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Lila Bilsky April 9, 2019

Parental Perceptions and Preferences of Asthma Medication Delivery Devices in a Pediatric Emergency Room

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Abstract

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Many children in the United States suffer from asthma, which is a common chronic lung disease characterized by airway inflammation and swelling. Typical symptoms include coughing, wheezing, shortness of breath, and sputum production. While patients and families can treat symptoms of asthma at home, there are numerous incidents in which parents bring asthmatic children to emergency departments for medical treatment.

Children's National is one such hospital that treats children with asthma. The hospital is a world-renowned pediatric hospital located in the center of Washington, D.C. It is also the only pediatric level I trauma center in the nation's capital, making it a premiere center to treat sick patients. Children's National uses the short acting bronchodilator albuterol to treat children who come to the emergency department experiencing asthma attacks.

Albuterol is typically administered either through a nebulizer or a metered dose inhaler with spacer (MDI+S). Both devices have been extensively studied to compare their efficacy in treating asthma. Studies have determined that the MDI+S is as effective as the nebulizer is at treating acute asthma exacerbations in pediatric emergency rooms. Additionally, the MDI+S cuts down time spent in the emergency department for patients. Thus, physicians at Children's National have been attempting to treat children with albuterol via an MDI+S. However, some doctors have been met with parental resistance to this treatment plan.

Determining whether parents prefer the nebulizer or MDI+S and why is critical for understanding the treatment perceptions and preferences of parents. The culture of American biomedicine has swayed towards emphasizing the preferences and decisions of physicians. However, patient care in emergency departments will hopefully be improved upon by developing treatment plans in accordance with the preferences of not only the physicians but also patients and their families.

A sample of parents visiting the emergency department at Children's National completed a survey inquiring into their perceptions and preferences of asthma medication delivery devices. The responses from this research project conducted at Children's National were used to explore parental perceptions as they relate to device ease, speed, comfort, and effectiveness.

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Chapter 1: Introduction

Pediatric emergency rooms throughout the country routinely see patients suffering from asthma. According to data from the Centers for Disease Control and Prevention, approximately six million children under the age of 18 have asthma (Centers for Disease Control and Prevention, 2016). Due to its high prevalence and chronic nature, asthma imposes a substantial health burden to families and society. In 2007, estimated U.S. medical costs of asthma alone topped $50 billion (Centers for Disease Control and Prevention, 2013). The burden is further exacerbated by pediatric patients due to millions of lost school and work days suffered by children and parents alike.

The pediatric asthma prevalence in Washington D.C. is higher than the national average, which presents a challenge to hospitals in a city where uninsured rates among children have recently risen (Alker & Pham, 2017). Children's National is a renowned hospital located in the heart of Washington D.C. and is the only pediatric level I trauma center in the city. In 2017, Children's National saw over 230,000 different patients and had over 120,000 emergency department visits, which flooded the 38-bed emergency room (Children's National Health System, 2018a). Thus, at any given point during the day, there are beds full of patients on C side. C side is the hallway in the Children's National emergency room designated for children experiencing respiratory distress. The children occupying beds during the day are presumably missing school or camp, while their parents have also had to forgo work or other plans to be by their side. The chief complaints written on the physician notes for patients on C side indicate a wide range of ailments, including allergic reactions, pneumonia, or more serious lung infections. Notably, many of the patients in this hallway of the esteemed hospital are being treated for asthma exacerbations.

Wandering the C side hallway will inevitably result in the appearance of a nebulizer. The machine that delivers medication through a mask is seen frequently worn by children receiving albuterol at Children's National. The machine is loud and is kept on a child's face for the duration of their treatment, which varies depending on the severity of the asthma exacerbation. However, research has demonstrated that a different device, the MDI+S, is just as effective at treating asthma exacerbations. Additionally, length of stay in the emergency department and tachycardia risk have been found to be reduced in children receiving asthma medication through the MDI+S (Chou, 1995). However, physicians in the emergency department at Children's National have been met with resistance when trying to use the MDI+S to treat acute asthma exacerbations, leading to the impression that parents prefer the nebulizer.

Children's National serves as a unique site to study parental preferences of asthma treatment devices due to high rates of asthma and a rising uninsured pediatric population in the nation's capital (Centers for Disease Control and Prevention, 2008; Alker & Pham, 2017). Additionally, the hospital does not discriminate against patients based on insurance status, so the patient population is extremely diverse. In 2016 alone, Children's National provided over $66 million in uncompensated care (Children's National Health System, 2018a). Thus, a voluntary, cross-sectional facilitated survey was administered to parents in the emergency department who had at least one child with asthma to garner parental perceptions regarding nebulizers versus MDI+S.

The survey was administered to eligible parents in the Children's National emergency department throughout the summer and fall of 2018 by emergency department clinical research assistants and associates. Questions on the survey aim to assess patient asthma severity, prior use of the devices, and parent preferences related to efficacy, ease, speed, and other medication

delivery beliefs of the nebulizer and MDI+S. Demographics, such as insurance status and self-identified racial and ethnic background, were also collected, but no personalized health information was disclosed or recorded in the data collection process.

In total, 99 surveys were administered and completed, which will be analyzed using descriptive and non-parametric statistics. Free response questions will also be qualitatively analyzed for frequent and notable themes. The motivation for this project is based on parental hesitation emergency department physicians have been met with when trying to transition children to using the MDI+S at Children's National. Consequently, the physicians would like to know why resistance from parents exists. Looking further into what treatment method parents prefer will be a crucial factor in understanding parental beliefs regarding treatment methods. While parental beliefs may end up conflicting with the beliefs of medical professionals, this study will hopefully provide information to better asthma treatment plans in accordance with or acknowledgement of parental beliefs grounded in their local cultural context.

The hypothesis of this research project is that parents will prefer treatment with a nebulizer over MDI+S for acute asthma exacerbations in the Children's National emergency department. Regardless of whether the null hypothesis will be rejected in this study, quantitative and qualitative survey responses will contribute insights to the literature on American preferences of the medication delivery devices. The efficacy of the nebulizer and MDI+S have been studied extensively from a biomedical perspective, but there is significantly less research on parent and patient beliefs. Thus, this research project is distinctive in that its aim is to investigate asthma treatment preferences through the lens of parents and compare results to preexisting biomedical literature.

Chapter 2: Literature Review

Defining Asthma

Asthma is a common chronic disease of the lungs, typified by inflammation and airflow obstruction (Moorman et al., 2012). The inflammation brought on by the disease results in symptoms such as coughing, breathlessness, chest tightness, sputum production, and wheezing, which ultimately result in decreased airflow (National Asthma Education & Prevention Program, 2007). Airflow obstruction can be further exacerbated by airway hyperresponsiveness, airway edema, and constriction of the bronchioles, which are also characteristically seen in those with asthma.

It is important to note that symptom frequency varies, and diagnosis is not determined based on the presence of all symptoms. However, respiratory symptoms such as isolated cough, shortness of breath accompanied by dizziness or lightheadedness, chest pain, and exercise induced labored breathing reduce the likelihood of a diagnosis of asthma if presented alone without other physiological responses (Global Initiative For Asthma, 2018). Patterns of symptoms can be perennial, seasonal or both, as well as continual, episodic, or both (National Asthma Education & Prevention Program, 2007). Time of day has also been seen to affect patterns of symptoms, with nighttime and early morning being associated with worsening asthma symptoms.

Comorbid conditions affecting the prevalence and severity of asthma symptoms include cardiovascular disease, gastroesophageal reflux disease, psychiatric diseases, rhinosinusitis (inflammation of the nasal cavities), and sleep apnea (Nunes et al., 2017). More research is needed to assess how comorbidities affect pediatric asthma burden, but a 2010 German National Health Telephone Interview Survey (GEDA) revealed that comorbidities increased the likelihood

of hospital visits for adult asthmatics (Steppuhn et al., 2013). However, the findings were not statistically significant for most comorbid conditions.

Asthma can be further broken down into specific phenotypes. Common phenotypes recognized by the Global Initiative for Asthma include allergic asthma, non-allergic asthma, late-onset asthma, asthma with fixed airflow limitation, and asthma with obesity (Global Initiative For Asthma, 2018). These distinct phenotypes of asthma highlight the complex etiology behind the disease.

Etiology

Asthma is known to be influenced by both genetic and environmental factors, but the specific causes of the disease remain unknown. Potential triggers of asthma affecting children include irregular immune responses, airborne pollutants and allergens, and in-utero and early life exposures (Global Initiative For Asthma, 2018).

An irregular immune response has been linked to the pathophysiology of pediatric asthma. Increased Th2 cytokine expression in airway cells is associated with asthma and allergic conditions (Barnes, 2001). An increased Th2 response may be due to lack of exposure to early childhood infections, which is in accordance with the hygiene hypothesis. Through public health and sanitation programs, there has been a drop in exposure to pathogens previously encountered by humans, but the hygiene hypothesis posits that this lack of exposure may actually increase vulnerability to asthma. The mismatch of pathogen exposure has been seen to make children in urban settings more vulnerable to the disease than those in rural environments (Ege et al., 2011).

Environmental factors, including but not limited to airborne pollutants and allergens, affect children worldwide, but disproportionately at higher rates in urban areas (Ege et al., 2011).

Pollutants such as smoke and chemical fumes can trigger asthma, so exposure should be minimized to avoid asthma exacerbations (Moorman et al., 2012). Exposure to dust, mold, and pollen should also be avoided by those with sensitivities to common allergens. Further research is required to confirm if early childhood exposure to sensitizing allergens will decrease the likelihood of pediatric asthma development.

In-utero and early life exposures are also important contributors to the development of pediatric asthma. Analysis of diet during pregnancy has found that consumption of common allergenic foods is associated with decreased risk of asthma in offspring. Data on tree nut, peanut, and fish consumption was collected from mothers in the Danish National Birth Cohort (Maslova et al., 2012; Maslova et al., 2013). While these studies found that mothers who consumed these allergenic foods during pregnancy had children with lower rates of asthma, further epidemiological studies have not shown consistent results (Global Initiative For Asthma, 2018). Thus, there are no widely accepted dietary suggestions for pregnant mothers on maternal diets that reduce the risk of pediatric asthma development. Maternal obesity during pregnancy and gestational weight gain have also been linked to increased likelihood of asthma development in offspring (Forno et al., 2014).

There are many other mechanisms by which asthma symptoms may be exacerbated by exposures such as cold air, diet, physical activity, and strong emotions (Mayo Clinic, 2018). History of injury to the airway, caused by bronchopulmonary dysplasia or pneumonia, is another potential factor that could result in the development of asthma (National Asthma Education & Prevention Program, 2007). While there remain unknowns as to the etiology of the disease, the numerous genetic, behavioral, and environmental influences contribute to the high prevalence

and burden of asthma that the U.S. faces annually.

Prevalence and Burden of Pediatric Asthma

Prevalence

Asthma prevalence is well-documented by the Centers of Disease Control and Prevention (CDC), which collects state and national statistics. Most epidemiological reports suggest six to seven million children in the U.S. currently suffer from asthma, which equates to 1 of every 12 children (Centers for Disease Control and Prevention, 2018). Of these children, 53.7% reported having at least one asthma attack within the past year. Current asthma is quantified by answering affirmatively to questions such as, "have you been told by a health professional that you have asthma?" and "Do you still have asthma?" (Centers for Disease Control and Prevention, 2016).

Pediatric asthma rates differ by race, age, and sex. White children have an asthma prevalence of 7.4%, whereas 16% of black children and 13.2% of multi-race children suffer from the disease (Centers for Disease Control and Prevention, 2018). African American children are more likely to visit the emergency department for asthma than white children. They also had a risk-based rate of emergency department visits that was twice as high as the rate for white persons during 2001-2009 (Moorman et al., 2012). Furthermore, it was discovered that primary healthcare visits for asthma were lower among African Americans than whites during this period, indicating the presence of racial disparities in the use of nonurgent and preventative healthcare services (Moorman et al., 2012). Younger children aged 0-4 are more likely to visit an emergency department for asthma than any other age group, but the prevalence of asthma for children aged 5-14 is higher than any other age group at 10.4% (Centers for Disease Control and Prevention, 2016). Amongst the pediatric population, asthma rates are higher for males, but the

reverse holds for adults, among whom females have higher reported asthma prevalence. Notably, this gender difference has not been adequately addressed in the literature (Akinbami et al., 2011).

Asthma prevalence rates also have been correlated with income levels. 11.2% of individuals who fall below the federal poverty line had asthma in 2010, compared to only 6.7% of those who were at or above 450% of the poverty line threshold (Moorman et al., 2012). Data gathered in 2003 showed that adults living in poverty were twice as likely to report having an asthma attack within the past 12 months, thus indicating an association between asthma rates and low income (National Center for Health Statistics, 2005).

Burden

The burden of asthma can be calculated by looking at medical expenses and lost productivity. In 2007, the estimated cost of asthma in the U.S. was $56 billion dollars, with $50.1 billion being attributed to medical care costs and $3.8 billion associated with lost productivity (Centers for Disease Control and Prevention, 2013). Medical costs can be broken down into doctor office visits, emergency department visits, and hospitalization rates. The CDC reported that in 2010, there were 1.8 million asthma-related emergency department visits and 14.2 million doctor office visits, with 439,400 asthma-related hospitalizations (Centers for Disease Control and Prevention, 2013). It also reported that 1 in 6 children with asthma would go to the emergency department and 1 in 20 would be hospitalized annually as of 2016 (Centers for Disease Control and Prevention, 2018). Emergency department visits and hospitalization rates are associated with poor asthma control and this burden suggests a pressing need to improve asthma treatment methods and reduce unnecessary healthcare utilization from children and adults alike (Follenweider & Lambertino, 2013).

While the U.S. healthcare system is burdened by visits and costs associated with asthma, parents and patients also suffer from burdens of managing the chronic disease (Akinbami et al., 2011). In 2008, asthma was responsible for 10.5 million days of school absences among K-12 school aged children (Centers for Disease Control and Prevention, 2013). No accurate estimate is available for the number of work days parents miss for having to take time off to care for a child with asthma, but the large number of missed school days alone suggests a correspondingly large parental burden of missed work or caregiver expenses. Taken together, these several sources contribute significantly to the societal burden of the disease.

Clinical Classification of Asthma Severity, Exacerbations, and Control

Severity

Asthma severity indexes the underlying disease intensity in the absence of long-term medication or treatment (Fuhlbrigge, 2004). Asthma severity may also be defined by the amount of medication required for asthma control once treatment has already commenced (National Asthma Education & Prevention Program, 2007). Severity can be broken down further into the categories of *impairment* and *risk*. Impairment is quantified by number, type, and severity of symptoms, number of nighttime awakenings, interference with daily functioning, and lung function (National Asthma Education & Prevention Program, 2007). Lung function is a standard measure of asthma severity and is ideal due to its objectivity and reproducibility (Fuhlbrigge, 2004). Symptom reports are not entirely objective measures in the pediatric population due to parental interpretations and biased perceptions of their children's asthma. Risk is the likelihood of decline in lung function or the probability of an asthma exacerbation.

Asthma severity can be characterized as either intermittent or persistent. Children with intermittent asthma have symptoms occurring less than two days a week and experience no interference with their normal activities (National Asthma Education & Prevention Program, 2007). Children with persistent asthma may either have mild, moderate, or severe asthma. Each subtype of persistent asthma is characterized by frequency of symptom as well as degree of interference in daily activities. Severe asthma is furthermore distinguished from uncontrolled asthma, which results from poor or incorrect adherence to treatment plan (Global Initiative For Asthma, 2018).

Exacerbations

An asthma exacerbation is a severe and acute deterioration of asthma control, marked by a varying combination of increased coughing, wheezing, shortness of breath, chest tightness and decreased lung functioning (Global Initiative For Asthma, 2018). Patients at high risk for an asthma exacerbation include those with prior exacerbations, three or more emergency department visits within the last year, low socioeconomic status, inner-city residence, psychiatric diseases, and comorbidities (National Asthma Education & Prevention Program, 2007). Patients with varying degrees of asthma severity are at risk for experiencing exacerbations, which are always taken seriously due to the possibility of experiencing a life-threatening attack. Exacerbations commonly are brought on by exposure to environmental risk factors or poor adherence to medication (Global Initiative For Asthma, 2018). The latter is a relevant concern in the pediatric community as it has been reported that control medications are not used as prescribed in up to 25% of pediatric asthma cases (Centers For Disease Control and Prevention, 2013). Note that the term “exacerbation” is often used interchangeably with the terms “asthma attack” and “asthma flare-up”.

Control

Asthma control comprises the degree to which treatment successfully prevents symptoms from occurring or reduces their severity when they do occur (Fuhlbrigge, 2004). Control is determined by factors such as the treatment itself, genetic predisposition, environmental exposure, and adherence to treatment. Hence, evaluation of asthma control is required to make necessary treatment adjustments as the clinical status of the disease changes. Children who have experienced two or more asthma exacerbations requiring treatment with corticosteroids within the past year would be classified as having not-well-controlled asthma. More intense exacerbations that require visits to the emergency department or admission to the intensive care unit are also signs of poor asthma control (National Asthma Education & Prevention Program, 2007).

Indicators of well-controlled asthma are minimal to no symptoms, no nighttime awakenings, minimal interference with daily activities and near normal lung function (Fuhlbrigge, 2004). However, high levels of control are not always achieved in patient populations, despite patient perceptions to the contrary. More than 40% of adult participants in the Asthma Insights and Reality in Europe (AIRE) study reported well-controlled asthma, yet also reported persistent symptoms that are inconsistent with their initial response about level of disease control (Vermeire et al., 2002).

Pediatric asthmatics also have not reached adequate levels of asthma control, despite parents believing that they have. In a survey-based study, 89% of parents reported that they were satisfied with their children's asthma treatment, even though only 18% of children were considered to have excellent asthma control (Kuehni & Frey, 2002). The discrepancy between

parental perceptions of asthma control and persistence of symptoms is troubling yet understudied, and merits greater attention.

Diagnosis and Treatment

Diagnosis

Determining whether someone has asthma is based on past respiratory symptoms and variation in lung function measures, including variable expiratory airflow limitation. When examining a patient's history of respiratory symptoms, physicians look for variation in time and intensity, because asthma symptoms commonly worsen in the evening or early morning (National Asthma Education & Prevention Program, 2007). Respiratory symptoms in response to typical asthma triggers, such as pollutants and allergens, also make a diagnosis of asthma more likely. Diagnostic criteria do not include the presence of specific symptoms, but more than one respiratory symptom is required (Global Initiative For Asthma, 2018). The lack of any specific symptom for a diagnosis highlights the different mechanisms through which the disease may arise and manifest.

Medical professionals can use multiple measures to determine if airflow limitation is present in a child suspected of having asthma. A standard and objective measure of airflow limitation is the forced expiratory volume in 1 second (FEV1), which is measured by a spirometer (Fuhlbrigge, 2004). FEV1, in combination with forced volume capacity (FVC), creates a ratio that can detect acute variation in lung function. A drop in the FEV1/FVC ratio below 0.9 in a pediatric patient is taken as confirmative of reduced lung function and airflow limitation (Global Initiative For Asthma, 2018). The FEV1/FVC ratio is highly reproducible with the spirometer, making it an extremely reliable measure (Fuhlbrigge, 2004).

