 7 different definitions of asthma prevalence. The definitions varied depending on the whether it was lifetime or annual prevalence and whether it was doctor diagnosed and treated asthma [34]. In the UK study, the prevalence rate varied from 29.5% for life-time asthma to 6.8% for annual treated asthma. While there is no consensus on the correct definition to use, the most common definitions in Ireland are asthma in the previous 12 months (annual asthma) or asthma at some point in their life-time (life-time asthma) [29]. The advantage of using annual asthma as a definition is that it reduces recall error and it is the more accurate indicator of those who consume healthcare on an annual basis. It is also used in other studies on the cost of asthma [34]. The disadvantage is that it is likely to underestimate the true burden of asthma because it does not capture those who have their asthma under control.

The Asthma Society of Ireland have previously estimated that 470,000 people have asthma in Ireland [1]. The data which informed this figure were based on a combination of different methodologies and asthma prevalence rates from 2011 . This report provides more accurate and up-to-date estimates of the prevalence of asthma in Ireland using consistent methodologies and the latest population figures. Specifically, it is estimated that 380,000 or 8% of the Irish population currently have asthma. Using the life-time prevalence rate, 890,000 people currently have or had asthma at some point in their life-time. This equates to almost 19% or 1 in 5 of the population.

Asthma is more common in children than in adults. In fact, asthma is also the most common chronic disease in children [7]. It affects 1 in 5 children sometime in their life-time and 1 in 10 of them on an annual basis. In relation to adults, 1 in 13 and them experience asthma on an annual basis and 1 in 5 of them have had asthma at some point in their lifetime.

Despite major advances in the treatment of asthma and the development of several national and international asthma guidelines, the risk of mortality from asthma has not reduced in recent years. In fact, Ireland had the worst death rate from asthma across 14 European countries in 2015 with 74 deaths. In 2016, 63 people died from asthma. A major report into asthma deaths in the UK, found that two-thirds of asthma deaths are preventable [11].

DIRECT AND INDIRECT COSTS

This chapter presents the direct and indirect costs of asthma. Direct costs include primary and secondary care and medication costs, while indirect costs include productivity losses associated with absenteeism from work and premature mortality due to asthma. Total costs are estimated by identifying the total units of healthcare consumed, total workdays lost and the number of premature deaths due to asthma and applying unit costs. Costs are based on 2017 prices.

DATA SOURCES

In the absence of a registry for asthma patients, a number of data sources were used including actual activity data e.g. number of hospitalisations and survey data. The sources were the Healthy Ireland surveys and the Asthma Society of Ireland (ASI) survey, 2019. The Healthy Ireland surveys contain data on healthcare resource use for adults (>15) with asthma and number of days work lost due to general ill-health. The ASI survey was conducted for this report by the ASI in March 2019 to provide data on the healthcare resource use by children (<15 years) with asthma. It also asked questions of the parents of children with asthma on the number of workdays lost specifically due to asthma and demographics to help inform the indirect cost of asthma.

The ASI survey was an open online survey administered by the ASI in March 2019. The questionnaire was sent out to all ASI members who have asthma and/or who have children with asthma. It was also advertised on social media e.g. Facebook, Twitter and LinkedIn. In total, 2,010 adults and parents of 1,414 children under 15 years of age consented to the survey. A summary of survey results is contained in Table 7.

To provide consistency between the amount of healthcare consumed between adults and children, the ASI survey included the same questions as the Healthy Ireland survey. Specifically, respondents were asked how many times they visited the GP and Practice Nurse and Consultant/Specialist in the previous 4 weeks. In this report, this number was multiplied by 12 and an annual average visit rate per person was estimated. In relation to emergency room attendances, respondents were asked how many times they visited the emergency room in the previous year in both surveys.

Using survey data as opposed to actual activity data introduces some uncertainty. First, surveys rely on respondents to self-report their healthcare usage and are thus subject to recall bias. This bias is reduced however if the recall period is shortened i.e. 4 weeks is preferable to a year. Second, surveys are subject to sample variability. For example, the annual GP visit rate per person with asthma varies from 5.2 to 6.7 in the Healthy Ireland Survey in 2015 and 2016 respectively. Third, the ASI survey is subject to both recall bias and self-selection bias e.g. people who are in contact with the ASI potentially have more severe asthma and consume more healthcare. For example, Table 7 shows that 84% of children consulted a GP in the previous 12 months which compared to 74% of the general population in the Healthy Ireland survey in 2016. Given the uncertainty in using the survey data, sensitivity analyses was conducted. This method tests the variability in total cost as a result of a change in key cost inputs i.e. resource use data, reported in the surveys. It allows decision makers to see the range of potential costs in low resource use and high resource use scenarios in the absence of population based activity data.

Table 7: Asthma society survey, 2019

	Adults	Children (<15)
No. who consented and understood the survey	2010	1414
Average age (years)	40.4	7.8
% female	75%	43%
% living in urban area	64%	59%
% asthma in previous 12 months	89%	91%
% Medical card	31%	31%
% GP visit card	7%	8%
% private health insurance	42%	41%
% consulted GP in previous 12 months		85%
% consulted Practice Nurse in previous 12 months		40%

SOURCE: ASI survey, 2019 (35)

PRIMARY CARE

Primary care costs include the cost of GP and Practice Nurse visits. The question in the surveys did not distinguish between scheduled and out of-hours consultations. So, it was assumed that the total number of GP consultations included both scheduled and out-of-hours GP consultations.

GP and Practice Nurse costs are a product of the annual number of visits per person with asthma, the number of people with asthma and the unit cost of a GP and nurse visit. Table 8 shows that people with asthma visit their GP between 6 and 8 times a year. These visit rates for asthma are higher than that of the general population (3.2-5.0 per adult and 1 .8-2.7 per child (36, 37)) but consistent with reported GP visit rates for people with a chronic disease (9.2 (38)). Children under six years visit their GP more often than other age groups because of the difficulty in diagnosing asthma, the availability of free GP care and a free initial and annual check-up for their asthma as part of the Asthma Cycle of Care programme. Previous research has shown that offering free GP care to the under sixes led to dramatic increases in the number of GP visits (39). There is also evidence of a general increase in GP out-of-hours consultations at the weekend for the under sixes (40).

Table 8: Average GP and practice nurse visit rates for people with asthma

Age	GP visit rate	Practice Nurse visit rate
0-5 years		
ASI survey, 2019	8.4	2.5
6-14 years		
ASI survey, 2019	5.7	2.0
>15 years		
Health Ireland Survey, 2016	6.2	1 .5

SOURCES: Asthma Society of Ireland (ASI) survey, 2019(35). Healthy Ireland Survey, 2016 (41)

The total number of primary care visits are estimated by applying visit rates from Table 8 to the estimated number of people with annual asthma in the relevant age groups (see Table 4 in the previous chapter). Unit costs for GP and Practice Nurse visits are then applied to the total number of visits and per child in the case of children under six years of age.

GP unit costs vary by age group. For children under six years of age, a capitation rate of €125 per child is paid to GPs (42). For children with asthma under six years of age registered under the Asthma Cycle of Care programme, GPs are paid an additional annual average of €52.5 for annual reviews[1]. This means that the unit cost of GP care per child under six with asthma amounts to €177.5 per child. A registration fee also applies which amounted to €307,150 in 2017(42).

1 *€90 for the first year after registration plus €45 for subsequent years up to the child's sixth birthday (€90+ (€45*5)) = €315/6).*

A weighted average of the GMS and private cost per visit applies to the other age groups. The weights are the proportion of people with asthma who have a medical card (47%). This weight/proportion for people with asthma was obtained from the Healthy Ireland Survey, 2016 (41). The GMS and private cost per visit are estimated at €32[2] and €52.5 per visit respectively (43). In the absence of unit cost data for a Practice Nurse, unit costs were estimated based on a Staff Nurse annual salary (44)[3].

Table 9 shows that asthma resulted in an estimated 2.4 million and 625,000 visits to the GP and Practice Nurse in 2017 respectively. In total, asthma costs €108 million in primary care in 2017.

Table 9: Total primary care costs, 2017

	No. Visits	Unit Costs (€)	Total Costs (€)
GP visits			
0-5 yr olds	245,805	177.5 per child	5,194,091
6-14 yr olds	379,978	43.2 per visit	16,415,039
>15 yr olds	1,768,856	43.2 per visit	76,414,574
Asthma Cycle of Care Registration			307,150
Total	**2,394,639**		**98,330,854**
Practice Nurse visits			
0-5 yr olds	73,156	15.2 per visit	1,115,246
6-14 yr olds	133,326	15.2 per visit	2,032,510
>15 yr olds	418,792	15.2 per visit	6,384,371
Total	**625,274**		**9,532,126**
Grand Total			**107,862,981**

SOURCES. See Table 8 and footnotes 1-3.

2 *Based on GMS fee per eligible patient of €249.07 from the Primary Care Reimbursement Service, Statistical Analysis of Claims and Payments (2017) and 7.6 GP visits per medical card patient from the Healthy Ireland Survey 2016.*

3 *Staff Nurse pay point 6. = €36,13745. Health Service Executive. Payscales for HSE staff 2017 [Available from: https://www.hse.ie/eng/staff/benefitsservices/pay/. Total staff costs = €47,466 including PRSI and pension costs as per HIQA guidelines. Hourly costs = €30.4 based on methodology by Central Expenditure Evaluation Unit. Practice Nurse visit assumed to last half an hour i.e. €30.4*0.5.*

MEDICATION COSTS

The cost of asthma medication was estimated by identifying the total number of asthma packs dispensed in 2017 and applying the corresponding unit cost, rebate and dispensing fees. Specifically, all packs with an indication for asthma were extracted from the IQVIA database, which records all medications dispensed from pharmacists in the State [46]. This include packs in the ATC4 classes of R3F1, R3D1, R3B2, R3A2, R3A3, R3A4, R3K1, R3C2 and R3X2. Some packs in these classes are indicated for COPD only e.g. Seretide 500 and are thus excluded from this analysis. Other packs are indicated for both asthma and COPD. In these cases, we assumed that 60% are for asthma based on another database from IQVIA which contained prescription data from a panel of 200 GPs in 2014 [47]. The price was obtained from the HSE reimbursement list [48] and associated fees and rebates applied as per the National Centre for Pharmacoeconomics guidelines for inclusion of drug costs [49].

Table 10 shows that 3.3 million packs of asthma medication were dispensed in 2017 at a cost of €45.4 million. Combination preventer treatments (ICS/LABA) and reliever inhalers (SABA) represent 44% and 27% of total costs respectively.

Table 10: Asthma medication costs, 2017

	No. Packs	Total cost (€)	%
ICS/LABA combination	511,511	20,045,041	44%
ICS	609,813	12,109,786	27%
SABA	2,138,267	11,455,649	25%
Leukotriene receptor antagonist	31,048	455,127	1%
Other	3,097	1,349,155	3%
Total	**3,293,737**	**45,414,758**	**100%**

NOTE: 129 units were excluded because price was not obtainable

ABBREVIATIONS: ICS=inhaled corticosteroid, LABA= long acting beta$_2$ agonist, LAMA= long acting muscarinic antagonist, SABA= short acting beta$_2$ agonist

SOURCES: IQVIA wholesale data, 2017 (46), HSE Reimbursement list (48).

