Chapter 1

Asthma and the role of community pharmacists in asthma management: a review of the literature

1.1. INTRODUCTION

In the first part of this chapter, an overview of asthma and its management in Australia and overseas will be presented. The second part of this chapter will focus on asthma education, the impact of asthma education programs on asthma outcomes and the role of the pharmacist in asthma management.

1.2. ASTHMA

Asthma is a disorder of the small airways of the lung defined by its clinical, physiological and pathological characteristics. Clinical features include wheezing, episodic shortness of breath, particularly at night, often accompanied by cough. The main physiological feature is episodic airway obstruction characterised by expiratory airflow limitation. Airway inflammation, often associated with airway structural changes, is the dominant pathological feature. Since the pathogenesis of asthma is not clear, much of its definition is descriptive. Based on the functional consequences of airway inflammation, an operational description of asthma is:

"*Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment."* (NHLBI/WHO 2005).

Asthma is also a highly variable disease where the pattern, frequency and intensity of symptoms may vary within an individual over a period of time and may also vary among individuals in duration and severity. While there is no cure for asthma, these changing characteristics make the management of the disease a challenge for both the health care professional and patient. Given the highly variable nature of the disease, it is important that patients have a good understanding of the disease process, are able to recognise worsening asthma symptoms, and are able to appropriately use and correctly administer the asthma medications. Asthma medications can help prevent and control symptoms, reducing the frequency and severity of asthma exacerbations and reversing airway obstruction. Their success is dependent on their proper use and correct administration.

1.3. FACTORS INFLUENCING THE DEVELOPMENT OF ASTHMA

A number of factors that influence a person's risk of developing asthma have been identified from studies of young children and are broadly divided into unmodifiable host factors i.e. intrinsic factors within an individual (genetic predisposition to atopy and to airway hyperresponsiveness, obesity and gender) and modifiable environmental factors (indoor/outdoor allergens, respiratory viral infections, occupational sensitisers, passive/active smoking, outdoor/indoor air pollution, diet). However, the mechanisms whereby they influence the development of asthma are complex and interactive. Genes may interact both with other genes and with environmental factors to determine asthma susceptibility (Holgate 1999). In addition, the maturation of the immune response and the timing of infectious exposures during the first years of life are emerging as important factors modifying the risk of asthma in the genetically predisposed individual (NHLBI/WHO 2005).

1.3.1. Host factors

1.3.1.1. Genetic predisposition

Asthma has a heritable component, but it is complex. Multiple genes may be involved in the pathogenesis of asthma (Holloway *et al* 1999, Wiesch *et al* 1999), and different genes may be involved in different ethnic groups. Genes associated with the production of allergen-specific IgE antibodies (atopy), expression of airway

hyperresponsiveness, generation of inflammatory mediators and the determination of the ratio between Th1 and Th2 immune responses have been the main focus in the search for genes linked to the development of asthma. A number of chromosomal regions associated with asthma susceptibility have been identified. The ADAM33 in the chromosome 20p13 has been identified as an important player in the natural history and possibly the origins of asthma (Cakebread *et al* 2004, Holgate *et al* 2006).

There is a strong link between asthma and allergy. Over 80% of people with asthma have evidence of allergic sensitisation. Atopy is strongly associated with asthma that persists beyond the first six years of life (Illi *et al* 2001, Rhodes *et al* 2001). The presence of other allergic disorders (eczema, allergic rhinitis) or parental history of atopy are risk factors for persistent asthma at six years (Martinez *et al* 1995).

1.3.1.2. Obesity

Obesity has been shown to be a risk factor for asthma. Certain mediators (leptins) may affect airway function and increase the likelihood of the development of asthma (Shore and Fredberg 2005, Breuther *et al* 2006).

1.3.1.3. Gender

Male gender is a risk factor for asthma in children. The prevalence of asthma is greater in boys than in girls (Gissler *et al* 1999). However, more females than males develop asthma during and after puberty, thus the prevalence of asthma in adults is higher in females than in males (de Marco *et al* 2000). The reasons for this gender-related difference are not clear.

1.3.2. Environmental factors

1.3.2.1. Allergens

The specific role of indoor (domestic mites, furred animals, cockroach, fungi, moulds and yeasts) and outdoor (pollens, fungi, moulds and yeasts) allergens has not been fully resolved. There is evidence that house dust mite allergens, cat dander, dog dander and Aspergillus mould are independent risk factors for asthma-like symptoms in children up to three years of age, however this relationship is not straightforward. It depends on the allergen, the dose, the time of exposure, the child's age, and probably genetics as well (Wahn *et al* 1997, Huss *et al* 2001, Hogaboam *et al* 2005). Cockroach infestation has been shown to be an important cause of allergic sensitisation, particularly in inner-city homes (Rosenstreich *et al* 1997). Early

exposure to dogs and cats has been shown to increase the risk of allergic sensitisation (Celedon *et al* 2002, Almqvist *et al* 2003) but other studies suggest that early exposure may protect a child against allergic sensitisation or the development of asthma (Platts-Mills *et al* 2001, Gern *et al* 2004).

1.3.2.2. Infections

Studies in children admitted to hospital with respiratory syncytial virus (RSV) have shown that 40% will continue to wheeze or have asthma in later childhood (Sigurs *et al* 2000), while other studies indicate that certain respiratory infections early in life may protect against the development of asthma (Shaheen *et al* 1996, Stein *et al* 1999). The interaction between atopy and viral infections appears to be a complex relationship and interactions can occur when individuals are exposed simultaneously to both allergens and viruses (Zambrano *et al* 2003). The hygiene hypothesis (which suggests that exposure to infections early in life influences the development of the immune system along a 'nonallergic' pathway, leading to a reduced risk of asthma and other allergic diseases) may explain observed associations between family size, birth order, day-care attendance, and the risk of asthma (de Meer *et al* 2005).

1.3.2.3. Occupational sensitisers

Over 300 substances have been associated with occupational asthma (Chan-Yeung and Malo 1999). These include animal and plant derived proteins and organic and inorganic chemicals. Occupational sensitisers are estimated to cause about 1 in 10 cases of asthma among adults of working age (Nicholson *et al* 2005). Agricultural work and farming, painting, cleaning work and plastic manufacturing are associated with a high risk for occupational asthma.

1.3.2.4. Tobacco smoke

Exposure to tobacco smoke prenatally and after birth has been associated with a greater risk of developing asthma-like symptoms in early childhood. However, evidence of increased risk of allergic diseases is uncertain (Strachan and Cook 1998). Maternal smoking during pregnancy has an influence on lung development (Martinez *et al* 1995) and infants of smoking mothers are four times more likely to develop wheezing illnesses in the first year of life (Dezateux *et al* 1999). There is little evidence that maternal smoking during pregnancy has an effect on allergic sensitisation. Passive smoking has been shown to increase the risk of lower respiratory tract illnesses in infancy and childhood. Active smoking has been associated with sharp decline of lung function in people with asthma, greater asthma

severity (Siroux *et al* 2000), poor response to corticosteroid treatment (Chalmers *et al* 2002) and poor asthma control.

1.3.2.5. Outdoor/indoor air pollution

The role of outdoor air pollution in causing asthma remains controversial. Studies have shown that children raised in a polluted environment have diminished lung function but the relationship of this loss of function to the development of asthma is not known (Gauderman *et al* 2004). Indoor pollutants including gas cooking ranges, heaters, wood fires and building materials containing formaldehyde, have been linked with asthma symptoms, but their link to the development of asthma is unclear.

1.3.2.6. Diet

It has been shown that infants fed formulas of intact cow's milk or soy protein have a higher incidence of wheezing illnesses in early childhood compared to those fed with breast milk (Friedman and Zeiger 2005). Recent data also suggest that increased use of processed foods and decreased antioxidant (in the form of fruits and vegetables) intakes characteristic of Western diets, have contributed to the recent increases in asthma and atopic diseases (Devereux and Seaton 2005).

1.4. CLASSIFICATION OF ASTHMA

1.4.1. Global classification of asthma

According to the GINA guidelines, asthma is classified based on the level of symptoms, airflow limitation, and lung function variability into four categories; intermittent, mild persistent, moderate persistent and severe persistent (NHLBI/WHO 2005).

1.4.2. Australian classification of asthma

The National Asthma Council of Australia (NAC) classifies asthma in terms of severity of symptoms into mild, moderate or severe, as shown in Table 1.1 (National Asthma Council 2002).

Table 1.1. Classification of asthma severity based on NAC guidelines

Symptoms	Mild	Moderate	Severe
Wheeze, tightness, dyspnoea	Occasional, with viral infections or exercise	Most days	Every day
Nocturnal asthma	Absent	< Once a week	> Once a week
Asthma symptoms on waking	Absent	< Once a week	> Once a week
Hospital or ER admission in the last year	Absent	Usually not	Usually
Previous life threatening attack (ICU or ventilator)	Absent	Usually not	May have a history
Bronchodilator use	< Twice a week	Most days	> 3-4 times a day
FEV_1 predicted	$>$ 80%	60-80%	$<$ 60%
Morning peak flow on waking	> 90% recent best	80-90% best	$<$ 80% best

Source: National Asthma Council Asthma Management Handbook, 2002.

1.5. EPIDEMIOLOGY OF ASTHMA

Worldwide studies have demonstrated a wide variation in the incidence of asthma and have shown that the incidence, particularly in children, is increasing. The international pattern of prevalence cannot be completely explained by our current knowledge of recognised risk factors for the development of asthma and the reasons for the wide variations in prevalence within and between populations remain unknown (ISAAC 1998, Pearce *et al* 2000, Jansen *et al* 2001).

1.5.1. Asthma prevalence

Several studies investigating the prevalence of asthma over the last twenty years indicate that there has been a trend towards an increase in the prevalence of current or diagnosed asthma in children in many countries, such as UK, Australia, New Zealand, Finland, Austria and Israel (Britton *et al* 1986, Shaw *et al* 1990, Peat *et al* 1993, Whincup *et al* 1993, Rimpela *et al* 1995, Rona *et al* 1995, Omran *et al* 1996, Goren and Hellmann 1997, Riedler *et al* 1998). In contrast, although studies from Belgium and Finland have reported an increase in the prevalence of diagnosed

asthma in adults (Dubois *et al* 1998, Huovinen *et al* 1999), the increase in the prevalence of asthma in adults has not been as significant as that demonstrated in children. Fewer studies have investigated the prevalence of diagnosed asthma in older adults with recognition that asthma in the elderly is often misdiagnosed (Burrows *et al* 1991, Bellia *et al* 2003, Pezzoli *et al* 2003) and that it may be undiagnosed (Enright *et al* 1999, Wilson *et al* 2005).

In the European Community Respiratory Health Survey (ECRHS) conducted in 22 countries, the USA and Australia had the highest percentage of people with severe asthma (40% of total population with asthma), followed by Germany and France (32%), Belgium and Italy (29%) and New Zealand (26%). The Netherlands had the lowest percentage of people with severe asthma (6%). Although the USA and Australia had the highest prevalence of severe asthmatics, paradoxically, both countries were found to have the poorest rates of adherence to asthma treatment (Cerveri *et al* 1999).

In the International Study of Asthma and Allergies in Childhood (ISAAC), Australian children had the eighth highest prevalence of self-reported wheeze, at 30% and the second highest percentage of children who had more than four episodes of wheeze in the last year, at 35% of all children who had current wheeze. This equates to 8-9 % of the population (ISAAC 1998, Robertson *et al* 1998). In the European Community Respiratory Health Survey (ECRHS), Australian adults aged 20-44 years had the fourth highest prevalence of current wheeze at 29% (Janson *et al* 2001, Burney 2002).

In Australia during the 1980s and into the early 1990s there has been consistent evidence of a rising trend in the prevalence of asthma among children, reported to be as high as 30% and amongst the highest in the world (Peat *et al* 1995). More recent data suggest that this rising trend may have peaked and has since reached a plateau or decreased (Robertson *et al* 2004, Toelle *et al* 2004, AIHW ACAM 2005). Although there has been some evidence of a small increase in the prevalence of asthma among adults since the early 1990s (Wilson *et al* 2003), over the more recent period the prevalence of asthma in adults appears to be stable (AIHW ACAM 2005).

In 2001, it has been estimated that 3, 864,987 Australians have at some stage in their life been diagnosed with asthma by a doctor (ABS 2002a). Of these, 2,199,411 or 11.6% of the population stated that they had current asthma in 2001 compared to

11.3% reported in 1995 and 8% reported in 1989-90. In the 2001 survey, current asthma was reported by 13.8% of children aged 0 to 17 years and 10.8% of adults aged 18 years and over (ABS 2002a). Data from a number of state, territory and locally-based surveys of the prevalence of asthma estimate that between 14-16% of children (one in six) and 10-12% of adults (one in nine) reported current asthma (AIHW ACAM 2005).

In 2001, reports indicate that Australian boys have a higher prevalence of asthma than girls, and as the move into adulthood, asthma was more common in women than in men. Asthma is more common among indigenous (17%) than non-Indigenous populations (12%) across all age groups. The prevalence of asthma is higher among Aboriginal and Torres Strait Islander women than among other Australian women. Asthma prevalence was lower in people born overseas (8%) than those born in Australia (13%). People from non-English-speaking backgrounds had a lower prevalence of asthma than those from English-speaking backgrounds. Among people with asthma, the highest proportions of current smokers were in the 18-24 years age group, in which 40% of males and 33% of females were current smokers. Overall, the prevalence of asthma does not significantly differ among the states or territories or between major cities, inner and outer regional areas and remote areas from the national average (11.6%) across all age groups (ABS 2002a).

1.5.2. Asthma mortality

The ISAAC and the ECRHS reveal that during the early 1990s, Australia had the highest mortality rate among persons aged 5-34 years, at 0.86 per 100,000 followed by Japan at 0.75, the UK at 0.52 and New Zealand at 0.50 per 100,000 respectively (Beasley 1998, ISAAC 1998, Burney 2002). Failure of most countries to decrease asthma mortality below 0.6 per 100,000 may be due to increasing severity, poorer asthma management and adverse reactions to asthma medications. In most countries, asthma deaths occurred mainly outside hospital. Other overseas studies report an increased risk of death from asthma related to race, lower socioeconomic status, and lower income and education (Grant *et al* 2000, Castro *et al* 2001) and higher death rates during winter in older age groups (Marks and Burney 1997).

In Australia over the last decade, asthma mortality rates have steadily declined. In 2004, there were 311 deaths attributed to asthma, representing 0.3% of all deaths in that year however, this is still moderately high by international standards (ABS 2004).

During 1999-2003, deaths due to asthma occurred in all ages and in most cases, may have been preventable. The risk of dying from asthma increased significantly with age in both males and females (AIHW ACAM 2005).

In rural and remote areas in Australia, people aged 35-64 years were more likely to die from asthma than their counterparts living in cities and large towns (AIHW 2006). In this age group, the death rate due to asthma among persons living in remote/very remote areas was 1.58 times higher than the rate among persons living in major cities. There were three times as many deaths of Indigenous people as expected. This is consistent with data on regional variation in all-cause mortality rates and with previous studies showing increased asthma mortality in rural areas (Jones and Bentham 1997, Tong and Drake 1999, Castro *et al* 2001, Dunn *et al* 2002). This increased risk in remote areas may be attributed to a limited number of and access to acute medical services due to great distances in travel (Watts 1999), differences in exposures influencing disease severity and exacerbation risk, and differences in access to effective long-term asthma management (AIHW 2006). People aged 35 to 64 years and living in socioeconomically disadvantaged areas had a higher risk of dying from asthma (3.2 times higher in males and 2.4 times higher in females) than people who lived in more advantaged areas (AIHW ACAM 2005).

1.5.3. Impact of asthma

The direct impact of asthma on health care utilisation (hospitalisations etc) and the indirect effect of the degree to which it impairs a person's quality of life (days off work/school etc) is often referred to as asthma morbidity (NHLBI/WHO 2005).

Asthma has been shown to have a significant impact worldwide among children and adults. A multinational survey of asthma, the Asthma Insights and Reality in Europe (AIRE) study provided an understanding of the current management of asthma in Western Europe. The AIRE study revealed that a large proportion of the population surveyed had poorly controlled symptoms. Around half the population reported experiencing daytime symptoms and about a third reported experiencing asthma-related sleep disturbances at least once a week. In the last 12 months, 25% reported an unscheduled urgent care visit, 10% reported one or more emergency room visits, and 7% reported overnight hospitalisation due to asthma (Rabe *et al* 2000). Several other international studies have reported similar findings including the problem of disturbed sleep among both adults and children with asthma (Janson *et al* 1997,

Rickard and Stempel 1999, Bellamy and Harris 2005). In the US, people with asthma reported more physically unhealthy days (6.5 vs 2.9 days), mentally unhealthy days (5.2 vs 3.0 days) and days with activity limitation (3.7 vs 1.6 days) than people without asthma (Ford *et al* 2003).

In children and adults, worldwide data estimates that the social impact of asthma is high and a major cause of absence from school and days lost from work (Mahapatra 1993, Lenney 1997, Lai *et al* 2003, Neffen *et al* 2005). Children with asthma are at greater risk of obtaining lower grades (Fowler 1992), have more behavioural problems (Bussing *et al* 1995), lower self-perceived health status (Forrest *et al* 1997), more self-pity and lower self-esteem (Donnelly 1994).

1.5.3.1. Impact of asthma on health care utilisation in Australia

In Australia, over the past decade, general practitioner (GP) visits and hospitalisations for asthma have declined substantially. The burden posed by GP consultations, hospitalisations and emergency department (ED) visits for asthma is highest among children.

In 2003-04, asthma was the ninth most common problem managed in general practice at the rate of 2.6 problems/100 encounters (Britt *et al* 2004). The rate of general practice (GP) visits for asthma decreased from 3.2% to 2.6% of all GP visits during the period 1998-99 to 2003-04 and the largest decrease was in the 0-4 year age group (AIHW GPSCU 2002). There were no differences in rates for asthma-related GP visits across metropolitan, rural and remote regions in Australia (AIHW GPSCU 2002-04, AIHW 2004a). Referrals to respiratory physicians or paediatricians were extremely rare at 2.7 per 100 asthma contacts (Britt *et al* 2004). These results suggest that Australians attending general practice may be gaining better control of their asthma (Henderson *et al* 2004).

Over the past decade, there has been a decline in hospitalisation rates for asthma among children (46% reduction) and adults (39% reduction) and a 48% reduction in the total hospital bed-days occupied by people with asthma. The average length of stay for people hospitalised for asthma fell from 2.9 days to 2.3 days during this period (National Hospital Morbidity Database). Hospitalisation rates for asthma in 2002-03 were higher among Indigenous Australian adults (Williams *et al* 1997), adults living rural and remote areas and people living in the most socioeconomically disadvantages localities (AIHW ACAM 2005). In 2002-03, hospitalisation rates for

asthma were higher amongst infants and pre-school children than school-aged children. Among pre-school and primary school-age children, hospitalisation rates for asthma were highest in February (AIHW ACAM 2005).

Asthma is the most common reason for ED attendance among children (ABS 2002b). In 2000-01, 67% of visits for exacerbations of asthma were among children aged 0-15 years (Kelly *et al* 2003). Rates of ED visits for asthma were much higher in infants than in older children. Boys with asthma had a higher rate of ED visits than girls and the gender difference was reversed in adult life. People aged 65 years and over and children aged 0-4 years were more likely to be admitted to hospital after visiting the ED for asthma (AIHW ACAM 2005). Among those visiting the ED for asthma during 1999-2004, 38.9% were admitted to hospital, rather than discharged home. The trend for fewer hospital admissions following ED presentations suggests that asthma management is relying increasingly on general practitioners (Chapman 2002).

People with severe asthma consume a disproportionately large amount of health care resources. Those who are hospitalised or those who die are a very visible and a costly component of asthma care. As shown in the Hunter region of New South Wales, the impact of severe asthma managed in primary care is large and remains hidden from view. It poses a significant burden of illness that escapes routine monitoring and needs to be addressed (Gibson 2000).

1.5.3.2. Impact of asthma on quality of life in Australia

Asthma impacts on physical, spiritual and psychological well-being, hence not surprisingly, quality of life. The repercussions of this are manifest in the economic burden on individuals and society as a whole.

People with asthma rate their health lower and have worse health-related quality of life than people without asthma (ABS 2002a and 2002b, Wilson *et al* 2002). Most of the impact of asthma is on physical functioning and on the ability to perform social roles, such as work or study. A recent Australian study found that the burden of asthma was broad, affecting social life, personal relationships, employment and finances (Goeman *et al* 2002).

In Australia, it has been estimated that 18% of people with asthma reported having days of reduced activity, 11% reported taking days off work/study due to illness and 2.6% reported taking days off work/study due to asthma (ABS 2002a and 2002b).

The Living with Asthma Survey conducted in New South Wales, Victoria and Queensland looked at the impact of asthma symptoms on daily activities. A high proportion of respondents reported avoiding physical and social activities because of their asthma, while 75% said asthma generally made them feel tired. One in five children with asthma did not ride a bike, play at school or play with animals and one in three did not participate in organised sports. Many respondents attributed frustration (61%), irritability (57%), fear (38%), and worry (43%) to their asthma (Sawyer and Fardy 2003).

In Australia, the New South Wales child health survey found up to 48% of children with asthma reported having sleep disturbance due to asthma over a 1-month period with 31% being disturbed on three or more nights and 58% of children aged 2-12 years with asthma reported being restricted in their normal activity. This resulted in an average 9.3 days of reduced activity in 2001 (Centre for Epidemiology and Research 2002).

Asthma also affects the families of children with asthma. Having a child with asthma has an impact on the parent or caregiver's time, other siblings and family-related activities and parents and carers may need to take time off work or daily activities to care for their child (Halfon and Newacheck 2000). These demands add to the family's emotional and economic burden and can increase stress and pressure on relationships (Rand and Butz 2000).

1.5.3.3. Economic impact of asthma

Data collected in several healthcare systems indicate that asthma poses a significant economic burden on society, the government and the individual, both in Australia and internationally.

Costs associated with asthma may be direct costs that arise from medications, hospitalisations and consultations outside the hospital system or indirect costs that arise from reduced productivity due to asthma. The total cost of asthma annually was estimated to be around 843 million pounds in the UK (Action Asthma 1990), 6.4 billion dollars in the USA (Weiss *et al* 1992) and A$ 585-720 million in Australia (National Asthma Campaign 1992). These costs translated to $522 per person with asthma in the UK, $640 per person with asthma in the USA and $926 per person with asthma in Australia per year.

In Australia during 2000-01, health expenditure on asthma was $693 million, which represented 1.4% of total allocated health expenditure (AIHW 2004c, ACAM 2005b). Children aged 0-4 years had the highest per capita rate of health expenditure for asthma and those aged 25-34 years had the lowest. Within the hospital sector, 46% of expenditure on asthma was attributable to children aged 0-14 years. Between 1993-94 and 2000-01, per capita health expenditure on asthma increased by 21%, after adjustment for inflation (AIHW 2004c, ACAM 2005b).

In Australia, a large proportion of the health expenditure associated with asthma (around $274 million) is directly linked to medication (AIHW 2004a, AIHW ACAM 2005). It has been estimated that 34% of people with asthma used medications to prevent and relieve their asthma symptoms, 8% used preventers only and 17% used relievers only in the fortnight prior to the 2001 National Health Survey interview (ABS 2002a, ABS 2002b). Medication comprised a greater proportion of expenditure on asthma in adult age groups than in children. The use of medication differed across certain age groups from a low of 49% of those aged 5-14 years to over 80% of those aged 75 years and over. Short-acting beta agonists were the most commonly used medications for asthma in all age groups. Inhaled corticosteroid use increased with increasing age, as did the use of short-acting anticholinergics and long-acting beta agonists. Inhalation devices that combined long-acting beta agonists and corticosteroids in the same unit were introduced onto the Australian market in 2000, and by 2004, combined therapy represented 64% of all DDDs (defined daily doses per 1,000 population per day) of inhaled corticosteroid therapy supplied by wholesalers (ABS 2002a). Only 25% of young adults aged 15-34 years reported using inhaled corticosteroids in the fortnight prior to the survey (ABS 2002a). This is consistent with findings from a previous study that only 30% of adults with asthma used inhaled corticosteroids daily or most days (Marks *et al* 2000).

There are several proposed explanations for this trend in medication use. It appears that patients are visiting the GP less frequently for the management of asthma and a steady medication rate of asthma preventatives for asthma problems plus a decreasing rate of bronchodilators may support the argument that patients are managing their asthma better, thus requiring fewer visits to the GP for acute exacerbations. Another explanation for the results is that because patients are obtaining bronchodilators directly from pharmacists, they have less need to visit the GP for repeat scripts, thus reducing the management rate of asthma in general practice (Britt *et al* 2004).

Another major source of health expenditure due to asthma (around $100 million) arises from some three million medical consultations, predominantly GP services, provided annually to people with asthma outside the hospital system. It was estimated that well managed asthma costs less than poorly managed asthma ($2,094 compared to $4,909 per person with asthma per year). The cost burden of asthma is not spread evenly across all degrees of severity. The more severe the underlying asthma, the greater is a person's need for medical and other services. Around 40% of the total medical costs of adult asthma were shown to be for a small number of people with severe and very severe asthma, whereas 15% of the total medical costs were consumed by a large number of people with very mild asthma (National Asthma Campaign 1992).

The other significant medical cost is the cost of hospitalising people with asthma. This is estimated at A$ 60 million and includes the costs of caring for people with asthma as hospital inpatients and in emergency and outpatient departments (AIHW 2004c, ACAM 2005b).

In addition to the above-mentioned direct costs, the other significant costs are the indirect costs from lost productivity associated with absenteeism directly due to asthmatic illness, employed caregivers having to stay with a child sick with asthma, reduced effectiveness of work and work time lost from attending consultations (AIHW 2004c, ACAM 2005b).

1.6. ASTHMA MANAGEMENT IN AUSTRALIA

1.6.1. A brief history

In Australia, the problem of asthma has been well documented. In 1988, the first comprehensive government report was published about rising asthma morbidity and mortality (Health targets and implementation Committee 1988). Consensus developed around the value of a systematic approach to asthma management and in response to serious concerns about asthma mortality and under management, a national asthma management plan was developed in 1989 by the Thoracic Society of Australia and New Zealand (Woolcock *et al* 1989). In 1990, a public education campaign called ‘Could it be asthma?’ was implemented and evaluated. Following

this campaign a body called The National Asthma Campaign (NAC) was formed (Pierce and Irving 1991). The NAC was a non-governmental organisation formed as a joint initiative between the Thoracic Society of Australia and New Zealand, the Pharmaceutical Society of Australia, the Royal Australian College of General Physicians and Asthma Foundations of Australia. The main task of the NAC was to promote the six step asthma management plan to all health professionals, undertake epidemiological surveys on asthma, develop policies on asthma issues and conduct national public education campaigns (National Asthma Campaign 1999). In association with other stakeholders interested in asthma care, the NAC successfully coordinated a decade of education and advocacy about asthma that targeted general practitioners, health professionals and the general public. These activities have been successful in raising awareness about asthma in the community (Comino and Henry 2001). In July 2001, the National Asthma Campaign renamed itself to the 'National Asthma Council' to reflect the organisation's relevance, reputation and longevity (Press release, National Asthma Council, July 31, 2001).

During the 1990s, it became clear that the NAC's goals and targets could not be implemented without Australian Government support. In collaboration with many significant stakeholders in asthma, public health and government, the NAC worked to have asthma made a National Health Priority Area in 1999 (Wooldridge 1999). Since then a range of programs and activities have been initiated by Australian and state governments to address the challenges associated with asthma.

1.6.2. The role of the National Asthma Council

The National Asthma Campaign was renamed the National Asthma Council Australia (NAC) in 2001 and now includes the Australasian Society of Clinical Immunology and Allergy. It continues to play a major role in professional and community asthma education and works with state and federal governments to develop policy to improve asthma care and asthma research in Australia. The role of the NAC over the past decade includes:

- the evolution of the six step Asthma Management Plan into the Asthma Management Handbook, of which there have been five editions. This asthma management handbook has been widely disseminated to health care professionals. The sixth edition of Asthma Management Handbook will be

launched in November 2006 and will be distributed nationally initially to all GPs, pharmacists and other health care professionals who treat asthma.

- the development of the Report on the Cost of Asthma in Australia in 1992, which made an important contribution to knowledge about the impact of asthma on the Australian community. This is the most comprehensive report on the cost impact of asthma in Australia.

- the implementation of national epidemiological surveys in 1990 and 1993 which showed improvement in the asthma management practices of adults in that period and significant improvements in children.

- the development of the National Asthma Strategy Goals and Targets in 1994, the National Asthma Strategy, Strategies and Implementation in 1996 and the National Asthma Strategy Implementation Plan in 1999; activities aimed to significantly reduce the prevalence, severity and risk of asthma.

- continuing the effect of the first national public education campaign with a series of campaigns supported by information for people with asthma and their families.

- inviting representation from the General Practitioners Asthma Group and the development of a network of GPs with a special interest in asthma (Asthma Liaison Officers), in most divisions of general practice (Divisions of General Practice represent distinct geographic areas and general practice activities are coordinated through the structure of these divisions).

- currently developing the National Asthma Strategy 2 in collaboration with the Department of Health and Aging (DoHA), which builds on the earlier National Asthma Strategy and the National Asthma Action Plan.

- currently working through Divisions of General Practice to train GPs and practice nurses to support the Asthma 3+ Visit Plan and conducting a virtual roadshow on childhood asthma management for GPs.

- the development of a series of information papers and consumer brochures on asthma topics. The information papers are based on current evidence for GPs, pharmacists and asthma educators with the latest information. The accompanying consumer brochures provide a summary of the information in layperson's language. The information is available in hard copy or via the NAC website (http://www.nationalasthma.org.au).

1.6.3. The role of the State Asthma Foundations and Asthma Australia

1.6.3.1. The Asthma Foundations

The State Asthma Foundations are 'not for profit' organisations and exist to provide asthma education, information, research, community advocacy and support to people with asthma and their carers. Asthma NSW, for example, founded in the 1960s by consumers has as its mission *"to be the leading consumer authority in NSW in asthma education, information, research and support."* The various services offered by Asthma NSW include an Asthma Information Line, a swimming program, an annual Asthma Camp for children and a magazine called `Asthma Matters' for consumers that provides current research in asthma, information about asthma and allergies, asthma management, medications and devices for asthma, and information about local and national activities relating to asthma. Asthma NSW also provides community talks and telephone support information, organises community information evenings, provides resources throughout rural and remote areas in the state and in conjunction with other stakeholders, run an Asthma Educators Training workshop. These or similar activities are carried on by the other state asthma foundations (http://www.asthma.nsw.org.au).