Peak expiratory flow rate (PEFR) is another measurement of airflow limitation that can be used in aiding a diagnosis of asthma. PEFR is usually taken as an average of a daily or twice-daily PEFR over the span of two weeks (Fuhlbrigge, 2004). Variable limitation of expiratory airflow can be confirmed if there is an average daily variability greater than 13% for PEFR measures (Global Initiative For Asthma, 2018). Other less commonly used tests to determine airflow limitation and poor lung function include measures of sputum and exhaled nitric oxide (Fuhlbrigge, 2004).

Treatment

The goal of asthma treatment is elimination of symptoms and limitations to daily function (Mayo Clinic, 2018). Children with a confirmed diagnosis of persistent asthma are medically indicated as candidates to take long-term control medications frequently to avoid using quick-relief medications to control an acute exacerbation. Control medications are advantageous because they can reduce inflammation of the airways, preventing the likelihood of an asthma exacerbation. Common asthma control medications include inhaled glucocorticoids, leukotriene modifiers, long-acting bronchodilators, and Omalizumab (Sawicki & Haver, 2018). It should be noted that inhaled glucocorticoids, despite producing negative side effects through constant usage, are the preferred long-term control medication because they reduce sensitivity of the bronchial tubes, in addition to reducing airway inflammation (Sawicki & Haver, 2018).

During asthma exacerbations, quick-relief medications should be administered to swiftly alleviate symptoms and increase lung function. These medications include short-acting bronchodilators and oral and intravenous corticosteroids (Mayo Clinic, 2018). Short-acting bronchodilators, otherwise known as beta-2 agonists, are effective during acute exacerbations because they quickly relax muscles surrounding narrowed airways within a few minutes

(Sawicki & Haver, 2018). In the U.S., albuterol is the most commonly used short-acting bronchodilator (Sawicki & Haver, 2018).

During acute asthma exacerbations, short-acting bronchodilators are delivered via a nebulizer or a metered dose inhaler with a spacer (MDI+S). Nebulizers are devices connected to compressor machines that use compressed air to convert liquid beta-2 agonists to a spray, which is received through a mask that lies over the nose and mouth (Sawicki & Haver, 2018). An MDI+S is a delivery device that releases liquid beta-2 agonists into the air, which is then breathed into the lungs through a mouthpiece. A spacer is a chamber that increases bronchodilator delivery to the lungs (Sawicki & Haver, 2018).

The online platforms and resources available to patients and families researching asthma and lung diseases describe the nebulizer and MDI+S as devices that deliver medication to the lungs that work "equally well" when used correctly (Brennan, 2017). Nebulizers are depicted as machines that are noisy and sometimes bulky that convert medication into a mist (Ben-Joseph, 2017). This mist is delivered to the patient via a tube, which is connected to the nebulizer. The tube is also attached to a facemask that covers a patient's nose and mouth, and this facemask is worn by the patient, who subsequently breathes in the medication (Ben-Joseph, 2017). Nebulizers are also described as easy to use because children do not have to do anything other than sit, but a drawback to using a nebulizer is lengthy treatment times ranging up to 20 minutes (Brennan, 2017). Nebulizers must also be washed and cleaned after usage and often require electricity, which is why they are not considered to be portable.

For readers of these online health websites, metered dose inhalers (MDI) are compared to aerosol cans because they release a spray of medicine into a person's airways (Ben-Jospeh, 2017). The pressurized devices, which are handheld and therefore can easily be carried around,

are connected to a mouthpiece or facemask. A set amount of medication is delivered to the patient quickly once the top of the device is pushed. Metered dose inhalers are often used with a spacer (MDI+S) in order to make sure the medication is effectively pushed into a patient's airway instead of remaining at the back of the throat (Brennan, 2017). The spacer is a holding chamber that is placed in between the inhaler and mouthpiece or facemask. Despite elaborating on faster medication delivery and portability of metered dose inhalers with spacers, health corporation websites emphasize the difficulty some children have with properly inhaling medication through the devices.

Medication dosages and delivery devices are patient specific, and vary based on age, disease severity, adherence likelihood and technique capabilities (Peters et al., 2002). Substantial research has examined the efficacy of nebulizers and inhalers in the delivery of medication to patients experiencing acute asthma exacerbations in emergency rooms worldwide, as will be discussed in the following section.

Nebulizer versus MDI+S Efficacy

The debate over whether the nebulizer or the MDI+S is more effective at treating asthma has been investigated for over 20 years. A study published in the Archives of Pediatrics & Adolescent Medicine in 1995 was one of the first to examine treatment outcomes from the use of the medication delivery devices in a pediatric emergency department (Chou et al., 1995). The randomized control trial, conducted in a New York City pediatric emergency room, had defined inclusion criteria as two years of age or older, having a history of two wheezing episodes, and wheezing upon arrival at the emergency department. Patients excluded from the study suffered from other chronic condition(s). Nebulizer treatment was the standard of care for albuterol

delivery for acute asthma exacerbations in 1995, so the experimental group received bronchodilators via an MDI+S and the control group used a nebulizer.

Comparison of these two treatment delivery options revealed that the experimental group spent only an average of 66 minutes in the emergency department, whereas the control group spent an average of 103 minutes (Chou et al., 1995). Clinical outcomes considered in the study included respiratory rate, PEFR, oxygen saturation, number of treatments given, and admission rates. No statistically significant differences in clinical outcomes were observed among those who were treated with the nebulizer versus the MDI+S. However, the MDI+S group saw less vomiting after treatment and the nebulizer group saw higher rates of tachycardia. Thus, it was concluded from this study that the MDI+S is as effective and safe as the nebulizer is in the delivery of bronchodilators in the emergency department. The MDI+S was also determined to be efficient because it cut down on patient time spent in the emergency department and therefore reduced burden of care. Similar clinical outcomes comparing use of a nebulizer versus an MDI+S had been found in an earlier study published in the Journal of Pediatrics (Kerem et al., 1993).

Later studies reproduced similar findings and confirmed that the MDI+S is effective and more efficient than the nebulizer at treating asthma in pediatric emergency room. In a pediatric emergency department in France, children ages 4-15 were assigned nebulizer or MDI+S treatment. Although there were no differences in clinical outcomes and hospitalization rates, the length of emergency department stays was substantially reduced in children receiving medication through the MDI+S (Sannier et al., 2006). A Brazilian study of the efficacy of an MDI with a home-made non-valved spacer noted faster medication delivery and cost as advantages of the

MDI, whereas taxing maintenance and complexity, as well as required electricity, were highlighted as disadvantages of the nebulizer (Duarte & Camargos, 2002).

Further reviews of adult and pediatric studies comparing the effectiveness of nebulizers and MDI+S for asthma medication delivery generally had positive findings in favor of the MDI+S as an equal or superior alternative to the nebulizer. A review published in *Health Technology Assessment* concluded that children ages 5-15 could be adequately treated using an inhaler but limited its findings to children with mild or moderate asthma, with further research being required to determine inhaler efficacy in children with severe asthma (Peters, 2002). Young children under five years of age were noted to have competence or adherence issues with inhalers, which is a factor that must be considered when choosing a medication delivery device.

An earlier review found that the MDI+S should be considered a preferred treatment option for children with acute asthma (Amirav & Newhouse, 1997). All reports included in the review found that the MDI+S was comparable or superior to the nebulizer in terms of effectiveness. Reduced cost, quicker and easier administration, and better time allocation of healthcare personnel were all considered factors that increased the efficiency of the MDI+S in comparison to the nebulizer (Amirav & Newhouse, 1997). A 2013 review (Cates et al., 2013) also found that faster administration of medication and marked reduction in length of emergency room visits were all benefits of the MDI+S. Additional findings that supported the use of MDI+S in children with acute, non-fatal asthma included reduction of emergency room stay by an average of 33 minutes, as well as reduced pulse rates (Cates et al., 2013).

Cost benefits of the MDI+S have been stressed in articles published in The Journal of Pediatrics and The Journal of Emergency Medicine in support of MDI+S usage. In 2000, researchers found that the MDI+S produced less wheezing than the nebulizer in a group of

children aged one to four presenting to the emergency department (Leversha et al., 2000). Additionally, average emergency room costs for children using MDI+S were $825, compared with $1,282 for children using the nebulizer (Leversha et al., 2000). In another study examining device efficacy, median costs to patients receiving MDI+S and nebulizer treatment were found to be $10.11 and $18.26, respectively (Dhuper, et al. 2011). Reduced costs, as well as shorter stays in the emergency department, make the MDI+S an attractive alternative to nebulizer therapy for emergency room providers.

Asthma Education and Partnerships

Asthma education has been advanced as a route to enhance treatment adherence among children and reduce emergency department visits. Use of the emergency room for asthma treatment is an indicator that asthma is not well controlled, so the hope is that visits to the emergency department for asthma-related causes could be reduced through a written asthma action plan, correct medication technique instructions, and an engaging doctor-patient partnership.

The National Asthma Education and Prevention Program recommends that every individual have an asthma action plan, which would enable patients better to recognize worsening symptoms and what to do in these situations. However, less than half of children (48.6%) with asthma reported having an asthma action plan in 2010 (Centers for Disease Control & Prevention, 2013). Asthma education can be improved by providing each child with asthma a personalized action plan that takes into consideration a family's beliefs, preferences, and lifestyle constraints in order to increase the likelihood of treatment adherence (National Asthma Education & Prevention Program, 2007).

Asthma control furthermore could be enhanced amongst the pediatric community through proper training in techniques of inhaler use. Reports indicate that on request, 70-80% of patients demonstrate incorrect inhaler technique (Global Initiative For Asthma, 2018). Strategies outlined by the Global Initiative for Asthma to increase correct inhaler technique include choosing the correct device, checking the technique, and correctly demonstrating to patients how to use the device. First, when choosing the appropriate device for asthma medication delivery, patient and family preferences should be considered, especially if families have distinctive beliefs or concerns regarding medication delivery. Second, once the appropriate device has been selected, healthcare providers must check that the patient is not misusing the device, which could result in decreased medication delivery. Third, the healthcare provider should be required to demonstrate correctly how to use any inhaler they prescribe in order to teach pediatric patients the correct technique themselves (Global Initiative For Asthma, 2018).

Forming a strong and engaging partnership between physicians and families who suffer from asthma is another essential component of asthma education and control. This relationship is complicated in many respects, but a shared-care approach in which both the physician and patient take an active role in medical decisions and care has been associated with improved medical outcomes (National Asthma Education & Prevention Program, 2007). Parental perceptions of asthma treatments, specifically parental preferences, must be addressed through the parent-healthcare partnership in order to come to a collective decision regarding treatment, which is typical of the shared-cared approach. Trying to effectively make joint decisions in this partnership can be complicated through differences in demographics and personality, amount of information provided, treatment and disease context, setting, cost, role preferences and past experiences (Bowling & Ebrahim, 2001). Regardless of patient or parent beliefs, it remains the

ethical charge for physicians to provide patients with all viable treatment options, regardless of which option the medical care provider prefers (Bowling & Ebrahim, 2001).

In order to reduce asthma morbidity in the pediatric population, cultural, ethnic, language, health literacy, and health numeracy factors must also be addressed more directly in the U.S. when beginning to develop a clinician-patient relationship. A 2013 study noted that increased emergency department visits by Puerto Rican children with asthma living in the U.S. was associated with lower parent health numeracy scores, which were determined by no correct responses on an asthma numeracy questionnaire (Rosas-Salazar et al., 2013). Thus, patient-specific partnerships with healthcare providers that take into consideration cultural, ethnic, and health literacy factors could improve patient and family understandings of asthma, which may help decrease morbidity and increase control. Beliefs about healthcare systems as a whole must also be addressed, as minorities have historically mistrusted physicians and other healthcare providers due to historic abuses of trust as well as persistent social and financial inequalities in healthcare (Kleinman & Benson, 2006).

Adjusting partnerships to foster an environment that supports the shared-care approach to treating asthma will inevitably require enhanced and more direct asthma education. Providing parents with knowledge allows them to formulate their own beliefs and opinions regarding their child's asthma treatment, and programs that support face-to-face asthma education have proven to be highly effective (Liu & Feekery, 2001). An Australian study compared parents who were assigned to different asthma education programs. Parents recruited at the Royal Children's Hospital in Melbourne received in-person asthma education classes, whereas parents recruited at Sunshine Hospital were enrolled in a home-video education program. Although all parents reported reduced child morbidity and a decrease in their own anxiety, children of parents

enrolled in the interactive, in-person classes reported an improvement in their asthma severity in follow-up surveys analyzed by research staff (Liu & Feekery, 2001). Similar results were found in education programs that highlighted parental empowerment. Empowerment relates to the increase in confidence of parents regarding their ability to care and manage their child's asthma. Parents enrolled in an empowerment focused asthma education program had additional training in parent-healthcare partnerships and were found to have a greater sense of control, ability to make decisions, and ability to provide care for their children with asthma as reported in follow-up interviews (McCarthy et al., 2002). However, parents enrolled in both the traditional and empowerment education programs demonstrated increases in their asthma knowledge. Initiating interactive and empowering asthma education for parents will require a change in the relationships families and asthma care providers form, moving away from the "doctor knows best" mentality to implement increased patient participation and engagement.

The Culture of American Biomedicine

Emphasis on Science and Technology

Asthmatics and their families spend an immense amount of time in and out of routine doctor office visits and hospitals. Thus, they are more immersed in the world of biomedicine than other Americans through the necessity of ongoing medical care. Modern biomedicine has strongly emphasized reliance on factual and scientific knowledge, which has translated into mainstream legitimacy for both the medical field and healthcare providers. This is apparent in medical education, which bases its teachings on evidence and empirically grounded "best practices." However, scientific knowledge by itself is not sufficient to inspire trust and expertise in a physician. Rather, healthcare interactions are also saturated with symbolic elements,

including clothes, accessories, technologies, and rituals that mark physicians as trustworthy healers (Salhi, 2015).

The social status and power that has been ascribed to physicians through their legitimacy and trust has led to doctor-patient interactions in which information is provided in a unidirectional manner, as opposed to the shared-care approach. However, a general public trust in American biomedicine may not be as applicable on the individual level in which physicians begin to assert their scientific knowledge and expertise as superior to ethnomedical beliefs held by patients. This is seen when physicians label patients who are non-adherent to treatment plans as disobedient due to the expectation that their healthcare decisions are authoritative commands that must be followed (Farmer et al., 2006).

Paternalism versus Autonomy

Medical professionals who become angered or frustrated with "disobedient" patients may engage in medical paternalism by maintaining that their knowledge puts them in a unique position to make decisions for patients. However, those who express paternalistic viewpoints believe that they may overrule patient wishes and desires and act on their own personal accord in order to benefit the well-being of their patients (Murgic et al., 2015). Medical paternalism, however, directly opposes autonomy, which is one of the four principles of medical ethics and can be equated with patient independence and freedom in medical decision making (Erlanger Medical Ethics Orientation Manual, 2000). Medical paternalism and patient autonomy are, however, interconnected through the shared goal of acting for the good of a patient (Murgic et al., 2015). While paternalistic physicians may infringe on their patients' autonomy, doctors may sometimes assert their opinions and decisions as superior due to the belief that a specific course of action is in the patients' best medical interest.

The balance between patient autonomy and beneficence is at the core of the doctor-patient relationship in a shared-care approach. Beneficence, or acting in a patient's best interest, is another principle of medical ethics (Kaba & Sooriakumaran, 2007). Paternalism is sometimes seen in biomedicine as a form of beneficence in Asian and Latin American societies, whereas cultures that promote independence have competing views of autonomy and paternalism and would not equate paternalism to a form of beneficence (Murgic et al., 2015).

Patients in an American biomedicine sphere highly value autonomy, and steer away from entirely paternalistic doctor-patient relationships. Prior doctor-patient models, such as the "active-passivity" and "guidance-co-operation" models, are paternalistic in nature and emphasize the power of physicians when building relationships (Kaba & Sooriakumaran, 2007). However, newer models, such as the shared-care approach and "mutual participation" model, are grounded in patient-client autonomy. These models, despite introducing legal liabilities for physicians, emphasize giving patients responsibility for the care of their health and an equal partnership between physicians and patients based on shared-decision making and respect (Kaba & Sooriakumaran, 2007). However, the notion of attaining respect in the doctor-patient relationship is complicated by the differing cultural values that physicians and patients hold.

Cultural Competence or Cultural Humility?

Both clinicians and patients live in cultural worlds that are shaped by education, ethnicity, gender, socioeconomic status, race, sexual orientation, and other factors that influence identity and sociality (Kohrt & Mendenhall, 2015). Physicians inhabit a world of biomedical culture, which is often foreign to patients who experience their own local cultures (Kohrt & Mendenhall, 2015). Differing cultural ecologies can result in disagreements or misunderstandings of diverging beliefs regarding diagnosis and treatment of illnesses. Thus,

cultural competence, or cultural sensitivity, has emerged as a valuable skill for physicians to improve communication with patients.

Cultural competence is a framework grounded in physicians and healthcare providers being sensitive to the cultural beliefs of patients. Physicians who have acquired cultural competence may attempt to understand patients' ethnomedical beliefs but acknowledging these beliefs and respecting them represent major sources of difficulty in achieving patient trust and effective communication (Kleinman & Benson, 2006). Cultural humility, the awareness and respect for different cultures, may be more relevant for physicians than gaining cultural competence, in which culturally-appropriate beliefs are not always legitimized (Kleinman & Benson, 2006). In order to increase their cultural humility, physicians could use explanatory models that allow patients to elaborate on their personal illness narrative and other viewpoints related to treatment and could be valuable for the development of the doctor-patient relationship for asthmatics (Kleinman & Benson, 2006). Explanatory models increase communication among physicians and patients and force clinicians to put their scientific expertise aside and not above that of the patients' beliefs (Kleinman & Benson, 2006). By listening to and acknowledging beliefs that may contradict their medical training, physicians gain cultural humility, which is essential for respectful doctor-patient relationships. Having awareness of and respecting ethnomedical beliefs allows for targeted interventions and strategies to enhance illness and disease treatments in a biomedicine context and could be critical to improving asthma treatment adherence and patient satisfaction.

Parental Perceptions of Treatments and Disease

Perceptions of Treatment

Nonadherence to asthma treatment plans may be due to negative perceptions regarding the specific treatment and association of further risks. Research regarding parental and patient perceptions of asthma treatment and risks is needed to understand why nonadherence is prevalent. This would enable the development of health strategies to combat treatment for asthma. A review of previous research on parental preferences of inhaled steroids as a treatment for asthma (Bender & Bender, 2005) identified the most prominent reasons of nonadherence as stigmatization, fear of side effects, fear of addiction/dependence, difficulty with administration of medication, and dividing responsibility for treatment among children and caregivers. Reduced child growth and irritability were noted as feared side effects (Bender & Bender, 2005).

