

Investing in Best Practice for Asthma:

A Business Case for Education and
Environmental Interventions



**MULTNOMAH COUNTY
HEALTH DEPARTMENT**



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Children's Hospital Boston



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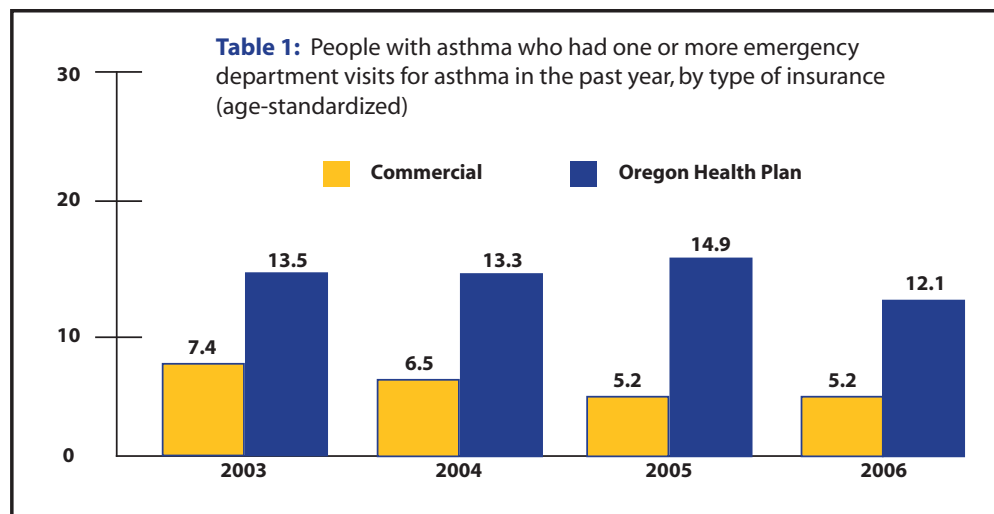
An increasingly robust evidence base shows widespread improvements in asthma patients' health when primary and specialist care are supplemented by in-depth asthma education, guided self management, home assessment and mitigation of home-based triggers provided by a team of health care providers. Both the research and practice-based literature show that clinic-based education, in-home education and environmental interventions can markedly improve patients' quality of life, and often decrease medical encounters. Information on health outcomes has been summarized elsewhere.^{1, 2, 3} The literature on the financial implications of these interventions is less extensive, but it makes a compelling case—from a business standpoint—for investing in asthma education and in-home environmental interventions, targeted to patients based on the severity of their disease and their utilization of health services.

Asthma: A Burden in Oregon

Rates of asthma have nearly doubled in the U.S. and today, asthma strikes nearly 11% of Americans.^{4,5} Asthma is a major burden on the quality of life of Oregonians and Oregon's health care system. In 2007, 9.9% of adults and 8.3% of children had asthma, suggesting that more than 355,000 Oregonians had asthma. The burden of asthma is both economic and personal, affecting the state of Oregon in direct costs (e.g., hospitalizations and emergency department visits) and indirect costs (e.g., missed school and work days and days of restricted activity) as well as an individual's quality of life.

- Oregon has a higher burden of asthma than the overall U.S. and is among the top five states with the highest percent of the adult population with asthma.
- Most adults and children understand how to manage their asthma. For example, 70.9% of the adults know what to do during an asthma attack or episode and 75.8% of children have been shown how to use their inhaler (95.6% and 94.5%). However, few adults (18.6%) and even fewer children (31.9%) have an asthma action plan or have taken an asthma management course or class (6.7% and 12.6%).
- The percentage of Oregonians with asthma who had an emergency department visit due to asthma was approximately 14.1% in 2007.
- Less than 40% of people who had an emergency department visit for asthma had a follow-up visit with a medical professional within 30 days after the emergency department visit.

- Members of the Oregon Health Plan, which is composed of Medicaid and SCHIP, have a higher burden of asthma than the general Oregon population. The Oregon Health Plan is intended to help ensure that medical care is affordable for those with low incomes.
- People with asthma who are enrolled in the Oregon Health Plan visit the emergency department more frequently than people with asthma who are enrolled with commercial plans (see Table 1).



For public and private payers of health care expenditures, loss of productivity, hospitalizations, emergency room visits and use of rescue medications for asthma comprise substantial costs, many of which are preventable.