1.6.3.2. Asthma Australia

Asthma Australia is an association of all the state Asthma Foundations throughout Australia and coordinates activities of all the state asthma foundations, so that there are uniform policies and standardised information materials in all the states. Asthma Australia has been responsible for the 'Asthma Friendly Schools' program, various asthma campaigns and activities and the Asthma Information Line service (http://www.asthmaaustralia.org.au).

1.7. ASTHMA MANAGEMENT GUIDELINES

1.7.1. Global asthma management guidelines

In 1993, the Global Initiative for Asthma (GINA) was formed. Its goals and objectives were described in a 1995 NHLBI/WHO Workshop Report, *Global Strategy for Asthma Management and Prevention.* This Report (revised in 2002) highlighted the importance of a multi-faceted approach to asthma management and outlined a comprehensive asthma management program that includes patient education as one

of the six critical elements to successful long-term asthma management. The concepts espoused in the GINA guidelines are also evident in the various published asthma management guidelines from different national health care settings including Australia (NHLBI/WHO 2005).

1.7.2. Australian asthma management guidelines

The Australian Asthma Management Plan was developed in 1989 by the Thoracic Society of Australia and New Zealand as a multifaceted approach to asthma management in Australia (Woolcock *et al* 1989). This six step asthma management plan was initially developed as a consensus document based on expert opinion at the time. It was promoted to health care professionals by the National Asthma Campaign, a joint initiative between the Thoracic Society of Australia and New Zealand, the Pharmaceutical Society of Australia, the Royal Australian College of General Practitioners and all state Asthma Foundations. It has achieved wide consensus and has been followed by other national (British Thoracic Society 1990, NAEPP 1997) and international plans (NHLBI/WHO 1995). The six step Asthma Management Plan is a simple set of guidelines for the management of asthma that aims to achieve and maintain disease control. It was disseminated widely amongst health care professionals and consumers, and is outlined below.

The six step asthma management plan

Step 1 - Assess asthma severity

Assess the asthma severity of every patient for individualised treatment. Asthma severity applies to overall disease severity, not the severity of an acute attack, and should be assessed when the patient is stable.

Step 2 - Achieve best lung function

The initial goal is to obtain maximal reversal of airway inflammation and obstruction. It is now well accepted that in adults with asthma, either oral or inhaled corticosteroids should be used, at least initially, to achieve this goal.

Step 3 - Identify and avoid trigger factors

Trigger factors may be allergic or non-allergic in nature. Continued exposure to allergens and other trigger factors may lead to worsening of asthma. The identification and avoidance of trigger factors may improve asthma.

Step 4 - Optimise medication program

Once the acute episode is controlled, it is necessary to evaluate whether best lung function and optimum asthma control have been achieved. This can be judged by the following criteria:

- absent or minimal symptoms
- absent or minimal reliever medication use ie. less than 3 times a week, excluding exercise
- no nocturnal or early morning symptoms
- normal lung function (at, or close to, personal best)
- no or minimal side effects from medication

Then the aim of the medication management is to:

- Relieve symptoms with intensive initial therapy.
- Use minimum maintenance doses to maintain good symptom control, minimise side effects and maximise adherence.

Treatment regimens for maintenance therapy in adults based on NAC guidelines are outlined in Tables 1.2 and dose titration in Table 1.3.

Table 1.2. Maintenance medications for adults

Severity	Common features	Maintenance therapy
Very Mild	• Episodic	• All people with asthma should have a short-acting β_2 agonist for symptom relief and be instructed about its use as their own guide to current control
Mild	• Occasional symptoms up to 2/week • Exacerbations > 6-8 weeks apart • Normal FEV_1 when asymptomatic	• Low dose inhaled corticosteroids (up to 250 mcg/day FP/BDP-HFA, or 400 mcg of BDP/BUD CFC) • Alternatively, use nedocromil sodium or sodium cromoglycate, but if control is not achieved then start low dose inhaled steroids • Short-acting β_2 agonist prn
Moderate	• Symptoms most days • Exacerbations < 6-8 weeks apart which affect day-time activity and sleep • Exacerbations last several days • Occasional Emergency Department visit	• Inhaled corticosteroid (up to 500 mcg/day FP/BDP-HFA or 800 mcg/day of BDP/BUD (CFC)) plus prn use of short-acting β_2 agonist • Consider adding salmeterol 25-50 mcg bd or eformoterol 6-12 mcg bd (some patients may prefer a combination treatment of a long-acting β_2 agonist and inhaled corticosteroid)
Severe	• Persistent • Limited activity level • Regular nocturnal symptoms > 1/week • Frequent ED visits and hospital admission in past year • FEV_1 may be significantly reduced between exacerbations	• High dose inhaled corticosteroids up to 1000 mcg/day FP/BDP-HFA, or 2000 mcg of BDP/BUD (CFC) plus long-acting β_2 agonist and prn use of short-acting β_2 agonist • Oral corticosteroid, when appropriate • Consider adding: ipratropium bromide, theophylline or leukotriene antagonist

Source: National Asthma Council Asthma Management Handbook, 2002.
FP= fluticasone proprionate; BDP= beclomethasone dipropionate; BUD= budesonide

Table 1.3. Dose titration for maintenance therapy

MILD (1)	MODERATE (2)	SEVERE (3)	STEP-DOWN (BACK TITRATION)
• Low dose inhaled corticosteroids: up to 250mcg/day FP/BDP-HFA or 400mcg/day BDP/BUD (CFC) • Alternatively, use nedocromil sodium or sodium cromoglycate, but if control is not achieved start inhaled corticosteroids • Short-acting inhaled beta$_2$ agonist prn	• Inhaled corticosteroids: up to 500mcg/day FP/BDP-HFA or 800mcg/day BUD/BDP (CFC) • Consider the addition of a long-acting beta$_2$ agonist (salmeterol 25-50mcg bd or eformoterol 6-12mcg bd) if short-acting beta$_2$ agonist required more than once daily • Short-acting inhaled beta$_2$ agonist prn	• Inhaled corticosteroids (match dose to disease severity). Up to 1000mcg/day FP/BDP-HFA or 2000mcg/day BDP/BUD (CFC) • + long-acting beta$_2$ agonist regularly • +/- S.R. theophylline • +/- ipratropium bromide • +/- leukotriene antagonist • + oral corticosteroids when required • Short-acting inhaled beta$_2$ agonist prn	• Once symptom control is achieved at any step, a reduction in therapy should be carefully considered. Following an exacerbation, the previous minimum effective dose of ICS or combination therapy required to maintain symptom control should be resumed. • **Use minium effective dose required to maintain symptom control.**

Source: National Asthma Council Asthma Management Handbook, 2002.
*Dose equivalence: 50mcg FP= 50mcg BDP (HFA 134a) = 100mcg BUD/BDP (CFC)

Important points highlighted in the guidelines regarding the initiation and maintenance of asthma therapy are outlined:

- Initiate therapy with enough medication to obtain prompt remission of symptoms. In general, the dose used in this phase of treatment will be greater than that required for daily maintenance treatment.
- Maintain initial dose until symptoms remit and FEV_1 is maximised. Then reduce the dose to the minimum required to prevent symptoms and maintain FEV_1 at or close to personal best readings. If there has been normal lung function and a

complete absence of asthma symptoms for several months, consider further reduction in dosage (Table 1.3).

Step 5 - Develop an action plan

Formulate and provide a written Asthma Action Plan so that all people with asthma will be able to recognise deterioration promptly and respond appropriately. An Action Plan will prevent delayed initiation of preventer dose increases, prolonged exacerbations of asthma, adverse effects on the patient's life, and reduce subsequent use of acute healthcare services. An Action Plan keeps patients in control of their condition.

Step 6 - Educate and review regularly

Education is necessary to help patients gain the confidence, skills and motivation to control their asthma. Education should begin at the time of diagnosis and be a significant component of all subsequent consultations.

These guidelines are included in the National Asthma Council of Australia (NAC) Asthma Management Handbook 2002, and have been compiled principally for general practitioners, community pharmacists and asthma educators, but would also be useful for all health care professionals working in asthma care, and for medical, pharmacy and nursing students. The guidelines are intended as a reference for health care professionals to be used as a general guide on the management of people with asthma.

1.7.3. Evidence-based review of the Australian Asthma Management Plan

Given that the six step asthma management plan was developed based on expert opinion at the time, an evidence-based review of the plan was conducted and focused on the extent to which recommendations in each step were supported by the first two levels of evidence (Coughlan *et al* 2000);

Level 1	Systematic review of randomised controlled trials/large multi-centre trial
Level 2	One or more randomised controlled trials
Level 3	Controlled trials without randomisation; cohort, case-control, analytic studies; multiple time series, before and after studies (preferably from more than one centre or research group)

Level 4	Other observational studies
Level 5	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

This review demonstrated the efficacy of some steps of the plan but could not find evidence in favour of other steps. There is good evidence of the effectiveness of preventer and reliever medication and symptom controllers in the treatment of asthma and that possession of written asthma action plan improves asthma outcomes. The review found strong evidence for the provision of asthma self-management education that involved self-monitoring of symptoms, regular medical review and use of written asthma action plans in adults with asthma (Gibson *et al* 1999). However, provision of information alone without active follow-up did not appear to improve health outcomes in adults with asthma (Gibson *et al* 1998a). The evidence for alternative therapies and for avoidance of triggers of asthma was not strong and no Level 1 evidence was identified to support the recommendations in step 1. Further research needs to be undertaken to assess the usefulness of steps 1 and 3. The summarised results are shown in Table 1.4 (Coughlan *et al* 2000).

Table 1.4. Systematic review of the six-step asthma management plan

Step	Step Recommendations	Evidence
Step 1	**Assess asthma severity**	No evidence
Step 2	**Achieve best lung function**	
	Adults, $FEV_1 \leq$ 80% predicted, ICS < 800 μg	Effective
	Adults, $FEV_1 \leq$ 80% predicted, ICS >800 μg	Effective
	Adults, $FEV_1 \geq$ 80% predicted, ICS < 800 μg	Effective
	Adults, $FEV_1 \geq$ 80% predicted, ICS >800 μg$\leq$	Effective
Step 3	**Maintain best lung function – identify and avoid trigger factors**	
	House dust mite control measures	No effect
	Reduction of cat dander by HEPA filter	No effect
	Pollens, animals, moulds	No evidence
	Influenza vaccines	No evidence
	Use of antibiotics without evidence of bacterial infection	No effect
	Allergen immunotherapy	Effective
	Reflux therapy	No effect
	Nedocromil sodium for exercise induced asthma	Effective
	Avoidance of food allergens and additives	No evidence
	Avoidance of drugs, emotional states, irritants, occupation sensitisers or temperature changes	No evidence
Step 4	**Maintain best lung function – optimise medication program**	
	Metered dose inhalers vs nebulisers	Equivalent effect
	Addition of eformoterol to ICS in mild moderate asthma	Effective
	Long acting β_2 agonists vs theophylline	Effective
Step 5	**Develop a written action plan**	
	Provision of a written action plan	Effective
Step 6	**Educate and review regularly**	
	Provision of information alone (structured or unstructured program)	No effect
	Information alone in the emergency department	Possibly effective
	Information coupled with self monitoring, regular review and a written action plan	Effective
	Doctor managed vs self-managed asthma	Equivalent effect

Source: Evidence-Based Review of the Australian Six Step Asthma Management Plan, 1999.

Where ‘no evidence’ is used in the table, this means ‘no Level 1 or Level 2 evidence’ was found, although Level 3 or Level 4 evidence for the recommendation may exist. Where there is evidence of ‘no effect’, this means Level 1 or Level 2 evidence found the treatment to be ineffective.

1.8. CURRENT ISSUES IN ASTHMA MANAGEMENT

Over the last decade, as outlined in Section 1.6, various programs and activities have been initiated to address the challenges associated with asthma and to increase asthma awareness and improve the standards of asthma care. Despite this however, various surveys and audits of asthma management in Australia have found that asthma is being sub-optimally managed and have highlighted the issues which still remain. The issues associated with asthma management include patient, health care professional and public health related issues. These issues have been documented in Australia and overseas and further highlight the need for asthma management interventions.

1.8.1. Patient related issues

Many issues in asthma management are patient-related issues associated with the inappropriate use of asthma medication. These have been highlighted in the literature and include the underuse of preventer medication, the overuse of reliever medication, non-adherence to treatment regimens and incorrect device use. Other patient related issues include trigger factor ignorance, worsening asthma not recognised and poor perception of asthma control.

Patients’ perceptions, attitudes to and knowledge of asthma medication may influence their self-management in asthma (Partridge 1995, Osman 1997, Horne 2006). The ECRHS assessed consumer treatment perceptions of young Australian adults with asthma and found that regular treatment in any form was considered to be ‘bad’ by 65% of diagnosed people with asthma and only 43% took medications as prescribed regularly (Reid *et al* 2000). A poor understanding of asthma and the role of medication has been shown to lead not only to insufficient intake of preventer medication, but also to overuse of reliever medication that are perceived to be more

useful because they provide immediate relief of symptoms (Fabbri *et al* 2004). Studies have revealed that a large proportion of people with asthma do not understand the role of their medications and have many misconceptions and fears in regard to inhaled corticosteroids and their side effects, reducing their willingness to use them (Boulet 1998a, Rao and Apter 2005). Medication side effects are common in patients with asthma and lead to medication taking decisions that often compromise asthma control (White and Sander 1999, Goeman *et al* 2003, Fabbri *et al* 2004, Horne 2006, Peters 2006).

It has been shown that asthma patients who use medication inappropriately (specifically excessive use of short-acting beta agonists combined with underuse of inhaled corticosteroids) are at higher risk for fatal and near fatal attacks and use significantly more health care resources than patients with appropriate medication use (Anis *et al* 2001). In Australia, 37% of adults and 26% of children reported using a reliever more than four times in the previous week (Sawyer and Fardy 2003).

Another important patient-related issue is adherence to asthma medication. Adherence rates to asthma medication in adults are known to be poor and are frequently less than 50% (Fish and Lung 2001, Bender 2002). Within the ECRHS study, treatment compliance was the lowest in Australia at 46% as compared to the average of 67% across surveyed nations (Cerveri *et al* 1999). Many studies have shown that people with asthma are reluctant to use their asthma medication regularly as recommended. Recent Australian surveys have found that 25-28% of adults with asthma had used preventer medications regularly, younger adults were less likely to use preventers regularly and past smokers with asthma used preventers more commonly than current smokers (Marks *et al* 2000, ABS 2002a). The Living with Asthma Survey found that 45% of adults did not use there preventer as prescribed (Sawyer and Fardy 2003). According to another Australian survey, the cost of asthma medication was an issue for nearly two-thirds of the participants and as a consequence some would not take their medication as prescribed (Goeman *et al* 2002). In the US, a study found that there were still major gaps between patients' knowledge, perceptions and adherence to recommendations (Garg *et al* 2005). Another study found that important risk factors for asthma deaths included poor compliance with and knowledge about asthma medications, regularly missing hospital and general practitioner appointments for asthma, use of three or more groups of asthma medications, previous visits to the ED for asthma, more extensive use of health services for asthma and indicators of asthma severity (Jalaludin *et al* 1999).

Research to identify risk factors for non-adherence has shown factors such as age, sex, objective measures of disease severity, subjects' educational level, complexity of the treatment regimen, side-effects, socio-economic barriers and denial of the illness to be associated with patients' low adherence to therapy (Mellins *et al* 1992).

In adolescent asthma, non-adherence to therapy is a major issue in addition to other issues such as self-image and denial, at a time where self-management skills assume a greater importance (Buston and Wood 2000, Sawyer and Bowes 1996). Often this is the time when young people engage in risk-taking behaviours such as smoking and are less likely to listen to advice from parents and practitioners (Gibson *et al* 1995, Forero *et al* 1996, Sawyer and Bowes 1996, Sawyer and Aroni 2005). It has been shown that adolescents have poor asthma knowledge and self management skills resulting in a significant increase in the severity of asthma exacerbations and a reduction in their quality of life (Gibson *et al* 1995) and have poorer psychosocial outcomes (Forero *et al* 1996).

In children, adherence rates to asthma medication are also poor. In 2002, a survey among Australian children aged 6-7 years found that 17% of those with wheeze were not taking any treatment for asthma and almost 50% were only taking intermittent treatment (Robertson *et al* 2004). In Australian children aged 2-12 years, 59% reported using a preventer in the last month, only 39% had used this medication every day, 9% used it most days and 26% had not used a preventer in the last month (Centre for Epidemiology and Research 2002, Poulos *et al* 2005). The Living with Asthma Survey found that 30% of children did not use there preventer as prescribed (Sawyer and Fardy 2003).

Another important patient-related issue associated with medication use is the incorrect use of asthma devices. Inability to use inhalers effectively is known to adversely affect the delivery of the drug and thus minimise the benefits of inhaled medication. Research has indicated 50-80% of patients do not use their inhalers correctly depending on the type of inhaler used, the patient sample, and the method of assessment (van Beerendonk *et al* 1998). It has been reported that only 20% of patients perform all steps correctly when using their metered dose inhalers (van der Palen *et al* 1997). In the UK and Australia sub-optimal inhaler technique was demonstrated by 77% of patients (85% for patients using a metered dose inhaler) and patients showed a significant improvement in their inhaler technique after education (Wilcock 2002, Basheti *et al* 2005). Previous studies have shown that

written instructions alone are not sufficient for improvements in inhaler technique to be achieved, and that verbal instructions, demonstrations and practice sessions need to be included (Nimmo *et al* 1993, van der Palen *et al* 1995, Basheti *et al* 2005). Further, it has been shown that inhaler technique tends to decline without routine review (De Blaquiere *et al* 1989, Kesten *et al* 1993).

One of the most important patient related issues of asthma management is self-management of asthma by patients. Self-management involves the patient making therapeutic, behavioural and environmental adjustments in accordance with advice given to them in advance by the health care provider (Partridge 1997). It has been shown in various studies that self-management of asthma by patients can reduce hospitalisations (Gibson 2000) and should include self-monitoring, regular medical review and use of written action plan (Gibson *et al* 1999). Peak flow-based self-monitoring has been recommended for those who are poor perceivers of their symptoms (Adams *et al* 2001). An Australian study found that cases of asthma death were significantly less likely than controls to use peak flow meters and that written asthma action plans were associated with a 70% reduction in the risk of death (Abramson *et al* 2001). Lack of self-management and self-monitoring of asthma are issues that need to be addressed. In rural and remote Australia where there is a limited access to health care, it becomes paramount that people with asthma become involved in self-management of their asthma. Teaching patients the importance and the relevance of their symptoms, prompt recognition of worsening asthma symptoms and the appropriate action to take can reduce morbidity and mortality of the disease and improve asthma outcomes (Rea *et al* 1996). Previous studies have revealed that patients' practical knowledge of the appropriate self-management behaviour to a hypothetical scenario of a slow-onset exacerbation was inadequate (Klein *et al* 1997, Kolbe *et al* 1996, Campbell *et al* 1996). Delay in seeking medical help was a feature among those who had been hospitalised for acute severe asthma (Kolbe *et al* 1998).

Another important patient-related issue is patients' poor perception of their level of asthma control. People with poorly controlled asthma may consider their asthma to be well controlled. In a survey among asthma patients recruited from pharmacies in France, it was found that control of asthma was adequate for only a minority of patients (28%) and most patients considered their asthma well controlled (Laforest *et al* 2005). Similarly in a Belgian study, it was found that 82% of patients believed their asthma to be totally or well controlled, whilst this was the fact for only 51% of the patients (Mehuys *et al* 2006). In a follow up to the AIRE study, it was shown that

asthma management practices and asthma control among adults and children were suboptimal in each of the seven countries surveyed (Vermeire *et al* 2002). Over 40% of patients with severe or persistent asthma reported that their asthma was well controlled and written asthma management plans were used by less than 50% of adults and less than 61% of children. Most adults and a large proportion of children had follow-up visits for their asthma only when problems developed. The ratio of recent inhaled corticosteroid use to recent short-acting beta agonist use was inappropriate in all seven countries (Vermeire *et al* 2002).

One other patient-related issue is trigger factor ignorance. Clinical guidelines have highlighted the importance of a multifaceted approach to achieve optimal asthma control. A study in the Netherlands found that, besides treatment with medication, stopping smoking and avoidance of triggers were factors that may have a high impact on asthma control (de Vries *et al* 2005).

1.8.2. Health care professional related issues

While patient self-management behaviour may be an important predictor of asthma outcomes, there is evidence to suggest that asthma management practices of health care professionals may need improvement.

One of the most important health professional-related issues is the sub-optimal management of asthma in general practice where most asthma management occurs. Although most general practitioners are aware of management guidelines, there is wide variability in the use of these (Collins *et al* 1998). An Australian study reported that asthma management practices fall well short of current asthma management guidelines. It was found that 53% of participants reported that a general practitioner had ever measured their breathing and 10% reported that they owned a peak flow meter (Matheson *et al* 2002). The Living with Asthma Survey found that national asthma management goals were not being achieved in a high proportion of patients and only 50% of patients had been reviewed by a general practitioner for asthma in the past year (Sawyer and Fardy 2003). Results from another Australian study showed that general practitioners have relatively poor insights into self-management practices, social background or trigger factors, even in high-risk patients (Abramson *et al* 2003).

Inappropriate prescribing by health care professionals may also be a reason for the inappropriate use of medications by people with asthma. In an audit conducted on asthma patients admitted to the John Hunter Hospital in Newcastle, New South Wales, initial emergency assessment and management of patients presenting to hospital was found to be satisfactory, but at three months follow up, up to one third of the patients were receiving inadequate corticosteroid therapy (Gibson and Wilson 1996). The Living with Asthma Survey found evidence of underprescribing of preventer medication resulting in their inappropriate use by people with asthma (Sawyer and Fardy 2003).

Misdiagnosed and undiagnosed asthma are other important issues in addition to inappropriate prescribing and sub-optimal management on the part of the health care professional. A study among indigenous children in a remote community in Australia showed that of those children referred for asthma treatment, 14% did not have asthma. Of those with asthma, medications were sub-optimally prescribed in 55% of children, 59% of parents knew the right dose of the asthma medication, 20% of parents knew the purpose of using the medication and inhaler techniques were optimal in only 33% of the children (Chang *et al* 2000). A recent Australian survey found that undiagnosed asthma was frequent in men and in those aged over 65 years (Adams *et al* 2003).

Another important health care professional related issue is failure to develop individualised written asthma action plans (WAAPs) for people with asthma, despite their proven benefits. In a survey conducted in Melbourne, Victoria among 443 caregivers of children with asthma, it was found that only 29% of participants owned a WAAP, while 13% possessed verbal instructions only, and 56% had no plan (Sulaiman *et al* 2004). Asthma action plans developed by a general practitioner were more likely to comprise verbal instructions, while those developed by a paediatrician were more likely to be written and only 59% of caregivers reported discussing their child's action plan the last time they visited their doctor for asthma (Sulaiman *et al* 2004). The 2001 National Health Survey found that about 18-20% of children aged 0-14 years own a WAAP compared to 9-11% of adults with asthma (ABS 2002b).

Lack of effective communication with patients and failure to provide them with tailored information (reinforced with written materials) for their specific needs are other important health care professional related issues (Partridge 1995, Partridge 1997, Boulet 1998b, Partridge and Hill 2000). Previous studies have shown that asthma

patients with frequent symptoms continue to have unmet information needs particularly about asthma medication and self-management (Ruffin *et al* 1999, Caress *et al* 2002, Raynor *et al* 2004). A study conducted in Melbourne, Victoria among children aged 2-5 years who visited the emergency department for asthma found that 50% of parents did not feel that they had enough information about their child's asthma or asthma triggers (Haby *et al* 2002). In the US, a survey investigating asthma patients' satisfaction with the frequency and content of pharmacist counselling showed that more than 90% indicated that their pharmacist never or rarely discussed their asthma management with them, 62% reported that they were satisfied with the type and amount of counselling provided by their pharmacist, and counselling sessions averaged less than three minutes (Liu *et al* 1999). Similarly another survey in the US found that 60% of people with asthma who visited their pharmacy received written materials on medications, 54% received inhaler counselling, fewer than 20% reported being counselled about trigger factors and 65% believed that pharmacists spend enough time counselling patients. Although general satisfaction with pharmacy services was high, patients' perceived benefit and satisfaction with cognitive services was lower (Kradjan *et al* 1999). A study conducted in Finland demonstrated that pharmacists and other health care providers needed to enhance their education activities in training asthma patients, especially the elderly, to self-monitor and self-regulate asthma medication usage (Narhi *et al* 2001a).

Failure in creating a high quality clinician/patient relationship to facilitate patient self-management is another important health care professional related issue. In the South Australian Health Omnibus Survey (SAHOS), people who rated their doctors as more participatory were significantly more likely to report more regular use of medications and possession of a written action plan. It was found that increasing patients' participation in their own care under the clinician's guidance was associated with better asthma management, independent of asthma symptoms (Adams *et al* 2005).

Insufficient continuing education for health care professionals who are key providers of asthma education and care in order to update their knowledge and skills is another important health professional related issue (Boulet 1998b). Updating knowledge and skills ensures the education provided to the patient conforms to best practice guidelines. Health care professionals including pharmacists have been shown to require further education to be able to assess and demonstrate correct inhaler technique to their patients (Hanania *et al* 1994, Chopra *et al* 2002). In a recent Australian telephone survey, 80-90% of asthma patients reported that their inhaler

technique had not been checked by a health care professional (Basheti *et al* 2005). In a qualitative study of general practitioners' views on the barriers to delivering asthma care and their priorities for achieving optimal outcomes in people with asthma, the main priorities were continuing education for GPs, facilitating regular patient review, making correct diagnosis, negotiated treatment/management plans, increased remuneration and consultation time as well as patient education and medication adherence (Goeman *et al* 2005).

1.8.3. Public health related issues

In addition to patient and health care professional related issues, public health related issues still remain.

An uncoordinated approach to asthma management among all health care providers is an important public health-related issue. A study conducted in a rural Australia during 2001-02 indicated that there was not a coordinated approach to asthma management among all health care providers in the region and a general lack of communication between hospitals, GPs and other health care providers. Evidence-based practice for asthma was not being implemented by health care professionals at the hospital level (Laurence *et al* 2004).

Review of asthma management practices suggests that asthma remains undertreated and poorly managed by those with the disease resulting in significant morbidity and mortality. The issues that still remain highlight the need for effective asthma management interventions. These interventions should promote asthma awareness and focus on the proper use of asthma medication through appropriate health promotion and education as the initial step on the path leading to patient asthma self-management.

1.9. ASTHMA EDUCATION

Patient education has been defined as *"a planned learning experience using a combination of methods such as teaching, counselling and behaviour modification techniques that influence patients' knowledge and health behaviour… (and) involves*

an interactive process which assists patients to participate actively in their health care" (Gibson *et al* 2001).

Education about asthma and self-management are key recommendations in asthma management guidelines; namely step 6 (Educate and review regularly) of the Australian six-step asthma management plan outlined in Section 1.7.2. Evidence-based review of the asthma management plan found strong evidence (Level 1) for the provision of asthma self-management education (Coughlan *et al* 2000) as outlined in Section 1.7.3.

Numerous asthma education programs have been included in several systematic reviews that specifically examine the effects of asthma education (Step 6) (Gibson *et al* 1998a, Gibson *et al* 1999). The impact of these programs on patient asthma outcomes and asthma-related health care utilisation is variable and the success of these programs is dependent on a number of factors.

1.9.1. Effective asthma education for adults

An effective asthma education program is dependent on a broad range of factors including the components of the asthma education program, factors associated with the delivery of the education (e.g. teaching styles, delivery formats, characteristics of the educator and participants, the theoretical framework on which the education is based) and the setting for the education. An effective education program is one which is relevant to the patients, their environment and situations and provides feedback regarding the learning process. The key to a successful education program appears to lie in the strategic application of a given asthma education program to the right audience, at the right time, at the right place and in the right way (Boulet 1998b).

1.9.1.1. Components of the asthma education program

Based on several systematic reviews, implementation of effective asthma education programs for adults addresses four main components (Gibson *et al* 1998a, Gibson *et al* 1999).

1. Provision of information about asthma and its management
2. Self-monitoring: this involves regular assessment of either symptoms or peak expiratory flow by the participant.
3. Provision of a written asthma action plan: this is an individualised written plan produced for the purpose of patient self-management of asthma exacerbations. It

informs the person with asthma when and how to modify medications and when and how to access medical services in response to worsening asthma.

4. Regular medical review: it involves the assessment of asthma severity, control and medications by a medical practitioner.

Providing information to people about asthma and its management is important but should not be the only component addressed in an asthma education program. A Cochrane systematic review of 12 randomised controlled trials (RCTs) examining the effects of limited education that offered information only, showed that it did not reduce hospitalisations or unscheduled doctors visits (Gibson *et al* 1998a). There were no changes in medication use or improvements in lung function following education. There was only a short-lived improvement in asthma knowledge, a reduction in emergency department (ED) visits, and patients reported less symptoms following education. Characteristics of the 12 trials included in the Cochrane systematic review are summarised in Table 1.5.

The provision of information alone has minimal impact on patient asthma outcomes and shows that the acquisition of knowledge does not necessarily translate into effective self-management behaviour (Gibson *et al* 1998a, Gibson *et al* 2003).

Table 1.5. Summary characteristics of the 12 trials included in the Cochrane systematic review (Gibson et al 1998a).

Limited (information only) patient education programs for adults with asthma
• *Primary comparison:* Information only education versus a usual care control group. The control comparisons (or usual care) varied from usual medical care and a waiting list control.
• *Types of participants:* Participants were adults with asthma and recruited from outpatient clinics, GPs, hospital emergency departments and advertising.
• *Setting:* The intervention was performed in hospital clinics/outpatient departments in 6 trials, GP clinic for 1, hospital exit interview in 1 and combined at home and hospital in 4.
• *Types of interventions:* The type of intervention varied between trials. It included either interactive sessions (group or individual education or interactive computer sessions) or non-interactive education (provision of written material, video and or audio-cassette).
• *Trial duration:* The duration of the intervention varied amongst the trials and was also dependent on the style of intervention. This varied from the time taken for home reading of a booklet, a single interview with an educator or watching a video to 20 hours of instruction over a 4-week period.

Source: Gibson *et al* 2003.

On the other hand, comprehensive asthma self-management education programs in a hospital setting that address all four components have been shown to have a significant impact on patient asthma outcomes and asthma-related health care utilisation. A Cochrane systematic review of 36 RCTs examining the effects of asthma self-management education showed that it is effective in a hospital setting and leads to a reduction in hospitalisations and ER visits for asthma, unscheduled doctors visits, days lost from work, episodes of nocturnal asthma, indirect costs and an improvement in asthma-related quality of life (Gibson *et al* 1999). The effects were large enough to be both clinically and statistically significant. Characteristics of the 36 trials included in the Cochrane systematic review are summarised in Table 1.6.

