Asthma Control and Cost Barriers to Asthma Care

UTAH DEPARTMENT OF HEALTH

Table of Contents

Executive Summary

The National Asthma Education and Prevention Program (NAEPP) categorizes asthma into three levels of control: well-controlled, not-controlled, and very-poorly-controlled. The level of control is defined by the frequency and intensity of symptoms and functional limitations. Uncontrolled asthma, which includes both those with not-controlled and very-poorly controlled asthma, has been associated with poor mental health, limited activities, missed work and school days, and asthma-related Emergency Department (ED) visits and hospitalizations. Asthma control can be affected by primary care, asthma specialist visits, and cost barriers to asthma medication. Cost barriers can lead to a lack of continuity and delayed medical care, resulting in poor asthma control and outcomes.

The purpose of this report is to identify high asthma burden populations with uncontrolled asthma in Utah and identify risk factors for uncontrolled asthma. The findings will be used to improve the Utah Asthma Home Visiting Program (UAHVP) processes, target resources, and help strategically plan activities for the Utah Department of Health Asthma Program (UAP).

Key Findings

- Adults had a higher prevalence of uncontrolled asthma (31.6% vs 20.2%) and cost barriers to medication (14.9% vs. 7.9%) when compared to children.
- Compared to children, fewer adults reported having asthma action plans (23.3% vs. 42.3%).
- For both children and adults, risk factors for uncontrolled asthma include cost barriers to asthma medication and care, lower income, exposure to mold and cigarette smoke, and a lack of healthcare coverage.
- Adults with health insurance reported more cost barriers to medication than those without insurance (15.2% vs. 10.1%).
- Fewer adults with Medicaid reported cost barriers to medication than those without Medicaid (10.7% vs. 16.0%).
- Children with uncontrolled asthma had a similar prevalence of asthma-related ED visits as those with controlled asthma (14.5% vs. 13.7%).
- People with uncontrolled asthma had double the prevalence of limited activities, missed school or work days, and urgent care visits compared to people with controlled asthma.
- Adults who reported cost barriers were more likely to have urgent care visits because they were more likely to have uncontrolled asthma.

Recommendations

- Use cost barrier data to target high burden populations and improve UAHVP activities.
- Reduce cost barriers for those with and without health insurance.
- Use uncontrolled asthma data to identify high burden populations.
- Use uncontrolled asthma risk factor data to target and improve UAP activities.
- Work with healthcare providers and UAHVP to make sure that adults and children with asthma (controlled and uncontrolled) receive guidelines-based care.

Introduction

Asthma is chronic inflammatory disease of the airway that affects about 250,000 adults and children in Utah (UAP, 2017). Recurring symptoms include shortness of breath, tightness in the chest, coughing, and wheezing. Asthma cannot be cured but with proper treatment, it can be managed without symptoms.

The National Asthma Education and Prevention Program (NAEPP) categorizes asthma into three levels of control: well-controlled, not-controlled, and very-poorly- controlled (NAEPP, 2007). Uncontrolled asthma includes both those with not-controlled and very-poorly controlled asthma. The level of control is defined by the frequency and intensity of symptoms and functional limitations. "Asthma control is a function of underlying severity, responsiveness to treatment, and the adequacy of asthma care and management" (Zahran, 2014). Asthma control is affected by multiple social-economic and environmental factors (Bloomberg, 2009; Hannaway, 2002). Uncontrolled asthma has been associated with poor mental health, limited activities, missed work and school days, and asthma-related ED visits and hospitalizations (Meng, 2008).

Costs related to asthma medication, primary care visits, and asthma specialist visits can be a barrier to care and affect asthma control (Nannpaneni, 2015). Cost barriers can lead to a lack of continuity in care and poor asthma outcomes related to uncontrolled asthma. Cost barriers are also related to delayed medical care, resulting in asthma-related ED visits and hospitalizations (Lawson, 2014). Even those with health insurance may report cost barriers to asthma care due to high co-pays and deductibles (Fung, 2015).

Asthma self-management education (AS-ME), in addition to regular checkups can improve and maintain asthma control (Pinnock, 2015). The UAHVP is home-based self-management education intervention based on key components of AS-ME and trigger remediation. The UAHVP includes three home visits with follow-up calls after the third visit at 6 and 12 months and is currently offered through the Salt Lake County and Utah County local health departments (LHDs). The goal of the UAHVP is to provide AS-ME to individuals with asthma to improve their asthma control and live a healthier symptom-free life. Self-report data has shown that the UAHVP does help improve asthma control, as measured by an asthma control test, in as little as 12 weeks (UAHVP, 2018).

Purpose of this report

The purpose of this report is to identify populations of children (aged 0-17) and adults (18+) with a high burden of uncontrolled asthma, identify risk factors for uncontrolled asthma, and understand how cost barriers to asthma medication and care are related to poor asthma outcomes. Analyses will examine the relationship between asthma control, cost barriers, and asthma-related urgent care visits. It is hypothesized that asthma control will mediate the relationship between cost barriers and urgent care visits. The findings from this report will help UAP target resources to high burden groups and improve activities by providing a better understanding of patterns in well-controlled and uncontrolled asthma. Information from this report will be used to improve UAHVP processes and to promote the UAHVP to groups at high risk for uncontrolled asthma and those at risk for suboptimal care due to cost barriers.

Methods

This report combined four years (2013-2016) of child data and three years (2014-2016) of adult data to produce stable estimates. The data came from the Utah Asthma Call-back Survey (ACBS) which is follow-up survey to the CDC Behavioral Risk Factor Surveillance System (BRFSS). Asthma control was defined using the CDC National Asthma Control Program algorithm from their article "Assessing asthma control and associated risk factors among persons with current asthma-findings from the child and adult Asthma Call-back survey" (Zahran, 2014). They adapted the asthma control measure from the NAEPP guidelines because the ACBS did not include all required measures to calculate asthma control (Zahran, 2014). Three impairment measures were used to calculate asthma control, these included daytime symptoms, night-time symptoms, and use of short acting B2-agonists (SABA) for symptom control (Figure 1)(Zahran, 2014). The asthma control variable included the following categories: well-controlled asthma, not-well-controlled asthma, and very-poorly-controlled asthma. Due to a small sample size in some group analyses, not-well-controlled and very-poorly-controlled asthma categories were combined to create uncontrolled asthma. Cost as a barrier to care was

assessed using questions about being unable to see a primary care physician (PCP) for asthma or asthma specialist or unable to buy medication for asthma in the past 12 months due to cost.

SAS-callable SUDAAN was used to account for the complex sample design of the BRFSS and ACBS. Sample weights were used to produce Utah generalizable estimates. Quartile grouping of variables and those in the 3rd and 4th quartile of uncontrolled asthma prevalence was used to define risk factors for uncontrolled asthma. A chi-square test was used to identify variables to be used in the multivariate logistic regression that tested for associations between dependent variables and asthma control. Mediation analysis was used to determine the relationship between urgent care visits, asthma control, and cost barriers. Statistical significance was determined as p-value of <0.05 or non-overlapping 95% confidence intervals. Relative standard error (RSE) was used as a measure of reliability (RSE<.30).

