EFFECTS OF A SELF-CARE DEFICIT NURSING THEORY-DESIGNED NURSING SYSTEM ON SYMPTOM CONTROL IN CHILDREN WITH ASTHMA

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by
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DECEMBER 2001
The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

EFFECTS OF A SELF-CARE DEFICIT NURSING THEORY-DESIGNED NURSING SYSTEM ON SYMPTOM CONTROL IN CHILDREN WITH ASTHMA

presented by Karen R. Cox

a candidate for the degree of Doctor of Philosophy

and hereby certify that in their opinion it is worthy of acceptance.
ACKNOWLEDGEMENTS

The late Mel Carnahan, our Missouri governor during the 1990s, had a heart that burned with a fire of advocacy for children. At the core of this fire was a desire to provide Missouri’s children with a strong and solid educational foundation. Mel Carnahan’s focus was on children because he believed passionately that our children are Missouri’s future. Mel Carnahan understood that, when children were sick, his goal could not be achieved. Sick children cannot effectively learn when illnesses cause concentration interference or school absences. Therefore, with diligence and determination, he searched for and hired a health care leader who shared his passion for achieving healthy outcomes for all of Missouri’s children. Mel Carnahan hired Coleen Kivlahan, M.D., M.S.P.H., to be the Director of Missouri’s Department of Health at a time when health policy was shifting. Dr. Coleen Kivlahan understood health care systems and financing, measurement of clinical outcomes, promotion of humanity, and the challenges associated with poverty. Mel Carnahan and Dr. Kivlahan spearheaded the design of a public insurance program that would promote access to health care for all children. As the results of this study suggest, we will not let Mel Carnahan’s fire of advocacy for Missouri’s children go out. Health outcomes can be significantly improved when children are provided with access to a health care system in which the team members use scientific evidence to make the best treatment decisions.

While this dissertation has only one author, it truly reflects a group effort. I would like to thank my committee members who encouraged me, yet demanded a quality product. Dr. Susan G. Taylor, who retired before I completed my formal studies, has
steadfastly pointed the way since 1985. Dr. Marilyn Rantz has been a great facilitator, always assuring forward progress. Dr. Larry Ganong has provided hours of meaningful teaching and advice; now I understand his motto: “research is not for sissies”. Dr. Alice Kuehn has shared a great deal of enthusiasm regarding Dorthea Orem’s nursing theory. Dr. Timothy Patrick spent hours preparing me for next steps and reflecting with me on lessons learned. Dr. Daryl Hobbs has inspired a revolution in my heart. At this point, I am not exactly sure where this revolution is leading, but I do know that it starts with Paulo Freire.

As I began the design and implementation of the nursing system, I was introduced to a treasure chest of special health care professionals with tremendous expertise, caring and compassion. All of these individuals, volunteering countless hours on the Pediatric Asthma Continuous Quality Improvement Team, have proven time and again to be very special people with a single focus for making children’s lives as orderly and normal as possible. These colleagues have become friends and have willingly shared their expertise across a variety of content areas to include respiratory pathology and treatment, health plan organization, research and evaluation, continuous quality improvement, and child development. This work could not have been done without each and every one of them. They include Dr. Bernard Ewigman, Ben Francisco, Dr. Peter König, Dr. Gavin Graff, Dr. Tom Cheek, Dr. Tom Selva, Dr. Steve Scott, Dr. Kay Davis, Donna Checkett, Gwen Burley, and Ryan Grueber.

My professional colleagues within the Office of Clinical Effectiveness are also my friends and, we share a common vision: to design health care processes that improve
clinical outcomes for patients. This vision is being achieved as we integrate scientific evidence into our delivery systems. These friends and colleagues are responsible for my personal and professional growth over the last four years. Coleen Kivlahan inspires me while teaching me about leadership, humanity, comfort, medicine, poverty, and quality. Kay Davis initially challenged me to work on an improvement project for children with asthma because she wanted me to pursue scholarly inquiry relative to Orem’s nursing theory. Kay was behind me all the way. Among many other things, Kathryn Nelson has taught me ‘customer’ advocacy. Pattie Malone has been a mentor for inquiry and scholarship. In addition to macro and micro editing, Jennifer Buddenbaum has helped me with patience, professionalism and logic. Betty Nikodim and Lori Wilcox have been personal anchors, specifically during data preparation and analytic phases. Louise Whitener has been, and continues to be, my cheerleader.

Lastly, I want to thank my husband Ted Cox and my daughter Jesse Alice Reinhold from the bottom of my heart. Jesse was in 6th grade when I started on this journey. Now she is a freshman at MU. Jesse has made my busy life very fulfilling because she chose to take control of her life and to learn skills surrounding personal organization, goal direction and responsibility. Ted provided support and space so that I could grow. Ted has optimized my scholarship through a great deal of personal sacrifice. You are all incredibly valuable to me and, from the bottom of my heart, I want to thank you for letting me learn from you.
Asthma is the most frequent reason for preventable hospital admissions among children regardless of race or socio-economic status. Since asthma hospitalizations are preventable, an implicit assumption is that parents are not optimally managing the illness condition. Using Orem's Self-Care Deficit Nursing Theory, 14 antecedent conditions necessary for competent action by dependent-care agents (usually parents) were uncovered in the pediatric asthma literature. All but two of the 14 antecedent conditions are influenced by factors partly or completely controlled by the health care system. Given this new understanding, a unique partnership between a health care system and a Medicaid managed care health plan was forged to remove health care system barriers that interfere with dependent-care agent competency for the management of asthma. A nursing system was designed and implemented to improve health care system factors associated with optimal symptom control: accurate diagnosis, appropriate treatment, continuity, access, and parent/child teaching. The multi-faceted nursing system was implemented across three professional groups (physicians, nurses, and respiratory therapists) within one ER, three hospital units, and six outpatient clinic sites. One component of the nursing system involved formal annual training of participants on appropriate diagnosis and optimal treatment. Other nursing system components focused attention on children who had failed outpatient management. Specifically, between
October 1, 1998, and March 31, 2001, 753 children were brought to one emergency room or three hospital units for treatment of an asthma exacerbation. The nursing system was successfully implemented on behalf of 75% of these children. Using Medicaid managed care enrollment files and claims data for asthma care, the effects of the nursing system on symptom control were compared before and after the nursing system intervention, and between two groups of health care providers who had either been maximally or minimally impacted by the nursing system. Rates for asthma claims used to proxy symptom control included ER, hospital, and clinic visits for asthma. Children who had providers in the maximally involved group were one-half as likely to be hospitalized for an asthma exacerbation as children with providers in the minimally involved group. The results of this study confirm that when nursing theory guides practice, patient outcomes improve.
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CHAPTER 1
INTRODUCTION

This study demonstrates that when nursing theory guides practice, patient outcomes improve. Specific nursing theories have been used to guide activities within professional practice and to frame important questions within that theoretical perspective (Meleis, 1991). As clinical questions are posed, nursing theory can guide scholarly synthesis and organization of current knowledge. Once that knowledge is synthesized and organized, the specific theoretical approach can be used to guide further knowledge development for the profession, specifically through scientific inquiry, description, measurement, and evaluation. This study applies Self-Care Deficit Nursing Theory (SCDNT; Orem, 2001) to current knowledge of children with asthma. The scholarly application of SCDNT to a population of children with asthma is intended to validate the proposition that when nursing theory guides practice, population-based outcomes improve.

Problem Statement

Asthma is a chronic inflammatory disorder of the airways characterized by hyperactivity of the trachea and bronchi to various stimuli, resulting in airflow obstruction that is reversible either spontaneously or as a result of treatment (National Asthma Education and Prevention Program, 1997a). Two factors cause airway narrowing, thus airflow obstruction: bronchospasm and inflammation. Bronchospasm is caused by bronchial smooth muscle constriction, resulting in a decreasing diameter of the airway lumen. Inflammation causes both edema of the mucous membranes lining the airways and
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an increase in the secretion of mucous. Airflow obstruction may be persistent or fluctuate widely during the course of the day, week, and year (Weinberger, 1990). Primary symptoms of airflow obstruction include wheezing, shortness of breath, dyspnea, and/or cough, particularly at night and in the early morning (National Asthma Education and Prevention Program, 1997a).

In March 1989, the National Heart, Lung, and Blood Institute (NHLBI), part of the National Institutes of Health (NIH), implemented the National Asthma Education and Prevention Program (NAEPP). The goal of the program was to establish management guidelines for clinicians and to develop a comprehensive asthma education campaign for health professionals and patients in the United States. By 1991, the first Expert Panel Report: Guidelines for the Diagnosis and Management of Asthma (NAEPP, 1991) set forth the first national standard on asthma diagnosis and management. This standard was revised in 1997 due to increased understanding about the role of inflammation in the pathogenesis of asthma, new pharmacologic additions, revised diagnostic considerations, improvements in monitoring devices, advances in environmental management, and improvements in patient education strategies (NAEPP, 1997a). Goals of the 1997 national standard included: (a) raising awareness that asthma is a serious chronic disease, (b) helping ensure that patients recognize symptoms of asthma and that health professionals correctly diagnose asthma, and (c) ensuring effective control of asthma by encouraging a partnership among patients, physicians, and other health professionals by using updated treatment regimens and education programs.
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Given 'best-practice' guidelines and a clear national priority to control asthma morbidity and mortality in children and adults (U.S. Department of Health and Human Services, 2000), current practices at University of Missouri-Columbia Health Care (MUHC) were compared with ideal childhood asthma practices. This 'gap analysis' revealed that systematic processes to support asthma symptom control were not in place. A one-year MUHC fiscal analysis determined that mean hospital charges for asthma care of children enrolled in Medicaid were 55% higher than the national Medicaid average (Elixhauser, Duffy, & Sommers, 1996; C. Kivlahan, personal communication, February 3, 1998).

As a result of the gap analysis, MUHC and a managed Medicaid health plan developed a collaborative partnership in early 1998 with the specific aim to improve symptom control in children with asthma. SCDNT (Orem, 2001) guided the design of the intervention that resulted from this partnership. Following design completion, the intervention was implemented across the entire MUHC system. Claims data submitted to the Medicaid health plan for asthma-related health care services were used to measure intervention effectiveness in the study population.

The literature review presented in Chapter 2 identifies and articulates actions that must be taken by parents to regulate the asthma condition on behalf of children. Four 'ideal sets of action' were identified. Theoretically, these four ideal sets of actions, when accomplished at the right time and in the right amount, are expected to result in successful regulation of the asthma condition as evidenced by symptom control (see Table 1). The four ideal sets of action identified from examining the literature from a
SCDNT perspective are (a) detection, interpretation and monitoring of meaningful symptoms, (b) regulation and administration of asthma medications, (c) identification and avoidance of environmental triggers, and (d) appropriately seeking medical advice in a timely manner.