Parental perceptions regarding asthma and anti-inflammatory medications were examined in another study in which parents were directly interviewed. Themes elicited from these interviews include “I know my child,” “trial and error,” “partnership,” “need for education,” “negotiating responsibility,” and “preferences” (Peterson-Sweeney et al., 2003). The “I know my child” theme relates to mothers taking a greater responsibility of care for their child’s asthma than other individuals. “Trial and error” refers to parents identifying symptoms and treating them through trial and error, which was associated with increased parent confidence. “Partnership” refers to the parent-physician partnership that forms through negotiations of medical decisions, and it was once again noted that parents wanted their perceptions to be acknowledged in the partnership. “Negotiating responsibility” is the same as dividing responsibility for treatment among children and caregivers, which has been noted as a reason for treatment nonadherence due to confusion of role responsibility (Bender & Bender, 2005). Through discussion of preferences, some parents shared their preference for the nebulizer over the MDI+S because of their belief that the nebulizer allows for the delivery of more medication (Peterson-Sweeney et

al., 2003). Other parents mentioned their dislike of albuterol related to their perceptions that the medication increases child hyperactivity (Peterson-Sweeney et al., 2003).

In an Australian study looking directly at perceptions of nebulizer versus MDI+S treatments in the emergency department for mild to moderately severe asthma, parents and patients noted that the MDI+S was easier to use, and hence they preferred this asthma medication delivery device (Cotterell et al., 2002). Parents of patients receiving bronchodilators via the MDI+S at Sydney Children's Hospital, as well as patients eight years or older, completed a questionnaire regarding this form of treatment. Of the parents who reported that their child had also previously used a nebulizer for asthma treatment, 84% said the MDI+S was easier to use, 77% claimed that the MDI+S was better tolerated by their child, and 84% said they preferred the MDI+S overall. Of the patients aged 8-14 who completed the questionnaire, 82% said the MDI+S was okay to use or that they liked it, and most patients preferred the MDI+S because it was quicker and easier to use than the nebulizer (Cotterell et al., 2002). While investigators were nervous that acceptability of the MDI+S would be limited because the nebulizer previously had stood as the standard of care for asthma exacerbations in the emergency department, resistance was small, and many parents and patients surprisingly preferred the MDI+S. Further studies of American parental perceptions of nebulizer and MDI+S treatments are needed to establish preferences, which will guide physicians who engage in the shared-care approach to treating asthma.

Ethnomedical Beliefs of Minority Patients and Parents

Ethnomedicine is a subdiscipline of medical anthropology that examines culturally-specific perceptions of illness and treatment options, which can be thought of as how different groups think about health and disease (Bailey, 2000). The ethnomedical beliefs of minority

groups, including African Americans and Hispanic American populations, are complicated by health disparities. Members of these groups tend to have higher rates of disease and limited access to preventative care when compared to white Americans (Riley, 2012). By seeking to understand the intricate factors that contribute to ethnomedical beliefs of minority populations, medical anthropologists hope to contextualize the health seeking processes of these groups. When and where patients seek medical treatment, as well as adherence to treatment plans, are components of the health seeking process (Bailey, 2000).

From 1960-2005, the percentage of children in the U.S. living with a chronic disease quadrupled, and minority children were disproportionately affected by this rise in disease (Price et al., 2013). Thus, it is not surprising that African American and Hispanic children have higher asthma prevalence rates than non-minority children (Centers for Disease Control & Prevention, 2018). However, minority children with asthma utilize non-emergency and preventative care centers with less frequency than white children do, despite higher disease rates (Moorman et al., 2012; Price et al., 2013). Thus, disadvantaged children, especially those living in urban centers, disproportionally visit emergency rooms for asthma treatment. The frequent and often unnecessary utilization of emergency rooms by patients with asthma and other chronic conditions is a financial concern of healthcare providers across the country (Nunes et al., 2017).

The care that these minority children receive in emergency departments is the product of multiple healthcare providers, which is less than ideal because the development of a comprehensive doctor-patient relationship is prevented (Szefler et al., 2010). Asthma care for some non-Hispanic black children can also be classified as inadequate due to the one-year hospital readmission rate of 21.4%, which is significantly higher than the 14.6% rate of readmission experienced by children of other racial and ethnic groups (Parikh et al., 2017). Thus,

the healthcare experience of pediatric asthmatics of minority status may drastically differ from that of white children, which inevitably influences the ethnomedical beliefs of patients and their families.

Acknowledgement of the cultural history minority groups have with the medical system also contributes to the understanding of patient perceptions and beliefs. African Americans have a long history of mistrust of the U.S. medical system, stemming from unethical medical experimentation of slaves (Bailey, 2000). The Tuskegee syphilis experiment and historical attitudes regarding AIDS have also contributed to African Americans' suspicion of the current healthcare system. More recently, current care received by African Americans in formalized healthcare settings is perceived negatively, with significantly more African Americans reporting dissatisfaction with physician interactions than white Americans (Blendon et al., 1989). African Americans are also more likely to report lower levels of satisfaction with medical care received during hospital admissions (Blendon et al., 1989).

Prior studies exist that specifically examine parents' ethnomedical beliefs of asthma in urban settings. Dinkevich et al., 1998, explored parent perceptions of asthma at Jacobi Medical Center emergency department in The Bronx, New York. The children of parents in the study sample were mostly Hispanic and African American and either on Medicaid or uninsured (Dinkevich et al., 1998). Interestingly, through the study it was discovered that over 90% of children had access to some sort of primary care provider, but 54% of the children's parents reported the emergency department as the site of their child's asthma care. Additionally, only a third of the caregivers tried to contact their child's doctor before the current visit to the emergency department. To justify this occurrence, it was hypothesized that these minority parents experience a lack of confidence in the effectiveness of asthma medications (Dinkevich et

al., 1998). There may also be a parental perception of higher quality of care at the emergency department, which may dictate health seeking processes.

Another New York City study examining perceptions of asthmatics specifically looked at the relationship of pediatric asthma and obesity. Researchers found that inner-city Hispanic and African American children with a diagnosis of asthma were significantly more likely to be overweight than their peers (Luder et al., 1998). The authors suggest that parents have a perception that their children with asthma should avoid exercise, which could serve as a possible explanation to this high comorbidity rate among inner-city minority asthmatics (Luder et al., 1998). However, this potential perception is not supported by medical professionals, who encourage children with asthma to exercise regularly.

A more recent study that explores the perceptions of parents discovered that reported level of asthma control by a child's caregiver predicts future asthma visits to acute care centers (Rossi et al., 2018). Of the caregivers who partook in the study, those who reported that their child's asthma was poorly controlled had a 1.7 times greater likelihood of a subsequent emergency room visit within three months (Rossi et al., 2018). Almost 80% of the study's sample was African American and nearly 90% were on public health insurance. The influence that parental asthma perceptions and beliefs have on subsequent health seeking processes is apparent from these results. Further steps are therefore needed to fully uncover the specific ethnomedical beliefs that parents hold on asthma treatment options.

Parenting: A Cultural Construct

The study of children and childhood is of interest to anthropologists in that human children occupy a unique niche not seen in other species. Humans undergo a slow life history

which translates into an extended childhood period where offspring learn and are provided for by their parents and other caregivers. The care that human offspring receive has common features but also widely varying elements, which suggests parenting is a behavior that has been subject to natural selection pressures sensitive to ambient social ecologies (Geary & Flinn, 2001). Thus, the examination of parental beliefs across cultures is essential in understanding the wide range of parenting behaviors seen throughout the world today and the implication those behaviors have for child development.

Dr. Sara Harkness and Dr. Charles Super developed a theoretical framework to examine how culture influences child development. The developmental niche is a framework composed of 3 subsystems: childhood physical and social setting, caretaker customs and practices, and caretaker psychology (Harkness et al, 2013). This framework attributes child development to caregiver behavior and psychology, which are culturally variable. Defining what is considered normative childcare influences parental tasks and responsibilities related to providing for offspring (Harkness et al, 2013). For instance, parenting may be viewed as a job in which parents themselves protect and provide for their offspring, whereas other cultures may put a greater emphasis on pluralistic caregiving in which grandparents and siblings help raise other children (Bornstein, 2001). Additionally, offspring health and wellbeing can be credited to the three subsystems outlined in the framework, which makes the study of parenting relevant from a medicine and public health perspective. The advance of globalization has thrown divergent models of child development and parenting into contact, leading to conflict over what constitutes legitimate forms of parenting as it relates to child development and health. Thus, it is imperative that the cultural dimensions of human parenting behavior are examined in specific cultural

contexts in which parents hold varying beliefs and values with respect to child development and parenting practices.

Psychological and Anthropological Frameworks

Psychological and anthropological frameworks have been developed to understand cross-cultural differences in parenting. Differentiating individualistic versus collectivist societies has substantiated psychological theory for the emergence of independent and interdependent individuals (Harkness et al., 2013). The differences between individualistic and collectivist cultures is used to identify goals that inform parental practices oriented to socializing offspring who are independent and seek autonomy or interdependent on others (Tuttle et al., 2012). Promoting the development of an individualistic or interdependent child can be associated with both positive and negative developmental outcomes. For example, parent-promoted interdependent behaviors have been accredited with school success for children in Asia and the inability of Mexican immigrant children to adequately adapt to U.S. culture (Harkness & Super, 2002). Parent role confusion in the treatment and care of children with asthma has been linked to nonadherence to treatment plans, with American parents unsure if an individual or collectivist approach to managing the disease is best (Bender & Bender, 2005). Parents may take a hands-on approach to managing the illness, or conversely may encourage their children to use medications and asthma devices independently. Thus, acknowledging the spectrum of individual and collectivist cultural beliefs in parenting may be informative in the study of cross-cultural parental behaviors and the development of guidelines related to parental role in chronic disease management.

There are certain beliefs regarding culture that anthropologists accept and incorporate into an anthropological framework for studies of parenting. Essential to the framework is both

that cultural beliefs can take on many different forms and recognizing that cultural beliefs can withstand ecological changes and often persevere even through change (Harkness et al., 2013). It is therefore possible that parents will continue to maintain their culture-specific beliefs about appropriate parenting practices, despite exposure to conflicting information, even when the source claims authority. For instance, researchers in Mexico examining mothers' perceptions regarding child feeding practices later categorized the mothers' perceptions as "misconceptions" because they differed from the standards set by nutritionists (Rodriguez-Oliveros et al., 2014). According to the authors of the study, the "misconceptions," which included viewing mango as a hazardous food for young children and believing that chicken and bean broth strengthened bones, should be addressed through culturally sensitive nutritional education. The study brings to light the social construction of reality, in which ideas and practices that are culturally appropriate are enacted and actualized in local settings (Kleinman, 2010). However, the local moral context that emerges from these cultural ideas and practices can cause strain when local realities conflict with global policies related to medicine and public health (Kleinman, 2010).

Case Studies: Value of Children to Parents in the United States and Effects of Globalization

Globally, birth rates have declined over the last 50 years, including in the U.S., suggesting that Americans want fewer children. Economic conditions and concerns about overpopulation could be driving people to reproduce less frequently, but it may be that other aspects of life are satisfying and replacing the need for children (Hoffman, 1975). For instance, working women do not have as many children as women who do not work, so increased employment and job satisfaction for women has been theorized to be linked to life fulfilment in the same way children are (Hoffman, 1975). Hoffman & Hoffman, 1973 looked at ways in which American parents value children, and nine categories were derived based on interviews: primary

group ties and affection, stimulation and fun, expansion of the self, adult status and social identity, achievement and creativity, morality, economic utility, power and influence, and social comparison (Hoffman et al., 1978, pg. 92).

In a follow up study, the different values placed on children by parents of specific racial groups in the U.S. were examined. African Americans more often valued children for their love and affection, whereas white Americans were more likely to value children for giving them purpose in life. African Americans also mentioned economic utility of children more often than white Americans (Hoffman et al., 1978). These findings highlight the different values placed on children within societies, which could influence parenting strategies. This study also highlights the need to study the effects of globalization trends on parenting. As the role of women and other ethnic and racial groups shift in societies through the process of globalization, the cultural practices and values parents place on parenting are also bound to transform.

The stigmatized biologies of immigrant children of Mexican American farmworkers shed light on how parenting practices shift with changing ecologies. As immigrants arrive to the U.S. and begin work, the ability to engage in feeding practices and schedules is dramatically altered. No mother who was interviewed as part of an ethnographic study reported breastfeeding their infants while conducting farm work, so Mexican immigrant children are often bottle fed in the U.S. (Horton & Barker, 2010). This contrasts with infant caregiving practices in Mexico, which are typified by breastfeeding. Thus, work demands conflict with the traditional form of infant feeding for Mexican immigrants and the bottle now serves as a new culturally construed form of parenting for these Mexican American children (Horton & Barker, 2010, pg. 206). However, these children have high rates of early childhood caries (ECC) as a result, contributing to tooth decay and stigma later in adult life. As noted earlier, parental beliefs are resilient even during

times of change, but pressures related to migration have shifted the environment and constraints operating on Mexican immigrants to the U.S., which has affected their ability to maintain culturally-sensitive parenting practices.

Difficulties in Effective Cross-Cultural Study of Parenting

Cross-cultural study of parenting mainly has been conducted ethnographically (Harkness & Super, 2002). However, as parents adapt their behaviors to specific economic, social, and political structures of a society, as well as physical and cultural ecologies of their current local context, parenting variability may also be a product of socioeconomic differences (Harkness & Super, 2002). Discerning whether specific parental behaviors result from culture-specific beliefs or from socioeconomic standing is difficult. Ethnographer bias or lack of local understanding may limit the ability to discern this distinction. Acknowledging desired versus actual parenting practices, or the inability to fulfill desired parental beliefs, should be noted as the result of socioeconomic status in applicable situations. For example, parents who suffer from low socioeconomic status are more likely to live in poverty, and these early life environments for children have been associated with poorer health outcomes and school performances (Worthman et al., 2016). However, normative parental beliefs encourage the wellbeing of offspring, and as such financial constraints may prevent parents from doing what they consider best for their children. Thus, variation in parenting may be the result of either culturally defined beliefs and practices or structural and economic constraints on parents, or a combination of both.

Children's National: A Pediatric Emergency Room in Washington D.C.

Children's National Medical Center is a provider of pediatric health services to the Washington D.C. metro area, with campuses throughout Washington D.C., Maryland, and

Virginia. The hospital's main campus is highly regarded, recently being named as the country's fifth best children's hospital (U.S. News & World Report, 2018).

Children's National has emergency departments at the hospital's main campus in Northwest D.C. as well as at United Medical Center in the Southeast corner of the city. These departments had over 120,000 visits in 2017, making it a premiere provider of emergency care for children in the District (Children's National Health System, 2018a). The emergency departments treat patients with public or private insurance, as well as those who are uninsured.

The number of uninsured children in the U.S. has declined since the implementation of the Affordable Care Act, but Washington D.C. saw a rise in the rate of uninsured children from 2015 to 2016 (Alker & Pham, 2017). This is striking given that no other U.S. state saw a rise in the rate of uninsured children during this period, but the nation's capital still has an uninsured rate that is lower than the national average (Alker & Pham, 2017). The Affordable Care Act has promoted the enrollment of more children in Medicaid, which has helped to increase the number of individuals in the U.S. who possess health insurance. However, Washington D.C. has seen no significant increase in the number of insured children since the Affordable Care Act was enacted, posing unique obstacles for Children's National, whose main campus is the only exclusive pediatric emergency room in the city (Alker & Pham, 2017).

Higher than average pediatric asthma rates constitute another challenge faced by providers at Children's National. In 2008, approximately 14,000 children in D.C. suffered from asthma, equating to a current childhood asthma prevalence of 12.6%, which was higher than the national average of 9% (Centers for Disease Control and Prevention, 2008). Hospitalization rates due to asthma were also significantly higher in Washington D.C. compared to averages throughout the country (Centers for Disease Control and Prevention, 2008). These statistics are

in accordance with the knowledge that children living in inner cities tend to have more severe asthma (Szefler et al., 2010). In order to combat high asthma prevalence rates in D.C., Children's National sponsored IMPACT DC, which stands for Improving Pediatric Asthma Care in the District of Columbia. IMPACT DC promotes improved asthma outcomes through enhanced clinical care, education, and resources (Children's National Health System, 2018b). The program conducts research on asthma and promotes outreach educational resources to those in the community with the disease. Additionally, the IMPACT DC Asthma Clinic works to provide consultations and individualized asthma action plans for patients, with the hopes of reducing the burden of asthma on the emergency departments.

Despite programs like IMPACT DC, Children's National emergency departments serve underserved patients in an urban setting that is burdened by high asthma rates, which undoubtedly strains the busy and crowded emergency departments with more visits (Nunes et al., 2017). Reducing recurrent patient visits in emergency departments is a national priority to reduce healthcare burdens, but there are certain demographics that predispose some hospitals to more recurrent visitors. Living in an urban setting, being of a minority status, and having public health insurance have all been correlated to increased recurrent visits to children's emergency departments (Neuman et al., 2014). A national cohort study in pediatric emergency rooms also found that the proportion of children with any chronic condition rose as frequency of recurrent visits increased (Neuman et al., 2014). Thus, Children's National's status as an elite urban pediatric care facility that treats children regardless of insurance status serves as a unique site to study parental perceptions of nebulizers and MDI+S.

Research Objectives and Hypotheses

The primary objective of the research project is to establish parental perceptions and preferences of nebulizer versus MDI+S in the treatment of pediatric asthma exacerbations. There is limited literature on parental preferences regarding the medication delivery devices, so further inquiry will provide novel insights into American parental preferences. Quantitative and qualitative data will help develop a preliminary framework that outlines the beliefs behind parental device preferences. This framework will contribute to the policy discussion physicians are having regarding nebulizer or MDI+S treatment for acute asthma exacerbations in the emergency department.

Other objectives of this project are to analyze and identify potential barriers that prevent healthcare providers from implementing MDI+S treatment in acute asthma exacerbations. Children's National Medical Center staff has previously been met with resistance to transitioning to MDI+S treatment, with some parents expressing preference for the nebulizer. Thus, the hope is that this project will effectively elicit parental beliefs regarding the two devices, which will allow healthcare personnel to develop an understanding and respect for parental beliefs and preferences. Examination of defined variables related to the devices, such as ease, speed, comfortability, effectiveness, and overall preference, will aid in analysis of collected data.

The hypothesis posits that parents who are interviewed at Children's National Medical Center will prefer treatment with a nebulizer over MDI+S for acute asthma exacerbations in the emergency department. This is grounded in observations of resistance to MDI+S treatment made by healthcare staff in the Children's emergency department. Further hypotheses include:

-Parents of children without health insurance or on public health insurance will prefer the nebulizer more than parents whose children have private health insurance due to more limited access to preventative and routine healthcare services.

-Parents of children under aged five years will prefer the nebulizer more than parents of older children aged 5-18 years due to technique demands associated with an MDI+S.

Research design and methods will be discussed further in the following chapter.