SECONDARY CARE

The cost of secondary care comprises of the cost of hospitalisations (inpatient and day-cases), emergency department and Specialist/ Consultant visits.

HOSPITALISATIONS

The data informing the cost of hospitalisations are the actual number of hospital discharges from the Hospital Inpatient Enquiry system (HIPE)(50) and cost per asthma hospitalisation based on Australian Refined Diagnostic Related Group (ARDRGs) (51). Specifically, all discharges with a principal diagnosis of asthma (ICD 10 codes J45 and J46) were abstracted from the HIPE database. Table 11 shows that in 2017 there were 7,688 hospital discharges due to asthma in Ireland. In comparison to other countries in Europe, Ireland had the second highest rate of asthma hospital discharges in Europe in 2016 (see Figure 6).

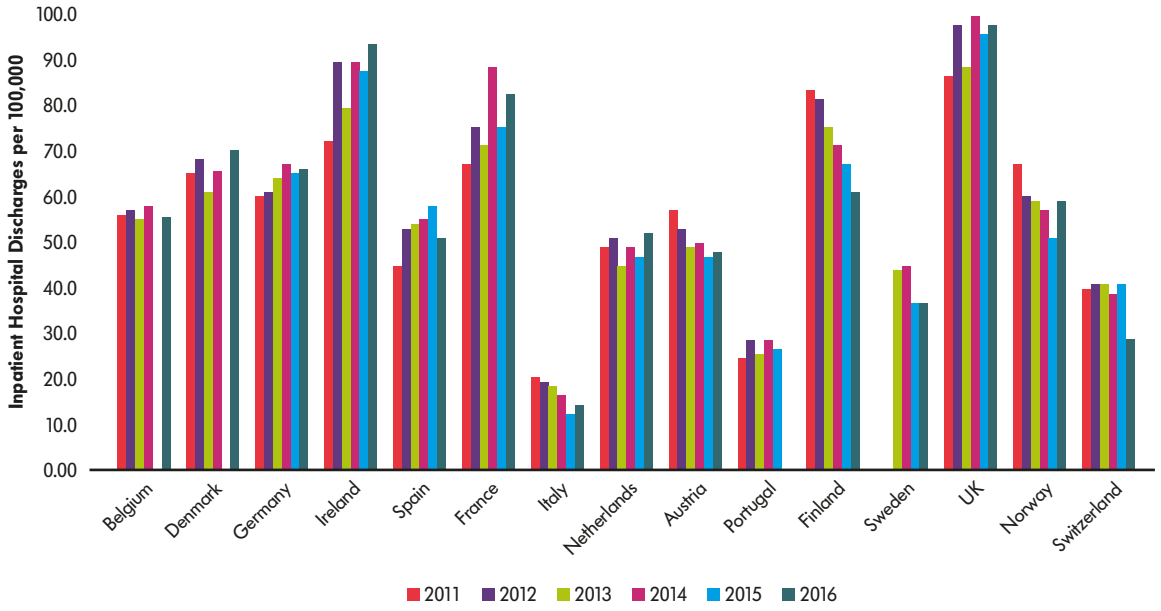
Unit costs are a weighted average of the cost of ARDRGs E69A, E69B and E42A (51), inflated to 2017 prices using the Consumer Price Index for Health (52). Table 11 shows that the cost of hospitalisations due to asthma amounted to €14.9 million in 2017.

Table 11: Cost of hospitalisations due to asthma, 2017

	0-14	15+	Total	Unit Cost (€)[3]	Total Cost (€)
In-patient discharges [1]	1,553	2,516	4,069	1,831 [2]	7,450,339
Day-cases [1]	156	3,463	3,619	2,048 [2]	7,410,541
Total			**7,688**		**14,860,880**

SOURCES: 1= Hospital Inpatient Enquiry Scheme, 2017 (50). 2=Health Pricing Office, 2013 (51)

Figure 6: European comparison of asthma hospital discharges, 2011-2016



SOURCE: Eurostat, 2019 (53)

EMERGENCY DEPARTMENT VISITS

Table 12 shows that there were an estimated 133,000 visits by people with asthma to emergency departments in 2017. This is based on the ASI survey and Healthy Ireland surveys. The cost of an emergency room visit was obtained from the Health Pricing office (€268) and inflated to 2017 prices using Consumer Price Index for Health (52). In total, emergency department visits by people with asthma cost €36.3 million in 2017.

Table 12: Cost of emergency department visits, 2017

Age	Average no. visit per person	Total visits	Unit Cost (€)3	Total Cost (€)
0-51	0.56	16,387		
0-141	0.42	27,998		
>152	0.31	88,011		
Total		**132,396**	**274**	**36,305,128**

SOURCES: 1. ASI Survey, 2019 (35). 2. Healthy Ireland Survey, 2016 (41) 3. Health Pricing Office, 2013 (51)

SPECIALIST VISITS

Table 13 shows that there were an estimated 421,000 visits by people with asthma to Specialists/Consultants in 2017. The cost of visit to a Specialist was based on the Salary of Category 1 consultants in 2017(45) and HIQA guidelines(54)[4] . In total, visits to Specialist/ Consultant by people with asthma cost €65 million in 2017.

Table 13: Cost of specialist visits, 2017

Age	Average no. visit per person	Total visits	Unit Cost (€)[3]	Total Cost (€)
0-51	0.27	7,901		
0-141	0.23	15,332		
>152	1 .40	397,467		
Total		**420,700**	**155**	**65,036,148**

SOURCES: 1=ASI Survey, 2019 (35). 2= Healthy Ireland Survey, 2016 (41) 3= HSE Pay Scales, 2017(45)

4 *Consultant annual salary in 2017 Category 1 = €183,225 (HSE Consolidated Pay Scales 2017). Total costs = €240,666 including PRSI and pension costs as per HIQA guidelines. Hourly costs = €155 based on methodology by Central Expenditure Evaluation Unit.*

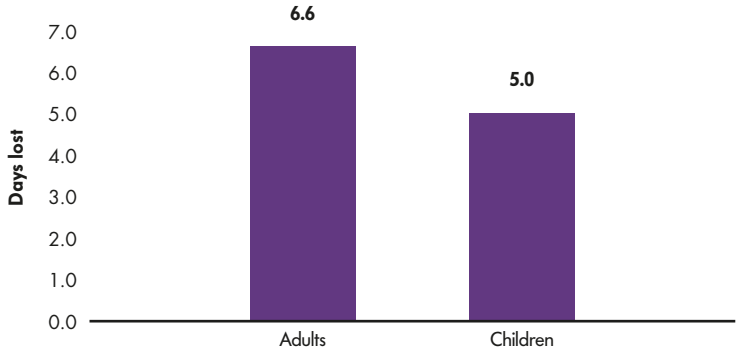
INDIRECT COSTS

To capture the impact beyond the health service i.e. the societal impact, the indirect cost of asthma was estimated. The Human Capital approach was adopted, which estimates losses from economic activity based on the average potential earnings for the individual. Losses in economic activity included were absenteeism from work and premature mortality due to asthma.

Figure 7 shows that adults and children lose on average 7 and 5 days from work and school respectively. These figures are broadly consistent with previous estimates which reported that people with asthma missed an average of 6 and 8 days of work and school due to their asthma respectively (14).

In terms of the economic cost of lost productivity, only workdays lost are included. The cost of absenteeism due to asthma is presented in Table 14. It shows that a total of 1 .38 million workdays were lost due to asthma in 2017 at a cost of €200 million.

Figure 7: Average work and school days lost due to asthma



SOURCE: ASI Survey, 2019

Table 14: Cost of absenteeism due to asthma, 2017

Variable	Female	Male	Total
Total number adults with asthma[1,2]	164,665	119,240	283,905
Annual average number workdays lost[3]	7.1	4.2	
Workforce participation rate (35-44 age group)[4]	78%	92%	
Total number of workdays lost	916,463	463,112	1,379,576
Average annual salary[5]	€37,646		
Annual number of working days	260		
Daily salary	€145		
Total cost absenteeism	**€132,696,839**	**€67,055,097**	**€199,751,936**

SOURCES: 1= Table 3 2. Healthy Ireland Survey, 2016. 2=57% of adults with asthma are female (41) 3. ASI Survey 2019 (35). 4=Central Statistics Office, 2017 (55). 5=Central Statistics Office, 2017 (56).

The productivity losses from premature mortality is presented in Table 15. Of the 63 people who died in 2016, 9 died before retirement age (66 years). For these 9 individuals, the average work years lost (WYL) based on labour participation rates up to and including age 65 were calculated. The total cost of productivity losses associated with premature mortality was estimated based on the average wage and the estimate for WYL. When estimating the present value of future benefits and losses, it is best practice to apply a discount rate[57]. Two estimates are presented a 0% discount rate i.e. unadjusted, and a 5% discount rate of WYL. The total unadjusted cost of productivity losses associated with premature mortality was €5.6 million. After adjustment with the recommended 5% discount rate to reflect the present value of future losses, this value was reduced to €2.7 million. A total of 150 work years (unadjusted) were lost due to premature mortality. As WYL are based on employment participation, the estimate for productivity losses does not include the economic value lost from informal care and voluntary activities; therefore this estimate does not capture the full extent of the economic impact of premature mortality losses.

Table 15: Cost of premature mortality due to asthma, 2017

Age	No. Deaths[1]	Participation rate (%)[2]	Work Years Lost (WYL)	WYL (5% Discount)	Total cost (€) (unadjusted)	Total cost (€) (Discounted)
Male						
15 – 19	1	26	39	15	1,468,947	546,476
20 – 24	0	71	0	0	-	-
25 – 34	0	91	0	0	-	-
35 – 44	1	92	23	13	881,669	492,097
45 – 54	0	89	0	0	-	-
55 – 59	0	78	0	0	-	-
60 – 64	1	62	3	2	81,692	65,132
Female						
15 – 19	1	23	33	13	1,232,718	474,572
20 – 24	1	66	31	13	1,148,956	504,370
25 – 34	0	81	0	0	-	-
35 – 44	0	78	0	0	-	-
45 – 54	1	71	11	7	421,447	282,127
55 – 59	2	61	9	7	327,144	254,447
60 – 64	1	47	2	1	61,928	49,374
Total	**9**		**150**	**71**	**5,624,501**	**2,669,595**

SOURCES: 1=Table 5. 2=Central Statistics Office 2017 (56). 3=Retirement age assumed to be 66 years. 4=Central Statistics Office, 2017. Average annual salary of €37,646. (55)

TOTAL COSTS

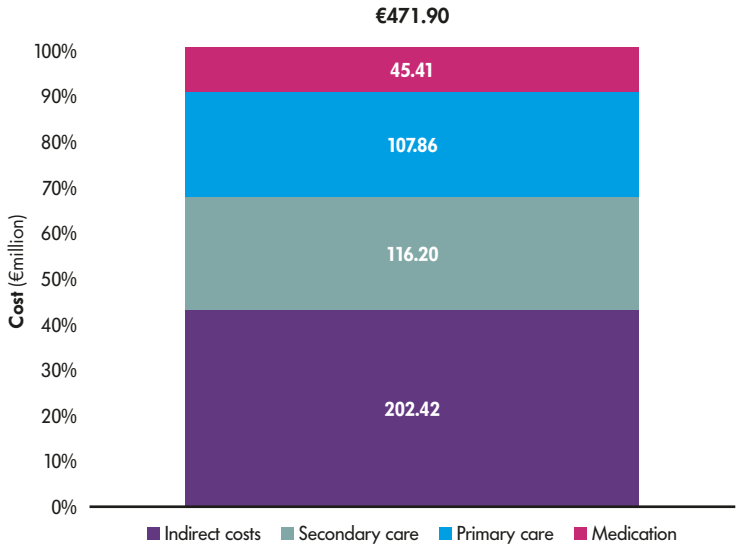
Asthma places a significant burden on the Irish healthcare system. In 2017, there was an estimated 2.4 million and 625,000 GP and Practice Nurse consultations respectively. There was also a significant burden in the hospital setting with an estimated 421,000 and 133,000 Specialist and emergency department visits respectively along with almost 8,000 hospital discharges (inpatient and day-case).