Multnomah County Healthy Homes: A Proven Success

The Healthy Homes Asthma Program, a part of Multnomah County Environmental Health Services, improves asthma control of low-income children by providing a series of six to eight home visit interventions. The Community Health Nurse focuses on medication management, asthma education, identification of asthma triggers,

case management and communication with the child's primary care provider. The Community Health Workers focus on further identification of asthma triggers, education, case management referrals for remediation and provision of incentives, such as vacuum cleaners. Environmental Health Specialists (Assessors) provide consultation on complex health related structural remediation assessment and recommendations. The program:

- Decreases emergency room visits for children enrolled in the project. Multnomah County Healthy Homes' participants were 2 ½ times less likely to use the emergency department after the intervention. The program saved \$130,925 in emergency department and hospitalization costs in a twelve month period. The average emergency department visit costs \$1,070, the average hospitalization for asthma costs \$11,540.
- The program has begun to accept older children, with more severe asthma at the request of Managed Care providers. Emergency department utilization continues to decline with the potential for even greater savings.
- The Center for Disease Control Asthma Task Force found that home-based, multi-trigger, multi-component models such as the Multnomah County Healthy Homes Program save between \$5 and \$14 for each dollar spent.
- Reduces children's exposure to asthma triggers (tobacco smoke, dust, chemical irritants, mold and insect/rodent triggers) by 60 percent by educating parents and caregivers about common substances in the home that can trigger asthma attacks.

- Improves asthma control. Seventy percent of Healthy Homes' children had improved asthma control that was sustained six months after the last home visit based upon the Asthma Control Test. The medication ratio, used as a national performance standard, improved in the children participating in the program.
- Improves health equity by focusing on asthma control as a health disparity. Asthma prevalence is 8.4% in Oregon children less than 18 years of age and is more than double among the Medicaid population.

Multnomah County Environmental Health also works with providers to help them learn about the environmental asthma triggers in their

patients' home through the Asthma

Inspection Referral (AIR)

program. When a medical provider refers their

patient for an AIR

Home Inspection

an environmental

health specialist is

able to determine if

there are conditions

in the patient's

home such as mold,

pests, excessive dust or

second hand smoke that can

be remediated and contribute to

improved health outcomes. The inspector



leaves a report with the patient at the time of the inspection, outlining measures the family can take to mitigate asthma triggers. Providers are e-mailed a link to the report, so that they can incorporate the findings into the patient care plan.

“The Healthy Homes Program takes the best I can offer and makes it even better. It is the extended arm of a physician for kids with asthma”

*- Peter Hatcher, Physician
Multnomah County Health Department*

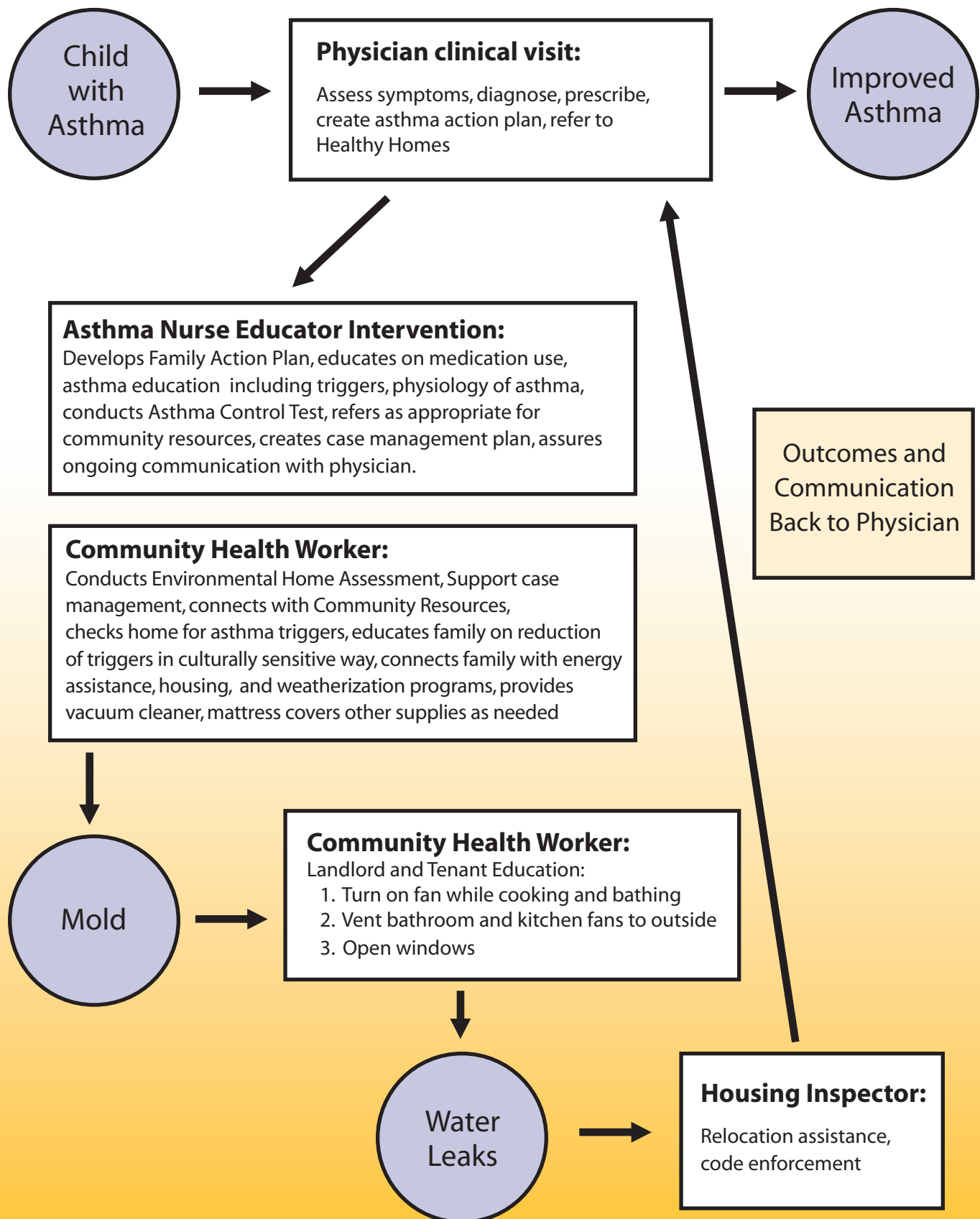
Best Practices for Improving Asthma Outcomes