Chapter 3: Design and Methods

Survey

A survey conducted in an interview fashion by clinical research associates is the source of data collection for this research project. The mode of administration for this survey was face-to-face, with research associates asking pre-scripted questions and informally recording the responses of parents in an electronic database. The mixed methods survey was developed by clinicians and primary study coordinators of the project at Children's National (see Appendix 1 for full survey). There are three yes or no questions inquiring into the patient's current visit to the hospital, entitled "Visit Characteristics," followed by 12 multiple-choice questions related to asthma severity, usage, and ownership of the nebulizer and MDI+S.

Asthma severity is assessed by asking the parent how many times their child has been seen by a doctor for asthma within the last year, as well as how many times their child has been hospitalized and/or admitted to the intensive care unit in their lifetime for asthma. Usage and ownership questions inquire into if and where a child has received albuterol treatments and makes distinctions between home and hospital settings.

The following 10 questions in the survey are assessed on a Likert scale and specifically examine perceptions by asking parents to compare the nebulizer and MDI+S. Parents are instructed to answer with "MDI+S much more," "MDI+S a little more," "They are the same," "Nebulizer a little more," or "Nebulizer much more" when responding to the following questions:

- Which of these is easiest to use overall?
- Which of these is faster to use?
- Which of these is more comfortable for your child?

- Which of these makes your child feel better faster?
- Which of these makes your child feel better for a longer amount of time?
- Which of these is easier to use while your child is awake?
- Which of these is easier to use while your child is asleep?
- Which of these do you prefer overall?

Parents who believe certain questions are not applicable or are unsure of their response have the option to respond with "I don't know/Not applicable." Directly following each of these questions, parents are asked to explain their answer in their own words and the responses are entered into the survey database by research associates.

The other two multiple-choice questions include, "Where would you be most likely to take your child for asthma care?" and "Would you take your child to a hospital where most asthma patients are being treated using MDI+S?" Response options to the first of these questions include: places that only use MDI+S to treat asthma, places that use a combination of MDI+S and nebulizer therapy to treat asthma, places that only use nebulizer to treat asthma, or neutral/no opinion. The second question is assessed on a 5-point Likert scale with response options ranging from "definitely" to "definitely not."

The final question targeted at eliciting parental preferences in the survey is a free-response question asking, "What do you think about Children's National Health System changing to MDI with spacers to treat the majority of patients with asthma in the emergency department?" The survey concludes by asking about the parent's own asthma history and, if applicable, what device the parent prefers to treat their own asthma. Demographic questions are also included in the survey, with the parent asked to report their child's age, their own ethnic background, their own racial background, and primary language. Insurance status is also

recorded on the survey, but parents are not asked directly what health insurance their child possesses. Rather, that information is pulled from the Patient's Medical Record and recorded on the survey by the research associate. English and Spanish versions of the survey and protocol were submitted and received approval by the Institutional Review Board, and patient screening and survey administration commenced in April 2018. The enrollment goal for this project was 100 surveys. Screening and enrollment concluded in December 2018.

Screening: Patient Eligibility

All patients aged 2-18 years who arrive at the Children's National emergency department may be screened for a suspected history of asthma, regardless of whether their visit on that day is related to asthma or respiratory distress. However, Children's National has many other clinical research studies that research staff must also recruit and enroll patients in, so 2-hour blocks were randomly assigned in which research assistants and associates would specifically screen patients for this project.

Inclusion criteria for parent participation is set as having a child 2-18 years of age with a known history of asthma presenting to the emergency department during an enrollment block. Additionally, only English or Spanish speaking parents were eligible to participate. For the purpose of the study, asthma history can be defined as a reported asthma diagnosis or two or more previous albuterol treatments for wheezing at Children's National. An asthma diagnosis was either confirmed in the patient's medical chart or by parental self-report. Parents of patients with heart disease, cystic fibrosis, or chronic lung disease were excluded from the study.

Patients who were deemed to meet inclusion criteria by research staff approached the patient's treating physician in the emergency department to request permission to approach the family and ensure a parent was present at the hospital. If the physician gave permission, a

research associate approached the family and asked if the parent would be willing to participate in a 15-minute voluntary survey about their child's asthma. After a brief explanation of the survey, parents were asked if they would like to proceed. If a parent agreed to partake in the study, the research associate would begin the survey. If the parent declined to complete the survey, the patient screening form was updated by noting that the parent did not consent to participation.

Survey Administration

The project protocol notes that patient care must not be interfered with or hindered through administration of the survey, so research associates were instructed to swiftly yet thoroughly work through the survey with parents. As one of eight research associates in the clinical research office, I took an active role in screening and enrolling parents. I was assigned afternoon and evening shifts at the hospital and was therefore able to be present during most of the enrollment blocks, which were frequently in the late afternoon and evening. The other research associates and I were trained to ask the questions on the survey in a conversational manner and would record the responses on an iPad containing a queued survey. No instructions were given to parents on the length of their free response questions. Therefore, free response answers could be as concise or as lengthy as parents wished.

In acknowledgement that the terminology used by healthcare professionals, grounded in biomedical culture, might be different or foreign to certain parents, pictures of a nebulizer and MDI+S were shown at the beginning of the survey.

Figure 1: Image of a nebulizer shown to parents during parental perceptions survey

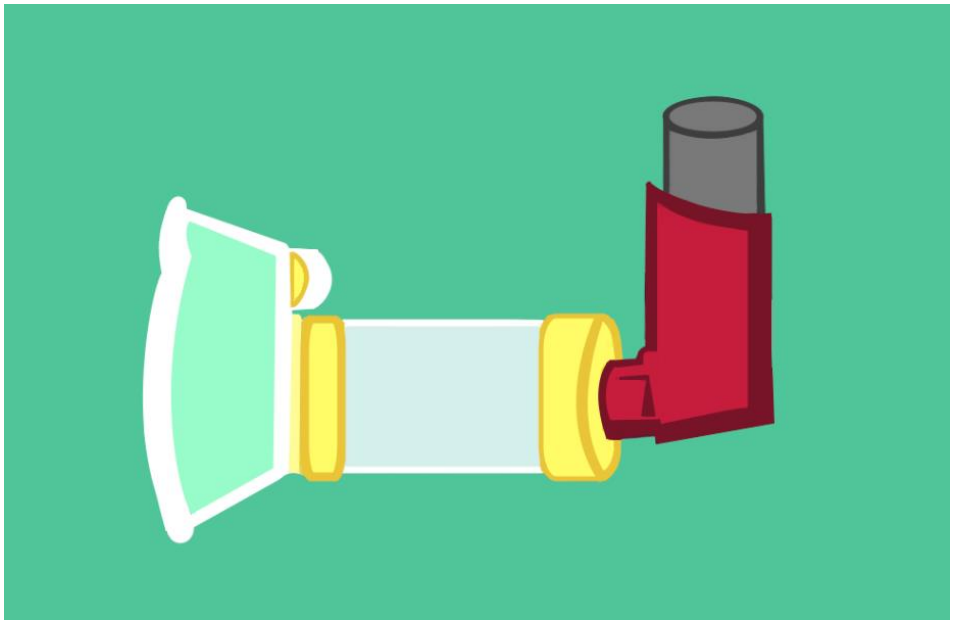


Figure 2: Image of an MDI+S shown to parents during parental perceptions survey

The figures were presented twice during administration of the survey in order to limit any potential parental confusion on device terminology. Furthermore, research associates were instructed to match a parent's vocabulary if they referred to the devices in other words in order to further prevent any potential confusion. Examples of other vocabulary I encountered include the words "mask" or "machine" for the nebulizer and "pump" or "inhaler" for the MDI+S.

Ideally, the survey was administered and completed in a single 15-minute block period. However, the busy emergency department setting sometimes prohibited research staff from conducting the survey uninterrupted. If, on the chance that a healthcare provider came to see the patient or the patient was temporary transported to a different hospital wing for further testing, the research associate stepped out of the patient room and saved the partially completed survey. When time permitted, the research associate re-approached the parent and completed the survey. No compensation was provided to families for participation, but they were thanked for their time and provided with an information sheet regarding the purpose and goals of the survey results.

Data Storage and Analysis

All generated surveys were stored on the database REDCAP. REDCAP is a data collection tool used at Children's National and other institutions to manage survey-based studies. The secure web database also stores screening forms used to identify eligible parents. Parents who were screened and either deemed ineligible or refused to participate were assigned REDCAP ID's in order to document and save their screening forms. However, no surveys were generated for those parents. In total, 177 total REDCAP ID's were generated during project enrollment. There are 108 surveys stored on REDCAP, although some remain incomplete. Of the remaining 69 patients who were screened for suspected asthma, five patients ultimately did not meet the project's standards for asthma diagnosis. 16 of the children were not eligible due to a

preexisting condition and six parents were not approached at the request of the clinician. Five screening forms note that there was no available parent or legal guardian present at the hospital and therefore no survey was generated for a missing parent. Of the parents who were deemed eligible and approached by research staff, seven parents refused to participate because they did not believe their child had asthma and eleven parents refused because they were uninterested or worried about time constraints. Other parents said they were too tired or overwhelmed and did not wish to participate. In total, 99 surveys deemed complete by research staff are included in the final enrollment total.

The quantitative data, most of which was graded on Likert-scales, was analyzed using descriptive statistics in IMB SPSS Statistics 25.0. Pearson Chi-Square tests were run on asthma severity, device ownership, and parent perception and preference variables, with overall device preference serving as the primary outcome variable. Independence tests between the other variables examined in the survey and overall preference were run to determine potential associations. Demographic statistics were assessed using Chi-Square tests to determine correlations between population characteristics and overall device preference. A multiple linear regression was run to identify potential covariates to any significant results.

Free-response questions were coded for frequent themes and analyzed similarly to the multiple-choice questions, with Pearson Chi-Square tests being run to determine potential significant associations between theme declaration and overall preference. Six recurrent themes during survey analysis were coded for frequency. The six categorical themes generated include:

1. Convenience
2. Length of treatment
3. Medication Delivery Beliefs

4. Efficacy
5. Severity
6. Technique demands

Mentioning of a specific theme was device-specific and categorized as: one or more affirmative/positive statements, no statements at all, or one or more opposing/negative statements. For example, one parent claimed that "You just use the pump and it goes fast, the machine takes a long time," when asked which device they perceived to be faster. This response elicited an affirmative statement for MDI+S length of treatment and a negative statement for nebulizer length of treatment. Another parent, when asked why they believe the nebulizer makes their child feel better faster, reported that, "I think the medicine is stronger. They say it's the same but the machine she feels and breathes better." This response garnered affirmative statements for nebulizer medication delivery beliefs and efficacy. Theme criteria are outlined in Appendix 2.

The project was originally designed to elicit parental perceptions and preferences through questions graded on a 5-point Likert scale, with a sixth option denoting "I don't know/Not applicable." However, through preliminary data analysis, it was determined that the smaller sample size hindered proper analysis on this scale, so the Likert scale was subsequently recoded on a 3-point scale. Table 1 highlights the differences between the original and new scales.

Table 1

Reorganization of Response Scale

	Original Likert-Scale	Recoded Likert-Scale
0	I don't know/Not applicable	
1	MDI with spacer much more	MDI with spacer
2	MDI with spacer a little more	They are the same
3	They are the same	Nebulizer
4	Nebulizer a little more	
5	Nebulizer a lot more	

Few parents responded with "I don't know/Not applicable," so those responses were exempt from analysis in order to condense the response scale. Only one parent responded that they were unsure what their overall device preference was, so the survey was exempt from further nonparametric statistical analysis. However, that parent survey was still included in the enrollment total because of its completion status and the total sample size remains n=99.

Chapter 4: Quantitative Results

The following data displays the results of statistical significance tests run on the quantitative independent variables against the dependent variable of overall device preference. Pearson Chi-Square tests were initially run in order to follow the study protocol for data analysis. However, due to a total sample size of 99, many of the expected values were below a value of five. Therefore, Fisher's Exact tests were also run in order to validate the results of the original significance tests and results of those tests can be found in Appendix 3. Pooling of the 5-point Likert scale into a 3-point Likert scale, as described in chapter 3 and displayed in Table 1, was also undertaken in order to help validate test values. Level of significance for this study was set at p=0.01

Asthma Severity and Device Ownership Responses

Indicators of asthma severity level are displayed in Table 2. Asthma severity was assessed by inquiring how often a child saw a doctor within the last year due to their asthma, as well as how many times that child has been admitted to the hospital and intensive care unit (ICU) in their lifetime as a result of their asthma. Of the parents who brought their children to the emergency room on the day they completed the survey, 26 (26.26%) reported bringing their child to Children's National to be seen for their asthma, while 73 (73.73%) reported that they were not being seen for asthma (p=0.234) There is no significant association between any of the asthma severity indicators and overall device preference.

Table 2

Association between Asthma Severity Indicators and Overall Device Preference

	0 visits	1-2 visits	3-4 visits	>4 visits	p-value
Doctor Office Visits (within the last year)	23 (23.23)	38 (38.38)	18 (18.18)	20 (20.20)	0.802
Lifetime Hospital Admissions	47 (47.47)	30 (30.30)	9 (9.09)	13 (13.13)	0.313
Lifetime Intensive Care Unit (ICU) Admissions	78 (78.79)	17 (17.17)	3 (3.03)	1 (1.01)	0.240

*Figures in parentheses represent percentages

Parents were also asked whether their child sees a specialist for their asthma. 28 parents reported that their child saw a specialist, which was categorized as either an allergist, pulmonologist, or both (p=0.226). Of the 71 children who do not see a specialist, 62 children reportedly see pediatricians for their asthma, although it is unclear whether this pediatrician is the child's primary care doctor or a pediatric emergency room doctor. Five parents reported that their child's asthma was cared for by both a pediatrician and the IMPACT DC clinic and two parents reported that their child's asthma was exclusively cared for by IMPACT DC. One parent reported that their child's asthma was cared for by the emergency room, while the remaining parent claimed that they saw a hematologist for asthma.

Asthma severity levels appear to be mixed for the sample group. More than 75% of the children have seen a doctor at least once in the last year for their asthma and more than 50% of the sample has been admitted to a hospital at least once in their lifetime. However, approximately 79% of patients have never been admitted to the ICU for asthma. Distinguishing between a regular hospital floor and ICU may have potentially confused some parents, but the

relative drop in percentages between parent-reported hospital admissions and ICU admissions indicates that parents were able to differentiate between the two types of hospital admissions.

All 99 parents reported that their child had at some point received albuterol from both an MDI+S and nebulizer. Research associates asked parents where their children had received these therapies, and the results are displayed in Table 3. Location of nebulizer and MDI+S usage was not significantly associated with overall device preference.

Table 3

Association between Device Usage and Overall Device Preference

	At home only	Doctor's office/urgent care center/ or ER only	Both Places	p-value
MDI+S	31 (31.31)	6 (6.06)	62 (62.62)	0.196
Nebulizer	6 (6.06)	27 (27.27)	66 (66.67)	0.687

Table 3 indicates that more children have used an MDI+S only at home (n=31) than the nebulizer (n=6). Similarly, more children have only used a nebulizer at a doctor's office or emergency room (n=27) than the MDI+S (n=6). This statistic suggests that, despite most children having used both devices in both locations, some parents may associate MDI+S for home usage and usage of a nebulizer with a healthcare facility.

Despite all parents reporting that their child has used both an MDI+S and nebulizer to receive albuterol, six parents reported that their child did not have asthma (p=0.612). However, the children of those parents met the asthma diagnosis enrollment criteria upon initial screening and those surveys were included in the final enrollment. Of those six parents, only one parent reported not keeping either an MDI+S or nebulizer at home.

Parents were asked if they kept a nebulizer, MDI, and spacer at home. The responses are displayed in Table 4. Only one parent said that they had neither a nebulizer nor an inhaler. All other parents report owning at least one of the devices and 71 parents reported owning both devices.

Table 4

Association between Device Ownership and Overall Device Preference

	Yes	No	p-value
Nebulizer	74 (74.75)	25 (25.25)	0.771
MDI	95 (95.96)	4 (4.04)	0.880
Spacer	83 (83.84)	16 (17.16)	0.959

More parents reported having an MDI at home than a nebulizer, which also suggests that some parents may associate an inhaler with home asthma management and a nebulizer with hospital asthma management. Parents were asked about spacer ownership separately, and the gap between the number of parents who reported having an MDI at home and a spacer at home (n=12) is indicative of improper inhaler technique. Physicians suggest that the spacer should always be used when receiving albuterol with an MDI, so parents who do not own a spacer are not following physician guidelines. Despite fewer parents owning a nebulizer, there is no significant association between device ownership and overall device preference.

Parent Perception Responses

A summary of responses to perceptions questions regarding ease, speed, comfort, efficacy, and overall preference of the MDI+S and nebulizer are displayed in Table 5.

Table 5

Parental Responses: MDI+S and Nebulizer Variable Comparison

	MDI+S much more	MDI+S a little more	They are the same	Nebulizer a little more	Nebulizer much more	I don't know/Not applicable
Easier Overall	48 (48.48)	7 (7.07)	13 (13.13)	3 (3.03)	27 (27.27)	1 (1.01)
Faster	67 (67.68)	9 (9.09)	5 (5.05)	1 (1.01)	17 (17.17)	0 (0.00)
More Comfortable	48 (48.48)	6 (6.06)	13 (13.13)	2 (2.02)	29 (29.29)	1 (1.01)
Feel Better: Faster	19 (19.19)	3 (3.03)	8 (8.08)	6 (6.06)	60 (60.61)	3 (3.03)
Feel Better: Longer	11 (11.11)	4 (4.04)	10 (10.10)	6 (6.06)	63 (63.64)	5 (5.05)
Easier: Child Awake	38 (38.38)	10 (10.10)	16 (16.16)	2 (2.02)	27 (27.27)	6 (6.06)
Easier: Child Asleep	18 (18.18)	3 (3.03)	9 (9.09)	7 (7.07)	43 (43.43)	19 (19.19)
Overall	27 (27.27)	5 (5.05)	16 (16.16)	6 (6.06)	44 (44.44)	1 (1.01)

A majority of parents reported that they perceive the MDI+S to be easier overall, faster, and more comfortable than the nebulizer by providing scores of one or two to the first three variables. However, more parents reported that the nebulizer makes their child feel better faster and feel better for longer than the MDI+S. The ease of use questions that differentiate whether the child is awake or asleep suggest that more parents think the MDI+S is easier to use when their child is awake but that the nebulizer is easier to use when their child is asleep. Approximately 51% of parents (n=50) ultimately reported that they prefer the nebulizer and

32.3% (n=32) of those interviewed reported preferring the MDI+S. 16.16% (n=16) of parents reported that they preferred the two devices equally and one parent reported that they were unsure of their preference.

For statistical testing to determine associations between perception variables and overall device preference, responses denoting, “I don’t know/Not applicable” were removed, which explains the varying sample sizes. Categories were also pooled into the three options displayed in Table 6.