Table 1.6. Summary characteristics of the 36 trials included in the Cochrane systematic review (Gibson et al 1999).

Self-management education and regular practitioner review for adults with asthma
• *Primary comparison:* The primary comparison based on the treatment of the intervention and control groups used was self-management versus usual care. Usual care may have included education, self-monitoring, or regular medical review. However, no control group received a written asthma action plan.
• *Types of participants:* A total of 6090 adults with asthma were randomised into 36 trials. Participants were recruited from a variety of settings including hospitals, outpatient clinics, emergency departments, GPs, and community settings.
• *Setting:* The interventions were conducted in outpatient clinics, GP asthma clinics, community based programs and hospital inpatients education programs.
• *Types of interventions:* All the interventions provided information plus components of self-management. The interventions fell into five subgroups according to the type of self-management intervention. These include: Optimal self-management (information, self-monitoring, written asthma action plan and regular medical review), 15 trials; Self-monitoring and regular review, 7 trials; Self-monitoring only, 10 trials; and inclusion of a written asthma action plan but not an optimal intervention, 2 trials.
• *Trial duration:* The duration of the intervention varied from a minimum of one 45 min session, 10 h of instruction over a 4-week period. Follow-up consisted of monthly visits or telephone follow-up for 12 months.

Source: Gibson *et al* 2003.

The NAC *Asthma Management Handbook 2002* has developed a patient education checklist to assess the individual needs of patients and to provide education tailored to patient needs. Based on this patient education checklist, topics that should be discussed and assessed when providing asthma education include the mechanisms and management of asthma, the role of asthma medications and the importance of regular long term therapy, the proper use of inhaled medication, symptom based or peak flow self-monitoring, usual signs and symptoms of worsening asthma, role of medications using a written asthma action plan, avoidance and management of trigger factors, assessment of medication adherence and strategies for overcoming barriers to adherence (National Asthma Council 2002). Given that many of the issues remaining in asthma management are patient-related issues associated with the inappropriate use of asthma medication as outlined in Section 1.8.1, education focusing on the proper use of asthma medication is the most critical element to successful asthma management.

1.9.1.2. Factors associated with the delivery of the education

An effective adult asthma education program is also dependent on a range of factors associated with the delivery of the education. These include the characteristics of the educator (e.g. skills, credibility) and participant(s) (e.g. learning styles, stages of change), whether the asthma education is based on a clear theoretical framework, the teaching styles or modalities (i.e. interactive or non-interactive) and delivery formats utilised (i.e. individualised and/or group) (Boulet *et al* 1994, Green and Frankish 1994, Boulet 1998b).

The characteristics of the educator are very important in the implementation of a successful asthma education program. Participants cannot learn unless they pay attention to what is happening around them. The attention process is influenced by the characteristics of the educator. The educator is more likely to be believable if he or she is perceived as socially competent, trustworthy, attractive, credible or similar and likeable (Bandura 1986). Their training, skills, feedback, empathy and language play an important role in this process (Boulet 1998b, Newman *et al* 2004). Similarly the characteristics of the participant are as important. Their age, asthma severity, level of education and knowledge, motivation, ethnicity, lifestyle etc are important. Instructional methods need to be matched to their readiness to learn, learning style, learning speed, and their “stages of change” (Wilson 1997).

Evidence shows that asthma education programs are more likely to be successful if they are based on a theory of patient behaviour change (Green and Frankish 1994) and focus on improvements beyond patient knowledge (Boulet 1998b, Gibson *et al* 1999, Sudre *et al* 1999).

Asthma education is more likely to be effective if it is delivered in an interactive style. Interactive leaning may involve lectures, audiovisual presentations to encourage discussions, demonstration of techniques, practice of skills, role playing, project or assignment based learning, participatory learning and case method to develop problem solving skills (Wagner and Karpel 2001). Non-interactive styles are less likely to be effective and incorporate written materials, audiocassette, video and non-interactive computer education (Gibson *et al* 2003).

Adult asthma education programs that have utilised small-group format (5-8 individuals) have been shown to be as effective in improving patient asthma outcomes as those that have utilised an individualised format (Wilson *et al* 1993).

However, there is some evidence that small-group asthma education is more effective for certain outcomes such as inhaler technique (van der Palen *et al* 1997) and physical activity (Wilson *et al* 1993). Small-group programs have the potential to provide social support and other benefits that come from interactions with others who have similar issues and they may also validate patients' own experiences and help them develop an accurate appraisal of their own condition. Small groups provide additional support to the individual through the influence of group participation and collaborative learning (Wilson 1997). To be of benefit, constructive interactions in small groups must be planned and facilitated and, even so, may depend to some extent on the characteristics of the participants and educator (Bandura 1986, Wilson 1997, Newman *et al* 2004). In small-group programs individualised education is also possible targeting the specific needs of individuals. The added benefits of small-group programs are that they are simpler to administer, more cost effective and better received by patients and educators (Wilson *et al* 1993, Wilson 1997). The disadvantages of small-group programs include the difficulty of gathering individuals in groups and the problem of the logistics of scheduling patients and an educator for multiple consecutive group sessions.

Small-group asthma education interventions for adults have been delivered by a range of educators mostly in a hospital setting as shown in Table 1.7. Wide variations in effectiveness exist among small-group formats as they do among individualised formats (Clark and Nothwehr 1997, Warsi 2004). The value of small-group asthma education for adults has been demonstrated in various settings by several education interventions (Snyder *et al* 1987, Bailey *et al* 1990, Windsor *et al* 1990, Wilson *et al* 1993, Yoon *et al* 1993, Allen *et al* 1995, Kotses *et al* 1995, de Oliveira *et al* 1999, Marabini *et al* 2002).

Table 1.7. Characteristics of small-group asthma education interventions for adults.

Year	Investigator	Format Group or Both (Individual + Group)	Setting	Educator
1986	Sheilds	Group	Hospital outpatients	Nurse educators
1987	Snyder	Group	Not stated	Respiratory therapist
1990	Bailey	Both	Hospital outpatients	Health educators
1990	Windsor	Both	Hospital outpatients	Health educators
1993	Wilson	Both	Allergy clinic	Nurse/educators
1993	Yoon	Group	Hospital inpatients	Educators at hospital
1994	Garrett	Both	Hospital ER	Health educators
1994	Thapar	Group	GP asthma clinics	Researcher educator
1995	Allen	Group	Hospital based	Asthma educators
1995	Kotses	Group	Not stated	Nurses
1996	Kotses	Both	Not stated	Nurses
1996	Neri	Group	Hospital outpatients	Nurse educators
1997	Berg	Group	Community based	Nurse educators
1999	Bailey	Both	Hospital outpatients	Health educators
1999	de Oliviera	Group	Hospital outpatients	Physician educators
1999	Gallefos	Both	Hospital outpatients	Nurse/physiotherapist
2001	Klein	Group	Hospital outpatients	Nurse educators
2002	Marabini	Both	Hospital outpatients	Physician educators
2002	Perneger	Group	Hospital inpatients	Physician/physiotherapist

Several systematic reviews of adult asthma education programs have shown excessive variability between programs in terms of content, methods and objectives and that insufficient documentation precluded their replication (Sudre *et al* 1999, Newman *et al* 2004). Interactive methods and problem based learning were often absent. Few interventions went beyond the transmission of knowledge. Most studies had no clear theoretical framework, did not specify the objectives of the intervention and important training characteristics were often not available such as duration of education, the number of sessions, who delivered the education and whether training was conducted in groups or was individualised. As a result this reduced the possibility of identifying their most effective components.

1.9.1.3. Setting for the education

An effective asthma education program for adults is not only dependent on program components and factors associated with the delivery of the program but also on the setting for the education. A familiar and supportive environment for patient behaviour change must also exist (Bandura 1986). Asthma education has been delivered in a variety of settings including emergency departments, inpatient hospital wards, outpatient hospital clinics, communities, schools and primary care. To date, there is no clear evidence that one setting is best (Partridge and Hill 2000).

Numerous asthma education programs for adults have been conducted in a hospital setting. Based on a Cochrane systematic review, structured asthma self-management education programs for adults, which include the provision of information, self-monitoring, a written asthma action plan and regular review have been shown to be effective in a hospital setting (Gibson *et al* 1999). In Australia, three structured asthma education programs have been conducted in a hospital setting to groups of adults and were shown to be effective (Yoon *et al* 1993, Allen *et al* 1995, Abdulwadud *et al* 1999a).

Fewer asthma education interventions for adults have been conducted in primary care with varying success (Gibson *et al* 1998a, Gibson *et al* 1999). Characteristics of adult asthma self-management interventions conducted in primary care and their effects are tabulated in Table 1.8.

In a recent Cochrane systematic review examining the effectiveness of primary care based asthma clinics, which are usually nurse led and doctor supported, and involve organised recall of asthma patients for symptom review, only one trial met the inclusion criteria (Fay *et al* 2002). This was an Australian study in which individualised education was provided by a nurse educator (Heard *et al* 1999). To date, due to limited evidence, the success of asthma education provided through primary care based asthma clinics has not been established (Fay *et al* 2002, Gibson *et al* 2003).

Most interventions in primary care have been provided by qualified practice nurses and/or general practitioners and asthma educators on an individual basis. To date, no small-group asthma education provided by pharmacists in the community pharmacy setting has been implemented and evaluated.

Table 1.8. Effect of adult asthma self-management education interventions conducted in primary care

Author, year (country)	N	Recruitment setting	Intervention groups	Type and duration of intervention	Individual or group	Delivered by	Follow-up period	Outcomes
Hilton, 1986 (UK)	339	General practices	1. Maximum education 2. Limited education	Education with GP and regular review (3 monthly appointments with GP) in addition to routine consultations	Individual	GP	12 months	Increase asthma knowledge Increase patient satisfaction No difference in asthma morbidity or self-management ability
Snyder, 1987 (USA)	79	Community volunteers, setting not stated	1. Education and PF monitoring	Group education 2x 2.5 hour sessions	Group	Respiratory therapist	1, 2 and 3 months	Increase asthma knowledge Reduced asthma attack frequency
Jones, 1995 (UK)	127	General practices	1. Optimal self-management 2. Regular review plus diary	Education with GP or nurse and regular review plus WAAP plus peak flow monitoring	Individual	GP or practice nurse	6 months	No difference in functional status, lung function or morbidity
Kotses, 1995 (USA)	76	Adult asthma volunteers, setting not stated	1. Education, daily PF and symptoms monitoring 2. Daily PF and symptom monitoring for 6 months and 2 weeks prior to finish	Education for 7x 90 mins sessions, once a week over 7 weeks	Group	Nurses	2-12 months	Reduced asthma attack frequency, decrease use of medication, fewer asthma related problems

Author, year (country)	N	Recruitment setting	Intervention groups	Type and duration of intervention	Individual or group	Delivered by	Follow-up period	Outcomes
Hayward, 1996 (UK)	44	GP clinic	1. Education plus written material, peak flow self monitoring plus action plan ? written 2. Standard care	Monthly clinic visit or telephone call for 12 months	Individual	Asthma nurse specialist	12 months	No difference in health care utilisation, morbidity or functional status
Kotses, 1996 (USA)	45	Community respondents to advert., setting not stated	1. Individual education, daily PF monitoring 2. Group education, daily PF monitoring	Individual education 1x 60 minute session Group education 2x 2.5 hour sessions	Individual and group	Nurses	1 month	Improved lung function in both groups Reduced asthma attack frequency for individual education group
Berg, 1997 (USA)	55	Brochures in rural GP surgeries, pharmacies. Newspaper, radio advert	1. Self-management education 2. Standard care	2 hours per week for 6 weeks	Group	Nurses	6 weeks	Improved compliance with inhaled medication
Heard, 1999 (Australia)	195	GP asthma clinic	1. Education plus GP review 2. Standard care	Education with nurse and regular GP review (3 x 3 hour sessions over 6 months)	Individual	Nurse	6 months	Increase in the ownership of peak flow meters and improvement in asthma control No difference in health care utilisation or morbidity

Author, year (country)	N	Recruitment setting	Intervention groups	Type and duration of intervention	Individual or group	Delivered by	Follow-up period	Outcomes
Premaratne, 1999 (UK)	10,873	General practices and community	1. Education on core elements of asthma care and management 2. Standard care	Education with practice nurse for six sessions Duration ?	Individual	Practice nurses supported by asthma nurse specialists	12 months	No difference in morbidity or health care utilisation Increase in steroid prescribing rates
Moudgil, 2000 (UK)	689	General practices	1. Education plus WAAP plus peak flow diaries plus optimisation of drug therapy 2. Standard care	Education for 40 minute sessions reinforced at 4 and 8 months	Individual	? Practice nurse	12 months	Improvement in asthma-related quality of life Decrease health care utilisation Decrease use of antibiotics and oral corticosteroids
Thoonan, 2003 (Netherlands)	214	General practices	1. Self-management education 2. Standard care	Tailored education, WAAP, peak flow monitoring, inhaler technique for 4 visits (30, 20, 2x10 mins) at GP surgery for 3 months then visited lung function lab every 6 months	Individual	GP	24 months	Fewer limited activity days Small improvement in asthma-related quality of life No difference in lung function parameters

Author, year (country)	N	Recruitment setting	Intervention groups	Type and duration of intervention	Individual or group	Delivered by	Follow-up period	Outcomes
Berg, 1997 (USA)	55	Brochures in rural GP surgeries, pharmacies. Newspaper, radio advert	1. Self-management education 2. Standard care	2 hours per week for 6 weeks	Group	Nurses	6 weeks	Improved compliance with inhaled medication

In the community setting, a small number of asthma education interventions in the form of asthma outreach programs have also been effective. These asthma outreach programs have been delivered to special needs groups (socioeconomically disadvantaged, lower-literacy and inner-city minority groups, rural and remote communities) mostly by outreach nurses and have been effective in terms of reducing hospital admissions, ED and unscheduled clinic visits and improved asthma outcomes. They have resulted in decreased cost of care and improved patient satisfaction and quality of care (Greineder *et al* 1995, Stout *et al* 1998, Kelly *et al* 2000, Lin *et al* 2004). In the US, an adult asthma outreach program by outreach nurses has been shown to improve patients' functional status, self-monitoring, and asthma knowledge and to reduce absenteeism and hospitalisations due to asthma (Legorreta *et al* 2000).

In the high school setting, various asthma education interventions have also been successful. A teacher-led asthma education program in New South Wales high schools showed improved asthma knowledge, tolerance to asthma, internal control and overall quality of life. Teachers showed significant increases in asthma knowledge and the high schools were more likely to seek further asthma education. Five years after the trial, 71% of high schools were still teaching the program to most students (Henry *et al* 2004). In New South Wales metropolitan high schools, a peer-led asthma education program called the Triple A (Adolescent Asthma Action) showed significant improvements in asthma knowledge in both students with asthma and their peers. Students held favourable attitudes towards asthma, with high degrees of tolerance and moderate locus of control (Gibson *et al* 1998b). In rural areas, the Triple A program showed a significant improvement in students' quality of life and a decrease in school absenteeism and asthma attacks (Shah *et al* 2001).

In Australia, very few structured asthma education programs for adults have been provided in primary care, where the vast majority of the burden of asthma is managed (Gibson 2000). Asthma education programs have mainly targeted hospital patients, communities and schools and very few programs were run through general practice. Most programs incompletely linked program evaluation to program aims and few programs focused on improvements beyond patient asthma knowledge (McDonald *et al* 1999).

1.10. EVALUATION OF THE EDUCATION

1.10.1. The impact of education on asthma knowledge

Evidence indicates that asthma education improves asthma knowledge, which is an essential prerequisite for the successful performance of self-management behaviours (Gibson *et al* 1999, Gibson *et al* 2003). However, it has been shown that the acquisition of knowledge does not necessarily translate into effective self-management behaviour (Gibson *et al* 1998a). Asthma education is currently provided by most health care professionals, including pharmacists, nurses, and other allied health care professionals (Fischer *et al* 1994, Gibson 2000). Since health care professionals are key providers of asthma education, their knowledge of asthma and asthma management practices often needs to be updated through continuing education. This is to ensure that the education provided to the patient conforms to best practice guidelines. Moreover, health care professionals need to tailor this education to the patients' needs and determine if the education provided results in an improvement in asthma knowledge. In order to attribute changes in asthma knowledge to the impact of the education, rather than measurement error, it is important to use a valid and reliable tool. A number of questionnaires have been developed for assessing the general asthma knowledge of different populations in a variety of settings. Their characteristics are shown in Table 1.9.

Table 1.9. Characteristics of published asthma knowledge questionnaires

Year	Investigator	Population	Recruitment setting	Limitations
1980	Parcel	Children with asthma attending a school health education program Parents of children with asthma	Elementary school	No evidence of validity, outdated Designed to reflect the content of an asthma education program
1990	Fitzclarence	Parents of children with asthma	Respiratory asthma clinic local asthma support group network	Validated, outdated
1993	Brook	Parents of children with asthma who attended an educational seminar	Hospital paediatric respiratory clinic	Tested on small sample size Designed to reflect the content of an asthma education program
1997	Moosa	Parents of children with asthma	Family practice	Tested on inadequately characterised sample
1997	Wade	Children with asthma aged 6-9 years	All attendees of a hospital ED and community clinic	No evidence of validity
1998	Allen	Adults with asthma attending an asthma education program	Hospital asthma clinic	Tested on small sample size Designed to reflect the content of an asthma education program
1999	Grant	General public	Random telephone survey	No evidence of validity
2000	Allen	Adults attending an asthma educator training course	Asthma Educators database	Tested on inadequately characterised sample Designed to reflect the content of an asthma education program
2001	Bertolotti	Adults with asthma	Outpatient pneumology clinics	No evidence of validity
2003	Ho	Parents of children with asthma	Public schools and HMO database	Tested on small sample size

These questionnaires assess the asthma knowledge of parents of children with asthma, adults with asthma, children with asthma or the general public. However, the existing asthma knowledge questionnaires have several limitations. The only validated asthma knowledge questionnaire was developed in 1990 and hence is out of date with current asthma management guidelines (Fitzclarence and Henry 1990). The shortcomings of the other knowledge questionnaires relate to the lack of evidence of the validity (Wade *et al* 1997, Grant *et al* 1999, Bertolotti *et al* 2001), being outdated with current concepts of asthma (Parcel *et al* 1980), or having been tested on small or inadequately characterised subject samples (Brook *et al* 1993, Moosa and Henley 1997, Allen and Jones 1998, Allen *et al* 2000, Ho *et al* 2003).

Furthermore, most of the published asthma knowledge questionnaires have been designed to assess the asthma knowledge of the consumer (i.e. a lay person with asthma or a parent/carer of a person with asthma). There is no questionnaire specifically developed for assessing the asthma knowledge of health care professionals who are key providers of asthma education. It is hence important to have a reliable and valid instrument to be able to assess education needs and to measure the impact of training programs on asthma knowledge of health care professionals as well. An asthma knowledge questionnaire for health care professionals might also be used to gauge how successful dissemination and implementation of guidelines have been.

1.11. ASTHMA AND COMMUNITY PHARMACISTS

Community pharmacists play an important role in health care through close interaction with patients, carers and other health care providers. Their role has evolved over the last half century into a new patient-centred philosophy of practice called pharmaceutical care, which focuses on enhancing care for individual patients with an emphasis on improving patients' quality of life (Hepler and Strand 1989). Improvements in dispensing are giving pharmacists the opportunity to concentrate on providing cognitive services for patients.

Community pharmacists are in a pivotal position to contribute to the overall management of asthma in view of their therapeutic expertise, accessibility, regular

contact with patients and contact with patients who do not see other health care providers on a regular basis. Since the proper use of medication is critical to successful asthma management, pharmacists have the opportunity and responsibility to ensure proper medication usage (Skipper and Annis 2003). The community pharmacy setting offers an ideal venue to screen patients with suboptimal asthma control, provide patient counselling and education, and monitor patients' inhaler use and patterns of medication use on an ongoing basis. Pharmacists are in a unique position to reinforce/clarify key messages, identify patients with poorly controlled asthma and provide referrals to other health care providers. When provided by a pharmacist, patient education and monitoring has been shown to improve patients' quality of life, reinforce physician's instructions, and reduce the cost of care (Moyer 1995).

1.11.1. Community pharmacy-based asthma care programs

In the community pharmacy setting, various types of service models have been trialed for the provision of asthma care using pharmacists as the providers of care in both Australia and overseas. Pharmaceutical care-based models include nationally driven programs (Lisper and Nilsson 1995, Haahtela *et al* 2001), programs based on patient empowerment (Odedina *et al* 2000), programs based on therapeutic outcomes monitoring (Grainger-Rousseau *et al* 1997, Narhi *et al* 2000, Herborg *et al* 2001), programs based on a number of pharmaceutical elements (Cairns and Eveleigh 2000, Bheekie *et al* 2001, Blumenschein *et al* 2001, Cordina *et al* 2001, Schulz *et al* 2001, Serrier *et al* 2001, Weinberger *et al* 2002, Emmerton *et al* 2003, McLean *et al* 2003, Mangiapane *et al* 2005) and programs based on an integrated disease-management approach (Munro *et al* 1997, Rupp *et al* 1997, Frederick 1999, Saini *et al* 2004). Various positive outcomes have been demonstrated by the provision of pharmacy-based specialised asthma services, including improved clinical outcomes (symptom scores, peak flow readings), improved humanistic outcomes (self efficacy, asthma knowledge, patient satisfaction, quality of life) and a reduction in health care utilisation and economic savings.

Although pharmacists have demonstrated their value in the management of high-cost chronic diseases such as asthma, hypertension and diabetes through the provision of various types of pharmacy-based service models (Pizzi *et al* 2001), these interventions often involve implementation of a rigid and complex package of education, are often time-consuming in terms of pharmacists' training and patient

visits and their adaptation into daily workflow practices are issues that need to be further addressed. However, pharmacists have also demonstrated their value through other less intensive pharmacy-based health promotion, screening and preventative health services and education programs.

1.12. HEALTH PROMOTION AND COMMUNITY PHARMACISTS

Health promotion is an "umbrella" term used for a broad range of strategies of which health education is but one part. Health promotion is defined as any combination of interventions involving health education and related (organisational, economic, political) interventions designed with consumer participation to promote changes (social, environmental, attitudinal, behavioural) conducive to the improvement in health of individuals or groups (Green and Anderson 1986). Health promotion is not just about changing lifestyle or providing information. It is also about providing services that improve the health of individuals and communities, and empowering people to have increased control and to improve their health. Community involvement, ownership and support are crucial in achieving successful health promotion.

1.12.1. Community pharmacy-based health promotion activities

Community pharmacy settings have been shown to be effective, yet under utilised sites for the delivery of health promotion, screening and education programs (Anderson 2000, Sunderland *et al* 2004, Saini *et al* 2006). In the UK, pharmacists have been involved in health promotion about diet, dental health, mental health, physical exercise, heart disease, HIV prevention, emergency contraception and health screening and smoking cessation services (Anderson and Green 1997, Anderson *et al* 2003, Watson *et al* 2003). In the rest of Europe there are few published studies about pharmacy health promotion, the exception being evaluations of campaigns based in Finland on asthma (Haahtela *et al* 2006) and in Sweden on skin diseases (Hammarstrom *et al* 1995) and asthma (Lisper and Nilsson 1996). In Canada, pharmacists have been involved in prevention and screening activities in skin cancer (Leinweber *et al* 1995), hypertension (Cote *et al* 2003), cardiovascular risk factors (Tsuyuki *et al* 1999, Chambers *et al* 2005) and HIV (Paluck *et al* 1994). In the US, pharmacists have been involved in screening services for osteoporosis

(Elliott *et al* 2002, Goode *et al* 2004) and men's health (Boyle *et al* 2004). Such services have been able to identify, educate and refer people at risk for further assessment and management, and patients have reported that they are willing to pay for pharmacy-based screening services (Goode *et al* 2004).

In Australia, the involvement of community pharmacists in health promotion activities or outreach programs has been limited. In rural areas, community pharmacies have been shown to play an active role in preventative health activities (Pharmacy Guild of Australia Report 2006) and health promotion and screening services for cardiovascular risk factors (Hourihan *et al* 2003). Although pharmacists are in a unique community-based setting in which to educate, inform and advise people with chronic disease such as asthma on an ongoing basis, few studies have reported their involvement in asthma health promotion activities. Hence, an enormous opportunity exists for community pharmacists to raise awareness of health issues and influence health behaviour, through the adoption of health promotion services for asthma and other chronic disease states particularly in rural areas which have a limited number of and access to health care services (Anderson 2000, Sunderland *et al* 2006).

1.13. OPPORTUNITY STATEMENT

Asthma management practices in the Australian community are currently unsatisfactory. The role of the community pharmacist in the management of asthma is important. Community pharmacies are a strategic venue in which to educate, inform and advise people with chronic disease such as asthma who are taking continuing responsibility for their own treatment and self-management. This resource is currently underutilised. Pharmacists are also keen to expand their role to contribute to the overall management of asthma in both rural and metropolitan communities. In Australia, community pharmacists' involvement in asthma health promotion activities and asthma education programs has been limited.

1.14. SCOPE AND AIMS

Therefore, work described in this thesis utilised the skills of the community pharmacist in the current environment, where we know that asthma management practices are suboptimal, to develop and investigate two new asthma intervention strategies for community pharmacists;

i. Asthma outreach health promotion in a rural setting
ii. Small-group asthma education in a community pharmacy setting

In this way, new effective strategies for community pharmacists directed at improving asthma management practices could be determined.

Chapter 2

Asthma health promotion and the role of the pharmacist

2.1. INTRODUCTION

A review of the literature has revealed that asthma management practices in the Australian community are currently suboptimal resulting in significant morbidity and mortality. In adolescent asthma there are added challenges, with problems of self-image, denial and non-adherence to therapy where self-management skills assume a greater importance (Forero *et al* 1996, Price 1996, Brook and Tepper 1997, Buston and Wood 2000, Kyngäs *et al* 2000).

In rural and remote areas in Australia, asthma management practices have been shown to be poorer and mortality rates from asthma are considerably higher compared to metropolitan areas (AIHW ACAM 2005, AIHW 2006). Limited access and chronic shortages of specialist services in rural areas are shifting the burden more and more towards the primary sector (AIHW 2006). It becomes paramount that people with asthma in rural settings become involved in self-management of their asthma and that community based health care providers be more proactive in facilitating these self-management behaviours by appropriate education and counselling.

Health promotion activities, which are a broad range of activities including health education, have been acknowledged as having the potential to improve the health status of rural populations (National Rural Health Alliance 2002). Community pharmacy settings have been shown to be effective sites for the delivery of health promotion, screening and education programs (Anderson 2000, Elliott *et al* 2002, Cote *et al* 2003, Hourihan *et al* 2003, Watson et al 2003, Boyle *et al* 2004, Goode *et al* 2004, Paluck *et al* 2004, Sunderland *et al* 2004, Chambers *et al* 2005, Saini *et al* 2006). In the case of asthma, outreach programs have been shown to have beneficial effects in terms of reducing hospital admissions and emergency visits and improved asthma outcomes (Greineder *et al* 1995, Stout *et a*l 1998, Kelly *et al* 2000, Legorreta *et al* 2000, Lin *et al* 2004).

We proposed to extend the role of the community pharmacist beyond the traditional realm of the “pharmacy” into the community in rural Australia with the first asthma outreach programs designed for community pharmacy. The outreach programs were designed to include two health promotion strategies, the first targeting adolescents in high schools and the second targeting the general community.

The project aimed firstly, to assess the feasibility of using community pharmacists to deliver two asthma outreach programs, one targeting adolescents and one for the wider community in a rural area and secondly, to assess the programs’ impact on adolescent asthma knowledge and requests for information at the community pharmacy.

2.2. OBJECTIVES

The specific objectives for the feasibility study were:

1. To increase awareness of issues associated with asthma in a rural community.
2. To enable the community pharmacist to take an active role in the provision of education and advice on asthma issues in a rural community.
3. To increase awareness of the pharmacist as a source of information and advice on asthma.
4. To enable pharmacists to implement a peer-led asthma education program targeted at adolescents in a rural community and thus promote asthma awareness in the school community and create a supportive school environment for those with asthma.
5. To assess the programs’ impact on adolescent asthma knowledge and requests for information at the community pharmacy.

2.3. METHODS

2.3.1. Study design

The study was conducted between September 2002 and May 2003 enabling community pharmacists to deliver two asthma outreach programs in two layers, one

targeting adolescents in high schools and one for the wider community. The study design is outlined in Figure 2.1.

The rural community of Orange, New South Wales was selected for this feasibility study based on a needs analysis conducted by the Mid Western Area Health Service (MWAHS) in 2000 (Blundell 2000). Orange (area 284.8 square kilometres, population 35,500) is serviced by one district hospital, five high schools and nine community pharmacies. The sampling frame included all high schools and community pharmacies in Orange. Ethics approval to conduct the study was obtained from the Human Ethics Committee, University of Sydney (Appendix 1).

2.3.2. Recruitment of pharmacists

All pharmacists located within the City of Orange were contacted personally, and invited to attend a project awareness evening in September. At this meeting, information about the project and the innovative role to be played by the pharmacists was disseminated (Appendix 2).