The widely respected National Asthma Education and Prevention Program’s (NAEPP) *Guidelines for the Diagnosis and Management of Asthma*⁷ outlines four vital components of controlling and managing asthma, including:

- 1) assessment and monitoring;*
- 2) pharmacotherapy;*
- 3) control of factors contributing to asthma severity; and*
- 4) education for a partnership in asthma care.*

Quality improvement initiatives by providers and payers have contributed to wider adoption of assessment/monitoring and appropriate prescribing

Multnomah County Comprehensive Chronic Care Model



of long-term controller and short-term rescue medications. Indeed, increased expenditures on pharmaceuticals have accompanied reductions in health care utilization expenditures, reflecting more consistent and appropriate use of medications to prevent and treat asthma attacks⁸. Health professionals have made less

headway on implementing the two other elements of the national

asthma management guidelines: control of

environmental triggers (these are the main “factors” above understood to contribute to asthma severity);

and ensuring access to asthma

education. As is the case with

other complex and variable

chronic conditions—such

as diabetes— effective

management of asthma often

requires more time than a

physician can typically provide

in a standard reimbursable office

or sick visit. Characteristics of and

responses to asthma are highly individual,

as are socio-economic and physical conditions

that can mitigate or exacerbate symptoms. Because of the role

of indoor environmental exposures in exacerbating the disease,

education in the home, along with home assessments and materials

and supplies, may make the difference in controlling a patient’s

asthma.

What is a business case for asthma management services and supplies?

We define a business case for asthma management as others have when assessing the financial implications of health care quality improvement programs:



“A business case for a health improvement intervention exists if the entity that invests in the intervention realizes a financial return on its investment in a reasonable time frame, using a reasonable rate of discounting. This may be realized as ‘bankable dollars’ (profit), a reduction in losses for a given program or population, or avoided costs. In addition, a business case may exist if the investing entity believes that a positive indirect effect on organizational function and sustainability will accrue within a reasonable time frame.⁹”

A clear-cut business case is one in which the financial benefits of an intended program exceed the costs (cost savings). *However, a business case also exists if the costs of achieving a health benefit are considered reasonable, often determined by comparing the cost with that of other approaches to achieving the same or a comparable health benefit (cost effectiveness).* Cost effectiveness is a more realistic way of assessing new health interventions and services for chronic diseases.