Table 6

Parental Responses: Significance of MDI+S and Nebulizer Variable Comparison

	MDI+S	They are the same	Nebulizer	p-value
Easier Overall (N=98)	55 (56.12)	13 (13.27)	30 (30.61)	$5.1x10^{-5}$
Faster (N=98)	75 (76.53)	5 (5.10)	18 (18.37)	0.017
More Comfortable (N=97)	54 (55.67)	12 (12.37)	31 (31.96)	0.001
Feel Better: Faster (N=95)	22 (23.16)	8 (8.42)	65 (68.42)	$3.0x10^{-5}$
Feel Better: Longer (N=93)	15 (16.13)	10 (10.75)	68 (71.58)	$1.7x10^{-4}$
Easier: Child Awake (N=92)	47 (51.09)	16 (17.39)	29 (31.52)	$1.4x10^{-4}$
Easier: Child Asleep (N=79)	21 (26.58)	9 (11.39)	49 (62.03)	$2.4x10^{-4}$

Prior to running the multilinear regression model, the following relationships were observed to be significant:

- An association between overall preference and perception of easiness of a device, $\chi^2(4) = 24.974$, $p = 0.000$. Of the 32 parents who prefer the MDI+S overall, 29 parents reported that the device was easier to use and two reported the devices were equally easy. Of the

50 parents who prefer the nebulizer overall, 23 parents indicated the nebulizer was easier to use, while seven said the devices were the same.

- An association between overall preference and perception of comfortability of a device, $\chi^2(4) = 18.725$, $p = 0.001$. 27 parents who prefer the MDI+S thought that the device was more comfortable than the nebulizer, while 23 parents who prefer the nebulizer associate that device with comfortability. One parent preferring the MDI+S and eight preferring the nebulizer stated the devices were equally comfortable for their child.
- An association between overall preference and perception of the ability of a device to make a child feel better faster, $\chi^2(4) = 26.138$, $p = 0.000$. 14 parents who prefer the MDI+S indicated that the MDI+S makes their child feel better faster, while five parents said both devices were the same. Of those preferring the nebulizer, 43 parents claimed the device made their child feel better faster, and no parent said both devices were the same.
- An association between overall preference and perception of the ability of a device to make a child feel better for longer, $\chi^2(4) = 22.429$, $p = 0.000$. 11 parents preferring the MDI+S responded that the inhaler makes their child feel better for longer, whereas 44 parents who prefer the nebulizer believed the machine makes their child feel better for longer. Five parents preferring the MDI+S and three preferring the nebulizer said the devices were equal in this regard.
- An association between overall preference and perception of easiness of a device while child is awake, $\chi^2(4) = 22.854$, $p = 0.000$. 23 parents who prefer the MDI+S said that the device was easier to use while their child is awake and four parents who also prefer the inhaler said the devices were both equally easy to use while their child is awake. 24

parents who prefer the nebulizer said the device was easier to use while their child was awake, and six parents who prefer the nebulizer said both devices were equally easy.

- An association between overall preference and perception of easiness of a device while child is asleep, $\chi^2(4) = 21.655$, $p = 0.000$. Only 23 parents preferring the MDI+S reported an answer other than, "I don't know/Not applicable." Of those parents, 14 perceived the MDI+S to be easier to use while their child is asleep and three said both devices were equally easy. 43 parents preferring the nebulizer provided an answer indicating a preference, with 33 parents claiming the nebulizer is easier to use while their child is asleep, and four parents indicated that the devices are equally easy.

Additional Variables

The survey also inquired into parental asthma status and overall device preference of those parents. 32 parents (n=32) reported having asthma, although parent asthma status was not significantly associated with overall device preference (p=0.528). Of the parents who had asthma themselves, 65.6% reported MDI+S preference, 21.9% reported no preference, and 12.5% reported nebulizer preference when treating their own asthma. Comparing the personal device preference of parents who have asthma with their reported overall preference when asked about their child's asthma management is not significantly associated with overall device preference (p=0.324). However, results are interesting in that all the parents who report preferring the nebulizer to treat their own asthma also report preferring the nebulizer to treat their child's asthma. However, 47.6% of parents who prefer the MDI+S to treat their own asthma prefer the nebulizer to treat their child's asthma. Most parents who had no device preference to treat their own asthma also preferred the nebulizer to treat their child's asthma. The survey did not include a free-response question pertaining to the difference of preferences that some parents expressed

when talking about their own asthma, but it would be fascinating to analyze this discrepancy further in future research.

Parent responses to the multiple-choice question "Where would you be most likely to take you child for asthma care?" are displayed in Figure 3. This question garnered the least amount of variation of all questions, with more than 78% of parents reporting that they are most likely to take their child to a facility that uses both an MDI+S and nebulizer to treat asthma. However, responses to this hospital preference question are not significantly associated with overall device preference (p=0.291).

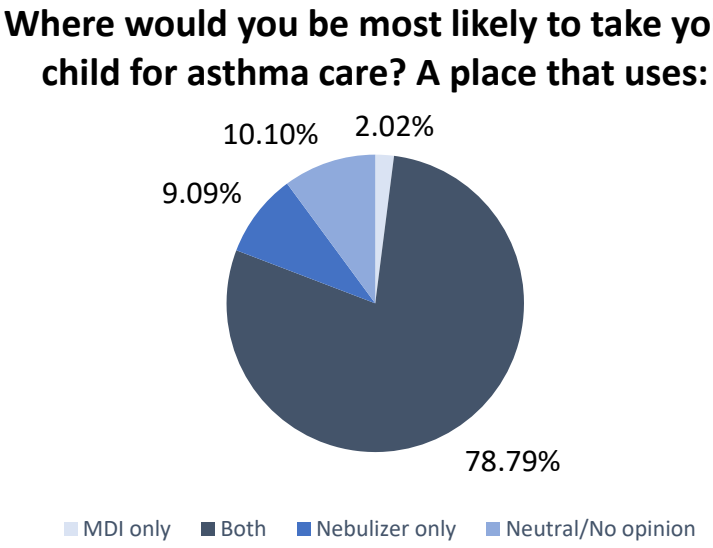


Figure 3: Chart indicating where parents prefer to bring their child with asthma

Parents were more split when asked whether they would take their child to a hospital that primarily uses MDI+S to treat asthma. Results of this inquiry are displayed in Figure 4. Responses to this question slightly missed the cutoff for a significant association with overall device preference (p=0.033).

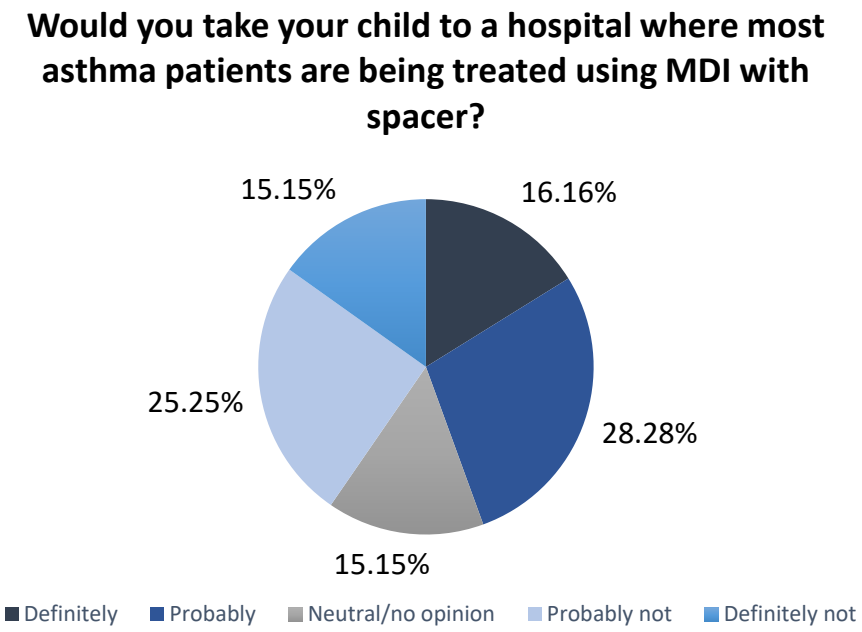


Figure 4: Chart displaying likelihood of parents bringing their child to a hospital that primarily uses MDI+S to treat asthma

Interpretation of these results is more meaningful with the qualitative data from the free response question, "What do you think about Children's National Health System changing to MDI with spacers to treat the majority of patients with asthma in the emergency department?" Refer to chapter 5 for further discussion regarding the qualitative data.

Sample Demographic Distribution

Demographic information collected as part of the survey provided information related to child age, parent race, parent ethnicity, and child insurance status. The study's sample makeup and breakdown of overall device preference by demographic measures is outlined in Table 7.

Table 7

Overall Device Preference by Demographic Distribution

		Sample Size (N)	MDI+S Preference (%)	Nebulizer Preference (%)	Equal Preference (%)	p-value
Age						0.192
	2-4	22	31.82	63.64	4.55	
	5-18	76	32.89	47.37	19.74	
Race						0.551
	White	12	41.67	50.00	8.33	
	Black/African American	60	30.00	55.00	15.00	
	Asian/Asian American	2	50.00	50.00	0.00	
	Other*	17	29.41	52.94	17.65	
	Prefer not to Answer	7	42.86	14.29	42.86	
Ethnicity						0.820
	Hispanic or Latino	29	34.48	44.83	20.69	
	Not Hispanic or Latino	63	33.33	52.38	14.29	
	Prefer not to Answer	6	16.67	66.67	16.67	
Insurance**						0.927
	Public/None	80*	33.75	51.25	15.00	
	Private	17*	29.41	52.94	17.65	

*Primary identified with Hispanic or Latino Ethnicity

**Insurance breakdown sums to n=97 because one survey is missing insurance status

As noted earlier, one parent indicated that they were unsure what their overall device preference was, so that survey was excluded from comparison of demographic measures and overall device preference.

The sample is mostly African American, with a large portion of parents identifying as Hispanic or Latino. Much of the sample was also either uninsured or on a form of public health insurance. The sample size is relatively small, so this demographic skew limits the power of the significance tests. The lack of equal age distribution, with most parents having a child aged five or above, also limits the sample power and makes it more difficult to accurately address one of the study hypotheses. However, according to statistical testing there is no significant association between any demographic variable and overall device preference, disconfirming the hypotheses that parents of younger children and children with public or no health insurance prefer the nebulizer more.

Results of Regression Model

A multiple linear regression was run to examine the relationship between overall device preference and multiple potential predictors. The specified independent variables, or predictors, included in the model were:

- Number of Lifetime Intensive Care Unit (Unit) Admissions
- Ownership of a nebulizer and/or MDI+S
- Whether a child sees a specialist for their asthma
- Parent asthma status
- Demographics: health insurance status, race, ethnicity, age (2-4 years old vs 5-18 years old)

- Responses to the perception questions: “Which of these is easiest to use overall?”, “Which of these is faster to use?”, “Which of these is more comfortable for your child?”, “Which of these makes your child feel better faster?”, “Which of these makes your child feel better for a longer amount of time?”, and “Would you take your child to a hospital where most asthma patients are being treated using MDI+S?”

Number of lifetime ICU admissions was included as the model’s sole asthma severity index predictor. In order to avoid multicollinearity and maintain a tolerance of >0.1 and VIF <10 for all variables, other measures of asthma severity index were excluded because ICU admissions is an adequate measure of asthma severity.

In another effort to reduce redundancy and ensure the model’s tolerance for all variables was met, responses to the perception questions, “Which of these is easier to use while your child is awake?” and “Which of these is easier to use while your child is asleep?” were not included in the regression. Responses to these questions were similar and highly predictive to the perception question inquiring into overall ease of use.

The variables included in the model statistically significantly predicted overall device preference, $F(15, 74) = 3.392$, $p<0.001$, $R^2=0.407$. The adjusted $R^2=0.287$. Thus, 28.7% of the variance in the dependent variable of overall device preference is explained by the independent variables of the model. However, none of the predictors independently had a statistically significant impact on the outcome variable ($p>0.01$ for all independent variables). More in-depth results of the multiple linear regression can be found in Appendix 4.

Chapter 5: Qualitative Results

Theme frequency results are displayed in Table 8. Six categorical themes emerged during data analysis. Due to the study's sample size, frequency was determined by theme mentioning at least one or more times per parent survey. Thus, a parent might have conveyed the same positive or negative belief multiple times, but for the purpose of statistical testing, there is no differentiation between a parent who discussed a theme once and another parent who brought up that same theme two or more times.

It was important in coding of the surveys to distinguish between devices and positive/negative statements. For example, one parent was discussing the efficacy of the MDI+S by stating that it makes their child feel better because, "the side effects are much worse with the nebulizer." That negative statement regarding nebulizer efficacy is differentiated from a parent claiming that the nebulizer "is more effective," which is a positive statement regarding nebulizer efficacy. Additionally, a parent stating that a nebulizer is effective at treating their child's asthma is not equitable to stating that the MDI+S is not effective. Distinguishing amongst these statements is essential for determining device-specific parent beliefs.

By looking at positive and negative remarks for both devices, general trends from the categorical themes elicited through survey administration include:

- The MDI+S is considered by many parents to be more convenient and faster than the nebulizer due to its portability and minimal interference with daily activities
- More parents hold strong beliefs that the nebulizer is able to deliver more medication to their child, which effects efficacy due to improved physiological responses. More parents also expressed beliefs that the nebulizer is more effective than the MDI+S.

- Parents reported their perceived need for nebulizer treatment during more severe asthma exacerbations
- Parents generally held mixed views on the technique demands of the devices. Parents highlighted that the MDI+S allows for child independence, whereas parents favoring the nebulizer believed there was less confusion on how to correctly use the device.

Table 8

Significance of Overall Device Preference by Theme Discussion

	Positive/Affirmative	Not Mentioned	Negative/Opposing	p-value
Convenience-MDI+S	74 (75.51)	20 (20.41)	4 (4.08)	.003
Convenience-Nebulizer	26 (26.53)	46 (46.94)	26 (26.53)	.014*
Length of Treatment-MDI+S	53 (54.08)	44 (44.90)	1 (1.02)	.051
Length of Treatment-Nebulizer	8 (8.16)	62 (63.27)	28 (28.57)	0.501
Medication Delivery Beliefs-MDI+S	14 (14.29)	70 (71.43)	14 (14.29)	0.025**
Medication Delivery Beliefs-Nebulizer	54 (55.10)	39 (39.80)	5 (5.10)	$6.5x10^{-8}$
Efficacy-MDI+S	25 (25.55)	49 (50.00)	24 (24.49)	0.009
Efficacy-Nebulizer	76 (77.55)	17 (17.35)	5 (5.10)	0.001
Severity-MDI+S	2 (2.04)	93 (94.90)	3 (3.06)	0.292
Severity-Nebulizer	24 (24.49)	74 (75.51)	0 (0.00)	0.365
Technique Demand-MDI+S	23 (23.47)	69 (70.41)	6 (6.12)	0.003
Technique Demand-Nebulizer	30 (30.61)	65 (66.33)	3 (3.06)	0.042

*****Fisher's Exact: p=0.009 (change in level of significance)

** Fisher's Exact: p=0.009 (change in level of significance)

Convenience

74 parents mentioned that the MDI+S was convenient at some point in the survey, whereas 20 did not discuss the topic and four mentioned that the MDI+S was inconvenient. Of the parents who thought the MDI+S was more convenient, portability and lack of device set-up and required electricity were seen as positives of the MDI+S:

> "It's portable. Easy to bring with her places in case she needs it."
>
> "When I'm out of the house it's more portable, I can take it with me."
>
> "You just take the top off and shake it and she inhales it. There are more steps with the nebulizer connecting tubes and things like that making it more difficult to use."
>
> "It's more of a set-up to do the nebulizer, and if we're out you can't really use the nebulizer."
>
> "More convenient because you don't have to plug it in."

In discussion of nebulizer convenience, fewer parents mentioned this theme during survey administration (n=46). However, parents who did discuss nebulizer convenience were split, with 26 parents discussing the convenience of the nebulizer and 26 parents mentioning the nebulizer for its inconvenience. One parent who spoke on the convenience of the nebulizer stated that, "The only thing to do is insert the medicine. With the spacer you have to make sure you connect the spacer and you can't tell if they're inhaling the medicine or not." One parent asserting that the nebulizer is inconvenient mentioned that, "Can't take the nebulizer in the car. Nebulizer isn't as convenient or compact."

Length of Treatment

More than half of parents stated that they perceived the MDI+S to be a fast device that operates quickly, and only one parent stated that they thought the device was slow to operate. Some parents who mentioned that the MDI+S results in a short length of treatment expressed that the device allows children the freedom to continue engaging with their daily activities, as opposed to being confined to lying down during nebulizer treatment:

> "For him, with the MDI he doesn't have to sit still for a while. He can get his medicine and go back to what he was doing."
>
> "All you do is pump it, but with the nebulizer you have to sit down."

Eight parents mentioned that they thought the nebulizer was a fast device, whereas 28 claimed the opposite. A parent who perceived that the nebulizer was a quick device said that, "I think the medicine gets to the nose area faster, and might distribute the medicine a little bit better than the MDI." A parent who thought the nebulizer was not quick to operate stated that, "the machine you have to set it up and wait until the medicine evaporates."

Medication Delivery Beliefs

In response to many of the Likert-graded questions, parents expressed their perceptions of how albuterol is delivered into the body via an MDI+S and nebulizer. 28 parents mentioned medication delivery beliefs related to the MDI+S, with 14 parents making positive remarks and 14 making negative remarks. However, 54 parents made at least one or more statements favoring medication delivery for the nebulizer, whereas only five parents said something negative when speaking about nebulizer medication delivery.

Parents who made positive remarks for either device often claimed that the specific device allowed for the medication to go directly into the lungs. Examples of responses from parents who spoke positively of the MDI+S medication delivery include:

> "Gets straight to her face, with the nebulizer some escapes."
>
> "Because this one [inhaler] goes directly to the lungs she things it is more effective"

Parents who spoke positively of the nebulizer also made negative comments regarding MDI+S medication delivery. Notable responses include:

> "The [nebulizer] medicine gets to him and with the spacer it doesn't get through his system how it's supposed to."
>
> "I feel like it's covering him, so he's getting it through his nose and mouth. Whereas with the spacer I'm not sure if he's getting it all the way."
>
> "I feel like it takes time and he gets more medicine through his body. The puff is not enough."
>
> "The nebulizer he has it on his face continuously for longer whereas with the MDI he just puts it to his face breathes fast. I think it's like when you have a migraine and take an aspirin-you feel better but not as good as when you use a true migraine medication. The MDI starts opening him up, but with the nebulizer the oxygen reaches deeper. I've used the MDI with spacer myself and it's not as good as the nebulizer. With the MDI I feel things in my mouth and throat but with the machine I feel the effects deeper inside."

More parents expressed the belief that the nebulizer delivers more medicine to the patient or that the medication is more effectively delivered upon administration via a nebulizer. These elicited beliefs are in opposition with the biomedical stance, which claims that the MDI+S is as effective at medication delivery as the nebulizer is.

Efficacy

25 parents made positive comments on the efficacy of the MDI+S and 24 made negative remarks. A generic positive remark made by one parent was that, "seems like it [inhaler] works

better and helps the kid more efficiently. Faster too." Negative comments were generally included in parent responses that also discussed the efficacy of the nebulizer.