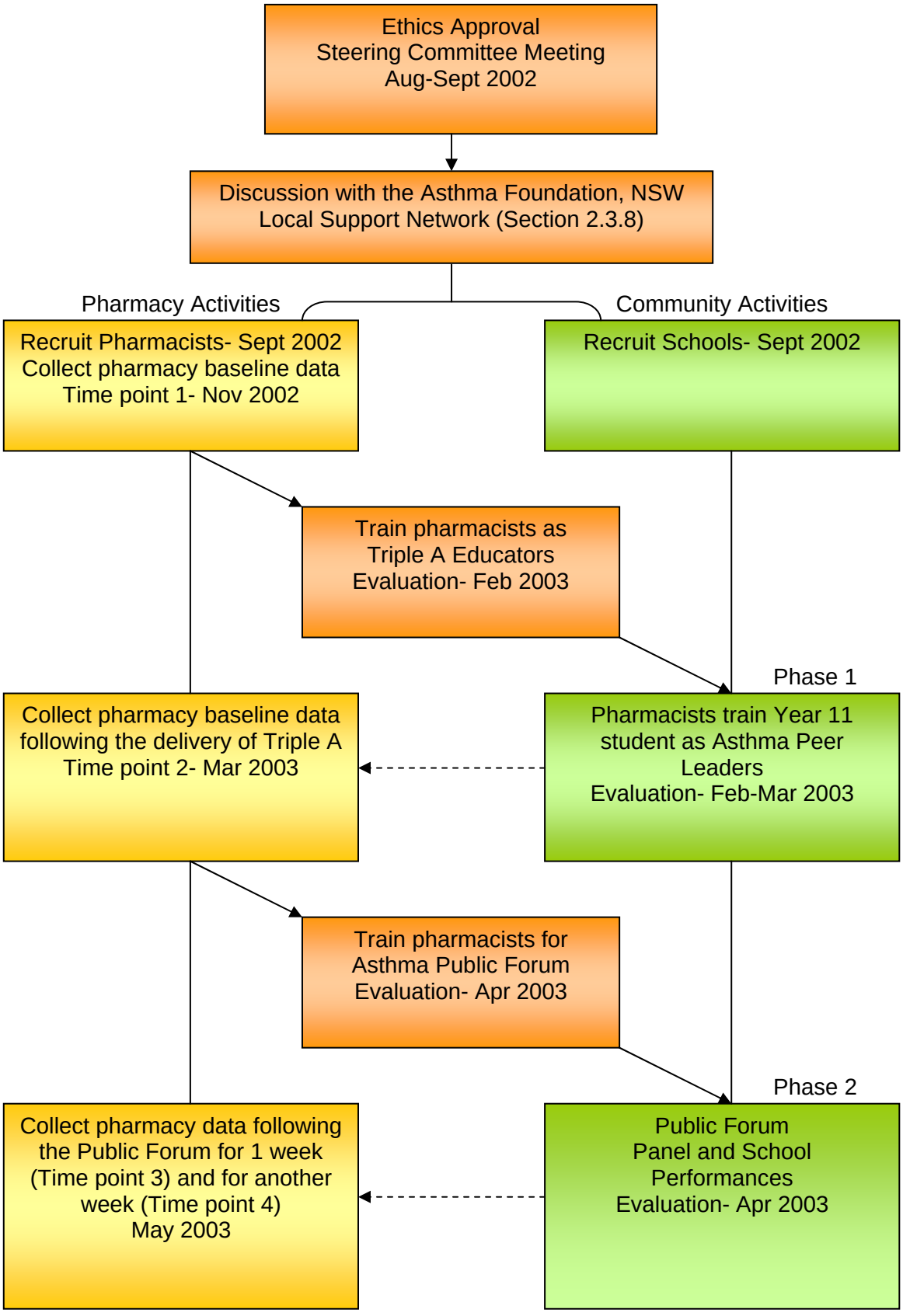
2.3.3. Recruitment of high schools

All five high schools in Orange were approached in July-August 2002 with the assistance of the Asthma Friendly Schools Program (AFSP), a Commonwealth Government initiative run by Asthma NSW[1], who usually "administer" the Triple A program[2]. By October 2002, letters of intention to participate in 2003 were obtained from all five high schools. In response, the research team requested schools to schedule training days in term 1, 2003 (Appendix 3).

[1] Asthma NSW, a not for profit organisation, is the body which conducts the National Asthma Friendly Schools Program for the state of NSW.

[2] The Triple A (Adolescent Asthma Action) program is a peer-led asthma education program designed for adolescents, and is one of the two options available as part of the Asthma Friendly Schools Program.

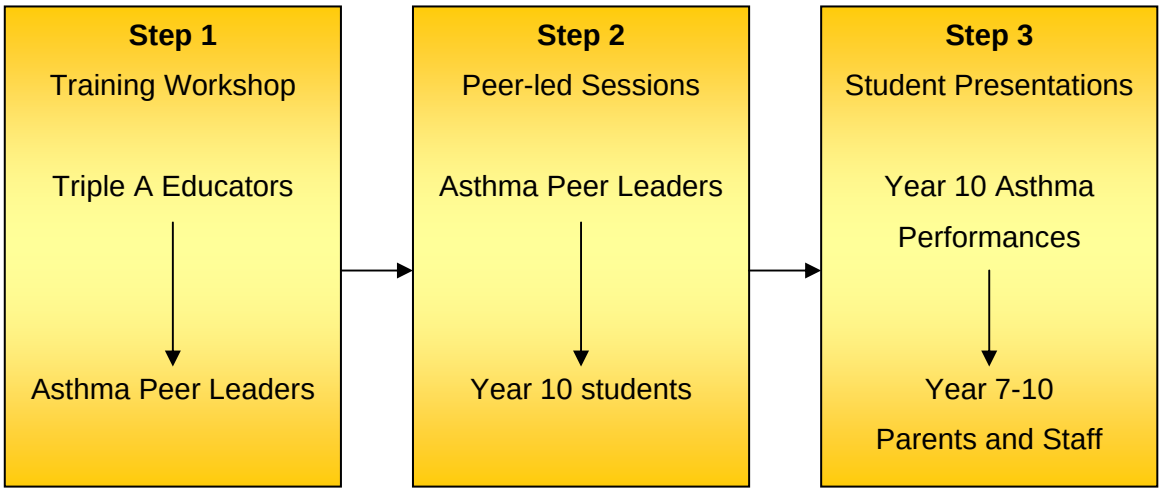
Figure 2.1. Study design



2.3.4. Adolescent health promotion

An evidence-based peer-led asthma education program, the Triple A program was used to educate adolescents. The Triple A program is based on Paolo Freire's empowerment education approach (Wallerstein and Bernstein 1988) and Bandura's social learning theory (Bandura 1986). The intervention is implemented in a three-step process as outlined in Figure 2.2. In Step 1, senior volunteer students are trained as Asthma Peer Leaders. In Step 2, the Asthma Peer Leaders educate their younger peers in three lessons, using videos games and discussions. In Step 3, the younger students then relay this information through creative performances using drama, dance, music and songs, to the school community.

Figure 2.2. The three-step process



2.3.4.1. Training of pharmacists

Pharmacists who agreed to participate were invited to attend a full day training session and were trained by a certified Triple A Trainer to become "Triple A Educators". The program itself uses a "train the trainer" approach such that after participation, trainees are eligible to educate others. The program consists of three sessions involving asthma knowledge, empowerment of adolescents and an interactive communication and leadership session (Appendix 4). In teams of two, pharmacists volunteered to implement step one of the Triple A program to Year 11 students in the high schools within the scheduled training days.

2.3.4.1.1. Evaluation of training

Evaluation of the Triple A training for pharmacists was completed using the validated asthma knowledge questionnaire before and immediately after the training (Fitzclarence and Henry 1990) (Appendix 5). The asthma knowledge questionnaire consisted of 31 items and response options were presented as true/false (25 items) or brief narratives (6 items). Correct answers were given a score of 1 and incorrect answers were given 0, with a perfect score on asthma knowledge being 31.

2.3.4.2. Delivery of Triple A program

Community pharmacists in 'buddy teams' implemented step one of the Triple A to Year 11 students who had signed informed consent in each of the participating high schools between February-March 2003 (Appendix 6). The research team was also present.

2.3.4.2.1. Evaluation by students

Year 11 students' asthma knowledge was assessed on the training day pre and post the delivery of the Triple A program, using the validated asthma knowledge questionnaire (Fitzclarence and Henry 1990) (Appendix 5). Year 11 students' perceptions and experiences during the Triple A training were assessed using the Asthma Peer Leader's Evaluation questionnaire (Appendix 7).

2.3.4.2.2. Evaluation by pharmacists

Pharmacists' perceptions and experiences were also assessed after the Triple A delivery using the Triple A Educator's Evaluation questionnaire, consisting of five-open ended questions relating to what was gained, what aspects worked well, what difficulties were faced, and three questions relating to the success of the topics covered in the training session which were rated on a five-point semantic-differential scale ranging from 1 "not at all successful" to 5 "extremely successful" (Appendix 8).

2.3.4.2.3. Evaluation by school staff

Attending teachers at the high schools were requested to provide feedback using the Teacher's Feedback questionnaire (Appendix 9).

2.3.4.3. Media promotion

Media coverage of the pharmacists' training session and future delivery of the Triple A program by community pharmacists to high schools was arranged so as to spread awareness about this community initiative and encourage further participation by

other high schools. The project and promotional activities timeline is outlined in Figure 2.3 and local newspaper articles are presented in Appendix 10.

Figure 2.3. Project and promotional activities timeline

2.3.5. Community based health promotion

2.3.5.1. Pharmacist training workshop

Three weeks before a training workshop, pharmacists received a pre-course training manual for self-study and for future use as a resource. The manual was divided into five modules dealing with pathophysiology and risk factors for asthma, asthma medications and devices, asthma action plans and self-management behaviours, communication skills and strategies for effective counselling by community pharmacists. Pharmacists then attended a second full-day workshop in preparation for the second phase of the project and were trained by a psychologist, two asthma researchers, a rural researcher and an asthma educator. The workshop objectives and learning outcomes are described in Appendix 11. The workshop covered asthma management practices in Australia and the role of the pharmacist in asthma care in rural areas, an interactive session that focused on factors that facilitate patient self-management that consisted of case studies and role-plays and a lecture on health beliefs and communication skills (Appendix 12). At the end of the workshop, pharmacists were encouraged to practise their new skills in their respective pharmacies.

2.3.5.1.1. Evaluation of the training

Evaluation of the pre-course manual and the training received by pharmacists was completed using a feedback survey specifically developed for this purpose (Appendix 13). Pharmacists were asked to rate how helpful the workshop and training manuals had been in terms of achieving the stated learning outcomes. A scale of 1-7, where 1 indicated very helpful/very relevant and 7 indicated not at all helpful/relevant was used for rating responses.

2.3.5.2. Public forum

A public forum on asthma, structured in two parts, was conducted for the community based health promotion layer of the project. The first part involved a panel discussion during which a panel of experts identified and discussed asthma issues in the community of Orange. The audience was invited to participate in the discussion. The panel consisted of the Director of the Emergency Department at the local hospital, a local GP, 2 local pharmacists, a researcher in asthma, an asthma educator and a person with asthma. In the second part of the program, students who had trained as asthma Peer leaders received their certificates and Year 10 students presented their drama and dance performances concerning asthma issues to the wider community.

2.3.5.2.1. Evaluation by attendees

Those who attended the public forum were requested to complete an exit survey, specifically designed for this event (Appendix 14). Their impressions of each part of the program, the useful and enjoyable aspects of the program and whether they would have made any changes to the program were elicited.

2.3.5.3. Media promotion

The public forum was promoted through media coverage (radio, television and newspaper) as well as street banners, school newsletters, poster and flyers in community health centres, pharmacies and banks. Invitations to attend the public forum were sent to all local GPs and other local health care providers. These promotional activities are outlined in Figure 2.3.and presented in Appendix 15.

2.3.6. Data collection from pharmacies

2.3.6.1. Data collection form

Asthma-related pharmacy visits were monitored at four different time points using a data collection form, specifically designed for this project (Figure 2.1). Data relating to patient demographics, circumstances for the visit (e.g. prescription), patient-initiated requests for information and referrals to general practitioner (GP) were recorded by the pharmacist (Appendix 16). Time point one corresponded to a one-week period of baseline data collection prior to any health promotion activity. Time point two corresponded to a one-week period of data collection after completion of the adolescent health promotion phase (Triple A program). Time points three and four corresponded to two consecutive one-week periods of data collection after the public forum.

2.3.6.2. Semi-structured interviews with pharmacists

Semi-structured interviews were conducted with pharmacists to further explore underlying issues about levels of asthma-related interactions with their patients at the end of the baseline data collection period (time point one) (Appendix 17). These issues were incorporated in a modified data collection form for use at time points two, three and four.

2.3.6.3. Dispensary records of asthma medications

Records of all asthma medications dispensed in the pharmacies during the four time periods were collected so as to triangulate data documented on the data collection form, and pharmacists' self-reported data.

2.3.7. Steering committee

A steering committee of representatives from the medical, pharmaceutical, respiratory care and education sectors from Orange and Sydney oversaw the operation of the study and at various stages provided feedback.

2.3.8. Establishment of a local support network

A local support network, the Asthma Advisory Group based at Orange Hospital, representing asthma educators, respiratory specialist nurses and hospital administrators, offered support and advice.

2.4. DATA ANALYSIS

2.4.1. Quantitative data

Data were entered into a data base and analysed using SPSS for Windows (Version 10). In addition to descriptive data analysis, continuous variables were analysed for normality. Student's paired *t*-tests were used to test for differences in mean asthma knowledge scores of pharmacists pre- and post Triple A training and in each school pre- and post-delivery of Triple A. Multivariate repeated measures analysis was used to test for differences in students' mean asthma knowledge scores within and between the high schools. The chi-squared test for trend was used to compare asthma-related pharmacy data at the four different time points and test for changes in the proportion of asthma-related pharmacy visits that involved requests for information about asthma. The level of significance for all statistical tests was set at $p<0.05$.

2.4.2. Semi-structured interviews

Semi-structured interviews were analysed using content thematic analysis and these data were compared with asthma dispensary records and data collection at baseline to gain insight into pre-project levels of asthma-related interactions.

The evaluation strategy relative to project objectives is outlined in Table 2.1.

Table 2.1. Program strategy

Objectives	Strategies	Evaluation
To increase awareness of issues associated with asthma in a rural community	• Pharmacists deliver Triple A to Year 11 school students who will further disseminate information to their peers. • Public education evening designed for the broader community. • Promotion by local media, street banners, posters, flyers and newspapers.	• Student pre/post asthma knowledge questionnaire (AKQ) and qualitative evaluations at Triple A delivery. • Pharmacist evaluation after delivery to students. • Exit feedback survey for attendees at the public education evening.
To enable the community pharmacist to take an active role in the provision of education and advice on asthma issues in a rural community	• Self-study pre-course manual. • Face-to-face workshop and interactive role plays. • Pharmacists trained during 2 full-day training sessions. • Promotion by local media.	• Pharmacist feedback survey after the second training workshop.
To increase awareness of the pharmacist as a source of information and advice on asthma	• Invitations to all local GPs and other primary health care providers for Public Forum. • Expert panel developed consisting of a physician from ED at local hospital, a local GP, 2 local pharmacists, a researcher, an asthma educator and a person with asthma, with pharmacists participating in the discussion. • Promotion by local media, street banners, flyers and posters.	• Number and nature of enquiries regarding asthma in the pharmacy at baseline compared to after the completion of Triple A and after the Public Forum. • Exit feedback survey from all attendees at the Public Forum.
To enable pharmacists to implement a peer-led asthma education program targeted at adolescents in a rural community	• Pharmacists trained to become Triple A educators. • Triple A program delivered in 3 local high schools targeting adolescents. • Promotion by local media and school newsletters.	• Pharmacist pre/post AKQ at Triple A educators training. • Student pre/post AKQ and qualitative evaluation at Triple A delivery. • Pharmacist evaluation after delivery to students.

2.5. RESULTS

2.5.1. Evaluation of adolescent health promotion

Seven of the ten community pharmacists who were approached agreed to participate (3 male and 4 female aged 22-65 years) and were trained as Triple A educators. Three of the five high schools in Orange agreed to participate in the Triple A program as part of the Asthma Friendly Schools program. The other two high schools did not choose the Triple A program as it would require logistic reshuffling of teaching periods. Pharmacists worked in pairs to deliver the program to the Year 11 students of the three participating schools.

A total of 92 Year 11 students, representing 26.3% of the total population of Year 11 students enrolled in the three participating high schools were trained as asthma peer leaders. By the end of April 2003 (project timeframe), these asthma peer leaders had disseminated information to 47% of the total population of Year 10 students. Steps two and three were continuing beyond this time (Table 2.2).

Table 2.2. Proportion of total students in a particular year that were trained

High school	Proportion (%) of total Year 11 students trained as Asthma Peer Leaders	Proportion (%) of total Year 10 students who received education	Proportion (%) of total Year 9 students who attended performances
Canobolas Rural Technology	39%	50%	100%*
Kinross Wolaroi	32%	54%	†
Orange High	8%	38%	100%*

* Performance at assembly
† Step 3 not completed within project timeframe

2.5.1.1. Evaluation of Triple A training by pharmacists

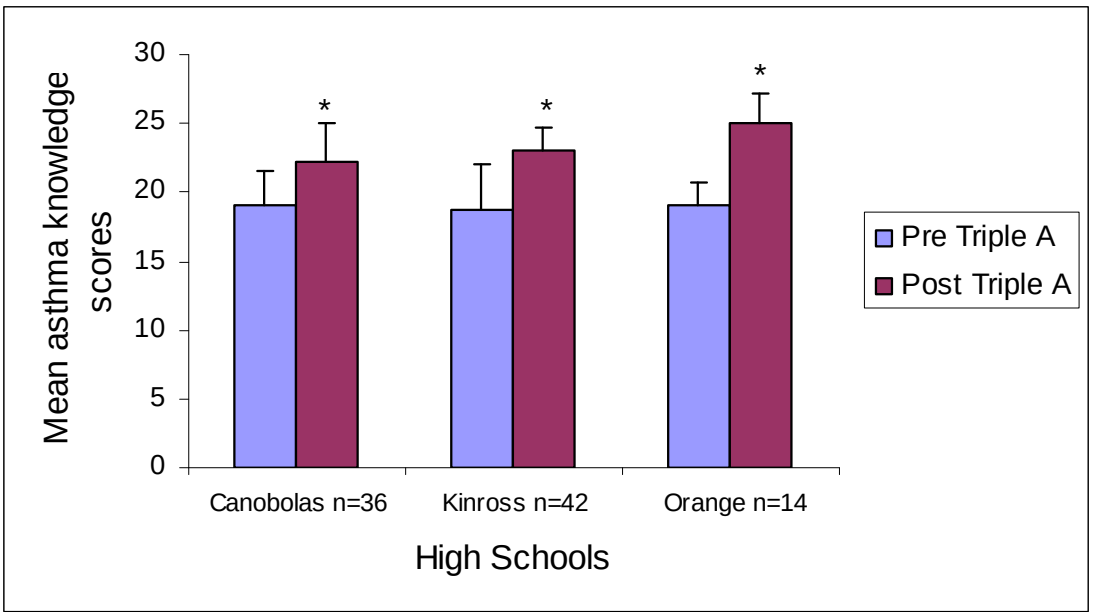
Seven community pharmacists completed the validated asthma knowledge questionnaire before and immediately after the training. There was no significant difference in pharmacists' mean asthma knowledge scores pre- and post-Triple A training [24.7 ± 4.0 vs 27.4 ± 1.5 (mean ± SD), n=7, $p>0.05$].

2.5.1.2. Evaluation of Triple A delivery

There was a statistically significant increase in the mean asthma knowledge scores of Year 11 students in each high school after delivery of the Triple A program [19.0 ± 2.6 vs. 22.2 ± 2.9 (mean ± SD), n= 36, p< 0.001], [18.7 ± 3.3 vs. 23.0 ± 1.7 (mean + SD), n= 42, p< 0.001], [19.1 ± 1.7 vs. 25.1 ± 2.1 (mean ± SD), n= 14, p< 0.001] (Figure 2.4).

From the multivariate analysis, although there was a significant increase in mean asthma knowledge scores over time (F=101.09, df=1, p<0.001), there was no differences between high schools (F=2.79, df=2,p>0.05).

Figure 2.4. Mean asthma knowledge scores of Year 11 students in each high school pre and post Triple A training



* Significant increase in mean asthma knowledge scores over time within each high school (p< 0.001). Multivariate analysis was used.

2.5.1.2.1. Evaluation of Triple A by Year 11 students and pharmacists

Perceptions and experience of Year 11 students and pharmacists after the delivery of the Triple A program are summarised in Table 2.3.

Table 2.3. Evaluation of the Triple A training by pharmacists and Year 11 students

Important points gained by students	**What pharmacists gained in their delivery**
• The symptoms of asthma • The triggers of asthma • Awareness of what it is like to have asthma • First aid for an asthma attack • How to prevent exercise induced asthma • Asthma can be controlled by regularly using a preventer • Smoking is bad for asthma	• Enjoyment, satisfaction and confidence • Experience in teaching • More knowledge in what adolescents know • Educate or fill in the gaps for those with some knowledge • Working proactively with students and responding to their enthusiasm
What students liked in particular	**What aspects of Triple A worked well**
• First aid for an asthma attack • Interactive sessions were interesting and exciting • The activities, discussions, video and the role plays • Educators (pharmacists) were excellent • Friendly and approachable pharmacists • Easy communication and relaxed approach of educators • A great experience	• Enthusiastic group participation • Attentive students • Interactive sessions, games, quiz, role-plays • Organising time aspects and being prepared • Having a “buddy” for back up • Video was extremely well received

2.5.1.2.2. Evaluation of Triple A by high school staff

Staff attending the sessions in which pharmacists implemented step one of the Triple A program, reported that they felt the students had enjoyed the experience and seemed keen to disseminate the information as asthma peer leaders. Staff indicated surprise at the attentiveness of students, and also the relaxed and friendly atmosphere created by the pharmacists.

2.5.2. Evaluation of community based health promotion

2.5.2.1. Evaluation of workshop by pharmacists

Ten pharmacists were invited to attend the second full-day training session after being given a pre-course study manual three weeks prior to the workshop. Eight pharmacists (6 female, 2 male) attended the interactive workshop. Pharmacist evaluation of the workshop and resources are summarised in Table 2.4.

Table 2.4. Pharmacist evaluation of the workshop and resources

Learning Outcomes	**Proportion (%) of pharmacists rating training format as being either very helpful/relevant or helpful/ relevant**		
	Training formats		
	Pre course manual	**Lecture**	**Interactive workshop**
Psychosocial/behavioural factors	66.7%	87.5%	87.5%
Communication skills	44.4%	77.8%	100%
Demonstration of skills	44.4%	55.6%	100%
Additional knowledge	77.8%	88.9%	88.9%

Pharmacists' feedback from the survey administered at the end of the full-day training is summarised in Table 2.5.

Table 2.5. Pharmacist evaluation of the training workshop

Item	Comments
Factors that enhanced learning	Group discussions and participation Role-plays, case studies Feedback from other pharmacists Active participation Better understanding of the factors which influence patient behaviour
Barriers to learning	Preconceived notions Too much information to read
What would improve skills acquisition	Attending a workshop such as this Practice, more role-playing
What would improve application to workplace	Placebo inhalers and devices Video Information leaflets
What would improve knowledge acquisition	Newsletters from institutions to update Workshops and training sessions
Other comments	Workshop run very well - need more of this Enjoyed this session and learnt a lot on asthma

2.5.2.2. Evaluation of public forum

Approximately 55 adults attended the public forum held at the Orange Civic Centre on Wednesday evening the 30th April 2003 and 41 exit surveys were collected (75%). In addition, 20 students from the participating high schools presented their dance and drama performances about asthma in the second part of the program. Eighty-two percent of the attendees agreed that they had learnt something new about asthma and 66% of the attendees were in the 40-60 year age group. Results from the 41 exit feedback surveys collected at the end of the evening are summarised in Table 2.6 and Table 2.7.

Table 2.6. Rating of public forum activities by attendees

Item	% of attendees			
	Interesting	**Informative**	**Helpful**	**Enjoyable**
Talks	88%	87%	90%	
Panel discussions	85%	54%	90%	
Student performances	84%	71%	71%	87%

Table 2.7. Perceptions of the public forum by attendees

Impressions of the program	Most useful and enjoyable aspect	What would they have changed
• Very well presented • Wide range of perspectives • Well organised, planned • Excellent overview • Innovative and educational • Very encouraging, very valuable and worthwhile • Professional and not too overwhelming	• Panel talks, discussions and personal experiences • All the information that was presented – the whole program • Questions and answers from audience and expert panel • Student performances • Animated slide show on future treatments for asthma • Community participation	• No changes • More time • More attendees

2.5.3. Impact of health promotion activities

2.5.3.1. Semi-structured interviews

The key points that emerged from the semi-structured interviews with pharmacists regarding asthma services at baseline are listed below.

- Most respondents felt that they supplied a reasonable number of asthma medications during a normal working day (range from 10-20 asthma prescriptions per day), the supply of prescription medication was greater than over-the-counter asthma medication and the ratio was about 4 to 1 (This was verified by examining the dispensary asthma medication records from the pharmacies).

- Most pharmacists indicated that they see all ages but mostly those in the upper age group (the elderly) and most of the patients were regulars.

- The majority of pharmacists regarded the asthma card as a counselling aid, which allowed them to see how much reliever medication the customer had been using or to verbally refer the patient to a doctor without having to resort to asking too many questions.

- With respect to prescription medication, the majority of pharmacists dispensed repeats without initiating any conversation and without going through the customer's inhaler technique. With regular customers who came in for an asthma medication for the first time, the counselling by pharmacists tended to be mainly medication related, focusing on how to use the medication and how it worked. The counselling was not targeted and there seemed to be no protocols in place. The pharmacists tended to rely on the use of printed material such as CMI.
  "If it's a new script we will always demonstrate the device, so we do that routinely. If they haven't been here before we ask them if they want to do it."
  "We do not go through their technique all the time with the regulars."
  "Any new script I would probably give them something printed. I'd try and tell them what this one is for, what treatment this is…….. I would run through three or four things that I want to get across because you can give too much I suppose."

- The majority of pharmacists did not ask if regular customers have an asthma action plan.
  "Well I don't ask them if they have any asthma action plan….that is interesting because I should ask that."

- The majority of pharmacists claimed to have a good rapport with the GPs but a formal referral process seemed to be lacking. The majority of the pharmacists did not know what GPs are telling asthma patients and which GPs are participating in the 3+Plan. They do not call the GP if it is a dose-related problem or a drug interaction and there seems to be no feedback mechanisms and a lack of coordination between pharmacists and GPs.

- The majority of pharmacists felt that they had good rapport with their customers and felt that most of the elderly are not well informed about asthma issues. Pharmacists seemed to have an inability to engage the patient and provide the

information that is needed. Pharmacists felt that patient education particularly for seniors and staff in nursing homes on medication usage and inhaler technique was an area that needs to be addressed.

"The elderly are not very well informed at all. They generally, if they have a problem and have been to their doctor about it and the doctor has given them some medication and that is the end of that, they accept that as gospel. And unless you initiate something with them, they are not going to talk about it, and it is generally pharmacists initiated conversation that occurs. In the younger generation they are much more willing to ask questions and to listen, because the younger generation is much more consumer aware, they tend not to take everything on face value."

It was found that despite a reasonable level of exposure to education, most pharmacists did not initiate discussion or review inhaler technique with their asthma patients, who were generally regular customers and mostly elderly.

2.5.3.2. Triangulation of data at baseline

Data collected from the semi-structured interviews, the baseline pharmacy data collection form and pharmacy dispensary were in agreement on the number of asthma medications supplied.

2.5.3.3. Quantitative data from pharmacies

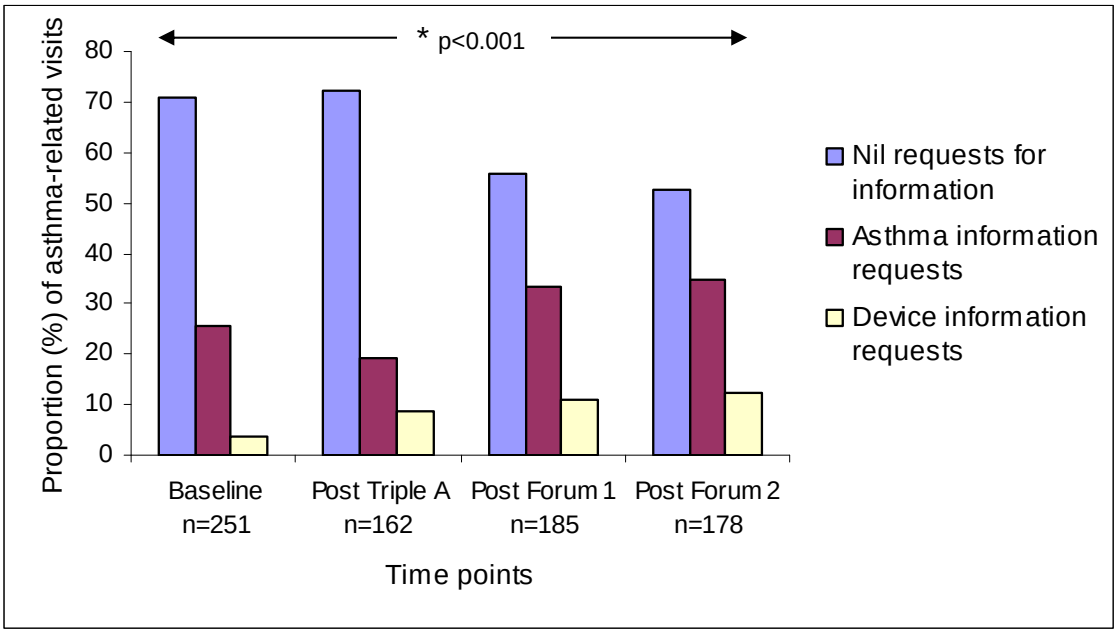
Data compared at the four different time points coinciding with baseline, one week after delivery of the Triple A and two consecutive weeks after the public forum are shown below in Table 2.8.

Table 2.8. Asthma-related activity at baseline and post health promotion activities

Item	**Proportion (%) of asthma-related pharmacy visits**			
	Time points of data collection			
	Baseline Week 1 n =251	**Post Triple A Week 1 n =162**	**Post Public Forum Week 1 n =185**	**Post Public Forum Week 2 n =178**
New patient	15.9	28.4	28.1	29.8
Age group: Under 18 yrs	11.2	17.3	14.6	12.4
Age group: 18-35 yrs	19.9	28.4	27.0	33.1
Prescription reason for visit	76.1	70.9	75.1	73.6
No information requested	70.8	72.2	55.7	52.8
Information on medicine and disease	25.6	19.1	33.5	34.8
Information on devices	3.6	8.6	10.8	12.4
Referrals to GP	6.8	11.1	9.2	10.7

There was no significant difference in the circumstances for the visit in which information was requested (chi-squared test for trend = 1.09; df=1; p=0.31) or in the number of referrals to the GP (chi-squared test for trend = 1.52; df=1; p=0.22). However, there was a significant increase in the proportion of asthma-related pharmacy visits involving requests for information on asthma (chi-squared test for trend = 23.62; df=1; $p<0.001$) and on asthma devices (chi-squared test for trend = 23.62; df=1; $p<0.001$) at the four different time points (Figure 2.5).

Figure 2.5. Asthma-related pharmacy visits at four different time points



* Significant increase in the proportion of asthma-related pharmacy visits requesting information on asthma ($p<0.001$) and asthma devices ($p<0.001$) from baseline to post forum 2 (Time point 4). Chi-squared tests for trend used.

2.6. DISCUSSION

The results of this study demonstrated that it is feasible for rural community pharmacists to become involved in proactive health promotion. Community pharmacists can be effective in providing outreach programs, shown by the increase in asthma knowledge of the Year 11 students and a significant increase in the proportion of asthma-related pharmacy visits involving requests for information on asthma and asthma devices.