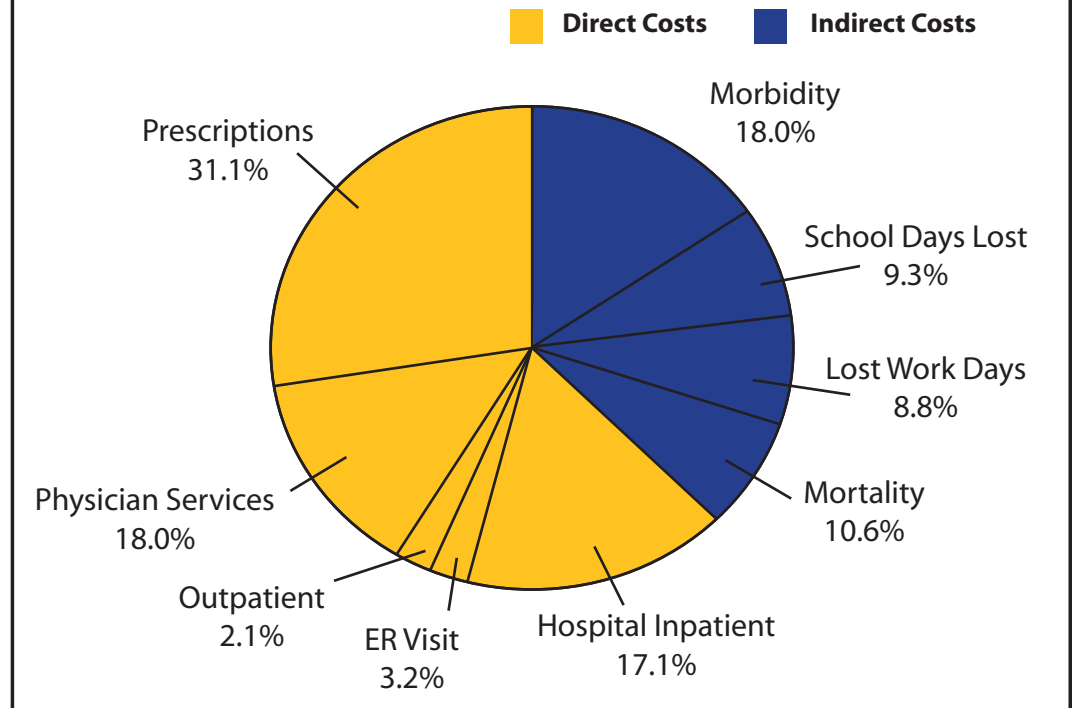
Evidence of Effectiveness & Cost Evaluations from the Research Literature

In 2004, the nation spent over \$16.1 billion on asthma-related direct and indirect expenditures (see Figure 1 on next page)⁶.

Asthma Education: Evidence of Cost Savings

The literature examined (see appendix) and corroborated by previous published literature reviews ^{11,12} provide strong evidence that effective asthma education programs targeted to high risk patients are likely to result in health care cost savings, as high risk patients tend to use health services most frequently. The literature also suggests that programs targeting patients whose health service utilization is lower may or may not generate net cost savings, but will result in improved health outcomes, such as quality of life, lung function, and reduced school and work absences.

Figure 1: Distribution of Asthma Costs in the US (2004):
\$16.1 Billion in Total Costs



Home-based Environmental Interventions: Evidence of Cost-Effectiveness and Reasonable Cost

Cost-effectiveness analyses of these programs examined the costs associated with each symptom-free day gained (see side-bar on next page):

- A high intensity home-based environmental intervention program (2005) – targeting high-risk asthmatic children and costing \$1469 per patient – resulted in 37.8 more symptom-free days over a 2-year period among those receiving the intervention than among those in the control group, at a cost \$28 for each symptom-free day gained (\$16 per symptom-free day gained if just one environmental counselor administered the intervention).¹²

^a The studies reviewed are the most rigorous in the literature. Nonetheless, they have limitations, including incomplete coverage of direct and indirect costs, lack of sensitivity analyses among many of the studies in which some subjects were lost to follow-up, and short follow-up periods.

What is “Cost per Symptom-free day Gained”?

A 1997 NAEPP working group evaluating the cost-effectiveness of asthma care programs recommended the use of a symptom-free day as the principle outcome measure for cost-effectiveness analyses.

A symptom-free day is a measure of overall control of asthma symptoms defined as a night and day with no asthma symptoms and no night-time awakenings.

Cost per symptom-free day gained is calculated using an incremental cost-effectiveness ratio (ICER) which measures the cost per additional unit of outcome gained by the intervention:

$$\text{ICER} = \frac{\text{Cost (Intervention Group)} - \text{Cost (Control Group)}}{\text{Symptom-free day (Intervention Group)} - \text{Symptom-free day (Control Group)}}$$

- A second high intensity home-based environmental intervention program (2005) targeting medium-high risk children with asthma at a program cost of \$1124 per patient resulted in fewer urgent care visits due to asthma, fewer symptom days and improved quality of life for caregivers. The program’s cost effectiveness was calculated at \$23 for each symptom-free day gained.^{13, 14} The results for the low intervention group in this study are particularly intriguing: the cost for each symptom-free day gained by children who received just 1 home visit (compared to the 5-9 visits for the high-intervention group) was just \$2 (the cost of the 1 visit was \$215).¹³

Although some may argue this is a placebo effect, the results suggest health outcome improvements result from relatively small interventions.