76 parents spoke positively on the efficacy of the nebulizer, with five making negative comments. Of those who made the latter, adverse side effects of the nebulizer were mentioned. One parent said that, "With the machine you notice he's using all of his muscles to breathe and we end up coming to the emergency room."

While some parents made positive remarks regarding the MDI+S and its quick operation speed, further qualitative responses revealed that other parents believe that the slower speed of the nebulizer actually gives the device more efficacy. Parents favoring the slow speed of the nebulizer also noted how the device forces their child to stop their activities and rest while receiving treatment:

> "He can sit down and rest [with the nebulizer]. With the inhaler he'll take it and leave."
>
> "Although the mask is slower, it seems like majority of the medicine can be taken through the mask over a period of time. The MDI is a bit too fast."
>
> "Same as before, it's pretty efficient because it's given over a longer period time. More medicine can be taken because it's slower and the child has time to breathe it in."

Other parents attributed nebulizer efficacy to their perception that treatment via this device lasts longer than MDI+S treatment. Some respondents did, however, note that the MDI+S is more convenient but not as effective at treating asthma:

> "It [nebulizer] treats his asthma better even though the MDI is more convenient sometimes."
>
> "It is more effective than the spacer an[d] it lasts longer. I like to know he will feel better for a longer time, and that is what the nebulizer does."
>
> "I like them both. The inhaler is more convenient. Nebulizer because it works better."

> "I like the inhaler because it's more practical whereas the machine if I'm out and about I have no way to use it. But I prefer the machine because it's more effective."

Statements asserting nebulizer efficacy were made by more parents than any of the other coded themes. Additionally, only 17 parents did not discuss positives or negatives of nebulizer efficacy, suggesting that efficacy is a critical variable significantly influencing overall preference of parents.

Severity

The quantitative questions were not specifically designed to distinguish varying device preferences for differing levels of asthma severity. However, almost a quarter of the study sample (n=24) made statements suggesting that they favored use of the nebulizer when their child's asthma became more severe. Additionally, no parent said anything implying opposition to using the nebulizer during more severe asthma situations. Examples of statements made by parents who were adamant that the nebulizer is needed to treat severe asthma include:

> "But when she is really really sick, she needs to use the machine."
>
> "When he's not feeling well, I use the nebulizer"
>
> "If she's really really sick, the machine helps more. The spray is OK when she's only a little sick. It'll hold her over."
>
> "They are case dependent. Nebulizer preference when he's feeling very sick"
>
> "It really depends on his distress. If he's really tight and coughing I would give him the nebulizer, whereas if he's been running around I would give him the spacer."
>
> "He gets more medicine with the nebulizer vs the spacer. The spacer is for a less severe incident where you need to get a shot of the medicine but not the entire treatment."

In comparison to the impassioned parents who expressed the belief that the nebulizer is essential for treating severe cases of asthma, only two parents made mention of preference for the MDI+S during exacerbated asthma incidents. One of these parents stated that, “It’s a lot less stressful to use. It’s e[a]sier to use when they’re alre[a]dy wheezing and sick.”

Technique Demands

Another theme elicited in parental free-responses was technique demands, or lack thereof, associated with the MDI+S and nebulizer. Parents were relatively split in their responses, although 30 parents mentioned the technique demands of the nebulizer in a positive light while only 23 parents spoke of the technique demands of the MDI+S positively. Of the parents who discussed the MDI+S, many emphasized the device’s practicality because their child could use the device independently:

> “The pump is easier because he can do it by himself. The machine we have to set up for him.”
>
> “He can do it on his own. I don’t have to do it for him.”
>
> “Now I prefer the inhaler because he can use it himself. He doesn’t need my help as much. I still help him, but when I help him I teach him how to use it for when I’m not able to help him anymore.”

Parents speaking positively of the MDI+S noted that they do not have to necessarily partake in aiding their child with the device and it is therefore less demanding on them personally. However, parents who spoke positively of the nebulizer inferred that they take an active role in helping their child with the device, but that the nebulizer is easier for them to use and the MDI+S is more confusing:

> “The mask just stays on their face and they don’t notice. It’s easy to hold them and check.”

> "The machine helps the medication reach the lungs. It takes longer but you know that the medication is working like it's supposed to. With the MDI I don't know if I'm doing it right."

> "Sometimes with the MDI we don't use it exactly as we're supposed to because you're supposed to wait 10 secs in between uses and in practice one really doesn't use it perfectly. I've been to the hospital with bronchopneumonia and when I'm given the nebulizer I'm able to just fall sleep and feel better. I use the MDI on the way as quick relief only. With the MDI he can probably lie and say that he used it correctly when he didn't. With the nebulizer I know he is using it correctly."

The comments regarding MDI+S confusion suggest that some parents and their children are confused on how to properly use the MDI+S. Incorrect technique could affect treatment outcomes, which could ultimately influence device preference.

Concluding Remarks

The most opinionated and passionate responses from surveying parents were elicited by asking the final question, "What do you think about Children's National Health System changing to MDI with spacers to treat the majority of patients with asthma in the emergency department?" Many parents emphasized their opposition to this shift, with some parents continuing to state that the nebulizer works best for children experiencing severe asthma attacks:

> "The sick people with asthma are going to die because with oxygen the medicine works better! No one can tell me that they work the same because they don't. I've used them both. When you use the nebulizer it makes you sleepy and when you fall asleep the medicine works better"

> "[This is] not good because when she needs serious treatment she needs the nebulizer."

> "I don't think it would be convenient because he sometimes needs faster effects. When my child is sick he needs the nebulizer to unplug his lungs."

> "I would prefer if they wouldn't. Because when they're really sick they need the machine."

Other parents fervently expressed their desire for treatment options. Responses that highlighted this theme often noted that all patients are different and asthma treatment options should therefore be determined on a case-by-case basis:

> "I don't like that idea. I think it should be a choice of the patient or the parent."
>
> "I don't like it, I feel like that is a bad idea because not everything works the same for everyone"
>
> "Wouldn't be good because cases are situational. They should have options."
>
> "Would not support, it depends on the patient in each case/scenario"
>
> "They will have a lot of losses on their hands. A lot of kids will get hurt behind it. Every child is different and sometimes they need more medicine."
>
> "Not happy. I'm dis[s]atisfied. Sometimes the inhaler the medicine does not get to the child. For some children it is effective and for some children it isn't. It depends on the individual child."
>
> "I don't like it because what if we come one day and the spacer is not working and we need to move to the machine? I think it should still be open for both options. Just because it's convenient for me doesn't mean it'll be convenient for the next person."

In addition to parents expressing the belief that asthma exacerbations are situation-dependent, some parents noted their concerns for younger patients if there was a shift at Children's National to primarily using the MDI+S. While the quantitative data did not suggest that child age was significantly associated with overall device preference, parents discussed issues with MDI+S usage and age when allowed to elaborate:

> "I don't think they should. Especially for younger kids like two and three years old, I don't think the inhaler will work well with them. My 6 year old can't use the spacer at all and she has really bad asthma. The only thing that helps is when she uses the nebulizer."
>
> "I think I would have to treat him at home. It's not effective for him. I think when he gets older the spacer would be good for him. Because he's young it doesn't work for him. I think it would [be] good for the older kids, but because he's young he doesn't get the concept of inhaling."

> "Depends on the child age if they can follow instructions because some children's can't follow instructions."
>
> "To me, the inhaler is good but I think that with little children the nebulizer is better even though sometimes they fight it. They can fall asleep with the mask on and absorb the medicine"

Not all parents expressed opposition to Children's National transitioning over to primarily using the MDI+S. Of those who were more tolerant of the idea, many noted that Children's National is a great hospital and would therefore trust the hospitals and the doctors. Some parents also expressed indifference to the transition, but indicated a need to understand why the hospital might move to mainly using the MDI+S:

> "The only thing is, I don't know. Whatever works best. If they feel that the other one works best and is faster that's okay. It doesn't matter as long as it works best."
>
> "It's fine but I would need to know a reason why"
>
> "I would still come here if that's the case. Whatever works."
>
> "Whatever the research says works, I don't really know! I think it's fine as long as it's backed with research that says that that's what works for the kids."
>
> "I guess I would question why they would change this. Are they finding that the inhaler works better to treat asthma than the nebulizer? Kids who come here with asthma must be very sick, so I guess if they found that the inhaler was more effective than the nebulizer that would make sense. I trust Children's hospitals that specialize in the treatment of the pediatric community."
>
> "I would be comfortable with whatever the doctor recommends"

By examining the qualitative responses of parents, there appears to be a subset of parents who favor the nebulizer and demonstrate strong belief perseverance when it is suggested that Children's National may switch over to primarily using the MDI+S. Other parents clearly demonstrate trust in the choices of the hospital and its physicians. Discussion of how parents'

social construction of realities intertwine with the beliefs and policies pushed for by physicians will be examined further in the next chapter.

Additional Themes

Other additional themes were discussed by parents in their free-responses, although with less frequency than the six coded themes. The relevance of such topics, which include blatantly disregarding physician suggestions and perceiving device usage to be location-specific, contributes to the framework that seeks to examine parent preferences. The following are examples of statements made by parents who articulated that they overlooked a doctor's directions to use the MDI+S:

> "If we're home, we're always using the machine which is why I think it works better, but the doctor told us to use the pump because it's directly going to the lungs."
>
> "The times we've used the nebulizer, we used to use the spray without relief and as soon as we used the machine she felt better. The pediatrician told us to stop using the machine though."

From these comments, it can be concluded that some parents are able to acknowledge an awareness for the biomedicine preference for MDI+S, despite holding opposing views. These comments also support the notion that parents can maintain their culture-specific beliefs about parenting and health decision practices, despite being exposed to conflicting, authoritative sources that may attempt to challenge their non-biomedical beliefs (Harkness et al, 2013).

Comments made by others suggest that parents may associate receiving treatment via a nebulizer with coming to the hospital:

> "A lot of times if we bring him to the hospital the spacer didn't work. So he needs the additional treatment from the nebulizer."
>
> "Only get nebulizer in ED, uses MDI at home"

All the parents in the sample stated that their child had received albuterol from both devices, but 25 parents said that they did not have a nebulizer at home and 31 parents noted that their child had only ever used the MDI+S at home. Examining statements such as these is critical to not only understanding parent device preferences but also parent beliefs and expectations of formalized healthcare settings.

Significance Results of Theme Discussion in Free Responses

As previously mentioned in chapter 4, Pearson Chi-Square tests were initially run in order to follow the study protocol for data analysis, but Fisher's Exact tests were later added to data analysis to validate the significance of the results. Convenience of the nebulizer and medication delivery beliefs were initially found to not be significant based on Pearson Chi-Square p-values but were significant with Fisher's Exact p-values.

The significance of theme mentioning is limited by several factors. Many of the free-responses given by parents are terse and the qualitative data recorded is therefore not rich in all surveys. There was also no audio recording of parental responses due to privacy concerns in the emergency room. Thus, responses were recorded by research associates, who were told to write responses in the parents' own words. However, the accuracy of some responses can be questioned, as many of the comments made by parents have grammatical errors consistent with trying to take down answers too quickly.

Despite the method of qualitative data collection, there appears to be significant associations between overall device preference and parents who expressed beliefs related to both MDI+S and nebulizer convenience, medication delivery beliefs, and efficacy. There is also a significant association between overall device preference and parents who shared perceptions of

MDI+S technique demands. Regardless of the results of the significant tests, all frequent themes bring to light the specific device perceptions parents have toward asthma medication delivery devices.

This clinical sample of parents generally found the MDI+S to be convenient and fast. Parents also conveyed beliefs that the nebulizer is more effective due to a perception that it provides more medication to children. These beliefs contribute insights of parent perceptions specifically regarding nebulizers and MDI+S, which was previously lacking in the literature.

Chapter 6: Discussions & Limitations

The quantitative and qualitative results of this project provide insights into parental perceptions of asthma medication delivery devices, a matter that was previously lacking in American literature. The quantitative results found that approximately 51% of parents prefer the nebulizer overall, which contrasts with the findings of Cotterell et al., 2002, in which 84% of parents interviewed at Sydney Children's Hospital said they preferred the MDI+S overall to treat their child's asthma. However, a majority of both the Australian parents and those interviewed at Children's National found the MDI+S to be easier to use. Thus, there are other factors, which may be grounded in a local cultural context, that are influencing the overall preferences of the parents in this sample.

Ease, Speed, and Comfortability

The quantitative results from some of the perception questions are not startling, given that the MDI+S arguably has a shorter treatment length. The MDI+S is also portable and can be used without necessarily stopping daily activities in order to receive treatment, which are factors that parents mentioned in their free responses. Therefore, it is unsurprising given these reported benefits of the MDI+S that the majority of parents believe the device is both easier and faster to use. Parents also reported the MDI+S to be more comfortable to use, which could be attributed to length of treatment and the use of a mouthpiece, as opposed to a facemask, when receiving bronchodilators.

Through free responses, parents further elaborated on device ease by making comments on the technique demands associated with the nebulizer and MDI+S. Parents in this sample noted that some children are able to use the MDI+S independently, whereas parents discussing nebulizer demands generally discussed their personal ability to use the machine. Fostering

independent or interdependent children is part of a parenting cultural belief system in which parents make choices to aid in the development of their offspring (Harkness et al., 2013). Thus, parental beliefs regarding the ability and desire for children to independently treat their asthma exacerbations with either a nebulizer or MDI+S can inform general parenting practices regarding asthma care and treatment.

While parental preferences may be related to their intentions to foster independent or interdependent offspring, I believe parents spoke of technique demands in the context of themselves treating asthma at home. Despite parents reporting that the MDI+S is easier, faster, and more comfortable to use, I hypothesize that these variables become less pertinent to parents when children experience severe exacerbations requiring treatment with the assistance from a medical professional. Ease, speed, and comfort of a medication delivery device may be essential for parents and children to manage and comply with asthma treatment plans at home. However, these variables are not always associated or prioritized by parents in a hospital setting who are seeking effective relief of asthma symptoms.

Medication Delivery, Effectiveness, and Severity

66 parents reported that the nebulizer makes their child feel better faster and 69 parents reported that the nebulizer makes their child feel better for longer when answering the Likert-scale questions. These results suggest that the satisfaction of many parents who bring their asthmatic child to the emergency department for effective care will be dependent upon treatment via a nebulizer. A parent may bring their child to the emergency department for asthma because of an actual or perceived inability of the parent or child to adequately control an exacerbation without professional medical intervention. In the occurrence that a parent decides their child

must receive treatment from a hospital, I hypothesize that their primary concern is that the child receive effective, rather than quick and comfortable, treatment.

When considering which device is more effective, parents preferring the nebulizer overall vehemently expressed the perception that more medication is delivered to their child via the machine in their free responses. Some of these parents perceived that the longer length of treatment with the nebulizer allowed for more medication to enter their child's body, whereas with the MDI+S there is a concern that not enough medication is delivered to the lungs. Others conveyed that the nebulizer can push more medication into the airways and lungs. Most parents did not elaborate further as to why they held this belief, but a few responses attributed greater medication delivery to the facemask of the nebulizer, which covers a patient's nose and mouth. Parents who perceived the MDI+S to be more effective cited similar reasons, claiming that the medication is delivered more directly to the lungs when using the inhaler.

The elicited belief that parents prefer the nebulizer to treat severe pediatric asthma exacerbations also contributes to the hypothesis that parents value efficacy over efficiency in medication treatment options when in a hospital setting. Almost a quarter of the parents in the sample said that the nebulizer is needed to treat children who have become extremely sick as a result of having an exacerbation. The idea that the MDI+S is a temporary holdover but that the nebulizer is the actual treatment method for asthma was conveyed by some parents. This intriguing perception must be further explored in greater detail, but nonetheless helps to develop a beginning framework that establishes parental perceptions and preferences of the nebulizer and MDI+S.

The Role of Doctors and Hospitals in Pediatric Asthma Care

Through examining the quantitative and qualitative data, I have concluded that this sample generally finds the MDI+S to be faster and more convenient but the nebulizer to be more effective, pushing overall preference towards the nebulizer to treat acute asthma exacerbations. This is grounded in the hypothesis that parents value efficacy over ease, speed, and comfortability when they seek out medical care at a hospital. However, it must be noted that nearly three quarters of the parents (n=74) own a nebulizer at home, which somewhat challenges the hypothesis. Are parents who bring their asthmatic child to the emergency room doing so for nebulizer treatment, despite having the device at home? Or are they primarily coming to the emergency department for expert care by a physician? The high ownership rate of the nebulizer would suggest that parents seek out hospital care primarily to receive treatment from a doctor. Yet, over 40% of parents said they would definitely or probably not bring their child to a hospital that primarily uses the MDI+S, which is the device physicians prefer. Thus, inquiring into parental expectations for emergency department visits would provide more insight into why parents visit the hospital as opposed to treating their children at home. Although I was constrained in the questions I asked parents due to the pre-determined survey questions, given what I know now I would want to ask parents what their expectations are in a home and hospital setting when caring for a child with asthma.

Opposition to using the MDI+S to treat acute asthma exacerbations in the emergency department became even more apparent in this study when asking parents how they felt about Children's National beginning to primarily use MDI+S to treat asthma. Even parents who previously reported that they would probably take their child to a hospital that primarily uses the MDI+S fervently disapproved of the potential transition, with some claiming that patients would

die as a result. Parents articulated the belief that not having the choice between the nebulizer and an MDI+S would negatively impact patients because asthma affects individuals differently. This desire for treatment options should put into question the legitimacy of transitioning over to the MDI+S, considering the preferences of parents.

Based on previous biomedical literature reporting that MDI+S treatment results in shorter emergency department stays and reduction of vomiting and tachycardia, physicians at Children's National favor the MDI+S over the nebulizer to treat acute asthma exacerbations. However, treatment with either a nebulizer or MDI+S in the emergency department results in similar clinical outcomes, such as oxygen saturation, PEFR, and hospital admission rates (Chou et al., 1993). Parental desire for treatment choices could therefore be justified, seeing that neither treatment ultimately results in a superior medical outcome. While medical paternalism and patient autonomy stand at odds with one another, the biomedical stance on the debate between the nebulizer and MDI+S should not restrict patient autonomy. Important patient outcomes are not at stake when choosing between the devices, so asserting either preference as superior is unnecessary.

An increase in patient and parent satisfaction could also result from physicians attempting to understand and respect, rather than change, the perceptions of parents. This study sample primarily consists of African American parents, who historically mistrust doctors and the U.S. medical system (Bailey, 2000). It has been demonstrated that the ethnomedical beliefs that parents of children with asthma hold influence parent health seeking processes and the health outcomes of patients (Dinkevich et al., 1998; Rossi et al., 2018). The predictive power of parental beliefs must therefore be acknowledged by physicians rather than disregarded, which could instill further mistrust amongst minority patients and families. An awareness of parental

perceptions related to the nebulizer and MDI+S must therefore be established and learnt in order for physicians to begin engaging in cultural competency and cultural humility.