Table 1

**Actions Required To Regulate Asthma**

<table>
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<tr>
<th>OUTCOME: Adequate Control of Asthma Symptoms</th>
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<td>PROCESS: Dependent-care agent takes appropriate, sequenced, and timely actions.</td>
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Four sets of action taken by a competent dependent-care agent to achieve the outcome:

1. Detects, interprets and monitors meaningful symptoms.
2. Regulates and administers medications.
3. Identifies and avoids environmental triggers.
4. Appropriately seeks medical advice in a timely manner.

According to SCDNT (Orem, 2001), once ideal sets of action are made known, the professional nurse assesses the capacity of the individual to competently carry out required actions. If there are gaps in the individual’s ability to perform required actions, the professional nurse designs a nursing system. According to Orem, a nursing system is a plan to bridge the identified gaps between action demands and action limitations. In some cases, the nurse can intervene by designing a nursing system focused on developing the parent’s ability to successfully perform all required actions (action demands). In other
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In cases, the nursing system must be designed so that required actions (action demands) are performed by another competent and willing person or persons.

According to SCDNT (Orem, 2001), the person who takes care-giving actions on behalf of another is referred to as the dependent-care agent (DCA). In order to achieve adequate control of asthma symptoms, a competent DCA must take appropriate, sequenced, and timely actions with regard to the four ideal sets of action. There is ample evidence to suggest that simply working with DCAs to develop competency is a prudent intervention for improving symptom control in children with asthma. Many studies have documented improved outcomes such as better symptom control and reduced emergency room (ER) visits for asthma after implementing educational programs (Brook, Mendelberg, & Heim, 1993; Charlton, Gharlton, Broomfield, & Mulee, 1990; Gillies et al., 1996; Ignacio-Garcia & Gonzalez-Santos, 1995; Lewis, Rachelefsky, Lewis, de la Sota, & Kaplan, 1984; Madge, McColl, & Paton, 1997; Mesters, Meertens, Kok, & Parcel, 1994; Pedersen, 1992; Wilson et al., 1996).

Educational programs designed to increase DCA competency are completely consistent with SCDNT, and these programs are necessary, but not sufficient for developing DCA competency. Other necessary conditions, antecedent to DCAs developing competence, were uncovered unexpectedly while framing the pediatric asthma literature from Orem's (2001) theoretical perspective. Specifically, the review of the literature (Chapter 2) presents the argument that competency development is directly influenced by factors completely or partially controlled by the health care system. Despite health care system factors that interfere with development of DCA competency,
expensive ER visits and hospitalizations are often presumed to result from the failure of DCAs to take effective actions to control symptoms in their children. In fact, asthma costs have shown dramatic decreases when persons are correctly diagnosed, medically managed, and effectively educated (Buchner et al., 1998; DuMont, 1998; Hughes, McLød, Barr, & Goldbloom, 1991; Lieu et al, 1997; Marosi, Stiesmeyer, & Faculjak, 1998; Volsko, 1998).

The development of competency to achieve symptom control continually and skillfully does not occur by chance. Specific knowledge, skills and attention to the asthma condition are required to perform ideal actions competently. From the nursing theoretical perspective presented in Chapter 2, symptom control in children can be achieved through development of DCA competency; however, symptom control will not be achieved until health care system barriers interfering with competency development are removed. The five health care system barriers that interfere with successful regulation of the asthma condition by DCAs are illustrated in Figure 1. Figure 1 also illustrates symptom control outcomes that would be expected to change if health care system barriers known to interfere with development of DCA competency are reduced or eliminated.

Purpose

The purpose of this study is to evaluate the impact of an intervention, a nursing system, explicitly designed according to Orem's (2001) theoretical constructs and implemented across a health care system to benefit a population of children with asthma. The evaluation is designed to quantify changes in measures of asthma symptom control across the population of children. The evaluation will compare measures of asthma
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Figure 1. Symptom control outcomes expected to improve when a SCDNT-designed nursing system is implemented.

symptom control in a population of children before and after implementation of the nursing system and between two groups of children. The comparison of two groups of children with asthma will be in children who were treated by health care providers who had been maximally involved in the nursing system and children with providers who were minimally involved in the nursing system. Measurement of symptom control is from health plan claims for asthma utilization (ER, hospital and clinic visits for asthma). If the nursing system is successful in controlling asthma symptoms in a population of children, a before and after nursing system comparison will result in reduced ER visits and
hospitalizations for asthma with a concurrent increase in asthma clinic visits. Further, a comparison between two groups of children with asthma (those treated by maximally involved [in the nursing system] providers and those treated by minimally involved providers) will result in improved symptom control by children with maximally involved providers.

Research Questions

The two research questions to be answered in this study are:

1. Is there a statistically significant difference in asthma health care utilization before and after implementing a nursing system to benefit a population of children with asthma?

2. Is there a statistically significant difference in asthma health care utilization when comparing a group of children with asthma who have providers maximally involved in the nursing system and a group of children with asthma who have providers who were minimally involved in the nursing system?

Assumptions

There are three assumptions in this study. First, the intervention can be implemented across an entire health care system so that children actually receive the intervention. Second, the intervention health plan has enrolled a sufficient number of children who have asthma and the range of symptom control in these children is no different than that reported in the literature. Third, if the nursing system is implemented across the health care system, changes in symptom control can be detected using asthma-related claims from the health plan.
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Significance of the Study

Symptom control significantly improves when national asthma treatment guidelines are followed (Buchner et al., 1998; DuMont, 1998; Hughes et al., 1991; Lieu et al, 1997; Taggert et al, 1991; Volsko, 1998). Failure to implement national guidelines and failure to control symptoms in children with asthma is disturbing. Against a backdrop of known treatment modalities, the prevalence of childhood asthma has been rising dramatically for 20 years, outpacing adult rates (Centers for Disease Control and Prevention [CDC], 1998). Deaths, hospitalizations and ER visits for children with asthma have consistently risen (Crain, Weiss, & Fagan, 1995; CDC, 1996). Identifying and altering obstacles across health care delivery sites that interfere with asthma symptom control is an enormous challenge.

Children with asthma usually rely on at least one other person to take appropriate, sequenced and timely action on their behalf to control asthma symptoms. DCAs who have children with asthma must know what action to take and have the skills to take required actions. This study presents, examines, and answers the SCDNT-based argument that development of DCA competency is heavily influenced by factors partially or completely controlled by the health care system. This study will significantly impact nursing practice and consumers of health care if implementation of a theoretically based nursing system improves symptom control in children with asthma.
CHAPTER 2
REVIEW OF THE LITERATURE

This chapter begins by describing those constructs and relationships from Orem's SCDNT (2001) that are salient to this study. These theoretical constructs and relationships are then applied to the scientific literature of the population of children with asthma to describe the asthma condition, optimal outcomes resulting from competent DCA action, four ideal action sets that must be taken to control symptoms, and antecedent conditions that influence development of care-giver competency. Chapter 2 then raises the argument that there are two 'centers of accountability' impacting the extent to which DCAs are successful in controlling the asthma condition on behalf of the child. These centers of accountability are the DCA and the health care system. Health care system factors are then grouped into five themes. Chapter 2 concludes with the results from a needs assessment to determine if health care system changes were needed to benefit the pediatric asthma population served by MUHC.

Orem's Self-Care Deficit Nursing Theory

As early as 1959, Dorthea E. Orem began publishing scholarly work defining "the nature and structure of nursing" (Orem, 1996, p. 2). To this day, she and others have continued to develop constructs and concepts that form three inter-related theoretical frameworks that constitute the general SCDNT. The three theories, Theory of Self-Care, Theory of Self-Care Deficit, and Theory of Nursing System, articulate to form the expression of SCDNT (Orem, 2001). The Theory of Self-Care proposes that humans have an ability to take deliberate action for regulating life, health, and well being. The capacity
and ability of an individual to take action in order to regulate life, health, and well being is termed self-care agency. The Theory of Self-Care Deficit proposes that, in order to maintain life, health, and well-being, each person must take many actions in an adequate and timely manner throughout the course of each day. A self-care deficit exists when the relationship between a human’s ability to perform the required actions is not adequate to meet all or part of the total need for self-care action. The Theory of Nursing System proposes that properly educated and experienced nurses are needed to identify and design a plan of care for individuals whose demands for self-care exceed their ability to perform required actions. Thus, a nursing system is the design and implementation of a plan that bridges the identified gap between the action requirements necessary for the regulation of life, health, and well being and the individual’s inability to accomplish required actions.

*Knowledge & Experience Required For Action*

Action as a construct is clearly foundational to the three theories that form SCDNT (Orem, 2001). In her general nursing theory construction, Orem studied MacMurray’s (1957) and others’ work concerning deliberate human action. Deliberate action is a behavior by an individual intended to bring about a goal (MacMurray). For Orem, human actions that are deliberately taken to achieve the goal of health promotion or illness prevention are defined as self-care actions. Both MacMurray and Orem name the individual taking deliberate action the ‘agent’. Since Orem’s interest in deliberate human action is narrower than MacMurray’s, she has named this individual the ‘self-care
agent'. Deliberate self-care actions are taken by the self-care agent in order to bring about goal achievement or improvement in life, health, and well being.

In order to choose specific actions, knowledge is required (MacMurray, 1957). When a self-care agent has no knowledge about a particular situation, that person does not know how to act optimally. Knowledge is developed over time particularly as an agent reflects on results achieved from prior action(s). Post-experience reflection is an intellectual process that influences future plans for deliberate action. A thoughtful plan for future deliberate action is called intention. Prior to deliberate action, the agent intellectually develops ideas about what needs to be accomplished and decides which actions ought to be taken. Even though thinking is commonplace prior to and following deliberate action, thinking about acting but never taking action is not considered deliberate action (MacMurray).

Knowledge is derived from experiences as one plans action, acts, and reflects on results achieved. As new knowledge is gained from each situation, more choices or alternatives become evident. With trial and error experiences, agents learn to make a selection among possible (known) action sequences. Eventually, from the newly formed knowledge base, one approach is selected as the best approach and, with 'practice makes perfect', patterned action sequences, or habits, result (MacMurray, 1957).