Table 16: Total healthcare resources, 2017

Resource use	Number
Hospital day-cases	3,619
Hospital stays	4,069
Hospital bed days	10,905
Emergency department visits	132,396
Specialist consultations	420,700
Practice Nurse consultations	625,274
GP consultations	2,394,639

Figure 8 shows that the total cost of asthma in 2017 was estimated at €472 million. This equates to a cost of €1,242 per person with asthma. Indirect cost accounted for €202 million (43%) while direct costs accounted for €270 million (57%).

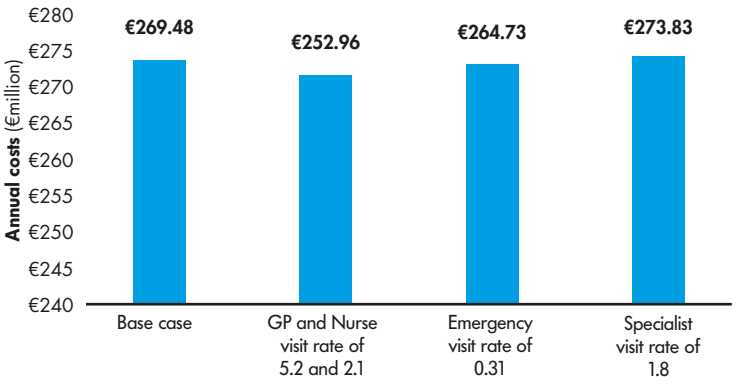
Figure 8: Total estimated cost of asthma, 2017



SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to show the variation in direct costs to changes in the resource use variables from the surveys e.g. GP, Practice Nurse, Specialist and emergency room visits. The rates of healthcare utilisation used in the sensitivity analysis were from the Healthy Ireland Survey 2015 and applied to all age groups. Figure 9 shows that direct costs are most sensitive to changes in the GP visit rate used in the analysis with direct costs decreasing to €253 million (a decrease of 6%) if lower GP visit rates are applied.

Figure 9: Sensitivity analysis



Someone in Ireland visits an Emergency Department with asthma on average **every 4 minutes.**

SUMMARY

Asthma is a big public health challenge. It is a common chronic illness that imposes a huge burden on the health system and society and is associated with substantial costs. It is estimated that asthma costs society approximately €472 million in 2017 equating to €1,242 per person. The direct cost of asthma accounts for 57% of total costs (€270 million). This included the cost of treating asthma in hospitals, in primary care and with medication.

Similar to other studies conducted on the cost of asthma, the cost of secondary care represents the largest proportion of direct costs. Overall, treating asthma in hospitals cost a total of €116 million in 2017 (25% of total costs). This comprises of €65 million, €36 million and €15 million for Specialist/Consultant, emergency department and hospital stays respectively. In total, asthma resulted in 133,000 visits to the emergency department and almost 8,000 hospitalisations (inpatient and day-cases) due to asthma in 2017.

Asthma also places a high burden on the primary care system in Ireland. It is estimated that asthma resulted in 2.5 million and 625,000 GP and Practice Nurse consultations respectively in 2017. This cost approximately €108 million. The Healthy Ireland and ASI member survey found that asthma resulted in an average GP visit rate per person that was considerably higher than the general population but consistent with that reported for people with a chronic disease. The fact that scheduled and out-of-hours consultations increased (especially at weekends) as a result of the introduction of free GP care to the under sixes contributed to the higher than average GP visit rate for asthma. This in turn may have contributed to the lower than average attendance rate per person at emergency rooms due to asthma (0.3-0.56 compared to 0.7 in Europe) possibly because of the availability of an out- of- hours GP service at weekends.

The cost of medications for asthma was €45 million in 2017. Combination preventer treatments and reliever inhalers represented 44% and 27% of total medication costs respectively. In contrast to other national studies on the cost of asthma, asthma medications represented only 10% of the total cost of treating asthma. This may be because of the high cost of treating asthma in primary care and the availability of generic alternatives which have reduced the cost of inhalers e.g. Ventolin.

The indirect costs of asthma accounted for 43% of total costs. On average, people with asthma missed 7 workdays in 2017 due to their asthma. Lost productivity in terms of missed workdays due to illness and premature death resulted in an estimated 1 .4 million workdays lost equating to €202 million in 2017.

This study provides the first comprehensive assessment of the direct and indirect cost of asthma. However, much of the data informing the data was based on self-reported data in surveys, one of which was conducted specifically for this study. These surveys are subject to sample variability and self-selection bias which introduces uncertainty into the analysis. A sensitivity analysis was performed which showed that the total cost of asthma is most sensitive to the GP visit rate per person used. Data was also not available for other costs associated with asthma such as out-of-pocket and informal care costs, which means that the total costs are likely to be under-estimated. The lack and variability in the data also highlights the fact that comprehensive data on people with asthma is required to better inform health policy.

LITERATURE REVIEW

National and international guidelines have long recommended that people with asthma should be provided with self-management programmes to help them manage their asthma [13]. A key part of the guidelines is patient education and regular review [58]. The USA, Australia and several European countries have had asthma self-management programme for all people with asthma in place since the early 1990s.

An asthma self-management programme was introduced in Ireland in 2015, known as the Asthma Cycle of Care. This programme only applies to children under six years of age with asthma. It provides a child with a free initial visit to the GP to assess their asthma. A further check is provided within 3 months of the initial check and every year thereafter until the child reaches 6 years of age.

The goal of national and international asthma self-management programmes is to reduce the mortality and morbidity associated with asthma and improve quality of life. As such, this chapter reviews the literature on the impact that asthma self-management programmes have on these outcomes.

ASTHMA MANAGEMENT PROGRAMMES

Asthma self-management support interventions are any interventions that help patients manage their asthma through education, training and support. The GINA guidelines state that self-management is key in maintaining good asthma control; this includes providing guided self-management training focusing on asthma information, inhaler techniques, adherence, written asthma action plan, self-monitoring and regular medical review [13].

Although guided by GINA guidelines, there is variation in asthma management programmes globally. Some programmes are fully integrated into the healthcare system and involve all people with asthma e.g. Finland, while others like Ireland only incorporate general practitioners and a sub-group of people with asthma e.g. children under six years of age in Ireland. Finland developed a national asthma self-management programme between 1994 and 2004 in order to address mortality risk from asthma, which resulted in significant reductions in asthma morbidity, hospital admissions, disability pensions and costs.

This was achieved with:

- earlier diagnosis and active treatment (inhaled corticosteroids as first-line therapy);
- implementation of simple guidelines;
- organisation of collaboration between primary care and specialists;
- development of local asthma physician, nurse and pharmacist networks;
- and patient-centred asthma education and empowerment (guided self-management).

The Finnish model of care stands out as an exemplar. As such, European asthma programmes somewhat analogous to the Finnish one were initiated in other European countries, including: France, the Netherlands, Denmark, Poland, Portugal and Spain over the past two decades. Programmes were updated and enhanced over time based on the growing evidence base and additions to international guidelines. For example, the Norwegian government issued a national asthma strategy in 2008–2012, which was followed by a more developed action plan for 2015-2024. Successful results of national asthma programmes outside Europe have been reported from Australia, Canada, Singapore, Brazil, Puerto Rico and Tonga [12].

Although these international programmes differ, key features include individual action plans, education, training of medical professional and regular review. Some countries have integrated asthma management programmes into other areas of the health system and chronic disease management programmes e.g. Germany, Norway and the Netherlands. Specifically, in the Netherlands primary care consultations are recommended annually for adult patients with a light disease burden and more frequently with increased severity and control. For children with asthma, a more coordinated management strategy is recommended with coordination between the GP and consultant on medication changes and written action plans.

Other countries have also focused on gathering data to monitor outcomes from the implementation of these programmes. For example, the Danish National Database for Asthma (DNDA) was launched in 2016 with the overall aim of collecting data on all patients treated for asthma and monitoring asthma occurrence, the quality of diagnosis, and management. As the database is based on existing healthcare registers within the Danish healthcare system, most patients are captured and evaluation of outcomes and healthcare utilisation can be performed regularly for asthma patients. In Germany, a central tenet of the German chronic disease management programme is a data-driven system for continuous quality improvement. To this end, relevant data on each subject are collected in a standardized manner for evaluation and quality improvement purposes.

The latest guidelines in the UK state that all people with asthma (and/or their parents or carers) should be offered self-management education which should include a written personalised asthma action plan and be supported by regular professional review. In addition, in light of the 2014 National Review of Asthma Deaths [11] which reported that only 23% had evidence of self-management education and nearly half of the people who died had not sought or received medical attention in their final attack, further consideration is given to hospital admissions and consultations as an opportunity to ensure that written action plans are in place and if already in place to pro-actively review them.

The Irish Asthma Control in General Practice guidelines (2013), adapted from the GINA guidelines states that the essential features of a self-management programme in asthma include: education and motivation, joint setting of goals, self-monitoring to assess control with educated interpretation of key symptoms, regular review of asthma control and a written action plan [18].

APPROACH TO LITERATURE REVIEW

A pragmatic literature search strategy was undertaken to obtain an in-depth understanding of self-management programmes for people with asthma and associated outcomes. The outcomes of interest were:

- GP visits;
- Hospitalisations;
- Emergency department visits;
- Drug usage;
- Absenteeism;
- Mortality; and
- Quality of life;

The starting point for the pragmatic literature review was an extensive review of asthma self- management programmes conducted by Pinnock et al. up to 2017 (59). This was then updated to 2019 by Salutem Insights. In addition, a country specific targeted search strategy was conducted in Google because the impact of international asthma self-management programmes may not necessarily be published in peer reviewed journals and therefore not captured in the above mentioned literature searches. In summary, the three elements of the literature review were:

1. Existing published review on the impact of self-management programmes for asthma contained in Pinnock et al. (2017) (59). There were two dimensions to this review: first a meta-review of systematic reviews (25 systematic reviews in total); and second, a systematic review of randomised controlled trials (RCTs);
2. Supplementary pragmatic literature review to update Pinnock et al (59) to 2019. This search strategy uncovered 11 additional studies.
3. Country specific audit of the impact of international asthma self-management programmes.