Figure 1. Classification of asthma control among adults with asthma adopted from the National Asthma Education and Prevention Program Expert Panel Report 3 Guidelines

Measures for current impairment	Controlled asthma	Uncontrolled asthma	
	Well-controlled asthma	Not-well-controlled	Very-poorly-controlled
Symptoms	≤2 d a week	>2 d a week	Throughout the day
Night-time awakenings			
Ages 0–4 years	≤1 time a month	>1 time a month	>1 time a week
Ages 5–11 years	≤1 time a month	≥2 times a month	≥2 times a week
Ages 12 years or older	≤2 times a month	1–3 times a week	≥4 times a week
Short-acting β2-agonists used for symptom control	≤2 d a week	> 2d a week	Several times a day

Source: Zahran, 2014.

Adult Results

Table 1. Prevalence and level of asthma control among adults (18+) by characteristics, Utah, ACBS, 2014-2016

	Controlled		Uncontrolled asthma				Uncontrolled asthma	
	Well-controlled		Not-well-controlled		Very-poorly-controlled		Not-well/Very-poorly-controlled	
Characteristics	No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)
Total	1176	68.4 (65.3-71.8)	325	17.4 (15.1-20.0)	276	14.2 (12.0-16.7)	601	31.6 (28.5-34.5)
Sex								
Male	502	69.8 (65.2-74.1)	147	19.0 (15.5-23.0)	103	11.2 (8.7-14.4)	250	30.2 (26.0-34.9)
Female	675	67.7 (63.4-71.7)	192	18.5 (15.2-22.2)	157	13.8 (11.0-17.2)	349	32.3 (28.3-36.6)
Age								
18-34	276	73.3 (66.4-79.1)	61	16.8 (12.1-22.9)	23	9.9 (6.3-15.2)	84	26.7 (20.9-33.6)
35-44	186	66.2 (58.8-73.0)	49	19.8 (14.4-26.5)	26	14.0 (9.6-20.1)	75	33.8 (27.0-41.2)
45-54	185	67.9 (60.5-74.5)	57	19.0 (13.8-25.6)	57	13.1 (9.0-18.7)	114	32.1 (25.5-39.4)
55-64	225	63.9 (57.1-70.2)	54	18.1 (13.3-24.0)	74	18.0 (13.3-23.9)	128	36.1 (29.8-42.9)
65+	303	67.1 (61.3-72.4)	104	20.7 (16.4-25.8)	96	12.2 (8.9-16.6)	200	32.9 (27.6-38.7)

Ethnicity								
White	1056	68.0 (64.7-71.1)	298	18.6 (16.1-21.2)	248	13.4 (11.2-15.9)	546	32.0 (28.9-35.3)
Hispanic	59	74.2 (59.5-85.0)	14	18.0 (9.4-31.7)	16	7.8 (3.2-17.6)*	30	25.8 (15.0-40.5)
Other	49	74.5 (57.9-86.1)	9	17.2 (7.6-34.4)	11	8.3 (3.9-16.9)*	20	25.5 (13.9-42.1)
Education								
High School graduate or less	317	70.2 (64.6-75.3)	84	15.4 (11.9-19.7)	140	14.4 (10.5-19.3)	224	29.8 (24.4-35.4)
Some college	377	67.0 (61.0-72.5)	108	18.9 (14.3-24.5)	119	14.1 (10.6-18.6)	227	33.0 (27.5-39.0)
College 4 or more years	479	68.2 (63.5-72.6)	133	21.9 (18.1-26.3)	68	9.8 (7.5-12.8)	201	31.7 (27.4-36.5)
Income								
<$15k	74	74.1 (61.8-83.5)	20	12.4 (6.0-24.0)*	46	13.5 (7.4-23.3)	66	25.9 (16.5-38.2)
$15-24k	152	65.0 (55.2-73.7)	44	19.7 (13.6-27.7)	33	15.2 (8.7-25.2)	77	34.9 (26.3-44.8)
$25-49k	250	65.5 (58.0-72.2)	79	18.1 (13.2-24.5)	63	16.4 (11.5-22.8)	142	34.5 (27.8-42.0)
$50-75k	194	74.9 (69.6-81.0)	55	16.9 (12.1-23.1)	37	8.2 (4.6-14.0)	92	25.1 (19.0-32.4)
$75+k	369	67.5 (61.6-72.9)	102	22.3 (17.5-28.1)	57	10.2 (7.5-13.7)	159	32.5 (27.1-38.4)
Healthcare Coverage								
Yes	1115	68.5 (65.3-71.6)	328	19.1 (16.6-21.9)	235	12.4 (10.4-14.8)	563	31.5 (28.4-34.7)
No	62	71.7 (58.6-81.9)	11	11.7 (5.8-22.0)	23	16.7 (9.3-28.1)	34	28.4 (18.1-41.4)
Medicaid								
Yes	28	75.5 (57.1-87.7)	7	7.2 (2.6-18.5)*	13	17.3 (7.4-35.4)*	20	24.5 (12.4-48.5)
No	1150	68.4 (65.2-71.4)	332	19.0 (16.5-21.8)	247	12.6 (10.6-14.9)	579	31.4 (27.9-34.7)
Anyone smoked in the home								
Yes	42	60.6 (45.3-74.0)	11	9.9 (4.1-22.1)	25	29.5 (17.9-44.6)	36	39.4 (26.0-54.7)
No	1135	68.9 (65.7-71.9)	328	19.1 (16.6-21.8)	235	12.1 (10.1-14.4)	563	31.2 (28.1-34.3)
Smoking Status								
Current Smoker	79	72.0 (60.5-81.2)	13	8.5 (4.4-15.8)	24	19.5 (11.8-30.5)	37	28.0 (18.8-39.5)
Former Smoker	231	66.3 (58.6-73.2)	72	19.9 (14.6-26.4)	51	13.9 (8.9-20.9)	123	33.7 (26.8-41.4)
Non-Smoker	847	69.4 (65.7-72.8)	248	19.1 (16.3-22.4)	176	11.5 (9.6-14.0)	424	30.6 (27.2-34.3)
Mold in House								
Yes	74	56.3 (45.2-66.9)	28	21.0 (13.8-30.7)	32	22.7 (14.3-33.9)	60	43.7 (33.1-54.8)
No	1101	69.7 (66.47-72.8)	311	18.5 (16.0-21.4)	224	11.7 (9.7-14.1)	535	30.3 (27.2-33.5)
Pets in the house								
Yes	642	64.9 (60.6-68.9)	199	20.3 (16.9-24.0)	153	14.8 (12.0-18.2)	352	35.1 (31.1-39.4)
No	536	73.5 (68.9-77.5)	140	16.5 (13.3-20.4)	107	10.0 (7.6-13.1)	247	26.5 (22.4-31.1)
Pets in the bedroom								
Yes	506	65.1 (60.4-69.6)	158	19.2 (15.7-23.3)	125	15.6 (12.3-19.7)	283	34.8 (30.7 39.9)
No	130	64.3 (54.3-73.2)	41	24.9 (16.8-35.3)	26	10.8 (6.7-16.9)	67	36.2 (27.3-46.2)
Obese								
Yes	717	68.0 (64.1-71.7)	208	18.8 (15.9-22.1)	164	13.2 (10.6-16.3)	372	32.2 (28.5-36.2)
No	382	68.5 (62.7-73.9)	110	18.8 (14.3-24.3)	81	12.6 (9.4-16.7)	191	31.4 (26.3-37.5)
COPD								
Yes	94	58.0 (46.9-68.3)	32	24.3 (16.0-35.1)	32	17.7 (11.1-27.1)	64	42.0 (31.7-53.1)
No	1077	69.6 (66.4-72.7)	304	18.1 (15.7-21.0)	224	12.2 (10.1-14.6)	528	30.3 (27.5-33.8)
Depression								
Yes	274	69.9 (63.6-75.6)	77	18.3 (13.8-24.0)	68	11.7 (10.8-15.9)	145	30.0 (25.1-37.2)
No	900	68.1 (64.5-71.6)	258	18.7 (16.0-21.9)	192	13.1 (10.8-15.9)	450	31.9 (28.4-35.5)

*Estimates with a relative standard error (RSE)>30% should be interpreted with caution.