**Therapeutic Self-Care Actions**

Ideal self-care actions for each individual are based upon specific life, health, and well-being situations. The term used to describe all actions required for an individual to
maintain life, health, and well being is termed therapeutic self-care demand (TSCD; Orem, 2001). The TSCD "stands for a specification of the kinds and numbers of care measures that are known or presumed to be regulatory of an individual's human functioning and development within some time frame" (Orem, 1995, p. 187). The ability of a person to accurately assess, judge, and act in a timely manner for the accomplishment of all actions within the TSCD is termed self-care agency. In like manner, the term dependent-care agent is used to refer to the person who takes action on behalf of an individual who does not have the capacity or ability to take required (self-care) action. Like self-care agency, the term dependent-care agency is used to describe the dependent-care agent's ability to provide appropriate and timely actions for individuals whose self-care agency is undeveloped (i.e., infants and children), inoperable (i.e., persons under general anesthesia) or inadequate (i.e., physically unable to perform required actions) (Orem, 2001).

Nursing practice that is grounded in SCDNT requires the nurse to assess an individual's ability to meet his or her TSCD (see Figure 2). The nursing assessment consists of both the action requirements demanded by a specific illness or situation (action demands) and the agent's ability to perform the required actions (identification of action limitations). Since self-care and dependent-care actions are learned behavior, the nurse guides and monitors development of self-care and/or dependent-care agency (Orem, 2001). Self-care/dependent-care agency is acquired from knowledge about situations and is developed through post-experience reflection. When an individual confronts unfamiliar
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**Figure 2.** Meeting the therapeutic self-care demand (TSCD).

health situations, he or she may not have any experiences from which to select actions. Knowledge and experience in managing requirements for action expands the known choices for action. In order to gain maximum insight, new experiences should be followed by thoughtful reflection (MacMurray, 1957). Nurses can guide purposeful reflection so that patients increase their knowledge base by thinking about results achieved through previous action (reflection) and planning (intention) what kinds of actions should be taken in the future. Over time, an individual's action system should result in the establishment of habitual self-care patterns that meet the TSCD.
With regard to taking action, Orem (2001) outlines three phases that occur in the production of deliberate action. Orem's three phases of deliberate action are termed self-care operations (see Figure 3). Estimative self-care operations include the cognitive processes such as the thinking, assessing, and deliberating that take place as an agent appraises his or her choices about actions to take. Transitional self-care operations also include cognitive processes such as judgments and decision-making as the agent chooses one course of action over others. The third and final phase, productive self-care operations, is the actual engagement in action (Orem). As a result of the estimative, transitional, and productive self-care operations, a system of self-care (or dependent-care actions) is achieved. When the system of actions is appropriate, sequenced, and timely, the goal of regulating health care demands is met (Orem, 2001). The appropriateness, sequence, and timeliness of self-care actions are influenced by knowledge about, and

![Diagram](image)

*Figure 3.* Self-care operations resulting in a system of self-care/dependent-care actions.
experiences with, the situation of interest. When an individual confronts unfamiliar health situations, the individual may not have any knowledge or experiences from which to select actions. As knowledge and experience grow over time, known action choices expand.

**Orem’s Investigative Matrix**

From Orem’s (2001) perspective, effective self-care is based on the balance between required demands for action and self-care abilities to perform required actions. Theoretically driven nursing practice uncovers action limitation gaps and guides the design of nursing systems to restore a balance between demands for action and abilities to meet these demands. For nurse researchers, SCDNT establishes an investigative matrix, directing tests of theory-based practice. Specifically, a researcher could measure the extent to which a nurse accurately calculated specific action limitation gaps, or measure the extent to which the nursing system restored a balance between the demands and limitations.

In order to begin testing the theory for a specific patient population, the theoretical action demands (the work to be done to manage the specific health condition) must be defined. After defining the theoretical action demands, the design, implementation, and evaluation of a nursing system follows. If the nursing theory guides the design and implementation of nursing interventions, and these interventions improve outcomes for patients, the value of professional nursing practice is revealed. The testing of Orem’s investigational matrix on a population of children with asthma begins with a listing of the
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'theoretical' demands for action. The scientific literature from children with asthma is the data source to determine necessary demands for action.

Application of SCDNT to the Pediatric Asthma Literature

With background about integral components of SCDNT (Orem's, 2001), an investigative matrix can proceed for a population of children with asthma. The results from the theoretical application of SCDNT with the asthma literature will be the organization of what is currently known about asthma from a nursing perspective. In addition, a theoretical listing of appropriate and timely action sequences that are necessary (ideal) for competent asthma management will be defined.

Prevalence of Asthma in Children

Asthma is a chronic inflammatory disorder of the airways characterized by hyperactivity of the trachea and bronchi to various stimuli, resulting in airflow obstruction that is reversible either spontaneously or as a result of treatment (NAEPP, 1997a). There are two factors that cause airway narrowing, thus obstruction to airflow: bronchospasm and inflammation. Bronchospasm is caused by bronchial smooth muscle constriction, resulting in rapid changes in the diameter of the airway lumen. Inflammation causes both edema of the mucous membranes lining the airways and an increase in the secretion of mucous. Airflow obstruction may be persistent or fluctuate widely during the course of the day, week, and year (Weinberger, 1990). Primary symptoms of airflow obstruction include wheezing, shortness of breath, dyspnea, and/or cough, particularly at night and in the early morning (NAEPP).
Despite improved understanding about asthma and a decade-long articulation of national goals, effective management of children with asthma remains an elusive goal. Pediatric asthma continues to be a common problem in the United States and elsewhere. One in every 14 children has asthma (CDC, 1998). This 7% prevalence rate has been rising dramatically since 1980 (CDC, 1998). Of all age cohorts, asthma mortality is lowest among children younger than 14. However, this rate is double that of the 1980 rate for children ages 5-14 (CDC, 1996). Deaths, hospitalizations and ER visits for children with asthma have consistently risen. In a 1991 survey of U.S. emergency departments, it was estimated that 1.6 million pediatric visits were for asthma care; representing 17% of all pediatric ER visits (Crain et al., 1995). Admissions to the hospital for children with asthma ages 0-14 has increased 74% in the past 20 years while the overall hospitalization rate during this same time only increased 17% (CDC, 1996).

Poor children are 40% more likely to be hospitalized for an asthma exacerbation than children from more affluent families, and African-American children are three times more likely to be hospitalized than white children (CDC, 1998). Asthma is the most frequent reason for preventable hospital admissions among all children regardless of race or socio-economic status (Billings et al., 1993; Weissman, Gatsonis, & Epstein, 1992).

Asthma is common in children across all ages and presents various challenges depending on the age group. The diameters of the young child’s airways are quite small, thus diseases causing airway narrowing such as asthma have a much greater impact (McWilliams, 1995). Triggers, such as respiratory infections, play a much larger role in
asthma exacerbations for young children compared with older children (Weinberger, 1990). One of the earliest warning signs of an asthma exacerbation is night-time coughing or dyspnea that causes awakening (NAEPP, 1997a). Parents may sleep through such an episode, thus missing an early warning sign of an impending respiratory crisis. There are limitations in available asthma medications for children less than six, and there are various different, more complex strategies for delivering the medications to the airways of young children (Weinberger, 1990).

The volume of children seen in hospitals suggests either complicated medical requirements, extraordinary management challenges for DCAs, or both. Since a young child’s capacity for declaring illness symptoms or reporting effectiveness of medical interventions is undeveloped, the care-giver demand for astute symptom detection and effective, timely action is critical. Knowing which symptoms should be attended to and having the ability to perform actions competently to treat and relieve symptoms is critical for ideal management. Diseases in children presents physiologic, pharmacologic, and human experiential differences that complicate ideal management.

Optimum Asthma Outcome

Adequate control of symptoms requires deliberate self-care or dependent-care actions. Specifically, adequate control of symptoms occurs when appropriate, sequenced and timely actions are taken before and during an asthma exacerbation. Adequate control of symptoms is evidenced by (a) being able to sleep at night, free from waking due to coughing, (b) being able to work or play hard without breathing problems, (c) not
require urgent or emergent care for an asthma exacerbation, and (d) having a medication regime that results in good symptom control without side effects (NAEPP, 1997a). Specific knowledge, skills and attention to the asthma condition are required to perform ideal actions competently.

**Necessary Actions For Achieving The Optimum Outcome**

In order to define action demands for children with asthma based on the literature, a template analysis was done (Crabtree & Miller, 1999). The primary objective for using this qualitative technique was to create an evidence-based listing of all actions required to achieve the optimal outcome of asthma symptom control. As a result of applying the template analysis process, four general action themes emerged.

A template was created to perform four discrete but iterative cognitive and analytical stages; each stage reflects relevant theoretical constructs. The first stage involved listing specific outcomes that could be expected when appropriate dependent-care actions were taken. Then, for each of these defined outcomes, all actions required to achieve the outcomes were defined. Third, each action required to achieve the outcome was categorized as estimative self-care operations (thoughts), transitional self-care operations (judgements/decisions) or productive self-care operations (actions). In the final stage, questions were created that could be asked of DCAs in order to assess competency with regard to each of the outcomes and self-care operations.

The data source for this process was the scientific literature and local experts from MUHC Pediatric Pulmonary Department (physicians and a pediatric nurse practitioner).
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The template analysis was completed during multiple lengthy sessions over approximately three months. During this phase, an iterative process occurred as developments and modifications were discussed with local experts in both asthma and Orem’s (2001) theory. From the ‘near-final’ template analysis listing, outcomes were named as, and grouped into, one of four ideal action demand themes. The ideal action demand themes are (a) detecting, interpreting and monitoring symptoms, (b) regulating and administering medications, (c) identifying and avoiding environmental triggers, and (d) appropriately seeking medical advice in a timely manner.

For each of the four ideal action demand themes, the flow of the self-care operations (estimative, transitional, and productive) required for competent asthma management was then formulated and illustrated. Once each of the four illustrations had been completed, the self-care operations defined in the template analysis process did not express all that was necessary for asthma symptom control. If fact, certain conditions must be present in order for the DCA to have the capacity to think, judge, and take competent action appropriately. These conditions were named, and they were antecedent to a DCA performing appropriate estimative, transitional, or productive self-care operations. If any of the antecedent conditions were not present, even the best intentioned DCA would not be able to control asthma symptoms successfully. The four action themes and their antecedent conditions were then validated with local clinicians. The four action theme illustrations were modified so that the antecedent conditions were included with the estimative, transitional, and productive self-care operations defined during the
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template analysis. Each theme, to include the antecedent conditions and the self-care operations, is now described and illustrated according to supporting literature.

