CALIFORNIA
HEALTH BENEFITS REVIEW PROGRAM

Analysis of Assembly Bill 264-Amended: Pediatric Asthma Self-Management Training and Education Services for Children at High Risk

A Report to the 2006–2007 California Legislature
May 25, 2006

CHBRP 06-08

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A Report to the 2006–2007 California State Legislature

Analysis of Assembly Bill 264-Amended
Pediatric Asthma Self-Management Training and Education Services for Children at High Risk

May 25, 2006

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PREFACE

This report provides an analysis of the medical, financial, and public health impacts of Assembly Bill 264 as amended on March 27, 2006. This bill would require health care service plans that cover outpatient prescription drug benefits to also cover pediatric asthma self-management training and education services in specific settings for children at risk of hospitalization and asthma exacerbations upon the referral of the treating physician. In response to a request from the California Assembly Committee on Health on March 24, 2006, the California Health Benefits Review Program (CHBRP) undertook this analysis pursuant to the provisions of Assembly Bill 1996 (2002) as chaptered in Section 127600, et seq., of the California Health and Safety Code.

Wade Aubry, MD, Janet Coffman, PhD, Patricia Franks, BA, Harold Luft, PhD, and Edward Yelin, PhD, all of the University of California, San Francisco (UCSF), prepared the medical effectiveness analysis. Michael Cabana, MD, of UCSF provided technical assistance with the literature review and clinical expertise for the medical effectiveness analysis. Min-Lin Fang, MLIS, of UCSF conducted the literature search. Nicole Bellows, MHSA, Helen Halpin, PhD, Sara McMenamin, PhD, Janine Santimauro, MPP/MPH, all of the University of California, Berkeley, prepared the public health impact analysis. Meghan Cameron, MPH, Gerald Kominski, PhD, Miriam Laugesen, PhD, Ying-Ying Meng, PhD, and Nadereh Pourat, PhD, of the University of California, Los Angeles, prepared the cost impact analysis. Robert Cosway, FSA, MAAA, of Milliman, provided actuarial analysis. Cynthia Robinson, MPP, of CHBRP staff prepared the background section and synthesized individual sections into a single report. Cherie Wilkerson, BA, provided editing services. In addition, a subcommittee of CHBRP's National Advisory Council (see final pages of this report) and a member of the CHBRP Faculty Task Force, Theodore Ganiats, MD, of the University of California, San Diego, reviewed the analysis for its accuracy, completeness, clarity, and responsiveness to the Legislature's request.

CHBRP gratefully acknowledges all of these contributions but assumes full responsibility for all of the report and its contents. Please direct any questions concerning this report to CHBRP:

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

California Health Benefits Review Program Analysis of Assembly Bill 264-Amended: Pediatric Asthma Self-Management Training and Education Services For High Risk Children

The California Legislature has asked the California Health Benefits Review Program to conduct an evidence-based assessment of the medical, financial, and public health impacts of Assembly Bill 264 as amended on March 27, 2006. AB 264 would amend Section 1367.06 of the California Health and Safety Code. This is CHBRP's second report on AB 264: the analysis of the February 27, 2006 amended version was submitted to the California State Legislature on March 3, 2006.

As amended on March 27, 2006, AB 264 would require a Knox-Keene licensed health care service plan that covers outpatient prescription drug benefits to cover educational interventions in specific settings for pediatric asthma self-management training and education for those children determined by the treating physician to be at risk for worsening symptoms that would lead to emergency room visits or hospitalization.[1] Analysis of this newly proposed "specific settings" requirement for "high risk" children distinguishes this report from CHBRP's previous analysis.

CHBRP's previously-submitted analysis of AB 264 examined the requirement that health plans cover self-management training and education for children with asthma. This analysis will examine the March 27th amended version of AB 264 that also requires health plans to cover education services adding three specific settings to be covered:

- group health education classes for the patient and his or her parent or guardian,
- home-based education and training, and
- school-based education and training.

In the previously-submitted analysis of AB 264, education was to be provided for all children with asthma. In the current amended version of AB 264, coverage is mandated for those children who have been treated in an emergency room "one or more times in one calendar year for an asthma attack" or who are at "high risk." The determination of "high risk" is left to the treating physician based upon broad criteria: whether the child is at "high risk for emergency room visits or hospitalization for an asthmatic episode, or a high number of days of restricted activity, nights of nocturnal asthma, or asthma exacerbations."

Currently, Knox-Keene licensed health plans regulated by the Department of Managed Health Care (DMHC) are required to provide general health education services for enrollees but are not required to cover specific educational strategies for pediatric patients. Current law requires that pediatric asthma education must be consistent with current professional medical practice.

According to the author's staff, the intent of this amendment is to ensure that those children with

[1] Health care service plans, commonly referred to as health maintenance organizations, are regulated and licensed by the California Department of Managed Care (DMHC), as provided in the Knox-Keene Health Care Services Plan Act of 1975. The Knox-Keene Health Care Services Plan Act is codified in the California Health and Safety Code. Specialized health care service plans would be exempt from AB 264.

uncontrolled asthma symptoms have access to in-person educational interventions that have proven successful in community-based settings.

This report evaluates the medical effectiveness, cost, and public health outcomes of the mandate for specific educational strategies for pediatric self-management training and education services for those children at high risk of hospitalization or asthma exacerbations.

I. Medical Effectiveness

The medical effectiveness section of this report summarizes findings from studies of the effects of asthma self-management training and education on children with symptomatic asthma. The review assesses all studies of children with symptomatic asthma because the amendments to AB 264 would give physicians discretion to determine whether a child is at risk for worsening symptoms that could lead to an emergency room visit or hospitalization. Asthma education interventions provided in all types of settings are addressed in the review because the amendments to AB 264 encompass all settings, not just the three settings that are specifically mentioned (i.e., group classes, homes, and schools). Additional analyses were conducted to determine whether results differ by setting or level of risk for worsening asthma symptoms.

- **Asthma Symptoms and Severity.** The asthma self-management training and education programs assessed in the medical literature had favorable effects on a variety of health outcomes for children with asthma. In particular, the programs exhibit a pattern toward favorable effects with respect to reducing the number of days of asthma symptoms, nights of nocturnal asthma, number of asthma exacerbations, and severity of asthma symptoms. There is also a pattern toward improvement in peak expiratory flow rate.

- **Health Care Use.** The literature suggests that asthma self-management training and education programs exhibit a pattern toward favorable effects in reducing the number of emergency room visits and the number of hospitalizations for asthma. However, there is a pattern toward no effect on the probability that a child will be hospitalized for asthma and on use of bronchodilator medications. In addition, the evidence regarding whether asthma self-management training and education affects the number of physician visits for asthma care is ambiguous.

- **Disability Outcomes.** Asthma self-management training and education programs have favorable effects in reducing school absences and increasing participation in other activities. Children who participate in asthma self-management training and education programs have fewer days of restricted activity. There is a pattern toward a favorable effect on decreasing the number of days children are absent from school. The evidence regarding whether asthma self-management training and education affects the number of days caregivers are absent from work to care for a child with asthma is ambiguous.

- **Intermediate Outcomes.** There are patterns toward favorable effects in increasing children's self-efficacy (i.e., children's perceptions of their ability to manage asthma) as well as children's and caregivers' knowledge about asthma. Increases in these

intermediate outcomes have been associated with better self-management behaviors which, in turn, may lead to better health outcomes.

- **Quality of Life.** Asthma self-management training and education programs have a pattern toward favorable effects on the quality of life for children with asthma and their caregivers.

- **Outcomes by Severity of Asthma.** For most outcomes assessed, asthma self-management training and education programs had similar or stronger effects on children who had previously had frequent asthma symptoms or emergency room visits or hospitalizations for asthma than on all children with symptomatic asthma. However, this finding should be interpreted with caution because none of the studies were explicitly designed to test whether results differ for high- and low-risk children with asthma.

- **Outcomes by Setting in Which Education Is Provided.** There is no evidence that providing asthma self-management training and education in any particular type of setting yields *consistently* better outcomes than providing training and education in other settings. For all settings, there are patterns toward favorable findings for most outcomes assessed.

II. Utilization, Cost, and Coverage Impacts

For this analysis, CHBRP uses the 2001 California Health Interview Survey (CHIS 2001) estimates of children who reported having been treated in an emergency room and/or having daily/weekly symptoms, to identify children at high risk and those who had been treated in an emergency room in the previous year. The cost analysis indicates that all children enrolled in health maintenance organizations (HMOs) in California are covered for asthma self-management training and education services, though the methods specified in AB 264, such as group health education classes, and home-based or school-based education or training are less frequently or not provided at all by health plans.

- Approximately 134,000 children with asthma in California (Table 1), who have been treated in an emergency room or who are at high risk, are insured by Knox-Keene licensed health plans obtained through employers, privately-purchased policies, California Public Employees' Retirement System (CalPERS), Medi-Cal, or Healthy Families.

- All children specified above, who are subject to this legislation, are currently covered for asthma self-management and training services. These services include one or more of the following services: individual self-management training and education, individual health education, patient education materials, and group health education.

- The mandate is expected to increase the utilization of pediatric self-management training and education services. This utilization is estimated to increase by approximately 10 percentage points (from 63.2% to 73.2%) for children already covered as a result of increased awareness by both providers and patients of the benefit following enactment of

the mandate (Table 1).

- The mandate is estimated to increase total net expenditures (Table 1) by $1,034,000 (0.002%). This is equivalent to a total increase of $0.0052 in the premium amounts per member per month (PMPM) (Table 6). The magnitude of increase varies by market segment—the large group, small group, and individual market, and the public insurance sectors.

- Costs are estimated to increase by 0.001% for CalPERS, and 0.002% for other small and large employers, as well as for the individual market. Costs of Medi-Cal and Healthy Families are expected to increase 0.007% and 0.017%, respectively.

- The overall net expenditure increase of $1,034,000 reflects an estimated gross cost of $2,355,000 for additional self-management training and education, offset by $1,321,000 in savings associated with reduced emergency room and hospital utilization. Thus, savings in other health care costs offset about 56% of the cost of the mandate. The calculation of the savings are based on the evidence from the medical effectiveness review suggesting that the increased use of self-management training and education services would reduce mean hospitalizations by 22% and mean emergency room visits by 11% for children with asthma.

- The analysis assumes that the mandate will increase the administrative expenses of health plans in proportion to the increases in health care costs.

Table 1. Summary of Coverage, Utilization, and Cost Effects of AB 264-Amended

	Before Mandate	After Mandate	Increase/ Decrease	% Change After Mandate
Coverage				
Percent of insured children aged 1–17 years with coverage for mandated benefit	100.0%	100.0%	—	0.0%
Number of insured children aged 1–17 years in California with coverage for the benefit	5,340,000	5,340,000	—	0.0%
Percent of covered children aged 1–17 years in California with high-risk asthma	2.5%	2.5%	—	0.0%
Number of covered children aged 1–17 years in California with high-risk asthma	134,000	134,000	—	0.0%
Utilization				
Percent of children aged 1–17 years with high-risk asthma receiving education	63.2%	73.2%	10.0%	16%
Number of children aged 1–17 years with high-risk asthma receiving education	84,000	98,000	14,000	17%
Number of emergency room visits per child with high-risk asthma	0.2037	0.2013	(0.0024)	–1.2%
Number of inpatient admissions per child with high-risk asthma	0.0548	0.0534	(0.0014)	–2.6%
Expenditures				
Premium expenditures by private employers for group insurance	25,936,592,000	25,937,020,000	428,000	0.002%
Premium expenditures for individually purchased insurance	3,041,505,000	3,041,556,000	51,000	0.002%
CalPERS employer expenditures	2,330,367,000	2,330,399,000	32,000	0.001%
Medi-Cal state expenditures	4,334,532,000	4,334,759,000	227,000	0.005%
Healthy Families state expenditures	644,314,000	644,426,000	112,000	0.017%
Premium expenditures by employees with group insurance or CalPERS, and by individuals with Healthy Families	8,948,536,000	8,948,689,000	153,000	0.002%
Individual out-of-pocket expenditures (deductibles, copayments, etc.)	1,724,145,000	1,724,176,000	31,000	0.002%
Expenditures for non-covered services	—	—	—	N/A
				0.002%
Total annual expenditures	46,959,991,000	46,961,025,000	1,034,000	0.002%

Source: California Health Benefits Review Program, 2006.
Note: The population includes individuals and dependents who are in Knox-Keene licensed plans (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families. All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage. Employees and their dependents who receive their coverage from self-insured firms are excluded because these plans are not subject to mandates.
Key: CalPERS = California Public Employees' Retirement System.

III. Public Health Impacts

- In California, it is estimated that 2.5% of insured children ages 1–17 years have high-risk asthma (identified using 2001 CHIS as those who have visited an emergency room in the past 12 months or reported daily or weekly symptoms of asthma). The baseline data suggest that adolescents (ages 12–17 years) in California with high-risk asthma missed an average of 1.4 days of school in the last four weeks due to their health condition and 79.3% of children (ages 1–11 years) with high-risk asthma reported that they experienced restricted physical activity due to their asthma. More than three-fourths of children with high-risk asthma report they currently take medicine for their asthma. In California in 2002, 23 deaths due to asthma were reported among children 1–19 years old.

- It is estimated that as a result of the mandate among children with high-risk asthma, there would be a total reduction of approximately 4,000 days of missed school each month due to asthma, or approximately 36,000 fewer days of missed school per year (assuming a nine9-month school year); 2,000 fewer children reporting that their physical activity is limited due to asthma; 300 fewer emergency department visits; and 160 fewer hospitalizations for asthma-related conditions.

- Males have higher rates of high-risk asthma compared to females, yet rates of asthma self-management education do not vary significantly between the two groups. Similarly, blacks have higher rates of asthma diagnoses compared to whites and Hispanics, yet rates of asthma self-management education do not vary significantly by race. Therefore, it does not appear that there are current disparities in asthma self-management education that would be affected by AB 264. Thus, AB 264 is not expected to affect gender or racial disparities in asthma management.

- Mortality among children with asthma is relatively rare. In California in 2002, 23 deaths due to asthma were reported among children 1–19 years. Reductions in childhood mortality have not been examined as a potential health outcome since mortality is such a rare occurrence among this population. As a result, CHBRP is not able to determine whether AB 264 would have any impact on premature death associated with high-risk childhood asthma.

- This analysis has found that approximately 36,000 missed school days per year would be averted with the passage of AB 264. As a result, there would likely be productivity gains in California through a decrease in lost workdays of caregivers. The extent to which these productivity gains would be realized, however, is unclear since the evidence regarding caregiver workdays as an outcome in examining the effectiveness of asthma management programs is ambiguous.

INTRODUCTION

This report analyzes Assembly Bill 264, as amended on March 27, 2006. AB 264 was introduced on February 8, 2005, amended on February 27, 2006, and subsequently amended on March 27, 2006. In response to a request from the Assembly Health Committee on March 24, 2006, the California Health Benefits Review Program (CHBRP) undertook this analysis pursuant to Assembly Bill 1996 (Statutes of 2002, Chapter 795).

As amended on March 27, 2006, AB 264 would require a Knox-Keene licensed health care service plan that covers outpatient prescription drug benefits to cover educational interventions in specific settings for pediatric asthma self-management training and education for those children determined by the treating physician to be at risk for worsening symptoms that would lead to emergency room visits or hospitalization.[2] Analysis of this newly proposed "specific settings" requirement for "high risk" children distinguishes this report from CHBRP's previously-submitted analysis.

CHBRP's previously-submitted analysis of AB 264 examined the requirement that health plans cover self-management training and education for children with asthma. This analysis will examine the March 27th amended version of AB 264 that also requires health plans to cover education services adding three specific settings to be covered:

- group health education classes for the patient and his or her parent or guardian,
- home-based education and training, and
- school-based education and training.

In the previously-submitted analysis of AB 264, education was to be provided for all children with asthma. In the current amended version of AB 264, coverage is mandated for those children who have been treated in an emergency room "one or more times in one calendar year for an asthma attack" or who are at "high risk." The determination of "high risk" is left to the treating physician based upon broad criteria: whether the child is at "high risk for emergency room visits or hospitalization for an asthmatic episode, or a high number of days of restricted activity, nights of nocturnal asthma, or asthma exacerbations."

As in the prior analysis, CHBRP determined that the AB 264 mandate applies to privately insured children (1–17 years) with prescription drug coverage (and their families) who are enrolled in health service plans regulated by the California Department of Managed Care (DMHC)[3] as well as to children (and their families) with prescription drug coverage who are enrolled in health service plans purchased by California Public Employees' Retirement System (CalPERS) and state-administered programs (e.g., Medi-Cal, Healthy Families).

In both the prior and current versions of this bill, pediatric asthma self-management training and

[2] Health care service plans, commonly referred to as health maintenance organizations, are regulated and licensed by the California Department of Managed Care (DMHC), as provided in the Knox-Keene Health Care Services Plan Act of 1975. The Knox-Keene Health Care Services Plan Act is codified in the California Health and Safety Code. Specialized health care service plans would be exempt from AB 264.

[3] Children ages 0–1 year are excluded from the affected population because asthma is not commonly formally diagnosed in this age group.

education is defined as those services "prescribed by a participating health care professional legally authorized to prescribe the services," including education "necessary to enable an enrollee to properly use the medications and devices prescribed for the treatment of pediatric asthma" and "instruction that will enable pediatric asthmatic patients and their families to gain an understanding of the disease process and the daily management of asthma in order to avoid frequent hospitalizations and complications." In both versions of the bill, services are to be provided "under the supervision of an appropriately licensed or registered health care professional."

Currently, Knox-Keene licensed health plans regulated by the Department of Managed Health Care (DMHC) are required to provide general health education services for enrollees.[4] As of January 2005, health plans are also required to ensure that education for pediatric asthma, including education to enable an enrollee to properly use medically necessary devices (e.g., inhaler spacers, nebulizers, and peak flow meters) is "consistent with current professional medical practice." (Health and Safety Code, Section 1367.06; AB 2185, Frommer).[5] There is no requirement in current law for pediatric asthma self-management and training.

According to the author's staff, the intent of this amendment is to ensure that those children with uncontrolled asthma symptoms have access to in-person educational interventions that have proven successful in community-based settings. The previous completed CHBRP analysis indicated that health plans currently provide access to some type of patient education; however, the interventions in settings specified by the March 27th version of AB 264 are not widely used. Common strategies for patient education include visits with providers, provision of educational materials, and toll-free nurse advice lines. A minority of health plans provide coverage for group education classes or home-based visits. No plans provide coverage for school-based programs.

This report analyzes medical effectiveness, cost, and public health outcomes of a mandate for specific educational strategies for pediatric self-management training and education services targeted to those children at high risk of hospitalization or asthma exacerbations.

[4] Knox-Keene licensed health plans are required to provide all "basic health care services." (Health and Safety Code, Section 1367, subd.(i)) DMHC has defined these basic health care services to include preventive health services. Preventive health services include effective health education services, including information regarding personal health behavior and health care, and recommendations regarding the optimal use of health care services provided by the plan or health care organizations affiliated with the plan.(Health and Safety Code, Section 1345(b)(5))These services are provided "under a physician's supervision."(California Code of Regulations, Section 1300.67(f) (8)).

[5] The National Heart, Lung, and Blood Institute's National Asthma Education and Prevention Program Guidelines for the Diagnosis and Management of Asthma are recognized as the standard of care nationally. However, the state does not require local medical practice to be consistent with these national guidelines.

I. MEDICAL EFFECTIVENESS

Successful management of children with asthma depends heavily on the actions of children and their caregivers. In many children, asthma symptoms are caused by environmental factors, some of which can be controlled by their caregivers, such as exposure to tobacco smoke, dust mites, cockroaches, and rodents. Effective treatment of asthma exacerbations (colloquially referred to as "asthma attacks") requires that children and parents recognize asthma symptoms and administer medications promptly and effectively. Some children need to take medications on a daily basis or before engaging in exercise to prevent exacerbations. Caregivers play an especially important role in caring for children with asthma because children may not be able to manage their asthma without assistance and may not be able to communicate effectively with their health care providers.

The goal of asthma self-management training and education is to teach children and their caregivers how to accomplish tasks that will enable them to control asthma. The National Heart, Lung, and Blood Institute's (NHLBI) *Guidelines for the Diagnosis and Management of Asthma* recommends that asthma self-management education encompass instruction regarding basic facts about asthma, correct use of medications (e.g., when and how to use an inhaler or nebulizer), self-monitoring skills, and strategies for controlling or avoiding environmental factors that cause asthma symptoms (NHLBI, 1997, pg. 125). The NHLBI guidelines also recommend that "patient education should begin at the time of diagnosis and be integrated into every step of medical care" (NHLBI, 1997, pg. 124).

Studies of the medical effectiveness of asthma self-management training and education interventions were identified through searches of the PubMed, CINAHL, and Cochrane databases, including the Cochrane Database of Systematic Reviews and the Cochrane Central Register of Controlled Trials (CENTRAL). The literature review for this report updates the literature reviews that CHBRP conducted for AB 264 as introduced earlier in this legislative session and for AB 1549 and AB 2185, two bills on childhood asthma self-management training and education that were introduced in 2003 and 2004, respectively. Only articles published in 2005 or 2006 were retrieved because the previous CHBRP literature review encompassed all relevant literature published prior to 2005. These new articles were added to articles identified in the previous searches.

A more thorough description of the methods used to conduct the medical effectiveness review and the process used to grade the evidence for each outcome measure may be found in Appendix A: Literature Review Methods. Tables presenting detailed findings for each outcome measure may be found in Appendix B: Summary of Medical Effectiveness Findings on Pediatric Asthma Self-Management Training and Education.