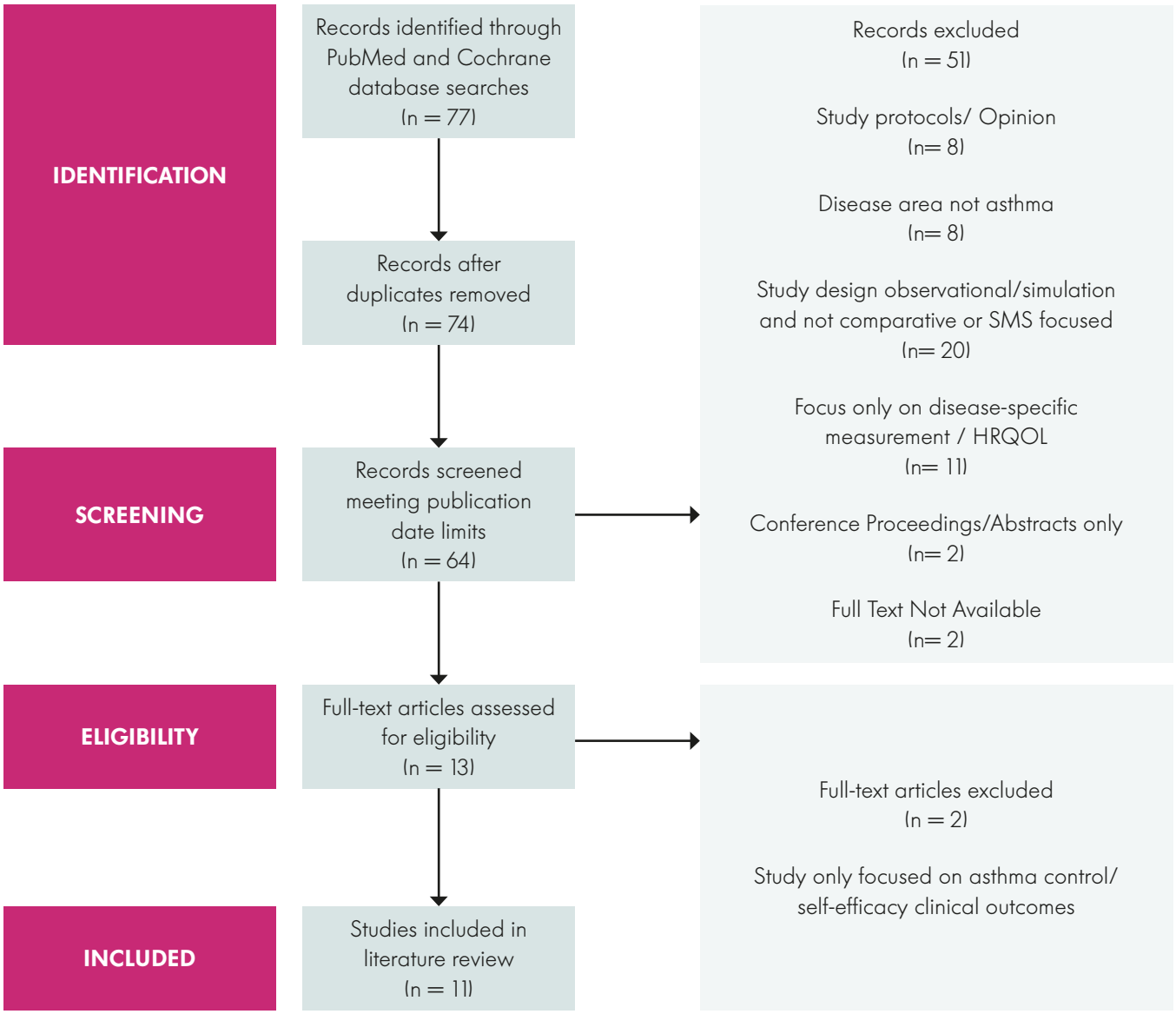
Table 17 highlights the PICO search strategy adopted and Figure 9 illustrates the PRISMA search strategy process for the supplementary pragmatic literature review highlighted in (2) above.

Table 17: PICO search strategy*

Population	People with asthma, including adults and/or children, ethnic minorities and groups who were perceived as finding services 'hard to reach'. Trials of generic self-management support was included if sub-group data for people with asthma were reported.
Intervention	Any research paper which focused on, or explicitly incorporated, strategies to support self-management.
Comparator	Typically 'usual care'. The nature of the control service was noted and accommodated, but papers were not excluded on this basis.
Outcomes	Mortality, use of primary, secondary and tertiary healthcare services (including unscheduled use of healthcare services and hospital admission rates), other health outcomes (including asthma control), productivity (including absenteeism, process/ intermediate outcomes/ drug utilisation (ownership of asthma action plans, self-efficacy, utilisation of medication). Studies that only focused on clinical outcomes/ asthma control were excluded.
Settings	Any healthcare setting: hospital (in-patient or out-patient), community or remote (e.g. web based) settings
Study design	Research articles and systematic reviews which had explicitly assessed self-management systems for asthma patients.
Databases	PubMed and Cochrane Database of Systematic Reviews.
Search terms	"Asthma" And "Self" And "Management" And "Healthcare" And "Utilisation" Filters: Publication date from 2017/02/01 to 2019/03/01; Humans; English
Unpublished and in progress studies	Abstracts identified in the search were used to identify recently published trials
Dates	1st February 2017 to 1st March 2019. This was decided on based on the extensive search criteria undertaken by Pinnock et al, 2017 which included reviews up to and including January 2017. Pinnock et al study publications in 2017 and onwards were removed classified as duplication.
Other exclusion criteria	Papers not published in English were excluded. (Detailed exclusion criteria are highlighted in Figure 10)

**adapted from Pinnock et al, 2017(59)*

Figure 10: PRISMA diagram of supplementary pragmatic review



RESULTS

1. PINNOCK ET AL (2017)

Table 18 summarises the results of the meta-review of systematic reviews (Table A1 in the Appendix reports the results of all 25 systematic reviews). Table 18 shows that 12 studies highlighted significant benefit from self-management programmes for reducing hospitalisations, while 8 studies highlighted no benefit for reducing hospitalisations and 5 did not report on hospitalisation. In terms of reductions in ED visits, 16 out of 20 studies highlighted a benefit from self-management programmes, with only 4 studies suggesting there was no reduction for this outcome.

A reduction in GP consultations from a self-management programme was highlighted in 10 of the 25 studies; 6 studies reported a reduction while 4 reported no impact on GP consultations. None of the studies explicitly highlighted changes in drug utilisation, although asthma control due to better utilisation practices and adherence of medication were included as an outcome measure in most studies, the majority of which favoured self-management interventions. Of the 6 studies that discuss the impact of absenteeism from work or school, 5 studies highlighted evidence of a reduction in absenteeism in the intervention groups. The impact on absenteeism ranged from 1 school/workday a year to a 21% reduction (see Table A1 in Appendix A).

None of the studies explicitly reported mortality as an outcome measure.

Health-related quality of life (QoL) was recorded in the majority of studies and estimated using a range of outcome measures. When assessing asthma control as a component of QoL, three meta-analyses reported a reduction in symptoms in participants who received self-management interventions compared to control groups. The other four narrative reviews had inconsistent results or showed no benefit on symptom control. The broader concept of QoL was assessed in 8 studies; four of these found an improvement from a self-management intervention.

Figure 11 shows the results of the meta-analysis of RCTs from Pinnock et al. (2017). It shows that self-management support interventions for people with asthma are associated with a reduction in hospitalisations (21-50%), in A&E visits (18-34%) and unscheduled consultations (32%).

Overall, the systematic meta-review concluded that supported self-management programmes for asthma can reduce hospitalisations, A&E visits and unscheduled consultations and at the same time improve asthma control and quality of life. The review also suggested that an optimal self-management strategy was defined as education including advice on self-monitoring and a written action plan that was supported by regular professional review (58).

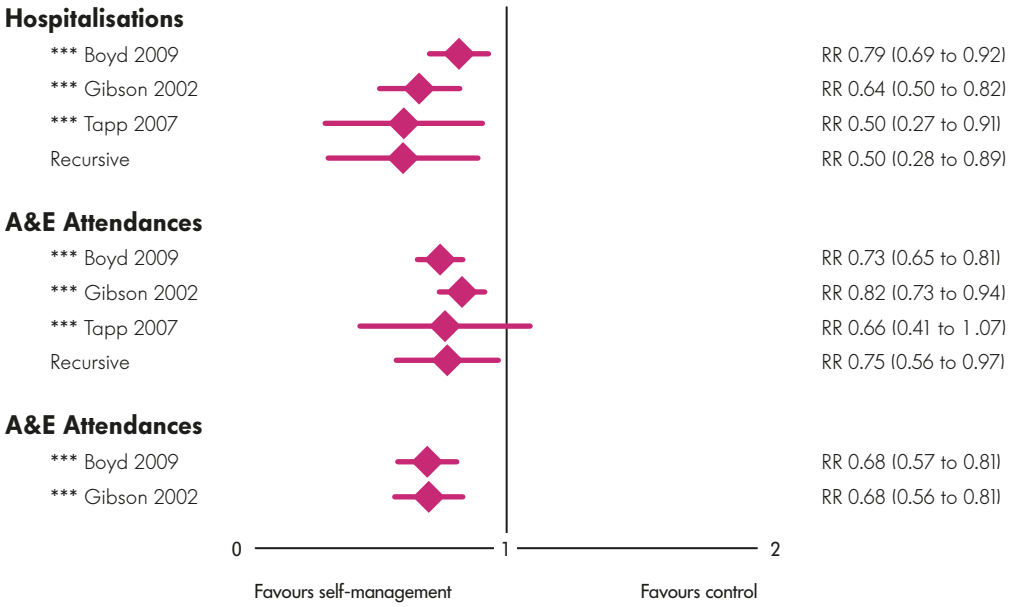
Table 18: Results from existing literature review of asthma self-management programmes

	Reduction in GP visits	Reduction in hospital stays	Reduction in ED	Impact on drug use	Improved QoL	Reduction in absenteeism
Meta-review of systematic reviews (n=25)	**Yes** (6/10 studies reported reduction)	**Yes** (12/20 studies reported reduction)	**Yes** (16/20 studies reported reduction)	**Yes**	**Yes** (4/8 studies reported improved QoL); (6/10 reported reduction in symptom scores)	**Yes** (5/6 studies reported a reduction in absenteeism)

ABBREVIATIONS. ED=emergency department

SOURCE: Pinnock et al. (2017)

Figure 11: Meta-forest plot of healthcare resource use from meta-analyses.



Students with asthma currently **miss an average of 5 school days** a year due to their asthma.