When assessing whether the cost of in-home environmental interventions for asthma are “reasonable,” it is useful to examine the cost-effectiveness of interventions that are considered the current standard of care.



Two recent studies estimate that each symptom-free day gained as a result of standard pharmacotherapy interventions cost \$7.50 in adult patients with mild to moderate asthma (inhaled corticosteroids)¹⁵ and \$11.30 in patients 5-66 years old with mild persistent asthma (budesonide).¹⁶ Medications such as Xolair (omalizumab), which is prescribed to patients with moderate-severe, uncontrolled allergic asthma, cost \$523 per symptomfree day gained.¹⁷

When looking across the spectrum of standard asthma management treatments, in-home environmental interventions – which cost \$2-\$28 per symptom-free day gained – are clearly within the range of what payer organizations have determined is “reasonable” to improve asthma outcomes, and may produce net cost savings if more costly treatment options are avoided. Indeed one Medical Director of a Managed Care Organization (MCO) stated, “The research suggests that home-based asthma education and intervention programs can substantially improve symptoms of patients with uncontrolled asthma. If covering proven environmental control measures can keep a handful of members from needing Xolair, then homebased programs will generate net cost savings.”

Case Studies of Cost-Effective Comprehensive Asthma Management

Prompted by the research literature, a number of health plans across the country are implementing comprehensive asthma management programs that include asthma education, guided self-management training, and environmental interventions in conjunction with primary and specialist care.

Optima Health Virginia Beach, Virginia

Optima Health is non-profit managed care system comprised of Medicaid HMO, and commercial HMO, PPO and POS plans. Optima Health provides education, both in-clinic and via mailed materials, to all members with asthma, and more intensive interventions to patients classified as having more severe asthma, based primarily on data from medical and pharmacy claims¹⁹. For its most severe asthma patients, Optima health combines clinical and self-management asthma education with home-based environmental interventions. These programs have realized cost savings:

- Between 1994 and 2004, hospitalizations for asthma among Optima members receiving the home visiting program decreased by 54% in the commercial plans, and 32% in the Medicaid HMO plan. Emergency room visits among members in commercial plans decreased by 18% and 33% among Medicaid HMO plan members.
- Overall costs for patients with severe asthma decreased by 35%.
- A financial return on investment for the program was estimated at 4.4:1 (\$4.10 saved for every \$1 spent on the program).

Asthma Network of West Michigan

The Asthma Network of West Michigan is a local asthma coalition that provides intensive home-based case management services to low-income families with

moderate to severe asthma. They are the recipients of the 2006 National Exemplary Award from the U.S. EPA for promoting quality care in asthma management. Their services are primarily reimbursed by a number of private and public health payers, including Priority Health (Medicaid or Commercial), Community Choice Michigan, Blue Care Network, Health Plan of Michigan, and Molina Healthcare, to whom they provide outcome data. Grant dollars pay for uninsured clients. Their health and financial outcomes are impressive:

- In 2000, they demonstrated that total hospital charges decreased by \$55,265 from the pre-study year to the study year, for an average charge reduction of \$1,625 per subject for the 34 children enrolled in their case management program. They further demonstrated that the mean Emergency Department charge/encounter and mean charge/all encounters were decreased significantly as well.
- In 2001 (study year), comparing 45 children they served to 39 children in a control sample (who had never received their interventions), they demonstrated that their asthma case management program significantly improved the clinical outcomes of low-income children with asthma severe enough to warrant an ED visit or hospitalization. The differences between the cohort group and the matched control group were highly significant. The program further extrapolated the reductions for the 45 children.
- Extrapolating the cost savings in 2000, to the intervention and control study groups, they estimated that the facilities cost savings for the 45 children was a total of \$119,816, or \$2,663/child/yr. The program itself, which includes 18 home visits per year and some medical supplies, cost \$2,500/child/year, netting a savings for health insurers of over \$160/child/year.

- In 2003, they demonstrated that their relationship with a managed care organization (MCO), a first between an MCO and an asthma coalition in this country, significantly improved the clinical outcomes of members with asthma. In 2005, reviewing the charts of 37 managed care (Commercial and Medicaid) patients who had been enrolled in the Asthma Network of West Michigan for one year and were served between 2003 and 2005, they demonstrated a 66% decrease in hospital admissions, 46% decrease in length of stay and 60% decrease in Emergency Department visits.