The search was limited to abstracts of peer-reviewed studies of children with asthma, defined as subjects aged 0–18 years.[6] Trials that included adults with asthma were excluded unless sub-

[6] Although children become adults at age 18, PubMed's age group category for children encompasses all persons aged 0 to 18 years. Only studies in which the vast majority of children were aged 0 to 17 years were included in the literature review. Studies in which most children were aged 0—1 year were excluded from the analysis because asthma symptoms cannot be distinguished from symptoms of other illnesses experienced by infants.

group analyses were performed for children. Only trials conducted in the United States were included in the review. The review encompassed meta-analyses, systematic reviews, randomized controlled trials, controlled clinical trials, and observational studies. Through the literature search, two recent meta-analyses published in the Cochrane Database of Systematic Reviews were identified (Haby et al., 2001; Wolf et al., 2003). Results from the meta-analyses were given substantial weight in decisions about the effectiveness of pediatric asthma self-management training and education interventions because the authors of meta-analyses pool results from multiple studies and apply rigorous methodological criteria prior to the inclusion of each article in their analyses. All other trials reviewed were published subsequent to the studies assessed by the meta-analyses.[7]

The scope of the literature search included studies of the effects of asthma self-management education and training interventions for children with asthma, written self-management action plans, and monitoring interventions, such as recording symptoms and pulmonary function in a paper or electronic diary. In most trials, the intervention was delivered by a health professional or a lay person trained to provide asthma education. Some trials assessed computer-assisted instructional games about asthma and internet-enabled, interactive multimedia devices. Due to the difficulty of distinguishing between educational and self-management interventions, any trial in which the intervention included an educational or self-management component was reviewed.

The medical effectiveness section of this report summarizes findings from studies of the effects of asthma self-management training and education on children with symptomatic asthma. The review assesses all studies of children with symptomatic asthma because the amendments to AB 264 would give physicians discretion to determine whether a child is at risk for worsening symptoms that could lead to an emergency room visit or hospitalization. Asthma education interventions provided in all types of settings are addressed in the review because the amendments to AB 264 encompass all settings, not just the three settings specifically mentioned (i.e., group classes, homes, and schools). Additional analyses were conducted to determine whether results differ by setting or level of risk for worsening asthma symptoms.

The scope and content of the asthma self-management training and education interventions varied widely across the studies. Due to a lack of sufficient evidence or inadequate program descriptions, the effectiveness of the various components of these programs could not be determined, nor was it possible to ascertain whether a specific intervention program was more effective than another. Most studies compared children who received an intervention to children who received their usual care for asthma. These studies were used to make all quantitative estimates. However, some studies compared interventions of varying intensity (e.g., seven home visits vs. one home visit) or modality (e.g., interactive media vs. in-person) and these were included in the qualitative assessment of effects. Table B-1 in Appendix B contains descriptions of the intervention and control groups. The trials also varied with respect to the setting in which the intervention was conducted (e.g., outpatient medical office, home, or school) and the manner in which the intervention was delivered (e.g., individual counseling, classes, or interactive computer programs). Some trials focused on specific groups of children with asthma, such as

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[7] Although the meta-analyses were published in 2001 and 2003, they only reviewed studies published prior to 1999.

children who had a hospitalization or an emergency room visit for asthma or children who live in low-income, inner-city areas.

Studies of the medical effectiveness of pediatric asthma self-management training and education assess the effects of self-management training and education on five categories of outcomes:

- health outcomes,
- health services utilization outcomes,
- disability outcomes,
- intermediate outcomes, such as self-efficacy in coping with pediatric asthma and knowledge about managing asthma, and
- quality-of-life outcomes.

The findings from the literature review follow. Overall findings for each category of outcomes are presented first. The discussion of overall findings is similar to the discussion in CHBRP's report on AB 264 as introduced, except for the addition of six new studies. Next, findings from additional analyses to determine whether results differ by setting or level of risk for worsening asthma symptoms are presented. Results from all studies of children with symptomatic asthma are compared to results from studies of children whose prior medical history suggests that they are at high risk for worsening asthma symptoms. Findings for studies of asthma education interventions conducted in the three types of settings enumerated in the amendments to AB 264 are compared to findings for interventions delivered in other settings.[8]

Findings

Asthma symptoms and severity

Days of asthma symptoms

Sixteen studies examined the effects of pediatric asthma self-management training and education on the number of days children experience asthma symptoms. Ten studies (Bonner et al., 2002; Butz, Pham, et al., 2005a; Clark et al., 2004; Evans et al., 1987; Evans et al., 1999; Krishna et al., 2003; Morgan et al., 2004; Tinkelman and Schwartz, 2004; Velsor-Friedrich et al., 2004, Yoos et al., 2002) found statistically significant reductions in the number of days of asthma symptoms for children participating in a pediatric asthma self-management training and education intervention. Five studies (Eggleston et al., 2005; Fireman et al., 1981; Krieger et al., 2005; Shames et al., 2004; Velsor-Friedrich et al., 2005) found a statistically nonsignificant decrease in days with asthma symptoms for the intervention group compared with the control group. One study found no difference in the decrease in days of asthma symptoms between children who received asthma education interventions of differing intensity (Walders et al., 2006). This study compared two asthma education interventions of differing intensity. The more-intensive intervention did not

[8] To assess whether the findings from the literature review were generalizable to children with asthma in California, results of four individual studies completed in California were compared to results of the two meta-analyses and 43 individual studies completed elsewhere. Findings from studies conducted outside California were similar to findings from the studies conducted in California.

reduce days of symptoms beyond reductions achieved by the less-intensive intervention. This finding differs from studies that compared a group of children that received an asthma education intervention to a group that received usual care for asthma. Overall, the preponderance of the evidence suggests that pediatric asthma self-management training and education interventions have a pattern toward favorable effects in reducing the number of days of asthma symptoms experienced by children with asthma.

Symptom-free days

Two randomized controlled trials examined the effect of pediatric asthma self-management training and education on the number of symptom-free days reported by children with asthma. Wilson and colleagues (1996) reported a statistically significant increase in symptom-free days in the intervention group. Brown and colleagues (2002) found a statistically significant increase for children aged 1–3 years but no difference for children aged 4–6 years. Overall, the evidence suggests that self-management training and education have favorable effects in increasing the number of symptom-free days for children with asthma.

Symptom scores

Symptom scores are a subjective measurement of how much a patient is bothered by symptoms or how often a patient experiences asthma symptoms. Two trials (Christiansen et al., 1997; Georgiou et al., 2003) demonstrated a statistically significant effect of pediatric asthma self-management training and education on improving symptom scores for children with asthma. Another trial (Bartholomew et al., 2000) demonstrated a statistically nonsignificant but positive effect. One study found no difference in the change in symptom scores in the intervention and control groups (Walders et al., 2006). However, the overall pattern of the evidence suggests that self-management training and education interventions have a pattern toward favorable effects on improving symptom scores for children with asthma.

Nocturnal asthma

One meta-analysis (Wolf et al., 2003) found that pediatric asthma self-management training and education were associated with statistically significant decreases in nights of nocturnal asthma. Four studies published subsequent to the studies reviewed in the meta-analysis reached the same conclusion (Butz, Pham, et al., 2005; Georgiou et al., 2003; Morgan et al., 2004; Tinkelman and Schwartz, 2004). Two randomized controlled trials reported that nights of nocturnal asthma decreased at similar rates in the intervention and control groups (Eggleston et al., 2005; Krishna et al., 2003). One study that used a nested design[9] found that children in the intervention group had more nights of nocturnal asthma than children in the control group and that the difference was statistically significant (Clark et al., 2004). One randomized controlled trial found that nights

[9] A nested design is a research design in which subjects are grouped into organizational or geographic units. The organizational or geographic units are randomized to either the intervention or the control group. All eligible subjects in the intervention units receive the intervention, and none of the eligible subjects in the control units receive it. Nested designs are often used in studies of educational interventions provided in schools that aim to assess the intervention's effects on individual children. Schools are randomized rather than children to prevent children in the control group from being exposed to the intervention.

of nocturnal asthma increased in both the intervention and control groups (Wilson et al., 1996). Overall, however, the evidence suggests that pediatric asthma self-management training and education interventions have a pattern toward favorable effect in reducing the mean number of nights with nocturnal asthma for children.

Asthma severity

Asthma severity is often defined subjectively rather than being measured in a standard way. The measures of asthma severity in the trials that were reviewed ranged from characterizations of days of asthma as being mild, moderate, or severe (Butz, Pham, et al., 2005; Homer et al., 2000; Huss et al., 2003; LeBaron et al., 1985; Minai et al., 2004; Whitman et al., 1985); the degree to which children were bothered by symptoms (Wilson et al., 1996); and functional measures, such as functional status (Bartholomew et al., 2000) and the ability of children with asthma to perform their chores (Perrin et al., 1992). One meta-analysis (Wolf et al., 2003) pooled trials using various definitions and found that asthma severity decreased in children who had received pediatric self-management training and education, but the findings were not statistically significant. Three studies published subsequent to the studies reviewed in the meta-analysis reported statistically significant effects showing reduced severity (Butz, Pham, et al., 2005; Georgiou et al., 2003; Yoos et al., 2002). One study found effects that were favorable but not statistically significant (Bartholomew et al., 2000). One observational study reported no difference in severity (Minai et al., 2004). Two studies report a greater decrease in asthma severity in the control group than in the intervention group but that the difference was not statistically significant (Homer et al., 2000; Huss et al., 2003). One study reported that the proportion of children with severe asthma increased in the intervention group but not in the control group and that the difference was statistically significant (Harish et al., 2001). Overall, however, the evidence suggests that pediatric asthma self-management training and education interventions demonstrate a pattern toward favorable effects in reducing asthma severity in children.

Exacerbations

"Exacerbations" are defined as acute episodes of asthma. One meta-analysis (Wolf et al., 2003) assessed the effects of pediatric asthma self-management interventions on asthma exacerbations. The meta-analysis found a reduction in the mean number of exacerbations experienced by children with asthma, but the reduction was not statistically significant. Thus, the evidence suggests that pediatric asthma self-management training and education interventions exhibit a pattern toward a favorable effect in reducing the mean number of exacerbations for children with symptomatic asthma.

Peak Expiratory Flow Rate

Peak expiratory flow rate (PEFR) measures lung function as the maximum rate of airflow that can be achieved during a sudden forced expiration following full inhalation. One meta-analysis (Wolf et al., 2003) found that pediatric asthma self-management training and education improved PEFR by a statistically significant amount. Two trials published subsequent to the studies included in the meta-analysis also found that pediatric asthma self-management training and

education improved PEFR by a statistically significant amount (Guendelman et al., 2002; Velsor-Friedrich et al., 2004). One study published after the meta-analysis found that children in the intervention group experienced a larger increase in PEFR than children in the control group but that the increase was not statistically significant (Shames et al., 2004;). Two studies reported no difference in PEFR in the intervention and control groups (Morgan et al., 2004; Velsor-Friedrich et al., 2005). Overall, however, the evidence suggests that pediatric asthma self-management training and education interventions a pattern of favorable effects on improving PEFR.

Health care utilization

Emergency department utilization

One meta-analysis concluded that children with asthma who received self-management training and education experienced a statistically significant reduction in the mean number of emergency department visits for asthma (Wolf et al., 2003). Seven trials published subsequent to the studies assessed in that meta-analysis (Anderson et al., 2004; Greineder et al., 1999; Harish et al., 2001; Kelly et al., 2000; Krishna et al., 2003; La Roche et al., 2006; Shelledy et al., 2005) also found that pediatric asthma self-management training and education reduced emergency department visits for asthma by a statistically significant amount. Four studies (Bartholomew et al., 2000; Catov et al., 2005; Homer et al., 2000; Morgan et al., 2004) found no difference in mean emergency department visits by children in the intervention and control groups. Overall, the evidence suggests that pediatric asthma self-management training and education interventions exhibit a pattern toward favorable effects in reducing the mean number of asthma-related visits to the emergency department. Based on studies in which children in the control group received usual care for asthma, mean emergency department visits per child are estimated to decrease by 11%.[10]

One meta-analysis (Haby et al., 2001) reviewed studies of children who previously had an emergency department visit for asthma. The authors found that a lower percentage of children who received asthma self-management interventions were readmitted to the emergency department for asthma, but that the difference was not statistically significant. Three studies published after the studies included in the meta-analysis also found reductions in the percentage of children who had one or more emergency room visits that were not statistically significant (Butz, Pham, et al. 2005; Guendelman et al., 2002; Harish et al., 2001). One study reported that children in the intervention group had a higher risk of having an emergency department visit than children in the control group (Lukacs et al., 2002). Overall, the evidence suggests a pattern toward favorable effects in reducing the percentage of children with asthma who visit the emergency department. Based on studies in which children in the control group received only usual care for asthma, the percentage of children with at least one emergency department visit for asthma is estimated to decrease by 28%.

[10] All quantitative estimates of the effects of asthma self-management training and education were computed by calculating the proportionate effect of the intervention in individual studies that address the outcome of interest and then computing the weighted average proportionate effect across the studies to obtain estimates of absolute differences. Studies were weighted by sample size. These estimates are highly sensitive to the results of the individual studies included.

Hospitalization

One meta-analysis found that asthma self-management and training reduced the mean number of hospital admissions for asthma, but that the difference was not statistically significant (Wolf et al., 2003). Among the trials published after the studies included in the meta-analysis, two randomized trials (Bartholomew et al., 2000; Greineder et al., 1999) and three observational studies (Anderson et al., 2004; Kelly et al., 2000; Shelledy et al., 2005) found that the intervention reduced the mean number of hospitalizations for asthma by a statistically significant amount. Two studies (Catov et al., 2005; Harish et al., 2001) reported no difference in mean hospitalizations. One randomized controlled trial in which the intervention and control groups received different types of educational interventions found that mean hospitalizations decreased in the control group but not in the intervention group (Krishna et al., 2003). However, the preponderance of the evidence suggests a pattern toward favorable effects of pediatric asthma self-management training and education on reducing the mean number of asthma-related hospitalizations. Based on studies in which children in the control group received only their usual care for asthma, the mean number of hospitalizations per child for asthma is estimated to decrease by 22%.

One meta-analysis (Haby et al., 2001) examined the effects of pediatric asthma self-management interventions on the probability of hospitalization for asthma among children who previously had an emergency department visit for asthma. The authors found that the rate of hospitalization for asthma was lower among children who participated in an asthma self-management and training intervention, but that the difference was not statistically significant. One study published after the studies included in the meta-analysis also found a lower rate of hospitalization for asthma among children who received the intervention, but that the difference was not statistically significant (Evans et al., 1999). Three studies found no difference in the percentage of children hospitalized in the intervention and control groups (Butz, Pham et al., 2005; Guendelman et al., 2002; Harish et al., 2001). Two studies reported that children in the intervention group were more likely to be hospitalized than children in the control group, but the difference was not statistically significant (Lukacs et al., 2002; Morgan et al., 2004). The lack of statistically significant findings suggests that pediatric asthma self-management training and education has a pattern toward no effect on the percentage of children hospitalized. Based on studies in which the children in the control group only received usual care for asthma, the percentage of children hospitalized for asthma is estimated to decrease by 6%.[11]

Acute and urgent physician visits versus routine visits

One meta-analysis found that pediatric asthma self-management training and education was associated with a decrease in mean office visits, but that the decrease was not statistically significant. To develop a clearer picture of the evidence, studies that measured only urgent or

[11] The difference in the qualitative call and the quantitative estimate for this outcome reflects differences in the methods used to arrive at the two conclusions. Qualitative calls consider whether findings are statistically significant and place greater weight on findings from meta-analyses than on findings from individual studies. Quantitative estimates are weighted averages of findings from individual studies and do not take statistical significance into account.

unscheduled visits to a primary care provider were examined. Whereas urgent or unscheduled visits suggest that a child is having an exacerbation, scheduled visits enhance asthma management by enabling the primary care provider to assess the child's health and adjust the child's treatment regimen if necessary. One meta-analysis (Haby et al., 2001) and two randomized controlled trials (Brown et al., 2002; Morgan et al., 2004) demonstrated a reduction in the number of urgent or unscheduled visits for children who received pediatric asthma self-management training and education; however, the reductions were not statistically significant. Three studies reported no difference in the mean number of urgent or unscheduled visits (Evans et al., 1987; Homer et al., 2000; Krishna et al., 2003). Two studies (Lukacs et al., 2002; Velsor-Friedrich et al., 2004) found that children in the intervention group had more urgent physician visits than children in the control group. Thus, the evidence regarding whether pediatric asthma self-management training and education affects the number of urgent or unscheduled physician visits is ambiguous.

Use of medications: inhaled corticosteroids

Some children have intermittent asthma that can be managed effectively by limiting exposure to environmental factors that trigger asthma symptoms and by taking bronchodilators when acute symptoms occur. Other children have persistent asthma and need to take medication daily to control their symptoms. Inhaled corticosteroids are among the most frequently used long-term controller medications. One study that sought to improve adherence to recommended asthma treatment regimens found that the percentage of children with a prescription for an inhaled corticosteroid increased among children who participated in the asthma self-management and education intervention and that the difference was statistically significant (Bonner et al., 2002). One study reported a statistically significant increase in the probability that children in the intervention group use one or more canisters of an inhaled corticosteroid (Lukacs et al., 2002). The authors state that this finding suggests that more children in the intervention group were using an inhaled corticosteroid as a long-term control medication than as a quick-relief medication, thus indicating better asthma management practices. Another study found that the daily dose of inhaled corticosteroids increased less rapidly among children in the intervention group than among children in the control group and that the difference was statistically significant. This finding suggests asthma was under better control among children in the intervention group than among those in the control group (Krishna et al., 2003). Overall, pediatric asthma self-management training and education has favorable effects on use of inhaled corticosteroids.

Use of medications: short-acting beta2-agonists and other bronchodilators

Two randomized controlled trials examined the impact of pediatric asthma self-management training and education on use of short-acting beta2-agonists and other bronchodilator medications that are used to relieve asthma acute asthma symptoms. The studies found that mean days of bronchodilator use decreased in both the intervention and control groups and that there were no statistically significant differences between the groups (Krieger et al., 2005; Shames et al., 2004). Overall, there is a pattern toward no effect of pediatric asthma self-management training and education on use of bronchodilators.

Disability outcomes

School absences

One meta-analysis (Wolf et al., 2003) found pediatric asthma self-management training and education interventions had a statistically significant effect in reducing school absences. Four studies (Clark et al., 2004; Krishna et al., 2003; Morgan et al., 2004; Shelledy et al., 2005) published after the meta-analysis also found a statistically significant reductions in school absences. Two studies found reductions in mean absences that were not statistically significant (Velsor-Friedrich et al., 2004; Velsor-Friedrich et al., 2005). One study with a small sample size found no difference in mean absences in the intervention group and the control group (Horner, 2004). Overall, however, the evidence suggests that pediatric asthma self-management training and education has a pattern toward favorable effects on reducing the mean number of days children with asthma are absent from school. Based on an analysis of studies in which children in the control group received usual care for pediatric asthma, the mean number of days absent due to asthma is estimated to decrease by 26%.

Three studies measured the proportion of children with asthma who reported any school absences following self-management training and education. Georgiou and colleagues (2003) demonstrated a statistically significant reduction in the proportion of children with asthma who missed school in the past six weeks. However, the study design was an uncontrolled, longitudinal survey and thus prone to more biases than a randomized controlled trial. The randomized controlled trials by Guendelman et al. (2002) and Krieger et al. (2005) found a reduction in the proportion of children reporting school absences, but the difference was not statistically significant. Thus, the evidence suggests that self-management training and education shows a pattern toward favorable effects in reducing the proportion of children with asthma who report any school absences. Based on an analysis of studies in which children in the control group received only usual care for asthma, the percentage of children absent due to asthma is estimated to decrease by 43%.

Restricted-activity days

Three studies examined the effects of pediatric asthma self-management training and education on the number of days of restricted activity for children with asthma (Krieger et al., 2005; Krishna et al., 2003; Morgan et al., 2004). All three studies found that children who participated in a pediatric asthma education intervention had fewer days of restricted activity than children in the control group and that the difference was statistically significant. Thus, these findings suggest that pediatric asthma self-management training and education has a favorable effect in reducing the number of restricted-activity days. Based on an analysis of studies in which children in the control group received only usual care for asthma, the mean number of restricted-activity days per child is estimated to decrease by 16%.

One recent study (Guendelman et al., 2002) reported that children who participated in a pediatric asthma self-management training and education intervention were less likely to experience one or more days with restricted activity. Another study reported no difference in the percentage of

children reporting one or more days of restricted activity (Eggleston et al., 2005). The difference in the findings from these two studies suggests that the effect of asthma self-management training and education on the percentage of children experiencing restricted-activity days is ambiguous. Based on studies in which children in the control group received only usual care for asthma, the percentage of children with one or more days of restricted activity decreased by 19%.[12]

Caregiver absences from work

Three studies examined the effects of pediatric asthma self-management training and education on caregivers' absences from work. One observational study found that caregivers of children in the intervention group experienced a statistically significant decrease in work absences (Georgiou et al., 2003). Tinkelman and Schwartz (2004) also reported a decrease in work absences in the intervention group, but the difference was not statistically significant. One randomized controlled trial found no difference in work absences between caregivers in the intervention and control groups (Krieger et al., 2005). Overall, the evidence regarding whether pediatric asthma self-management training and education affects caregivers' absences from work is ambiguous.