2. SUPPLEMENTARY LITERATURE REVIEW

Table 19 presents the 11 studies included in the supplementary pragmatic literature review. The 11 studies were published from February 2017 to February 2019 (inclusive).

Table 19: Results from supplementary literature review 2017-2019

Reference	Reduction in GP visits	Reduction in hospital stays	Reduction in ED	Impact on drug use	Improved QoL
Harris et al. (2019) [60]	Yes OR 0.74 (CI 0.60, 0.90)	Yes SMD -0.19 (CI -0.35, -0.04)	Yes OR: 0.70 (CI 0.53, 0.92)	Uncertain	Yes SMD 0.36 units higher on paediatric AQLQ
van Buul at al. (2018) [61]	No	N/A	N/A	N/A	N/A
Hall et al. (2018) [62]	No	Yes OR: 0.29, (CI 0.16, 0.50)	No	N/A	No
Niznik et al. (2018) [63]	N/A	N/A	N/A	Yes, improved medication adherence	Yes, Improved MDI technique
Sarzynski at al. (2017) [64]	N/A	Yes reduction 59%	Yes reduction 42%	N/A	N/A
Kercsmar at al. (2017) [65]	N/A	Yes 41 .8% (CI, 41 .7%-42.0%) relative reduction	Yes 42.4% (CI, 42.2%-42.6%) relative reduction	N/A	Yes (12.5% change in asthma control)
McClure at al. (2017) [66]	N/A	Yes (71% reduction) *Small sample size (n=17)	N/A	N/A	N/A
Kuipers at al. (2017 [67]	N/A	N/A	N/A	Yes, improved ICS adherence	No
Hanlon P at al. (2017) [68]	N/A	Yes (at 12m) (risk reduction 79%)	No	N/A	No
Rau-Murthy at al. (2017) [69]	N/A	Yes (63% reduction)	Yes (64% reduction)	N/A	Yes (35% higher ACT score)
Pool at al. (2017) [70]	No	No	No	None	Yes (77% higher mean difference in ACT)

ABBREVIATIONS: ACT=asthma control test, CI= confidence interval, ED=emergency department, ICS=inhaled corticosteroids, MDI= metered dose inhaler, OR = odds ratio, SMD=standardised mean difference.

The impact of self-management interventions on GP visits was highlighted in 4/11 studies. One study highlighted significant reductions for GP visits, one evidenced an increased number in the intervention group presenting at primary care (compared to presenting in tertiary/ emergency care) and the other 2 citing no differences observed. Hospitalisations were assessed in 9/11 studies with 8 suggesting a reduction in hospitalisations of varying magnitude from self-management interventions. Emergency department (ED) visits were assessed in 8/11 studies with a reduction highlighted in 5 studies.

The impact of medication usage and cost impacts were not well documented. Only 4/11 studies highlighted an impact and focused on medication adherence. One study suggested there was a benefit of improved adherence and MDI technique while another highlighted improved ICS adherence. The other two studies suggested inconclusive or no change in terms of medication adherence impacts.

Quality of life (QoL) benefits were measured using a range of validated disease-specific and generic QoL measures as well as symptom score scales. QoL was reported in 8/11 studies; 5 studies highlighted a benefit and 3 suggested no significant benefit on QoL from self-management programmes for asthma.

Only one study in the supplementary pragmatic review reported an assessment of absenteeism (Harris et al (60), not shown in Table 19). and found the impact of self-management interventions inconclusive on work/ school absences.

None of the studies reported impacts on mortality.

Overall, the supplementary pragmatic literature review is consistent with the extensive review conducted by Pinnock et al (2017)(59) in that supported self-management programmes for asthma can reduce hospitalisations, ED and GP visits and at the same time improve quality of life.

3. INTERNATIONAL ASTHMA MANAGEMENT PROGRAMME AUDIT

The results of the audit of international asthma management programmes is presented in Table 20.

In Finland between 1994 and 2004, a national asthma self-management programme resulted in significant reductions in asthma morbidity, hospital admissions, disability pensions and costs. At the programme's inception, an estimated 20% of Finnish patients with asthma had severe or uncontrolled symptoms; by 2001, that proportion had halved, and by 2016 it was down to 2.5% (71). The number of days of asthma-related hospital admissions in Finland also more than halved over the course of the programme. The first 13 years of the programme drop of 46% in the overall number of asthma-related visits to the emergency room in Finland; the decrease was even sharper among children (71).

In Germany, the results of a recent study suggested that the German disease management programme for asthma has been effective in enhancing the quality of care in regard to an improved symptom frequency, adherence to guidelines, pharmacotherapy, and hospitalisation (72).

The results of the regional programme in 2000–2003 in the Lodz area of Poland also showed a decrease in hospital days (number of hospital episodes as a result of asthma exacerbation from 1 .48 per 1,000 in 2000 to 0.84 per 1,000 in 2003), length of hospitalisation and

overall asthma costs despite an increase in number of patients [73] The Portuguese national programme in 2000–2007 showed a 15% reduction in the hospitalisation rate [74]. In Spain, several regional programmes have been initiated since 1992. In northwest Spain, hospital admissions due to childhood asthma decreased from 2.91 per 1000 inhabitants in 1995 to 1 .33 per 1000 inhabitants in 2007 [75].

The goal of national asthma self-management programmes is to also reduce asthma mortality. Changes in global and European asthma mortality rates are highly variable [76]. However, data on asthma mortality rates rom Eurostat, show that the greatest reductions in asthma mortality were evidenced in countries with long established asthma self-management programmes e.g. Germany (-13.7%), France (-6.6%), Portugal (-10%), Finland (-33%) and Norway (-28.3%).

Table 20: Results of audit of international asthma management programmes

Reference	Country	Reduction in GP visits/ medication	Reduction in hospitalisations	Reduction in ED	Improved QOL
Haahtela (2006) [77] **Burki** (2019) [71]	Finland	N/A	Hospital admissions reduced by 54% from 1994-2016	From 2000-2013 ED visits reduced by 46%	From 1994-2016 patients with uncontrolled symptoms reduced from 20% to 2.5%
Mehring et al. (2013) [72]	Germany	Reduction in the prescription of oral corticosteroids from 15.7% in 2006 to 13.6% in 2007, and again from 7.5% in 2008 to 5.9% in 2010	Reduction in hospitalisations from 2.8% to 0.7% (40% reduction)		Improved symptom frequency (in 2006 only 15% of the subjects were symptom-free, by 2010 this had increased to 26%)
Stelmach et al. (2005) [73]	Poland		Decreasing number of hospital episodes as a result of asthma exacerbation from 1 .48 per 1,000 in 2000 to 0.84 per 1,000 in 2003 (43% reduction)		
Bugalho de Almeida et al. (2009)[74]	Portugal		15% reduction in hospitalisations for asthma exacerbation from 2000-2007		
Barcala et al. 2010 [75]	Spain		Hospital admissions due to childhood asthma decreased from 2.91 per 1000 inhabitants in 1995 to 1 .33 per 1000 inhabitants in 2007 (54% reduction)		

LITERATURE REVIEW OVERVIEW

Table 21 reports the minimum and maximum impacts of asthma self-management programmes from the comprehensive literature review conducted in this chapter. The most robust sources for the impact of asthma self-management programmes on GP consultations, hospitalisations and emergency department visits are from the meta forest plot in Figure 11 and the actual reported impact from national asthma programmes in Table 20. The impact on work days lost and on deaths was not reported in Pinnock (2017) [59] or from the majority of the international asthma programmes. As such, individual studies and Eurostat data on asthma mortality provided the sources for the minimum and maximum impact from asthma self-management programmes for absenteeism and asthma mortality respectively.

Table 21: Minimum and maximum impacts reported from the literature

	Minimum		Maximum	
	%	Source	%	Source
Hospitalisations	-15%	Portugal programme [74]	-54%	Finland Programme [71, 77]
Emergency department visits	-18%	Figure 11	-46%	Finland programme [71, 77]
GP consultations	-19%	Figure 11 (lower confidence interval)	-32%	Figure 11
Absenteeism	1 workday a year	Pinnock (2017) [59]	-21%	Pinnock (2017) [59]
Deaths	0%	Eurostat [33]	-33%	Eurostat data for Finland [33]

SUMMARY

National and international guidelines have long recommended that people with asthma should be provided with asthma self-management programmes. A key part of the guidelines are written action plans, patient education and regular review [58]. The USA, Australia and several European countries have had national guidance which includes some form of asthma management programme for all people with asthma in place since the early 1990s. The goal of asthma self-management programmes is to reduce the morbidity and mortality associated with asthma and improve quality of life.

The evidence presented from randomised controlled clinical trials in the literature provides strong evidence for significant benefits from self-management programmes for people with asthma in terms of reductions in unscheduled care and improvements in quality of life. This benefit is also reflected in real-life. Finland developed a coordinated national asthma self-management programme in 1994 for all people with asthma, which more than halved the number of hospitalisations and reduced the number of emergency department visits by 46% [71]. There were also big improvements in the level of asthma control in Finland as a result of the programme.

Asthma self-management programmes somewhat analogous to the Finnish one were initiated in other European countries, including: France, Germany, the Netherlands, Denmark, Sweden, Poland, Portugal and Spain over the past two decades. Reductions in hospitalisations have been reported in Germany (40%), Portugal (15%), Poland (43%) and Spain (54%). The variation in results could be due to different approaches adopted in these countries in implementing asthma self-management programmes. There is evidence to suggest that it is a combination of approaches in a multidisciplinary framework (e.g. including nurses and pharmacists in Finland) that provides the most successful outcomes for people with asthma (78).

Overall, the literature review reveals that asthma self-management interventions reduce hospitalisations and emergency department visits from 15-54% and 18-46% respectively. Improvements in quality of life and asthma control are also evidenced in several of the studies. The literature review also revealed that asthma self-management programmes can reduce absenteeism from work or school due to asthma by 21%.

As mentioned, the goal of asthma self-management programmes is to also reduce asthma mortality. Although, the impact on mortality is not commonly reported from international asthma self-management programmes, Eurostat data shows that the greatest reductions in asthma mortality are evidenced in countries with long established asthma self-management programmes e.g. Germany (-13.7%), France (-6.6%), Portugal (-10%), Finland (-33%) and Norway (-28.3%). In contrast, deaths in countries with less established asthma management programmes have increased e.g. Ireland, The Netherlands, Sweden and the UK.

A recent review carried out by HIQA also found that self-management support interventions for patients with asthma can improve quality of life, reduce hospital admissions and use of urgent and unscheduled healthcare (57). They stated that the optimal intervention format is not clear but should include education supported by a written asthma action plan as well as improved skills training including the use of inhalers and peak flow meters. Gibson (2002) suggested that an optimal self-management strategy was defined as education including advice on self-monitoring and a written action plan that was supported by regular professional review (58).