Outreach health promotion activities in rural areas have the potential to benefit the health status of the community given the limited access to health care services, the shortages of health care providers, and the presence of greater personal health risk factors of rural and remote communities in Australia (AIHW ACAM 2005, AIHW 2006). Asthma outreach programs were selected for the rural community of Orange, NSW based on a needs analysis (Blundell 2000), which clearly indicated that asthma management practices in the mid-western area of NSW were suboptimal, and that there was a need to increase community based services for asthma in the town of Orange.

In Australia, community pharmacists have not generally been involved in community health promotion, or outreach programs. In other countries around the world, such roles have been tested with reasonable success. In the UK, Canada and USA, pharmacists have been effectively involved in a range of community pharmacy-based health promotion, screening and prevention activities such as mental health, dental health, smoking cessation, diet and exercise, cardiovascular risk factors, osteoporosis, skin diseases, emergency contraception and HIV (Anderson 2000, Elliott *et al* 2002, Cote *et al* 2003, Watson *et al* 2003, Boyle *et al* 2004, Goode *et al* 2004, Paluck *et al* 2004). In Europe, health promotion by pharmacists has been limited and linked to the wider concept of pharmaceutical care. In rural Australia, community pharmacists have played an active and effective role in health promotion and screening programs, however, this resource is currently underutilised (Hourihan *et al* 2003, Sunderland *et al* 2006). In the USA, outreach nurses have generally been involved in the delivery of asthma outreach programs that have led to improved patient asthma outcomes (Kelly *et al* 2000, Legorreta *et al* 2000, Lin *et al* 2004). In Australia, this is the first time that such an innovative role has been played by community pharmacists. In this respect, the pharmacists in Orange have been pioneers in demonstrating the feasibility of this role in a rural community setting.

In Australia, the profession of pharmacy is in a process of change (Benrimoj and Roberts 2005). The profession has recognised the need to diversify from product supply and to add value through the provision of professional services. These services should be based on public need and on creating supportive environments for health in the community. Asthma is a significant health problem in Australia (Comino and Henry 2001, Woolcock *et al* 2001) and many studies have demonstrated that care of asthma patients is less than ideal (Marks *et al* 2000, Matheson *et al* 2002, Sawyer and Fardy 2003) and that the provision of asthma care by pharmacists is less than optimal (Gibson 2000). Thus, the time is right for provision of additional health services by pharmacists in collaboration with other members of the health care team.

The Triple A program was chosen as the method to promote asthma awareness in a school community and to create a supportive school environment for adolescents with asthma due to its successful long-term outcomes, established in both rural and metropolitan schools in Australia (Gibson *et al* 1998b, Shah *et al* 2000, Shah *et al* 2001). The Triple A program is one of two options which Asthma NSW provides to high schools in NSW (Australia) as part of the Asthma Friendly Schools Program and it differs in being a peer-led, non didactic asthma education program. The alternative

option is called “Living with Asthma” and is a “kit” supplied by Asthma NSW but run by each individual school. Those schools which did not choose to participate in this study and the Triple A program were already part of the Asthma Friendly Schools Program but had chosen the “Living with Asthma” option due to school timetabling issues.

Adolescents are considered to be a special group in terms of health care needs (Gibson *et al* 1995, Forero *et al* 1996, Price 1996, Brook and Tepper 1997, Buston and Wood 2000, Kyngäs *et al* 2000). Many health-related behavioural patterns formed in adolescence continue into adulthood (van Es *et al* 2002). During adolescence, peer group influence has often been shown to be a more effective tool for influencing health behaviour as compared to conventional education, especially in relation to high risk, controversial issues such as reduction of high-risk behaviour among drug abusers (Madray and van Hulst 2000). The Triple A program uses the concept of peer influence in devising a program of asthma education and empowerment that can be relayed from a small group of peer leaders through a school community using peer group influence factors. The program gives control to young people with asthma rather than asthma controlling their lives (Shah and Cantwell 2000).

Adolescents received an evidence-based peer-led asthma education program that made them aware of asthma related issues, created asthma peer leaders to spread asthma awareness, and spread interest in the immediate school community and the wider community. Pharmacists required minimal training to enable them to train this cohort. This method is time/cost effective with the proven effectiveness of the Triple A program (Shah *et al* 2001). Pharmacists, who trained these adolescents, achieved professional satisfaction. The community developed an awareness of the role played by community pharmacists in health promotion outside the confines of the pharmacy. This awareness raises the professional profile of the community pharmacist.

In this study, the Triple A Program was a success not only in terms of showing a significant increase in the asthma knowledge scores of the Year 11 students but also through the interest and enthusiasm developed during the program. These results are consistent with previous projects that were led by volunteer Triple A Educators instead of pharmacists (Gibson *et al* 1998b, Shah *et al* 2000, Shah *et al* 2001). The students evaluated the program highly and were enthusiastic in their development of the performances for the public forum. Students also had very positive comments

about the role of the pharmacist and used terms such as 'friendly and approachable' to describe their interaction with the community pharmacists. It was interesting to note that pharmacists also felt at ease in this new setting. Pharmacists in the buddy teams consisted of diverse age groups and different genders. Students' comments about the approachability of all pharmacists, regardless of age, were felt to be a very positive outcome. It can be expected that these students, when they move on as adults within the community, will keep this impression and will utilise the community pharmacy and the pharmacists as a source of reliable health information.

Community pharmacies are a strategic venue for the provision of asthma health promotion and education programs. They are an ideal community-based setting in which to educate, inform and advise people with a chronic disease such as asthma who are taking continuing responsibility for their own treatment and self-management. Community pharmacists have the capacity to contribute to the overall management of asthma due to their therapeutic expertise, their regular contact with patients and their accessibility. They have been shown to have a positive impact on patient asthma outcomes and potentially reduce health care utilisation through more intensive individualised pharmacy-based asthma services in Australia and in Europe (Narhi *et al* 2000, Haahtela *et al* 2001, Saini *et al* 2004). Their involvement in proactive health promotion outside the confines of the pharmacy provides pharmacists with an opportunity and a new strategy to raise awareness of health issues and influence health behaviour, particularly in areas which have a limited number of and access to health care services (Anderson 2000, Sunderland *et al* 2006).

The pharmacists in Orange demonstrated an overwhelming enthusiasm for their role in health promotion. All those who attended the two training programs, the first for training to be Triple A Educators, and the second for facilitating self-management in patients, improved their knowledge and confidence. The training enabled them to overcome their personal barriers, lack of confidence and resistance to a new concept, and truly stepped into unknown territory. In fact, most of these pharmacists have continued with the asthma services and are now providing a comprehensive disease state management service in their community. Their change in practice behaviour is perhaps reflected in the results, in that there was an increase in the number of patients to whom they provided asthma and asthma medication/device information after the first and second health promotion activities. This may, of course be a dual effect, in that patients may have sought more information through enhanced

awareness, and also the pharmacist may have become more proactive in delivering counselling and providing information; both events are likely to have influenced the results. Whether the delivery of two asthma outreach health promotion programs is causally related to this increase in the number of requests for information on asthma and asthma devices cannot be proven in such a study. This would require a controlled study with a larger sample size.

An important feature that emerged from our study is the requirement for collaboration. With the support of Asthma NSW and their collaboration with the research team, it was possible to approach high schools. This collaboration also indicated to high schools that there was a committed concerted effort to increase asthma awareness and improve asthma management practices. The collaboration and encouragement offered by various health professionals, members of the steering committee and local support of the Asthma Advisory Group, at each stage of this study, worked well. Community involvement and ownership are crucial in achieving success in health promotion programs.

The health care community, represented through various professionals at the forum, sent a consistent message to the community. Comments made by the attendees on the exit survey form indicated that the attendees were impressed by the notion that so many professionals were committed to the care of asthma and had more or less the same message to pass on to the community. Maybe other community health education programs could use more multi-professional teams, and the message spread in unison may be more powerful than that spread in isolation. The researchers to date are unaware of any community health education programs that have utilised such multi-professional teams.

The purpose for the public forum was to promote asthma awareness in collaboration with other health care professionals and, more importantly, to provide a platform for community pharmacists to promote the new individualised service they would later provide in the second research phase. Despite the well-planned and extensive promotion of the public forum, the attendance was low. This was not surprising, as generally people with asthma are known to have poor attendance rates at group asthma information or education events (Yoon *et al* 1991, Abdulwadud *et al* 1997, Muntner *et al* 2001). Furthermore, the asthma outreach program designed for the wider community was not targeting any specific group(s). Those who did attend were

very vocal and had specific issues that they wanted to discuss. It may be argued that their needs were addressed successfully.

There were several limitations to this feasibility study including the lack of controls, non-randomisation, small sample size and short follow-up, all of which affect the causality and the ability to generalise the results. However, this study will form the basis for future work in demonstrating the effectiveness and sustainability of this model using a controlled design preferably in a randomised setting.

2.6.1. Future directions

In rural Australia, such interactions with community pharmacists hold great potential. The chronic shortage of medical practitioners results in extremely long waiting times, and often patients fail to approach health care practitioners due to the difficulty of access (National Rural Health Alliance 2002, AIHW 2006). Heightened awareness of the pharmacist and the role they play in health care does not go unnoticed and may help in alleviating this. Primary care initiatives should include pharmacists, as has been the case during a successful ten year National Asthma Program in Finland (Haahtela *et al* 2007). This particular model using pharmacists as Triple A Educators to train adolescents, followed by community awareness for asthma through public events can be used as a tool for building sustainable health awareness in a community. This successful project should not be limited to one community or one disease but used as a model for other chronic common conditions such as diabetes, obesity, AIDS awareness, and hypertension and cholesterol management.

2.7. CONCLUSIONS

The study provided a unique opportunity for community pharmacists to increase asthma awareness in a rural setting. The study demonstrated that it is feasible for rural community pharmacists to become involved in proactive health promotion and effectively provide asthma outreach programs. These programs can result in an increase in asthma knowledge and asthma-related information requests within the pharmacy. This model appears to be sustainable as not only will the trained and asthma aware students go on to be responsible carers of their own asthma and the asthma of others, but also the pharmacists, who are now Triple A Educators are

qualified to train future cohorts of high school students. It is recommended this feasibility study form the basis for future work in demonstrating the effectiveness and sustainability of this model using a controlled design preferably in a randomised setting.

Chapter 3

The development and evaluation of two asthma knowledge questionnaires

3.1. INTRODUCTION

Patient education is one of the six critical elements to successful long-term asthma management included in international and national asthma management guidelines, which have emphasised education as a process underpinning the understanding associated with appropriate medication use, the need for regular review, and self-management on the part of the person with asthma (Boulet *et al* 1999, National Asthma Council 2002, National Asthma Education and Prevention Program 2002, British Thoracic Society 2003, NHLBI/WHO 2005). The ongoing process of asthma education is considered necessary for helping people with asthma gain the knowledge, skills, confidence and motivation to control their own asthma. Since most health care professionals are key providers of asthma education, their knowledge of asthma and asthma management practices often needs to be updated through continuing education. This is to ensure that the education provided to the patient conforms to best practice guidelines. Moreover, health care professionals need to tailor this education to the patients' needs and determine if the education provided results in an improvement in asthma knowledge.

A review of the literature has revealed that a number of questionnaires have been developed that assess the asthma knowledge of parents of children with asthma (Parcel *et al* 1980, Fitzclarence and Henry 1990, Brook *et al* 1993, Moosa and Henley 1997, Ho *et al* 2003), adults with asthma (Wigal *et al* 1993, Allen and Jones 1998, Allen *et al* 2000, Bertolotti *et al* 2001), children with asthma (Parcel *et al* 1980, Wade *et al* 1997), or the general public (Grant *et al* 1999). However, the existing asthma knowledge questionnaires have several limitations. The only validated asthma knowledge questionnaire was developed in 1990 and hence, out of date with current asthma management guidelines (Fitzclarence and Henry 1990). The shortcomings of the other knowledge questionnaires relate to the lack of evidence of the validity (Wade *et al* 1997, Grant *et al* 1999, Bertolotti *et al* 2001), being outdated

with current concepts of asthma (Parcel *et al* 1980) or having been tested on small or inadequately characterised subject samples e.g. subject samples consisting of mainly middle class and well educated parents (Brook *et al* 1993, Wigal *et al* 1993, Moosa and Henley 1997, Allen and Jones 1998, Allen *et al* 2000, Ho *et al* 2003).

Furthermore, most of the published asthma knowledge questionnaires have been designed to assess the asthma knowledge of the consumer (i.e. a lay person with asthma or a parent/carer of a person with asthma). There is no questionnaire specifically developed to assess the asthma knowledge of health care professionals, who are key providers of asthma education. It is hence important to have a reliable and validated instrument to be able to assess education needs and to measure the impact of training programs on asthma knowledge of health care professionals as well. An asthma knowledge questionnaire for health care professionals might also be used to gauge how successful dissemination and implementation of guidelines have been.

In light of these findings, the aim of this research was to develop and validate two asthma knowledge questionnaires, one for consumers (CQ) and one for health care professionals (HQ).

3.2. OBJECTIVES

The specific objectives for the study were:

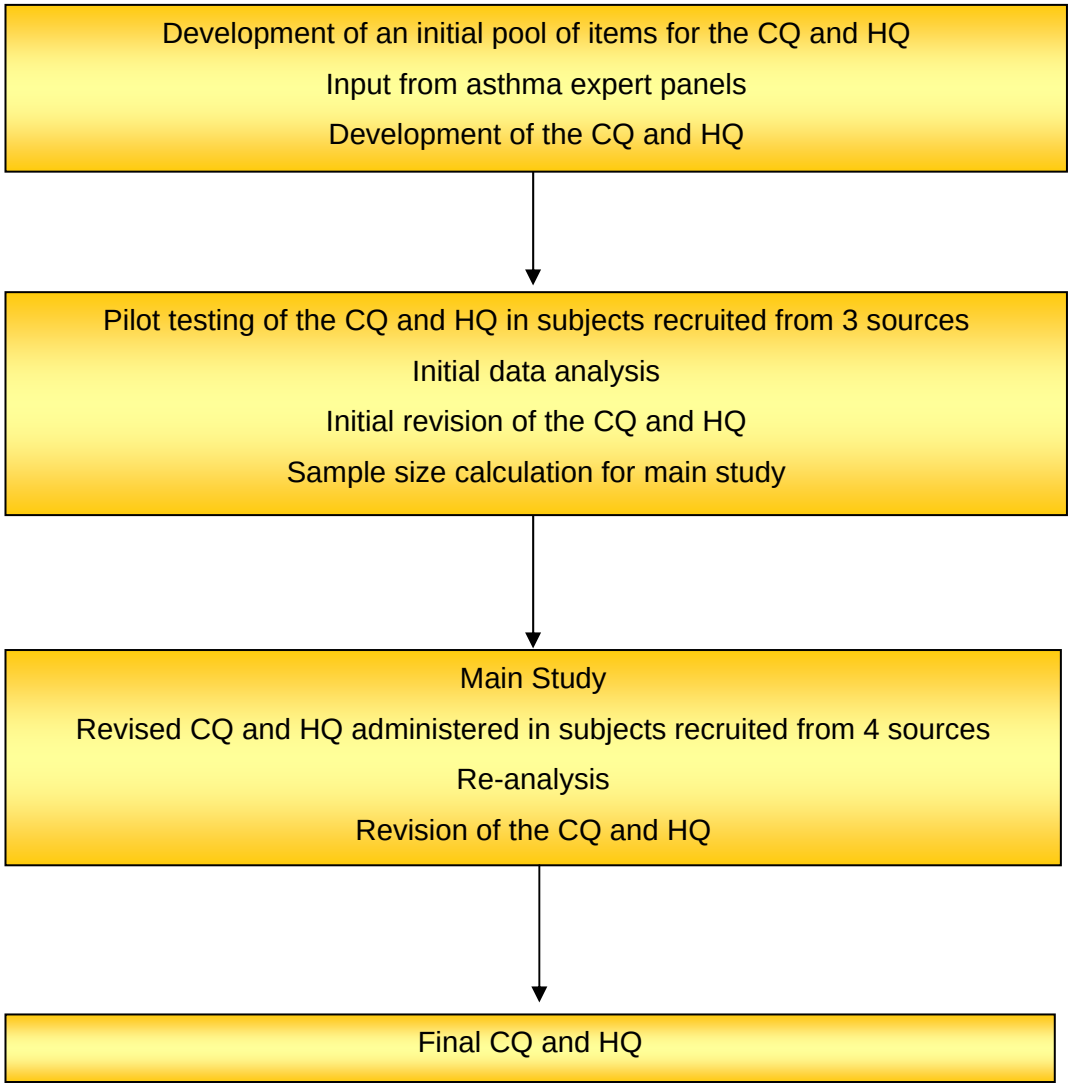
1. To develop a simple self-administered asthma knowledge questionnaire for assessing the asthma knowledge of consumers (CQ) based on current national asthma management guidelines.
2. To develop a simple self-administered asthma knowledge questionnaire for assessing the asthma knowledge of health care professionals (HQ) based on current national asthma management guidelines.
3. To pilot test both questionnaires assessing their validity and reliability by administering to subjects recruited from three sources (fourth year pharmacy students, and people with and without asthma).

4. To validate both questionnaires by administering to subjects recruited from four sources (respiratory physicians, pharmacists, and people with and without asthma).

3.3. METHODS

The overall study design is outlined in Figure 3.1.

Figure 3.1. Study design



3.3.1. Development of the questionnaires

Most of the items from the CQ were developed from the National Asthma Council (NAC) Asthma Management Handbook (National Asthma Council 2002). Some items of the CQ were modified and adapted from previously published questionnaires (Fitzclarence and Henry 1990, Allen and Jones 1998). All of the items of the HQ were developed from the NAC Asthma Management Handbook (National Asthma Council 2002). The initial pool of items was assembled, with items being discarded or replaced based on the input from asthma expert panels (including asthma experts from the Faculty of Pharmacy, University of Sydney). Efforts were made to reflect the latest practice of asthma management. The newly developed CQ consisted of 23 items and the HQ consisted of 41 items and can be seen in Appendix 18 and 19 respectively.

3.3.2. Reliability and validity

Reliability and validity are two important qualities that help establish the credibility of findings measured by an instrument (Neuman 2003). Reliability refers to the consistency or dependability of an instrument. It is a measure of the extent to which the results of a particular test, question or instrument are consistent over time and it is affected by random error (De Vellis 1991, Neuman 2003).

Two different ways of establishing the reliability of a particular instrument include:

- Stability (or test-retest reliability): refers to reliability over time, and is usually examined using the test-retest method where the instrument is retested on the same group of people at two different times (1-2 weeks apart) to see if the same results are obtained (Bryman 2004).
- Internal consistency: applies to consistency across different items that are used to measure the same construct or latent variable. Cronbach's alpha is a commonly used test for measuring the internal consistency of an instrument and is a statistic that reflects the homogeneity of the scale. A Cronbach's alpha of 0.70 or greater is considered satisfactory (Jackson and Furnham 2000).

On the other hand, validity refers to the 'truthfulness' of an instrument. It is a measure of the extent to which an instrument measures what it purports to measure and is affected by non-random error (De Vellis 1991).

There are four types of validity:

- Face validity: concerned with whether the instrument appears to be measuring what it says it does. In other words do the items make sense, appear to be relevant, reasonable and clear (Bowling 2000).
- Content validity: concerned with the extent to which a measure is representative of the content (Bowling 2000). It is usually achieved following an evaluation and judgement of the instrument by experts in the field (Nunnally 1978, Jackson and Furnham 2000).
- Criteria-related validity: relates the test scores obtained with some external variable(s) or criteria. It is usually established by comparing the instrument to another instrument which is accepted as the gold standard, and is only possible if a 'gold standard' instrument exists (Bowling 2000).
- Construct validity: refers to the extent to which the instrument tests the hypothesis or theory it is measuring (Bowling 2000). There are two parts to construct validity: convergent validity (item to correlate to related variables) and discriminant validity (item not to correlate with unrelated variables) (Bowling 2000).

3.3.3. Pilot testing of the questionnaires

Both newly developed questionnaires were pilot tested to ensure readability, content and face validity, and to establish how well items within each questionnaire correlated with each other in measuring the underlying construct they were intended to measure. The number of items in the CQ and HQ were reduced based on the contribution of each item to the overall reliability of the scales. Findings from the pilot study (by comparing the mean asthma knowledge scores between the three groups with different levels of knowledge) would also determine the sample size required for the main study. Response categories of both questionnaires were "true" or "false". Subjects were asked not to respond if they were not sure, or if they did not know whether the statement was true or false. One mark was allocated to each correct answer and zero for each incorrect answer or each question that was left unanswered.

3.3.3.1. Study subjects for the pilot study

Subjects were recruited from three sources in the Sydney metropolitan area. Fourth year pharmacy students enrolled in Pharmacotherapeutics at the Faculty of Pharmacy, University of Sydney were randomly selected to participate in this study.

People with asthma were recruited through the New South Wales Asthma Foundation who provided a list of people with asthma who attended their focus groups. These people were contacted and asked if they would like to participate in the study. People without asthma were recruited from a random selection of people around the University of Sydney Camperdown campus. The inclusion criteria included being 18 years of age or older and able to read English. All subjects were asked to answer both sets of questionnaires (the CQ and HQ). All the participants in the study signed an informed consent form that had been approved by the Human Research Ethics Committee of the University of Sydney (Appendix 20).

3.3.4. Main study

The revised CQ and HQ were then further validated by administering to respiratory physicians, pharmacists, and people with and without asthma. All subjects completed both sets of questionnaires unaided.

3.3.4.1. Study subjects for the main study

Subjects were recruited from four sources. Respiratory physicians were recruited through the Thoracic Society of Australia and New Zealand (TSANZ). All registered respiratory physicians in Australia were sent both questionnaires in a reply paid envelope by the TSANZ staff. Pharmacists were recruited through the Pharmaceutical Society of Australia (PSA). Pharmacists attending evening continuing education seminars organised by the PSA, which were not asthma-related, were approached to participate in the study. People with and without asthma were recruited through community pharmacies, which were randomly selected from the Sydney metropolitan area. The inclusion criteria included: being 18 years of age or older and able to read English. All the participants in the study signed an informed consent that had been approved by the Human Research Ethics Committee of the University of Sydney (Appendix 21).

3.4. DATA ANALYSIS

All data analyses were performed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 11.00). The level of significance was set at 0.05 for all analyses.

3.4.1. Content and face validity

Face validity of the CQ and HQ was assessed by an asthma expert panel. The contents of the CQ and HQ were examined at the level of the entire instrument and at that of individual items by the asthma expert panel. The asthma experts were asked to rate the clarity, concreteness, centrality and importance of each item. Rephrasing, deleting or supplying new items into the CQ and HQ were then suggested. Comments from these experts were obtained in an effort to minimise ambiguity and potential misinterpretation of questions (De Vellis 1991).

3.4.1.1. Readability of the instruments

The Flesch-Kincaid Grade Level score was used to estimate the readability of both questionnaires. For most documents, a score of approximately 7.0 to 8.0 is considered adequate [i.e. a 7th (12 years of age) or an 8th grader (13 years of age) can understand the document] (http://office.microsoft.com/en-au).

3.4.2. Construct validity

Factor analysis was used to investigate the construct validity of the CQ and HQ. The results of factor analysis indicated whether it was appropriate to sum all the items of the measure as one scale or treat factors identified in the analysis as individual subscales. Finding a large first factor that explains a majority of the variance in the set of items is support for the presence of one dimension (De Vellis 1991, Pett *et al* 2003). The factor structures of the CQ and HQ were examined by principal components analysis with direct oblimin rotation. The Kaiser Criterion (eigenvalues > 1), number of steps in the scree plot and the proportion of the total variance explained were the criteria implemented for the number of factors to be extracted. Items that had poor factor loadings (<0.30) or cross-loaded on two or more factors were removed (Pett *et al* 2003).

3.4.3. Criteria-related validity

The CQ was tested on health care professionals and the HQ was tested on consumers to provide an assessment of criteria-related validity (De Vellis 1991). The ability of the CQ and HQ to discriminate between groups with different levels of knowledge was assessed by comparing the four groups with varying expertise. An analysis of variance (ANOVA) was used on the CQ and HQ to compare the mean asthma knowledge scores between respiratory physicians, pharmacists, people with asthma and people without asthma. Scheffe's post hoc comparisons were conducted for significant effects. We considered as significant a P value <0.05.

3.4.3.1. Discriminant analysis

Discriminant analysis was conducted on the CQ and HQ so as to assess the instruments' ability to discriminate between high-versus-low scorers. All items for each of the CQ and HQ were entered into the model simultaneously (Hair *et al* 1998).

3.4.4. Reliability

3.4.4.1. Internal consistency

The internal consistency of both questionnaires was assessed using Cronbach's alpha coefficient. This reliability estimate is concerned with the homogeneity of items within a scale and it measures the degree to which a set of items assesses a single one-dimensional construct (Carmines and Zeller 1979). Coefficient alpha corresponds to the proportion of variance in a scale that is attributable to the true score of the latent variable or construct. Items were excluded that were answered correctly by all subjects or if they did not contribute to the overall reliability of the scale. Internal consistency estimates of modest magnitude are < 0.70 but > 0.70 were sought (Nunnally 1978, Jackson and Furnham 2000).

3.5. RESULTS

3.5.1. Pilot study

129 participants (51 people without asthma, 20 people with asthma and 58 fourth year pharmacy students) were used to develop and pilot test the questionnaires. Following pilot testing the number of items in the CQ and the HQ were reduced

(based on the contribution of each item to the overall reliability of the scales) to 14 items and 20 items respectively. The reliability analysis of the 14-item CQ returned a Cronbach's alpha coefficient of 0.85 and 0.89 for the 20-item HQ. The revised 14-item CQ and 20-item HQ can be seen in Appendix 22 and 23 respectively.

For the CQ, the comparison of the three groups with different levels of knowledge showed that there were significant differences in the mean asthma knowledge scores between fourth year pharmacy students versus people with asthma versus people without asthma ($p<0.001$). There was no significant difference between people with and without asthma ($p=0.07$) (Table 3.1).

Table 3.1. Comparison of mean total score obtained on the CQ for people without asthma, people with asthma and fourth year pharmacy students. Maximum possible score is 14 (n = 129)

	People without asthma n = 51	**People with asthma n = 20**	**Fourth year pharmacy students n = 58**
Mean	7.57	9.05	12.90
SD	2.96	3.53	1.05

For the HQ, the comparison of the three groups with different levels of knowledge showed that there were significant differences in the mean asthma knowledge scores between fourth year pharmacy students versus people with asthma versus people without asthma ($p<0.001$). There was no significant difference between people with and without asthma ($p=0.20$) (Table 3.2).

Table 3.2. Comparison of mean total score obtained on the HQ for people without asthma, people with asthma and fourth year pharmacy students. Maximum possible score is 20 (n = 129)

	People without asthma n = 51	**People with asthma n = 20**	**Fourth year pharmacy students n = 58**
Mean	7.84	10.60	16.00
SD	3.90	4.88	2.86

3.5.1.1. Sample size

Based on the CQ scores for people with asthma (mean asthma knowledge score = 9.05) and without asthma (mean asthma knowledge score = 7.57) in the pilot study,

the sample size calculation determined that 90 subjects per group were required to detect a difference in the mean asthma knowledge scores of 1.5 and standard deviation of 3.5 with 80% power using a two-tailed 5% significance level.

3.5.2. Main study

Following revision, a further 505 subjects completed both questionnaires: 174 respiratory physicians responded from 408 that were approached (43%), 121 pharmacists responded from 150 that were approached (81%), 110 people with asthma responded from 130 that were approached (85%), and 100 people without asthma responded from 130 that were approached (77%).

3.5.2.1. Validity

3.5.2.1.1. Content and face validity

Reports from asthma experts on the content and coverage of the questionnaires showed content and face validity to be high, in that the CQ and HQ covered all relevant concepts of the asthma knowledge consistent with current asthma management guidelines. The 14 items of the CQ tested the content area of asthma medications and asthma management. The 20 items of the HQ mainly assessed the important and relevant content area of asthma causes, triggers, pathophysiology, and management. The CQ and HQ had a Flesch-Kincaid Grade Level score of 8.1 and 12.0 respectively.

3.5.2.1.2. Construct validity

Following factor analysis, two items from the CQ [Item 3 (Factor Loading of 0.252)] and Item 4 (Factor Loading of 0.223)] were removed due to the poor factor loading and two items from the HQ [Item 7 (Factor Loadings of 0.397 and 0.579) and Item 18 (Factor Loadings of 0.340 and 0.571)] were removed due to cross loading on two factors. The 12-item CQ and 18-item HQ are presented in Appendix 24 and 25 respectively.

For the 12-item CQ, factor analysis extracted two primary factors with eigenvalues greater than unity accounting for 42% of the total variance as shown in Table 3.3. The factor solution was interpretable as most items loaded as predicted. The first factor accounted for 31% of the variance explained by the factor solution. The eight items that loaded on the first factor indicated a general factor reflecting consumers' knowledge on asthma management. The eight-item subscale returned an alpha

coefficient of 0.73. The second factor contained four items assessing consumers' knowledge on asthma medication use and accounted for 11% of the variance. The four-item subscale returned an alpha coefficient of 0.67.

Table 3.3. Principal component estimates of the direct oblimin factor loadings for the 12-item CQ (n = 505)

	Factor loading	**Eigenvalues**	**Total variance**
Factor 1 (Asthma Management)		3.69	31%
Item 1	0.400		
Item 2	0.604		
Item 7	0.484		
Item 9	0.434		
Item 10	0.524		
Item 11	0.519		
Item 12	0.621		
Item 14	0.769		
Factor 2 (Asthma Medication)		1.38	11%
Item 5	0.838		
Item 6	0.784		
Item 8	0.453		
Item 13	0.589		

*Only items with factor loadings $\geq$ 0.30 have been retained

For the HQ, principal component analysis yielded a strong general factor with an eigenvalue of 8.0 accounting for 45% of the total variance as shown in Table 3.4. The factor solution for the HQ is strong support that the items measure a single phenomenon and therefore it is appropriate to calculate internal consistency for the questionnaire as a whole.

Table 3.4. Principal component estimates of the direct oblimin factor loadings for the 18-item CQ (n = 505)

	Factor loading	Eigenvalues	Total variance
Factor 1 (General Asthma Management)		8.0	45%
Item 1	0.647		
Item 2	0.655		
Item 3	0.712		
Item 4	0.639		
Item 5	0.543		
Item 6	0.791		
Item 8	0.631		
Item 9	0.582		
Item 10	0.715		
Item 11	0.610		
Item 12	0.793		
Item 13	0.673		
Item 14	0.605		
Item 15	0.564		
Item 16	0.788		
Item 17	0.560		
Item 19	0.635		
Item 20	0.793		

*Only items with factor loadings $\geq$ 0.30 have been retained

3.5.2.1.3. Criteria-related validity

For the CQ, the comparison of the four groups with different levels of knowledge showed that there were significant differences in the mean asthma knowledge scores between pharmacists versus people with asthma versus people without asthma ($p<0.001$). There was no significant difference between pharmacists' and respiratory physicians' mean asthma knowledge scores ($p>0.5$) (Table 3.5). Comparison of responses to individual items by the four groups confirmed predicted differences (Table 3.6).