In Table 1, in Utah, 31.6% of adults with asthma have uncontrolled asthma, 17.4% have not-well-controlled asthma, and 14.2% have very-poorly-controlled asthma. About 68% of adults with asthma are well-controlled. As seen in Table 1, males and females had similar rates of uncontrolled asthma (30.2% vs. 32.3%). Those aged 55-64 had the highest rate of very-poorly-controlled asthma and those 18-34 had the lowest rates (18.0% vs. 9.9%). People who identify as white had the highest rate of uncontrolled asthma when compared to people who identified as Hispanic or "other" (32.0% vs. 25.8% vs. 25.5%). There does not appear to be differences in uncontrolled asthma prevalence among education levels. However, once uncontrolled asthma is stratified into not-well-controlled and very-poorly-controlled asthma, then those with 4 or more years of college had a lower prevalence of very-poorly-controlled asthma when compared to some college or high school (9.8% vs. 14.1% vs. 14.4%). Those with an income of $15-24k (35.0%) or $25-49k (34.5%) had the highest prevalence of uncontrolled asthma when compared to those with an income of <$15k (25.9%), $50-79k (25.4%), or $75k+ (32.5%).

The prevalence of uncontrolled asthma varied among risk factors. Those with healthcare coverage had a higher prevalence of uncontrolled asthma when compared to those without healthcare coverage (31.5% vs. 28.4%). In contrast, those on Medicaid had a lower prevalence of uncontrolled asthma when compared to those not on Medicaid (26.7% vs. 31.2%). Current smokers (19.5%) had a higher prevalence of very-poorly controlled asthma when compared to former smokers (13.9%) and non-smokers (11.5%). Those who lived with someone who smoked had a higher prevalence of very-poorly-controlled asthma when compared to those who did not live with someone who smoked in their home (29.5% vs 12.1%). Those with mold (22.7%), pets in the house (14.8%), and those with pets in the bedroom (15.6%) had a higher prevalence of very-poorly-controlled asthma when compared to those without these asthma triggers (11.7%, 10.0%, 10.8%). Those who were obese (32.2%) or depressed (30.0%) had a similar prevalence of uncontrolled asthma as those who were not obese (31.4%) or depressed (31.9%). Those with Chronic Obstructive Pulmonary Disease (COPD) had a higher prevalence of uncontrolled asthma than those without COPD (42.0% vs. 30.3%).

Table 2. Quartiles used for determining risk factors for asthma control

Not-well-controlled		Very-poorly-controlled	
Quartile 1	17.4	Quartile 1	12.2
Quartile 2	18.9	Quartile 2	14
Quartile 3	20.3	Quartile 3	16.4
Quartile 4	37.6	Quartile 4	29.5

Risk factors were defined as variables that had uncontrolled asthma prevalence in the 3rd and 4th quartiles (Table 2). Risk factors for not-well-controlled asthma were: having COPD, income greater than $75k a year, college with 4 or more years, mold and pets in the house, no pets in the bedroom, being aged 65+, cost barriers to accessing a primary care provider, cost barriers to accessing an asthma specialist, and cost barriers to accessing asthma medication (Table 1). Risk factors for very-poorly controlled asthma were: cigarette smoke exposure, current smoker, mold in the home, aged 55 - 64, having COPD, yearly income of $25-49k, and having cost barriers to asthma medication and an asthma specialist (Table 1).

Table 3. Asthma control by poor asthma outcomes among adults (18+), Utah, ACBS, 2014-2016

	Limited Usual Activites	Missed work or usual activities	Urgent Care or ED visit	ED visit
Characteristics	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Total	46.5 (42.8-50.3)	24.3 (21.1-27.7)	22.8 (19.3-26.7)	15.2 (12.0-19.0)
Well-controlled	30.6 (26.2-35.4)	15.5 (12.5-19.2)	15.2 (11.2-20.4)	8.8 (5.6-13.6)
Not-well-controlled	61.6 (53.9-68.7)	22.4 (16.9-29.0)	18.8 (13.3-25.8)	15.4 (9.5-23.9)
Very-poorly-controlled	77.3 (68.9-83.9)	55.2 (45.8-64.2)	42.1 (33.1-51.6)	27.0 (19.3-36.2)

In Table 3, about 47% of people with asthma reported limiting their activities due to asthma. About 25% reported missing work or usual activities, about 23% had an urgent care or ED visit, and about 15% reported going to the ED for their asthma. Those with very-poorly-controlled asthma had the highest prevalence of poor outcomes for the three asthma control groups. These included (very-poorly-controlled vs. not-well-controlled vs. well-controlled): limited activities due to asthma (77.3% vs. 61.6% vs. 30.6%), missed work or usual activities (55.2% vs.22.4% vs. 15.5%), had an urgent care or ED visit (42.1% vs. 18.8% vs. 15.2%), and had an ED visit (27.0% vs. 15.4% vs. 8.8%). Those with very-poorly-controlled asthma had almost triple the prevalence of ED visits and missed work or usual activities than those with well-controlled asthma.

Table 4. Asthma control by poor asthma outcomes among adults (18+), Utah, ACBS, 2014-2016

	Routine Check Up	Asthma Action Plan	Ever advised to change things in their environment
Characteristics	% (95% CI)	% (95% CI)	% (95% CI)
Total	80.0 (76.1-83.2)	23.3 (20.6-26.2)	24.8 (22.1-27.7)
Well-controlled	75.2 (69.5-80.1)	20.5 (17.3-24.0)	20.6 (17.6-24.0)
Not-well-controlled	78.9 (70.4-85.4)	28.5 (22.2-35.7)	30.3 (23.9-37.4)
Very-poorly-controlled	90.1 (83.9-94.1)	30.0 (23.0-38.3)	38.5 (23.9-37.4)
Uncontrolled (not-well-controlled/ very-poorly-controlled)	84.1 (78.8-88.3)	29.2 (24.4-34.5)	33.9 (28.7-39.6)

In Table 4, 80.0% of adults with asthma have had a routine checkup, 23.3% have an asthma action plan, and 24.8% have been advised to change things in their work, school, or home environment. Those with very-poorly-controlled asthma (90.1%) had the highest prevalence of routine checkup when compared to other levels of control (well-controlled: 75.2%; not-well-controlled: 78.9%).