The study's objective was to elicit parental perceptions and preferences of asthma medication delivery devices to help establish a framework, which would enable physicians to gain an understanding of these beliefs. However, it is unclear how many parents in the sample have a similar awareness of the biomedical preference for the MDI+S. Despite parents forming their own beliefs and preferences that are grounded in a local cultural context, these beliefs and preferences are subject to change. There were parents who initially expressed an overall preference for the nebulizer but later said they would support whatever the biomedical research favored as a treatment option. There were also parents in this sample who were very trusting of medical staff and claimed they would be comfortable with whatever device a doctor recommended. Yet, other parents acknowledged that they still preferred the nebulizer, despite being told by a physician that they should use the MDI+S. Thus, there are some individuals in the sample who overwhelmingly trust medical professionals to such an extent that they view their own preferences as inferior, while others demonstrate belief perseverance. Therefore, the policy of transitioning children from the nebulizer to the MDI+S may become more widely accepted if parents are also informed and understand the biomedical preference. However, resistance will still exist amongst those who remain steadfast in their belief that the nebulizer is a more efficacious and beneficial medication delivery device to treat asthma.

This project allows physicians to acknowledge the varying preferences parents have for asthma medication delivery devices. Cultural competence precedes cultural humility, but the former can only be achieved by physicians who understand the beliefs of their patients and families. By establishing a preliminary framework of parental perceptions and preferences of the

nebulizer and MDI+S, this research can provide pediatric physicians with the necessary awareness of parental beliefs grounded in local cultural contexts. By incorporating this awareness and respect for parental preferences into biomedical practice and policy, doctors and other healthcare providers will be able to tailor asthma strategies in such a way that improves treatment adherence and satisfaction.

Limitations

This study was able to evoke a copious amount of data, although there are restrictions limiting the power of the significance tests. When the survey was initially designed, parental perceptions and preferences were intended to be established on a 5-point Likert scale. However, the sample size of 99 made conducting Pearson Chi-Square tests nonsensical. In hindsight, the survey ideally would have only allowed parents to declare a strict preference for either the nebulizer or the MDI+S. However, I was able to recategorize the Likert scale by combining clear and slight preferences for a device into one category. Despite the reduction of the multiple-choice responses into a 3-point Likert scale, the significance tests are somewhat limiting due to the sample size. For example, approximately 64% of parents with a child aged two to four preferred the nebulizer, whereas 47% of parents with a child aged five or above preferred the nebulizer. There appears to be a sizeable difference in the percentage of parents who prefer the nebulizer based on child age. However, the significance test determined that child age was not significantly associated with overall device preference, thus technically disconfirming one of the study hypotheses.

The demographic skew of the sample size also limits the power of significance tests, as well as further analysis of different ethnomedical beliefs based strictly on race, ethnicity, or insurance status. 60 parents identified as African American and 29 parents identified as Hispanic

or Latino, but recorded their race as either white, other, or prefer not to answer. While many parents in the sample are African American, comparing ethnomedical beliefs between racial groups is difficult due to the small proportion of other racial groups. Similarly, there is an unequal ethnic distribution within the sample, which in combination with the study's sample size limits the power of significance tests.

This project did not collect any information regarding family income or socioeconomic status, but child health insurance status was recorded. There are significantly more children who are uninsured or on public health insurance than those who are privately insured. Statistical testing shows that there is no significant association between patient insurance status and parent overall device preference. However, the p-value for this association would be more meaningful if the sample were larger.

Qualitative data analysis is also limited by potential bias. I served as the sole investigator when analyzing and coding the qualitative data, which does not prevent against researcher bias. However, having a team of research members analyze qualitative data collectively can prevent bias. Group members may check each other's results and confirm that conclusions were appropriately determined. Having multiple investigators analyze qualitative data also increases the likelihood of reaching theoretical saturation. I investigated only the most frequently mentioned themes in the free responses but ensuring theoretical saturation would allow for a more descriptive and comprehensive framework. In order to develop a more detailed framework and prevent researcher bias, the next step will be to assemble a team of researchers at Children's National to assist in reaching theoretical saturation in the qualitative analysis of the surveys.

Appendix 1. Project Survey

Survey: Parental Perceptions of MDI use in Asthma

Visit Characteristics:

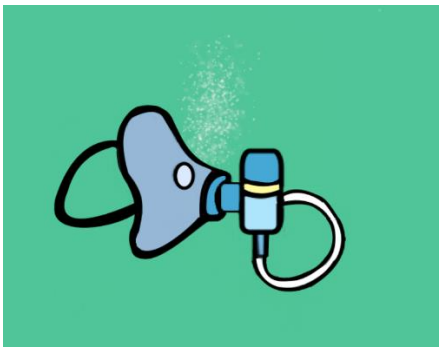
-Do you have multiple children diagnosed with asthma? Yes No
-Has your child ever been diagnosed with asthma? Yes No
-Is your child being seen today for asthma? Yes No

Asthma Severity:

1. Not INCLUDING today's visit, how many times over the last year has your child had to see a doctor for his asthma? (This includes visits to the doctor's office, and urgent care center, or the emergency room.)
    a. 0 b. 1-2 c. 3-4 d. >4
2. How many times has your child been admitted to the hospital for asthma in his/her life? (This means that they were moved out of the emergency room to a regular hospital floor for monitoring and asthma treatments)
    a. 0 b. 1-2 c. 3-4 d. >4
3. How many times has your child been admitted to the intensive care unit for asthma? (This is the hospital floor with the sickest children where nurses check on patients every hour)
    a. 0 b. 1-2 c. 3-4 d. >4
4. Is your child's asthma cared for by a specialist like a pulmonologist (lung doctor) or an allergist (allergy doctor)?
    a. Yes, a pulmonologist
    b. Yes, an allergist
    c. Yes, both
    d. No
5. (If answer was "no" to question 4) Who cares for your child's asthma?
    a. Pediatrician
    b. IMPACT clinic
    c. Pediatrician and other
    d. Other (if other, please specify)

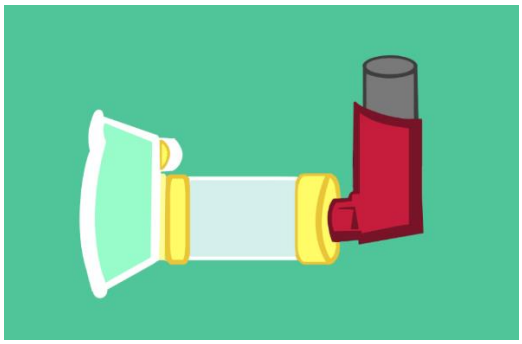
Use Questions:

Here is an image of a nebulizer with mask, mist and straps:



6. Has your child ever received albuterol via nebulizer machine (mask and vapor/mist)?
    a. Yes, at home ONLY
    b. Yes, at doctor's office/urgent care center/or ER ONLY
    c. Yes, at BOTH places
    d. No

Here is an image of Metered Dose Inhaler (MDI) with spacer



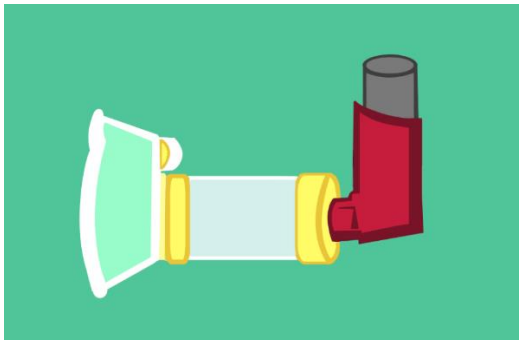
7. Has your child ever received albuterol via a metered dose inhaler (pump with spacer)?
    a. Yes, at home ONLY
    b. Yes, at doctor's office/urgent care center/or ER ONLY
    c. Yes, at Both places
    d. No
8. Has your child received albuterol in the last week?
    a. Yes, via nebulizer machine
    b. Yes, via MDI without spacer
    c. Yes, via MDI with spacer
    d. Yes, using both nebulizer and MDI
    e. No

Ownership Questions:

9. Do you keep a nebulizer machine at home? Yes No
10. Do you keep an MDI at home? Yes No
11. Do you have a spacer to use with the MDI at home? Yes No
12. When using the MDI, how often do you use it WITH a spacer to administer albuterol to your child?
    a. Every time
    b. Most of the time
    c. Some of the time
    d. Rarely
    e. Never

As a reminder, here is an image of a nebulizer with mask, mist, and straps

As a reminder, here is an image of Metered Dose Inhaler (MDI) with a spacer



13. For the following questions, please compare MDI with spacer and nebulizer, and select the statement that best fits

	MDI with spacer, much more	MDI with spacer, a little more	They are both the same	Nebulizer a little more	Nebulizer a lot more	I don't know/not applicable
Which of these is easiest to use?						
Which of these is faster to use?						
Which of these is more comfortable for your child?						
Which of these makes your child feel better faster?						

(*Each question is proceeded with a “why is this the case?” question, allowing for free response)

Perception Questions (continued):

	MDI with spacer, much more	MDI with spacer, a little more	They are both the same	Nebulizer a little more	Nebulizer a lot more	I don’t know/not applicable
Which of these makes your child feel better for a longer amount of time?						
Which of these is easier to use while your child is awake?						
Which of these is easier to use while your child is asleep?						
Which of these do you prefer overall?						

(*Each question is proceeded with a “why is this the case?” question, allowing for free response)

14. Some hospital emergency departments use a combination of nebulizer and MDI with spacers to treat children with asthma, but others use MDI with spacer only
    a. Where would you be most likely to take your child for asthma care?
        i. A place that uses MDI with spacer only to treat asthma
        ii. A place that uses a combination of MDI with spacer and nebulizer to treat asthma
        iii. A place that uses a nebulizer only to treat asthma
        iv. Neutral/no opinion
    b. Would you take your child to a hospital where most asthma patients are being treated using MDI with spacer?
        i. Definitely
        ii. Probably
        iii. Neutral/No opinion
        iv. Probably not
        v. Definitely not

15. What do you think about Children's National Health System changing to MDI with spacers to treat the majority of patients with asthma in the emergency department?

Parent Asthma History

16. Have you (the parent) ever been diagnosed with asthma? Yes No
17. (If answer was "yes" to question 16) Which do you prefer to treat your own asthma?
    a. Nebulizer
    b. MDI with spacer
    c. No preference/They are the same
    d. I don't know

Demographics

18. How old is your child? (in years)
19. What is your (parent's) ethnic background?
    a. Hispanic or Latino
    b. Not Hispanic or Latino
    c. Prefer not to answer
20. What is your (parent's) racial background?
    a. White
    b. Black/African American
    c. Asian/Asian American
    d. American Indian or Alaska Native
    e. Other
    f. Prefer not to answer
21. What is your (parent's) primary language?
    a. English
    b. Spanish
    c. Other
22. Does your child currently have health insurance? yes/no
    a. Insurance name:

Appendix 2. Code Descriptions for Qualitative Study of Nebulizer and MDI+Spacer Perceptions

Variable	Convenience
Short Description	Ease of use for child and parent; portability
Detailed Description	Ease of treatment method on both parent and child factors into preferences for treatment. Perceptions on portability of treatment method also factors into convenience scoring
Inclusion Criteria	Discussion of: -Portability or a specific device preference in a place other than in the home -Responses including the phrases “convenient,” “easy,” or “difficult.” -Distinction between parental and child ease and convenience
Typical Exemplars	[Inhaler] “More convenient because you don't have to plug it in” [Inhaler] “It's portable. Easy to bring with her to places in case she needs it” [Nebulizer] “The mask is on the child's face, so they don't have to worry about holding anything up or worrying anything”
Variable	Length of Treatment
Short Description	Perceptions on how quickly the devices operate
Detailed Description	Treatment options vary in length of time and number of treatments required for symptom alleviation. How fast or slow the nebulizer or inhaler is at ridding a patient of symptoms is a quantifiable measure that relates to treatment preferences
Inclusion Criteria	-Specific numerical estimates for length of time associated with treatments -Responses including the phrases “Faster,” “longer,” or “slower” or terms quantifying length of time -Reports on difficulties/ease of sitting through treatment duration

Typical Exemplars	[Inhaler] “It's fast... Whereas with the machine he has to sit for a longer period of time” [Inhaler] “She won't sit there long enough for the treatment to finish” [Inhaler] “The MDI w/ spacer used for 7 seconds at a time, so you're done in under 2 minutes” [Nebulizer] "I just feel like it's faster"
Variable	Medication Delivery Beliefs
Short Description	Perception of medication deliverance through treatment devices
Detailed Description	Parental perceptions of how each treatment is delivered to different parts of the body. The medication may, according to perceptions, be delivered more directly or to a greater extent with one device over the other
Inclusion Criteria	-Discussion of physiological responses to treatment -Reports on device structure (importance of “mask” on face for the nebulizer for medication delivery)
Typical Exemplars	[Nebulizer] In my opinion, medicine is administered directly as opposed to being unsure if the right dose was given with the MDI. [Nebulizer] I feel like it's covering him, so he's getting it through his nose and mouth. Whereas with the spacer I'm not sure if he's getting it all the way. I have to tell him when to take the breath. [Nebulizer] The nebulizer he has it on its on his face continuously for longer whereas with the MDI he just puts it to his face breathes fast. I think it's like when you have a migraine and take an aspirin- you feel better but not as good as when you use a true migraine medication. The MDI starts opening him up, but with the nebulizer the oxygen reaches deeper. [Nebulizer] Because it gets to the inside of her lungs. Spacer does the same but I guess because it's forced in due to the nebulizer mask
Variable	Efficacy
Short Description	Treatment ability to alleviate asthma symptoms

Detailed Description	The treatment effects of nebulizer and inhaler treatments may be measured in terms of how well the devices rid patients of asthma symptoms. Efficacy can be measured by speed of symptom relief and length of effects.
Inclusion Criteria	-Commentary and discussion of symptom relief with devices -Responses including the terms “effective,” “efficient,” “better,” “worse,” or other terms directed at quantifying symptom relief or exacerbation after nebulizer or inhaler treatment
Typical Exemplars	[Nebulizer] It gets down deep and lasts longer than the MDI. There is often still coughing after using MDI. [Nebulizer] Resolves tightness the quickest [Nebulizer] I think the medicine is stronger. They say it's the same but with the machine she feels and breathes better.
Variable	Severity
Short Description	Asthma exacerbation severity impacting treatment preference
Detailed Description	Different asthma severity levels may impact choice of treatment during an exacerbation. There exist perceptions on the best treatment device dependent on symptom severity.
Inclusion Criteria	-Mentioning of device preferences in the context of a specific health status that diverges from baseline -Key words: “sick,” “not feeling well,” serious”
Typical Exemplars	[Nebulizer] When he gets sick they give me the MDI with spacer to use and if he doesn't get better then they prescribe the nebulizer and he feels better. [Nebulizer] Because when we come here for that it's because the asthma pump wasn't working for her anymore [Nebulizer] When he's not feeling not feeling well, I use the nebulizer. [Nebulizer] If she's really really sick, the machine helps her more. The spray is OK when she's only a little sick. It'll hold her over.

Variable	Technique Demands
Short Description	Perceptions on required abilities to use the devices
Detailed Description	The two devices require different skill sets. There are perceptions as to which skills are more complex and demanding, for either the child or the parent.
Inclusion Criteria	-Discussion of ability or inability to use a device due to human capacity (i.e. understanding the concept of inhaling, being able to hold the mask on properly) -Responses discussing use of independence, or lack thereof (can the child use the device by themselves, or is further help needed to ensure proper administration of the medication?)
Typical Exemplars	[Inhaler] I think it would good for the older kids, but because he's young he doesn't get the concept of inhaling. [Nebulizer] He can just have it on his face and I don't have to sit there and hold it [Inhaler] I think it's only smart for kids who know how to take it in but for kids who don't then they should use a nebulizer

Appendix 3. Results of Pearson Chi-Square Tests and Validation with Fisher's Exact Test

Table 9

Correlation Significance between Asthma Severity, Device Usage, and Device Ownership Variables and Overall Device Preference

	Pearson Chi-Square Value	Asymptotic Significance	Fisher's Exact Value	Exact Significance
Reason for Current Hospital Visit	2.903	0.234	2.987	0.225
Doctor Office Visits (within the last year)	3.058	0.802	3.132	0.811
Lifetime Hospital Admissions	7.085	0.313	6.176	0.393
Lifetime ICU Admissions	7.970	0.240	6.930	0.256
Child-Specialist Access	2.977	0.226	3.016	0.217
Usage of Nebulizer	2.268	0.687	1.870	0.788
Usage of MDI+S	6.036	0.196	6.523	0.134
Asthma Diagnosis Status	0.981	0.612	1.236	0.632
Ownership of Nebulizer	0.520	0.771	0.498	0.857
Ownership of MDI	0.256	0.880	0.702	0.852
Ownership of Spacer	0.084	0.959	0.242	1.000

Table 10

Correlation Significance between Device Perception Variables and Overall Device Preference

	Pearson Chi-Square Value	Asymptotic Significance	Fisher's Exact Value	Exact Significance
Easier Overall	24.974	5.1×10^{-5}	27.176	7.0×10^{-6}
Faster	12.084	0.017	12.517	0.006

More Comfortable (n=97)	18.725	0.001	18.916	$4.5x10^{-4}$
Feel Better: Faster (n=95)	26.138	$3.0x10^{-5}$	26.421	$6.0x10^{-16}$
Feel Better: Longer (n=93)	22.429	$1.7x10^{-4}$	20.466	$1.3x10^{-4}$
Easier: Child Awake (n=92)	22.854	$1.4x10^{-4}$	21.256	$1.5x10^{-4}$
Easier: Child Asleep (n=79)	21.655	$2.4x10^{-4}$	20.460	$1.5x10^{-4}$

Table 11

Correlation Significance between Responses to Hospital Preference Questions and Overall Device Preference

	Pearson Chi-Square Value	Asymptotic Significance	Fisher's Exact Value	Exact Significance
Responses to "Where would you be most likely to take your child for asthma care?"	7.336	0.291	6.284	0.329
Responses to "Would you take your child to a hospital where most asthma patients are being treated using MDI+S?	16.691	0.033	15.939	0.033

Table 12

Correlation Significance between Sample Demographic Variables and Overall Device Preference

	Pearson Chi-Square Value	Asymptotic Significance	Fisher's Exact Value	Exact Significance
Age group (2-4 versus 5-18)	3.303	0.192	3.211	0.188
Race	6.840	0.551	6.934	0.517
Ethnicity	1.536	0.820	1.696	0.821
Insurance (public versus private) (n=97)	0.151	0.927	0.283	0.937

Table 13

Correlation Significance between Coded Free Responses and Overall Device Preference

	Pearson Chi-Square Value	Asymptotic Significance	Fisher's Exact Value	Exact Significance
Convenience-MDI+S	15.776	0.003	18.734	$2.2x10^{-4}$
Convenience-Nebulizer	12.500	0.014	13.138	0.009
Length of Treatment-MDI+S	9.454	0.051	9.768	0.021
Length of Treatment-Nebulizer	3.353	0.501	2.740	0.608
Medication Delivery Beliefs-MDI+S	11.106	0.025	12.518	0.009
Medication Delivery Beliefs-Nebulizer	39.132	$6.5x10^{-8}$	38.871	$7.0x10^{-9}$
Efficacy-MDI+S	13.568	0.009	13.692	0.007
Efficacy-Nebulizer	18.563	0.001	16.421	0.001
Severity-MDI+S	4.955	0.292	4.467	0.301
Severity-Nebulizer	2.014	0.365	2.078	0.354
Technique Demands-MDI+S	15.765	0.003	13.427	0.005
Technique Demands-Nebulizer	9.894	0.042	8.031	0.055

Appendix 4. Results of Multiple Linear Regression

Table 14: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
0.638	0.407	0.287	0.749	0.407

Table 15: Change Statistics

F Change	df1	df2	Sig F Change
3.392	15	74	.000

Table 16: Coefficients

	Unstandardized Coefficients: B	Unstandardized Coefficients: Std. Error	Standardized Coefficients: Beta	t	Sig
Constant	0.057	0.733		0.078	0.938
Easier	0.282	0.121	0.290	2.331	0.022
Faster	0.070	0.121	0.064	0.578	0.565
Comfort	-0.008	0.127	-0.008	-0.060	0.952
Better faster	0.120	0.144	0.115	0.833	0.407
Better longer	0.286	0.160	0.246	1.786	0.078
Insurance	0.157	0.239	0.066	0.659	0.512
Race	0.012	0.080	0.015	0.152	0.879
Ethnicity	0.172	0.152	0.120	1.132	0.261
Age	-0.096	0.207	-0.045	-0.465	0.644
ICU	0.241	0.147	0.158	1.635	0.106
Specialist	0.291	0.193	0.148	1.512	0.135
Home nebulizer	0.062	0.210	0.030	0.294	0.769
Home MDI+S	-0.303	0.380	-0.079	-0.798	0.428
Hospital Question	0.032	0.068	0.049	0.475	0.636
Parent Asthma Status	-0.095	0.181	-0.050	-0.525	0.601

References:

Akinbami, L. J., Moorman J. E., & Liu, X. (2011). Asthma prevalence, health care use, and mortality: United States, 2005–2009. National health statistics reports; no 32. Hyattsville, MD: National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/data/nhsr/nhsr032.pdf

Alker, J., & Pham, O. (2017). Nation's Uninsured Rate for Children Drops to Another Historic Low in 2016. Georgetown University Health Policy Institute: Center for Children and Families, 1-7. Retrieved from https://ccf.georgetown.edu/wp-content/uploads/2017/09/Uninsured-rate-for-kids-10-17.pdf

Amirav, I., & Newhouse, M. T. (1997). Metered-Dose Inhaler Accessory Devices in Acute Asthma. *Archives of Pediatrics & Adolescent Medicine, 151*(9), 876-882. doi:10.1001/archpedi.1997.02170460014003

Bailey, E. J. (2000). *Medical Anthropology and African American Health* (pp. 5-82). Westport, CT: Bergin & Garvey.