Although not published in peer-reviewed journals, these case studies provide valuable practice-based evidence regarding the costs of asthma education and environmental trigger reduction interventions. They demonstrate that enhanced asthma management programs can result in decreased medical utilization costs and improved health outcomes. However, the Monroe Plan for Medical Care failed to incorporate the cost of the actual program into the assessment of total costs, so a cost savings could not be demonstrated. Nevertheless, officials from the Monroe Plan subsequently expanded the program beyond the pilot stage based on the weight of the evidence of reduced medical expenditures and health outcome improvements.

*Costs not converted to U.S. dollars for the year as reported in the study. Costs not adjusted to reflect an equivalent current day value. i statistically significant at ($p=0.05$ or less); ii Data measured by the Health Related Quality of Life survey and/or the St. Georges Respiratory Questionnaire; iii Data reported in Norwegian Krone, converted to US dollars (\$8.9914 NOK : \$1US, 2001) ; iv Data reported in Finnish Marks: converted to US dollars (7.07M: \$1US, 1998); v Data measured by the Asthma Quality of Life Questionnaire; vi Data reported in Euros, converted to US dollars (0.912 E : \$1 US, 2000); vii Data measured by the Psychosomatic Discomfort Scale; viii Data measured by the Asthma Quality of Life Scale questionnaire; ix Data reported in sterling pounds, converted to US dollars (1.77lb : \$1US, 1992)

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LITERATURE REVIEWED

Study	Study Size/ Type of Patient	Risk Level	Setting (#, length, group/ individual, site)	Staff	Main Health Effectiveness Outcomes	Positive Intervention Results Relative to Control group (in RCT) or Baseline Group (in Pre-Post)	Program Cost* (per person)	Cost* Evaluation (intervention group compared to control group or baseline)
PATIENT EDUCATION STUDIES								
Randomized Control Trials								
Bolton et al, 1991 ¹³	241/Adults	High	3, hr, group, clinic	RN (w/ specialized training)	ED visits; Physician visits; Hospitalizations; Days of limited activity	59% fewer ED visits	\$85	Saved \$1913 per person per year in direct health care costs saved \$22.50 (direct costs) for every \$1 spent on the program
Castro et al, 2003 ¹⁴	96/Adults	High	NA, NA, clinic, home, phone	Asthma Nurse Specialist	Hospital readmissions; ED visits; Quality of Life; Lost school/work days	54% fewer asthma-hospital readmissions; 34% fewer ED visits; 8% greater improvement in overall Quality of Life; 76% fewer lost work/school days	\$186	Saved \$6,650 per person per 6 months in direct & indirect health care costs; saved \$36 (direct & indirect) or \$24 (direct only) for every \$1 spent on the program
Clark et al, 1986 ¹⁵	310/Children (ages 4-17)	Low-High	6, 1 hr, group, clinic	Health educator	ED visits; Hospitalizations	58% fewer hospitalizations & 59% fewer ED visits among cases with 1 or more baseline hospitalizations	\$1558	Saved \$11.22 in direct health care costs for every \$1 spent on the program for children hospitalized the previous year