Steps towards improvements in asthma care have been taken in Ireland with the introduction of a national asthma self-management programme for the under-sixes. The Asthma Cycle of Care only provides children with a free initial visit to the GP to assess their asthma. Further free checks are provided within 3 months of the initial check and every year thereafter until the child reaches 6 years of age. In contrast to international asthma self-management programmes, the Asthma Cycle of Care programme only applies to children under six years of age and it is not integrated with the rest of the healthcare system. In addition, there is no monitoring of progress e.g. proportion of people with asthma with a written action plan or outcomes to assess whether the programme is working or not.

IMPACT OF A UNIVERSAL ASTHMA SELF-MANAGEMENT PROGRAMME

The previous chapter highlighted the impact that universal asthma self-management programmes have on patient outcomes from the comprehensive literature review. This chapter applies the finding from the literature review to estimate the potential impact that a universal asthma self-management programme would have on the number of hospitalisations, emergency department visits, GP consultations, absenteeism and deaths in Ireland due to asthma. It also estimates the cost savings that could be achieved as a result of the reduction in healthcare utilisation.

IMPACT

Tables 22 and 23 show that there are substantial benefits associated with asthma self-management programmes. Specifically, a universal self-management programme can result in a reduction of 610-2,035 hospitalisations and 24,000-61,000 emergency department visits a year in Ireland. In terms of GP consultations, a universal asthma self-management programme could result in a reduction of between 455,000 and 766,000 GP consultations a year. The total savings from a reduction in healthcare utilisation is estimated at €27- €54 million a year.

Universal asthma self-management programmes can also prevent people from dying with asthma. For example, asthma deaths in Finland were reduced by 33% [33]. Applying this figure to the total number of asthma deaths in Ireland in 2016 [63] means that 21 asthma deaths that could be prevented as a result of an asthma self-management programme. This equates to an indirect cost saving of €6 million.

The literature also showed that asthma self-management programmes reduce absenteeism from work and school. Up to 290,000 lost work-days could be avoided from a universal self-management programme equating to a cost saving of up to €48 million a year.

In total, the cost savings (direct and indirect cost) as a result of the implementation of a universal asthma self-management programme is estimated at €68 -€102 million a year.

Table 22: Minimum impact from a universal asthma self-management programme

	Original no.	% Reduction[4]	No. Prevented	Cost avoided (€)
Direct Costs				
Hospitalisations	4,069	15%	610	1,117,551
Emergency department visits	132,396	18%	23,831	6,534,923
GP visits	2,394,639	19%	454,981	19,655,193
Total				**27,307,667**
Indirect Costs				
Absenteeism (workdays)[2]	1,379,576	1 workday a year	283,905	41,107,260
Deaths3	63	0%	-	-
Total				**41,107,260**
Grand Total				**68,414,927**

SOURCES: 1=Table 16. 2=Table 14. 3=Figure 4. 4=Table 21.

Table 23: Maximum impact from a universal asthma self-management programme

	Original no.[1]	% Reduction[3]	No. Prevented	Cost avoided (€)
Direct Costs[1]				
Hospitalisations	4,069	54%	2,197	4,023,183
Emergency department visits	132,396	46%	60,902	16,700,359
GP visits	2,394,639	32%	766,284	33,103,483
Total				**53,827,025**
Indirect Costs				
Absenteeism (workdays) [2]	1,379,576	21%	289,711	41,947,907
Deaths[3]	63	33%	21	6,166,764
Total				**48,114,671**
Grand Total				**101,941,696**

SOURCES: 1=Table 16. 2.=Table 14. 33=Figure 4. 4=Table 21.

SUMMARY

An extension of the current Asthma cycle of care programme to all people with asthma in Ireland is likely to result in substantial benefits to people with asthma and to the State. A review of the literature and the real life impact from asthma self-management programmes in other countries shows that there is a clear reduction in the number of hospitalisations due to asthma as a result of the implementation of universal asthma self- management programmes. Hospitalisations due to asthma are an important indicator of the level of asthma care and health system efficiency because the majority of them are preventable. The literature shows that just over 50% or 2,000 hospitalisations due to asthma could be avoided in Ireland as a result of the implementation of a universal asthma self-management programme. Indeed, a target of a 50% reduction in asthma hospitalisations due to asthma over 5 years had been set by GINA in 2010 (79). Hospitalisations were selected as the main outcome measure because they are a significant driver of costs and are also highly responsive to self-management interventions.

Other clear results from the literature are reductions in emergency department visits and GP consultations as a result of the implementation of a universal asthma self-management programme. Specifically, asthma self-management programmes have resulted in reductions of up to 46% and 32% in the number of emergency department and GP consultations respectively. This equates to 61,000 and 766,000 emergency department visits and GP consultations avoided a year.

Although the impact of asthma self-management programmes on asthma deaths is not often reported in the literature, Eurostat data shows that countries, like Finland, with long established asthma self-management programmes have been very successful in reducing the number of deaths due to asthma.

The reduction in above mentioned healthcare utilisation results in direct cost savings. This chapter shows that direct cost savings of €27 and €54 million a year could be achieved from the implementation of a universal asthma self-management programme. Indirect cost savings, from reductions in missing work-days due to premature asthma mortality and illness could increase the cost savings to €68-€102 million a year. Cost savings have occurred in other countries. For example, Finland experienced a 36% reduction in the cost of asthma per person with asthma in the first 10 years of their national asthma self-management programme (77).

This chapter suggests that non-implementation of a universal asthma self-management programme in Ireland represents not only a missed opportunity in terms of improved outcomes for people with asthma and increased efficiency in the health system, it also represents a missed cost saving opportunity.

CONCLUSION

Asthma is a big public health problem because it is a chronic condition that affects a lot of people. During their life-time, asthma affects 890,000 people in Ireland or 1 in 5 of the population. On an annual basis, 380,000 people are affected with asthma equating to 1 in 13 of the population. It is more common in children than adults with 1 in 10 children and 1 in 13 adults experiencing asthma annually.

People can die from asthma. In 2016, 63 people died from asthma in Ireland: two-thirds of these deaths are preventable (11). Ireland had the worst death rates from asthma in Western Europe in 2015 and also had one of the highest asthma hospitalisation rates in Europe. These figures are important because when asthma is properly managed the majority of asthma deaths and hospitalisations can be avoided (11).

Asthma places a large burden on the Irish health system. It resulted in an estimated 133,000 visits to the emergency department and almost 8,000 hospitalisations (inpatient and day-cases) in 2017. People with asthma also made an estimated 421,000 visits to see a Consultant/Specialist in the same year. Asthma is also estimated to have resulted in 2.4 million and 625,000 visits to the GP and Practice Nurse respectively. Moreover, 3.3 million asthma medications were dispensed in 2017.

The impact that asthma imposes on the health system comes at a considerable cost. Specifically, the direct cost of asthma amounted to €270 million in 2017. The cost of hospitalisations, emergency department visits and GP consultations accounted for 57% of total direct costs. Indirect costs, in terms of absenteeism from work and premature mortality due to asthma amounted to an additional €202 million. The total cost of asthma was €472 million in 2017 equating to €1,242 per person who experiences asthma on an annual basis.

During their life-time, asthma affects **890,000 people** in Ireland.

Much of the healthcare and costs associated with asthma could be avoided with the introduction of a universal asthma self-management programme. Asthma self-management programmes have long been recommended to help people control their asthma through education, written asthma action plans and regular review. The goal of these programmes is to reduce the mortality and morbidity associated with asthma and improve quality of life.

The results from randomised controlled clinical trials, which are also reflected in real life, show that the morbidity due to asthma could be reduced and quality of life improved from the implementation of asthma self-management programmes. Specifically, hospitalisations due to asthma could be reduced by up to 50%, as experienced in Finland with the implementation of an asthma self-management programme for all people with asthma. This experience in Finland and in other countries has led to asthma hospitalisations being used as an indicator for improved asthma care. Given that the asthma hospitalisation rate has been increasing in Ireland and is the second highest in Europe, opportunities exist for improvements in asthma care in Ireland. The introduction of the Asthma Cycle of Care programme for children under six years of age in 2015 is the first step towards this but the full benefits of such a programme may not be achieved until it is extended to all people with asthma.

Evidence is also strong for reductions in emergency department (up to 46%) and GP visits (up to 32%) as a result of asthma self-management programmes for all people with asthma. If the reductions in hospitalisations, emergency department and GP consultations seen in other countries occurs in Ireland, direct cost savings of up €68 million a year could be achieved in Ireland if the current asthma management programmes is extended to all people with asthma. Furthermore, including indirect costs could result in cost savings of up to €102 million annually.

In conclusion, asthma is a big public health problem that requires a big public health solution. Other European countries have applied big public health solutions by providing all people with asthma with an asthma self-management programme and have subsequently reaped the benefits in terms of significant reductions in healthcare utilisation and costs. These benefits may be achieved in Ireland from an extension of the current asthma management programme for the under sixes to all people with asthma.

APPENDIX A1

Table A1: Results from Pinnock (2017)