Intermediate outcomes

Self-efficacy

Self-efficacy is defined as "the belief in one's capabilities to organize and execute the sources of action required to manage prospective situations" (Bandura, 1995). The studies reviewed assessed measures of coping skills and health locus of control scales (a metric of how much control people feel they have over their health). One meta-analysis (Wolf et al., 2003) found a statistically significant increase in reported self-efficacy among children who participated in pediatric asthma self-management training and education interventions. Three studies published after the studies included in the meta-analysis (Bonner et al., 2002; Butz, Pham, et al. 2005; Shegog et al., 2001) also found statistically significant increases in the self-efficacy of children with asthma following self-management training and education. Three studies found no difference in the self-efficacy of children in the intervention and control groups (Bartholomew et al., 2000; Velsor-Friedrich et al., 2004; Velsor-Friedrich et al., 2005). However, overall, the evidence suggests that pediatric asthma self-management training and education interventions have a pattern toward favorable effects on increasing children's self-efficacy in managing their asthma.

[12] The difference in the qualitative call and the quantitative estimate for this outcome reflects differences in the methods used to arrive at the two conclusions. Qualitative calls consider whether findings are statistically significant and place greater weight on findings from meta-analyses than on findings from individual studies. Quantitative estimates are weighted averages of findings from individual studies and do not take statistical significance into account.

Knowledge: children with asthma

Studies that examine the effects of pediatric asthma self-management training and education interventions on knowledge of asthma used a variety of instruments to measure knowledge. Nine trials found that children with asthma who received self-management training and education experienced statistically significant improvements in their knowledge of asthma and its management (Bonner et al., 2002; Christiansen et al., 1997; Homer et al., 2000; Krishna et al., 2003; LeBaron et al., 1985; Parcel et al., 1980; Perrin et al., 1992; Rubin et al., 1986; Whitman et al., 1985). Two studies found an increase in children's knowledge about asthma that was not statistically significant (La Roche et al., 2006; 1996; Shames et al., 2004;). Six studies reported no difference in knowledge of asthma between children in the intervention and control groups (Bartholomew et al., 2000; Lewis et al., 1984; Persaud et al., 1996; Shegog et al., 2001; Velsor-Friedrich et al., 2004; Velsor-Friedrich et al., 2005). One trial found a statistically significant increase in asthma knowledge among children in 1st and 2nd grade and an increase among children in 3rd, 4th, and 5th grades that was not statistically significant (Butz, Pham, et al., 2005). Overall, the findings suggest that pediatric asthma self-management training and education exhibits a pattern of favorable effects on increasing children's knowledge of their condition.

Knowledge: caregiver

Eight studies assessed the effects of pediatric asthma self-management training and education interventions on caregivers' knowledge of asthma. As with children's knowledge of asthma, the studies used varying instruments to measure caregivers' knowledge. Four studies (Butz, Pham, et al., 2005; Krishna et al., 2003; La Roche et al., 2006; Shames et al., 2004) found a statistically significant increase in caregiver knowledge. One study found an increase in caregiver knowledge that was not statistically significant (Homer et al.., 2000). Three studies found no difference (Butz, Syron et al., 2005; Persaud et al., 1996; Rubin et al., 1986). Thus, the evidence suggests that pediatric asthma self-management training and education exhibits a pattern of favorable effects on increasing caregiver knowledge about asthma and its management.

Quality-of-life effects

Quality of life: child

Quality of life concerns physical and emotional well-being, as well as happiness, in aspects of life a person considers important. Studies that analyzed the effects of pediatric asthma self-management training and education on quality of life used several different instruments to measure quality of life. Four studies found that quality of life for children with asthma who participated in the pediatric asthma self-management training and education intervention improved by a statistically significant amount (Evans et al., 1987; Georgiou et al., 2003; Perrin et al., 1992; Shames et al., 2004). One study found an increase in children's quality of life that was not statistically significant (Tinkelman and Schwartz, 2004). Brown and colleagues (2002) reported that asthma education was associated with a statistically significant increase in quality of life for children aged one to three years, but had no effect on quality of life for children aged 4 to 6 years. Three studies reported no difference in the quality of life of children in the

intervention and control groups (Butz, Pham, et al., 2005; Eggleston et al., 2005; Walders et al., 2006). In two cases, findings for the intervention and control groups may not differ because the children in the control group received more than usual care for asthma. All of the children enrolled in Eggleston and colleagues' (2005) evaluation of an individualized, home-based asthma education program were previously enrolled in a school-based asthma education intervention program. Walders and colleagues' (2006) study compared children who received interventions of differing intensities. In both cases, the more intensive intervention had no effect beyond the effect of the less intensive intervention. However, the overall pattern of the evidence suggests that self-management training and education interventions have a pattern toward favorable effects on the quality of life of children with asthma.

Quality of life: caregiver

Three trials assessed the impact of pediatric asthma self-management training and education on the quality of life of caregivers of children with asthma. One trial found a statistically significant increase in quality of life among caregivers of children with asthma who had participated in a self-management training and education intervention (Krieger et al., 2005). One study (Butz, Pham, et al., 2005) reported no difference in quality of life between caregivers in the intervention and control groups. One trial (Brown et al., 2002) found a statistically significant increase in quality of life for caregivers of younger children (aged 1–3 years) in the intervention group, but no difference for caregivers of older children. Overall, the evidence suggests a pattern toward a favorable effect of pediatric asthma self-management training and education on improving caregiver quality of life.

Effects by severity of asthma

The amendments to AB 264 would require health plans to cover pediatric asthma self-management training and education for children who have been treated in an emergency room or whose physician determines them to be at risk for worsening asthma symptoms that could lead to hospitalization or an emergency room visit. Under this provision, physicians would have discretion to decide which children with asthma to refer for asthma self-management education and training. To ascertain whether outcomes of asthma self-management training and education for children who are at high risk for worsening symptoms differ from outcomes for all children with symptomatic asthma, studies were grouped by the severity of children's symptoms. For this purpose, a definition of "high risk" was developed based on NHLBI guidelines for asthma diagnosis and Health Plan Employer Data and Information Set (HEDIS) criteria (Cabana et al., 2004; NHLBI, 1997). The criteria included frequent asthma exacerbations, daily use of asthma medications, hospitalizations, emergency department visits, and urgent/unscheduled physician visits for asthma. Results of studies for which the eligibility criteria were consistent with this definition of high risk were compared to results of studies that included children at other levels of risk. Sub-group findings from studies that reported results separately for high-risk children and all children were also analyzed.

Findings from the comparison of the effects of pediatric asthma self-management training and education programs on high-risk children with asthma and all children with asthma are

summarized in Table 2. Seventeen studies examined high-risk children. These studies assessed 19 of the 24 outcomes analyzed for this report. For 14 of these 19 outcomes, findings for high-risk children were as good as or better than findings for all children with symptomatic asthma. Findings for high-risk children were less favorable than findings for all children only for asthma severity, symptom scores, caregivers' knowledge of asthma, children's self-efficacy, and children's quality of life. The results of this analysis should be interpreted with caution for two reasons. First, none of these studies was explicitly designed to test whether outcomes of asthma education differ for high-risk and low-risk children. Second, for many outcomes, the number of studies of high-risk children is very small. For eight outcomes, only one study assessed high-risk children. Patterns of evidence are difficult to discern when only small numbers of studies have analyzed an outcome.

Effects by setting in which education is provided

The amendments to AB 264 would require that pediatric asthma self-management training and education include "at a minimum group health education classes for the patient and his or her parent or guardian, home-based education and training, and school-based education and training". To determine whether outcomes differed by the setting in which asthma education was provided, the 47 individual studies included in this review were divided into categories based on the primary setting in which the intervention was delivered. Eleven trials were carried out primarily in schools, a setting in which health plans typically do not cover services. Seven trials assessed group classes provided to children and/or their caregivers in settings other than schools. Eight trials involved individual education of children and, in some cases, their caregivers in primary care or specialty outpatient clinics. In eight trials, the intervention consisted primarily of visits to children's homes to provide education to children and/or their caregivers. Two trials involved one or more telephone calls with children's caregivers. Five trials involved interactive, educational computer games that used outside children's homes. One study evaluated a device that enabled children to access an Internet-based educational program through their home telephones. In some cases, interventions were delivered in multiple settings.

Findings by the type of setting in which pediatric asthma self-management training and education was furnished were analyzed for each of the 24 outcomes discussed in this report. A summary of the results of this analysis appears in Table 3. Outcomes were not consistently better for educational interventions delivered in any particular type of setting. For most types of settings, outcomes were better than outcomes in other settings for some measures, but worse for others.

The differences in outcomes across types of settings should be interpreted with caution for three reasons. First, only a few of the studies were designed to compare the provision of similar asthma education interventions in different settings. Differences observed across settings may therefore be due to differences in the content and intensity of asthma education interventions typically provided in different settings. Second, for many outcomes, studies have not been conducted in all of the major types of settings. This is especially true in the case of group classes. Studies of group classes have not reported on several important outcomes, such as days of restricted activity, urgent/unscheduled physician visits, and days of asthma symptoms. Third, in

many cases, the number of studies that have measured an outcome in a given type of setting is very small.

Moreover, all of the studies were conducted by researchers who sought to test asthma self-management and training interventions that they believed to be improvements upon the care typically received by children with asthma. In all cases, the children in the intervention group (and, in some cases, their caregivers) participated in visits, classes, or sessions with interactive media devices that focused exclusively on asthma education and which were in addition to any visits the children had with primary care providers. The researchers also had incentives to ensure that all children in the intervention groups received all the components of the intervention and the intended number of sessions. Practices in non-research settings may differ considerably. Busy clinicians may not be aware of comprehensive asthma education, or have the time, support staff, or resources to ensure that all children receive it. The survey of health plans completed for this report suggests that large health plans in California cover fewer asthma education sessions than the number of sessions provided to children in the studies summarized in this report.

Conclusions

A review of studies of pediatric asthma self-management training and education programs finds that these programs reduce the frequency and severity of asthma symptoms and utilization of acute and urgent health care services, and improve disability outcomes, intermediate outcomes, and quality of life outcomes for children with asthma.

Health Outcomes: The pediatric asthma self-management training and education programs assessed in these studies have a pattern toward favorable effects on reducing the number of days of asthma symptoms, nights of nocturnal asthma, number of asthma exacerbations, and severity of asthma symptoms. There is also a pattern toward improvement in peak expiratory flow rate.

Health Care Utilization Outcomes: The pediatric asthma self-management training and education programs assessed have a pattern toward favorable effects in reducing the number of emergency room visits and the number of hospitalizations for asthma. However, there is a pattern toward no effect on the probability that a child will be hospitalized for asthma or on use of bronchodilators. In addition, the evidence regarding whether pediatric self-management programs affects the number of physician visits by children with asthma is ambiguous.

Disability Outcomes: Children who participate in asthma self-management training and education programs have fewer days of restricted activity. There is a pattern toward favorable effects on the number of days children are absent from school. The evidence regarding whether pediatric asthma self-management training and education affects the number of days caregivers are absent from work to care for children with asthma is ambiguous.

Intermediate Outcomes: Pediatric asthma self-management training and education programs have a pattern toward favorable effects in increasing children's self-efficacy and children's and caregivers' knowledge about asthma.

Quality of Life Outcomes: Pediatric asthma self-management training and education programs have a pattern toward favorable effects in improving the quality of life for children with asthma and their caregivers.

Outcomes by Severity of Asthma. For most outcomes assessed, asthma self-management training and education programs had similar or stronger effects on children who had previously had frequent asthma symptoms or emergency room visits or hospitalizations for asthma than on all children with symptomatic asthma. However, this finding should be interpreted with caution because none of the studies were explicitly designed to test whether results differ for high- and low-risk children with asthma.

Outcomes by Setting in Which Education Is Provided. There is no evidence that providing asthma self-management training and education in any particular type of setting yields *consistently* better outcomes than providing training and education in other settings. For all settings, there are patterns toward favorable findings for most outcomes assessed.

II. UTILIZATION, COST, AND COVERAGE IMPACTS

Present Baseline Cost and Coverage

Current Utilization Levels and Costs of the Mandated Benefit

The mandated services under AB 264 include pediatric asthma self-management training and education services. In estimating the impact of AB 264 on costs, utilization, and premiums, the mandated services are defined to include child and caregiver self-management training and education on a group or individual basis provided under the supervision of appropriately licensed or registered health care professionals by the plan or contracting provider. According to the legislation, "these benefits shall include, but not be limited to, instruction that will enable pediatric asthmatic patients and their families to gain an understanding of the disease process and the daily management of asthma in order to avoid frequent hospitalizations and complications, including, at a minimum, group health education classes for the patient and his or her parent or guardian, home-based education and training, and school-based education and training."

Health services utilization associated with poor management of childhood asthma includes emergency department visits and inpatient hospital stays. For the utilization and cost analysis, children who had visited the emergency room for an asthma attack or who would be considered "high risk" were identified as having been treated in an emergency room and/or having daily/weekly symptoms in the last year, using the 2001 California Health Interview Survey (CHIS 2001) data. Children under one year of age are excluded from this analysis as a diagnosis of asthma is difficult to make in this age group and thus is rarely made.

Under these criteria, approximately 2.5% of children ages 1 to 17 years enrolled in Knox-Keene licensed health plans would be affected by this mandate. This analysis assumes similar costs and rates of utilization for children covered under all insurance categories included due to a lack of specific utilization data for each category.

Using data from CHIS and commercial databases maintained by Milliman, the analysis finds that approximately 134,000 children with asthma in California who have been treated in the emergency room for asthma or would be considered "high risk," have prescription drug coverage, and are insured by Knox-Keene licensed health plans obtained through employers, privately-purchased policies, California Public Employees' Retirement System (CalPERS), Medi-Cal, or Healthy Families.

Based on Milliman claims data, the current utilization rates, costs per service, and per member per month (PMPM) costs for children with asthma who have been treated in the emergency room for asthma or would be considered "high risk" insured by Knox-Keene health plans are approximately as follows:

- 662 sessions of pediatric asthma self-management training and education per 1,000 members per year (self-management and training, individual and group education, and patient education materials);
- 0.0548 inpatient admissions per patient per year;

- 0.2037 emergency room visits per patient per year;
- $150 annual cost for education and training (self-management and training, individual and group education, and patient education materials) per patient;
- $22.51 PMPM costs for inpatient hospital services; and
- $10.68 PMPM costs for emergency room visits.

Current Coverage of the Mandated Benefit

Coverage of pediatric asthma self-management training and education services in Knox-Keene licensed plans in California was determined by a survey of the seven largest health plans in the state and was found to be extensive (Table 4). The six plans that responded represented 93% of those enrolled in commercial Knox-Keene licensed health plans. Approximately 3% of children enrolled in these plans had alternative prescription drug coverage. Due to lack of information about this alternative drug coverage, CHBRP assumes children enrolled in these plans have drug coverage and therefore includes them in this analysis. Consequently, the cost estimates in this report represent the upper bound.

Members in participating plans are covered for self-management training and education, primarily during the initial office visit (100%) or in follow-up visits (91%), individual health education with toll-free automated numbers or advice (100%) or computer-based health management (59%), and patient education materials in paper or electronic form (100%). The educational interventions in settings specified by AB 264, such as group health education classes, and home-based or school-based education or training are less frequently covered or not covered at all by health plans. For instance, about half of enrollees (56%) have access to group health education, whereas only about 8% of enrollees have access to home-based education and none of them is covered by school-based education. As discussed in the medical effectiveness review, it is not evident that one setting is consistently superior to the others in reducing emergency room visits or hospitalizations. Consequently, the following analysis is based on the assumption that self-management training and education is covered *in some form* by Knox-Keene licensed health plans.

Public Demand for Coverage

As a way to determine whether public demand exists for the proposed mandate (based on criteria specified under AB 1996 [2002]), CHBRP is to report on the extent to which collective bargaining entities negotiate for and the extent to which self-insured plans currently have coverage for the benefits specified under the proposed mandate. Currently, the largest public self-insured plans are CalPERS' PERSCare and PERS Choice preferred provider organization (PPO) plans. These plans include coverage for disease management programs for specific conditions, including asthma, diabetes, heart disease, and depression. Based on conversations with the largest collective bargaining agents in California, no evidence exists that unions currently include such detailed provisions during the negotiations of their health insurance policies. In order to determine whether any local unions engage in negotiations at such detail, they would need to be surveyed individually.

Impacts of Mandated Coverage

How Will Changes in Coverage Related to the Mandate Affect the Benefit of the Newly Covered Service and the Per-Unit Cost?

CHBRP surveyed various providers of education services, which included for-profit disease management organizations, non-profit community-based organizations under contract with Medi-Cal managed care plans, and commercial health plans. Based on the survey results, the estimated cost for group education is about $50 per session per child, and cost for home-based education is about $100 per session. School-based programs, such as the American Lung Association Open Airways for Schools program, are equivalent in price per enrollee to one home-based visit. As a result, CHBRP estimated the per-unit cost as $150 per eligible member for education in settings specified by the legislation. This average per-unit cost estimate includes up to three sessions of group education, or a combination of one group education session and a home-based visit or school-based education program.

No effect on per-unit cost of the services, such as group education, is expected. This is because this legislation does not propose an increase in the number of children who have coverage for a benefit, but rather it mandates settings in which the benefit is to be made available. CHBRP does not anticipate any inflationary pressure on the price of services since there are no supply constraints. CHBRP does not have data on the possible distribution of educational services (i.e., how many children would use what type of service) after the mandate. If home-based visits were to make up a larger portion of the services used after the mandate, for example two home-based visits per intervention, then the per-unit cost could be higher than that estimated here. Therefore, the actual cost per intervention could be higher or lower than our estimates.

How Will Utilization Change as a Result of the Mandate?

Current rates of coverage for pediatric asthma self-management training and education services in California indicate wide coverage of these types of services by all plans subject to this mandate. However, current data indicate that the utilization rate for these programs by children ages 1–17 years with asthma who have been treated in the emergency room for asthma or would be considered "high risk" enrolled in Knox-Keene licensed health plans statewide (CHIS, 2001) is approximately 63.2% or 84,000 children. The utilization of these programs is estimated to increase by 10 percentage points (i.e., from 63.2% to 73.2%) for an estimated additional 14,000 children receiving asthma self-management education following the mandate. The rationale for the 10 percentage point increase in utilization is based on evidence of utilization of asthma medication. For instance, data from the Pacific Business Group on Health's HealthScope (quality of care report card for health plans) indicated that utilization rates of asthma medication for children ranged from 57% to 74%, asthma medication for adolescents from 62% to 70%. Additionally, a review of the literature on the effect of insurance on the utilization of outpatient care by children showed that insurance coverage has the effect of increasing utilization of well-child visits and routine checkups by 11–17 percentage points. Furthermore, pediatric asthma is a health condition with a strong advocacy base; such advocates could use the media to increase awareness of the importance of asthma self-management training and education and could thus increase demand and utilization on the part of both physicians and patients following the

enactment of the mandate. As a result, we conclude that utilization rates for pediatric asthma self-management training and education services could get as high as 70% to 80% of eligible children/adolescents if families and physicians were aware that these services are covered.

Our previous analysis of AB 2185 (coverage for devices to manage pediatric asthma) assumed a 10 percentage point increase from the baseline. In January 2005, AB 2185 took effect mandating coverage of medical devices with asthma, but struck out language that would have mandated coverage of asthma self-management training and education services. It is likely that the law based on AB 2185 led to a small increase in use of education services related to use of medical devices; however, no data are available on the scope of this effect, and the sequential introduction of these bills (one in 2005 and one in 2006) makes it essentially impossible to assess their impacts separately. Thus, the estimate of the 10 percentage point increase in utilization is assumed to include the effects of passage of AB 2185, as well as the proposed mandate. The actual change in utilization of the benefit as a result of this mandate may be higher or lower than that estimated here.

It is possible that the increased use of education services would lead to greater use of inhalers and prescription drugs to self-manage the condition. However, many children with asthma who have been treated in the emergency room for asthma or would be considered "high risk" are likely to already have the devices, but are either not using them or are not using them properly. At the same time, education services are likely to result in an improvement in the condition that, in turn, reduces the use of prescription drugs. Thus, our analysis assumed no increase in the utilization of inhalers or prescription drugs as a result of this mandate.

Based on the review of the medical effectiveness of pediatric asthma self-management training and education programs, the evidence suggests that the mean number of inpatient hospitalizations for children with asthma who receive self-management training and education services as a result of this mandate, may be reduced by 22%, and the mean number of emergency room visits may be reduced by 11%. The effects identified in the literature review, on which the above utilization estimates were made, were observed as part of clinical trials and therefore may not be achieved at the same levels when implemented in a population, because the trials were conducted under tightly controlled circumstances. Thus, ***all estimates of effects of the mandate on health services utilization should be viewed as upper bounds.***

To What Extent Does the Mandate Affect Administrative and Other Expenses?

The mandate is expected to increase the administrative expenses for health plans but not disproportionately to the increase in health care costs (see the following section). An increase in pediatric asthma treatment and education claims may increase claims administration costs. Plans may have to modify their insurance contracts and member materials and may have to contract with new providers that specialize in asthma education. Health care plans include a component for administration and profit in their premiums, which may be sufficient for covering increased administrative costs (see Appendix C).