Gallefoss et al, 2001 ¹²	78/Adults	Low- Med	2, 2 hr, group and 1, 1-2 hr, individual, clinic	Respiratory Nurse or Physio-therapist	Quality of Life ^a includes days with symptoms; Lung function; Lost work days	16.3 unit ¹ improvement in Health Related Quality of Life score; 6.1% improvement in FEV1; 71% fewer lost work days	\$122 ^a	10 unit improvement in HRQoL associated with a savings of \$378 ^a ; A 5% improvement in FEV1 associated with a savings of \$500 ^a
Greineder 1999 ¹⁶	57/ Children (Ages 1-15)	High	Varied # and length, individual, clinic & telephone	Asthma outreach nurse	ED visits; Hospitalizations	57% fewer ED visits; 75% fewer hospitalizations;	\$190	Saved \$7.69-\$11.67 in direct health care costs per year for every \$1 spent on a case manager's salary
Kauppinen et al, 1999 ³³	162/Adults	NA	3, 1.5 hr, individual, clinic	Respiratory Nurse or Attending Chest Physician	Lung function; Quality of Life ^a	5.3% improvement and 4.4% FEV1 & PEF, respectively	\$426 ^a	No difference in costs between intervention and control programs
Lahdensuo, 1999 ^{34,35}	115/Adults	Low-Med	1+, 2.5 hr, individual, clinic	Nurse with specialized training	Hospitalizations; unscheduled ambulatory visits; Lost work days; Courses of antibiotics; Courses of prednisolone; Quality of life ^a	98% higher Quality of Life score; 50% fewer unscheduled ambulatory visits; 42% fewer lost work days; 56% fewer courses of antibiotics; 60% fewer course of prednisolone	\$334 ^a	Saved \$22 ^a (direct & indirect health care costs) or costs \$8 ^a (direct health care costs only) for every healthy day gained per patient per year
Neri et al, 1996 ³⁶	55/Adults	Low-High	6, 1 hr, group, clinic	Chest Physician, Respiratory Therapist & Psychologist	Asthma attacks; Urgent medical exams; Hospitalizations; Lost work days	53% fewer asthma attacks; 74% fewer urgent medical exams; 29% fewer lost work days (all mean measures)	\$713	Saved \$2.66 (direct & indirect health care costs) or \$1.89 (direct health care costs only) for every dollar spent on the program
Schermer et al, 2002 ³⁷	193/Adults	Med- High	4, NA hr, individual, clinic	Family Physician	Successfully treated weeks in 2 years of follow-up; Lung function; Quality of life ^a	6 additional successfully treated weeks in 2 years (measure of asthma control) gained; 17% more participants showed higher emotional control	\$172 ^a	Saved \$7.90 ^a (direct & indirect health care costs) or costs \$6.69 ^a (direct health care costs only) for each successfully treated week
Sondergarard et al 1992 ³⁸	62/Adults	NA	1, NA hr, group, hospital; and 1, NA hr, individual, hospital; and 2, NA hr, individual, home	Physician, Nurse & pharmacist	Hospitalizations; Quality of life ^a ; Health status ^a	Improvements in both quality of life and health status (relative % improvement unavailable)	\$204 ^a	\$56 ^a saved in lost earnings for every \$1 spent on the program (only indirect benefits measure)
Sullivan et al, 2002 ³⁹	1033/Children	High	4, group (2 for child only and 2 for adult); clinic AND home-based pest program	Social worker	Asthma symptoms; Medical visits (unscheduled & scheduled); ED visits; hospital days (ICU & non-ICU); Inpatient Dr. visits	26.6 (5%) additional symptom free days over 2-years; 19% fewer unscheduled medical visits; 5% fewer ED visits; 3% fewer non-ICU hospital days; 2.9% fewer inpatient Dr. visits	\$337	\$9.20 per symptom-free day gained