Table 3.5. Comparison of mean total score obtained on the CQ for people without asthma, people with asthma, pharmacists and respiratory physicians. Maximum possible score is 12 (n = 505)

	People without asthma n = 100	**People with asthma n = 110**	**Pharmacists n = 121**	**Respiratory Physicians n = 174**
Mean	5.90	8.20	10.89	10.87
SD	2.64	1.89	1.28	1.02

Table 3.6. Comparison of responses to individual items of the CQ completed by people without asthma, people with asthma, pharmacists, respiratory physicians. Number (%) of subjects responding correctly

Item	**People without asthma n = 100**	**People with asthma n = 110**	**Pharmacists n = 121**	**Respiratory Physicians n = 174**
1	44 (44%)	72 (66%)	112 (93%)	174 (100%)
2	86 (86%)	102 (93%)	118 (98%)	171 (98%)
5	57 (57%)	82 (75%)	114 (94%)	166 (95%)
6	54 (54%)	87 (79%)	118 (98%)	170 (98%)
7	22 (22%)	41(37%)	103 (85%)	151 (87%)
8	54 (54%)	83 (76%)	115 (95%)	157 (90%)
9	11 (11%)	48 (44%)	81 (67%)	139 (80%)
10	65 (65%)	80 (73%)	120 (99%)	173 (99%)
11	40 (40%)	77 (70%)	112 (93%)	143 (82%)
12	50 (50%)	88 (80%)	110 (91%)	172 (99%)
13	65 (65%)	76 (69%)	100 (83%)	143 (82%)
14	42 (42%)	66 (60%)	115 (95%)	168 (97%)

For the HQ, the comparison of the four groups showed that there were significant differences in mean asthma knowledge scores between the four groups ($p<0.001$)(Table 3.7). Comparison of responses to individual items by the four groups confirmed predicted differences (Table 3.8).

Table 3.7. Comparison of mean total score obtained on the HQ for people without asthma, people with asthma, pharmacists and respiratory physicians. Maximum possible score is 18 (n = 505)

	People without asthma n = 100	**People with asthma n = 110**	**Pharmacists n = 121**	**Respiratory Physicians n = 174**
Mean	4.59	6.90	13.77	16.29
SD	3.28	3.84	2.60	1.51

Table 3.8. Comparison of responses to individual items of the HQ completed by people without asthma, people with asthma, pharmacists, respiratory physicians. Number (%) of subjects responding correctly

Item	**People without asthma n = 100**	**People with asthma n = 110**	**Pharmacists n = 121**	**Respiratory Physicians n = 174**
1	49 (49%)	67 (61%)	115 (95%)	173 (99%)
2	43 (43%)	61 (56%)	120 (99%)	174 (100%)
3	38 (38%)	55 (50%)	115 (95%)	174 (100%)
4	28 (28%)	47 (43%)	102 (84%)	161 (93%)
5	59 (59%)	72 (66%)	109 (90%)	171 (98%)
6	14 (14%)	30 (27%)	99 (82%)	169 (97%)
8	24 (24%)	38 (35%)	64 (53%)	168 (97%)
9	25 (25%)	36 (33%)	69 (57%)	149 (86%)
10	5 (5%)	17 (16%)	87 (72%)	145 (83%)
11	44 (44%)	69 (63%)	110 (91%)	171 (98%)
12	11 (11%)	24 (22%)	84 (69%)	162 (93%)
13	9 (9%)	21 (19%)	55 (46%)	140 (81%)
14	15 (15%)	33 (30%)	81 (67%)	132 (76%)
15	55 (55%)	80 (73%)	116 (96%)	174 (100%)
16	5 (5%)	21 (19%)	89 (74%)	166 (95%)
17	8 (8%)	29 (26%)	72 (60%)	104 (60%)
19	17 (17%)	39 (36%)	95 (79%)	137 (79%)
20	10 (10%)	20 (18%)	84 (69%)	165 (95%)

3.5.2.1.3.1. Discriminant analysis

Discriminant analyses were performed to determine the capacity of both the 12-item CQ and the 18-item HQ to discriminate between high-versus-low scores. The samples were divided into two subgroups based on median asthma knowledge scores for each group: high knowledge (CQ total score ≥10, HQ total score ≥13) and low knowledge (CQ total score ≤ 9, HQ total score ≤ 12). For the CQ, discriminant analysis showed that the instrument correctly predicted the score for 99.3% of the 'high' knowledge group and 87.1% of the 'low' knowledge group (Wilks' Lambda = 0.298, $p<0.001$). For the HQ, discriminant analysis showed that the instrument correctly predicted the score for 99.6% of the 'high' knowledge group and 94.0% of the 'low' knowledge group (Wilks' Lambda = 0.192, $p< 0.001$).

3.5.2.2. Reliability

3.5.2.2.1. Internal consistency

With regards to the reliability analysis, two items from the CQ (Item 3 and 4) and two items from the HQ (Item 7 and 18) were removed as their removal improved the overall reliability of the scale. These items were the same items identified in the factor analysis with poor factor loadings or cross factor loadings. The reliability analysis of the overall 12-item CQ returned a Cronbach's alpha coefficient of 0.78 and 0.92 for the final 18-item HQ.

3.6. DISCUSSION

This study aimed to produce two validated asthma knowledge questionnaires for consumers and health care professionals, which assessed asthma knowledge based on current asthma management guidelines. The findings showed that both newly developed questionnaires demonstrated good reliability and validity for the assessment of asthma knowledge in clinical practice. The questionnaires were simple and quick to administer, thus fulfilling the main practical aim as to their suitable use in primary or secondary care settings.

A systematic approach was used in the development of the two new asthma knowledge questionnaires by drawing on the previous literature, using asthma expert panels and incorporating the latest practice guidelines used internationally and in

Australia. The pilot study conducted by the researchers, which followed questionnaire construction, was designed to ensure readability, content and face validity of the questionnaires. The questionnaires were not designed to reflect the content of any particular asthma education program since such questionnaires are more restrictive in their use (Parcel *et al* 1980, Brook *et al* 1993, Allen and Jones 1998, Allen *et al* 2000). The CQ and the HQ were designed to be of international relevance and to quantify the level of general asthma knowledge of consumers (Bertolotti *et al* 2001, Ho *et al* 2003) and health care professionals in clinical practice or in a research setting.

With regards to the pilot study and the CQ, we found that fourth year pharmacy students had superior asthma knowledge compared to people with or without asthma. Although this was an expected result, surprisingly there was no significant difference in mean total CQ scores between people with and without asthma. Possible explanations for this finding include the small sample size of people with asthma, limited knowledge of people with asthma, and selection bias, in that people with asthma were not a random sample.

Although the response rate of respiratory physicians was low, this was better than expected, as generally physicians are known to have poor response rates at around 30% in other recent studies (Fischer *et al* 2006, Hillmer *et al* 2006).

The CQ had a Flesh-Kincaid Grade Level Score of 8.1, indicating that an eighth grader (average age 13 years) can read and understand the questionnaire and demonstrates its accessibility to a wide population. With regards to the HQ, the Flesh-Kincaid Grade Level Score was 12.0 indicating that a twelfth grader (average age 18 years or over) would have no difficulty in understanding the questionnaire; and this was expected given that the HQ was intended to be used in assessing health care professionals' asthma knowledge.

Factor analysis of the CQ revealed that asthma knowledge is being assessed in two dimensions for this population, one relating to knowledge on asthma management and the other relating to knowledge on asthma medication. Knowledge relating to both of these areas is highlighted and considered critical in current asthma management guidelines (Boulet *et al* 1999, National Asthma Council 2002, National Asthma Education and Prevention Program 2002, British Thoracic Society 2003,

NHLBI/WHO 2005). Further, these two areas are commonly covered in asthma education programs.

Factor analysis for the HQ demonstrated excellent construct validity and showed that asthma knowledge is a single, unified dimension for this population. This is supported by the high reliability coefficient of internal consistency for the questionnaire as a whole. The findings from the factor analyses of previous questionnaires argue against a single unified dimension and as a consequence reliability coefficients were modest at best (Allen and Jones 1998, Allen *et al* 2000, Ho *et al* 2003). Furthermore, unlike previously developed asthma knowledge questionnaires (Fitzclarence and Henry 1990, Allen and Jones 1998, Ho *et al* 2003), response rates and sample size in the study were adequate for factor analysis and discriminant analysis.

With regards to the CQ, the comparison of mean total scores as well as individual item responses by the people in the four groups indicates that the questionnaire tests the specialised knowledge that is considered necessary for effective asthma self-management. We hypothesised that for the CQ, respiratory physicians and pharmacists would have better asthma knowledge than people with asthma, and that people without asthma would have the poorest asthma knowledge. In this study, as expected, we found that both respiratory physicians and pharmacists had superior asthma knowledge compared to people with or without asthma. Furthermore, there was no significant difference in mean total CQ scores of pharmacists and respiratory physicians. This result was also expected since the CQ was not designed for assessing the asthma knowledge of health care professionals.

For the HQ, we hypothesised that respiratory physicians would have the most comprehensive asthma knowledge compared to the other three groups and this was confirmed in our study findings. There were significant differences in total HQ scores between the four groups. Hence, the HQ clearly discriminated between groups with different levels of knowledge. Moreover, both questionnaires successfully discriminated between high and low scoring respondents.

With regards to the HQ, a small proportion of pharmacists responded correctly to item 8 (53%) and item 9 (57%) compared to other item responses of the HQ. Item 8 stated “the inflammatory process in asthma does not cause permanent changes in the airways”. A possible explanation for this finding is that perhaps the pharmacists’ knowledge has not been updated with the most recent concepts of the disease

process and the notion of airway remodelling. Item 9 stated “multiple actuations of aerosol devices before inhaling from a spacer will result in more effective medication delivery”. This finding perhaps can be explained by the fact that the information accessible to pharmacists may not cover/highlight this aspect of aerosol devices and medication delivery.

The proportion of pharmacists (60%) and respiratory physicians (60%) who responded correctly to item 17 of the HQ was also small compared to other item responses. Item 17 stated “dry powder inhalers require higher respiratory flow rates than metered dose inhalers”. Most health care professionals that specialise in asthma, such as respiratory physicians, are expected to be able to correctly answer this technical question. However, the information that is accessible to them perhaps does not highlight or explain this technical detail.

The internal reliability rating of the CQ exceeded the 0.70 index, which is regarded as satisfactory and the rating of the HQ exceeded the 0.90 index, which is regarded as excellent (Carmines and Zeller 1979). For the CQ, the Cronbach’s alpha coefficient of 0.78 indicates that the CQ is internally consistent and that at least 78% of the variance in the observed scores can be attributed to variation in knowledge rather than measurement error. Additionally, it is important to note that the Cronbach’s alpha coefficient obtained for the CQ was better than previously published questionnaires (Allen *et al* 2000, Ho *et al* 2003). For the HQ, the Cronbach’s alpha coefficient showed a very high internal consistency and that at least 92% of the variance in the observed scores can be attributed to variation in knowledge rather than measurement error. Since there is no gold standard questionnaire specifically designed for assessing the asthma knowledge of health care professionals, our pioneer HQ findings further suggest that this instrument may be a useful tool for future research in this field and may be used to assess the effectiveness of undergraduate and continuing professional education programs before they are rolled out on a large scale.

Although several general asthma knowledge questionnaires have been developed and published, there is still no ‘gold standard’ questionnaire for consumers with which to compare our CQ results. This is because most of the published studies recruited a selected group of asthmatic patients or only partially validated their questionnaires. There is one validated asthma knowledge questionnaire, that was developed in 1990

and is now outdated with the current concepts of asthma and its management (Fitzclarence and Henry 1990).

When it comes to the generalisability of these asthma knowledge questionnaires, it can be considered that, as these questionnaires are based on guidelines consistent with international asthma management guidelines then they can be easily adapted to different national health care settings.

Knowledge about asthma is frequently assumed to be an essential prerequisite for the successful performance of self-management behaviours. However, the acquisition of knowledge does not necessarily translate into effective self-management behaviour (Gibson *et al* 1998a, Gibson *et al* 2003). It is important to assess, and change attitude, intent and actual behaviour as well. Thus, using our questionnaires may tell us that a change of knowledge has occurred but this will not necessarily predict whether an individual will change their professional practice or self-care behaviour.

The limitations of the pilot study include small sample size of people with asthma and selection bias, in that people with asthma who completed the questionnaires were a self-selected sample. A possible limitation to the main study is selection bias, in that the respiratory physicians and pharmacists who completed the questionnaires were not a random sample, all of which would affect the ability to generalise the results.

3.6.1. Future directions

Our study has formed the basis for future work in this area, which will include the validation of these questionnaires in different populations (such as GPs and practice nurses), and the assessment of the questionnaires' temporal stability (repeatability) and sensitivity to change in knowledge (i.e. pre and post training/education). Further work could investigate whether asthma knowledge correlates with self-management behaviour such as medication adherence and device use and, could also focus on the development and expansion of these instruments to encompass measurement of self-management skills such as device technique and peak flow or symptom based self monitoring.

3.7. CONCLUSIONS

Two validated asthma knowledge questionnaires that are consistent with current international and national asthma management guidelines are now available. These were shown to be simple and reliable instruments for the assessment of asthma knowledge of consumers (CQ) and health care professionals (HQ). These instruments could be used to assess the educational and information needs of individuals and subsequently, to direct educational and information resources more appropriately. Future research will evaluate the utility of these instruments in clinical practice.

Chapter 4

Interactive small-group asthma education in the community pharmacy setting: a pilot study

4.1. INTRODUCTION

Asthma self-management education for adults that includes information about asthma and self-management, self-monitoring, a written action plan and regular medical review has been shown to be effective in improving asthma outcomes (Gibson *et al* 1999). These interventions have been delivered mostly in a hospital setting and have utilised individual and/or group formats. Fewer interventions have been delivered in a primary care setting, usually by qualified practice nurses and/or general practitioners or asthma educators and, to date, their success has not been established (Fay *et al* 2002, Gibson *et al* 2003).

Community pharmacy provides a strategic venue for the provision of patient education about asthma. Traditionally, patient education provided by community pharmacists has been individualised. However, group education has been shown to be as effective as individualised education with the added benefits of being simpler, more cost effective and better received by patients and educators (Wilson *et al* 1993, Wilson 1997).

While small group education has been shown to improve asthma outcomes (Snyder *et al* 1987, Bailey *et al* 1990, Wilson *et al* 1993, Yoon *et al* 1993, Allen *et al* 1995, Kotses *et al* 1995, Berg *et al* 1997, de Oliveira *et al* 1999, Marabini *et al* 2002), to date, no small-group asthma education provided by pharmacists in the community pharmacy setting has been implemented and evaluated.

Given that many of the issues remaining in asthma management are patient related issues associated with the inappropriate use of asthma medication (Marks *et al* 2000, Bender 2002, Wilcock 2002, Fabbri *et al* 2004, Basheti *et al* 2005, Garg *et al* 2005), this project aimed to develop, implement and evaluate the impact of a pharmacist-led small-group asthma education program focusing on the proper use of asthma medication by comparing the effects of the pharmacist-led delivery to a ‘gold

standard-led' delivery (i.e. delivery by a pharmacist trained as an asthma educator) and to usual care provided by community pharmacists on clinical and humanistic outcomes for people with asthma.

4.2. OBJECTIVES

The specific objectives for the study were:

1. To develop an interactive small-group asthma education program focusing on the proper use of asthma medication relevant to the needs of patients attending the community pharmacy.
2. To assess the feasibility of using pharmacists to deliver an interactive small-group asthma education program.
3. To enable community pharmacists to implement an interactive small-group asthma education program focusing on the proper use of asthma medication in the community pharmacy setting.
4. To assess the impact of the program on clinical (asthma severity/control, inhaler technique, medication adherence) and humanistic (asthma-related quality of life, asthma knowledge) outcomes for people with asthma.

4.3 METHODS

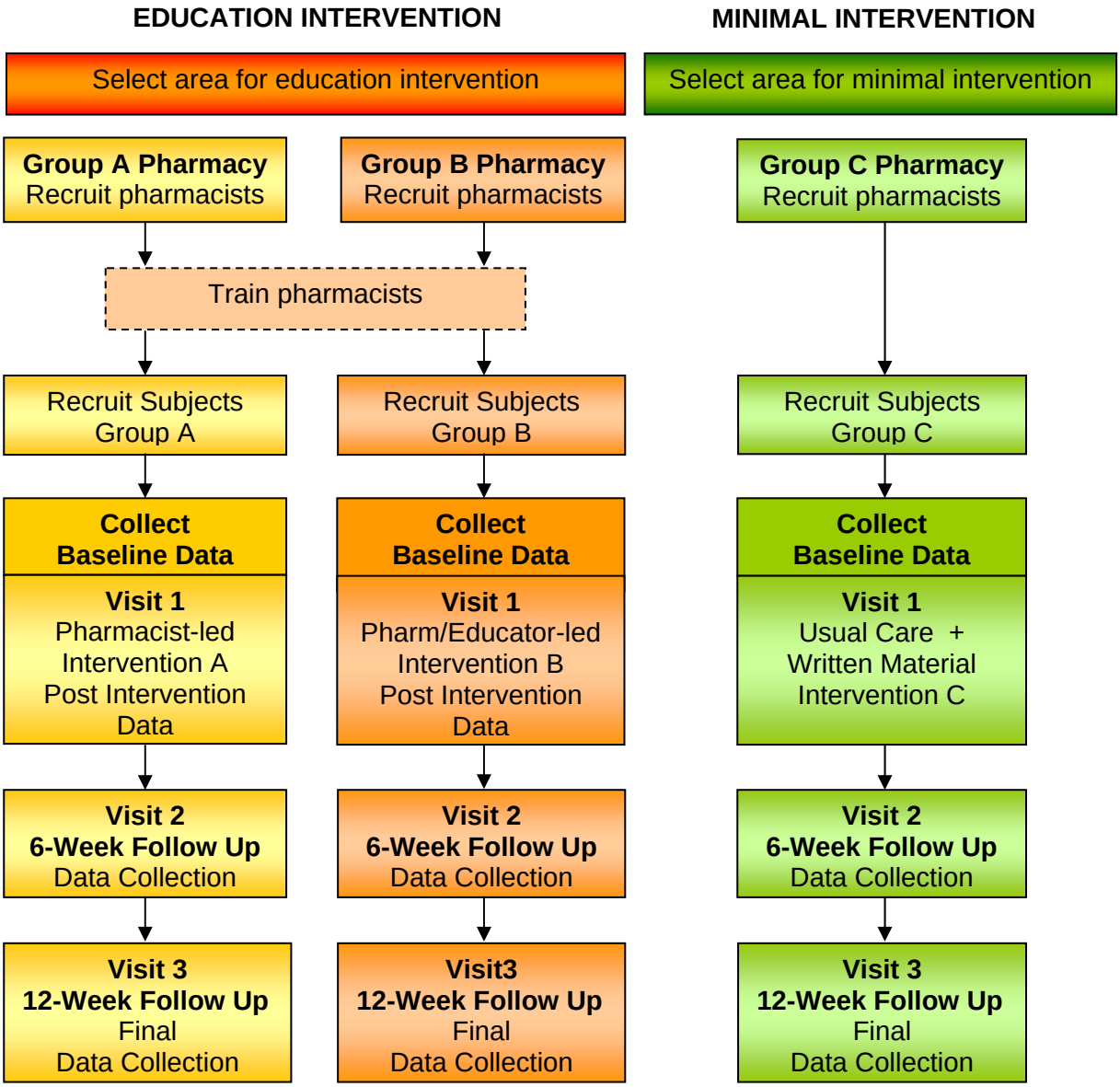
4.3.1. Study design

The study was conducted between January and July 2005 and used a parallel group, repeated measures design as outlined in Figure 4.1.

Three pharmacies (Group A, Group B and Group C) were randomly selected from two convenient and matched Sydney metropolitan areas for this pilot study. At Visit 1, after baseline data were collected, subjects recruited in Group A received an asthma education program delivered by a pharmacist (intervention A), subjects recruited in Group B received the same asthma education program delivered by a pharmacist/asthma educator (intervention B) and those recruited in Group C received

usual asthma care (no special education beyond what was typically provided within the community pharmacy setting) as well as written information (minimal intervention C). Data were collected immediately after the education intervention for Groups A and B and all subjects were assessed for clinical and humanistic outcomes at 6 weeks (Visit 2) and 12 weeks (Visit 3) from baseline. Ethics approval for the study was obtained from the Human Research Ethics Committee, University of Sydney (Appendix 26) and informed consent was obtained from all participants (Appendix 27).

Figure 4.1. Study design



4.3.2. Recruitment of pharmacists

Pharmacists were recruited from the three randomly selected pharmacies (Groups A, B and C) using a personal approach. Pharmacists in Groups A and B, who agreed to participate, were invited to attend a half-day training workshop. Pharmacists in Group C were not offered any training since their role would involve data collection and providing usual asthma care supplemented with written information to people with asthma. Group C pharmacists were blinded to the nature of the study and believed the study was about comparing the effects of usual care to usual care supplemented with written information on clinical and humanistic outcomes for people with asthma.

4.3.3. Recruitment of subjects

Subjects who presented to the pharmacy with a request for asthma medication were approached by the pharmacists to participate in the study.

Inclusion criteria included people > 16 years of age with a previous clinical diagnosis of asthma, who used preventer medication, could read and understand English and who fulfilled at least one of the following criteria modified from the Revised Jones Morbidity Index (Unwin *et al* 2000) for asthma assessment:

- used a reliever medication more than three times a week in the last 4 weeks
- woken up on a night or morning with cough/chest tightness on at least one occasion in the last 4 weeks
- had to take time off work/study because of asthma on at least one occasion in the last 4 weeks
- experienced symptoms of asthma (cough, breathlessness, wheeze etc) at least once a week over the last 4 weeks
- have not seen a doctor for asthma within the last 6 months

People with a clinical diagnosis of chronic obstructive pulmonary disease, those who were undergoing review with their GP as part of the 3+ Visit Plan, or those who did not self-administer their inhaler were excluded from this study.

Subjects in Groups A and B, who agreed to participate, were enrolled in a scheduled asthma education session in the community pharmacy after business hours and received the education, after baseline data were collected. Subjects in Group C, who agreed to participate, received usual care and supplementary information at the first

visit, after baseline data were collected. Pharmacists in all groups arranged subsequent follow-up visits for participants at 6 and 12 weeks after baseline data collection. A few days prior to the follow-up visits, pharmacists contacted the participants by phone to remind them of the visits. At the two follow up visits pharmacists in all groups collected data similar to baseline and provided usual asthma care.

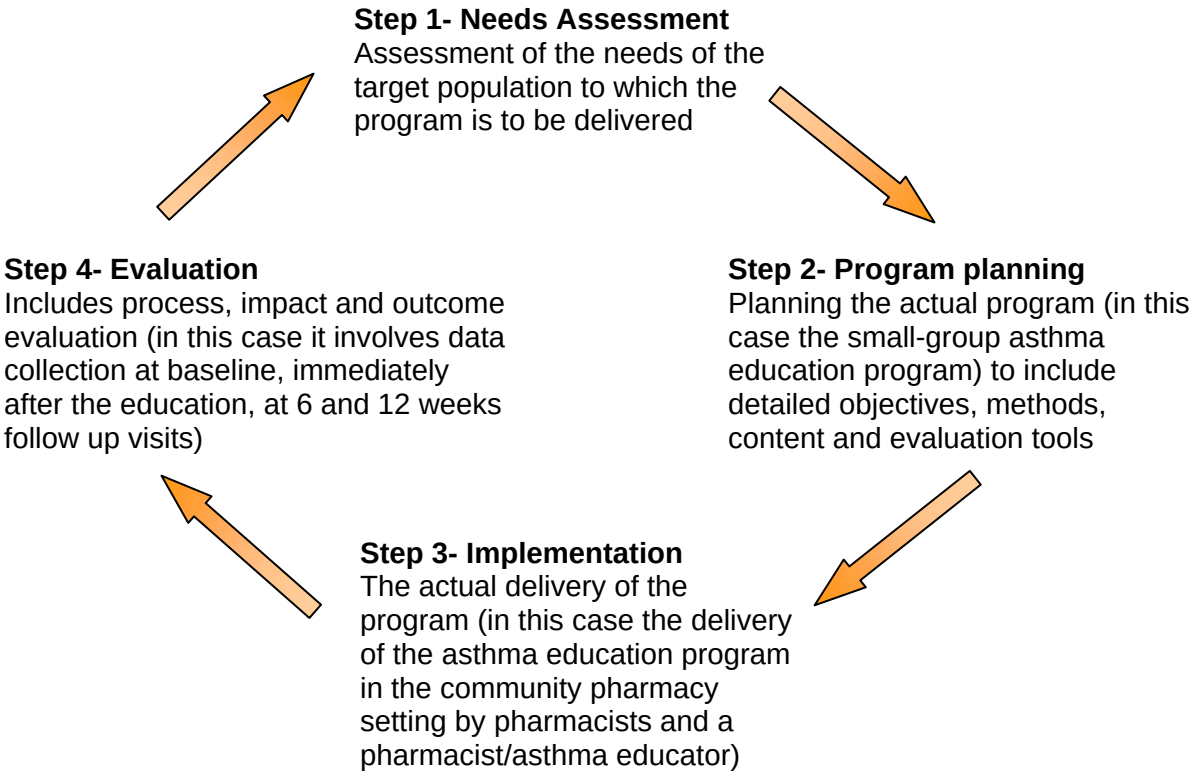
4.3.4. Sample size

In order to detect a change of 42% in the proportion of subjects who use their metered dose inhalers optimally (performed all steps correctly) from an expected baseline of 10% (Bailey *et al* 1990), with a power of 90% and significance level of 0.05, assuming a cluster effect of 1.5 and allowing for a subject dropout rate of 20%, 16 subjects were required to complete each of the three groups.

4.3.5. Program development

An asthma education program was developed for pharmacists to use in Group A and observe in Group B in their community pharmacies. The approach taken to develop the asthma education program was based on a standard approach commonly used to plan and evaluate health promotion models (Hawe *et al* 1990). This approach involves 4 steps outlined in Figure 4.2.

Figure 4.2. Steps in health promotion program planning and evaluation



Step 1: The educational needs of people with asthma attending the community pharmacy were identified from the patient education checklist described in the National Asthma Council *Asthma Management Handbook 2002.* A broad-based asthma education program suitable for community pharmacy could be developed by prioritising and addressing these generic educational needs.

Step 2: An asthma education program was planned for small groups (5-8) that aimed to empower people with asthma to use their asthma medication as recommended for controlling their asthma. The content of the asthma education program focused on the proper use of asthma medication and was structured on a framework of four program components necessary for effective asthma education based on several systematic reviews (Gibson *et al* 1998a, Gibson *et al* 1999). In order to maximise the likelihood of this asthma education program resulting in a change in individual behaviour, the asthma education program was based on Bandura's social learning theory (Bandura 1986), which states that learning mainly occurs through observation and modelling of others. Hence, an educational resource kit "Talk in A Box' (provided by the Asthma Foundation of NSW) consisting of visual aids (model airways, diagrams, medication charts) and other resources was used to focus attention and

assist in an interactive delivery. An asthma education program was planned to include detailed objectives, content, methods and evaluation tools.

Step 3: The asthma education program was delivered in the community pharmacy setting to small groups of participants (5-8) in Group A by a trained pharmacist and in Group B by a pharmacist/asthma educator (Figure 4.1). This program was a single interactive session of 150 mins duration. Specifically, the session covered asthma, its management, asthma medication, inhaler use, strategies for overcoming problems with taking asthma medications and the role of medication using a written asthma action plan. Participants received relevant pamphlets and leaflets endorsed by the Asthma Foundation of New South Wales during the education to take home. Detailed program guidelines were used through each session which enabled standardised delivery of the program (Appendix 28). A checklist was used during the delivery of the education to audit the structure and completion of each part of the program. Participants were informed that they would be contacted by phone to remind them of the follow up visits for data collection.

Step 4: Evaluation of the program: Data collected for all participants at baseline (first visit before any education) included demographics, asthma history, asthma-related conditions (e.g. allergic rhinitis, eczema) asthma severity/control, asthma medication, asthma action plan ownership and concerns about asthma medication (Appendix 29). The severity/control of asthma was categorised using a modified table from the Australian asthma management guidelines (National Asthma Council 2002) and inhaler technique was assessed using a checklist for all possible devices. Optimal inhaler technique was recorded only if participants performed all the steps correctly for that device. The 5-item Medication Adherence Report Scale (MARS) (Horne and Weinman 2002) was used to assess participants' medication adherence, the 20-item Asthma Quality of Life Questionnaire (AQLQ) (Marks et al 1992) was used to assess asthma-related quality of life and asthma knowledge was assessed using the validated 12-item asthma knowledge questionnaire (CQ) (Kritikos et al 2005). In addition, for participants in Groups A and B, asthma knowledge and inhaler technique were assessed immediately after the education session (Appendix 30).

Data collected for all participants at the 6-week follow up included asthma severity/control, inhaler technique, medication adherence, asthma-related quality of life, asthma knowledge, and medication profiles (Appendix 31). In addition, for participants in Groups A and B, satisfaction regarding the education received was

assessed using a modified participant satisfaction questionnaire from previous asthma studies (Narhi *et al* 2001) (Appendix 32). Similar data were collected at 12-weeks (final visit) and in addition asthma action plan ownership and concerns about asthma medication were also recorded (Appendix 33).

4.3.6. Training of pharmacists

Three weeks before the training workshop, pharmacists in Groups A and B received a pre-course training manual for self-study and for future use as a resource. The manual was divided into five modules dealing with, pathophysiology and risk factors for asthma, asthma medications and devices, asthma action plans and self-management behaviours, communication skills and strategies for effective counselling by community pharmacists. Pharmacists then attended the half-day training workshop facilitated by a health educator, three asthma researchers and an asthma educator. The training workshop objectives and learning outcomes are described in Appendix 34. Asthma management and micro skills of teaching relevant to engaging active learning about asthma medication to small groups were the focus of the education. The training workshop is described in Appendix 35. At the end of the workshop, pharmacists were provided with the educational resource kit and detailed program guidelines (Appendix 28) to guide them through the single educational session and supplementary written information that would be given during the education for participants to take home. Group C pharmacists received the same supplementary written information that would be given for participants to take home after baseline data were collected. No pharmacists were offered any remuneration.