Impact of the Mandate on Total Health Care Costs

Total net expenditures (including total premiums and out-of-pocket expenditures) are estimated to increase by approximately $1,034,000. This is equivalent to $0.0052 in overall premiums PMPM. The impact varies by insurance category, with increases of 0.017% ($0.0139 PMPM) for the Healthy Families program, 0.007% ($0.0078 PMPM) for Medi-Cal, 0.002% ($0.0043 PMPM) for the individual market, 0.001% ($0.004 PMPM) for CalPERS, and 0.002% for employment-based insurance ($0.0043 PMPM for large employers and $0.0045 PMPM for small employers) (Table 6). These are the net effects of the mandate on costs, factoring in both the new costs associated with increased utilization of asthma self-management training and education services as well as the estimated cost savings resulting from reduced asthma-related emergency room visits and hospitalizations. The overall net expenditure increase of $1,034,000 reflects an estimated gross cost of $2,355,000 for additional self-management training and education, offset by $1,321,000 in savings associated with reduced emergency room and hospital utilization. Thus, savings in other health care costs offset about 56% of the cost of the mandate. When estimating this offset, CHBRP assumed the cost reduction would be proportionate to the estimated reductions in emergency room visits and hospital admissions.

Costs or Savings for Each Category of Insurer Resulting from the Benefit Mandate

Based on the evidence of medical effectiveness, inpatient and emergency department utilization is expected to decrease by approximately 22% and 11%, respectively, for the additional increased utilization in self-management training and education services as a result of the enactment of this mandate. The total amount of this savings is estimated at $1,321,000. Total costs associated with physician visits are not expected to change. However, no impact is expected on rates of coverage as a consequence of AB 246.

Current Costs Borne by Payers (Both Public and Private) in the Absence of the Mandated Benefit

Pediatric asthma self-management and education services currently provided to children enrolled in Knox-Keene licensed plans in California are covered. After the mandate was enacted, these costs would continue to be borne by the same plans with the same distribution between the private and public markets.

Impact on Access and Health Service Availability

The mandated benefit would not change access to pediatric asthma self-management and education services for children with asthma who are currently covered. Given the size of the population affected, expected reductions in utilization of inpatient and emergency department services, and a 10 percentage point increase in use of education and training, there is no evidence that the mandate would create price pressures and thus impact the unit cost of asthma self management training and education services. This mandate would also not impact the availability or supply of providers, such as disease management organizations or health educators.

III. PUBLIC HEALTH IMPACTS

Present Baseline Health Outcomes

In California, 15.8% of insured children ages 1–17 years have ever been diagnosed with asthma (CHIS, 2003).[13] However, more than 40% of these children did not report currently having asthma or experiencing any symptoms in the past year. This means that approximately 9.4% of insured children in California have symptomatic asthma (i.e., asthma for which they experienced symptoms in the past year). It is estimated that 2.5% of insured children in California ages 1–17 years have high-risk asthma as identified using the 2001 California Health Interview Survey (CHIS, 2001). Using the 2001 CHIS data, children are defined as "high risk" if they have visited an emergency room in the past 12 months or reported daily or weekly symptoms of asthma.

The baseline data suggest that adolescents (ages 12–17 years) in California with high-risk asthma missed an average of 1.4 days of school in the last four weeks and, of the 49.3% who missed any school, an average of 2.8 days of school were missed (CHIS, 2001). A total of 79.3% of children (ages 1–11) with high-risk asthma experienced restricted physical activity due to their asthma (CHIS, 2001). Death from asthma is a rare event, but in California in 2002, 23 deaths due to asthma were reported among children 1–19 years (CDC, 2006).

In terms of medication usage, of those children (ages 1–17 years) with high-risk asthma, more than three-fourths report they currently take medicine for their asthma (CHIS, 2001). In addition, 18% of children ages 1–17 years with high-risk asthma had an emergency room visit because of their asthma in the past year, and 5% were hospitalized because of their disease in the past year (See Table 1). Finally, 63.2% of adolescents with high-risk asthma report having ever received any information from their doctor on how to avoid the things that make their asthma worse (CHIS, 2001).

Impact of the Proposed Mandate on Public Health

Impact on Community Health

It is estimated that in California there are 134,000 children (ages 1–17 years) with high-risk asthma in health insurance plans affected by this mandate (enrolled in Knox-Keene licensed plans that include prescription drug coverage offered through employers, privately-purchased policies, CalPERS, Medi-Cal, or Healthy Families). Although nearly all children in California with high-risk asthma currently have coverage for self-management training and education, a 10 percentage point increase (i.e., from 63.2% to 73.2%) in the utilization of self-management training and education is estimated after the enactment of the mandate (See Section II: Utilization, Cost, and Coverage Impacts for justification of this assumption). This would result in approximately 14,000 more children with high-risk asthma receiving self-management education and training postmandate. The remainder of this section discusses the potential impact of the proposed mandate on selected health outcomes based on the findings of the medical

[13] The data used in this section from the 2001 and 2003 CHIS are restricted to children ages 1–17 years with the following health insurance types: privately purchased, employer-based, Medi-Cal, and Healthy Families.

effectiveness literature presented in Section I. A summary of the findings is presented in Table 8. The estimated impact of AB 264 is discussed below.

The four specific outcomes for which quantitative estimates of the public health impacts of the mandate were made were school absences (mean number of days missed), restricted-activity days (percentage of children reporting), emergency department visits (percentage of children reporting), and hospitalizations (percentage of children reporting).

School absences

Nearly 50% of adolescents (12–17 years) with high-risk asthma missed school in the past month due to illness, with a reported 1.4 days of school missed per month per asthmatic child (CHIS, 2001). Assuming similar rates of missed school days among the 5–11-year-old population, this translates into over 150,000 total days of school missed among the children with high-risk asthma affected by this mandate. The evidence suggests that pediatric asthma self-management training and education leads, on average, to a 26% reduction in the number of school days missed by children with asthma. Based on this evidence, the analysis suggests that for the 10 percentage point increase of children with high-risk asthma who would newly use the self-management training and education after the mandate, approximately 4,000 fewer days of school would be missed each month due to asthma, or approximately 36,000 fewer days of missed school per year, assuming a 9-month school year.

Restricted-activity days

A total of 79.3% of children (ages 1–11 years) with high-risk asthma report that their physical activity is limited to some extent because of their asthma (CHIS, 2001): 31.5% report that their physical activity is rarely limited due to asthma, 30.8% report that their physical activity is sometimes limited due to asthma, and 17.0% report that their physical activity is limited either most of the time or always due to asthma. Assuming similar rates of restricted-activity days among adolescents (12–17 years), this would translate into more than 106,000 children with high-risk asthma affected by this mandate reporting limited physical activity. The evidence suggests that pediatric asthma self-management training and education leads to a 19% reduction in the percentage of children reporting that their physical activity is limited due to asthma. Based on the evidence, the analysis suggests that for the for the 10 percentage point increase of children with high-risk asthma who would newly use the self-management training and education after the mandate, approximately 2,000 fewer children would report that their physical activity is limited due to asthma.

Emergency department visits

Approximately 18% of children with high-risk asthma visit the emergency department each year. This translates into 0.2037 emergency department visits per child with high-risk asthma, or a total of approximately 27,000 children with asthma-related emergency room visits per year in the population affected by this mandate (Table 1). The evidence suggests that pediatric asthma self-management training and education leads, on average, to a decrease of 11% in the number of

asthma-related emergency department visits. Based on this evidence, the analysis suggests that there would be approximately 300 fewer emergency department visits for children with asthma.

Hospitalizations

An estimated 5.0% of children with high-risk asthma are hospitalized in California each year for asthma-related conditions. This translates into 0.0548 hospitalizations per child with high-risk asthma or 7,000 asthma-related hospitalizations annually (Table 1). The evidence suggests that pediatric asthma self-management training and education leads, on average, to a 22% reduction in the number of asthma-related hospitalizations. Based on this evidence, there would be approximately 160 fewer children hospitalized for asthma-related conditions.

For all of the public health outcomes, the effects identified in the literature review, which were observed as part of trials, may not be achieved at the same levels when implemented in a population, because the trials were conducted in tightly controlled circumstances that do not necessarily represent how care is provided in the real world. In addition, there could be variations from insurer to insurer that could affect actual health outcomes. If fewer children newly receive services as a result of the mandate, or if the actual interventions are less effective than what was observed in clinical trials, the public health benefits of this mandate would be less.

Other significant public health effects

A review of the literature on the effectiveness of pediatric asthma self-management training and education identified other outcomes for which such training and education is effective. However, quantitative estimates of the impact on children in California with high-risk asthma could not be made for these other outcomes due to the lack of baseline data. These outcomes include an overall reduction in asthma severity for children, fewer days of asthma symptoms, more symptom-free days, reduced nocturnal asthma, and improvement in lung function as measured by peak expiratory flow rate (PEFR). In addition, literature on the impact of pediatric self-management training and education suggests that children and, in some cases, their caregivers, report an increase in their quality of life and increased knowledge about asthma and its management. Finally, evidence suggests that children who have had asthma self-management training and education perceive they are more capable of organizing and executing the actions that are required to manage their asthma.

Impact on Community Health Where Gender and Racial Disparities Exist

A literature review was conducted to determine whether there are gender or racial disparities associated with the prevalence and outcomes for pediatric asthma documented in the peer-reviewed literature. Additionally, the CHIS and Milliman data were examined for gender and racial differences in high-risk asthma prevalence and related health outcomes.

Table 8 reports data on children with high-risk asthma by gender. According to the CHIS data, there are significant gender differences in high-risk asthma prevalence, with 2.9% of males aged 1 to 17 years reporting having high-risk asthma, compared with 2.1% of females in the same age group. A review of the literature shows that during early childhood, asthma is more prevalent in males; however, during adolescence, asthma prevalence equalizes between the genders, and in

adulthood, females have higher rates of asthma (Bjornson and Mitchell, 2000). Among children with high-risk asthma in California, Milliman health care utilization data did not show a significant gender difference in whether children with high-risk asthma had an asthma-related emergency room visit or hospitalization in the past year. Additionally, more female children reported that they were provided education on how to avoid making their asthma worse compared to males (70.8% vs. 56.2%), but this difference was not significant at the $p \leq 0.05$ level (p-value = 0.076) (CHIS, 2001).

Table 9 shows data on children with high-risk asthma by race and ethnicity. Black children have the highest rates of high-risk asthma (3.5%), followed by Hispanics (2.5%), whites (2.3%), and Asians (1.5%). In addition, black children with high-risk asthma reported the highest rate of restricted-activity days compared to white and Hispanic children. A substantial amount of research has documented racial and ethnic disparities with regards to childhood asthma. Nationally, non-Hispanic black children have a substantially higher prevalence of asthma and a higher number of asthma attacks (NCHS, 2005; Smith et al., 2005). The prevalence gap between white and black children widened progressively from 1980 to the mid-1990s (Akinbami and Schoendorf, 2002). Black children with asthma have also been found to have more severe asthma as evidenced by greater physical limitations, asthma-related hospitalization rates, emergency room visits, and mortality rates (Akinbami and Shoendorf, 2002; Boudreaux et al., 2003; Lozano et al., 1995; Smith et al., 2005).

Although some research has found that Hispanic children have the same or lower asthma prevalence compared with white children (Akinbami and Shoendorf, 2002; Lieu et al., 2002; NCHS, 2005), other research has examined asthma rates in subpopulations of the heterogeneous Hispanic population residing in the United States and finds that certain subpopulations, such as Puerto Ricans, have significantly higher rates of asthma, whereas Mexicans appear to have lower than average rates (Lara et al. 2006). In Los Angeles County, Hispanics were more likely than non-Hispanic whites to report physical activity limitations and a need for urgent care associated with asthma (Simon et al., 2003).

One concern regarding racial disparities is whether minority children have sufficient access to preventive care for asthma. Researchers found that, after controlling for numerous risk factors, black and Hispanic children with asthma received fewer preventive medications compared with white children (Lieu et al., 2002; Ortega et al., 2002). In addition, compared with white children, minority children were less likely to receive high-quality preventive care for asthma (Finkelstein et al., 1995). For Hispanic children in particular, language barriers can contribute to poor asthma management (Chan et al, 2005). Despite these differences, there was no significant difference in the rates in which education on how to avoid making asthma worse was provided across different racial groups.

Males have higher rates of high-risk asthma compared to females, yet rates of asthma self-management education do not vary significantly between the two groups. Similarly, blacks have higher rates of asthma diagnoses compared to whites and Hispanics, yet rates of asthma self-management education do not vary significantly by race. Therefore, it does not appear that there are current disparities in asthma self-management education that would be affected by AB 264. Thus, AB 264 is not expected to affect gender or racial disparities in asthma management.

Reduction of Premature Death and the Economic Loss Associated with Disease

A literature review was conducted to determine the extent to which childhood asthma results in premature death and economic loss to California and whether AB 264 might have an impact on these outcomes.

Mortality among children with asthma is relatively rare. In 2002, the National Center for Health Statistics reported that there were 0.3 deaths due to asthma per 100,000 children. In California in 2002, 23 deaths due to asthma were reported among children 1–19 years and 458 deaths were reported among the entire population, including adults (CDC, 2006). The Medical Effectiveness section of this report summarizes how pediatric asthma management programs have been found to improve health outcomes. However, reductions in childhood mortality are not examined as a potential health outcome since mortality is such a rare occurrence among this population. As a result, we are not able to determine whether AB 264 would have any impact on premature death associated with high-risk childhood asthma.

The economic loss associated with childhood asthma consists of the direct costs discussed in the Utilization, Cost, and Coverage Impacts section and the indirect costs related to a reduction in productivity. For childhood asthma, the productivity losses are due primarily to lost workdays for caregivers of children with asthma. A few studies have examined caregiver productivity losses due to childhood asthma. Two studies have calculated the indirect costs of asthma in the United States due to caregiver time associated with missed school among children ages 5 to 17 years (Smith et al., 1997; Weiss et al., 2000). The calculated annual cost (in 1994 dollars) of caregiver productivity losses due to childhood asthma was $194.5 million in one study and $956.7 million ($191.4 per child with asthma) in the other. The difference in these estimates is due to the use of different data sources for estimating the number of missed school days and substantially different estimates in valuation of caregiver time (Smith et al., 1997; Weiss et al., 2000).

This analysis has found over 36,000 missed school days per year would be averted with the passage of AB 264. As a result, there could be productivity gains in California through a decrease in lost workdays of caregivers. The extent that these productivity gains would be realized, however, is unclear since there is ambiguous evidence regarding caregiver workdays as an outcome in examining the effectiveness of pediatric asthma management programs (Georgiou et al., 2003; Kreiger et al., 2005; Tinkelman and Schwartz, 2004).

TABLES

Table 2. Summary of Findings by Outcome and Level of Risk for Asthma Exacerbations and/or Frequent Symptoms

Outcome\ Setting	Total Number of Studies	Number of Studies of High-Risk Children	Results Regardless of Level of Risk	Results for Studies of High-Risk Children
Asthma Symptoms and Severity				
Days of asthma symptoms	16	6	Pattern toward favorable	Pattern toward favorable
Symptom scores	4	1	Pattern toward favorable	Pattern toward no effect/weak evidence
Nights of nocturnal asthma	8	3	Pattern toward favorable	Pattern toward favorable
Asthma severity	12	2	Pattern toward favorable	Pattern toward no effect/weak evidence
Exacerbations	4	0	Pattern toward favorable	No studies
Peak expiratory flow rate	6	3	Pattern toward favorable	Pattern toward favorable
Health Care Utilization				
Emergency department visits (mean visits)	17	8	Pattern toward favorable	Pattern toward favorable
Emergency department visits (% children)	5	1	Pattern toward favorable	Pattern toward favorable
Hospitalization (mean admissions)	12	4	Pattern toward favorable	Pattern toward favorable
Hospitalization (% children)	5	2	Pattern toward no effect/weak evidence	Pattern toward no effect/weak evidence
Urgent/ Unscheduled Physician Visits (mean visits)	7	1	Mixed evidence	Pattern toward favorable
Urgent/ Unscheduled Physician Visits (% children)	2	0	Pattern toward favorable	No studies

Table 2. Summary of Findings by Outcome and Level of Risk for Asthma Exacerbations and/or Frequent Symptoms (con't.)

Outcome\ Setting	Number of Studies	Number of Studies of High-Risk Children	Results Regardless of Setting	Results for Studies of High-Risk Children
Health Care Utilization (cont'd.)				
Medication (inhaled corticosteroids)	3	0	Favorable	No studies
Medication (beta2-agnonists)	3	1	Pattern toward favorable	Pattern toward favorable
Disability Outcomes				
School absences (mean days)	14	5	Pattern toward favorable	Pattern toward favorable
School absences (% children)	3	1	Pattern toward favorable	Pattern toward favorable
Restricted activity (mean days)	3	1	Favorable	Favorable
Restricted activity (% children)	2	1	Mixed evidence	Favorable
Work absence—caregiver	3	0	Mixed evidence	No studies
Intermediate Outcomes				
Self-efficacy—child	13	1	Pattern toward favorable	Pattern toward no effect/weak evidence
Knowledge—child	18	2	Pattern toward favorable	Pattern toward favorable
Knowledge—caregiver	8	2	Pattern toward favorable	Mixed evidence
Quality of Life Effects				
Quality of Life—child	9	2	Pattern toward favorable	Mixed evidence
Quality of Life—caregiver	3	0	Pattern toward favorable	No studies

Source: CHBRP analysis of research literature. Please see Appendix A for details on literature review methods.

Table 3. Summary of Findings by Outcome and Type of Setting

Outcome\ Setting	Number of Studies	Results Regardless of Setting	Group Classes	Home	School	Individual Education in Outpatient Setting	Interactive Media	Telephone	Combination of Settings
Health Outcomes									
Days of asthma symptoms	16	Pattern toward favorable	No studies	Pattern toward favorable (4 studies)	Pattern toward favorable (6 studies)	Mixed evidence (2 studies)	Favorable (1 study)	No studies	Pattern toward favorable (3 studies)
Symptom scores	4	Pattern toward favorable	No studies	No studies	Favorable (1 study)	No effect (1 study)	Pattern toward favorable (1 study)	Favorable (1 study)	No studies
Nights of nocturnal asthma	8	Pattern toward favorable	Not favorable (1 study)	Mixed evidence (2 studies)	Mixed evidence (3 studies)	No studies	Favorable (1 study)	Pattern toward favorable (1 study)	No studies
Asthma severity	12	Pattern toward favorable	Mixed evidence (3 studies)	Pattern toward favorable (1 study)	Favorable (1 study)	Mixed evidence (3 studies)	Mixed evidence (2 studies)	Favorable (1 study)	Pattern toward not favorable (1 study)
Exacerbations	4	Pattern toward favorable	Pattern toward favorable (1 study)	No studies	Favorable (1 study)	Mixed evidence (2 studies)	No studies	No studies	No studies
Peak expiratory flow rate	6	Pattern toward favorable	No studies	Pattern toward no effect/weak evidence (1 study)	Pattern toward favorable (3 studies)	No studies	Favorable (1 study)	No studies	Pattern toward favorable (1 study)

Table 3. Summary of Findings by Outcome and Type of Setting (con't.)

Outcome\ Setting	Number of Studies	Results Regardless of Setting	Group Classes	Home	School	Individual Education in Outpatient Setting	Interactive Media	Telephone	Combination of Settings
Health Care Utilization									
Emergency department visits (mean visits)	17	Pattern toward favorable	Pattern toward favorable (4 studies)	Mixed evidence (3 studies)	Mixed evidence (2 studies)	Pattern toward favorable (4 studies)	Mixed evidence (3 studies)	Favorable (1 study)	No studies
Emergency department visits (% children)	5	Pattern toward favorable	No studies	No studies	Pattern toward favorable (2 studies)	Pattern toward no effect/weak evidence (2 studies)	Pattern toward favorable (1 study)	No studies	No studies
Hospitalization (mean admissions)	12	Pattern toward favorable	Mixed evidence (2 studies)	Mixed evidence (2 studies)	Pattern toward favorable (2 studies)	Pattern toward favorable (3 studies)	Mixed evidence (2 studies)	Favorable (1 study)	No studies
Hospitalization (% children)	5	Pattern toward no effect/weak evidence	No studies	Pattern toward not favorable (1 study)	Pattern toward no effect/weak evidence (1 study)	Pattern toward not favorable (1 study)	No effect (1 study)	No studies	Pattern toward favorable (1 study)
Urgent/ Unscheduled Physician Visits (mean visits)	7	Mixed evidence	No studies	Pattern toward favorable (2 studies)	Mixed evidence (2 studies)	Pattern toward not favorable (1 study)	Mixed evidence (2 studies)	No studies	No studies
Urgent/ Unscheduled Physician Visits (% children)	2	Pattern toward favorable	No studies	Pattern toward not favorable (1 study)	Pattern toward favorable (1 study)	No studies	No studies	No studies	No studies

Table 3. Summary of Findings by Outcome and Type of Setting (con't.)

Outcome\ Setting	Number of Studies	Results Regardless of Setting	Group Classes	Home	School	Individual Education in Outpatient Setting	Interactive Media	Telephone	Combination of Settings
Health Care Utilization (cont'd.)									
Medication (inhaled cortico-steroids)	3	Favorable	No studies	No studies	No studies	Favorable (1 study)	Favorable (1 study)	No studies	Favorable (1 study)
Medication (beta2-agnonists)	3	Pattern toward favorable	No studies	Pattern toward no effect/weak evidence (1 study)	Pattern toward favorable (1 study)	No studies	No studies	No studies	Pattern toward favorable (1 study)
Disability Outcomes									
School absences (mean days)	14	Pattern toward favorable	Mixed evidence (2 studies)	Favorable (2 studies)	Pattern toward favorable (7 studies)	Favorable (1 study)	Pattern toward favorable (2 studies)	No studies	No studies
School absences (% children)	3	Pattern toward favorable	No studies	Pattern toward favorable (1 study)	No studies	No studies	Pattern toward favorable (1 study)	Favorable (1 study)	No studies
Restricted activity (mean days)	3	Favorable	No studies	Favorable (2 studies)	No studies	No studies	Favorable (1 study)	No studies	No studies
Restricted activity (% children)	2	Mixed evidence	No studies	Pattern toward no effect/weak evidence (1 study)	No studies	No studies	Favorable (1 study)	No studies	No studies

Table 3. Summary of Findings by Outcome and Type of Setting (con't.)