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Systematic Reviews			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
Bailey, 2009 4 RCTs, 617 participants, 2000-2008	Minority groups: Puerto Rican; African-American; Hispanic; Indian sub-continent. Adults and children.	MA: Reduced hospitalisation in children [RR: 0.32 (95%CI 0.15 to 0.70) 1RCT] but not reported in adults. Improved QoL in adults [WMD 0.25 (95%CI 0.09 to 0.41)] [2 RCTs] NA: 2 of 2 RCTs reported a reduction in A&E visits, and hospitalisations: one reported no difference in 'use of healthcare resources' 2 of 3 reported improved QoL (adults)	Yes	N/A	Yes	N/A	N/A	N/A
Bernard Bonnin, 1995 11 RCTs, 1,290 participants, 1981-1991	Children: aged 1 to 18 yrs. Overall severity classified as 'mild to moderate'	MA: Reduced hospitalisation [ES: 0.06 (+/- -.08)] and emergency visits [ES 0.14 (+/-0.09)] [5 RCTs] NA: It was among children with high baseline numbers of hospitalisations and emergency visits that the greatest subsequent reduction in morbidity was observed.	Yes	N/A	Yes	N/A	N/A	N/A
Bhogal, 2006 4 RCTs 355 participants, 1990-2004	Children aged 6 -19 yrs with mild to severe asthma.	MA: Symptom-based PAAPs reduced unscheduled care compared to peak-flow-based PAAPs [RR 0.73 (95%CI 0.55 to 0.99)] [4 RCTs] There was no difference in hospital admissions [RR 1 .51 (95%CI 0.35 to 6.65)] Peak flow-based PAAPs reduced the number of symptomatic days/week [mean difference: 0.45 days/week (95%CI 0.04 to 0.26)] [2 RCTs] No significant difference for QoL	No	N/A	Yes	N/A	N/A	N/A
Zemek, 2008 5 RCTs 423 participants 1990 – 2005	School-aged children with mild to severe asthma	MA: A peak flow-based PAAP reduced unscheduled care compared to no plan: [WMD -0.50 (95%CI -0.83 to -0.17)][1 RCT] A peak flow–based PAAP compared to no plan reduced symptom scores: [WMD -11 .80 (95%CI -18.22 to -5.38)] and mean difference of school days missed [WMD -1 .03 (95%CI -1 .85 to -0.21)] [1 RCT]	No	N/A	Yes	N/A	Yes	N/A
Boyd, 2009 38 RCTs, 7,843 participants 1985 – 2007	Children (0 - 18 yrs of age) who had attended the emergency room for asthma within the previous 12 months.	MA: Education reduced A&E attendances: [RR 0.73 (95%CI 0.65 to 0.81) 17 RCTs], hospital admissions [RR 0.79 (95%CI 0.69 to 0.92) 18 RCTs] and unscheduled doctor visits [RR 0.68 (95%CI 0.57 to 0.81) 7 RCTs] No effect on QoL: [WMD 0.13 (95%CI 0.73 to 0.99) 2 RCTs]. SGA: Type/timing of intervention, timing of outcome assessment, age of participants) had no effect on outcomes.	Yes	Yes	Yes	N/A	N/A	N/A
Bussey Smith, 2009 9 RCTs, 957 participants, 1986 – 2005	Patients aged 3 - 75 yrs. 7 RCTs focused on children, 2 on adults. 4 RCTs evaluated urban or inner-city populations	NA: 7 studies reported unscheduled care: 1 of 4 improved hospitalisation, and 1 of 5 reduced unscheduled care. 5 of 9 studies found statistical improvements in asthma symptoms compared to control.	Yes	N/A	Yes	N/A	N/A	N/A
Chang, 2010 1 RCT, 113 participants 2010	African-American and Hispanic communities. Children aged 1-17 yrs. Mean age approx. 7 yrs.	NA: There was no effect on hospitalisations: [OR 1 .58 (95%CI 0.37 to 6.79)] or A&E attendances: [OR 0.30 (95%CI -0.17 to 0.77)] [1 RCT] Days absent from school were reduced by 21% in the intervention group (95%CI 5-36%) [1 RCT]	No	N/A	No	N/A	Yes	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Systematic Reviews			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
Coffman, 2009 18 asthma RCTs (of 25 studies), 8,077 participants, 1987-2007	Children aged 4 - 17. Severity ranged from mild to severe, majority of participants were black or Latino. 15 RCTs incorporated parents, school personnel and classmates w/o asthma.	NA: Unscheduled healthcare was not reported. School absences significantly reduced in 5 of 13 RCTs. QoL improved in 4/6 RCTs. Days with symptoms were reduced in 3 of 8 RCTs. Nights with symptoms improved in 1 of 4 RCTs: 1 found improvement in control group.	N/A	N/A	N/A	N/A	Yes	N/A
Gibson, 2002 36 RCTs, 6,090 participants 1986 – 2001	Adults and children. Recruited from a variety of settings including hospital; emergency room; OPD; community setting; general practice.	MA: Self-management education reduced hospitalisations [RR 0.64 (96%CI 0.50 to 0.82) 12 RCTs], A&E visits [RR 0.82 (95% CI 0.73 to 0.94) 13 RCTs], unscheduled consultations [RR 0.68 (95% CI 0.56 to 0.81) 7 RCTs] Self-management education improved QoL [SMD 0.29 (95% CI 0.11 to 0.47) 6 RCTs], days off work or school [RR 0.79 (95% CI 0.67 to 0.93) 7 RCTs] SGA: Optimal self-management (supported by a PAAP and regular review) reduced hospitalisations [RR 0.58 (96%CI 0.43 to 0.77) 9 RCTs], A&E visits [RR 0.78 (95% CI 0.67 to 0.91) 9 RCTs]	Yes	Yes	Yes	N/A	Yes	N/A
Gibson, 2004 26 RCTs 6,090 participants 1987 – 2002	Adults and children. Recruited from a variety of settings including hospital; emergency room; OPD; community setting; general practice.	NA: Benefits were found for any number of action points (2 to 4). Both reduced hospitalisations, but only % personal best reduced A&E visits. PAAPs which included advice on increasing ICS and starting oral steroids reduced hospitalisations, and A&E visits. Efficacy of incomplete and non-specific action plans was inconclusive.	Yes	N/A	Yes	N/A	N/A	N/A
Moullec, 2012 18 RCTs, 3,006 participants 1990 – 2010	Moderate - severe asthma patients (one also included COPD patients). Age range 35 - 50 yrs. Women over-represented in most studies	MA: ES for adherence to ICS compared by number of components of the Chronic Care Model (CCM) in the study: #1 CCM components (n=13): small ES 0.29 (95%CI 0.16 to 0.42) #2 CCM components (n=5): large ES 0.53 (95%CI 0.40 to 0.66) #4 CCM components (n=4) very large ES 0.83 (95%CI 0.69 to 0.98)	N/A	N/A	N/A	N/A	N/A	N/A
Newman, 2004 18 asthma RCTs (of 63 studies) 2,004 participants, 1997 – 2002	Adults with 3 LTCs (including asthma)	NA: 7 of 11 studies reported a reduction in unscheduled healthcare. 6 of 12 studies reported improved QoL. Eight of the studies for asthma measured severity of symptoms and frequency or the percentage of symptom-free days. The three studies that recorded reductions in severity all used education and action plans. 8 of 14 reported improved adherence. Little difference recorded between symptoms or PEF guided actions	N/A	N/A	Yes	N/A	N/A	N/A
Postma, 2009 7 RCTs, 2,316 participants 2004 – 2008	Participants aged 5-9 years, low-income, and ethnic minorities (mainly African American and Hispanic). 28% -75% of participants tested positive to at least 1 allergen.	NA: 3 of 6 studies reported reduced hospitalisation and reduced unscheduled consultations. 4 of 6 reported reduced A&E attendances. 'Consistent and significant decrease in caregiver-reported asthma symptoms among intervention subjects compared with control subjects in 6 studies'	Yes	Yes	Yes	N/A	N/A	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Systematic Reviews			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
Powell, 2009 15 RCTs, 2,460 participants 1990 – 2001	Adults with asthma recruited from a range of primary, community, A&E, secondary care	NA: Of 6 studies, 4 reported no difference in hospitalisation, 1 reported no difference in A&E visits, 3 reported inconsistent effects on unscheduled consultations. Of 6 studies, 6 reported no difference in hospitalisation, 5 reported inconsistent effects on A&E visits. Omission of regular review increased unscheduled consultations. [1 RCT] Reduction of intensity of education increased unscheduled consultations. [1 RCT] Verbal (as opposed to written) PAAPs had no effect on hospitalisations, or A&E visits. [1 RCT]	No	No	No	N/A	N/A	N/A
Ring, 2007 14 RCTs, 4,588 participants 1993 – 2005	Adults or children with asthma with moderate-to-severe asthma or were recruited following medical care for acute asthma	NA: The only outcome was ownership and use of PAAPs. 4 of 5 studies of self-management education reported an increase in PAAP ownership, 1 reported an increase in PAAP use. 1 of 2 studies of telephone consultations reported an increase in PAAP ownership, and increased understanding of PAAPs. 1 of 2 studies of asthma clinics reported increased PAAP ownership. 1 of 2 studies of asthma management systems reported more children receiving PAAPs, and the other reported significantly greater use. Educating HCPs facilitated PAAP use for up to 2 years post intervention and a quality improvement project had no effect.	N/A	N/A	N/A	N/A	N/A	N/A
Tapp, 2010 13 RCTs, 2,157 participants 1979 – 2009	Adults recruited during an A&E attendance.	MA: The intervention reduced hospital admissions [RR 0.50 (95%CI 0.27 to 0.91) 5 RCTs], A&E visits [RR 0.66 (95% CI 0.41 to 1.07) 8 RCTs] NA: Effect on QoL (2 RCTs) was inconsistent. There was no effect on days off work/school.	Yes	N/A	Yes	N/A	No	N/A
Toelle, 2004 7 RCTs, 967 participants 1990 – 2001	Adults (and children in 1 RCT) with asthma. Mean age of adults in the RCTs ranged from 28 - 45 yrs	MA: Unscheduled use of healthcare was only assessed in one RCT and not reported by the SR. SGA: There was no difference between symptom and peak flow based PAAPs in hospitalisations [RR 1.17 (95%CI 0.31 to 4.43) 3 RCTs] or A&E attendances [RR 1.17 (95% CI 0.31 to 4.43) 3 RCTs]. Symptom-based PAAPs reduced unscheduled consultations [RR 1.34 (95% CI 1.01 to 1.77) 2 RCTs]	No	Yes	No	N/A	N/A	N/A
Welsh, 2011 12 RCTs, 2,342 participants, 1986 – 2010	Children (mostly up to 12 yrs rather than teenagers with mild – severe asthma, with recent healthcare visit. Range of demographic settings, though many were ethnic and/or deprived communities in US.	MA: Heterogeneity of outcomes precluded meta-analysis of hospitalisation and A&E visits. There was no difference between groups in mean number of unscheduled consultations [mean difference 0.04 (95%CI -0.20 to 0.27) 2RCTs)] NA: 2 of 5 studies reporting hospitalisation one found a reduction and one an increase in the intervention group. Effect on A&E visits (6 RCTs), unscheduled consultations (3 RCTs) was inconsistent. Overall no effect on QOL (5 RCTs).	No	No	No	N/A	N/A	N/A
Bravata, 2009 63 RCTs (of 79 studies) 13,476 participants. 1966-2006	Children (<18 years).	MA: Interventions targeting parents/caregivers reduced hospitalisation rates by 1.2% per year (95% CI, 0.1 to 2.4%) n=5 Self-management intervention studies improved symptom-free days by 2.8% (95% CI 0.6% to 5%) = 0.8 days per month n=7; and reduced monthly school absenteeism by 0.4% (95% CI, 0%-0.7%) = 0.1 day per month n=16. Longer duration of intervention increased the effect on school absences.	Yes	N/A	N/A	N/A	Yes	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Systematic Reviews			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
Denford, 2013 38 RCTs, 7883 participants 1993-2000	Adults (18 and over) with a diagnosis of asthma.	MA: Intervention group participants had reduced asthma symptoms [SMD= - 0.38, (95% CI -0.52 to 0.24) 27 RCTs] and unscheduled healthcare use [OR 0.71 (95% CI 0.56 to 0.91 23 RCTs]. Increased adherence to preventative medication. For IG's compared to CG [OR 2.55 (95% CI: 2.11 to 3.10)16 RCTs] Interventions including stress management were less effective in reducing symptoms [SMD=0.01 (95% CI:-0/08, 0.11] vs [SMD=-0.44 (95% CI -0.57, 0.31)] 'Active involvement of participants' associated with reduced unscheduled healthcare use [OR=0.50, (95% CI 0.28, 0.90) 6RCTs] vs [OR=0.79 (95% CI: 0.62, 1 .01)17 RCTs].	N/A	N/A	Yes	N/A	N/A	N/A
de Jongh, 2012 1 asthma RCT (of 4 studies) 16 asthma participants (of 182 participants). 1993 – 2009	Included participants regardless of age, gender or ethnicity.	NS: In the single asthma study, there were fewer admissions (2 vs 7) but more unscheduled consultations (21 vs 15) in the IG. The pooled asthma symptom score showed a significant difference between groups, favouring the IG (MD-0.36, 95%CI -0.56 to -0.17). The IG showed no improvements in spirometry, but there was a significant reduction in peak flow variability compared to control (MD -11 .12, 95% CI -19.56 to -2.68)	Yes	No	N/A	N/A	N/A	N/A
Kirk, 2012 10 RCTs, 2,195 participants. 1995-2010	Did not restrict to asthma, included any long term illness.	NS: Significant reduction was reported in asthma admissions (2/8 RCTs), A&E attendance (5/8 RCTs) and unscheduled consultations (3/8 RCTs). Control improved in 5 of 8 RCTs. QoI improved in 2/5 RCTs	Yes	Yes	Yes	N/A	N/A	N/A
Marcano-Belisario, 2013 2 RCTs 408 participants, 2000-2013	Children aged 18 or younger, diagnosed with a long term condition: asthma (10 RCTs), Cystic fibrosis (2), diabetes (1).	NS: Compared to control, 2 out of 2 RCTs showed no difference in hospital admissions. 1 of 2 studies showed fewer A&E attendances, 1 RCT found no difference in unscheduled GP consultations, or out of hours consultations, but reduced primary care nurse consultations. 1 study found no difference in the mean difference in ACQ scores between the intervention and control group at 6 months. 1 of 2 studies found improved QOL in the IG.	No	No	Yes	N/A	N/A	N/A
Press, 2012 7 RCTs (of15 studies), 1,459 participants. 1950-2010	Adults (18 or older). Ethnic minority groups.	NS: An education intervention reduced A&E attendance in 2 of 4 RCTs and hospital admissions in 2 of 3 RCTs. Symptoms were not reduced in any of the 3 RCTs that measured control. QoL was improved in 3 of 4 RCTs that used an asthma-related QoL outcome.	Yes	N/A	Yes	N/A	N/A	N/A
Stinson, 2009 4 RCTs (of 9 studies). 826 asthma participants. 1993-2008	5 studies entirely focused on African Americans (4), Asian Americans (1)	NS: 1 RCTs reported no difference in hospitalisations compared to control; 1 RCT reported significant reductions in A&E visits; and 1 of 2 RCTs showed fewer unscheduled consultations 4 out of 4 reported significant improvement in a measure of control. 1 of 4 asthma RCTs reported a significant benefit on QOL	No	Yes	Yes	N/A	N/A	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Randomised controlled trials			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
RCT: Al-Sheyab, 2012 n=261 HIGH risk of bias	Adolescents in northern Jordanian high school. The Intervention group had fewer females, less symptomatic and with higher English proficiency.	Compared to control improvements QoL improved [I: 5.42 (0.14) vs C: 4.07 (0.14) mean diff 1 .35 1 .04–1 .76]	N/A	N/A	N/A	N/A	N/A	N/A
RCT: Baptist, 2013 n=70 HIGH risk of bias	Aged 65 or older. Physician diagnosis of asthma, no restriction in severity. Majority Caucasian.	No between-group differences in ED visits or hospitalisations. After adjusting for baseline differences, unscheduled visits and overall healthcare utilisation was significantly lower at 6, but not 12m. Asthma control (ACQ) was similar at 6, 12m. At 12m IG participants were 4.2 times more likely to have an ACQ score <0.75. Mean QoL was significantly higher in the IG than in control at (1,6 and 12m)	No	Yes	No	N/A	N/A	N/A
RCT: Ducharme, 2011 N=219 LOW risk of bias	Canadian children aged 1-17 recruited during A&E attendance for acute asthma (78% were under the age of 6y)	At 28 days, there was no between group differences in unscheduled care. Compared to control, at 28 days children given the PAAP had better asthma control. At 28 days, there was no between-group difference in child/ caregiver QoL. At 28 days both groups showed marked decline in patient adherence to ICS from 90% at Day 1 to about 50% at Day 14, with no significant group difference. More IG children filled their oral steroid prescription [I: 64%. C: 53%. RR 1 .31 (95%CI 1 .07, 1 .60)]	N/A	No	N/A	No	N/A	N/A
RCT: Goeman, 2013 n=114 Low risk of bias	55 year or older, community based asthmatics with no restriction in asthma severity.	Compared to control group, at 12 months the IG had better asthma control. [ACQ. Mean diff 0.3 (95% CI: 0.06–0.5); p = 0.01] and better asthma-related QoL (p = 0.01). There was no significant difference in number of steroid courses (p=0.17) At 12 months a significantly greater number of IG (n= 36, 61%) owned a PAAP compared to control (n= 21, 37.5%) p = 0.015. Adherence to preventer medication was similar at 12m (p = 0.015)	N/A	N/A	N/A	N/A	N/A	N/A
RCT: Khan, 2014 N=91 HIGH risk of bias	1-14 years. Partly controlled asthma, defined as daytime symptoms >2x/ week, any activity limitation or nocturnal symptoms, lung function < 80%best or an exacerbation in previous year. Recruited children via A&E or paediatric clinic	There was a trend to improved outcomes at 6m but no significant between group difference in proportion of children attending A&E I:36 vs. C:52% (p=0.141) There was no between group difference in unscheduled doctor visits, asthma attacks, missed school days, night-time awakenings.	No	No	No	N/A	No	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Randomised controlled trials			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
RCT: Halterman, 2014 N=638 LOW risk of bias	Urban, primary care practices in deprived communities.	11% of children in both groups had an A&E visits or hospitalisation. Compared to control practices at 2m, children in the PAIR-UP practices had more symptom free days [I: 10.2 (SD4.8) vs C: 9.5 (5.1) d/2w (mean diff, 0.78; 95% CI, 0.29 to 1 .27) but the difference was not significant at 6m. Nights (but not days) with symptoms remained significant at 6m [I: 1 .4 (3.0) vs C: 1 .8 (3.2) mean diff: —0.43 (—0.77 to —0.09)]	No	N/A	No	N/A	N/A	N/A
RCT: Horner, 2014 N=183 UNCLEAR risk of bias	Grades 2-5 (Age 7-11). Physician diagnosis of asthma	There was no significant between group difference for admissions or ED visits. There was no significant between group difference in QOL scores. Inhaler skill improved significantly in the IG compared to control after 4 months. Treatment group parents reported higher self-efficacy and home management scores than their control group counterparts.	No	N/A	No	N/A	N/A	N/A
RCT: Joseph, 2013 N= 422 Unclear risk of bias	9 – 12 grade (14-18 years). Physician diagnosis of asthma and report >4 days of restricted activity in the past 30 days at baseline	There was no difference in self-reported ED visits and hospitalisations at 12 months. Compared to controls, at 12m the IG had fewer days with symptoms [I:3.9 (5.9) vs C: 5.2 (6.4) RR 0.8 (0.6 to 1 .0)]. There was no difference in other measures of symptom control (nights with symptoms; schooldays missed; days of restricted activity; days had to change plans.	No	N/A	No	N/A	No	N/A
RCT: Rhee, 2011 N=112 Unclear risk of bias	13-17 years. Mild/ moderate/severe asthma. Asthma diagnosis for 1 year. Able to understand spoken and written English. Recruitment varied: Keen to gain adolescents from low income families, but not a main thrust of inclusion	Both groups reported significantly increased quality of life over time (F=4.31, P=.002), with the IG having significantly higher QoL at 6m (difference, 11 .38; 95% CI, 0.96-21 .79; P=.03) and 9m (12.97; 3.46-22.48; P=.008). Both groups reported improved attitude to asthma (F=11 .94,P=.001); with greater improvement in the IG at 6m (mean difference, 4.11; 95% CI, 0.65-7.56; P=0.02). Adolescents of male gender or low family income, reported more positive attitudes at 3,6 and 9 months.	N/A	N/A	N/A	N/A	N/A	N/A
RCT: Rikkers Mutsaerts, 2012 N= 90 Unclear risk of bias	12 – 18 years mild to severe persistent asthma on regular ICS medication and poorly controlled at recruitment	There was no between-group difference in exacerbations, physicians' visits or telephone contacts. Compared to control, asthma-related QoL was better in the intervention group at 3m [PAQLQ I: 6.00 vs C: 5.68 diff: 0.40 (0.17 to 0.62)] but no different at 12m [I: 5.93 vs C: 6.05 diff: 0.05 (0.50 to 0.41) Compared to control, asthma control was improved in the IG at 3m [ACQ I: 0.96 vs C: 1 .19 diff: -0.32 (-0.56 to -0.08)] but no different at 12m [I: 0.83 vs C: 0.79 diff: -0.05 (-0.35 to 0.25) There was no between-group difference in symptom-free days.	N/A	No	N/A	N/A	N/A	N/A
RCT: Shah, 2011 N=150 GP s and 201 children LOW risk of bias	150 GPs and 221 children with asthma in their care	There was no between-group difference in hospitalisation or ED visits [I: 18% vs 12% diff 6% (— 4% to 15%)]. There was no between-group difference in school absence or parent absenteeism for child's asthma. Compared to controls, more patients of GPs in the IG reported receipt of a PAAP [I: 61% vs 46% diff 15% (95% CI, 2%-28%)	No	N/A	No	N/A	No	N/A