*Action Theme #1: Detecting, Interpreting and Monitoring Symptoms*

In order to control symptoms adequately, symptom detection, interpretation and monitoring are critical. Symptoms can be characterized by type (wheeze, cough, shortness of breath, labored breathing), pattern (intermittent, continuous, seasonal, exercise induced), associated conditions (viral respiratory infection, rhinitis, sinusitis, fever), and precipitating factors (trigger exposure) (Weinberger, 1990).

*Figure 4. Symptom management self-care operations.*
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Figure 4 illustrates symptom-related estimative, transitional, and productive self-care operations and the four antecedent conditions identified as necessary for competent action. When symptoms are assessed (estimative self-care operations), there are four possible decisions (transitional self-care operations) for action (productive self-care operations). These decisions include independent treatment; seeking treatment advice by contacting a member of the health care team; traveling to a treatment facility; or taking no action except to reappraise symptoms at a later time. When seeking advice from a member of the health care system either by phone or by traveling to a facility, the DCA intentionally transfers care decisions to someone believed to be more competent or to access treatment methods not available to the DCA. If the DCA chooses either to act independently or to continue to appraise for worsening symptoms, the agent 'loops' back through this assessment, judgement, decision-making cycle (self-care operations) until the symptoms are judged to be resolved or the care is delegated to a member of the health care system. With either the decision to independently treat or to reappraise symptoms at subsequent intervals, two additional self-care operations are required. One is selecting the appropriate time intervals between reassessments. The second is a judgement about the child's direction of change: improving, worsening, or unchanged. An accurate assessment of symptom severity, frequency, and control is critical in determining what additional actions should be taken.

With regard to antecedent conditions, one should not expect a DCA to be able to detect, interpret or monitor symptoms if the agent does not believe, or has not been told,
the diagnosis of asthma is relevant. A second, much more obvious, antecedent condition is that the DCA must have the basic cognitive capacity to appraise the child's symptoms. Third, the DCA must be able to discriminate between those symptoms that are asthma related and those that are not. Finally, the DCA needs to have sufficient time to think through, decide, and take action on behalf of the child needing care. The asthma literature is now presented according to the four antecedent conditions necessary for competent thoughts, decisions, and actions relative to detecting, interpreting and monitoring symptoms.

*Dependent-care agent believes the diagnosis of asthma is relevant.* Before an agent can begin learning how to manage asthma, the provider has to diagnose the condition in the child and begin appropriate medication therapy. The literature clearly documents an international concern about under-diagnosis of asthma and under-estimation of disease severity leading to under-treatment (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Ehrlich et al., 1995; Kaur et al., 1998; Mostgaard, Siersted, Hansen, Hyldebrandt, & Oxhoj, 1997; Sennhauser & Kuhni, 1995; Siersted, Boldsen, Hansen, Mostgaard, & Hyldebrandt, 1998).

There are three elements that must be present for the diagnosis of asthma. First, during the evaluation of the agent's recollection of symptoms and the provider's physical exam, there needs to be clear evidence of episodic airflow obstruction patterns. Second, the airflow obstruction must be demonstrated to be partially reversible, usually via
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spirometry measurement before and after using quick-relief medications. Third, alternative diagnoses must be excluded (NAEPP, 1997a).

In order to conduct tests regarding airflow obstruction and its reversibility, the patient must be able to follow directions for spirometry tests consisting of timing and force of inhalation and exhalation. Most children younger than six years of age are not able to follow directions for spirometry testing. Therefore, in children less than six years of age, the diagnosis of asthma relies predominantly on reported symptoms and exam findings. To further complicate the diagnosis of asthma, there are multiple periodic respiratory illnesses in children this age that result in asthma-like signs, such as retractions and wheezing. Periodic respiratory illnesses that cause reactive airways but which are not directly linked to asthma include respiratory syncitial virus, pneumonia, and bronchiolitis (NAEPP, 1997a).

An asthma diagnosis can affect future life choices for the child such as playing sports in school, joining the military, and obtaining health or life insurance. There are illnesses that mimic asthma, that cause legitimate concerns about inaccurately labeling a child with asthma. A child must have at least two episodes of wheezing before a diagnosis of asthma is considered since asthma is characterized by recurrent wheezing (NAEPP, 1997a). Young children with multiple episodes of wheezing, in whom alternative diagnoses can be reasonably ruled out, and who respond favorably to asthma medications should be medically managed as though they have asthma unless proven otherwise (NAEPP). Because of uncertainties in making an asthma diagnosis and
potentially enormous social consequences, it is no wonder that physicians under-diagnose asthma in young children. However, there are consequences to DCAs before the diagnosis is made. Mesters, Pieterse, and Meertens (1991) found that parents of infants and toddlers had been frustrated with their physician during the diagnosis stage. Once diagnosed, basic practical asthma education was not provided resulting in serious misconceptions about asthma that affected parental attitude toward, and ability to manage episodes.

Dependent-care agent has the cognitive ability to appraise. Orem (1995) makes a distinction between humans and other living things by the human “capacity (a) to reflect upon themselves and their environment, (b) to symbolize what they experience, and (c) to use symbolic creations (ideas, words) in thinking, in communicating, and in guiding efforts to do and to make things that are beneficial for themselves or others” (p. 96). The DCA must utilize this human capacity for the appraisal of the asthma condition. Having the willingness and ability to regularly appraise the child for signs of an asthma exacerbation is so obvious it could almost be overlooked, but this is clearly an essential antecedent to competency. Specific appraisal requirements for asthma management include the capacity for determining relevance of symptoms in the context of exposure to triggers, the intensity of symptoms (mild, moderate and severe), and the effectiveness of treatment at an appropriate time interval as evidenced by symptom changes. To establish the DCA’s competency relative to appraisal, the agent should be questioned about the
child's range of symptoms, what triggers make the child's asthma worse, and what signs
let the DCA know the child is or is not responding to treatment.

**Dependent-care agent is aware of and able to discriminate meaningful asthma
symptoms.** There are a range of symptoms that may be present during a mild, moderate, or
severe exacerbation. Mild signs and symptoms of an asthma exacerbation include
breathing problems such as wheezing and/or coughing which may or may not disturb the
sleeping child (NAEPP, 1997a). Other initial symptoms include fever, anorexia,
decreased activity, lethargy, and irritability. Moderate signs and symptoms include
tachypnea, continuous wheezing, frequent coughing, dyspnea on exertion, or insomnia.
Severe signs and symptoms include retractions, dyspnea despite administration of
bronchodilators, inability to talk, walk or eat due to breathing problems, or cyanotic lips
or nail beds (NAEPP, 1997a). Severe symptoms require urgent provider notification or
emergency treatment. A competent DCA should be able to distinguish between mild,
moderate, and severe symptoms and initiate appropriate actions relative to medication
administration, trigger protection and health care provider contact.

Symptom detection and severity interpretation is the first ‘domino’ for the
initiation of action intended to reverse breathing problems. If a DCA can not discriminate
meaningful asthma symptoms, the child could die. If a DCA transfers the responsibility
for symptom detection, interpretation, and monitoring to another care-giver, the person
accepting this responsibility must know which symptoms require action and have the
capacity and supplies necessary for effective action should symptoms appear. In one case-
control study of deaths among a group of adolescents with asthma over a 10-year period, there was a statistically significant difference in those adolescents who were expected to care for themselves with non age-appropriate actions (Strunk, Mtazek, Fuhrmann, & LaBrecque, 1985). In a follow-up analysis of all asthma fatality literature, Strunk (1989) summarized these tragedies as having identified inappropriate actions by parents and children as well as actions not initiated when they should have been. Fatality stems from poor assessment of symptom severity, complacency in initiating action, and confusion about which and how much asthma medications to give.

Yoos and McMullen (1999) and Mesters et al. (1991) confirmed Strunk's (1989) adolescent age group findings in school age children with regard to DCAs inaccuracies in physical assessments, inability to identify important symptoms such as low peak flow readings, attending to unimportant symptoms, and waiting too long to take action. Findings reported in young pre-school children are also troubling. Wilson et al. (1993) interviewed parents of children under six years of age and their health care providers about effective and ineffective asthma management actions. Dozens of ineffective parental asthma management behaviors were identified. This study reinforces earlier findings of Strunk (1989), Yoos and McMullen (1990), and Mesters et al. (1991): appropriate decision-making cannot be expected of persons who do not sufficiently assess symptoms, and who do not understand, or have misconceptions about pathophysiology, triggers, or medication management.
Across all age groups, three studies reported increased hospital visits, readmissions, and costs among those who are younger than six years (Dawod, Ehlayel, & Osundwa, 1996; Farber, 1998; Gottlieb, Beiser, & O’Conor, 1995). Using five years (1991-1995) of Wisconsin discharge data for asthma hospitalizations, the CDC (1998) reported that 44% of children with asthma (between the ages of 0-25 years) were younger than five years of age. At MUHC, 73% of all asthma hospitalizations for children covered by Medicaid during fiscal year 1997 occurred in children under age six (C. Kivlahan, personal communication, February 3, 1998). Recognizing the earliest symptoms of an attack in young children is an example of an essential estimative skill for the DCA.

As MacMurray (1957) describes, knowledge is increased following new experiences. With a recent diagnosis or in very young children, the parent is more likely to have limited knowledge, experience, and confidence in handling the child’s breathing difficulties (Donnelly, 1994; Yoos & McMullen, 1999). If agents reflect on the circumstances surrounding recent experiences, they think about the consequences of action choices and discover other action alternatives that might have been taken to alter the outcome. One randomized controlled trial described the effects of providing almost immediate reflection after an asthma exacerbation. Led by an asthma nurse expert, the DCA’s recollection of events surrounding the exacerbation were used to guide learning for future situations. Hospital readmissions were significantly reduced to 8% from the 25% observed in both the control group and in non-study participants (Madge et al., 1997). While this study suggests that past experience reflection for learning about the
meaning of child-specific symptoms is a very successful strategy, these patients were also
given short courses of rescue steroids and were given directions on when to take them.
Without taking into account differences between the groups for this intervention, the
readmission rate may be a reflection of early administration of steroids rather than
understanding early meaningful symptoms.