Outcome\ Setting	Number of Studies	Results Regardless of Setting	Group Classes	Home	School	Individual Education in Outpatient Setting	Interactive Media	Telephone	Combination of Settings
Disability Outcomes (cont'd.)									
Work absence—caregiver	3	Mixed evidence	No studies	Pattern toward not favorable (1 study)	Pattern toward favorable (1 study)	No studies	No studies	Favorable (1 study)	No studies
Intermediate Outcomes									
Self-efficacy—child	13	Pattern toward favorable	Pattern toward favorable (1 study)	No studies	Pattern toward favorable (6 studies)	Pattern toward favorable (1 study)	Pattern toward favorable (3 studies)	No studies	Favorable (1 study)
Knowledge—child	18	Pattern toward favorable	Mixed evidence (4 studies)	No studies	Mixed evidence (6 studies)	Favorable (1 study)	Pattern toward favorable (5 studies)	No studies	Pattern toward favorable (2 studies)
Knowledge—caregiver	8	Pattern toward favorable	Favorable (1 study)	Pattern toward no effect/ weak evidence (1 study)	Mixed evidence (2 studies)	No studies	Mixed evidence (3 studies)	No studies	Favorable (1 study)

Table 3. Summary of Findings by Outcome and Type of Setting (con't.)

Outcome\ Setting	Number of Studies	Results Regardless of Setting	Group Classes	Home	School	Individual Education in Outpatient Setting	Interactive Media	Telephone	Combination of Settings
Quality of Life Outcomes									
Quality of Life—child	9	Pattern toward favorable	Favorable (1 study)	Mixed evidence (2 studies)	Pattern toward favorable (3 studies)	Pattern toward no effect/weak evidence (1 study)	No studies	Favorable (1 study)	Pattern toward favorable (1 study)
Quality of Life—caregiver	3	Pattern toward favorable	No studies	Favorable (2 studies)	Pattern toward no effect/ weak evidence (1 study)	No studies	No studies	No studies	No studies

Source: CHBRP analysis of research literature. Please see Appendix A for details on literature review methods.

Table 4. Current Coverage of Pediatric Asthma Self-Management Training and Education

Type of Education or Training	Percent of Members Covered
Education materials to patient or guardian	
Paper form	100%
Electronic form	100%
Individual health education	
Toll-free automated number	100%
Toll-free advice	100%
Computer-based health management	59%
Group health education classes to patient or guardian	56%
Self-management training and education	
Initial office visit	100%
Follow-up office visit	91%
Follow-up with other provider	91%
Home-based visit, provider	8%
School-based visit, provider	0%

Source: California Health Benefits Review Program, 2006. Analysis of health plan and insurers responses to CHBRP questionnaire on current coverage for AB 264. Responding plans represent approximately 93% of the commercially insured population.
Note: Percentages are estimates of the members in each responding health plan that have coverage for each service.

Table 5. Baseline (Pre-Mandate) Per Member Per Month Premium and Expenditures, California, Calendar Year 2006, by Insurance Plan Type

	Large Group	Small Group	Individual	CalPERS	Medi-Cal		Healthy Families	
	HMO	HMO	HMO	HMO	HMO 65 yrs and Over	HMO Under 65 yrs	HMO	Total Annual
Population currently covered	8,237,000	2,593,000	984,000	782,000	339,000	2,423,000	714,000	16,072,000
Average portion of premium paid by employer	$202.76	$189.45	$0.00	$248.33	$265.00	$112.00	$75.20	$33,245,805,000
Average portion of premium paid by employee	$62.47	$74.62	$257.58	$43.82	$0.00	$0.00	$4.80	$11,990,041,000
Total Premium	**$265.23**	**$264.07**	**$257.58**	**$292.16**	**$265.00**	**$112.00**	**$80.00**	**$45,235,846,000**
Covered benefits paid by member (deductibles, copays, etc.)	$9.39	$15.90	$15.68	$10.35	$0.00	$0.00	$2.18	$1,724,145,000
Benefits not covered	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0
Total Expenditures	**$274.62**	**$279.97**	**$273.26**	**$302.51**	**$265.00**	**$112.00**	**$82.18**	**$46,959,990,000**

Source: California Health Benefits Review Program, 2006.
Note: The population includes individuals and dependents in California who have private insurance (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families.
All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage. Members enrolled in preferred provider organizations and fee-for-service plans are not included in this analysis since AB 264 apply to Knox-Keene licensed plans.
Employees and their dependents who receive their coverage from self-insured firms are excluded because these plans are not subject to mandates.
Key: CalPERS = California Public Employees' Retirement System; HMO = health maintenance organization and point of service plans.

Table 6. Post-Mandate Impacts on Per Member Per Month and Total Expenditures, California, Calendar Year 2006, by Insurance Plan Type

	Large Group	Small Group	Individual	CalPERS	Medi-Cal		Healthy Families		
	HMO	HMO	HMO	HMO	HMO 65 yrs and Over	HMO Under 65 yrs	HMO	All Plans	Total Annual
Population currently covered	8,237,000	2,593,000	984,000	782,000	339,000	2,423,000	714,000	16,072,000	16,072,000
Average portion of premium paid by employer	$0.0033	$0.0032	$0.0000	$0.0034	$0.0000	$0.0078	$0.0131	$0.0041	$798,000
Average portion of premium paid by employee	$0.0010	$0.0013	$0.0043	$0.0006	$0.0000	$0.0000	$0.0008	$0.0011	$204,000
Total premium	$0.0043	$0.0045	$0.0043	$0.0040	$0.0000	$0.0078	$0.0139	$0.0052	$1,002,000
Covered benefits paid by member (deductibles, copays, etc)	$0.0002	$0.0003	$0.0003	$0.0001	$0.0000	$0.0000	$0.0004	$0.0002	$31,000
Benefits not covered	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	—
Total expenditures	$0.0045	$0.0047	$0.0046	$0.0042	$0.0000	$0.0078	$0.0143	$0.0054	$1,034,000
Percentage impact of mandate									
Insured premiums	0.002%	0.002%	0.002%	0.001%	0.000%	0.007%	0.017%	0.002%	0.002%
Total expenditures	0.002%	0.002%	0.002%	0.001%	0.000%	0.007%	0.017%	0.002%	0.002%

Source: California Health Benefits Review Program, 2006.
Note: The population includes individuals and dependents in California who hare enrolled in Knox-Keene licensed health plans (group and individual) or are enrolled in public plans subject to the Health and Safety Code, including CalPERS, Medi-Cal, or Healthy Families.
All population figures include enrollees aged 0–64 years and enrollees 65 years or older covered by employment-based coverage.
Employees and their dependents that receive their coverage from self-insured firms are excluded because these plans are not subject to mandates. Members enrolled in preferred provider organizations and fee-for-service plans are not included in this analysis since AB 264 apply to Knox-Keene licensed plans.
Key: CalPERS = California Public Employees' Retirement System; HMO = health maintenance organization and point of service plans.

Table 7. Health Outcomes Related to Asthma Management in Children (ages 1–17 Years) with High-Risk Asthma in Health Maintenance Organizations and Point-of-Service Plans, California, Estimates for Calendar Year 2006

Public Health Measure	Baseline Rates	Change Based on Effectiveness Review*	Change as a Result of AB 264
School absences	1.4 mean days/month	–26%	–4,000 days/month
Restricted-activity days	79.3% of children	–19%	–2,000 children
Number of emergency room visits per child with high-risk asthma	0.2037	–11%	–300 children
Number of hospitalizations per child with high-risk asthma	0.0548	–22%	–160 children hospitalized

Sources: California Health Benefits Review Program, 2006. School absences and restricted-activity days are from direct analysis of 2001 CHIS data; emergency room visits and hospitalizations are based on estimates provided by Milliman.
Note: The number of children to whom AB 264 applies is 134,000. This represents the number of children with high-risk asthma in health plans subject to the mandate.
* It is estimated that 10% of children with asthma who are presently covered will newly use the benefit following the mandate (i.e., 13,400 ages 1–17 years or 10,900 school-aged 5–17 years).

Table 8. Asthma Prevalence and Related Information by Gender in Children 1–17 Years with Health Insurance Coverage, California, 2001

Variable	All	Males	Females	p-Value
High-risk asthma (emergency room visit or daily/weekly symptoms)	2.5%	2.9%	2.1%	0.002
School absences (% missing 1 or more days)	49.3%	43.7%	54.1%	0.030
Restricted-activity days	79.3%	79.0%	79.4%	0.133
Emergency room visits	18%	18%	18%	n.s.
Hospitalizations	5%	5%	5%	n.s.
Physician ever provided information on how to avoid asthma getting worse	63.2%	56.2%	70.8%	0.076

Source: California Health Interview Survey, 2001. Respondents 1–17 years with health insurance coverage (employer-sponsored, privately purchased, Healthy Families Program, and Medi-Cal).
Note: Rates of school absences, restricted-activity days, emergency room visits, hospitalizations, and asthma education are presented for those children with high-risk asthma.
Key: n.s = not significant

Table 9. Asthma Prevalence and Related Information by Race in Children 1–17 Years with Health Insurance Coverage, California, 2001

Variable	All	White	Black	Hispanic	Asian	p-Value
High-risk asthma (Emergency room visit or daily/weekly symptoms)	2.5%	2.3%	3.5%	2.5%	1.5%	0.000
School absences (% missing 1 or more days)	49.3%	40.9%	73.9%	40.0%	*	0.114
Restricted-activity days	79.3%	80.6%	88.5%	76.8%	*	0.000
Physician ever provided information on how to avoid asthma getting worse	63.2%	64.7%	52.2%	61.8%	*	0.086

Source: California Health Interview Survey, 2001. Respondents 1–17 years with health insurance coverage (employer-sponsored, privately purchased, Healthy Families Program, and Medi-Cal).
Note: Rates of school absences, restricted-activity days, emergency room visits, hospitalizations, and asthma education are presented for those children with high-risk asthma.
* Cell size too small to make an estimate

APPENDICES

Appendix A: Literature Review Methods

This report analyzes Assembly Bill 264 (AB 264) as amended on March 27, 2006. This legislation would require all health care service plans regulated and licensed by the California Department of Managed Care (DMHC) that cover outpatient prescription drug benefits include coverage for pediatric asthma self-management training and education.

As amended, AB 264 would require health plans to cover these services for children whose physicians determine them to be "at high-risk for emergency room visits or hospitalization for an asthmatic episode, or a high number of days of restricted activity, nights of nocturnal asthma, or asthma exacerbations" or who have had one or more emergency room visits for an asthma exacerbation within one calendar year. The amendments would also mandate that pediatric asthma self-management training and education include "at a minimum group health education classes for the patient and his or her parent or guardian, home-based education and training, and school-based education and training."

Appendix A describes the methods used in the literature review for the analysis of the amendments to AB 264. This literature review updates literature reviews on pediatric asthma self-management training and education that CHBRP previously conducted for AB 264 as introduced earlier in this legislative session, AB 2185 introduced in 2004, and AB 1549 as introduced in 2003. Only articles published after these reviews were completed were retrieved because the previous CHBRP literature reviews encompassed all relevant literature published earlier.

This literature review included meta-analyses, systematic reviews, randomized controlled trials, controlled clinical trials, and observational studies. The PubMed, CINAHL, and Cochrane databases, including the Cochrane Database of Systematic Reviews and the Cochrane Central Register of Controlled Trials (CENTRAL), were searched.

The scope of the literature search included effects of self-management education interventions and written asthma action plans on health, disability, utilization, quality of life, and intermediate outcomes for children with asthma. The search was limited to abstracts published in English and to studies of children, defined as subjects aged 0–18 years.[14] Trials that included adults with asthma were excluded unless sub-group analyses were performed for children. Only individual trials conducted in the United States were included in the review because "usual care" for asthma may vary across nations and because utilization of specific types of health care services, such as emergency room visits, may vary across nations with differing types of health care systems. Due to the difficulty of distinguishing between educational and self-management interventions, any trial in which the intervention included an educational or self-management component was reviewed.

[14] Although CHBRP's analysis is limited to children aged one year or older, the search included infants under age one because PubMed's options for limiting searches by subjects' age are limited. The category for children encompasses persons aged 0–18 years. After promising articles were identified, CHBRP read the articles and excluded studies in which most of the subjects were younger than one year old or 18 years or older.

At least two reviewers screened the title and abstract of each citation returned by the literature search to determine eligibility for inclusion. Full text articles were obtained and reviewers reapplied the initial eligibility criteria.

Twelve articles were obtained and reviewed to update the literature review on pediatric asthma self-management and training. Six articles were not included in the analysis for the following reasons: unsystematic summary of the literature; conducted outside the United States; all subjects were infants, an age group for which asthma cannot be diagnosed definitively; intervention not targeted toward children and caregivers (e.g., targeted toward physicians and medical groups); or addressed asthma self-management training and education, but did not address medical effectiveness (e.g., addressed cost). Findings from the six new articles were synthesized with findings from 43 articles included in the previous literature review on pediatric asthma self-management and training.

Due to a lack of sufficient evidence, the effectiveness of the various components of self-management training or education programs could not be determined, nor was it possible to ascertain whether a specific intervention program was better than another. Accordingly, the conclusions drawn with respect to interventions affecting each outcome measure do not concern *components* of interventions, only *entire* interventions.

Two meta-analyses published in the Cochrane Database of Systematic Reviews were identified through previous literature searches on pediatric asthma self-management training and education. One meta-analysis, entitled "Educational Interventions for Asthma in Children," included 32 trials published between 1980 and 1998. The second meta-analysis, entitled, "Interventions for Educating Children Who Have Attended the Emergency Room for Asthma," included eight trials published between 1985 and 1999, in which the subjects were children who had had an emergency room visit for asthma. Meta-analysis can be defined as "quantitative statistical analysis that is applied to separate but similar experiments of different and usually independent researchers and that involves pooling the data and using the pooled data to test the effectiveness of the results" (Merriam-Webster, 2006). Results from the meta-analyses were given substantial weight in decisions about the effectiveness of asthma self-management training and education interventions because the authors of the meta-analyses applied rigorous methodological criteria prior to the inclusion of each article in their analyses.

Of the individual trials analyzed, the results of randomized controlled trials were given more weight than nonrandomized trials. In nonrandomized trials, intervention and control groups are often not equivalent prior to the intervention, which can bias the trial's results. This is less likely to occur in randomized controlled trials because randomization should ensure that the intervention and control groups are equivalent prior to the intervention and, thus, increase the likelihood that differences in outcomes for the intervention and control groups are due to exposure to the intervention and not to other differences between the groups.

The studies fell into three broad groupings. The first involved before and after comparisons of intervention and control groups, reporting four sets of measures. The second grouping provided "after" measures for intervention and control groups, implicitly assuming that the "before"

values were the same because randomization process was adequate. A third group consisted of a few studies that reported before and after measures for an intervention group without a control group.

The asthma self-management training and education interventions varied widely across the studies. In some cases, the intervention focused on the use of medical devices used to dispense asthma medications, such as metered-dose inhalers (e.g., Minai et al., 2004) or nebulizers (e.g., Butz, Syron, et al., 2005). In other cases, the intervention emphasized mitigation of exposure to household environmental risk factors for asthma symptoms such as dust mites, cockroaches, and rodents (e.g., Eggleston et al., 2005; Krieger et al., 2005, Morgan et al., 2004). In still other cases, the intervention provided children and their caregivers with education about multiple topics relevant to asthma self-management (e.g., Butz, Pham, et al., 2005; Clark et al., 2004; Evans et al, 1999, Horner, 2004; La Roche et al., 2006; Shames et al., 2004)

The control groups also varied across the studies. In most cases, the control group received "usual care" for asthma, which means that they did not receive any asthma self-management training or education above and beyond what they might otherwise receive from their primary care practitioner or other asthma care provider. "Usual care" may vary across children enrolled in a study, but the studies do not provide sufficient information for us to determine the magnitude of variation. In other cases, the control group received a less intensive or less comprehensive intervention (e.g., Butz, Syron, et al., 2005; Greineder et al., 1999; Huss et al., 2003; Krieger et al., 2005; Krishna et al., 2003; Kubly and McClellan, 1984; Lewis et al., 1984; Walders et al., 2006) or a different intervention (Homer et al., 2000; Yoos et al., 2002). Studies in which the control group received some sort of intervention were excluded from our quantitative estimates of the effects of asthma self-management training and education.

The trials were conducted in a variety of settings. Eleven trials were carried out primarily in schools, a setting in which health plans typically do not cover services. Seven trials assessed group classes provided to children and/or their caregivers in settings other than schools. Eight trials involved individual education of children and, in some cases, their caregivers in primary care or specialty outpatient clinics. In eight trials, the intervention consisted primarily of visits to children's homes to provide education to children and/or their caregivers. Two trials involved one or more telephone calls with children's caregivers. Five trials focused on interactive, educational computer games. One study assessed a device that connected to the Internet through children's home telephones. In some cases, interventions were delivered in multiple settings.

The asthma self-management training and education interventions were delivered by a variety of providers. In some cases, the provider was not a licensed or registered health professional, or the article did not provide sufficient information to determine whether the provider was supervised by a licensed or registered health professional. Among individual trials, nurses were the most common providers, furnishing interventions in 25 trials. Other licensed health professionals who delivered interventions included physicians (four trials), respiratory therapists (four trials), and nurse practitioners (three trials). In two trials, the intervention was provided by a health educator. Seven trials involved providers with training and/or experience in mental health or social services. In three trials, the intervention was delivered by an educator, either a teacher or a research assistant with a master's degree in education. Three trials assessed home-based

interventions delivered by community health workers who were specifically trained to deliver the intervention. Eight trials involved interactive, educational computer games that children were expected to play on their own. In four of the computer game trials, the child also received education from a licensed health professional or unlicensed asthma educator, and in four cases the child learned about asthma self-management solely through the game. In six cases, the articles did not provide sufficient information to ascertain who provided the intervention. The total number of provider types exceeds the number of trials because in some trials the intervention was delivered by more than one type of provider (e.g., physicians and nurses).

To "grade" the evidence for all outcome measures, the CHBRP effectiveness team uses a system[15] with the following categories:

1. Favorable (statistically significant effect): Findings are uniformly favorable, and many or all are statistically significant.
2. Pattern[16] toward favorable (but not statistically significant): Findings are generally favorable, but there may be none that are statistically significant.
3. Ambiguous/mixed evidence: Some findings are significantly favorable, and some findings with sufficient statistical power show no effect.
4. Pattern toward no effect/weak evidence: Studies generally find no effect, but this may be due to a lack of statistical power.
5. No effect: There is statistical evidence of no clinical effect in the literature with sufficient statistical power to make this assessment.
6. Unfavorable: No findings show a statistically significant benefit, and some show significant harms.
7. Insufficient evidence to make a "call": There are very few relevant findings, so that it is difficult to discern a pattern.

The search terms used to locate studies relevant to the AB 264 were as follows:

Medical Subject Headings (MeSH) for searching PubMed and Cochrane:

Explode: Indicates searches of the broader term and all narrower terms under the broader term.

Adolescent
Asthma
Asthma/economics/education/prevention and control/therapy
Explode Child
Explode Costs and Cost Analysis
Counseling
Health Education
Outcome Assessment (Health Care)

[15] The foregoing system was adapted from the system used by the U.S. Preventive Services Task Force, available at http://www.ahcpr.gov/clinic/3rduspstf/ratings.htm. The medical effectiveness team also considered guidelines from the Centers for Medicare & Medicaid Services (available at http://www.cms.hhs.gov/FACA/downloads/recommendations.pdf and guidelines from the Blue Cross and Blue Shield Association (available at http://www.bcbs.com/tec/teccriteria.html).

[16] In this report, the word "trend" may be used synonymously with "pattern."

Outcome of Education
Patient Education/economics
Program Evaluation
Quality of Life
School Health Services
Self Care

Publication types:

Meta Analysis
Randomized Controlled Trial
Clinical Trial
Practice Guidelines
Multicenter Study

Keywords:

Below is a list of keywords used in the search to retrieve recently published articles that have not been indexed with MeSH terms.

* Truncation

asthma, asthma (education or educational) intervention*, asthma (educational or education) plan, asthma (education or educational) program*, asthma (education or educational), child, children, childhood, clinical trial*, cost*, cost effective*, costs benefits analysis, (counsel* or counsell*), health education, home-based, school-based, nurse*, meta analysis, multicenter study, outcome*, patient education , pediatric asthma, practitioner-based, program evaluation, quality of life, randomized controlled trial*

CINAHL

Below is a list of CINAHL subject headings and keywords used to search CINAHL.

Subject Headings:

Explode: Indicates searches of the broader term and all narrower terms under the broader term.

Adolescence
Asthma
Asthma/economics/education/therapy
Explode Child
Clinical Trials
Explode Costs and Cost Analysis
Health Education
Outcomes of Education
Outcomes (Health Care)

Outcome Assessment
Patient Education/economics
Program Evaluation
School Health Education/evaluation
Systematic Reviews

Keywords:

$ Truncation

asthma, asthma (education or educational) intervention$, asthma (educational or education) plan, asthma (education or educational) program$, asthma (education or educational), child, children, childhood, clinical trial$, cost$, cost effective$, costs benefits analysis, (counsel$ or counsell$), health education, home-based, school-based, nurse$, meta analysis, multicenter study, outcome$, patient education , pediatric asthma, practitioner-based, program evaluation, quality of life, randomized controlled trial$

Appendix B: Summary of Medical Effectiveness Findings on Pediatric Asthma Self-Management Training and Education

Appendix B presents detailed information on medical effectiveness findings on pediatric asthma self-management training and education in two tables.