Reference	Target Group	Outcomes	Reduction in Healthcare Utilisation/ Economic Impacts:					
Randomised controlled trials			Hospital Stays	GP	ED	Drug Use	Absent-eeism	Mortality
RCT: van Gaalen, 2013 N=107 HIGH risk of bias	Adults with asthma aged (18-50 years), with using ICS 107/200 (54%) participated: I: 47/101 (47%) C: 60/99 (61%). The patients who participated at 30m were comparable to non-participants based on the ACQ scores at 0 and 12 months. but between group difference in AQLQ was greater in participants.	Compared to control, at 12 months after baseline, participants in the CG had improved asthma-related QoL [AQLQ 0.37 (95% CI 0.14 to 0.61) and asthma control [ACQ -0.57 (95% CI -0.88 to -0.26). At 30 months after baseline, there was a slightly attenuated improvement for both QoL [AQLQ adjusted between-group difference 0.29 [95% CI 0.01-0.57]) and ACQ (adjusted difference of -0.33 [95% CI -0.61 to -0.05]) scores in favour of the Intervention. No differences were demonstrated for lung function measured as FEV1 .	N/A	N/A	N/A	N/A	N/A	N/A
RCT: Wong, 2012 N=80 High risk of bias	Malaysian children (mix of Malay, Chinese, and Indian) all severities of asthma. Ages 6-17 years. Recruitment process not described.	At 6m there was no difference in A&E/unscheduled care [I: 4 (10.8) vs C: 6 (21 .1) p=0.35]. At 6m there was no difference in proportion controlled [ACT≥20 I: 81% vs C: 87% p=0.50] or with no exacerbations [ACT≥20 I: 89% vs C: 82% p=0.62].	N/A	No	No	N/A	N/A	N/A

Notes: MA- Meta-Analysis; NA- Narrative Analysis; NS: Narrative Synthesis; SGA- Sub-Group Analysis; IG: Intervention Group; CG: Control Group; ES: Effect Size; RR: Relative Risk; QOL: Quality of Life; RCT: Randomised Controlled Trial

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