4.3.7. Evaluation by pharmacists

A questionnaire was designed to elicit information from the pharmacists about the training and delivery of the education. The questionnaire consisted of ten questions using a 5 point semantic-differential scale; four questions rating how helpful the pre-course training manuals had been, how relevant the training had been, how useful the resources and guidelines had been and six questions rating how successful each topic covered during the education had been. Their opinions about the delivery of the education were elicited using four open-ended questions (Appendix 36).

4.4. DATA ANALYSIS

Data were analysed using SPSS for Windows (Version 10). Medications used were grouped under salbutamol, terbutaline, inhaled corticosteroids (ICSs), combination therapy (ICS plus a long acting beta agonist in one device), anticholinergics. Optimal inhaler technique recorded for various devices were grouped into either optimal metered dose inhaler (MDI) technique or optimal dry powder inhaler (DPI) technique. Baseline categorical variables were summarised as percentages and associations tested in contingency tables by Chi-squared tests for independence. For continuous variables that were normally distributed, analyses of variance (ANOVA) with Scheffe's post hoc comparisons were used to compare means between three independent groups. For continuous variables that were not normally distributed, Kruskal-Wallis tests were used.

Student's paired t-tests or Wilcoxon Signed Ranks tests were used to test for differences in asthma knowledge scores within each group pre- and post-delivery of asthma education. One way repeated measures analyses of variance or Friedman tests were used to test for differences in asthma knowledge scores within in group over time. McNemar's tests were used to test for differences in the proportion of subjects who demonstrated optimal MDI and DPI technique in each group pre and post-delivery of asthma education. To test for differences in asthma knowledge scores between Groups A and B immediately after the education, Student's t-test or the Mann-Whitney U test was used. Multivariate repeated measures analysis was used to test for differences in mean scores within and between groups. Changes in categorical variables within each group over time were analysed using Chi-squared tests for trend. A 2-tailed, 5% (0.05) level of significance was used for all statistical procedures.

4.5. RESULTS

4.5.1. Study sample

The South East Sydney Area was selected as the site for the education interventions for Group A and Group B. The Central Sydney Area was selected as the site for the minimal intervention Group C, as it matched most of the population demographics, particularly asthma prevalence (Table 4.1).

Table 4.1. Demographic indicators for areas selected

Indicator	South East Sydney Groups A and B	Central Sydney Group C
Total number of people	187,101	171,096
Aged 65 years and over (%)	14.8	13.9
Gender ratio M: F	1:1	1:1
% Born overseas	11.7	6.5
% Speak English only	89.2	93.0
% Employed	41.8	41.6
% Unemployed	3.2	3.3
Asthma prevalence/100,000	9.1	9.2

4.5.2. Participation and response rates

All seven pharmacists approached from three pharmacies agreed to participate in the study (3 in Group A, 2 in each of Groups B and C). Group A pharmacists delivered the asthma education program to three small groups (n=5, n=5, n=6) of participants (N=16). In Group B, the pharmacist/asthma educator delivered the same program to three similar small groups (n=5, n=6, n=5) of participants (N=16). All educational sessions for asthma participants in Groups A and B were delivered within 5 weeks following recruitment. Group C pharmacists enrolled 16 participants. Group A, B and C pharmacists performed follow up visits with participants on an individual basis at 6 weeks (Visit 2) and 12 weeks (Visit 3) after the intervention (Visit1). All forty-eight people with asthma from Groups A, B and C completed the study (100% retention rate).

4.5.3. Baseline characteristics

There were no statistically significant differences between Groups A, B and C at baseline in terms of demographic and asthma-related variables (Table 4.2).

There were no statistically significant differences in medication use between Groups A, B and C with regards to salbutamol use (94%, 88% and 75%) (Chi-squared test for independence, n=48, $p>0.05$) inhaled corticosteroid use (25%, 25% and 19%) (Chi-squared test for independence, n=48, $p>0.05$) or combination therapy (75%, 75% and 81%) (Chi-squared test for independence, n=48, $p>0.05$) respectively. Compared to other types of medication the use of anticholinergics was low in all three groups.

There were no statistically significant differences in the proportion of subjects who owned a written asthma action plan (Chi-squared test for independence, n=48, p>0.05) and who had concerns about asthma medication (Chi-squared test for independence, n=48, p>0.05) (Table 4.2). In total, 24 subjects (50%) had concerns about their asthma medications and steroid side effects were the main concerns reported.

Table 4.2. Baseline characteristics of the three groups

Profiles	**Group A (n=16)**	**Group B (n=16)**	**Group C (n=16)**	**P value**
		Mean + SD		
Age (years)	49.5 + 20.6	56.9 + 19.4	46.4 + 20.6	0.33*
		Number (%)		
Male gender	5 (31)	6 (38)	9 (56)	0.33†
Occupation				
Professional	5 (31)	2 (13)	5 (31)	
Non-professional	5 (31)	5 (31)	3 (19)	
Retired	3 (19)	5 (31)	5 (31)	0.90†
Student	2 (13)	2 (13)	1 (6)	
Home duties	1 (6)	2 (13)	2 (13)	
Asthma-related conditions	6 (38)	11 (69)	10 (63)	0.20†
Age at onset of asthma				
Infancy	2 (13)	2 (13)	4 (25)	
Childhood (2-12 years)	4 (25)	4 (25)	4 (25)	0.87†
More than 12 years	10 (63)	10 (62)	8 (50)	
Asthma severity/control category				
Mild	1 (6)	1 (6)	1 (6)	
Moderate	6 (38)	8 (50)	7 (44)	0.97†
Severe	9 (56)	7 (44)	8 (50)	
GP review in last 12 months	6 (38)	10 (63)	6 (38)	0.26†
Action plan ownership	2 (13)	3 (19)	4 (25)	0.66†
Concerns about medication	10 (63)	9 (56)	5 (31)	0.34†

* Analyses of variance (ANOVA) were used.
† Chi-squared tests for independence were used.

On entry to the study there were no statistically significant differences between Groups A, B and C in mean MARS scores, total quality of life scores, median asthma knowledge scores, the proportion of subjects in each category of asthma severity/control and the proportion of subjects who demonstrated optimal MDI and DPI technique (Table 4.3).

Table 4.3. MARS, quality of life, asthma knowledge and optimal inhaler technique at baseline

Parameter (maximum score)	Group A (n=16)	Group B (n=16)	Group C (n=16)	Comparison between groups
		Mean + SD		
MARS (25)*	18.3 + 4.0	19.5 + 4.6	19.9 + 3.2	p=0.46‡
Total quality of life (10)†	2.5 + 1.4	2.8 + 1.6	2.3 + 1.8	p=0.76‡
		Median (interquartile range)		
Asthma knowledge (12)	6.0 (5.0-8.0)	6.5 (5.0-7.0)	7.5 (6.3-8.0)	p=0.09§
		Number (%)		
Optimal MDI technique	1, n=11 (9)	2, n=14 (14)	1, n=11 (9)	p=0.89‖
Optimal DPI technique	0, n=7 (0)	1, n=13 (8)	2, n=13 (15)	p=0.51‖

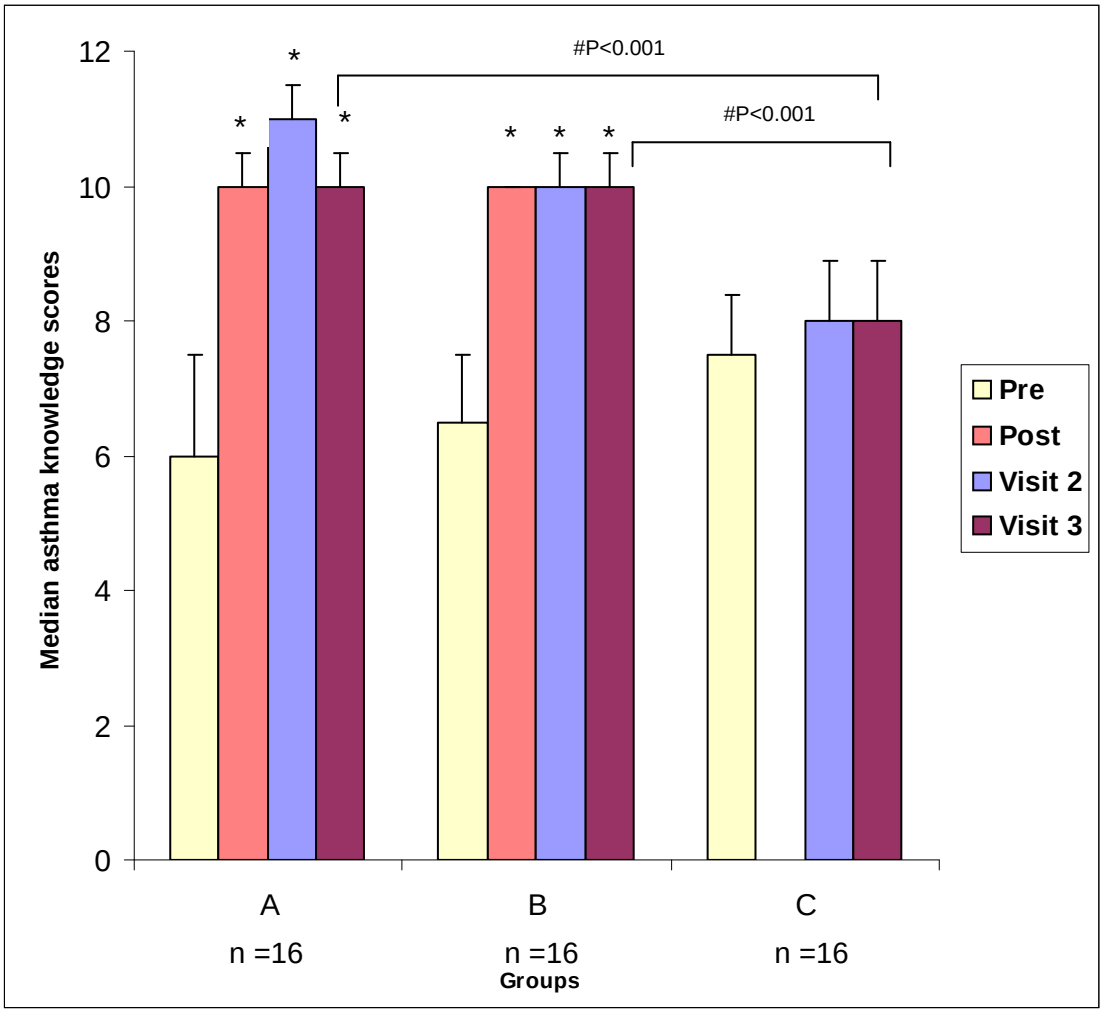
* A higher score indicates higher levels of reported adherence to medication.
† A lower score indicates a better asthma-related quality of life.
‡ Analyses of variance (ANOVA) were used.
§ Kruskal-Wallis test was used.
‖ Chi-squared tests for independence were used.

4.5.4. Impact of education

4.5.4.1. Asthma knowledge

Figure 4.3 shows the median asthma knowledge scores at baseline, immediately after the education, at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up for Groups A, B and C. There was a statistically significant but equal increase in the median asthma knowledge scores in Group A (Wilcoxon Signed Ranks test, n=16, $p<0.001$) and in Group B (Wilcoxon Signed Ranks test, n=16, $p<0.001$) immediately after the education. This increase was sustained over the 12 weeks of the study for both groups (Friedman tests, n=16, $p<0.001$). Knowledge scores were statistically significantly higher for Groups A and B when compared to Group C at 6 weeks (Kruskal-Wallis tests, n=48, $p<0.001$, $p<0.001$ respectively) and at 12 weeks (Kruskal-Wallis tests, n=48, $p<0.001$, $p<0.001$ respectively).

Figure 4.3. Median asthma knowledge (interquartile range) scores for Group A (pharmacist-led), Group B (asthma educator-led) and Group C (usual care) at baseline (pre), immediately after the education (post), and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up



* Significant increase in median asthma knowledge scores over time within Groups A and B (p<0.001). Wilcoxon Signed Ranks and Friedman tests were used.
# Significant differences between Groups A and B compared to Group C (p<0.001) at 12 weeks. Kruskal-Wallis tests were used.

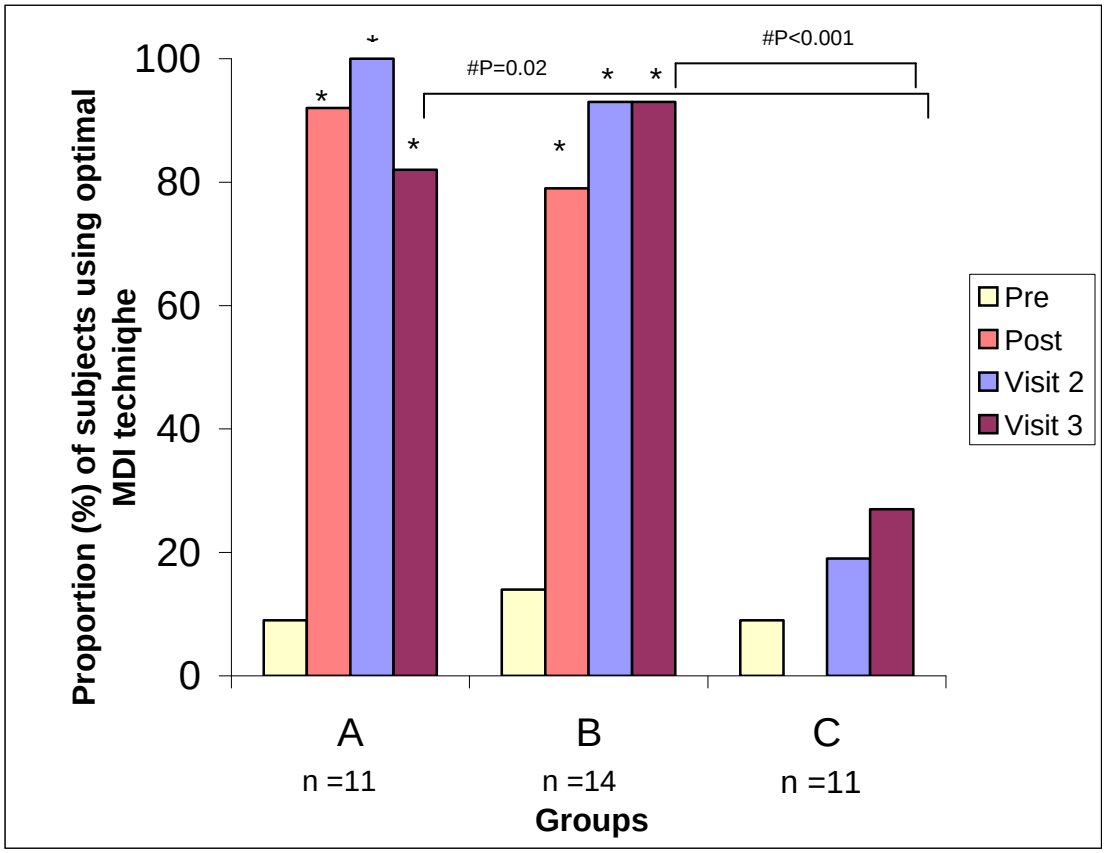
4.5.4.2. Inhaler technique

4.5.4.2.1. Optimal metered dose inhaler (MDI) technique

Figure 4.4 shows the proportion of participants who demonstrated optimal MDI technique at baseline (pre), immediately after the education (post), and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up. There was a significant but equal improvement in the proportion of participants who were able to demonstrate optimal MDI technique in Group A (McNemar test, n=11, p=0.004) and in Group B (McNemar test, n=14, p=0.004) immediately after the education (Chi-squared test for

independence, n=25, p=0.78). This improvement was sustained for both groups over the 12 weeks of the study. In Groups A and B, the proportion of subjects with optimal MDI technique improved from 9% and 14% respectively at baseline to 82% and 93% (Chi-squared test for trend, n=11, p=0.02; Chi-squared test for trend, n= 14, p<0.001) respectively at 12 weeks.

Figure 4.4. The proportion (%) of subjects demonstrating optimal MDI technique in Group A (pharmacist-led), Group B (asthma educator-led) and Group C (usual care) at baseline (pre), immediately after the education (post), and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up



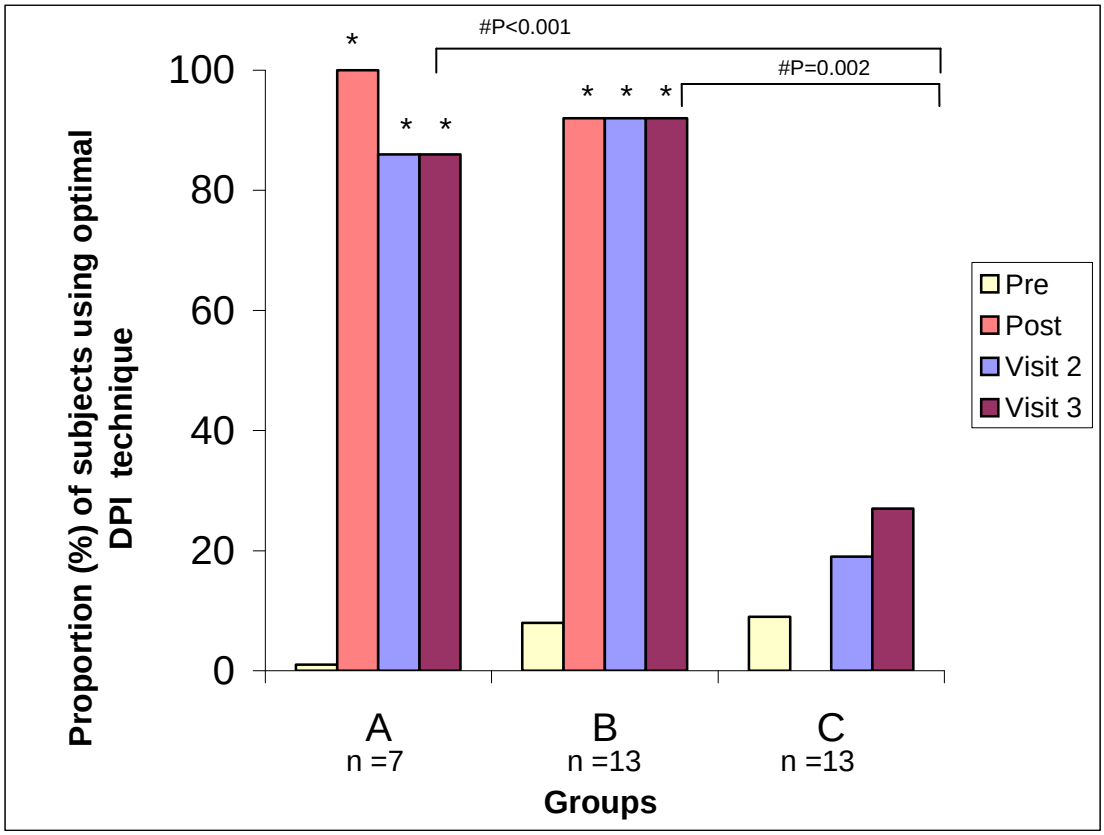
* Significant improvement in inhaler technique over time in Groups A and B (p<0.05). McNemars tests and Chi-squared tests for trend were used.
# Significant differences between Groups A and B compared to Group C at 12 weeks. Chi-squared test for independence were used

4.5.4.2.2. Optimal dry powder inhaler (DPI) technique

Figure 4.5 shows the proportion of participants who demonstrated optimal DPI technique at baseline (pre), immediately after the education (post), and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up. There was a significant but equal improvement in Group A (McNemar test, n=7, p<0.001) and in Group B (McNemar

test, n=13, p=0.002) immediately after the education (Chi-squared test for independence, n=20, p>0.5). This improvement was sustained for both groups over the 12 weeks of the study. The proportion of subjects with optimal DPI technique improved in Groups A and B from 0% and 8% respectively at baseline to 86% and 92% (Chi-squared test for trend, n=7, p=0.001; Chi-squared test for trend, n=13, p=0.002) respectively at 12 weeks.

Figure 4.5. The proportion (%) of subjects demonstrating optimal DPI technique in Group A (pharmacist-led), Group B (asthma educator-led) and Group C (usual care) at baseline (pre), immediately after the education (post), and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up



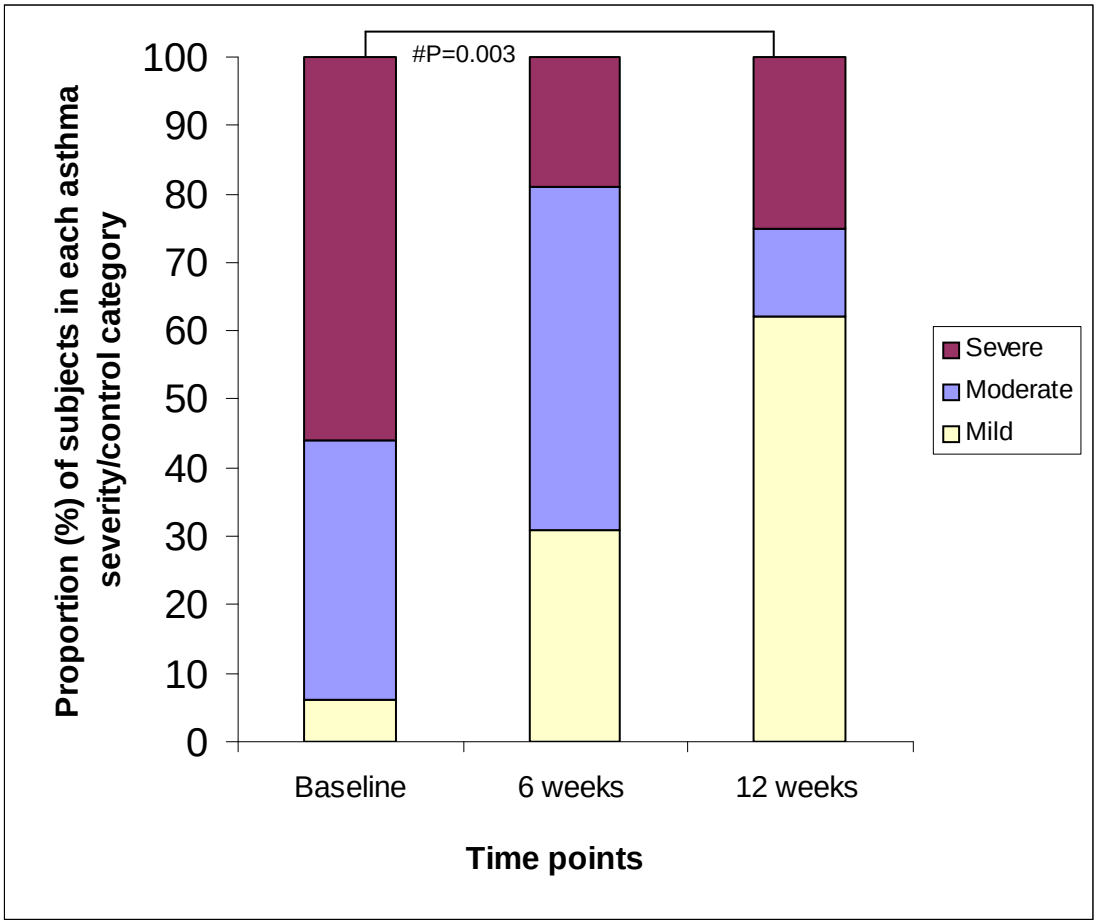
* Significant improvement in inhaler technique over time in Groups A and B (p<0.05). McNemars tests and Chi-squared tests for trend were used.
# Significant differences between Groups A and B compared to Group C at 12 weeks. Chi-squared test for independence were used.

4.5.4.3. Asthma severity/control

Figures 4.6, 4.7 and 4.8 show the proportion of subjects in each asthma severity/control category at baseline, and 6 and 12 weeks for Groups A, B and C respectively. There were significant changes in the proportion of subjects in each category over time in Group A (Chi-squared test for trend, n=16, p=0.003) and Group

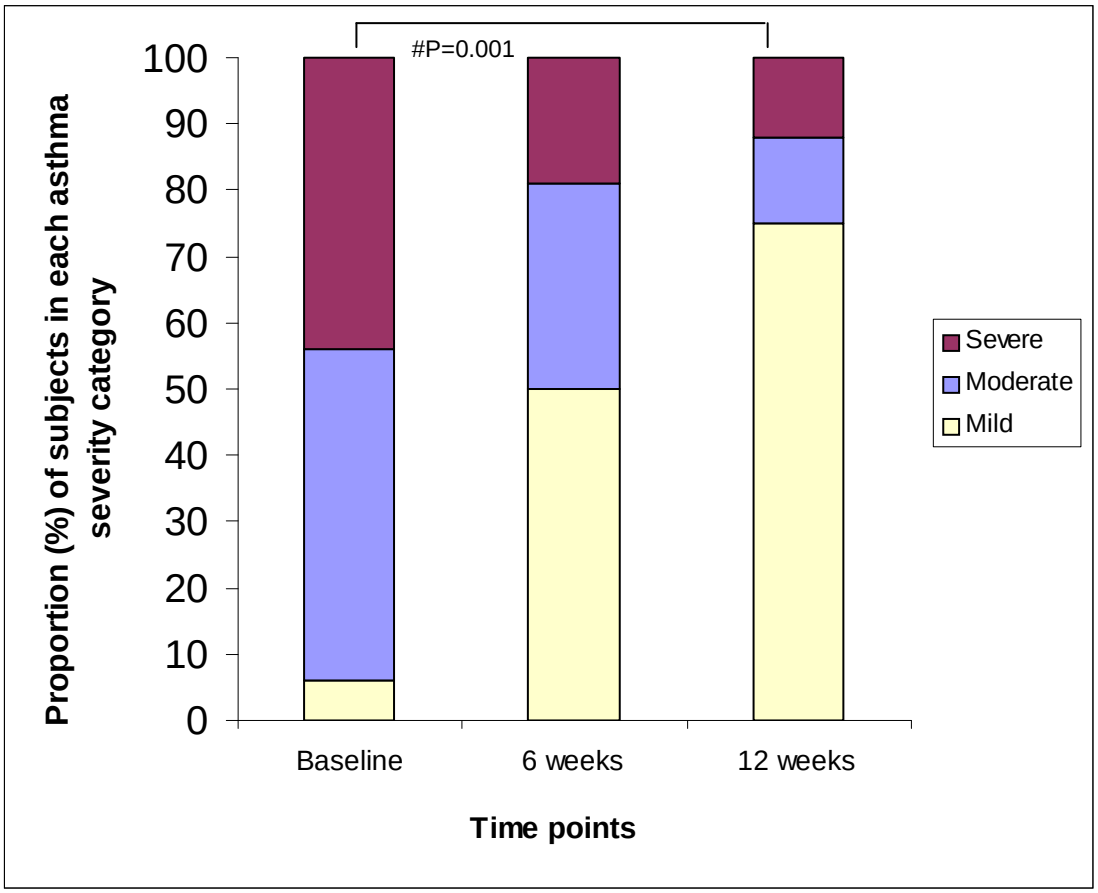
B (Chi-squared test for trend, n=16, p=0.001) but not in Group C (Chi-squared test for trend, n=16, p=0.62). Comparisons between the three groups showed a statistically significant difference in the proportion of subjects in each category at 6 weeks and 12 weeks (Chi-squared test for independence, n=48, p=0.05; n=48, p=0.02 respectively). At 12 weeks, the proportion of subjects with severe asthma/poor control in Groups A (25%) and B (13%) were not significantly different (Chi-squared test for independence, n=32, p=0.65) but were significantly lower compared to Group C (50%) (Chi-squared tests for independence, n=32, p=0.04; n=32, p=0.006 respectively).

Figure 4.6. The proportion (%) of subjects in each asthma severity/control category at baseline, and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up for Group A (pharmacist-led) (n=16)



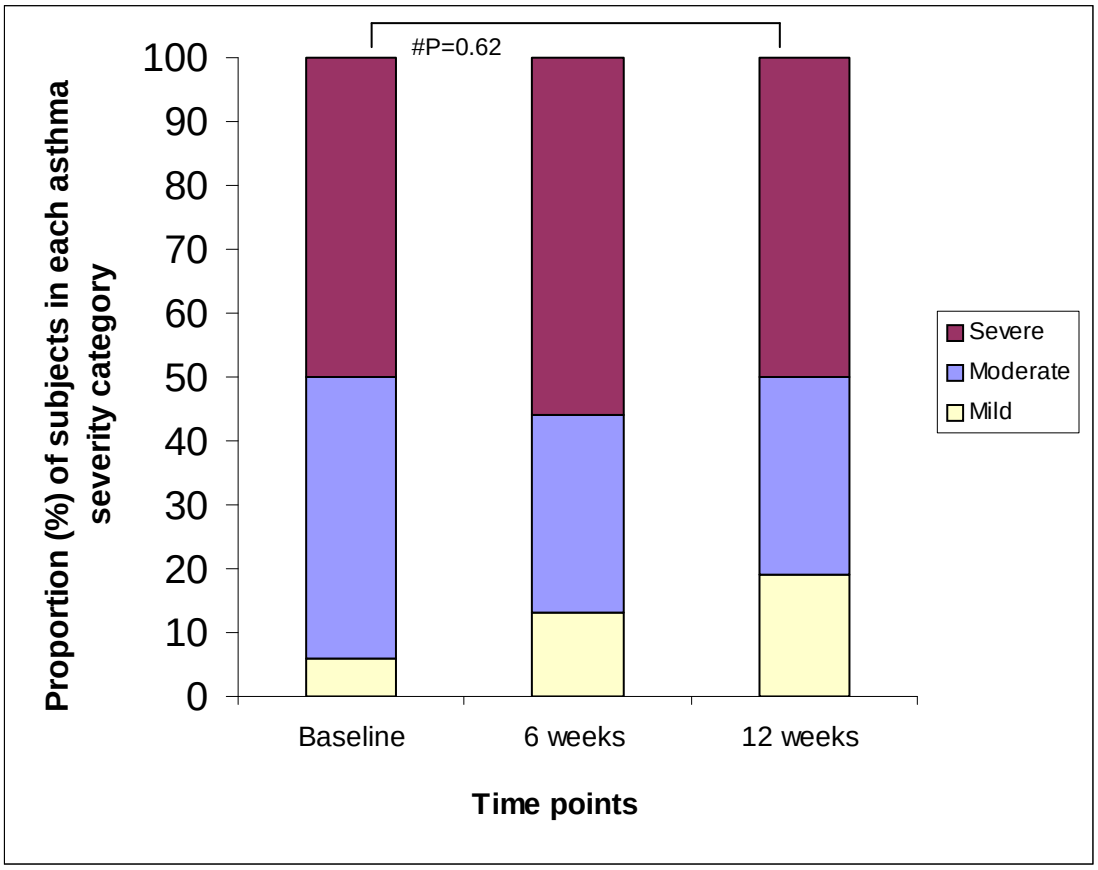
Significant changes in the proportion of subjects in each asthma severity category over time. Chi-squared test for trend was used.