Table B-1 is a summary of the published studies on pediatric asthma self-management training and education reviewed for AB 264 and of earlier studies reviewed for AB 1549 and AB 2185. The table includes study citations and descriptions of the types of trials, intervention and control groups, populations studied, and locations in which studies were conducted.

Table B-2 is a summary of the evidence of medical effectiveness of asthma self-management training and education interventions by outcome, including the citation, the results, and the categorization of results.

These tables include the 13 studies obtained from the current literature review and the 32 studies assessed in CHBRP's previous reports on childhood asthma self-management training and education.

Full bibliographic information can be found in the list of references at the end of this report.

Table B-1. Summary of Published Studies on Pediatric Asthma Self-Management Education and Training

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Haby et al., 2005	Meta-analysis of 8 randomized controlled trials and controlled clinical trials	Interventions included interactive communication of information about asthma, self-monitoring of symptoms, and/or written asthma action plans vs. usual care (7 trials) or low-intensity education (1 trial)	Children aged 0–18 years with an emergency room visit for asthma	United States, New Zealand, United Kingdom
Wolf et al., 2003	Meta-analysis of 32 randomized controlled trials and controlled clinical trials	Interventions included group education, individual education, and/or asthma self-management strategies	Children aged 2–18 years	United States, Australia, Canada, Germany, Israel, Italy, Netherlands, New Zealand, Sweden, United Kingdom
Alexander et al., 1988*	Randomized controlled trial	Education, management, vs. usual care	Children who had no consistent source for asthma management other than emergency room (children primarily from low-income families)	Memphis, TN
Anderson et al., 2004	**Observational study—pre/post with comparison group composed of matched controls**	**Enrollment in a school for children with chronic diseases that provides disease management services on a daily basis vs. enrolled in other schools/usual care**	**Children with a mean age of 11 years; Most were African-American or Latino; Most were from low-income families**	**Denver, CO**
Bartholomew et al., 2000	Randomized controlled trial	Computer-assisted instructional game (self-management education) vs. usual care	6.8% health maintenance organization, 6.8% Medicare, 48.3% Medicaid, 6.8% self-pay, 31.4% none	Inner-city Texas

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Bonner et al., 2002	Randomized controlled trial	Education and management (diary, peak flow meter) vs. usual care	Almost 85% of families received Medicaid or had no insurance, urban families	New York, NY
Brown et al., 2002	Randomized controlled trial	Education vs. usual care	More than 80% received Medicaid (84% in intervention group)	Metro Atlanta, GA
Butz, Pham et al., 2005	Nested design	A school-based educational intervention that consisted of 2 two-hour sessions for children and 1 one-hour session for caregivers vs. written materials about asthma	Children diagnosed with asthma; recruited from rural elementary schools; aged 6–12 years; children from multiple racial/ethnic groups	Rural areas in Maryland
Butz, Syron et al., 2005	Randomized controlled trial	Six home visits focused on educating caregivers on identification and treatment of asthma symptoms, especially use of nebulizers, vs. three home visits that address use of a peak flow meter and asthma action plans	Children diagnosed with asthma who used a nebulizer to administer at least one asthma medication; recruited from university-affiliated primary care practices, specialty pediatric practices and pediatric emergency rooms; aged 2–8 years; lived in inner-city areas; 89% were African-American	Baltimore, MD
Catov et al., 2005	Observational study—two analyses: (1) pre- and post-test with nonequivalent comparison group, and (2) one group pre- and post-test analysis	Home visits by a respiratory therapist vs. usual care	Persons who had one or more hospitalizations or three or more emergency room visits with a primary diagnosis of asthma; recruited enrollees in a managed care plan; 59% of subjects were children—subgroup analyses for children only are reported; all enrolled in Medicaid; included African-American and European-American children	Western Pennsylvania—rural and urban areas
Christiansen et al., 1997*	Observational study—untreated comparison group with pre/post test	Education, management vs. usual care	Inner-city	San Diego, CA

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Clark et al., 2004	Nested design	Comprehensive, school-based educational intervention for children and caregivers vs. usual care (control group received the intervention after the trial was completed)	Children whose caregivers reported a diagnosis of asthma and active asthma symptoms or use of asthma medication, or no diagnosis but reported three or more of seven asthma symptoms in the previous year or either of two exercise-related asthma symptoms; recruited from schools in urban areas with high asthma prevalence; grades 2–5; 54% lived in families with incomes of less than $15,000; 98% were African-American	Detroit, MI
Clark et al., 1986*	Randomized controlled trial	Education, management vs. usual care	Low-income urban children	New York, NY
Eggleston et al., 2005	**Randomized controlled trial**	**Three home visits and telephone calls from a community health worker who provided education about environmental factors that trigger asthma symptoms plus equipment and services to mitigate exposures (e.g., HEPA filter, mattress and pillow encasings, pest management) vs. usual care (control group received the intervention after the trial was completed)**	**Children diagnosed with asthma who had current symptoms and no other chronic lung disease; Recruited from graduates of a school-based asthma education program; aged 6-12 years; lived in an inner-city area; most lived in families with incomes below 100% poverty.**	**Baltimore, MD**

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Evans et al., 1999	Randomized controlled trial	Group and individual education and telephone calls for caregivers plus group education for children vs. usual care	Children diagnosed with asthma who used at least two asthma medications, had at least one asthma hospitalization, or had at least one unscheduled physician visit during the six months prior to recruitment, or who had respiratory symptoms for two days or nights during the two weeks prior to recruitment; aged 5–11 years; lived in inner-city census tracts where at least 20% of the population was below 100% of poverty; African-American and Hispanic children and children from other racial/ethnic groups	Baltimore, Chicago, Cleveland, Detroit, New York, St. Louis, Washington, DC
Evans et al., 1987*	Nested design	School-based education, management vs. usual care	Low-income (71% received Medicaid or other public assistance)	New York, NY
Fireman et al., 1981*	Controlled clinical trial - sequential assignment	Education, management vs. usual care	Selected from pediatric allergist's office and Allergy Clinic of Children's Hospital	Pittsburgh, PA
Georgiou et al., 2003	Nested design	Education and management with peak flow meter (no control group)	Children with asthma and their caregivers who were enrolled in United Healthcare (national health care organization)	Multiple states within the United States
Greineder et al., 1999	Randomized controlled trial	In-person education for children and family members, written asthma action plan, and follow-up telephone calls vs. in-person education and written asthma action plan	Selected from urban health centers of Harvard Pilgrim Health Care (health maintenance organization)	New England
Guendelman et al., 2002	Randomized controlled trial	Education and management w/Health Buddy vs. asthma diary	Intervention 92% public, 8% private. Control group 93% public, 6% private	Oakland, CA
Harish et al., 2001	Randomized controlled trial	Asthma clinic (w/education, action plan) vs. usual care	Low-income, inner-city population	New York, NY

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Homer et al., 2000	Randomized controlled trial	Educational computer game (designed to teach asthma management) vs. written educational materials	Adolescents 13.3% total sample had private insurance	Boston, MA
Horner, 2004	Nested design	School-based group education program vs. usual care	Children diagnosed with asthma; grades 3–5; 46% were from poor or working-class families; African-American, Mexican-American, and European-American children	United States—article does not mention a specific state or city
Huss et al., 2003	Randomized controlled trial	Education and computer-based instructional asthma game and written educational materials vs. written educational materials	Inner-city children	Baltimore, MD
Kelly et al., 2000	Controlled clinical trial—alternating assignment	Education in clinic and management (w/ written action plan) vs. usual care	All children were covered by Medicaid	Norfolk, VA
Krieger et al., 2005	Randomized controlled trial	Seven visits from a community health worker plus full resources (e.g., bedding encasements, low-emission vacuums, rodent traps, allergy tests) vs. one visit and limited resources (i.e., only bedding encasements)	Households containing at least one child whose caregiver reported persistent asthma symptoms, and whose medical record indicated a diagnosis of asthma, or at least one emergency room or hospital visit for asthma; recruited from clinics, hospitals, emergency rooms, and from referrals from community agencies and community residents; aged 4–12 years; all enrolled in Medicaid and/or lived in households with incomes below 200% of poverty; caregivers spoke English, Spanish, or Vietnamese	Seattle, WA

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Krishna et al., 2003	Randomized controlled trial	Internet-enabled, interactive, multimedia asthma education program, in-person education, written educational materials, and written asthma action plan vs. in-person education, written educational materials, and written asthma action plan	Participants were children who visited a pediatric pulmonary clinic	Missouri
Kubly and McClellan, 1984*	Randomized controlled trial	Factual information about asthma, self-care skills, and breathing exercises vs. factual information about asthma	Mostly Anglo American, median family income $20,000–$30,000	Southwestern United States
La Roche et al., 2006	**Randomized controlled trial**	**Compared three groups: (1) children whose families participated in group classes that emphasized collaborative learning and sociocultural context, (2) children whose families participated in group classes that were more structured and did not address sociocultural context, (3) children in a control group who received usual care**	**Families who had at least one child diagnosed with asthma who was aged 7–13 years; Recruited from an inner-city community health center; all children were African-American or Hispanic**	**Boston, MA**
LeBaron et al., 1985*	Randomized controlled trial	Education vs. usual care	Patients at private pediatric allergy practices; low-to-middle-income or higher	San Antonio, TX

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* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Lewis et al., 1984*	Randomized controlled trial	Five, one-hour, interactive asthma education classes provided to groups of five to seven children and their parents vs. three 1.5-hour asthma education lectures provided to groups of 12 to 25 persons.	Patients of the Southern California Permanente Medical Group	Los Angeles, CA
Lukacs et al., 2002	Observational study—untreated comparison group with pre- and post-tests	Education, management (written action plan) vs. usual care	Kaiser Permanente members.	Colorado
Minai et al., 2004	Observational study—one group pre- and post-test design	Education re: proper use of metered dose inhalers (no control group—pre-/post-test study)	Children referred to a pediatric asthma education clinic at an inner-city hospital; aged 4 years or older; African-American, Hispanic, and European-American children	Cleveland, OH
Morgan et al., 2004	**Randomized controlled trial**	**Home visits by community health workers who provided education about indoor allergens and/or tobacco smoke and services to remediate exposure (e.g., HEPA air cleaner, HEPA vacuum cleaner, vent filters, mattress and pillow encasings, pest management) vs. usual care**	**Children who tested positive for at least one indoor allergen and who had at least one hospitalization, two unscheduled clinic visits, or two emergency department visits within the previous six months; Recruited from academic health centers; aged 5–11 years; lived in census tracts in which at least 20% of households had incomes below 100% of poverty.**	**Boston, Chicago, Dallas, New York, Seattle, Tucson**
Parcel et al., 1980*	Observational study – untreated comparison group	School-based education vs. usual care	Mostly African American, low-middle to lower socioeconomic status	Galveston, TX
Perrin et al., 1992	Randomized controlled trial	Education and stress management program vs. usual care	Predominantly white, middle to upper class	Boston, MA

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* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Persaud et al., 1996*	Randomized controlled trial	Education, management vs. usual care	69% Medicaid	Galveston, TX
Rubin et al., 1986*	Randomized controlled trial	Educational asthma computer game vs. brief verbal instructions	Children were patients at Yale-New Haven Hospital, Hospital of St. Raphael, Yale Health Plan (university-based health maintenance organization), Community Health Care Plan (private health maintenance organization), or private pediatrician's office	New Haven, CT
Shames et al., 2004	Randomized controlled trial	Multi-component asthma education intervention that included an educational video game vs. usual care	Children diagnosed with moderate-to-severe asthma whose parents reported significant asthma symptoms and had at least one hospitalization or two acute care or emergency room visits for asthma during the previous year; aged 5–12 years; lived in low-income urban areas; over 70% enrolled in Medi-Cal; African-American, Hispanic children, and children from other racial/ethnic groups	San Francisco and San Jose, CA
Shegog et al., 2001	Randomized controlled trial	Computer-assisted instruction game designed to teach self-management vs. conventional education	Recruited from clinics and schools in a large urban area	Texas
Shelledy et al., 2005	**Observational study—one group pre- and post-test design**	**Eight home visits by respiratory therapists who provided asthma disease management services (no control group—pre- and post-test study)**	**Children with moderate to severe asthma; Recruited from patients of a large, urban not-for-profit hospital who had high utilization; aged 3–18 years; 50% were Hispanic**	**United States—article does not mention a specific state or city**
Shields et al., 1990*	Randomized controlled trial	Education vs. usual care	Drawn from urban health maintenance organization	Chicago, IL

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Tinkelman and Schwartz, 2004	Observational study—one group pre- and post-test/post design	School-based asthma education program plus an interactive web site (no control group—pre- and post-test study)	Children diagnosed with asthma; aged 5–15 years; enrolled in urban elementary or middle schools; most from low-income families; most children are Latino	Denver, CO, and Carrollton, TX (in Dallas metropolitan area)
Velsor-Friedrich et al., 2005	Nested design	Participation in Open Airways, a school-based intervention, and five follow-up visits with a nurse practitioner vs. no intervention	Children diagnosed with asthma; recruited from schools; aged 8–13 years; resided in inner-city neighborhoods	Large city in the midwestern United States
Velsor-Friedrich et al., 2004	Nested design	Participation in Open Airways, a school-based intervention, vs. no intervention	Children diagnosed with asthma; recruited from schools; aged 8–13 years; resided in inner-city neighborhoods	Large city in the midwestern United States
Walders et al., 2006	**Randomized controlled trial**	**Asthma education, training in use of metered-dose inhalers, asthma risk assessment, written asthma management plan, and 24-hour nurse-staffed advice line vs. written asthma management plan and training in use of metered dose inhalers**	**Children diagnosed with asthma who had no serious comorbidities, were not under the care of an asthma specialist, did not have an asthma treatment plans, and had at least two emergency department visits for asthma and/or at least one hospitalization for asthma in the previous year; recruited from outpatient clinics, inpatient units, and emergency departments; most were African-American**	**Cleveland, OH**
Whitman et al., 1985*	Two designs: Randomized controlled trial for school age children and observational study with one group pre/post design for preschool children	Education, management vs. usual care	School-aged, preschool; referred by private physicians	Utah

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Citation	Type of Trial	Intervention vs. Control Group	Population Studied	Location
Wilson et al., 1996*	Randomized controlled trial	Education, management vs. usual care	Mothers were relatively well-educated (52% graduated from college), 10.7% minority	St. Paul, MN
Yoos et al., 2002	Randomized controlled trial	Education about asthma plus one of three interventions for monitoring asthma symptoms: (1) subjective symptom monitoring, (2) peak expiratory flow rate (PEFR) monitoring when symptomatic, (3) PEFR monitoring twice daily and when symptomatic	Recruited from diverse primary care settings	New York

Notes: Studies in bold were published or obtained subsequent to the literature search for CHBRP's initial report on AB 264.
* Studies included in Wolf et al.'s (2003) meta-analysis.

Table B-2. Summary of Evidence of Medical Effectiveness of Pediatric Asthma Self-Management Training and Education Interventions by Outcome

Days of asthma symptoms—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Bonner et al., 2002 (RCT, n = 119 children) ±	Frequency of wheezing, sleep disturbance, and confinement to home (sum of measures on three 1–3 point scales—1 = <1 time; 2 = 1–2 times; 3 = >2 times): Int pre 6.72→post 5.46, control pre 6.30→post 6.72	Sig, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Intervention group had significantly fewer symptoms of shortness of breath; p = 0.007	Sig, fav
Clark et al., 2004 (nested design, n = 835 children, 14 schools) ±	Days with symptoms/12 months: 17% fewer in the intervention group than in the control group	Sig, fav
Eggleston et al., 2005 (RCT, n = 100 children) ±	**% children reporting symptoms/12 months: Int pre 58%→post 55%, control pre 50%→post 59%; OR = 0.62, [0.36, 1.05] p = 0.07**	**NS, fav**
Evans et al., 1999 (RCT, n = 1033 children) ±	Days with symptoms/2 weeks: Int pre 5.1→post 3.51, control pre 5.1→post 4.06; Difference between intervention and control groups: –0.55 [–0.92, –0.18], p = 0.004	Sig, fav
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Days with symptoms/12 months: Int pre 31.9→post 18.1, control pre 28.3→post 30.3	Sig, fav
Fireman et al., 1981* (CCT, n = 26 children)	Average # of wheezing days/patient/month: Int post 3.1, control post 4.6; p = 0.2	NS, fav
Krieger et al., 2005 (RCT, n = 214 children) ±	Days with symptoms/12 months: Int pre 8.0→post 3.2, control pre 7.8→post 3.9; Difference between treatment and control groups: –1.24 [–2.9, 0.4]	NS, fav
Krishna et al., 2003 (RCT, n = 228 children) ±§	Days with symptoms/2 months: Int pre 104.5→post 23.9, control pre 97.8→post 48.2	Sig, fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**Days/2 weeks: Int pre 4.5→post 2.65, control pre 4.2→post 3.43**	**Sig, fav**
Shames et al., 2004 (RCT, n = 119 children) §	% days with symptoms: Int pre 55→post 31, control pre 59→post 40; Difference between intervention and control groups: –1.9 [–14.4, 10.7]	NS, fav
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Frequency with which child has asthma symptoms (1 = ≤ 2 times/week, 4 = continual): Int pre 1.5→post 0.43	Sig, fav
Velsor-Friedrich et al., 2005 (nested design, n = 52	% At least 1 day of symptoms/12 months: Int post 50%, control post 54%	NS, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.
§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Trial	Results	Categorization (Significance, Direction)
children, 8 schools)		
Velsor-Friedrich et al., 2004 (nested design, n = 102 children, 8 schools) ±	Days with symptoms/2 weeks: Int post 1.26, control post 1.49	Sig, fav
Walders et al., 2006 (RCT, n = 175 children)	**Mean decrease in days with symptoms/1 month: Int –1.99, control –1.84**	**NS, no difference**
Yoos et al., 2002 (RCT, n = 168 children)	Mean # days/week of symptoms, baseline and in 3 months: (1) pre 2.83→post 2.87 (2) pre 2.87→post 2.00 (3) pre 3.19→post 2.68	Sig, fav for group 2 (objective monitoring when symptomatic with peak flow meter vs. subjective monitoring); NS, fav for group 3 (continuous monitoring with peak flow meter vs. objective monitoring when symptomatic)

Symptom-free days—favorable

Trial	Results	Categorization (Significance, Direction)
Brown et al., 2002 (RCT, n = 95 children)	Int pre 42→post 101, control pre 33→post 91	Sig, fav for younger children, not for older children
Wilson et al., 1996* (RCT, n = 76 children)	In 2 weeks: Int pre 8.5→post 10.2, control pre 11.9→post 9.3 For 1 month: Int pre 20.2→post 22.2, control pre 24.6→post 20.8	Sig, fav; Sig, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.
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Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Symptom scores—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Bartholomew et al., 2000 (RCT, n = 133 children)	Usherwood Symptom Questionnaire: Int pre 60.4→post 65.8, control pre 60.3→post 64.9. Effect size 0.10	NS, fav
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	Mean: Int post 2.87, control post 4.36	Sig, fav
Georgiou et al. 2003 (pre/post, n = 401 children)	Symptoms improved 2.4 points	Sig, fav
Walders et al., 2006 (RCT, n = 175 children)	**Decrease in symptom scores—scale 0–4 (0 = none of the time, 4 = all of the time): Int -0.71, control –0.66**	**NS, no difference**

Nights of nocturnal asthma—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 3 trials)	SMD –0.34 [–0.62, –0.05]	Sig, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Int group reported significantly fewer nights waking with wheezing, shortness of breath, chest tightness/discomfort	Sig, fav
Clark et al., 2004 (nested design, n = 835 children, 14 schools) ±	Nights symptoms/12 months: the intervention group had 40% more nights with symptoms than the control group	Sig, not fav
Eggleston et al., 2005 (RCT, n = 100 children) ±	**% children reporting symptoms/12 months: Int pre 42%→post 30%, control pre 36%→post 31%**	**NS, no difference**
Georgiou et al., 2003 (pre/post, n = 401 children)	Symptoms improved 5.8 (scale 0–100)	Sig, fav
Krishna et al., 2003 (RCT, n = 228 children) ±§	Nights of sleep disturbance: Int pre 64.7→post 15.2, control pre 62.0→post 17.1	NS, no difference
Morgan et al., 2004 (RCT, n = 937 children)	**Nights/2 weeks: Int pre 2.9→post 1.55, control pre 2.6→post 2.17**	**Sig, fav**
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Frequency with which child has nocturnal asthma (1 = ≤ 2 times/week, 4 = continual); Int pre 1.07→post 0.14	Sig, fav
Wilson et al., 1996* (RCT, n = 76 children)	Parental nights of sleep interruption/week: Int pre 0.6→post 1.3, control pre 0.8→post 2.6	Sig, not fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Asthma severity—pattern toward favorable