Table 5. Percent of uncontrolled asthma by local health district, Utah, ACBS, 2014-2016

Local Health District	Uncontrolled Asthma Percent	Lower 95% confidence bound	Upper 95% confidence bound	Sample Size
Tooele	38.3	28.0	49.9	134
Summit	38.0	22.6	56.3	66
Weber-Morgan	36.2	21.6	53.8	73
Wasatch	35.6	21.8	52.3	55
San Juan	33.8*	13.5	62.7	29
Salt Lake	33.7	28.5	39.4	504
Utah County	32.5	22.4	44.5	125
Central	32.0	22.4	43.5	135
Southwest	31.2	18.7	47.1	69
Davis	26.3	17.5	37.5	153
Bear River	23.0	15.2	33.3	124
Tricounty	22.9	12.6	37.9	83
Southeast	15.3*	8.3	26.6	79
Total	**31.5**	**28.5**	**34.8**	**1629**

*Estimates with an RSE>30% should be interpreted with caution.

In Table 5, asthma control was analyzed by geographic area. Tooele Local Health Department (LHD) (38.3%) had the highest prevalence of uncontrolled asthma and Southeast LHD (15.3%) had the lowest prevalence of uncontrolled asthma.

Table 6. Percent of uncontrolled asthma by Small Area, Utah, ACBS, 2014-2016

Small Area	Uncontrolled Asthma Percent	Lower 95% confidence bound	Upper 95% confidence bound	Sample Size
West Jordan/Copperton	70.2	41.0	88.8	14
South Ogden	65.4	30.3	89.1	17
Pleasant Grove/Lindon	52.5	24.7	78.8	17
Draper	51.5	27.7	74.7	22
Summit County (East)	49.0	27.0	71.4	33
Cedar City	46.9*	20.2	75.4	15
Holladay	44.1*	17.6	74.4	15
Tooele County	44.0	24.1	66.1	34
Daggett/Uintah County	43.7	27.5	61.3	57
Salt Lake City Foothill/East Bench	40.6*	18.4	67.4	19
Cottonwood	38.3	21.8	58.1	34
Layton/South Weber	37.4*	14.8	67.2	40
Murray	36.7*	15.8	64.2	29
Tooele Valley	36.3	24.6	49.8	99
Magna	36.2*	12.8	68.6	14
Sanpete Valley	35.8*	17.6	59.3	32
Wasatch County	35.4	22.0	51.4	58
Kaysville/Fruit Heights	34.8*	14.4	62.8	22
Central	31.7	17.6	50.2	47
Delta/Fillmore	31.2*	13.2	57.5	24
South Jordan	30.8	16.3	50.4	33
Roy/Hopper	30.6*	11.4	60.2	15
'Logan V2'	30.4*	13.8	54.3	30
SLC Sugarhouse	29.5*	12.9	54.0	21
SLC Downtown	29.2*	11.6	56.5	22
North Logan	28.8*	10.0	59.6	17
Bountiful	28.2*	12.9	51.1	28
West Valley Center	27.0*	11.3	51.7	28
Blanding/Monticello	26.2*	10.4	52.0	24
Emery County	25.9*	8.8	55.9	25
Talyorsville	24.1*	9.3	49.7	22
Cache County/Rich County	22.2*	8.4	46.9	28
Park City	20.8*	10.1	37.9	38
St. George	20.6*	9.0	40.7	25
Clearfield/Hooper	18.0*	7.4	37.8	26
Carbon County	9.3*	4.4	18.6	36
Duchesne County	6.6*	2.6	15.8	32
Total	**31.4**	**28.5**	**34.5**	**1777**

*Estimates with an RSE>30% should be interpreted with caution.

In Table 6, West Jordan/Copperton (70.2%) had the highest prevalence of uncontrolled asthma and Duchesne County (6.6%) had the lowest prevalence of uncontrolled asthma.

Table 7. Prevalence of cost barriers to asthma care among adults (18+), Utah, ACBS, 2014-2016

| | Could not afford because of cost | | | | | |
| | Asthma Medication | | Primary Care Physician | | Asthma Specialist | |
Characteristics	No.	% (95% CI)	No.	% (95% CI)	No.	% (95% CI)
Total	1362	14.9 (12.6-17.6)	1362	7.9 (6.1-10.0)	1365	4.5 (3.2-6.4)
Asthma Control						
Well-controlled	768	10.0 (7.6-13.0)	769	5.3 (3.6 -7.7)	769	2.7 (1.6-4.6)
Not-well-controlled	338	19.0 (14.0-25.3)	338	11.0 (7.1-16.5)	339	6.7 (3.7-12.4)
Very-poorly-controlled	257	26.2 (19.5-34.3)	256	12.3 (8.0-18.6)	257	7.6 (4.1-13.4)
Not-well/very-poorly-controlled	595	21 (17.6-26.6)	594	11.4 (8.4-15.4)	595	7.1 (4.6-10.8)
Sex						
Male	569	15.0 (11.5-19.2)	570	8.7 (6.0-12.5)	569	5.4 (3.2-9.0)
Female	793	14.9 (12.0-18.4)	792	7.3 (5.3-9.9)	795	4.0 (2.5-6.2)
Age						
18-34	277	11.6 (7.7-17.1)	278	6.2 (3.5-10.8)		
35-44	215	16.1 (10.9-23.1)	216	9.8 (5.9-15.7)		
45-54	210	17.7 (12.0-25.3)	210	9.6 (5.8-15.5)		
55-64	284	18.6 (13.4-25.2)	283	7.1 (4.1-11.9)		
65+	371	13.8 (9.7-19.2)	370	7.8 (4.5-13.2)		
Income						
<$15k	92	14.8 (6.9-28.9)	91	15.3 (7.0-30.2)*		
$15-24k	170	20.2 (13.0-30.0)	170	7.4 (3.9-13.6)*		
$25-49k	239	20.7 (14.3-28.9)	240	9.9 (5.5-17.3)*		
$50-75k	230	13.5 (9.1-19.5)	230	6.5 (3.6-11.4)		
$75k+	411	12.9 (9.4-17.5)	411	7.1 (4.7-10.7)		
Ethnicity						
White	11245	15.1 (12.7-17.9)				
Hispanic	55	19.6 (9.1-37.1)*				
Other	45	**				
Education						
High School graduate or less	396	14.6 (10.6-19.6)				
Some college	435	15.5 (11.5-20.5)				
College 4 or more years	522	14.7 (11.2-19.1)				
Anyone smoked in the home						
Yes	67	29.3 (17.0-45.6)				
No	1296	14.2 (11.9-16.9)				
Healthcare Coverage						
Yes	1282	15.2 (12.8-18.0)				
No	78	10.1 (4.7-20.5)*				
Medicaid						
Yes	20	10.7 (3.4-28.2)				
No	988	16.0 (3.4-28.8)*				

Smoking Status							
Current Smoker	91	23.1 (13.8-36.2)					
Former Smoker	259	16.3 (11.1-23.3)					
Non-Smoker	981	13.6 (11.1-16.7)					

*Estimates with an RSE>30% should be interpreted with caution. ** Estimates with an RSE>50% are suppressed.