DCAs have been shown to be more compliant when the treatment plan is
explained verbally and is accompanied by written instructions (Pedersen, 1992). The most
successful patient education interventions in the pediatric asthma literature involve the
use of asthma management plans (AMP). AMPs provide written advice on typical
triggers that aggravate the asthma condition and the range of symptoms to watch for. In
fact, the NHLBI guidelines recommend the use of AMPs for all patients with asthma
(NAEPP, 1997a), yet AMPs are not widely used (Bauman et al., 1995; Dales et al., 1992;

The typical AMP provides three color-coded zones for directing action: green,
yellow, and red (NAEPP, 1997a). The green zone provides information about normal
symptoms and includes directions on frequency and medication dosage. The yellow zone
lists worrisome symptom changes with recommended alterations of medications,
frequency, or doses and advises the agent to contact the provider. The red zone lists
actions to take as though an impending emergency will occur. Most AMPs, in addition to
being symptom based, utilize peak flow readings as the guide to determine whether to
follow the green, yellow, or red portion of the plan. Of course, children under six can not
Ordinarily perform peak flow readings so AMPs for young children are symptom based only and do not include objective measures of lung function.

Several studies document that AMPs improve symptom control and decrease ER and hospitalization rates (Charlton et al., 1990; Gillies et al., 1996; Ignacio-Garcia & Gonzalez-Santos, 1995; Volsko, 1998). One retrospective case-control study found that when AMPs had been used, associated hospitalizations were cut in half (Lieu et al., 1997). However, Farber, Johnson, and Beckerman (1998) reported that none of the parents who presented to a New Orleans emergency room with their young child (ages 2-6) during an asthma exacerbation had ever been given an asthma management plan.

Vignettes have been used to test decisions self-treatment based on the AMP. Despite receiving several educational sessions, adults and patients older than 13 years had difficulty making the correct decision in self-care, such as adding inhaled steroids and seeking emergency care (Kolbe, Vamos, James, Elkind, & Garrett, 1996). This study suggests that individuals with asthma don't always take the appropriate action listed on the AMP. For studies reporting use of AMPs, the plan itself was never the sole intervention. Plans are usually developed in conjunction with a comprehensive educational program, with physician specialists prescribing appropriate medications, and where continuity relationships have a chance to develop. There were no studies evaluating an AMP as the sole intervention.

Dependent-care agent keeps time available to assess and to take action. Vigilant attention to symptoms and their management requires time and energy. When living
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conditions are complicated and stressed, taking actions to control symptoms may not always be the top priority. Poverty is associated with a higher asthma prevalence (Weiss, Gergen, & Wagener, 1993), and children who are eligible for public insurance such as Medicaid may be living in stressful home environments. Only one study examined family system factors among Medicaid eligible children. Wade et al. (1997) studied 1,528 four to nine year olds with asthma living in the inner-city and concluded that the systems of care were coordinated by multiple care-givers who all had limited asthma problem-solving skills, adjustment problems, and high stress levels. In addition, throughout any given day, the responsibility to care for a young child was often shifted among adults. One study reported that pre-school teachers did a poor job of administering asthma medications even though the medications were supposed to be given daily (Gibson, Ferguson, Aitchison, & Paton, 1995). Rather than concentrating on the development of one DCA, training other willing care-givers may be a necessity. A written AMP that outlines symptoms to watch for and appropriate actions to take may be the only commonly understood message in a chaotic household.

**Action Theme #2: Regulation and Administration Of Medications**

Figure 5 illustrates estimative, transitional and productive self-care operations and antecedent conditions necessary for the second ideal set of actions, competent regulation and administration of medications. Once the DCA deems medications are necessary, additional decisions ensue. These include knowing which medication is appropriate, how much to give, how to give it, how long the medication is expected to last, and when, or if,
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Figure 5. Medication management self-care operations.

It would be appropriate to administer another dose. Once the decision to act in a particular way has been made, delivery of the medication (productive self-care operations) requires availability of the appropriate medications and necessary supplies to deliver them (e.g., nebulizer or spacer). Further, skills to set up and effectively deliver a dose of medication to the distal airways must be mastered. The extent to which these antecedent conditions are present will influence the extent to which the DCA is successful in managing the asthma condition.
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Following independent treatment of symptoms with medications, a competent DCA will cycle to the estimative phase to reappraise the symptoms in order to judge the effectiveness of the medication in controlling the symptoms. Based upon the DCA’s judgement of the direction of change (improvement, deterioration, or unchanged) and knowledge about the expected medication effect and its duration, the agent faces the same four decisions mentioned earlier: initiate independent treatment (repeat the medication), seek treatment by contacting the health care provider, proceed to a local hospital, or do nothing beyond reappraisal of symptoms.

*Dependent-care agent has appropriate medications prescribed.* The antecedent condition for having appropriate medication prescribed is exclusively under the control by members of the health care system. Once diagnosed with asthma, the child’s asthma severity should be classified and medicines prescribed accordingly. There are four symptom severity classifications: mild intermittent, mild persistent, moderate persistent, and severe persistent (NAEPP, 1997a). Individuals with symptoms such as coughing, wheezing, shortness of breath or activity limitations less than three times per week or with sleep disturbances (due to coughing, wheezing or shortness of breath) less than three times per month are classified as having mild intermittent disease. Individuals who experience symptoms more often than two times each week or who have night time symptoms more often than two times each month are categorized as having persistent disease (NAEPP, 1997a). With persistent disease, there is gradation of mild, moderate, or severe depending on symptom frequency. Mild persistent disease is the classification used
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for persons with regular symptom occurrence between three and six times per week; moderate persistent is used for daily symptoms; severe persistent is used for continual symptoms.

Accurate severity assessment is critical in determining the type and amount of medications required to achieve symptom control. There are two types of medications for symptom control: quick relief and control. Quick-relief medications are bronchodilators and these must be readily available at all times. Control, or anti-inflammatory medications, should be prescribed for all patients with persistent disease (NAEPP, 1997a).

Providers have a responsibility to prescribe the lowest possible dosage of quick relief and control medications to achieve symptom control while staving off medication side effects (CDC, 1990). Even though medications should be prescribed based on frequency of symptoms, it is well known that patients are under-treated resulting in uncontrolled symptoms (Duran-Tauleria et al., 1996; Ehrlich et al., 1995; Kaur et al., 1998; Mostgaard et al., 1997; Sennhauser & Kuhni, 1995; Siersted et al., 1998). Two studies confirmed that children with persistent asthma who did not have a prescription for control medications were at higher risk for asthma ER visits and hospital stays (Farber, 1998; Lieu et al., 1997). There is evidence that outcomes such as hospitalizations and quick-relief and control asthma medication refills vary widely among physician practices, particularly when comparing pulmonary specialists with general practitioners (Bartter & Pratter, 1996; Engel, Freund, Stein, & Fletcher, 1989; Vollmer et al., 1997).
Dependent-care agent has medications and supplies available at all times.

Medications and medication delivery supplies must be prescribed by a provider and then obtained by the DCA. Filling a prescription usually requires a cash payment. During a survey of 83 federally funded community health clinic sites serving low-income persons with asthma in eight southeastern states, 29% of the clinics were not able to provide needed asthma medications with 66% reporting that while medications could be provided, the medications were drug company samples. In those community health clinics who could provide medications to patients, 82% provided quick relief refills, but 46% could not provide control medication refills. In terms of supplies, only 17% could provide peak flow meters and only 35% provided spacers that maximize medication delivery (Rust et al., 1999).

Beyond payment for medications and supplies, other barriers exist for asthma medication and delivery device availability. For example, the requirement to use a bulky machine that will nebulize medications but requires electricity to power can be challenging for DCAs. Some medications need to be measured and diluted with sterile saline just prior to administration, requiring organization and availability of several types of supplies. Children often reside in more than one household or facility. In these cases, care-givers must be trained and necessary arrangements made for duplicate equipment and medication supplies.

Dependent-care agent is skilled in medication administration. The age and development of the child directs how the medications can be delivered. The most rapid
and effective approach for both quick-relief and control medication delivery is through aerosolized mist to the lungs. Oral (PO) doses compared with inhaled quick relief medications do not provide quick symptom relief, and PO doses have a higher likelihood of systemic side-effects. Metered-dose inhaler canisters are manufactured to release a precisely measured amount of medication with each activation. During activation, a deep breath must then be taken and followed by breath holding for at least five seconds (Weinberger, 1990). When not done correctly, the medication will not reach the distal airways since it enters the mouth and is subsequently expelled with the next expiration. Prescriptions for metered-dose inhalers are usually for one to four puffs at a time, each puff separated by at least one minute. For younger children without coordination and breath-holding capacity, aerosol holding chambers, called spacers, have been developed to receive the aerosol from the metered-dose inhaler into a chamber. This device permits a younger child to breathe normally through a mask with a one-way valve that, upon inspiration, evacuates the medication from the chamber. The mask must remain secure over the child's nose and mouth for several breathing cycles.

A nebulizer, using a compressed air-driven modality, delivers a continuous output of aerosolized medication through a face mask or mouthpiece. The nebulizer eliminates the need for coordination and deep, sustained breaths. Nebulizers are used widely for young children and for persons whose exacerbation is so sudden or severe, their ability to take deep breaths or even hold a breath is compromised. In the United States, only one asthma control medication has been available since October 1, 2000 for nebulization.
Prior to that time, only quick relief medications could be delivered via a nebulizer. Nebulized medications require the DCA to learn necessary skills for appropriate mixing of the dose, adding diluents such as saline, and operating required equipment. Other medication issues concern proper handling and storage; other equipment issues concern assembly, cleaning, storage, and electrical safety (Weinberger, 1990).

Dependent-care agent is knowledgeable in asthma medications, their purpose, duration of action, dosing, and when it is appropriate to repeat doses. The decision to give asthma medications versus continued reappraisal of symptoms or rushing to a clinic or ER for increasing symptoms is based upon antecedent knowledge and experience concerning the meaning of, and assessing severity of, symptoms. Knowledge about which asthma medication to give, when it is expected to start working, how long it should last, and beliefs about how many times to re-medicate before seeking a clinic provider or ER are based upon sufficient knowledge about the child and the medication. Once this is understood, a competent DCA would accurately decide on the timing of the medication and appropriateness of dose (what and how much to administer), have ready access to the medications and delivery supplies, deliver the medications effectively, and accurately judge the effectiveness of actions taken over time. Recognition of medication subResponsiveness is crucial since this suggests either ineffectiveness of the medication or an increase in the inflammatory component requiring prescription adjustment (Weinberger, 1990). Based upon a judgement about symptom control in relation to treatments delivered, the competent DCA must judge when the child’s health care provider should
be notified or when to proceed to a facility where urgent management of symptoms could occur. DCAs should be instructed that, when required frequency of quick-relief medication is more often than every four hours or when quick-relief is needed for five days in a row, the need for health care contact is certain (P. König & G. Graff, personal communication, August 5, 1998).