Trial	Result	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 4 trials)	SMD –0.15 [–0.43, 0.12]	NS, fav
Bartholomew et al., 2000 (RCT, n = 133 children) ±§	Functional status: Int pre 138.0→post 139.6, control pre 136.5→post 137.3; effect size = 0.16	NS, fav
Butz, Pham et al. 2005 (nested design, n = 201 children, 7 counties)	Change in severity score, scale 1–4 (1 = mild intermittent, 4 = severe persistent): Int –0.40, control 0.01	Sig, fav
Georgiou et al., 2003 (pre/post. n = 401 children)	% with mild symptoms: Int pre 66.9%→post 75.3%	Sig, fav
Harish et al., 2001 (RCT, n = 129 children)	Severe asthma: Int pre 26.5%→post 35.0%, control pre 19.8%→post 16.18%	Sig, not fav
Homer et al., 2000 (RCT, n = 137 children) ±§	Severity based on National Institutes of Health criteria (0 = mild, 2 = severe): Int pre 1.11→post 0.94, control pre 1.05→post 0.78 (-18% vs. -35%)	NS, not fav
Huss et al., 2003 (RCT, n = 101 children)	Patients with moderate or severe asthma: Int pre 46%→post 34%, control pre 38%→post 20%	NS, not fav
LeBaron et al., 1985* (RCT, n = 31 children)	Asthma severity (0 = severe, 10 = none): Int pre 8.6→post 8.87, control pre 6.81→post 8.81	NS, not fav
Minai et al., 2004 (pre/post, n = 45 children)	Severity based on clinical criteria (1 = mild, 4 = severe persistent): Int pre 2.6→post 2.3	NS, no difference
Perrin et al., 1992 (RCT, n = 56 children) ±	Functional measures: Daily chores (#/week): Int pre 15.3→post 19.5, control pre 17.2→post 17.6 Time playing with friends (hours/week): Int pre 8.1→post 11.1, control pre 10.2→post 11.5 After-school activities (#/week): Int pre 3.4→post 4.5, control pre 5.7→post 4.7	Chores: Sig, fav; Other measures: NS, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Asthma severity—pattern toward favorable (cont'd)

Trial	Result	Categorization (Significance, Direction)
Whitman et al., 1985* (RCT for school-aged children and pre/post for preschool children, n = 59 children) ±	Preschool children: Days of no asthma: Int pre 69.37→post 69.62 Days of mild asthma: Int pre 18.67→post 17.62 Days of moderate asthma: Int pre 5.52→post 5.10 Days of severe asthma: Int pre 1.76→post 0.81 School-aged children: Days of no asthma: Int pre 68.26→post 70.56, control pre 63.74→post 72.21 Days of mild asthma: Int pre 16.53→post 13.59, control pre 13.74→post 12.95 Days of moderate asthma: Int pre 7.21→post 6.00, control pre 9.05→post 7.79 Days of severe asthma: Int pre 0.79→post 1.84, control pre 1.26→post 0.63	Preschool kids: No asthma—NS, no difference; Mild asthma—NS, fav; Moderate asthma—NS, no difference; Severe asthma—Sig, fav School-aged children: No asthma—NS, fav; Mild asthma—NS, fav; Moderate asthma—NS, no difference; Severe asthma—NS, not fav
Wilson et al., 1996* (RCT, n = 76 children)	Degree to which child was bothered by symptoms: Int pre 2.7→post 2.3, control pre 2.6→post 2.3	NS, no difference
Yoos et al., 2002 (RCT, n = 168 children)	Mean scores: Group 1—pre 1.70→post 1.56 Group 2—pre 1.85→post 1.49 Group 3—pre 1.76 →post 1.50	Sig, fav for group 2 (objective monitoring when symptomatic with peak flow meter vs. subjective monitoring); NS, no difference for group 3 (continuous monitoring with peak flow meter vs. objective monitoring when symptomatic)

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Exacerbations (mean)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 5 trials)	SMD –0.21 [–0.43, 0.01]	NS, fav
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Average annual # episodes: Int pre 10.6→post 9.0, control pre 10.1→post 11.8 Average duration of episodes (days): Int pre 2.77→post 1.87, control pre 2.85→post 2.40	Sig, fav; Sig, fav
Fireman et al., 1981* (CCT, n = 26 children)	Average # of attacks/patient: Int post 1.5, control post 6.0	Sig, fav
LeBaron et al., 1985* (RCT, n = 31 children)	Frequency of attacks (0 = constant, 10 = none): Int pre 9.13→post 8.87, control pre 8.31→post 8.75	NS, no difference
Whitman et al., 1985* (RCT for school-aged children and pre/post for preschool children, n = 59 children) ±	Preschool children: Int pre 10.10→post 5.14. School-aged children: Int pre 11.05→post 6.26, control pre 7.84→post 4.47	Pre-school—Sig, fav School-age—NS, fav

Peak expiratory flow (PEF) rate—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 3 trials)	SMD 0.53 [0.19, 0.86]	Sig, fav
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	Int pre 261.04→post 331.37, control pre 272→post 313.53	NS, fav
Guendelman et al., 2002 (RCT, n = 134 children) §	PEF in yellow or red zone—OR –0.43	Sig, fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**PEF in morning (liters/min): Int pre 202.3→post 216.7, control pre 205.4→post 219.3**	**NS, no difference**
Shames et al., 2004 (RCT, n = 119 children) §	Mean PEF rate: Int pre 209.4→post 276.4, control pre 217.5→post 294.5; Difference between intervention and control groups: -6.3 [-40.8, 28.2]	NS, fav
Velsor-Friedrich et al., 2005 (nested design, n = 52 children, 8 schools)	% increase in peak flow at 12-month follow-up: Int post 26.21%, control post 27.80%	NS, no difference
Velsor-Friedrich et al., 2004 (nested design, n = 102 children, 8 schools) ±	Mean change in PEF rate: Int 7.5%, control 2.9%	Sig, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Emergency department visits (mean)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Haby et al., 2005 (meta-analysis, n = 3 trials)	3 trials whose results could not be combined—difference between int and control groups -0.64 to -5.5 ED visits	NS, fav
Wolf et al., 2003 (meta-analysis, n = 12 trials)	SMD –0.21 [–0.33, –0.09]	Sig, fav
Alexander et al., 1988* (RCT, n = 21 children)	Int pre 2.6→post 0.6, control pre 2.5→post 2.4	Sig, fav
Anderson et al., 2004 (Observational study—nonequivalent comparison group, n = 54 children)	**Mean visits per child/12 months: Int pre 1.1→post 0.5, control pre 1.3→post 1.3**	**Sig, fav**
Bartholomew et al., 2000 (RCT, n = 133 children) ±§	Int pre 2.0→post 1.3, control pre 1.9→post 1.2; effect size 0.03	NS, no difference
Catov et al., 2005 (pre/post with comparison group, n = 224 children)	Mean visits/year: no difference between intervention and control groups	NS, no difference
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	Mean per subject year: Int post 0.304, control post 0.197	NS, no difference
Clark et al., 1986* (RCT, n = 310 children)	Int pre 2.36→post 1.72, control pre 2.64→post 2.49	NS, fav
Fireman et al., 1981* (CCT, n = 26 children)	Visits/child: Int post 0.08, control post 1.00	NS, fav
Greineder et al., 1999 (RCT, n = 57 children)	Int pre 1.55→post 0.41, control pre 1.57→post 0.96	Sig, fav
Harish et al., 2001 (RCT, n = 129 children)	Mean number of ED visits per patient/month: Int post 0.101, control post 0.326	Sig, fav
Homer et al., 2000 (RCT, n = 137 children) ±	Mean/year: Int pre 2.14→post 0.86, control pre 2.24→post 0.73	NS, no difference
Kelly et al., 2000 (CCT**,** n = 78)	Mean/year: Int pre 3.6→post 1.7, control pre 3.5→post 2.3. Control RR = 1.4 [1.02, 1.9]	Sig, fav
Krishna et al., 2003 (RCT, n = 228 children) ±	Int pre 2.0→post 0.1, control pre 1.2→post 0.6	Sig, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Emergency department visits (mean)—pattern toward favorable (cont'd)

Trial	Results	Categorization (Significance, Direction)
La Roche et al., 2006 (CCT, n = 33)	**Mean visits/12 months: Collaborative int pre 2.4→post 0.7, standard int pre 1.5→post 1.2, control pre 1.1→post 1.4**	**Sig, fav—collaborative intervention vs. standard intervention** **Sig, fav—collaborative intervention vs. control group**
Lewis et al., 1984* (RCT, n = 76 children)	Int pre 3.68→post 2.30, control pre 3.04→post 3.71	Sig, fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**Mean visits/12 months: Int post 0.93, control post 1.08**	**NS, no difference**
Shelledy et al., 2005 (pre/post, n = 18 children)	**Mean visits/12 months: Int pre 4.22→post 0.61**	**Sig, fav**
Shields et al., 1990* (RCT, n = 253 children)	Int post 0.54, control post 0.38	NS, not fav

Emergency department visits (total days across all patients)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	ED visits/6 months: Int pre 5→post 0 (p = 0.063)	NS, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Emergency department visits (% patients)— pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Haby et al., 2005 (meta-analysis, n = 4 trials)	4 trials whose results were combined: 0.87 [0.37, 2.08]	NS, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	% with one or more ED visits/6 months: Int pre 17%→post 13.4%, control pre 18.9%→post 18%	NS, fav
Guendelman et al., 2002 (RCT, n = 134 children)§	%/6 weeks: Int pre 27%→post 10%, control pre 28%→post 18%	NS, fav
Harish et al., 2001 (RCT, n = 133 children)	%/12 months: Int post 53.3%, control post 66.7%	NS, fav
Lukacs et al., 2002 (pre/post with comparison group, n = 298 children, 4 primary care offices)	%/18 months: Int post 26%, control post 22%; RR = 0.86 [0.49, 1.40]	NS, no difference
Persaud et al., 1996* (RCT, n = 36 children)	%/20 weeks: Int post 22%, control post 50%	Sig, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Hospitalizations (mean)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Haby et al, 2005 (meta-analysis, n = 3 trials)	3 trials whose results could not be combined: difference between intervention and control groups –0.04 to 0.56 hospital admissions	NS
Wolf et al., 2003 (meta-analysis, n = 8 trials)	SMD –0.08 [–0.21, 0.05]	NS, fav
Anderson et al., 2004 (Observational study—nonequivalent comparison group, n = 54 children)	**Mean admissions per child/12 months: Int pre 0.94→post 0.55, control pre 0.94→post 0.89**	**Sig, fav**
Bartholomew et al., 2000 (RCT, n = 133 children) ±§	Mean/year: Int pre 0.7→post 0.4, control pre 0.6→post 0.5; effect size = –0.14	Sig, fav
Catov et al., 2005 (pre/post with comparison group, n = 224 children)	No difference between intervention and control groups	NS, no difference
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	Mean per subject-year: Int post 0.027, control post 0.254	NS, fav
Clark et al., 1986* (RCT, n = 310 children) ±	Int pre 0.13→post 0.11, control pre 0.25→post 0.21	NS, no difference
Fireman et al., 1981* (CCT, n = 26 children)	Admissions/child: Int post 0, control post 0.31	NS, fav
Greineder et al., 1999 (RCT, n = 57 children)	Int pre 0.86→post 0.14, control pre 1.00→post 0.57	Sig, fav
Harish et al., 2001 (RCT, n = 129 children)	Int post 0.37, control post 0.42	NS, no difference
Kelly et al., 2000 (CCT**,** n = 78 children)	Int pre 0.6→post 0.2, control pre 0.53→post 0.48; control RR = 2.4 [1.04, 5.4]	Sig, fav
Krishna et al., 2003 (RCT, n = 228 children) ±§	Int pre 0.1→post 0.1, control pre 0.6→post 0.1	NS, not fav
Lewis et al., 1984* (RCT, n = 76 children)	Child/year: Int post 0.27, control post 0.60; p = 0.08	NS, fav
Shelledy et al., 2005 (pre/post, n = 18 children)	**Mean hospitalizations/12 months: Int pre 1.78→post 0.33**	**Sig, fav**

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Hospitalizations (total admissions across all patients)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Hospitalizations/6 months: Int pre 2→post 0	NS, fav

Hospitalizations (% patients)—pattern toward no effect/weak evidence

Trial	Results	Categorization (Significance, Direction)
Haby et al., 2005 (meta-analysis, n = 8 trials)	5 trials whose results were combined: RR = 0.74 [0.38, 1.46]	NS, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	% hospitalized/6 months: Int pre 5.4%→post 3.6%, control pre 7.9%→post 5.6%	NS, no difference
Evans et al., 1999 (RCT, n = 1033 children)	% hospitalized/1 year: Int post 14.8%, control post 18.9%; difference between int and control groups: –4.19 [–8.75, 0.36]; p = 0.071	NS, fav
Guendelman et al., 2002 (RCT, n = 134 children)	% hospitalized/6 weeks: Int pre 14%→post 7%, control pre 13%→post 7%	NS, no difference
Harish et al., 2001 (RCT, n = 129 children)	%/1 year: Int post 26%, control post 26%	NS, no difference
Lukacs et al., 2002 (pre/post with comparison group, n - 298 children, 4 primary care offices)	%/18 months: Int post 10%, control post 4%; RR = 1.37 [0.48, 3.71]	NS, not fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**% hospitalized/12 months: Int post 17.1%, control post 15.5%**	**NS, not fav**

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.
§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Physician visits (mean)—mixed evidence

Trial	Results	Categorization (Significance, Direction)
Urgent/unscheduled visits		
Brown et al., 2002 (RCT, n = 95 children)	Visits for acute asthma exacerbations: Int pre 5.04→post 2.71, control pre 4.52→post 2.80	NS, fav
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Episodes requiring a visit to a physician: Int pre 4.3→post 3.6, control pre 3.8→post 3.3	NS, no difference
Homer et al., 2000 (RCT, n = 137 children) ±§	Mean acute office visits: Int pre 0.91→post 0.93, control pre 0.96→post 0.77	NS, no difference
Krishna et al., 2003 (RCT, n = 228 children) ±§	Urgent visits to physician: Int pre 6.6→post 0.8, control pre 6.4→post 1.3	NS, no difference
Lukacs et al., 2002 (pre/post with comparison group, n = 298 children, 4 primary care offices)	1 or more acute outpatient visits; RR = 1.16 [0.70, 1.84]	NS, not fav—acute asthma outpatient visit (w/ nebulized beta-agonist treatment given)
Morgan et al., 2004 (RCT, n = 937 children) ±	**Visits/12 months: Int post 1.28, control 1.49; p = 0.11**	**NS, fav**
Velsor-Friedrich et al., 2004 (nested design, n = 102 children, 8 schools) ±	Visits/2 weeks: Int post 0.07, control post 0.00	Sig, not fav
Follow-up visits		
Anderson et al., 2004 (Observational study—nonequivalent comparison group, n = 54 children)	**Mean visits per child/12 months: Int pre 3.3→post 0.8, control pre 2.0→post 2.3**	**Sig, fav**
Not distinguished as to type of visit		
Wolf et al., 2003 (meta-analysis, n = 6 trials)	SMD –0.15 [–0.31, 0.01]	NS, fav
Shelledy et al., 2005 (pre/post, n = 18 children)	**Mean visits/12 months: Int pre 6.39→post 2.17**	**Sig, fav**
Shields et al., 1990* (RCT, n = 253 children)	Mean office visits—Int post 1.63, control post 1.86	NS, no difference

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Unscheduled physician visits (total days across all patients)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Visits/6 months: Int pre 35→post 14	Sig, fav

Physician visits (% patients)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Urgent/Unscheduled Visits		
Haby et al., 2005 (meta-analysis, n = 8 trials)	5 trials: RR = 0.74 [0.49, 1.12]	NS, fav
Eggleston et al., 2005 (RCT, n = 100 children) ±	**% 1 or more visists/3 months: Int pre 32%→post 15%, control pre 36%→post 13%**	**NS, not fav**
Velsor-Friedrich et al., 2005 (nested design, n = 52 children, 8 schools)	% with one or more visits/year: int post 14%, control post 20%	NS, fav

Urgent care use: emergency department or unscheduled physician visit (mean)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Evans et al., 1999 (RCT, n = 1,033 children) ±	Mean visits/year: int post 2.64, control post 2.85; Difference between intervention and control groups: –0.21 [–0.62, 0.20], p = 0.32	NS, no difference
Rubin et al., 1986* (RCT, n = 54 children) ±§	Mean visits/12 months: Int pre 5.6→post 2.8, control pre 5.2→post 4.5; p = 0.13	NS, fav
Shames et al., 2004 (RCT, n = 119 children) §	Mean visits/2 months: int pre 3.0→post 0.06, control pre 4.0→post 1.3; difference between intervention and control groups: –0.48 [–1.12, 0.17]	NS, fav

Urgent care use: emergency department visit or hospital admission visit (percentage)—favorable

Trial	Results	Categorization (Significance, Direction)
Walders et al., 2006 (RCT, n = 175 children)	**%/12 months: Int post 28%, control post 41%; OR = 1.92 [1.00, 3.69], p = 0.05**	**Sig, fav**

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Urgent care use: emergency department, hospital, or unscheduled clinic visit (mean)--favorable

Trial	Results	Categorization (Significance, Direction)
Krieger et al., 2005 (RCT, n = 214 children) ±	Mean visits/2 months: int pre 23.4%→post 8.4%, control pre 20.2%→post 16.4%; Probability of having an urgent care visit in 2 months: OR 0.38 [0.16, 0.89]	Sig, fav

Medications: inhaled corticosteroids—favorable

Trial	Results	Categorization (Significance, Direction)
Bonner et al., 2002 (RCT, n = 119 children) ±	Prescribed inhaled corticosteroids: Int pre 54%→post 70%, control pre 44%→post 38%.	Sig, fav
Krishna et al., 2003 (RCT, n = 228 children) ±§	Daily dose of inhaled corticosteroids: Int pre 353.09→post 433.51 μg, control pre 350.53→post 753.88	Sig, fav
Lukacs et al., 2002 (pre/post with comparison group, n = 298 children, 4 primary care offices)	Int group more likely to receive at least 1 dispensing of inhaled corticosteroid compared with controls; RR = 1.41 [1.08, 1.72]	Sig, fav

Medications: cromolyn—favorable

Trial	Results	Categorization (Significance, Direction)
Bonner et al., 2002 (RCT, n = 119 children) ±	Prescribed cromolyn: Int pre 26%→post 24%, control pre 36%→post 36%	Sig, fav

Medications: beta2-agonists or other rescue medications—pattern toward no difference/weak evidence

Trial	Results	Categorization (Significance, Direction)
Krieger et al., 2005 (RCT, n = 214 children) ±	Days used beta2-agonists/2 weeks: Int pre 7.5→post 4.0, control pre 6.9→post 4.0; Difference between intervention and control groups: –0.23 [–1.88, 1.42]	NS, no difference
Shames, et al., 2004 (RCT, n = 119 children) §	Days used bronchiodilator/1 year. follow-up: Int pre 47→post 32, control pre 52→post 42; Difference between intervention and control groups: –7.7 [–21.2, 5.9]	NS fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.
§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Medications: type not specified—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	% taking "daily controller medicine": Int pre 57.5%→post 52.7%, control pre 60.4%→post 62.9%	Sig, fav
Krieger et al., 2005 (RCT, n = 119 children) ±	Days used "controller medications"/2 weeks: Int pre 5.9→post 3.5, control pre 4.4→post 3.6; Difference between intervention and control groups: –1.03 [–2.79, 0.73]	NS, fav
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	# of patients using long-term controller medications: Int pre 20→post 26, a 30% increase	NS, not fav
Velsor-Friedrich et al., 2004 (nested design, n = 102 children, 8 schools) ±	Days used medication/2 weeks: Int post 0.83, control post 1.00	NS, no difference
Velsor-Friedrich et al., 2005 (nested design, n = 52 children, 8 schools)	% ever used/2 weeks: Int post 39%, control post 46%	NS, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

School absences (mean days)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (Meta-analysis, n = 16 trials)	SMD –0.14 [–0.23, –0.04]	Sig, fav
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	Mean: Int post 2.39, control post 2.98	NS, fav
Clark et al., 2004 (nested design, n = 835 children, 14 schools) ±	Sick days/3 months: 34% lower in the intervention group than in control group; Sick days/12 months: 8% lower in the intervention group	Sig, fav
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Absences/year: Int pre 21.3→post 19.4, control pre 20.8→post 19.7	NS, no difference
Fireman et al., 1981* (CCT, n = 26 children)	Mean: Int post 0.5, control post 4.6	Sig, fav
Horner, 2004 (nested design, n = 44 children, # schools not reported) ±	Sick days/12 months: Int pre 3.98→post 4.09, control pre 4.35→post 3.78	NS, no difference
Krishna et al., 2003 (RCT, n = 228 children) ±§	Int pre 7.9→post 1.4, control pre 6.4→post 5.4	Sig, fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**Days missed/2 weeks: Int pre 1.1→post 0.65, control pre 0.9→post 0.82**	**Sig, fav**
Perrin et al., 1992* (RCT, n = 56 children) ±	#/month: Int pre 0.73→post 0.24, control pre 0.14→post 0.22	NS, fav
Persaud et al., 1996* (RCT, n = 36 children)	Int post 6.4, control post 7.6	NS, fav
Rubin et al., 1986* (RCT, n = 54 children) ±§	Int pre 13.0→post 14.1, control pre 17.0→post 18.6	NS, no difference
Shelledy et al., 2005 (pre/post, n = 18 children)	**Mean absences/12 months: Int pre 19.0→post 6.69**	**Sig, fav**
Velsor-Friedrich et al., 2005 (nested design, n = 52 children, 8 schools) ±	Sick days/12 months: Int pre 13.5→post 9.03, control pre 15.5→post 14.4	NS, fav
Velsor-Friedrich et al., 2004 (nested design, n = 102 children, 8 schools) ±	Sick days/12 months: Int pre 13.5→post 9.03, control pre 15.5→post 14.4	NS, fav
Wilson et al., 1996* (RCT, n = 76 children)	Sick days in 1 month: Int pre 1.0→post 0.8, control pre 0.7→post 1.4	NS, no difference