Figure 4.7. The proportion (%) of subjects in each asthma severity/control category at baseline, and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up for Group B (asthma educator-led) (n=16)



Significant changes in the proportion of subjects in each asthma severity category over time. Chi-squared test for trend was used.

Figure 4.8. The proportion (%) of subjects in each asthma severity/control category at baseline, and at 6 weeks (Visit 2) and 12 weeks (Visit 3) follow up for Group C (usual care) (n=16)



Significant changes in the proportion of subjects in each asthma severity category over time. Chi-squared test for trend was used.

4.5.4.4. Asthma-related quality of life

Table 4.4 shows the total asthma quality of life (AQOL) scores at baseline, at 6 weeks (Visit 2) and 12 weeks (Visit 3) for Group A, Group B and Group C. Relatively low total AQOL scores (the lower the score the better the quality of life) were reported at baseline. There was a statistically significant decrease in mean total AQOL scores over time in Group A (One way repeated measures, n=16, p=0.03) and Group B (One way repeated measures, n=16, p=0.003), (indicating an improvement in quality of life) but not in Group C (One way repeated measures, n=16, p=0.64). At 12 weeks Group B had a significantly lower mean AQOL score compared to Group C (Scheffe's test, n=48, p=0.02).

Table 4.4. Total asthma quality of life (AQOL) scores for the three groups

Total asthma quality of life (max score =10)	Group A (n=16) Mean (95% CI)	Group B (n=16) Mean (95% CI)	Group C (n=16) Mean (95% CI)	Comparison between groups P value
Baseline*	2.5 (1.8 to 3.2)	2.8 (1.9 to 3.6)	2.3 (1.4 to 3.3)	0.76†
6 weeks (Visit 2)*	1.5 (1.1 to 1.9)	1.3 (0.8 to 1.9)	2.2 (1.3 to 3.1)	0.14†
12 weeks (Visit 3)*	1.4 (1.0 to 1.8)	1.0 (0.4 to 1.6)	2.3 (1.4 to 3.2)	0.02† (B vs C 0.02)
Changes within groups over time	p=0.03‡	p=0.003‡	p=0.64‡	

* A lower score indicates a better asthma-related quality of life.
† Analyses of variance (ANOVA) (Scheffe's post hoc comparisons were used).
‡ One way repeated measures were used.

4.5.4.5. Medication adherence

Table 4.5 shows the MARS scores at baseline, at 6 weeks (Visit 2) and 12 weeks (Visit 3) for Group A, Group B and Group C. Relatively high MARS scores were reported at baseline meaning that participants self-reported high levels of adherence to asthma medication. Although there were statistically significant improvements in mean MARS scores over time in Group A (One way repeated measures, n=16, p<0.001) and Group B (One way repeated measures, n=16, p=0.03), there were no differences between the three groups at 6 weeks (ANOVA, n=48, p=0.36) or 12 weeks (ANOVA, n=48, p=0.52).

Table 4.5. MARS scores for the three groups

MARS (maximum score=25)	Group A (n=16) Mean (95% CI)	Group B (n=16) Mean (95% CI)	Group C (n=16) Mean (95% CI)	Comparison between groups P value
Baseline*	18.3 (16.1 to 20.4)	19.5 (17.1 to 21.9)	19.9 (18.3 to 21.6)	0.46†
6 weeks (Visit 2)*	21.3 (19.1 to 23.5)	22.1 (20.3 to 23.9)	20.1 (17.9 to 22.3)	0.36†
12 weeks (Visit 3)*	21.1 (19.5 to 22.7)	21.9 (19.7 to 24.0)	20.6 (19.2 to 21.9)	0.52†
Changes within groups over time	p<0.001‡	p=0.03‡	p=0.71‡	

* A higher score indicates higher levels of reported adherence to medication.
† Analyses of variance (ANOVA) were used.
‡ One way repeated measures were used.

4.5.4.6. Other asthma-related variables

Although there was a significant decrease in the proportion of subjects who had concerns about their asthma medications from baseline to final visit in Group A (63% to 25%) (Chi-squared test for trend, n=16, p=0.03) and Group B (56% to 13%) (Chi-squared test for trend, n=16, p=0.01) but not in Group C (31% to 25%) (Chi-squared test for trend, n=16, p=0.69), there was no statistically significant difference between the three groups at the final visit (Chi-squared test for independence, n=48, p=0.58). Further, there were no statistically significant differences in the proportion of participants with regards to asthma action plan ownership between the three groups at 12 weeks follow up (Chi-squared test for independence, n=48, p=0.56) or medication use; salbutamol use (Chi-squared test for independence, n=48, p=0.76) inhaled corticosteroid use (Chi-squared test for independence, n=48, p=0.22) or combination therapy (Chi-squared test for independence, n=48, p=0.37).

4.5.4.7. Participant satisfaction

Based on the participant satisfaction questionnaire completed at 6 weeks by participants in Groups A and B (n=32), participants indicated that they had been satisfied with the asthma education program they had attended (in terms of content and time, pharmacists' knowledge, skills and ability to answer questions), they felt comfortable being educated in a group session and that they had benefited from the social support of the group. Thirty-one subjects (97%) indicated that the scheduled time and setting for the asthma education program were suitable, indicating they would participate in a similar program in the future and would recommend the asthma education program to a friend with asthma. The majority found many aspects of the asthma education program very useful, in particular how their medications worked, the rationale for their use, and the correct use of their asthma devices. Twenty-five subjects (78%) indicated that they had not received any previous asthma education and those that had, found this education better than that previously received.

4.5.5. Evaluation by pharmacists

The three pharmacists who delivered the group asthma education (Group A) indicated that it had been a rewarding experience and that they had gained confidence and professional satisfaction. All three pharmacists scored 4-5 out of 5 for the ten questions that used a five-point semantic-differential scale (e.g. ranging from 1 "not at all successful" to 5 "extremely successful"). All indicated that the asthma education sessions were conducted as planned, the resources, guidelines and visual

aids provided were very practical and useful, and that the group had responded to the education extremely well. Although they felt that each topic covered during the asthma education session had been successful, the timing of each topic could have been better. When asked about the training that had been provided, all indicated that the training was extremely relevant and the training manuals were very helpful.

4.6. DISCUSSION

The results of this study demonstrate that community pharmacist-led asthma education that focuses on the proper use of asthma medication delivered to small groups of people with asthma appears to be more effective than usual care in improving asthma severity/control, inhaler technique and asthma knowledge. Specially trained community pharmacists can be as effective as a pharmacist/asthma educator in delivering small-group asthma education. This is the first time in Australia that the outcomes associated with such an innovative role in pharmacist-led small-group asthma education have been evaluated and indicated that the pharmacist educators have been pioneers in demonstrating the feasibility and efficiency of this role in the community pharmacy setting.

This study is consistent with previous studies in demonstrating the value of a small-group asthma education programs for adults (Snyder *et al* 1987, Bailey *et al* 1990, Windsor *et al* 1990, Wilson *et al* 1993, Yoon *et al* 1993, Allen *et al* 1995, Kotses *et al* 1995, Berg *et al* 1997, de Oliveira *et al* 1999, Marabini *et al* 2002). Although evidence suggests that both small group and individual delivery formats can improve patient health outcomes (eg. reduction in ED and hospital visits), small-group education can be more effective for certain outcomes (eg. improvement in inhaler technique and physical activity) (Wilson *et al* 1993, van der Palen *et al* 1997) with the added benefits of being simpler, more cost effective and better received by patients and educators (Wilson 1997). In our study, the efficiency of this method of patient education was demonstrated by the minimal training required to train the pharmacists and the minimal effort required by pharmacists to identify and gather people with poorly controlled asthma for group education in a familiar and local setting.

The asthma education program developed in this study was based on a theoretical framework (Bandura 1986) and structured on a model for health promotion planning and evaluation (Hawe *et al* 1990), incorporating the practice guidelines used in Australia at the time (National Asthma Council 2002). Evidence shows that asthma education programs are more likely to be successful if they are based on a theory of patient behaviour change and focus on improvements beyond patient knowledge (Boulet 1998b, Gibson *et al* 1999, Sudre *et al* 1999). The small-group asthma education program was carefully designed to focus on the proper use of asthma medication given that many problems remaining in asthma management are patient-related issues associated with the inappropriate use of medication, an area in which pharmacists have expertise. It has been well documented that people with asthma are reluctant to use their asthma medication as recommended (Osman 1997, Boulet 1998a, Goeman *et al* 2003, Horne 2006, Peters 2006), do not optimally use their inhalers (van der Palen *et al* 1997, van Beerendonk *et al* 1998, Basheti *et al* 2005) and have unmet information needs particularly in relation to concerns about asthma medication (Ruffin *et al* 1999, Caress *et al* 2002, Raynor *et al* 2004). Pharmacists are ideally placed to meet these information needs and were able to address all these issues during the asthma education program and deliver messages that were consistent with best practice guidelines and practitioners' instructions. The community pharmacy is a unique setting for ongoing education and care to people with chronic disease such as asthma who are taking continuing responsibility for their own treatment and self-management.

Bandura's social learning theory (Bandura 1986) states that individuals acquire new ideas and behaviours mainly through observation and modelling of others in a familiar and supportive environment. Hence, this theory of patient behaviour change was used as a framework for the asthma education because it provided the rationale for using the community pharmacist as a positive role model to deliver the asthma education program in a familiar and supportive learning environment (the community pharmacy). In this setting, the pharmacist was in an ideal position to provide incentive and feedback, to review and reinforce positive behaviour. In addition, it made possible the selection of interactive activities (e.g. group discussions, demonstrations, round robins) which provide opportunities for modelling positive behaviour. By focusing on small-group education, collective group behaviour was utilised to promote changes in the individual members of the group. Therefore, small groups provided additional support to the individual through the influence of group participation and collaborative learning. In contrast to individualised education, this

'peer effect' and support may play a critical role in information retention and behaviour change in patients. Further, delivery of education by a known and familiar educator in a non-threatening venue appears to be as successful as sending the patient to a specialised educator in a hospital-based clinic.

The study timeframe involving two follow-up visits at 6 and 12 weeks from baseline was based on several factors. Firstly, it was based on previous group asthma education programs that have evaluated similar outcomes such as inhaler technique and asthma knowledge (Snyder *et al* 1987, Wilson *et al* 1993, Allen *et al* 1995). Secondly, it was based on the fact that a 3-4 week period is necessary for the benefits of properly used inhaled corticosteroid medications to occur. Since pharmacists are a highly accessible source of information and advice and patients visit their pharmacy on a regular basis for prescription refills, the timing of the two follow-up visits appeared to be ideal and convenient for patients, since no patients were lost to follow up, as observed in the high retention rate. Whether patients visited the pharmacy in between the two follow-up visits was not monitored in this study.

In response to the small-group asthma self-management education, there were improvements in participants' inhaler technique and asthma knowledge as shown previously in other similar group education studies (Snyder *et al* 1987, Bailey *et al* 1990, Wilson *et al* 1993, Yoon *et al* 1993, Allen *et al* 1995, de Oliveira *et al* 1999). For improvements in inhaler technique to be achieved, previous studies have shown that written instructions alone are not sufficient and that verbal instructions, demonstrations and practice sessions need to be included (Wilson *et al* 1993, van der Palen *et al* 1997, Basheti *et al* 2005). Although short term improvements in knowledge and inhaler technique are rarely sustained without ongoing review and reinforcement (De Blaquiere *et al* 1989, Gibson *et al* 1998a) pharmacists are ideally placed to review and reinforce correct inhaler technique on an ongoing basis. In this study, correct inhaler technique was sustained for 12 weeks but it would be necessary to provide ongoing review and reinforcement as a follow up to the initial small-group education (De Blaquiere *et al* 1989, Kesten *et al* 1993) .

This study showed an improvement in asthma severity/control in those groups who received the asthma education (Groups A and B). It is likely that the improvement in inhaler technique contributed to the improvement in asthma severity/control as there were no significant differences in medication profiles and medication adherence at the final visit. Fewer concerns about asthma medication reported by Groups A and B

over time could also be a contributor to improvements in asthma severity/control as it has been shown that people with asthma have fears and many misconceptions in regard to inhaled corticosteroids and their side effects, reducing their willingness to use them (Osman 1997, Goeman *et al* 2003, Horne 2006, Peters 2006). Thus, both improved inhaler technique and willingness to take medications may have contributed to the improved asthma severity/control we observed.

An interesting outcome in this study was the fact there was only a significant improvement in asthma quality of life in the group that received the asthma education provided by the pharmacist/asthma educator (Group B). It is known that the burden of asthma on quality of life is greater in patients with more severe asthma (Juniper *et al* 1992). Hence, a possible explanation for the improvement in quality of life observed in Group B could be this group had less severe asthma or better asthma control than Group A by the end of the study. Another possible explanation for this finding was that baseline quality of life scores were low in each group leaving small room for improvements to occur in this outcome measure within the study time frame.

When it came to medication adherence, we observed no change in adherence to asthma medication within the study time frame, using the 5-item MARS, a questionnaire that has not been previously used in a population from a primary care setting. Possible explanations may include the high MARS scores reported at baseline, leaving small room for improvements to occur, or perhaps this questionnaire may not be sensitive to changes within this study population. Given that adherence behaviour is influenced by a complex range of factors (Sawyer and Aroni 2003), the educational approach taken may not have been appropriate and/or the time allocated in addressing this issue during the asthma education program may not have been sufficient in achieving an improvement in this outcome. Furthermore, the study was not powered to detect a difference in adherence. An increase in sample size and follow-up period in which adherence is addressed may be required to be able to detect a significant difference in this outcome measure.

Similarly, there was no impact of the education on asthma action plan ownership. An asthma action plan is a written set of instructions that guides the patient to identify early signs and symptoms of worsening asthma and gives instructions of what to do as asthma control worsens (National Asthma Council 2002). The aim of a written asthma action plan is to avoid or prevent an exacerbation, and includes instructions on when and how to increase medication, how long to stay on increased medication

and when to seek further medical attention. These plans are individually tailored and are usually provided by general practitioners or respiratory physicians during an asthma review consultation. A possible explanation for no impact on asthma action plan ownership maybe that emphasis was not on ownership of an asthma action plan during the asthma education but on the role of medication using a written asthma action plan. Other possible explanations could be the short follow-up period in which participants may not have had sufficient time to be reviewed by their doctor to obtain an asthma action plan or that an active referral process was not in place.

With regards to concerns about asthma medications, although there was a significant decrease in the proportion of subjects who had concerns about their asthma medication from baseline to final visit in the education Groups A (63% to 25%) and B (56% to 13%), but not in Group C (31% to 25%), there was no significant difference between the three groups at the final visit. A possible explanation could be that the trained pharmacists may have been more proactive in eliciting this information from subjects at baseline before the education. Other possible explanations include sampling bias, subject selection bias, a small sample size and short follow-up period, all of which are limitations to this study and hence, affect the ability to generalise the results.

The participant attendance and retention rates of 100% seem inconsistent with patterns observed in similar studies utilising a group format in various health care settings. Generally, people with asthma are known to have poor attendance rates and low retention rates at group asthma education events (Yoon *et al* 1993, Allen *et al* 1995, Abdulwadud *et al* 1997, Muntner *et al* 2001). The high attendance and retention rates in our study indicated a committed and motivated sample, recruited to participate in a familiar local setting, involving one intensive education session with two less intensive visits within a short follow-up period. The small sample size of subjects involved in this study may have been the ideal size to motivate and easily follow up. Hence, high retention rates were observed. The fact that subjects were not randomly selected could also have had an impact on the attendance and retention rates. Whether the pharmacist/patient relationship or the nature of the intervention was the main factor in the high retention rates was not explored.

The asthma education provided by pharmacists was perceived by participants as very useful and both participants and pharmacists alike were highly satisfied. Although the asthma education program was structured, it did provide the opportunity

for flexibility based on the specific needs of individuals within the group. Participants considered the most useful advice they received was on how their medications worked and the rationale for their use, and how to use their asthma devices correctly. Such features associated with appropriate medication use are highlighted in the current asthma management guidelines and lie at the core of existing problems faced in asthma management in Australia. Pharmacists may be inclined to assume that people with asthma have already been well educated at initial diagnosis or thereafter by their general practitioner or asthma educator. In this study, twenty-five participants (78%) indicated that they had not received any previous asthma education. Thus, a gap exists here, which provides an opportunity for pharmacists to fill, in their contribution to the overall management of asthma.

When it comes to the feasibility of this study, the results from this study indicate that it is feasible for pharmacists to deliver interactive small-group asthma education in the practice setting. Pharmacists were ideal role models as health educators due to their therapeutic expertise, their high profile in the community, their accessibility, approachability and regular contact with their patients (Roller 1995, Kritikos *et al* 2003). Both pharmacists and participants alike were highly satisfied with the education. Participants felt comfortable in small groups in their community pharmacy, they indicated that they would participate in a similar asthma education program in the future and would recommend the program to a friend with asthma. Pharmacists received professional satisfaction and commented that it was a rewarding experience and they would do this again in future. They felt they needed more time to cover some of the topics during the session and commented that there would be more time available for them if the research data collection required was eliminated. All pharmacists indicated that the training was extremely relevant and the guidelines and resources were very useful.

The results from this study may be have implications for the management of other chronic disease states through pharmacy and further add to the body of evidence that pharmacists can have an impact on clinical and humanistic outcomes for people with asthma. This positive impact can potentially reduce asthma-related health care utilisation as shown previously through other more intensive community pharmacy-based asthma services in Australia and in Europe (Narhi *et al* 2000, Saini *et al* 2004).

This study forms the framework on which future studies should be designed and tested. Future training of pharmacists perhaps should involve a full day training

workshop in which pharmacists would have the opportunity to practise and streamline the delivery of each topic using the program guidelines. Future studies will also test the study timeframe involving the number and frequency of follow-up visits. Thus, the long term effectiveness and sustainability of this model of pharmacist-led asthma education may be evaluated. Further, this model should be compared to individualised education for cost effectiveness.

4.7. CONCLUSIONS

Small-group asthma education delivered by specially trained pharmacists appears to be more effective then usual care in improving clinical and humanistic outcomes for people with asthma. Specially trained community pharmacists are as effective as a pharmacist trained as an asthma educator in delivering small-group asthma education.

Chapter 5

Summary and Conclusions

5.1. SUMMARY

The research carried out in this thesis utilised the skills and therapeutic expertise of the community pharmacist in the current environment, to develop and investigate two new asthma intervention strategies for community pharmacists;

i. Asthma outreach health promotion in a rural setting
ii. Small-group asthma education in a community pharmacy setting

In addition, the lack of a simple, reliable and validated tool to assess asthma knowledge, based on current asthma management guidelines in clinical practice was addressed through the development and evaluation of two asthma knowledge questionnaires, one for consumers and one for health care professionals.

Asthma is a significant health problem in Australia (AIHW ACAM 2005). Over the last decade significant progress has been made in the understanding and treatment of asthma. Various programs and activities have been initiated to address the challenges associated with asthma and to increase asthma awareness and improve the standards of asthma care. Despite this however, there is still a gap between what is considered 'optimal asthma management' and current care (Marks *et al* 2000, Matheson *et al* 2002, Sawyer and Fardy 2003). In order to bridge this gap, the development of new effective strategies and services is necessary to help reduce the significant health burden posed by asthma on the Australian community.

In Australia, the vast majority of the burden of asthma in Australia is managed in primary care (Gibson 2000). Given that many of the issues that still remain in asthma management are patient related issues associated with the inappropriate use of medication (Marks *et al* 2000, Wilcock 2002, Basheti *et al* 2005, Garg *et al* 2005), community pharmacists are ideally placed to provide services that will help improve asthma management practices in the community. Pharmacists are in a key position to provide ongoing screening, counselling, monitoring, and education and to reinforce key messages and provide referrals in view of their therapeutic expertise,

accessibility, regular contact with patients and contact with patients who do not see other health care providers on a regular basis. They are the last health care professional that the patient sees before they start using their medication. Community pharmacists are a skilled resource and offer a practical solution in improving the way people use their medication. Currently, community pharmacists are underutilised in the long term care of people with asthma and new ways in which pharmacists can be involved in the care of people with asthma need to be investigated.

When it comes to the variety of different ways in which the community pharmacist can contribute to asthma care, various types of service models using pharmacists have been shown to have a positive impact on asthma outcomes in Australia and overseas (Narhi *et al* 2000, Odedina *et al* 2000, Cordina *et al* 2001, Haahtela *et al* 2001, Herborg *et al* 2001, Schulz *et al* 2001, Weinberger *et al* 2002, Emmerton *et al* 2003, McLean *et al* 2003, Saini *et al* 2004, Mangiapane *et al* 2005). However, despite being effective, these service models involve the implementation of a complex package of individualised education. They are often time-consuming in terms of pharmacists' training and patient visits, and their adaptation into daily workflow practices are issues that need to be further addressed. Therefore, simple, easily adaptable and effective ways in which pharmacists, particularly those in a busy metropolitan community pharmacy setting, can be involved in the care of people with asthma need to be investigated.

Small-group asthma education has been shown to be as effective as individualised education with the added benefits of being simpler to administer, more cost effective and better received by patients and educators (Wilson *et al* 1993, Wilson 1997). Further, there is some evidence that small-group asthma education is more effective for certain outcomes such as inhaler technique (van der Palen *et al* 1997) and physical activity (Wilson *et al* 1993). While small-group education has been shown to improve asthma outcomes (Snyder *et al* 1987, Bailey *et al* 1990, Windsor *et al* 1990, Wilson *et al* 1993, Yoon *et al* 1993, Allen *et al* 1995, Kotses *et al* 1995, Berg *et al* 1997, de Oliveira *et al* 1999, Marabini *et al* 2002), to date, no small-group asthma education provided by pharmacists in the community pharmacy setting has been implemented and evaluated. The development of a small-group asthma education program, focusing on the proper use of asthma medication, for community pharmacists to deliver in their community pharmacies, provides pharmacists with an opportunity and a new strategy to improve the way people use their asthma medication and influence health behaviour.

In Chapter 4, small-group asthma education in the community pharmacy setting was developed, implemented and evaluated. In this study, the effect of small-group asthma education delivered by pharmacists was compared to a 'gold-standard delivery' (i.e. delivery by a pharmacist trained as an asthma educator) and to usual care provided by community pharmacists on clinical (asthma severity/control, inhaler technique, medication adherence) and humanistic (asthma-related quality of life, asthma knowledge) outcomes for people with asthma.

This pilot study demonstrated that pharmacist-led small-group asthma education focusing on the proper use of asthma medication is feasible and appears to be more effective than usual care in improving asthma severity/control, inhaler technique and asthma knowledge. Specially trained community pharmacists can be as effective as a pharmacist trained as an asthma educator in delivering small-group asthma education.

Another important element to this study was that it demonstrated that this method of patient education was not only feasible and effective but also efficient from both the pharmacists' and participants' perspective. With regards to the pharmacists' perspective, as pharmacists are already highly skilled and knowledgeable, minimal training was required to enable pharmacists to deliver the small-group asthma education. With regards to the participants' perspective, this form of asthma education i.e. small groups after business hours in the community pharmacy was obviously well accepted by participants, as the pharmacists found it easy to recruit them into the study and subsequently the participants were not lost to follow up within the study timeframe.

This thesis also addresses the issue of asthma management in the Australian rural setting. In rural Australia, asthma management practices have been shown to be poorer and asthma mortality rates considerably higher than those of metropolitan areas (AIHW ACAM 2005, AIHW 2006). There is a limited number of and access to health care services and shortages in specialist services are shifting the burden more and more towards the primary sector. The chronic shortage of medical practitioners results in extremely long waiting times, and often patients fail to approach health care practitioners due to difficulty of access. People in rural communities may not be monitoring their asthma to the same extent as people in metropolitan areas with more direct access to health care. Therefore, it becomes paramount that people with

asthma in rural areas become involved in self-management of their asthma and that the community-based health care providers be more proactive in facilitating these self-management behaviours.

In Australia, the involvement of community pharmacists in asthma health promotion or outreach programs has been limited, despite the beneficial effects associated with these programs in improving asthma outcomes (Greineder *et al* 1995, Lisper and Nilsson 1996, Stout *et al* 1998, Kelly *et al* 2000, Legorreta *et al* 2000, Lin *et al* 2004, Haahtela *et al* 2006). The development of asthma outreach programs for rural community pharmacists, extending their role outside the confines of the pharmacy, provides pharmacists with another opportunity and new strategies, to raise awareness of asthma issues and influence health behaviour. In particular, pharmacists will have an opportunity to connect with groups in the community who underestimate the seriousness of asthma and are unlikely to visit the pharmacy on a regular basis to seek information and advice about asthma.

In Chapter 2, the involvement of rural community pharmacists in asthma outreach health promotion in a rural setting was investigated through a feasibility study carried out in the rural community of Orange, New South Wales. The study assessed the feasibility of two outreach programs. Firstly, the Triple A program, an evidence based peer-led asthma education program for adolescents and secondly, a public forum for the wider community of Orange. The public forum primarily aimed to promote asthma awareness in collaboration with other health care professionals. The public forum utilised a panel of experts in asthma representing the perspectives of both consumer and health care professionals. The impact of the two programs on asthma knowledge of adolescents and patient involvement with community pharmacy was evaluated.

The results of this study demonstrated that community pharmacists can be effective in delivering health promotion. In high schools, there was in increase in asthma knowledge of adolescents trained by pharmacists and the creation of Asthma Peer Leaders to spread asthma awareness amongst their peers and the school community. Pharmacists were effective in terms of the developing enthusiasm and interest amongst adolescents during the program. This study provided an opportunity for community pharmacists to engage with adolescents who generally do not visit the pharmacy on a regular basis, and to influence their health-related behavioural patterns at a critical stage in their lives. Adolescents developed an awareness of the new role played by pharmacists outside the confines of the pharmacy and their

comments about the approachability of all pharmacists, regardless of age, were a positive outcome. It can be expected that these adolescents, as they move into adulthood, will keep this impression and will utilise the community pharmacy and pharmacists as a source of reliable information and advice.

This study demonstrated that community pharmacists can effectively work in collaborative teams with other health care professionals in delivering health promotion to the wider community. There was an increase in asthma awareness and a positive impact on community attitudes and perceptions about asthma care. The impact of a consistent message delivered in unison by the panel of experts was more powerful than a message spread in isolation within the community. The researchers are unaware of any community health education programs that have utilised such expert panels representing both consumer and health care professional perspectives.

In this study, there was a significant increase in the proportion of asthma-related pharmacy visits involving requests for information on asthma and asthma devices. This increase may have been influenced by a dual effect, in that the patients may have sought more information through enhanced awareness, and also the pharmacists may have become more proactive in delivering counselling and providing information. Whether the delivery of two asthma outreach programs was causally related to the increase in the number of requests for information on asthma and asthma devices cannot be proven in this feasibility study. This would require a controlled study with a larger sample size preferably in a randomised setting. Nevertheless, these programs were successful from both the pharmacists' perspective, through the development of new skills, knowledge and confidence after the two training workshops, and from the community perspective, through enhanced awareness of asthma and of the new role played by the pharmacist outside the confines of the pharmacy.

An important element to this study was that it demonstrated the need for collaboration in order to be able to achieve successful asthma outreach health promotion. Collaboration with Asthma NSW to facilitate access into high schools, with local support groups and various health care professionals at the public forum, indicated to high schools and the wider community that there was a concerted effort to increase asthma awareness and improve asthma management practices in the rural community of Orange.

This thesis also addresses the lack of a simple, reliable and validated tool to assess asthma knowledge based on current asthma management guidelines in clinical practice, through the development and evaluation of two asthma knowledge questionnaires, one for consumers (CQ) and one for health care professionals (HQ) in Chapter 3. This research utilised standard methodologies of questionnaire construction and evaluation. Following development and pilot testing, the revised CQ and HQ were administered to respiratory physicians, pharmacists and people with and without asthma. In Chapter 4, the CQ was further evaluated in terms of its sensitivity to change in asthma knowledge following the small-group asthma education intervention.

The results of this research showed that both the CQ and HQ were reliable tools with Cronbach's alpha of 0.78 and 0.92 respectively. Both were also found to have good content, face, construct, and discriminant validity. The CQ had a Flesch-Kincaid Grade Level Score of 8.1, indicating that a person aged 13 years can read and understand the questionnaire and demonstrates its accessibility to a wide population. The HQ had a Flesch-Kincaid Grade Level Score of 12.0 indicating that a person aged 18 years or over would have no difficulty in understanding the questionnaire. Further, the CQ demonstrated that it was sensitive to change in asthma knowledge following the small-group asthma education.

These instruments could be used to assess the educational and information needs of individuals and subsequently, to direct educational and information resources more appropriately. The CQ could also be used to assess the impact of asthma education/training on asthma knowledge. Further, the asthma knowledge questionnaires, because of their simplicity can be used as 'teaching tools', besides their intended use as research tools. The questionnaires can be used in standard asthma education sessions, or included in education packs, with a catchy phrase such as "Test How Much You Know About Your Asthma?" to stimulate consumers', students' or health care professionals' appetite for seeking further information. This potential use as teaching resources would of course need to be tested, and compared against standard didactic asthma education techniques.

5.2. CONCLUSIONS

The work completed in this thesis shows that community pharmacists are an underutilised resource within asthma care. They are keen and willing to embrace a variety of new strategies aimed at improving asthma management practices which can extend their role beyond the traditional role of the community pharmacist. Community pharmacists demonstrated that they can effectively deliver asthma outreach programs in rural settings which result in an increase in asthma awareness and an improvement in asthma knowledge, and they can effectively deliver small-group asthma education in their pharmacies which can result in an improvement in patient asthma outcomes. In so doing, the pharmacists involved in the work presented in this thesis have been pioneers in demonstrating the feasibility of new roles for pharmacists in both rural and metropolitan settings.

The work completed in this study also indicated that the community was willing to accept the extended role of the pharmacist and the pharmacists were accepted by the community as educators. This highlights the fact that pharmacists are ideal role models when it comes to asthma education and health promotion.

Further, the community pharmacists participating in the work completed in this thesis have demonstrated that they can effectively work in collaborative teams with other health care professionals.

It can therefore be concluded that in Australia, interactions with community pharmacists hold great potential. Future work would involve, engaging more pharmacists to deliver these models on a larger scale across Australia, developing a method of integrating these models into the health care system and evaluating the long term effectiveness and sustainability of these models.

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