**Action Theme #3: Identification and Avoidance of Environmental Triggers**

There are multiple internal and external triggers as well as confounding illnesses that can initiate or aggravate airway reactivity in children (NAEPP, 1997a). The competent DCA would be responsive to the earliest signs of exacerbation after an exposure to known triggers. Figure 6 illustrates the estimative, transitional and productive self-care operations as well as four antecedent conditions for competent action relative to trigger identification and avoidance.

Based upon knowledge of, and experiences with strategies to control triggers, the DCA can take a number of actions. These include pre-medicating the child in a timely manner when exposures are probable, avoiding situations in which exposures are anticipated, attempting to alter the behavior of others who are increasing trigger exposure (e.g., tobacco smoke) by advocating on behalf of the child's requirements for a trigger-free environment, and using strategies to protect the child from the degree to which he or she is exposed to known triggers. The competent DCA must also be aware of trigger-specific strategies that will curtail the child's exposure and minimize unnecessary
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### Figure 6. Trigger control self-care operations.

Exposures. Other than smoke, triggers that precipitate exacerbations are highly individualized.

**Dependent-care agent is aware of relevant triggers.** Specific triggers causing reactive airways include allergens (pets, cockroaches, dust mites, pollens) or irritants (cold air, exercise, respiratory infections, mold, mildew, smoke, fumes, strong odors, strong feelings; Weinberger, 1990). Patients with asthma should never be exposed to tobacco smoke since it is a major precipitant of asthma symptoms in both children and adults (Chilmonczyk et al., 1993; Dekker, Dales, Bartlett, Brunekreef, & Zwanenburg, 1991; Jindal, Gupta, & Singh, 1994; Morgan & Martinez, 1992). Members of the health

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<table>
<thead>
<tr>
<th>Identification and Avoidance of Environmental TRIGGERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimative Self-Care Operations (Thinking &amp; Assessment)</strong></td>
</tr>
<tr>
<td>• Timing of symptoms in the context of recent surroundings, activities, time of day, and time of year (triggers)</td>
</tr>
<tr>
<td>• Timing of symptoms in the context of confounding illnesses (sinusitis, rhinitis, gastric reflux, viral exposure)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transitional Self-Care Operations (Judgements &amp; Decisions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I will direct my own actions</td>
</tr>
<tr>
<td>I will call my provider who will direct my actions</td>
</tr>
<tr>
<td>I will seek treatment from a facility with trained providers</td>
</tr>
<tr>
<td>I will take no action at this time but continue to appraise for worsening symptoms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Productive Self-Care Operations (Actions Taken)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement or refuse provider directed action</td>
</tr>
<tr>
<td>(No Action Taken)</td>
</tr>
</tbody>
</table>

Perform one or more of the self-care operations from this list:
- Pre-medicate with quick-relief medication
- Avoid aggravating situations (i.e., environmental conditions)
- Advocate for child in eliminating/reducing aggravating conditions (i.e., smoking)
- Attempt protection when facing aggravating conditions (i.e., cold air protection, breathing through nose)
care system have a responsibility to educate the DCA regarding relevant triggers and their management, and, in appropriate cases, health care team members should identify the need for allergy testing (Weinberger, 1990).

Dependent-care agent pays attention to symptoms associating with confounding illnesses that trigger asthma exacerbations. Once aware of environmental factors that make the child’s asthma condition worse, DCAs need to be hyper-vigilant for early signs of respiratory distress, especially during the winter. Children with asthma have a high risk of exacerbation in the winter due to infectious viruses. Children less than six years old have unique growth and development limitations that put them at risk for sudden and severe life threatening sequelae following viral and bacterial pulmonary illness exposure. The lung mucosa allows edema formation with little prompting. The narrowest part of the infant airway is at the level of the cricoid cartilage rather than the level of the vocal cords, as in adults. Since the cricoid cartilage is a complete ring, any regional inflammation can dangerously narrow the diameter (McWilliams, 1995). The peripheral airways account for approximately half of the total airflow resistance in young children, so diseases affecting the small airways such as asthma and viral bronchiolitis are usually more severe in younger children. DCAs must be prepared to take action following exposures.

Dependent-care agent understands, identifies and avoids triggers. Once DCAs are made aware of relevant triggers, they are responsible for enacting a series of trigger-specific strategies to curtail the child’s exposure to, and enhance protection from, triggers. Interventions can be taken to control both indoor and outdoor exposure. When exposures
are highly predictable (e.g., seasonal allergens), the DCA initiates a prophylactic breathing treatment for symptom control. On the same order, when exercise or play induces an exacerbation, a prophylactic breathing treatment should be given approximately 15 minutes before exertion. Exercise should be avoided when air pollution or relevant pollen levels are high (NAEPP, 1997a).

Obviously, tobacco smoke should always be avoided. Almost 40% of children are born to women who either smoke themselves or who with a tobacco user during the pregnancy. In 1999 in Missouri, almost 20% of pregnant women reported smoking during the pregnancy (Missouri Department of Health [MDOH], 1998). During the first two years of life for children born to women regularly exposed to tobacco smoke, the reported incidence of either chronic bronchitis or three or more episodes of wheezing is two and one-half times more likely. In children between two and five years of age who were exposed to tobacco smoke in utero, the diagnosis of asthma was twice as likely as those without smoke exposure (Gergen, Fowler, Maurer, Davis, & Overpeck, 1993). It is imperative that family members and friends perceive the costly link between tobacco smoke and morbidity and mortality in asthma. In order to protect the child from obvious triggers such as tobacco smoke, the DCA often has to persuade others of the serious consequences of smoke exposure. Eliminating smoking from the household of children with asthma will affect normal patterns of living among family members who smoke. If the DCA is not successful in modifying smoking behavior of persons in the household, control of symptoms will remain an elusive goal.
Dependent-care agent understands protective strategies that minimize trigger exposure. Parents of preschoolers with asthma expressed dissatisfaction with their physicians because they did not understand their ability to limit their child's exposure to triggers (Mesters et al., 1991). Mattresses and pillows can be encased in special dust-proof covers; sheets and blankets should be washed in water hotter than 130°F weekly. Regular vacuuming should be done while the child is not in the home, and indoor humidity should be maintained at less than 50 percent. Ideally, carpets should be removed and replaced with tile or linoleum; real and stuffed animals should be avoided, or at least kept out of the bed. Stuffed animals can be washed weekly in hot water. Food and garbage should never be left out to minimize incidence of cockroaches. To curtail indoor mold, leaky faucets or other sources of water leaks should be repaired and surfaces cleaned with a bleach solution (NAEPP, 1997a).

Action Theme #4: Appropriately Seeking Medical Advice in a Timely Manner

Figure 7 illustrates estimative, transitional and productive self-care operations and the antecedent conditions necessary for competent action in seeking medical advice in a timely manner. When symptoms are severe or stubborn, the DCA ultimately decides to obtain treatment advice from a more experienced family member, friend or member of the health care system either by phone, clinic visit, or emergency services. The two antecedent conditions for appropriately seeking medical advice in a timely manner includes access to treatment and availability of trained providers.
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Appropriately Seeking MEDICAL ADVICE in a Timely Manner

Estimative Self-Care Operations (Thinking & Assessment)

- Symptoms determined to be severe
- Symptoms not sufficiently controlled after medication administration

Transitional Self-Care Operations (Judgements & Decisions)

- I will try to contact someone who has more knowledge, experience, and capabilities for providing higher level decisions about what actions to take

Productive Self-Care Operations (Actions Taken)

- Call friend or family member with more experience
- Call primary provider or go to the clinic
- Go to emergency room or urgent care
- Call Ambulance

Figure 7. Seeking medical advice self-care operations.

Dependent-care agent has access to medical treatment. In order to seek medical advice in a timely manner, the DCA must recognize both severe symptoms and stubborn exacerbations not responding to treatments. To decrease morbidity and mortality, patients with asthma must be allowed access to adequate treatment through the reduction or elimination of financial barriers to the health care system. Asthma disproportionately impacts people living in poverty within urban environments (Weiss et al., 1993). There is an association between resource availability and symptom control (Billings et al., 1996), yet poor children with asthma have less doctor visits and more hospitalizations than non-poor children (Halfon & Newacheck, 1993). Other research suggests that African
Americans lack regular access to medical care and delay seeking health care, resulting in increased morbidity (Malveaux, Houlihan, & Diamond, 1993). In persons with private insurance, hospital utilization for asthma for ages 0-17 is ranked 15th highest of all reasons for hospital discharge, accounting for one percent of all discharges. This ranking compares with a Medicaid rank of 6th highest, accounting for 2.5 percent of all Medicaid discharges. Inpatient care also is more costly for public compared with private insurance, at $5,045 and $3,957 respectively (Elixhauser et al., 1996).

Common asthma-related health care costs include the diagnostic work-up, regular follow-up, measures to limit triggers, and medication/supply purchases. Out-of-pocket expenses for insurance deductibles, co-payments or uncovered items can add up quickly. In one study of the financial impact of asthma costs on family income between 1977-80, asthma expenditures accounted for an average of 6.4 percent of a family's yearly gross income, with one outlier family whose costs approached 33 percent (Marion, Creer, & Reynolds, 1985).

With a U.S. free market economy, the quest for profitable health care has influenced the design of delivery systems (Herzlinger, 1997). Under fee-for-service, every time the health care delivery system is accessed, fees are generated. When fees are guaranteed through either the insurer or patient out-of-pocket payments, hospitalizations and ER visits could produce a profit for both providers and institutions. In terms of asthma care in this model, it may be more profitable to allow patients to be in crisis.
Further, expensive medications that could achieve a state of symptom control might be too expensive for some families to afford.

Under capitated managed care, economic incentives are altered 180 degrees from the fee-for-service model (Herzlinger, 1997). In the capitated model, each enrollee (or their sponsor) contributes a fixed monthly premium to the health care system. Regardless of how much treatment the health plan member requires from the health care system, the monthly premium does not change. The managed care model is profitable only when members are 'healthy'. For a managed care company to maximize profits, programs or incentives must be designed to contain expenses of 'unhealthy' members. This can be achieved by subsidizing expensive, but effective, medications and by maximizing opportunities for prevention (getting care in the lowest cost delivery site) in order to decrease the need for unexpected and more expensive emergency care. Thus, in the theoretical managed care model, economic incentives are aligned to spend health care dollars on activities designed to ensure wellness. Interventions designed to develop DCA competency for successful asthma management is one example (Kongstvedt, 1993).