In Table 7, the data for cost barriers to primary care or asthma specialist access could not be stratified by some demographic variables because there was insufficient data to provide reliable estimates once the data was limited to those who reported they could not afford care due to cost. In Table 7, 14.9% of those with asthma reported that cost was a barrier to getting needed asthma medication. About 7.9% reported cost was a barrier to seeing their primary care physician for asthma and 4.5% reported cost was a barrier to seeing an asthma specialist. Those with uncontrolled asthma had almost double the prevalence of each cost barrier when compared to well-controlled asthma (medication 21.0 % vs. 10.0%, PCP 11.4% vs. 5.3%, specialist 7.1% vs. 2.7%). Those with very-poorly-controlled asthma also had a higher prevalence for each cost barrier to care when compared to not-well-controlled asthma (medication 26.2% vs. 19.0% , PCP 12.3% vs. 11.0%, specialist 7.6% vs. 6.7%). There were no differences between males and females in cost barriers to care. Those aged 18-34 had the lowest cost barrier to asthma medication (11.6%) and cost barrier to seeing their primary care provider (6.2%) when compared to other age groups. Those aged 55-64 had the highest prevalence of cost barrier to medication (18.6%) and those aged 35-44 had the highest cost barrier to seeing their primary care provider (9.8%). Those with an annual income of $25-49k had the highest prevalence of cost barrier to medication (20.7%) while those with an income of $75k+ had the lowest prevalence (12.9%). Those with an income of <$15k had the highest prevalence of cost barriers to seeing their primary care provider and those $50-79k had the lowest prevalence (15.3% vs. 7.1%). Hispanics reported a higher prevalence of cost barrier to medication when compared to whites (19.6% vs. 15.1%). There were no differences between levels of education. Those who reported they lived with someone who smoked in the home (29.3%) and current smokers (23.1%) had the highest prevalence of cost barrier to medication when compared to those who did not live with someone who smoked in their home (14.2%) or were former smokers (16.3%) or non-smokers (13.6%). Those with healthcare coverage reported a higher prevalence of cost barrier to medication than those with Medicaid (15.2% vs. 10.7%).

Risk factors for cost barriers to medication and seeing their primary care physician include: making less than $49.9k a year, no healthcare coverage, and being Hispanic. Additionally, 9.9% of those who reported that cost was a barrier to asthma medication reported that cost was not a barrier to seeing their primary care physician.

Table 8. Prevelance of asthma outcomes among adults (18+) by characteristics, Utah, ACBS, 2014-2016

	Limited Usual Activites	Missed work or usual activities	Urgent Care or ED visit	ED visit	Routine Check Up	Asthma Action Plan	Ever advised to change things in their environment
Characteristics	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Cost as a barrier to asthma medication							
Yes	71.9 (63.6-78.9)	43.1 (34.5-52.3)	36.6 (27.4-46.9)	25.1 (16.4-36.5)	82.3 (71.2-89.7)	34.4 (26.7-43.0)	40.7 (32.4-49.6)
No	41.9 (37.9-46.1)	21.1 (17.9-24.7)	19.8 (16.2-24.1)	13.0 (9.8-17.1)	79.6 (75.4-83.1)	24.4 (21.0-28.3)	25.4 (22.1-29.0)
Cost as a barrier to seeing a primary care provider (PCP)							
Yes	78.1 (66.2-86.7)	53.2 (40.7-65.3)	43.3 (28.8-59.1)	49.0 (33.6-64.5)	68.0 (50.3-81.7)	26.6 (17.3-38.6)	38.9 (27.8-51.3)
No	43.8 (39.9-47.8)	21.8 (18.7-25.3)	20.9 (17.4-24.9)	12.1 (9.1-15.7)	81.0 (77.3-84.3)	25.8 (22.4-29.4)	26.7 (23.5-30.2)

Cost as a barrier to seeing an asthma specialist							
Yes	82.8 (66.6-92.0)	63.2 (45.4-77.9)	38.0 (20.6-59.1)	51.3 (30.8-71.4)	72.4 (46.3-88.9)	31.2 (18.1-48.2)	44.2 (28.3-61.3)
No	44.8 (41.0-48.6)	22.5 (19.4-25.9)	21.9 (18.4-25.9)	13.0 (10.1-16.7)	80.3 (76.6-83.6)	25.6 (22.4-29.2)	26.8 (23.7-30.3)

In Table 8, those who reported cost as a barrier to care had a significantly higher prevalence of poor asthma outcomes (limited usual activities, missed work/activities, urgent care/ED and ED visit) when compared to those that did not report cost as a barrier to care. Those who reported cost barrier to seeing an asthma specialist reported almost double the prevalence of limited usual activities and missed work and usual activities than those who did not report cost as a barrier to seeing an asthma specialist (limited activities 82.8% vs. 44.8%; missed work/activities 63.2% vs. 22.5%). Those who reported cost as a barrier to seeing a primary care physician had a higher prevalence of urgent care/ED and ED visits when compared to those that did not report this cost barrier (urgent care/ED 43.3% vs. 20.9%; ED 49.0% vs. 12.1%). It appears that cost barrier to seeing a primary care physician and asthma specialist have the biggest impact on outcomes. Those who reported cost as a barrier to seeing an asthma specialist had a larger prevalence of each poor outcome when compared to other cost barriers to care.

Those who report cost as a barrier to seeing a primary care physician when compared to those who did not report this cost barrier had a lower prevalence of getting a routine checkup (68.0% vs. 81.0%) but had a higher prevalence of receiving good asthma care including having an asthma action plan (26.6% vs. 25.8%) and being advised to change things in their work, school, or home environment (38.9% vs. 26.7%). This pattern was the same for cost barrier to seeing an asthma specialist (asthma action plan 31.2% vs. 25.6%; modify environment 44.2% vs. 26.8%). Thus it appears that despite cost barriers, there are still opportunities to receive good asthma care.

Table 9. Association of cost barriers with uncontrolled asthma, adults (18+), Utah, ACBS, 2014-2016

	Model 1	Model 2
Variables	**Uncontrolled Asthma OR (95%)**	**Uncontrolled Asthma OR (95%)**
Cost was barrier to asthma medication (No)		
Yes	2.2 (1.3-3.5)	N/A
Cost was barrier to seeing a primary care physician (No)		
Yes	1.1 (0.6-2.3)	N/A
Healthcare Coverage (No)		
Yes	N/A	0.9 (0.4-1.7)
Medicaid (No)		
Yes	N/A	1.2 (0.4-3.7)

None of the demographic variables (sex, age, education, race/ethnicity, income) were significantly associated with asthma control in the chi-square tests. Variables that were significantly associated with asthma control were: cost as a barrier to care/medication, COPD status, ED visits, routine visit for asthma, was told to modify their environment, missed days of work or usual activities in the past 12 months, has an asthma action plan, went to urgent care or ED, exposed to cigarette smoke in the home, had mold in the house, and missed usual activities in the past 30 days. The only variable significantly associated with the mediator variable - well-controlled asthma - was cost barrier to asthma medication. In Table 9, in model 1, those who reported cost as a barrier to getting asthma medication were 2.2 times more likely to have uncontrolled asthma.