Barnes, P. J. (2001). Th2 cytokines and asthma: an introduction. *Respiratory Research*, *2*(2), 64-65. doi:10.1186/rr39

Bender, B. G., & Bender, S. E. (2005). Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunology and Allergy Clinics of North America, 25*(1), 107-130. doi:10.1016/j.iac.2004.09.005

Ben-Jospeh, E. P. (2017). What's the Difference Between a Nebulizer and an Inhaler? In *KidsHealth*. Retrieved from https://kidshealth.org/en/kids/nebulizer-inhaler.html

Blendon, R. J., Aiken, L. H., Freeman, H. E., & Corey, C. R. (1989). Access to medical care for black and white Americans. A matter of continuing concern. *JAMA: The Journal of the American Medical Association*, *261*(2), 278-281. doi:10.1001/jama.261.2.278

Bornstein, M. H. (2011). Parenting: Science and Practice. *Parenting*, *1*(1-2), 1-4. doi:10.1080/15295192.2001.9681208

Bowling, A., & Ebrahim, S. (2001). Measuring patients' preferences for treatment and perceptions of risk. *BMJ Quality & Safety*, *10*, i2-i8. doi:10.1136/qhc.0100002

Brennan, D. (2017). What Devices Help Treat COPD?. In *WebMD*. Retrieved from https://www.webmd.com/lung/copd/how-copd-devices-work#1

Cates, C. J., Welsh, E. J., & Rowe, B. H. (2013). Holding chambers (spacers) versus nebulisers for beta-agonist treatment of acute asthma. *Cochrane Database of Systematic Reviews*, 4-21. doi:10.1002/14651858.CD000052.pub3

Centers for Disease Control and Prevention. (2008). Asthma in the District of Columbia. Retrieved from https://www.cdc.gov/asthma/stateprofiles/Asthma_in_DC.pdf

Centers for Disease Control and Prevention. (2013). Asthma Facts—CDC's National Asthma Control Program Grantees. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/asthma/pdfs/Asthma_Facts_Program_Grantees.pdf

Centers for Disease Control and Prevention. (2016). Most Recent Asthma Data. Retrieved from https://www.cdc.gov/asthma/most_recent_data.htm

Centers for Disease Control and Prevention. (2018). Asthma in children. Retrieved from https://www.cdc.gov/vitalsigns/childhood-asthma/index.html

Children's National Health System. (2018a). Facts about Children's National. Retrieved from https://childrensnational.org/about-us/fast-facts--stats

Children's National Health System. (2018b). IMPACT DC Improving Pediatric Asthma Care in the District of Columbia. Retrieved from https://childrensnational.org/departments/impact-dc-asthma-clinic

Children's National Health System, (2018c). Insurance. Retrieved from https://childrensnational.org/specialty-care-patients/preparing-for-your-visit/insurance-and-billing/insurance#tab-2

Chou, K. J., Cunningham, S. J., & Crain, E. F. (1995). Metered-Dose Inhalers With Spacers vs Nebulizers for Pediatric Asthma. *Archives of Pediatrics & Adolescent Medicine, 149*(2), 201-205. doi:10.1001/archpedi.1995.02170140083015

Cotterell, E. M., Gazarian, M., Henry, R. L., O'Meara, M. W., & Wales, S. R. (2002). Child and parent satisfaction with the use of spacer devices in acute asthma. *Journal of Paediatrics and Child Health, 38*(2), 604-607. doi:10.1046/j.1440-1754.2002.00063.x

Dhuper, S., et al. (2011). Efficacy and cost comparisons of bronchodilatator administration between metered dose inhalers with disposable spacers and nebulizers for acute asthma treatment. *The Journal of Emergency Medicine, 40*(3), 247-255. doi: 10.1016/j.jemermed.2008.06.029

Dinkevich, E. I., Cunningham, S. J., & Crain, E. F. (1998). Parental Perceptions of Access to Care and Quality of Care for Inner-City Children with Asthma. *Journal of Asthma, 35*(1), 63-71. doi:10.3109/02770909809055406

Duarte, M., & Camargos, P. (2002). Efficacy and safety of a home-made non-valved spacer for bronchodilator therapy in acute asthma. *Acta Paediatrica, 91*(9), 909-913. doi:10.1111/j.1651-2227.2002.tb02876.x

Ege, M. J., et al. (2001). Exposure to Environmental Microorganisms and Childhood Asthma. New England Journal of Medicine 364(8): 701-708. doi:10.1056/NEJMoa1007302

Erlanger Medical Ethics Orientation Manual, *Principles of Biomedical Ethics*, May 2000.

Farmer, P. E., Nizeye, B., Stulac, S., & Keshavjee, S. (2006). Structural Violence and Clinical Medicine. *PLOS Medicine 3*(10): e449. In *Understanding and Applying Medical Anthropology* (3rd ed.). P. J. Brown and S. Closser. (2016). Taylor & Francis.

Follenweider, L., & Lambertino, A. (2013). Epidemiology of Asthma in the United States. *Nursing Clinics of North America*, *48*(1), 1-10. doi:10.1016/j.cnur.2012.12.008

Forno, E., Young, O. M., Kumar, R., Simhan, H., & Celedón, J. (2014). Maternal Obesity in Pregnancy, Gestational Weight Gain, and Risk of Childhood Asthma. *PEDIATRICS*, *134*(2), e535-e546. doi:10.1542/peds.2014-0439

Fuhlbrigge, A. L. (2004). Asthma severity and asthma control: symptoms, pulmonary function, and inflammatory markers. *Current Opinion in Pulmonary Medicine*, *10*(1), 1-6. doi:10.1097/00063198-200401000-00002

Geary, D. C., & Flinn, M. V. (2011). Evolution of Human Parental Behavior and the Human Family. *Parenting*, *1*(1-2), 5-61. doi:10.1080/15295192.2001.9681209

Global Initiative For Asthma. (2018). *Global Strategy for Asthma Management and Prevention*. Retrieved from: https://ginaasthma.org/2018-gina-report-global-strategy-for-asthma-management-and-prevention/

Harkness, S., & Super, C. M. (2002). Culture and parenting. *Handbook of parenting, Vol 2. Biology and ecology of parenting*. M.H. Bornstein, Mahwah, N.J., L. Erlbaum Assoc.: 253-280. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.464.494&rep=rep1&type=pdf

Harkness, S., et al. (2013). Culture and early childhood development: Implications for policy and programs. *Handbook of early childhood development research and its impact on global policy*. P. R. Britto, P. L. Engle and C. M. Super. New York, Oxford University Press**:** 142-160. doi.org/10.1093/acprof:oso/9780199922994.003.0007

Hoffman, L. (1975). The Value of Children to Parents and the Decrease in Family Size. *Proceedings of the American Philosophical Society*, *119*(6), 430-438. Retrieved from http://www.jstor.org/stable/986377

Hoffmann, L. W., Thornton, A., & Manis, J. D. (1978). The Value of Children to Parents in the United States. *Journal of Population*, *1*(2), 91-130. doi: 10.1007/BF01277597

Horton, S., & Barker, J.C. (2010). Stigmatized biologies: Examining the cumulative effects of oral health disparities for Mexican American farmworker children. *Medical Anthropology Quarterly*, 24(2), 199-219. doi:10.1111/j.1548-1387.2010.01097.x to

Kaba, R., & Sooriakumaran, P. (2007). The evolution of the doctor-patient relationship. *International Journal of Surgery, 5*(1), 57-65. doi:10.1016/j.ijsu.2006.01.005

Kerem, E., et al. (1993). Efficacy of albuterol administered by nebulizer versus spacer device in children with acute asthma. *The Journal of Pediatrics*, *123*(2), 313-317. doi:10.1016/S0022-3476(05)81710-X

Kleinman, A., & Benson, P. (2006). Anthropology in the Clinic: The Problem of Cultural Competency and How to Fix It. *PLOS Medicine 3*(10): e294. In *Understanding and Applying Medical Anthropology* (3rd ed.). P. J. Brown and S. Closser. (2016). Taylor & Francis.

Kleinman, A. (2010). Four social theories for global health. *The Lancet*, *375*, 1518-1519. doi:10.1016/S0140-6736(10)60646-0

Kohrt, B. A., & Mendenhall, E. (2015). *Global Mental Health*. In *Understanding and Applying Medical Anthropology* (3rd ed.). P. J. Brown and S. Closser. (2016). Taylor & Francis.

Kuehni, C. E., & Frey, U. (2002). Age-related differences in perceived asthma control in childhood: guidelines and reality. *European Respiratory Journal*, *20*(4), 880-889. doi:10.1183/09031936.02.00258502

Leversha, A. M., Campanella, S. G., Aickin, R. P., & Asher, M. I. (2000). Costs and effectiveness of spacer versus nebulizer in young children with moderate and severe acute asthma. *The Journal of Pediatrics*, *136*(4), 497-502. doi:10.1016/S0022-3476(00)90013-1

Liu, C., & Feekery, C. (2001). Can Asthma Education Improve Clinical Outcomes? An Evaluation of a Pediatric Asthma Education Program. *Journal of Asthma, 38*(3), 269-278. doi:10.1081/JAS-100000114

Luder, E., Melnik, T. A., & DiMaio, M. (1998). Association of being overweight with greater asthma symptoms in inner city black and Hispanic children. *The Journal of Pediatrics*, *132*(4), 699-703. doi:10.1016/S0022-3476(98)70363-4

Maslova, E., et al. (2012). Peanut and tree nut consumption during pregnancy and allergic disease in children-should mothers decrease their intake? Longitudinal evidence from the Danish National Birth Cohort. *Journal of Allergy and Clinical Immunology, 130*(3), 724-732. doi:10.1016/j.jaci.2012.05.014

Maslova, E., et al. (2013). Fish intake during pregnancy and the risk of child asthma and allergic rhinitis - longitudinal evidence from the Danish National Birth Cohort. *British Journal of Nutrition, 110*(7), 1313-1325. doi:10.1017/S000711451300038X

Mayo Clinic. (2018). Childhood Asthma. Retrieved December 6, 2018, from https://www.mayoclinic.org/diseases-conditions/childhood-asthma/diagnosis-treatment/drc-20351513

McCarthy, M., Herbert, R., Brimacombe, M., Hansen, J., Wong, D., & Zelman, M. (2002). Empowering parents through asthma education. *Pediatric Nursing, 28*(5), 465-473. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/12424982

Moerman, D. (2002). *Meaning, Medicine and the "Placebo Effect."* Cambridge: Cambridge University Press: 32-46. In *Understanding and Applying Medical Anthropology* (3rd ed.). P. J. Brown and S. Closser. (2016). Taylor & Francis.

Moorman, J. E., Akinbami, L. J., Bailey C. M., et al. (2012). National Surveillance of Asthma: United States, 2001–2010. National Center for Health Statistics. Vital Health Stat 3(35). Retrieved from https://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf

Murgic, L., Hébert, P. C., Sovic, S., & Pavlekovic, G. (2015). Paternalism and autonomy: views of patients and providers in a transitional (post-communist) country. *BMC Medical Ethics, 16*(1). doi:10.1186/s12910-015-0059-z

National Asthma Education and Prevention Program: Expert panel report III. (2007). Guidelines for the diagnosis and management of asthma (Summary report). Bethesda, MD: National Heart, Lung, and Blood Institute. (NIH publication no. 08-4051). Retrieved from https://www.nhlbi.nih.gov/sites/default/files/media/docs/asthsumm.pdf

National Center for Health Statistics (2005). Health, United States, 2005 With Chartbook on Trends in the Health of Americans. Retrieved from https://www.cdc.gov/nchs/data/hus/hus05.pdf

Neuman, M. I., et al. (2014). Characteristics of Recurrent Utilization in Pediatric Emergency Departments. *PEDIATRICS, 134*(4), e1025-e1031. doi:10.1542/peds.2014-1362

Nunes, C., Pereira, A. N., & Morais-Almeida, M. (2017). Asthma costs and social impact. *Asthma Research and Practice, 3*(1). doi:10.1186/s40733-016-0029-3

Parikh, K., et al. (2017). Racial and Ethnic Differences in Pediatric Readmissions for Common Chronic Conditions. *The Journal of Pediatrics, 186,* 158-164. doi:10.1016/j.jpeds.2017.03.046

Peters, J., Stevenson, M., Beverley, C., Lim, J. N., & Smith, S. (2002). The clinical effectiveness and cost-effectiveness of inhaler devices used in the routine management

of chronic asthma in older children: a systematic review and economic evaluation. *Health Technology Assessment*, *6*(5), 1-167. doi:10.3310/hta6050

Peterson-Sweeney, K., McMullen, A., Yoos, H., & Klitzman, H. (2003). Parental perceptions of their child's asthma: Management and medication use. *Journal of Pediatric Health Care*, *17*(3), 118-125. doi:10.1067/mph.2003.31

Price, J., Khubchandani, J., McKinney, M., & Braun, R. (2013). Rachial/Ethnic Disparities in Chronic Diseases of Youth and Access to Health Care in the United States. *BioMed Research International.* doi:10.1155/2013/787616

Riley, W. (2012). Health Disparities: Gaps in Access, Quality and Affordability of Medical Care. *Transactions of the American Clinical and Climatological Association*, *12*3, 167-174. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3540621/

Rodriguez-Oliveros, M., Bisogni, C. A., & Frongillo, E. A. (2014). Knowledge about food classification systems and value attributes provides insight for understanding complementary food choices in Mexican working mothers. *Appetite*, *83*, 144-152. doi:10.1016/j.appet.2014.08.022

Rosas-Salazar, C., et al. (2013). Parental numeracy and asthma exacerbations in Puerto Rican children. *Chest*, *144*(1), 92-98. doi:10.1378/chest.12-2693

Rossi, S. L., et al. (2018). Caregiver report of child's asthma control predicts future acute visits in a mouse-sensitized population, independent of guideline-based measures of asthma control. *Journal of Allergy and Clinical Immunology*, *141*(2). doi: 10.1016/j.jaci.2017.12.707

Salhi, B. (2015). Beyond the Doctor's White Coat: Science, Ritual, and Healing in American Biomedicine. *Understanding and Applying Medical Anthropology* (3rd ed.). P. J. Brown and S. Closser. (2016). Taylor & Francis.

Sannier, N., et al. (2006). Metered-dose inhaler with spacer vs nebulization for severe and potentially severe acute asthma treatment in the pediatric emergency department. *Archives de Pédiatrie*, *13*(3), 238-244. doi:10.1016/j.arcped.2005.12.009

Sawicki, G., & Haver, K. (2018). Patient education: Asthma treatment in children (Beyond the Basics). In *Up To Date*. Retrieved from https://www.uptodate.com/contents/asthma-treatment-in-children-beyond-the-basics?topicRef=1222&source=see_link

Steppuhn, H., Langen, U., Scheidt-Nave, C., & Keil, T. (2013). Major comorbid conditions in asthma and association with asthma-related hospitalizations and emergency department admissions in adults: results from the German national health telephone interview survey (GEDA) 2010. *BMC Pulmonary Medicine*, *13*. doi:10.1186/1471-2466-13-46

Szefler, S. J., Peter, G. J., Mitchell, H., & Morgan, W. (2010). Achieving asthma control in the inner city: Do the National Institutes of Health Asthma Guidelines really work? *Journal of Allergy and Clinical Immunology, 125*(3). doi:10.1016/j.jaci.2010.01.025

Tuttle, A. R., Knudson-Martin, C., & Kim, L. (2012). Parenting as Relationship: A Framework for Assessment and Practice. *Family Process, 51*, 73-89. Retrieved from https://pdfs.semanticscholar.org/753c/53b7eb01b57ab72f1620e2da113a4b8bca94.pdf

U.S. News & World Report. (2018). U.S. News Announces the 2018-2019 Best Children's Hospitals. Retrieved December from https://www.usnews.com/info/blogs/press-room/articles/2018-06-26/us-news-announces-the-2018-2019-best-childrens-hospitals

Vermeire, P. A., Rabe, K. F., Soriano, J. B., & Maier, W. C. (2002). Asthma control and differences in management practices across seven European countries. *Respiratory Medicine, 96*(3), 142-149. doi:10.1053/rmed.2001.1241

Worthman, C. M., Tomlinson, M., & Rotheram-Borus, M. (2016). When can parents most influence their child's development? Expert knowledge and perceived local realities. *Social Science and Medicine, 154, 62-69*.