Payment for health care is not the only barrier to access. Almost half (47%) of Harvard managed care members who sought treatment in an urgent care center were unable to get an appointment with their provider within the next day or two. When examining all participants who sought treatment at the urgent care center (regardless of provider office hours), 41% claimed it was not easy to get an appointment with their provider when sick or needing medical advice (Plauth & Pearson, 1998).
Dependent-care agent has a relationship with a health care provider who is available for medical concerns. Gate-keeper managed care models are believed to increase the likelihood of containing costs as continuity relationships are established between the patient, family and health-care team members (Gill & Mainous, 1998). With chronic illness management such as for asthma, provider continuity is believed to enhance co-management of the illness because patients are trained to identify and avert physiologic or emotional crises and contact their provider when symptoms are no longer controllable. When comparing seven indicators of primary care quality in adults with chronic diseases, access to services was highest among capitated members, but continuity was highest in fee-for-service plans (Safran, Tarlov, & Rogers, 1994). To complicate matters, achieving higher efficiency systems often leads to increasing patient volume during office hours. Zyzanski, Strange, Langa, and Flocke (1998) compared high-volume physician practices with low-volume practices and found that there was greater efficiency with high-volume practices providing similar services in a shorter amount of time. However, greater economic efficiency translated into meaningful trade-offs in overall patient outcomes. The high-volume practices had less preventive service delivery, lower patient satisfaction, and less positive doctor-patient relationships.

The NHLBI asthma diagnosis and treatment guidelines emphasize the value of patient-provider partnerships, or ‘continuity relationships’ (NAEPP, 1997a). Other researchers have found that continuity relationships make a difference in outcomes. Examining two years of Delaware Medicaid claims, Gill and Mainous (1998) found that
higher provider continuity was associated with a lower likelihood of hospitalization for any condition. When comparing the effect of forced discontinuity between stable insurance coverage and employer mandated insurance coverage changes, Flocke, Strange, and Zyzanski (1997) concluded that the quality of primary care was less dependent on the particular payment system than on the maintenance of the patient-provider relationship.

Asthma symptom control improves when patients form continuity relationships with members of the health care team (Billings et al., 1996; Dinkevich, Cunningham, & Crain, 1998). In one study of a comprehensive asthma outreach education program where both ER visits and hospitalizations were significantly reduced, the partnership and trust that developed between the outreach nurse and the patients contributed to decreases in utilization (Greineder, Loane, & Parkes, 1995). In another study, positive results were associated with the establishment of a provider relationship with the child and family (Tinkelman, Raum, & Lung, 1997). Using a large capitated health plan claims database to predict risk of asthma ER visits or hospitalizations, Lieu et al. (1997) found that children without a personal provider were more likely to be subsequently hospitalized. They also concluded that members with three or more physicians prescribing asthma medications during a previous six month period were more likely to be hospitalized.

Under a gate-keeper model, patients are assigned to a primary care provider (PCP). It is believed that this model aligns incentives for continuity relationships, thus better preventive services, patient education, and establishment of a coordinated plan of care. As with any chronic disease, finding a member of the health care team who is able
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and willing to partner with the patient is highly important. Practically speaking, the child needs to be seen on a regular basis by the same provider. When this happens, relationships can be forged, theoretically driving improvements in outcomes. From Orem’s (2001) perspective, the relationship between positive outcomes and continuity relationships is explained because, as health care team members regularly assess a DCA’s ability to manage an illness, providers adjust treatment plans based on DCA action limitations.

DCAs must feel confident in being able to access their PCP any time of the day or night for questions or simple reassurance about their decisions for action. DCAs must be comfortable in their relationships with PCPs so the DCA can be frank about perceived limitations in following the treatment plan and in reporting their child's tolerance to that plan. The PCP needs to take the time to assess limitations in the DCA’s capacity for plan complexity and adjust the treatment plan accordingly. Clearly, the value of continuity relationships between the child, DCA, and PCP are an important link to successful asthma management. When continuity is lacking, the worst case scenario could occur: unclear messages about management, incorrect medication prescriptions, and a DCA whose limitations are not understood or addressed by any member of the health care system.

Design of a Nursing System to Improve Asthma Symptom Control

Using the qualitative template analysis technique (Crabtree & Miller, 1999) to understand the pediatric asthma literature from Orem’s (2001) theoretical perspective,
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four action demand themes for a competent DCA have been named and described. During the template analysis, 14 conditions were uncovered that are antecedent to the DCA acting in a competent manner. Stated differently, when any of the 14 antecedent conditions are not present, the DCA will have limitations in achieving the goal of adequate asthma symptom control.

Table 2 summarizes the 14 antecedent conditions. The presence or absence of each antecedent condition is influenced by either DCA factors, health care system factors, or both. In fact, 11 of the 14 antecedent conditions are shared by both the DCA and health care system. The extent to which the health care system directly and indirectly influences development of competency cannot be ignored. Table 2 summarizes the antecedent conditions for each of the four action demand themes. The two left columns use an “✓” to denote those antecedent conditions under the control of the health care system, the DCA, or both. The 12 health care system conditions have been grouped into five themes. These five themes would be present in an optimal health care system: accurate asthma diagnosis, appropriate treatment, sufficient asthma education, and access to, and a continuity relationship with, a provider. Programs targeted toward optimizing antecedent conditions would result in improved asthma symptom control.
Table 2

Antecedent Conditions Known To Influence Asthma Symptom Control Competency

<table>
<thead>
<tr>
<th>HCS factors</th>
<th>DCA factors</th>
<th>Antecedent conditions for taking appropriate and timely action</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td><em>Competent action set #1: Detecting, interpreting and monitoring symptoms</em></td>
</tr>
<tr>
<td>✓ (Diagnosis)</td>
<td>✓</td>
<td>DCA believes the diagnosis of asthma is relevant</td>
</tr>
<tr>
<td>✓ (Diagnosis)</td>
<td>✓</td>
<td>DCA has the ability to appraise</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA is aware of and able to discriminate meaningful asthma symptoms</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA keeps time available to assess and to take action</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Competent action set #2: Regulation and administration of medications</em></td>
</tr>
<tr>
<td>✓ (Treatment)</td>
<td></td>
<td>DCA has appropriate medications prescribed</td>
</tr>
<tr>
<td>✓ (Access)</td>
<td>✓</td>
<td>DCA has medications and supplies available at all times</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA is skilled in medication administration</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA is knowledgeable in asthma medications, purpose, duration of action, dosing, and when it is appropriate to repeat doses</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Competent action set #3: Identification and avoidance of environmental triggers</em></td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA is aware of relevant triggers</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA pays attention to symptoms associating with confounding illnesses that trigger asthma exacerbations</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA understands and takes strategies to identify and avoid triggers</td>
</tr>
<tr>
<td>✓ (Education)</td>
<td>✓</td>
<td>DCA understands protective strategies that minimize trigger exposure</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Competent action set #4: Appropriately seeking medical advice in a timely manner</em></td>
</tr>
<tr>
<td>✓ (Access)</td>
<td>✓</td>
<td>DCA has access to medical treatment</td>
</tr>
<tr>
<td>✓ (Continuity)</td>
<td>✓</td>
<td>DCA has a relationship with a health care provider who makes self available for medical concerns</td>
</tr>
</tbody>
</table>

*Note.* HCS = health care system; DCA = dependent-care agent
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Assessment of Nursing System Need at MUHC

Given obvious clinical imperatives uncovered from the articulation of the asthma literature with Orem's theory (2001), a needs assessment was conducted at MUHC to determine the feasibility for investing in a program to improve care for children with asthma. The results of the needs analysis are now summarized.

In Missouri, dispersion of the population, resources, and clinical expertise over large geographic distances coupled with high childhood poverty and adult smoking rates provide considerable challenges for successful implementation of national asthma guidelines. MUHC is the largest medical center in mid-Missouri. As part of a public land-grant university, MUHC is the referral base for large rural areas, where the population is widely scattered. The MUHC service area is a 100-mile radius that includes 18 rural counties and 127,000 children. Eight of the 18 counties have been designated as medically under-served areas with a need for 10-20 additional primary care providers (MDOH, 1997). Missouri is ranked second in the nation in adult smoking prevalence and almost 20% of pregnant women smoke (MDOH, 1998). Exposure of Missouri children to second-hand smoke throughout childhood is a significant problem for child health in Missouri. Given CDC (1996) asthma prevalence estimates, there are approximately 9,000 children with asthma in the MUHC service region.

The MUHC system consists of University Hospital and Clinics, Children's Hospital, Ellis Fischel Cancer Center, Columbia Regional Hospital in Columbia and Missouri Rehabilitation Center in Mt. Vernon, MO. Academic components include the
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Schools of Medicine, Nursing and Health Related Professions. University Physicians (UP), the group practice plan for the faculty of the University of Missouri School of Medicine, is the largest group practice in mid-Missouri.

Access to medical insurance, thus affordable health care, is critical for asthma symptom control. Nineteen percent of Missouri’s citizens fall below the federal poverty line (FPL), but 35 percent of Missourians fall under 200% of FPL. One in four children under 18 years of age are enrolled in Medicaid as their primary insurer. Beginning in 1997 in Missouri, care to uninsured children was massively expanded through the “MC+” program. The MC+ program is a managed care Medicaid program that uses the gatekeeper model (Health Care Financing Administration [HCFA], 1997). In 1998, uninsured children whose gross family income was up to 300% of FPL became eligible for MC+. This change allowed an additional 90,000 uninsured Missouri children to become eligible for health plan coverage (HCFA, 1998; Missouri’s Health Insurance Program for Children, 1999). In response to the MC+ expansion, the University of Missouri created Missouri Care, a health plan serving Medicaid families in the 18 central Missouri counties. Since that time, Missouri Care has continued to expand from 766 children in January 1998 to 12,120 by January 1999, 14,876 by January 2000, and 19,032 by January 2001 (T. Cheek, personal communication, May 4, 2001).

A clinical analysis of MUHC asthma practices performed in early 1998 revealed that only Pediatric Pulmonary Specialists consistently used the NHLBI guidelines. These providers saw only a small proportion, usually the sickest, of all children with asthma.
There were no standardized patient education materials, AMPs, symptom diaries, or even an educational plan for parents before hospital discharge. There was no consistency in determining which children should be seen by a pulmonary specialist and which children could be managed by generalists. A fiscal analysis of MUHC childhood asthma utilization was then performed. The analysis compared mean hospital charges for inpatient asthma admissions in fiscal year 1997 with a national Medicaid average and found that MUHC charges were 55% higher (C. Kivlahan, personal communication, February 3, 1998).