Table 10. Mediation regression analysis for Asthma-related urgent care/ED visits among adults, Utah, ACBS, 2014-2016

Variables	Unadjusted Model	Adjusted Model
	Asthma-related urgent care/ED visit OR (95% CI)	Asthma-related urgent care/ED visit OR (95% CI)
Asthma control (well-controlled)		
Uncontrolled		2.2 (1.4-3.4)
Cost was barrier to asthma medication (No)		
Yes	1.8 (1.1-3.2)	1.6 (0.9-2.8)
Cost was barrier to seeing a primary care physician (No)		
Yes	2.1 (1.0-4.4)	2.1 (0.9-4.4)

In the unadjusted model (Table 10) those who reported cost as a barrier to asthma medication or seeing their primary care physician were 1.8 and 2.1 times more likely to report an urgent care/ED visit than those who did not report cost as a barrier. In the adjusted model (Table 10), cost barriers were no longer significant and asthma control explained their effect on urgent care/ED visits. In the adjusted model, those with uncontrolled asthma were 2.2 times more likely to report an urgent care/ED visit than those with well-controlled asthma while controlling for cost barriers (Table 10).

Child Results

Table 11. Prevalence of asthma outcomes among children, Utah, ACBS, 2013-2016

Uncontrolled (not-well-controlled/very-poorly-controlled) among children		
Characteristics	% (95% CI)	Sample Size
Total	20.2 (16.0-25.1)	554
Sex		
Male	20.0 (16.1-25.2)	326
Female	20.7 (14.8-28.3)	200
Ethnicity		
White	21.3 (16.7-26.8)	461
Hispanic	10.6 (4.0-25.1)*	46
Other	15.1 (9.6-63.9)*	15
Parent's education		
High School graduate or less	20.9 (13.7-30.5)	129
Some college	19.2 (11.9-29.5)	174
College 4 or more years	20.1 (14.4-28.1)	225
Income		
<$15k	**	19
$15-24k	24.5 (10.5-47.3)*	47
$25-49k	20.1 (12.1-31.4)	90
$50-75k	13.3 (6.9-24.0)*	98
$75+k	23.9 (17.4-31.9)	245
Healthcare coverage		
Private	20.8 (16.0-26.6)	386
Medicaid/Medicare	25.2 (12.7-43.8)*	61
Other	15.1 (6.6-30.9)*	50

Mold in house		
Yes	22.5 (9.1-45.8)	25
No	20.0 (15.7-25.3)	500
Pets in the house		
Yes	20.9 (15.6-27.5)	326
No	18.9 (12.9-26.9)	202
Pets in the bedroom		
Yes	21.4 (14.8-29.9)	219
No	21.8 (13.3-33.7)	101
Cost as a barrier to medication		
Yes	15.0 (5.6-34.2)*	29
No	28.2 (22.6-34.7)	368
Cost as a barrier to seeing a primary care physician		
Yes	27.2 (21.6-33.5)*	22
No	27.7 (10.9-54.5)	375
Parent with Depression		
Yes	21.7 (14.2-31.5)	165
No	19.4 (14.7-25.2)	363

*Estimates with an RSE>30% should be interpreted with caution.** Estimates with an RSE>50% are suppressed.

In Utah, 20.2% of children with asthma have uncontrolled asthma (Table 11). Males and females have similar rates of uncontrolled asthma (20.0% vs. 20.7%). Children who identified as white had a higher prevalence of uncontrolled asthma when compared to children who identified as Hispanic (21.3% vs. 10.6%). Those with a household yearly income of $15-24k dollars a year had the highest prevalence of uncontrolled asthma and those with $50-75k a dollars a year had the lowest (24.5% vs. 13.3%). Those on Medicaid/Medicare had a higher prevalence of uncontrolled asthma when compared to those who had private insurance (25.2% vs. 20.8%). There were no significant differences in the prevalence of uncontrolled asthma among risk factors like mold and pets in the house. There was no difference in the prevalence of uncontrolled asthma among those who reported cost barriers to care and those who did not.

Table 12. Prevalence of asthma control by poor asthma outcomes, Children, Utah, ACBS, 2013-2016

		Limited Usual Activities	Missed School Days	Urgent Care or ED Visit	ED Visit
Characteristics	**No.**	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**
Total	528	40.6 (34.-47.3)	33.2 (27.2-39.8)	32.5 (26.0-39.7)	14.0 (9.5-20.1)
Well-controlled	416	27.9 (21.5-35.3)	26.2 (20.1-33.3)	26.1 (19.0-34.8)	13.7 (8.4-21.7)
Uncontrolled (not-well-controlled/very-poorly-controlled)	112	75.3 (64.4-83.8)	51.3 (38.4-63.9)	45.4 (32.8-58.7)	14.5 (7.8-25.5)*

*Estimates with an RSE>30% should be interpreted with caution.

In Table 12, 40.6% of children in Utah reported limited usual activities, 33.2% reported missed school days, 32.5% reported an urgent care/ED visit, and 14.0% reported an ED visit. Those with uncontrolled asthma had a higher prevalence of poor asthma outcomes, except for ED visits, when compared to those with well-controlled asthma. Those with uncontrolled asthma had a higher prevalence of limited activities (75.3% vs. 27.9%), missed school days (51.3% vs 26.2%), and urgent care/ED visits (45.4% vs. 26.1%) when compared to those with well-controlled asthma. There is no difference between uncontrolled and well-controlled asthma in the prevalence of ED visits (14.5% vs. 13.7%).

Table 13. Prevalence of asthma control by healthcare utilization among children, Utah, ACBS, 2013-2016

Characteristics	No.	Routine Check Up % (95% CI)	Asthma Action Plan % (95% CI)	Ever Advised to Change Things in the Environment % (95% CI)
Total	528	86.7 (81.2-90.8)	42.3 (36.3-48.5)	22.6 (18.4-27.6)
Well-controlled	416	83.0 (75.4-88.6)	40.0 (33.0-46.7)	19.5 (15.11-24.8)
Uncontrolled (not-well controlled/very-poorly controlled)	112	94.5 (86.8-97.8)*	52.8 (40.3-65.0)	35.0 (24.2-47.5)

*Estimates with an RSE>30% should be interpreted with caution.

In Table 13, 86.7% of children in Utah get a routine checkup for asthma, 42.3% have an asthma action plan, and 22.6% have been advised to change things in their home, work, or school environment. Those with uncontrolled asthma have a higher prevalence of good asthma care when compared to those with well-controlled asthma. Those with uncontrolled asthma had a higher prevalence of routine checkups (94.5% vs. 83.0%), having an asthma action plan (52.8% vs. 40.0%), and being advised to change things in their environment (35.0% vs. 19.5%) than those with well-controlled asthma.

Table 14. Prevalence of asthma control among children, Utah, ACBS, 2013-2016

Characteristics	No.	Barriers to Asthma Care		
		Couldn't afford because of cost		
		Asthma Medication % (95% CI)	Primary Care Physician % (95% CI)	Asthma Specialist % (95% CI)
Total	528	7.9 (5.1-12.3)	6.6 (4.0-10.8)	2.6 (1.2-5.4)*
Asthma Control				
Well-controlled	416	9.3 (5.6-15.1)	6.6 (3.6-11.7)	
Not-controlled/very-poorly-controlled	112	4.4 (1.7-10.9)*	6.7 (2.6-16.5)*	

Highlighted boxes are estimates with an RSE>30% and should be interpreted with caution.