*Costs converted to U.S. dollars for the year as reported in the study but were not adjusted to reflect equivalent current day value (if year not reported in study, study period used; if no study period published, publication year used); ¹statistically significant at (p=0.05 or less); ^aData measured by the Health Related Quality of Life survey and/or the St. Georges Respiratory Questionnaire; ^bData reported in Norwegian Krone, converted to US dollars (9 NOK :\$1 US, 2001) ; ^cData reported in British Sterling Pounds: converted to US dollars (.58£: 1\$US, 1991-1992); ^dData reported in Finnish Marks: converted to US dollars (5.35M: \$1US, 1998); ^eData measured by the Asthma Quality of Life Questionnaire; ^fData reported in Euros, converted to US dollars (1 E : \$.912 US, 2000); ^gData measured by the Psychosomatic Discomfort Scale; ^hData measured by the Asthma Quality of Life Scale questionnaire; ⁱData reported in sterling pounds, converted to US dollars (.57£ : \$1US, 1992)

LITERATURE REVIEWED: Continued

Study	Study Size/ Type of Patient	Risk Level	Setting (#, length, group/ individual, site)	Staff	Main Health Effectiveness Outcomes	Positive Intervention Results Relative to Control group (in RCT) or Baseline Group (in Pre-Post)	Program Cost* (per person)	Cost* Evaluation (intervention group compared to control group or baseline)
Windsor et al, 1990 ⁴⁰	254/Adults	Low-High	1, 0.5 hr, individual, clinic; and 1, 1hr, group, clinic; and 2, brief, phone	Health education specialist	Correct inhaler use; Inhaler adherence; Medication adherence; Total adherence	No between group statistical analyses. Greater: inhaler use (410%); inhaler adherence (100%); medication adherence (48%); total adherence (123%)	\$32	Cost effectiveness ^a calculated separately for intervention group (\$96) & control group (\$244)
Pre-Post Intervention								
Shelley et al, 2005 ⁴¹	18/Children (ages 3-18)	Med-High	8, 1-2 hr, individual, home	Respiratory Therapist	Hospitalizations; ICU days; Non ICU hospital days; ED visits; Dr. Office visits; Missed school days	Reduction in: hospitalizations (82%); ICU days (92%); non-ICU hospital days (90%); ED visits (86%); unscheduled Dr. visits (66%); school days missed (65%)	\$640	Saved \$8542 per patient per year from reduced health care utilization expenditures; Saved \$13.3 in direct health care costs for every \$1 spent on the program
Taitel et al, 1995 ⁴² / Kotes et al ⁴²	76/Adults	Med-High	7, 1hr, group	Group education leader	Asthma symptoms (day-time and nighttime symptoms and PEFr; coughing, chest tightness, wheezing); Medication use; Asthma-related behavior; Cognitive asthma skills; physician visits; ED visits, hospital days	Short term: greater improvement in asthma symptoms (majority of measures); use of asthma management skills; physician visits and cognitive abilities. Long term: greater improvement in asthma attack frequency; cognitive abilities; use of asthma management skills and reduction of medications.	\$208	Saved \$1.01 (in direct health care costs) or \$2.41 ⁴³ (in direct & indirect health care costs) for every \$1 spent on the program
Trautner et al, 1993 ⁴³	132/Adults	High	5, 4hr, group, hospital	Specialized Nurse Educator	Hospital days, Missed work days; Physician visits, Severe asthma attacks; Lung function	Average reduction 3-yr after intervention in: hospital days (51%); missed work days (44%); physician visits (70%); asthma attacks (79%). Average improvements in lung function, FEV1 %VC (8.5%)	\$223 ⁴⁴	After 3-years saved \$1.63 ⁴⁵ (direct health care costs) or \$3.00 ⁴⁶ (direct & indirect health care costs) for every \$1 spent on the program
Weinstein et al, 1996 ⁴⁴	59/Children	High	2x weekly, individual, hospital	Various staff	Hospital days; ED visits; Corticosteroid bursts; Physician visits;	100% reduction in median ED visits and hospital days in 1 st -4 th follow-up years; 50% reduction in median corticosteroid bursts in 2 nd -4 th follow-up years	NA	Over 4 year post-rehabilitation period, discounted cumulative net savings in medical charges was \$502 per patient
HOME-BASED ENVIRONMENTAL INTERVENTIONS								
Randomized Control Trials								
Kattan et al, 2005 ⁴⁹	937/Children	High	5, 1 hr, individual, home	Environmental Counselor	Scheduled & unscheduled medical visits; ED visits; hospital days; anti-inflammatory medication use; B-agonist inhaler use; symptom days	19% reduction in unscheduled physician visits per year; 13% reduction in B-agonist inhaler use per year; 37.8 additional symptom free days (7%)	\$1469	Each symptom-free day gained costs \$28 (\$15.76 if just 1 staff rather than 2 were used for each home visit (Program Cost=\$970)
Krieger et al, 2005 ⁵⁰	213/Children	Med-High	5-9, 1hr, individual, home	Community Health Worker	Quality of life; Asthma symptom days; Urgent health service use; Medication use (rescue & controller); missed school & work days	10% greater reduction in days with symptoms/2wks; 17% greater improvement in care giver quality of life; 45% greater reduction in urgent health service use/2mo; 13% fewer days with limited activity/2wks;	\$1124	Each symptom-free day gained costs \$23 ⁵¹ . The projected 4-year net saving among the high-intensity group relative to the low intensity group was \$189-\$721
Pre-Post Intervention								
Krieger et al, 2005 ⁵⁰	104/Children	Med-High	1, 1hr, individual, home	Community Health Worker	Quality of life; Asthma symptom days; Urgent health service use; Medication use (rescue & controller); missed school & work days	50% reduction in days with symptoms/2wks; 23% improvement in care giver quality of life; 42% reduction in rescue medication use; 60% improvement in days with limited activity/2wks	\$215	Each symptom-free day gained costs \$2 ⁵²

^a Cost effectiveness calculated as total costs divided by total adherence improvement score; ⁴³ Authors report \$2.28 for every \$1 spent on program, but using only on statistically significant benefits rather than all benefits (as reported in table above). ⁴⁴ Data reported German Marks, converted to US dollars (1.66DM : \$1US, 1991); ⁴⁵ Incremental Cost Effectiveness Ratio calculated by Atherly et al, 2007



**MULTNOMAH COUNTY
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ENVIRONMENTAL HEALTH**

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To get connected to our Healthy Homes and AIR Program,
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Healthy Homes Program:

<http://web.multco.us/health/healthy-homes>

Asthma Inspection Referral Program:

<http://www3.multco.us/CAIR>