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

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± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

School absences (total days across all patients)—favorable

Trial	Results	Categorization (Significance, Direction)
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Sick days/6 months: pre 85→post 28; 67.1% decrease	Sig, fav

School absences (% patients)—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 1 trial)	OR 0.78 [0.36, 1.66]	NS, fav
Georgiou et al., 2003 (pre/post. n = 401 children)	36%→23% (missed 1 or more days in past month)	Sig, fav
Guendelman et al., 2002 (RCT, n = 134 children) §	%/6 weeks: Int pre 52%→post 15%, control pre 44%→post 22%	NS, fav
Krieger et al., 2005 (RCT, n = 214 children) ±	% with one or more sick days/2 weeks: Int pre 31.1→post 12.2, control pre 28.4→post 20.3; Probability of having a sick day in 2 weeks: OR 0.46 [0.18, 1.18], p = 0.105	NS, fav

Restricted activity (# of days)—favorable

Trial	Results	Categorization (Significance, Direction)
Krieger et al., 2005 (RCT, n = 214 children) ±	Days with activity limitations/2 weeks: Int pre 5.6→post 1.5, control pre 4.3→post 1.7; difference between intervention and control groups: -1.5 [-2.84, -0.15]	Sig, fav
Krishna, et al., 2003 (RCT, n = 228 children)	Days/12 months: Int pre 46.2→post 6.7, control pre 35.3→post 13.5	Sig, fav
Morgan et al., 2004 (RCT, n = 937 children) ±	**Days/2 weeks: Int pre 3.9→post 2.39, control pre 3.9→post 2.84**	**Sig, fav**

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

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§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Restricted activity (% patients)—mixed evidence

Trial	Results	Categorization (Significance, Direction)
Eggleston et al., 2005 (RCT, n = 100 children) ±	**% reporting: Int pre 71%→post 43%, control pre 60%→post 41%**	**NS, no difference**
Guendelman et al., 2002 (RCT, n = 134 children) §	Int pre 66.7%→post 32.3%, control pre 72.1%→post 46.7%	Sig, fav

Work absence—caregiver—mixed evidence

Trial	Results	Categorization (Significance, Direction)
Georgiou et al., 2003 (pre/post, n = 401 children)	% missed 1 or more days of work/1 month: Int pre 17.1%→post 9.6% # days/12 months: Int pre 3.8→post 1.8	Sig, fav Sig, fav
Krieger et al, 2005 (RCT, n = 214 children) ±	%/2 weeks: Int pre 13.1%→post 11.2%, control pre 21.0%→post 13.0%; Difference between intervention and control groups: OR = 1.07 [0.04, 2.85]	NS, no difference
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	# days/6 months: Int pre 11→post 0; p = 0.0693	NS, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Self-efficacy—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Wolf et al., 2003 (meta-analysis, n = 6 trials)	SMD 0.36 [0.15, 0.57]	Sig, fav
Bartholomew et al., 2000 (RCT, n = 133 children) ±§	Int pre 74.3→post 75.3, control pre 72.0→post 73.6; effect size = 0.06	NS, no difference
Bonner et al., 2002 (RCT, n = 119 children) ±	9 items—Scale 1–7 (higher score = more confidence): Int pre 33.22→post 46.70, control pre 31.18→post 34.08	Sig, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Child Asthma Self-Efficacy Measure, 9 items with scale 0–3 (0 = none of the time, 3 = all of the time): Int pre 18.40→post 21.02, control pre 20.43→post 20.32	Sig, fav
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Self-efficacy index (% change): Int 3%, control 0%	Sig, fav
Kubly and McClellan, 1984* (RCT, n = 28 children)	Children's Health Locus of Control: F = 4.29 Self-Care Activity Questionnaire for Asthmatic Children: F = 1.60	Sig, fav NS, fav
LeBaron et al., 1985* (RCT, n = 31 children)	Overall control of asthma (0 = very poor, 10 = excellent): Int pre 6.23→post 6.93, control pre 6.50→post 6.91	NS, no difference
Parcel et al., 1980* (post with comparison group, n = 104 children)	Health locus of control: Int pre 29.0→post 30.2, control pre 27.1→post 27.5	Sig, fav
Persaud et al., 1996* (RCT, n = 36 children)	Children's Health Locus of Control Scale—change in score: Int post 2.2, control post 0.8	NS, fav
Rubin et al., 1986* (RCT, n = 54 children) ±§	Children's Health Locus of Control Scale—child's total score: Int pre 32.2→post 33.5, control pre 32.3→post 31.4	NS, no difference
Shegog et al., 2001 (RCT, n = 71 children) ±§	Int pre 53.4→post 56.5, control pre 51.6→post 51.5 F (analysis of variance) = 4.45	Sig, fav
Velsor-Friedrich, 2005 (nested design, n = 52 children, 8 schools)	Scale 1-5 (1 = I cannot do this, 5 = I can do this): Int post 4.09, control post 3.82	NS, no difference
Velsor-Friedrich, 2004 (nested design, n = 102 children, 8 schools)	Scale 1-5 (1 = I cannot do this, 5 = I can do this): Int post 4.25, control post 4.15	NS, no difference
Whitman et al., 1985* (RCT for school-aged children and pre/post for preschool children, n = 59 children) ±	Maximum score = 16; Int pre 0.89→post 13.95, control pre 0.59→post 2.11	Sig, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Knowledge—child—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Bartholomew et al., 2000 (RCT, n = 133 children) ±§	Int pre 13.7→post 16.4, control pre 4.0→post 15.8; effect size = 0.17	NS, no difference
Bonner et al., 2002 (RCT, n = 119 children) ±	Int pre 2.86→post 5.38, control pre 2.84→post 3.18	Sig, fav
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Maximum possible score = 25: Grades 1–2—Int post 12.45, control post 10.75, p = 0.0001; Grades 3–5—Int post 10.41, control post 9.93; p = 0.18	Sig, fav—grades 1-2; NS, fav—grades 3-5
Christiansen et al., 1997* (nested design, n = 52 children, 4 schools)	17 true/false questions (1 = correct answer): Int pre 9.9→post 13.7, control pre 11.3→post 10.9	Sig, fav
Homer et al., 2000 (RCT, n = 137 children) ±§	% responses correct: Intervention pre 60→post 77, control pre 57→post 63	Sig, fav
Krishna et al., 2003 (RCT, n = 228 children) **±§**	Int: Children aged 7–17 years pre 43.11→post 53.12, control aged 7–17 years pre 43.44→post 47.51	Sig, fav
La Roche et al., 2006 (CCT, n=33)	**Mean # correct responses: Collaborative int pre 9.49→post 13.3, standard int pre 8.0→post 10.0**	**NS, fav—collaborative intervention vs. standard intervention**
LeBaron et al., 1985* (RCT, n = 31 children)	Patient knowledge of cromolyn: Int pre 9.00→post 11.93, control pre 9.00→post 10.63	Sig, fav
Lewis et al., 1984* (RCT, n = 76 children)	% responses correct: Int pre 66%→post 61%, control pre 74%→post 71%	NS, no difference
Parcel et al., 1980* (post with comparison group, n = 104 children)	Grades K–2: Int pre 13.07→post 14.62, control pre 11.58→post 12.19. Grades 3–5: Int pre 14.19→post 15.96, control pre 13.95→post 14.10	Sig, fav. Sig, fav
Perrin et al., 1992 (RCT, n = 56 children) ±	Int pre 11.76→post 13.76	Sig, fav
Persaud et al., 1996* (RCT, n = 36 children)	Change in score on a 20-item instrument: Int 1.8, control 1.9	NS, no difference
Rubin et al., 1986* (RCT, n = 54 children) ±§	Parcel Knowledge of Asthma Questionnaire—% responses correct: Int pre 76.1%→post 90.5%, control pre 78.4%→post 80.4%	Sig, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Knowledge—child—pattern toward favorable (cont'd)

Trial	Results	Categorization (Significance, Direction)
Shames et al., 2004 (RCT, n = 119 children) §	Survey with maximum of 23 points: Int pre 17.4→post 20.5, control pre 17.1→post 18.9; difference between intervention and control groups: 0.44 [–0.70, 1.58]	NS, fav
Shegog et al., 2001 (RCT, n = 71 children) ±§	Int pre 18.6→post 21.1, control pre 15.7→post 17.8; F for difference between intervention and control groups = 0.55	NS, no difference
Velsor-Friedrich, et al.,2005 (nested design, n = 52 children, 8 schools)	Int post 14.28, control post 11.88	NS, no difference
Velsor-Friedrich et al.,2004 (nested design, n = 102 children, 8 schools) ±	Maximum possible score = 25: Int post 14.05, control post 13.35	NS, no difference
Whitman et al., 1985* (RCT for school-aged children and pre/post for preschool children, n = 59 children) ±	Int pre 5.63→post 8.00, control pre 5.68→post 6.63	Sig, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Knowledge—caregiver—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Maximum possible score = 20: Int post 17.51, control post 16.34	Sig, fav
Butz, Syron et al., 2005 (RCT, n = 210 children)	% likely to give correct answer to question about appropriateness of giving child asthma medication for cough symptoms: Int post 83.9%, control post 74.7%. Both groups more likely to give correct answers to four other asthma knowledge questions. Neither group improved on one question 98.2% answered correctly at baseline.	NS, fav—1 item; NS, no difference—other items
Homer et al., 2000 (RCT, n = 137 children) ±§	% responses correct: Int post 81%, control post 78%	NS, fav
Krishna et al., 2003 (RCT, n = 228 children) ±§	Intervention caregivers for children aged 0-6 years: pre 47.94→post 55.68. Caregivers for children 7-17: pre 49.95→post 55.38. Control caregivers for children 0-6: pre 48.41→post 52.30. For caregivers for children 7-17: pre 49.57→post 51.70	Sig, fav
La Roche et al., 2006 (CCT, n=33)	**Mean # correct responses: Collaborative int pre 10.5→post 13.6, standard int pre 11.6→post 11.7**	**Sig, fav--collaborative intervention vs. standard intervention**
Persaud et al., 1996* (RCT, n = 36 children)	Change score on 55-item questionnaire: Intervention 1.9, control 2.6	NS, no difference
Rubin et al., 1986* (RCT, n = 54 children) ±§	Parcel Knowledge of Asthma Questionnaire—% responses correct: Int pre 81.7%→post 87.3%, control pre 80.4%→post 84.9%	NS, no difference
Shames et al., 2004 (RCT, n = 119 children) §	Survey with maximum of 25 points: Int pre 14.6→post 18.7, control pre 14.9→post 15.9; difference between intervention and control groups: 1.74 [0.58, 2.90]	Sig, fav

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Quality of life—child—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Brown et al., 2002 (RCT, n = 95 children)	Pediatric Quality of Life Scale—Scale 1–7 (1 = not bothered, 7 = extremely bothered): Int pre 2.50→post 1.63, control pre 2.47→post 1.74	Sig, fav for younger, no treatment effect for older children
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Scale 1–7 (1 = maximum impairment, 7 = no impairment): Int pre 5.10→post 5.50, control pre 4.47→post 4.81	NS, no difference
Eggleston et al., 2005 (RCT, n = 100 children) ±	**Mean score (scale not reported):** Int pre 3.69→post 4.70, control pre 4.01→post 5.00	**NS, no difference**
Evans et al., 1987* (nested design, n = 239 children, 12 schools) ±	Positive feelings about asthma (% change): Int 6%, control –4%	Sig, fav
Georgiou et al., 2003 (pre/post, n = 401 children)	Reduction in functional limitations, life interruptions, and impact on family activity; graph provided, no data available	Sig, fav
Perrin et al., 1992 (RCT, n = 56 children)	Child Behavior Checklist: Total problems score: Int pre 60.8→post 54.4, control pre 57.7→post 55.0	Sig, fav
Shames et al., 2004 (RCT, n = 119 children) §	Child Health Survey for Asthma: Physical Domain—Int pre 53.5→post 79.9, control pre 49.3→post 69.9; difference between intervention and control groups: 7.67 [1.61, 13.72]; Child Emotional Health Domain—Int pre 63.7→post 81.9, control pre 64.3→post 74.2; difference between intervention and control groups: 6.01 [–2.05, 14.07]; Child Social Activity Domain—Int pre 58.3→post 80.3, control pre 63.4→post 74.6; difference between intervention and control groups: 7.25 [–0.02, 14.52]; Family Social Activity Domain—Int pre 67.6→post 87.3, control pre 69.7→post 86.5; difference between intervention and control groups: 3.43 [–2.61, 9.46]	Sig, fav—physical activity and child social activity; NS, fav—child emotional health, and family social activity
Tinkelman and Schwartz, 2004 (pre/post, n = 41 children)	Mean overall score (1 = very poor, 7 = very good): Int pre 6.1→post 6.49; p = 0.101	NS, fav
Walders et al., 2006 (RCT, n = 175 children)	**Children's Health Survey for Asthma: improvement in both intervention and control groups, but no difference between groups**	**NS, no difference**

*Notes***:** Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).

* Study included in Wolf et al.'s (2003) meta-analysis.

± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.

§ Study in which the intervention included an educational computer game or an interactive, internet-based device.

Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Quality of life—caregiver—pattern toward favorable

Trial	Results	Categorization (Significance, Direction)
Brown et al., 2002 (RCT, n = 95 children)	Juniper's Pediatric Asthma Caregiver Quality of Life Questionnaire—Scale 1–5 (1 = never bothered, 5 = bothered every day or very much): Int pre 1.77→post 1.35, control pre 1.83→post 1.50	Sig, fav for younger children; NS for older children
Butz, Pham et al., 2005 (nested design, n = 201 children, 7 counties)	Pediatric Caregiver Quality of Life Questionnaire—Scale 1-7 (1 = none of the time, 7 = all of the time): Int pre 6.22→post 6.49, control pre 6.27→post 6.38	NS, no difference
Krieger et al., 2005 (RCT, n = 214 children)	Higher score = better quality of life: Int pre 4.0→post 5.6, control pre 4.4→post 5.4; Difference between intervention and control groups: 0.58 [0.18, 0.99]	Sig, fav

Notes: Studies in bold were published subsequent to the studies assessed in CHBRP's prior reports on asthma self-management training and education for children (i.e., studies published in 2004 or 2005).
* Study included in Wolf et al.'s (2003) meta-analysis.
± Study in which the intervention was delivered by an unlicensed person or for which the article did not contain sufficient information to determine whether the person who delivered the intervention was a licensed or registered health professional or was supervised by one.
§ Study in which the intervention included an educational computer game or an interactive, internet-based device.
Key: CCT = controlled clinical trial; ED = emergency department; int = intervention; OR = odds ratio; RCT = randomized controlled trial; RR = relative risk; SMD = standardized mean differences.

Appendix C: Cost Impact Analysis: Caveats and Assumptions

This appendix describes caveats and assumptions used in conducting the cost impact analysis. For additional information on the cost model and underlying methodology, please refer to the CHBRP Web site, http://www.chbrp.org/costimpact.html.

The cost analysis in this report was prepared by Milliman, Inc., and University of California, Los Angeles, (UCLA) with the assistance of CHBRP staff. Per the provisions of AB 1996 (California Health and Safety Code, Section 127660, et seq.), the analysis includes input and data from an independent actuarial firm, Milliman. In preparing cost estimates, Milliman and UCLA relied on a variety of external data sources. The *Milliman Health Cost Guidelines* (HCG) were used to augment the specific data gathered for this mandate. The HCGs are updated annually and are widely used in the health insurance industry to estimate the impact of plan changes on health care costs. Although this data was reviewed for reasonableness, it was used without independent audit.

General Caveats and Assumptions

The expected costs in this report are not predictions of future costs. Instead, they are estimates of the costs that would result if a certain set of assumptions were exactly realized. Actual costs will differ from these estimates for a wide variety of reasons, including:

- Prevalence of mandated benefits before and after the mandate different from our assumptions;
- Utilization of mandated services before and after the mandate different from our assumptions;
- Random fluctuations in the utilization and cost of health care services.

Additional assumptions that underlie the cost estimates presented here are:

- Cost impacts are only shown for people with insurance;
- The projections do not include people covered under self-insurance employer plans because those employee benefit plans are not subject to state-mandated minimum benefit requirements;
- Employers and employees will share proportionately (on a percentage basis) in premium rate increases resulting from the mandate. In other words, the distribution of premium paid by the subscriber (or employee) and the employer will be unaffected by the mandate.

There are other variables that may affect costs, but which Milliman did not consider in the cost projections presented in this report. Such variables include, but are not limited to:

- Population shifts by type of health insurance coverage. If a mandate increases health insurance costs, then some employer groups or individuals may elect to drop their coverage. Employers may also switch to self-funding to avoid having to comply with the mandate.

- Changes in benefit plans. To help offset the premium increase resulting from a mandate, enrollees or insured may elect to increase their overall plan deductibles or copayments. Such changes would have a direct impact on the distribution of costs between the health plan and the insured person, and may also result in utilization reductions (i.e., high levels of patient cost sharing result in lower utilization of health care services). Milliman did not include the effects of such potential benefit changes in its analysis.
- Adverse selection. Theoretically, individuals or employer groups who had previously foregone insurance may now elect to enroll in an insurance plan postmandate because they perceive that it is to their economic benefit to do so.
- Health plans may react to the mandate by tightening their medical management of the mandated benefit. This would tend to dampen our cost estimates. The dampening would be more pronounced on the plan types that previously had the least effective medical management (i.e., FFS and PPO plans).
- Variation in existing utilization and costs, and in the impact of the mandate, by geographic area and delivery system models: Even within the plan types we modeled (HMO, PPO, POS, and FFS), there are variations in utilization and costs within California. One source of difference is geographic. Utilization differs within California due to differences in the health status of the local commercial population, provider practice patterns, and the level of managed care available in each community. The average cost per service would also vary due to different underlying cost levels experienced by providers throughout California and the market dynamic in negotiations between health plans and providers.
- Both the baseline costs prior to the mandate and the estimated cost impact of the mandate could vary within the state due to geographic and delivery system differences. For purposes of this analysis, however, we have estimated the impact on a statewide level.

Mandate-Specific Caveats and Assumptions

- An estimated 2.5% of children 1–17 years insured by employment-based, privately purchased, Medi-Cal, and Healthy Families plans could be categorized as "high risk" according to the criteria specified in the bill. This estimate correlates with mild to severe persistent categories for severity of asthma exacerbations as defined by the National Heart, Blood, and Lung Institute's (NHBLI) guidelines. The number of children meeting these criteria is derived from self-reported daily/weekly symptoms or an emergency room visit in the past year according to the California Health Interview Survey (CHIS) 2001. Based on expert opinion, children under one year of age are excluded from this analysis since diagnosis of asthma is difficult in this age group and thus is rarely made.

- The unit costs for the educational interventions in settings specified in this bill were estimated as $150 per enrollee per year based on CHBRP surveys of providers of these services. These providers included for-profit disease management organizations, non-profit community-based organizations under contract with Medi-Cal managed care plans, and commercial health plans, that provide pediatric asthma group education classes or home-based visits. The estimate assumes a minimum of one home visit ($100/each) and

one session of group education per enrollee ($50 per session) or three sessions of group education. School-based programs, such as the American Lung Association Open Airways for Schools program, were equivalent in price per enrollee to one home-based visit. However, school-based programs are not available statewide.

- The baseline of utilization rate of asthma self-management and education services was obtained from the 2001 CHIS Survey. Data were only available for children 12–17 years and with daily/weekly symptoms or an emergency room visit in the past year. An estimated 63.2% responded "yes" to the following question: "Did your doctor ever give you information on how to avoid the things that make your asthma worse?" The same rate was assigned to children under 12 years of age.

- Data for the utilization of emergency room visits and inpatient visits for high risk children with asthma was based on the Health Plan Employer Data and Information Set (HEDIS) criteria for "severe asthma": at least four asthma medication dispensing events or at least one emergency department visit, or at least one hospitalization, or at least four outpatient asthma visits and at least two asthma medication dispensing events.

Appendix D: Information Submitted by Outside Parties for Consideration

CHBRP policy includes analysis of information submitted by outside parties, and places an open call to all parties who want to submit information during the first two weeks of the CHBRP review.

No information was submitted for this analysis.

For information on the processes for submitting information to CHBRP for review and consideration please visit: http://www.chbrp.org/requests.html

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A group of faculty and staff undertakes most of the analysis that informs reports by the California Health Benefits Review Program (CHBRP). The CHBRP **Faculty Task Force** comprises rotating representatives from six University of California (UC) campuses and three private universities in California. In addition to these representatives, there are other ongoing contributors to CHBRP from UC. This larger group provides advice to the CHBRP staff on the overall administration of the program and conducts much of the analysis. The CHBRP **staff** coordinates the efforts of the Faculty Task Force, works with Task Force members in preparing parts of the analysis, and coordinates all external communications, including those with the California Legislature. The level of involvement of members of CHBRP's Faculty Task Force and staff varies on each report, with individual participants more closely involved in the preparation of some reports and less involved in others.

As required by CHBRP's authorizing legislation, UC contracts with a certified actuary, Milliman, to assist in assessing the financial impact of each benefit mandate bill. Milliman also helped with the initial development of CHBRP's methods for assessing that impact.

The **National Advisory Council** provides expert reviews of draft analyses and offers general guidance on the program to CHBRP staff and the Faculty Task Force. CHBRP is grateful for the valuable assistance and thoughtful critiques provided by the members of the National Advisory Council. However, the Council does not necessarily approve or disapprove of or endorse this report. CHBRP assumes full responsibility for the report and the accuracy of its contents.

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