In Table 14, about 7.9% of children in Utah had a cost barrier to medication, 6.6% had a cost barrier to seeing a primary care physician, and 2.6% a cost barrier to seeing an asthma specialist. Those with uncontrolled asthma had a lower prevalence of cost as a barrier to medication than those with controlled asthma (4.4% vs. 9.3%).

Table 15. Poor asthma outcomes by cost barriers to care among children, Utah, ACBS, 2013-2016

	No.	Limited Usual Activities	Missed School Days	Urgent Care or ED Visit	ED Visit
		% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Cost as a barrier to asthma medication					
Yes	29	60.9 (37.4-80.3)	49.9 (25.7-74.2)	43.1 (20.7-68.7)*	**
No	368	38.8 (32.3-45.8)	32.1 (26.0-38.8)	31.5 (24.9-39.0)	**
Cost as a barrier to seeing a primary care physician					
Yes	22	73.5 (46.6-89.8)*	57.8 (29.8-81.5)*	68.6 (37.6-88.8)*	**
No	375	38.2 (31.7-45.2)	31.7 (25.7-38.5)	30.0 (23.5-37.5)	**
Cost as a barrier to seeing an asthma specialist					
Yes	10	55.5 (21.7-84.9)*	**	**	**
No	387	40.2 (33.4-46.7)	**	**	**

*Estimates with an RSE>30% should be interpreted with caution.** Estimates with an RSE>50% are suppressed.

 In Table 15, children in Utah who had a cost barrier to care or medication had poorer health outcomes. The differences are starkest among those with cost barriers to seeing a primary care physician or asthma specialist. Those who reported a cost barrier to medication had a higher prevalence of limited activities (60.9%) and missed school days (49.9%) when compared to those who did not report a cost barrier (38.8%). Those who reported cost as a barrier to seeing a primary care physician had a higher prevalence of limited activities (PCP: 73.5%; medication: 60.9%; asthma specialist: 55.5%) and missed school days (PCP: 57.8%; medication: 49.9%) when compared to other cost barriers.

Table 16. Asthma care by cost barriers to care among children, Utah, ACBS, 2013-2016

	No.	Routine Check Up	Asthma Action Plan	Ever Advised to Change Things in the Environment
		% (95% CI)	% (95% CI)	% (95% CI)
Cost as a barrier to asthma medication				
Yes	29	**	49.1 (26.7-71.2)	31.8 (14.1-56.9)
No	368	86.2 (80.3-90.4)	45.7 (39.0-52.6)	24.3 (19.2-30.06)
Cost as a barrier to seeing a primary care physician				
Yes	22	**	54.0 (29.2-76.9)	33.3 (14.4-59.8)
No	375	**	45.4 (38.7-52.3)	24.4 (19.2-30.6)

** Estimates with an RSE>50% are suppressed.

In Table 16, children in Utah who reported cost as a barrier to care or medication received better care than those who did not report a cost barrier to medication. Those with a cost barrier to medication are still getting checkups. Those with a cost barrier to seeing a primary care physician had a higher prevalence of better healthcare when compared to those who did not report a cost barrier to seeing a primary care physician (asthma action plan 54.0% vs. 45.4%; advised to change things in their environment: 33.3% vs. 24.4%).

Conclusions

There is significant room for improvement in helping those with asthma access care and receive guidlines-based care. This is especially true for those with uncontrolled asthma. Those with uncontrolled asthma report more cost barriers to asthma medication and care (PCP and asthma specialist) and have worse asthma outcomes than those with controlled asthma. However, when patients with uncontrolled asthma can get care, it appears they receive better care in terms of more asthma action plans, routine checkups, and being advised

to change things in their environment when compared to those with controlled asthma.

There were many differences in asthma outcomes and barriers to care between adults and children. Adults had a higher prevalence of uncontrolled asthma when compared to children (31.6% vs 20.2%). Adults had less routine visits, less asthma action plans, and reported more barriers to care than children. Children did report more urgent care/ED visits than adults. For adults, the highest levels of uncontrolled asthma were among those who were older, had lower income, were current smokers, had mold in the house, had COPD, and had healthcare coverage. For children, those with the highest prevalence of uncontrolled asthma were among those who were white, had lower income, and those with Medicaid/Medicare. For both children and adults, risk factors for uncontrolled asthma were cost barriers to care, lower income, exposure to triggers like mold and cigarette smoke, and not having health insurance.

The data on healthcare coverage is nuanced. Those who report having no healthcare insurance have better asthma outcomes likely because they have better controlled asthma, better overall health, and do not seek healthcare coverage. Additionally, those with insurance also report a higher prevalence of cost barrier to asthma medication than those without insurance. In contrast, adults on Medicaid reported a lower prevalence of cost barrier to asthma medication than those who report having any health insurance. Having insurance does not guarantee affordable asthma care likely due to high deductible and co-pays. The opposite may be true for those on Medicaid who have less cost barriers because of low or no deductibles or co-pays. One study found "Parents at or below the 250% of the federal poverty level (FPL) with lower out-of-pocket costs were less likely to delay/avoid office visit and the emergency department compared with those with higher cost-sharing levels" (Fung, 2014).

There appears to be a linear association between the level of asthma control and the prevalence of poor asthma outcomes (missed school/work/usual activities and urgent care/ED/hospital visits). For example, those with well-controlled asthma reported fewer poor asthma outcomes than those with not-well-controlled asthma. Those with not-well-controlled asthma reported fewer poor asthma outcomes than those with very-poorly-controlled asthma. Additionally, moving from very-poorly-controlled asthma to not-well-controlled asthma reduces the risk of poor asthma outcomes. One study found that children with very-poorly-controlled asthma were 1.4 times more likely to have a future episode than children with not-well-controlled asthma (Chipps, 2012). Another study found that patients with consistently (2 years) very-poorly-controlled asthma were 6.4 times more likely to have an asthma episode than those who improved from very-poorly to not-well-controlled asthma and those that improved from not-well-controlled to well-controlled asthma (Haselkorn, 2009). Improving asthma control at any level will improve poor asthma outcomes but improving asthma control for those with very-poorly-controlled asthma will have the greatest impact on poor asthma outcomes.

There is a similar pattern between cost barriers and asthma control. Those with well-controlled asthma report fewer cost barriers to care than those with not-well-controlled asthma, and those with not-well-controlled asthma report fewer barriers to care than those with very-poorly-controlled asthma. Those with very-poorly-controlled asthma have more than double the prevalence of cost barriers than those with well-controlled asthma. The most commonly reported cost barrier was to asthma medication; however, cost barriers to care (PCP and asthma specialist) appear to have the largest effect on poor asthma outcomes. Reducing cost barriers, especially cost barriers to asthma specialists will improve asthma outcomes especially the most severe outcomes like ED visits.

Those with uncontrolled asthma had double the prevalence of poor outcomes (limited activities, missed school/work days, and urgent care visits) when compared to those with well-controlled asthma, except for ED visits in children. Children with uncontrolled asthma had a similar prevalence of ED visits as those with controlled asthma. Children with well-controlled asthma are at risk of exacerbations (Reddel, 1999) despite regular inhaled steroid treatment (Belda, 2001). Children with well-controlled asthma may end up in the ED possibly due to an unexpected acute exposure to asthma triggers like rhinoviruses that account for the

majority of exacerbations in children (Doughetry, 2009). The findings in this report indicate that even those with well-controlled asthma who experience an ED visit may benefit from asthma self-management education, and using an asthma-related ED visit as enrollment criteria for the UAHVP is important. This finding also supports the recommendation that everyone with asthma, even those with controlled asthma, should have an asthma action plan to help manage their asthma symptoms and care (AAFA, 2015). Data from this report showed that those with well-controlled asthma were less likely to report having an asthma action plan when compared to those with uncontrolled asthma. Asthma-related ED visits are related to worsening asthma and uncontrolled asthma. Rates of uncontrolled asthma can help healthcare providers and public health agencies identify communities and populations at greatest risk of poor asthma outcomes, direct resources to those in greatest need, and implement effective interventions to prevent asthma-related ED visits and hospitalizations.

Cost barriers to asthma medication and care are associated with uncontrolled asthma. Those with uncontrolled asthma report more cost barriers than those with well-controlled asthma. Those who reported cost barriers to asthma medication and primary care were more likely to report urgent care visits. Mediation analysis showed that uncontrolled asthma accounted for the relationship between cost barriers (medication and seeing a PCP) and urgent care visits. This indicates that cost barriers lead to uncontrolled asthma (Nguyen, 2011) and uncontrolled asthma leads to urgent care visits (Christopher, 2011). Therefore, it is essential to address cost barriers in order to improve asthma control and reduce urgent care visits and other poor asthma outcomes.

Recommendations

- Use uncontrolled asthma and cost barrier data to identify populations at highest risk for poor asthma outcomes and target activities and resources to those in greatest need.
- Reduce cost barriers to asthma medication and care (PCP and asthma specialist) for those with and without insurance.
- Improve access to asthma specialists for those who report cost as a barrier to specialist care.
- Identify populations with very-poorly-controlled asthma and target activities and resources to those in greatest need.
- Use uncontrolled asthma risk factor data to target activities.
- Work with healthcare providers to make sure all patients with asthma have an asthma action plan and are educated on asthma triggers.
- Hospitals and EDs should refer anyone who has an asthma-related ED visit to the Utah Asthma Home Visiting Program, regardless of whether or not their asthma is well-controlled.
- All participants in the Utah Asthma Home Visiting Program should be provided help and resources to identify whether or not mold is in their homes. If mold is found, they should be referred to remediation agencies and partners for help removing it.
- Populations and communities with the highest rates of uncontrolled asthma should be prioritized for interventions and resources. These priority populations and communities include: those with lower incomes (<$50k); those who report cost as a barrier to asthma medication; older adults; smokers (current and former); those who live with someone who smokes in their home; those with mold or pets in their home; those with COPD; and those living in West Jordan/Copperton, South Ogden, Pleasant Grove/Lindon, Draper, Summit County (east), Cedar City, Holladay, Tooele County, Daggett/Uintah County, and Salt Lake City Foothill/East Bench.
- Populations with the highest rates of barriers to care should be prioritized for interventions and resources. These populations include: those who identify as Hispanic, those with lower income (<$50k), smokers (current and former), those who live with someone who smokes in their home, and those with uncontrolled asthma.

References

Asthma and Allergy Foundation of America (AAFA). Asthma Action Plan 2015. Available at https://www.aafa.org/asthma-treatment-action-plan/ [accessed on 8 May 2019].

Bloomberg GR, Banister C, Sterkel R, Epstein J, Bruns J, Swerczek L, Wells S, et al. Socioeconomic, family, and pediatric practice factors that affect level of asthma control. Pediatrics 2009; 123:829–835.

Chipps B, Zeiger R, Dorenbaum A, Borish L, Wenzel S, Miller D, Hayeden ML, Bleeker E, Simons F, Szefler S, Weiss S, Haskelkorn T. Assessment of asthma control and asthma exacerbations in the epidemiology and natural history of asthma: outcomes and treatment regimens (TENOR) observational cohort. Current Respiratory Care Reports 2012; 1 (4): 259-269.

Christopher K.W., Fanny W.S., Arvind B. Relationship between asthma control status, the Asthma Control Test™ and urgent health-care utilization in Asia. Respirology 2011; 16(4):688-697.

Doughetry RH, Fahy John. Acute Exacerbations of Asthma: Epidemiology, Biology and the Exacerbation-Prone Phenotype. Clinical and Experimental Allergy 2009; 39(2):193-202.

Hannaway, PJ. Asthma—an emerging epidemic: a manual for patients with asthma, parents of children with asthma, asthma educators, health-care providers, school nurses and coaches. Marblehead (MA): Lighthouse Press; 2002.

Haselkorn T, Fish JE, Zeiger RS, Szefler SJ, Miller DP, Chipps BE. Consistently very poorly controlled asthma, as defined by the impairment domain of the Expert Panel Report 3 guidelines, increases risk for future severe asthma exacerbations in The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) study. Journal of Allergy and Clinical Immunology 2009; 124(5): 895-902.

Lawson C, Crroll K, Gonzalez R, Priolo C, Apter A, Rhodes K. "No Other Choice": Reasons for emergency department utilization among urban adults with acute asthma. Academic Emergency Medicine 2014; 1-8.

Fung F, Graetz I, Galbraith A. Financial Barriers to Care Among Low-Income Children With Asthma: Health Care Reform Implications. Pediatrics 2015; 136:3.

Meng Y, Babey SH, Hastert TA, Lombardi C, Brown ER. Uncontrolled asthma means missed work and school, emergency department visits for many Californians. Policy Brief UCLA Center Health Policy Research 2008; July PB2008: 1-8.

Nannapaneni N, Baher R, Secord E. Insurance Barriers in the Management of uncontrolled asthma in an inner-city population. Journal of Allergy and Clinical Immunology 2015; AB50.

Pinnock H. Support self-management for asthma. Breathe 2015; 11(2): 98-109.

Reddel H, Ware S, Marks G, et al. Differences between asthma exacerbations and poor asthma control. Lancet. 1999; 353:364–9.

Soriano JB, Rabe KF, Vermeire PA. Predictors of poor asthma control in European adults. J Asthma 2003; 40:803–813.

National Asthma Education and Prevention Program (NAEPP). Guidelines for the Diagnosis and Management of Asthma (EPR-3). 2007. Available from https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma [last accessed 8 May 2019].

National Heart, Lung, and Blood Institute (NIH). Follow-up visits: Stay on track 2013. Available from https://www.nhlbi.nih.gov/health-pro/resources/lung/naci/discover/follow-up-visits.htm [last accessed 8 May

2019].

Nguyen K, Zahran H, Shahed I, Peng J, Boulay E. Factors, Associated with Asthma Control among Adults in Five New England States, 2006–2007. Journal of Asthma 2011; 48(6): 581-588.

Utah Asthma Program (UAP). Fast Stats 2017. Available from http://health.utah.gov/asthma/data/index.html [last accessed 8 May 2019].

Utah Asthma Home Visiting Program (UAHVP). Utah Asthma Program 2018. Available from http://health.utah.gov/asthma/ [last accessed 8 May 2019].

Zahran H, Bailey C, Xiaotin Q, Moorman J. Assessing asthma control and associated risk factors among persons with current asthma –findings from the child and adult Asthma Call-back Survey. Journal of Asthma 2014; 52:318-326.