Given these findings and several high level administrative discussions, a collaborative agreement to improve childhood asthma outcomes was signed by administrative and clinical leaders from MUHC and Missouri Care. Chapter 3 now describes the design and implementation of an intervention targeted to reduce theoretical health care system gaps.
CHAPTER 3

METHODS

Chapter 2 described required actions and potential limitations of those actions relative to the population of children with asthma. Chapter 3 now presents the nursing system design and its implementation as well as the plan for examining changes in symptom control in a population of children. If the design and implementation of the nursing system are successful, improvements in asthma symptom control in children are expected. Post-intervention results will affirm or refute the effectiveness of the nursing system design and the standardized implementation of that system among practitioners who treat children with asthma within the MUHC health care system.

Two methodology sections are necessary to describe the two key interventions in this study. Specifically:

1. Methodology for Implementing the Nursing System – The nursing system intervention is designed to close health care system gaps surrounding pediatric asthma care and treatment. The number of children with asthma in Mid-Missouri is estimated at 9,000 (MDOH, 1997). Children with asthma can be cared for in a number of health care delivery sites (clinics, ER, hospitals), by a variety of physician and advanced practice nurse providers (representing family practice, pediatrics, or specialties such as pulmonology and allergy), and professions (nurses and respiratory therapists). In order to assure that these children benefit from the ‘gap-reduction’ intervention, the intervention must be consistently applied throughout multiple delivery sites and within multiple professional groups. The first methodology section in this chapter
describes the complexities surrounding implementation of a standardized nursing system across multiple sites and professionals.

2. Methodology to Detect Symptom Control in Children With Asthma – If the nursing system was successfully designed for the multiple delivery sites and professionals and, if it was sufficiently implemented, an improvement in clinical outcomes, specifically asthma symptom control, is expected. In particular, symptom control improvements are quantified by less hospital and ER visits, and more clinic visits for asthma. These bi-directional changes are expected following implementation of the nursing system and these changes are expected to be present in the group of children who had providers who had maximal involvement in the nursing system. Thus, this second methodology section details the specific research questions, hypotheses, data source, definition of terms, and analytic aims to measure the effect of the nursing system on asthma symptom control in children.

Methodology for Implementing the Nursing System

The nursing system, as the intervention, was designed and implemented to close identified health care system gaps that have been shown to influence development of DCA competency (refer to Table 2). The five identified health care system gaps include under-diagnosis, under-treatment, access barriers, incomplete or ineffective parent/child education, and poor provider continuity. The nursing system, implemented on October 1, 1998, has consisted of a cadre of actions designed to optimize asthma diagnosis, treatment, access, education, and continuity. Participants involved in the adoption of the
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nursing system included health care team members from three different professions, three hospital units, one emergency department, and six outpatient clinic sites. These participants are now described.

Participants

Because children with asthma are treated in a variety of care settings by multiple providers, one requirement of the nursing system was to include the portions of the MUHC enterprise where children with asthma are treated. A firm commitment to health care system alignment was made by participating health plan, providers, and service sites (see Figure 8).

Figure 8. Participating health plan, providers, and service sites.
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Health Plan

As described earlier, access to the Medicaid MC+ health care coverage was expanded significantly in 1997 and 1998. In central Missouri at that time, Medicaid eligible children could choose from among three insurance plans who had contracts with the state to provide MC+ coverage for children ages 0-17. The three plans were Healthcare USA, Missouri Care, and Care Partners (D. Checkett, personal communication, September 5, 1998). Only Missouri Care contracted with MUHC and UP as network providers so Missouri Care was a logical participant. The partnership with Missouri Care proved critical in alignment of health plan incentives that directly and indirectly influence asthma symptom control.

A partnership agreement with the largest commercial insurance health plan in mid-Missouri was also sought, but this offer was declined. The rationale for declining participation was that, as a national health plan, relevant services had already been contracted (telephone consultations to persons with expensive claims for asthma care). No other commercial health plan was approached to participate as a partner in the intervention.

Providers

In terms of the estimated 9,000 children with asthma in the MUHC service region, some provider groups were maximally involved in the intervention while others were either minimally involved, or not involved at all. UP and Family Health Center (FHC) providers were maximally involved.
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UP is mid-Missouri’s largest group practice with over 300 physicians in almost 70 specialties. UP also staffs University Hospital, Children’s Hospital, and outpatient clinics located throughout Columbia and surrounding communities (University of Missouri-Columbia, 2001d). UP providers from both Family and Community Medicine (family practice), Child Health (pediatrics) and Emergency Service (ES) agreed to maximal participation. Although not affiliated with UP, physician and nurse practitioners at FHC in Boone County enthusiastically requested to be included as maximally involved participants due to the high-risk population that FHC serves and their strong commitment to evidence-based medicine.

Minimal involvement occurred when providers, not affiliated with UP or FHC, contracted with Missouri Care as a PCP for children members. The specific ‘minimal involvement’ (and ‘maximal involvement’) activities are described in a later section.

Sites

Prior to site selection, the MUHC gap analysis was presented to site-specific leaders who then enthusiastically agreed to participate. Within each care delivery site, these leaders began to seek agreement from medical providers, nursing and respiratory therapy professionals. Within six months, full support and agreement to participate was obtained from four hospital areas and six outpatient clinic sites.

The four hospital areas selected were University Hospital (UH) ER, and Children’s Hospital Pediatric Unit, Adolescent Unit and Pediatric Intensive Care unit. The UH ER is the only Level I Trauma Center in mid-Missouri and serves as a tertiary...
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care referral center and a regional resource center. More than 25,000 patients seek treatment at UH ER annually (University of Missouri-Columbia, 2001c). Children's Hospital, a hospital within University Hospital, is mid-Missouri's largest and most comprehensive pediatric health-care facility. Dedicated exclusively to meeting the health-care needs of children, the hospital has more than 115 beds. The Pediatric Unit is a 29-bed unit specially designed for medical and surgical pediatric patients. The Adolescent Unit in Children's Hospital is a 16-bed adolescent unit designed to meet the unique needs of teen-age patients. The Pediatric Intensive Care Unit is an 11-bed unit in which management of critically ill and injured children takes place within the context of a full range of high-tech services, including ventilatory support and invasive and noninvasive hemodynamic monitoring (University of Missouri-Columbia, 2001a).

The six outpatient clinic sites participating in the intervention consisted of five UP clinics and one community health clinic. Two UP Pediatric clinics, both in Columbia, represent generalist care ("Green Meadows Pediatrics") and specialist care ("Pediatric Pulmonary/Allergy Clinic"). Green Meadows Pediatrics has an average visit volume exceeding 20,000 visits annually (T. Nations, personal communication, October 17, 2001); Pediatric Pulmonary Clinic has approximately 1,700 visits annually (A. Painter, personal communication, October 24, 2001). Family and Community Medicine UP providers manage three outpatient clinics with approximately 80,000 visits annually (University of Missouri-Columbia, 2001b). Two of the three FP clinics serve rural populations in Fayette and Fulton; one serves the Columbia area. The FHC, located in
Columbia, serves qualified families in Boone and surrounding counties. This federally qualified community health center primarily serving Medicaid and uninsured persons has approximately 26,000 outpatient visits annually (C. Kivlahan, personal communication, October 14, 2001). FHC providers are not UP providers, but were maximally involved in the nursing system.

**Methodology**

Because implementation of a multi-faceted intervention was planned across a large volume of participants and service sites, the continuous quality improvement (CQI) approach was taken to operationalize the nursing system across participants and sites. CQI is a method of continuously examining processes and making them more effective (Deming, 1993).

*Continuous Quality Improvement*

CQI was developed in a business environment where solving problems was common (Deming, 1993). The CQI methodology resulted from the application of specific sciences to understand, adapt, and ultimately achieve improvements in daily work (Blumenthal & Scheck, 1995). The theoretical foundation of CQI is based on systems theory and involves human and non-human sciences, as the focus has been on understanding and resolving processes that influence production quality. Human sciences directly affecting the practical application of CQI include psychology and the science of learning. Specifically, these sciences inform systems production when factors such as group dynamics, conflict resolution, motivation, and creativity are considered. The use of
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mathematical sciences for understanding variation, prediction, and experimentation are examples of the applications of non-human sciences. In summary, CQI was initially developed from a business model with the purpose of achieving improvements in outputs from daily work (Deming, 1993).

Pediatric Asthma Continuous Quality Improvement Team

In December 1997, before a team was assembled, this study’s principal investigator (PI) was hired full-time to serve as the program manager. Shortly thereafter, asthma expert professionals were sought for voluntary team membership and two physician champions, one representing family practice and one representing pediatrics, volunteered to co-lead the team. Two nationally renowned pediatric pulmonologists and one pediatric nurse practitioner within the MUHC Child Health Department also agreed to join the team. These MUHC experts had been providing specialty ambulatory services to more than 1,100 children in mid-Missouri (B. Francisco, personal communication, August 5, 1998).

Other team member volunteers were added between March and October 1998 when various program design decisions unfolded and key representatives were needed to assure successful implementation. In addition to adding team members who represented and had direct authority over certain participating sites, membership selection decisions were based upon proven leadership skills, enthusiasm, and commitment to improving care for children. Team membership was voluntary and only secured after each potential member was oriented to expected roles and contributions.
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Prior to implementation of the nursing system on October 1, 1998, team membership included attending and resident leaders in Child Health, Family and Community Medicine, Pediatric Pulmonary, Family Health Center, Emergency Medicine, and Missouri Care. The team also included professional and nurse leaders representing administration across the participating sites to include the 24-Hour Telephone Triage Line and Missouri Care representation of case management services. Twelve of the original 18 CQI team members remain on the team 36 months after implementation.

Between March and November 1998 (six months before and two months after nursing system implementation), team meetings were held almost every week. During this time, all activities centered around creating, integrating, and building an infrastructure to bridge the health care system gaps identified from the literature. Team meetings were reduced from weekly to every other week between December 1998 and August 1999. During this time, lessons were continually learned and adjustments made to program components. By the end of the first year, program components rarely required revision. Thus, beginning in September 1999, one year after implementation, monthly team meetings primarily consisted of oversight.

Materials

The MUHC gap analysis (refer to Chapter 2) revealed that systematic processes to support asthma symptom control were not in place. For example, not one generalist physician surveyed admitted to using AMPs, but each agreed to adopt an AMP template if one was developed for them. Although UH and Children's Hospital had a pre-
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established strategy for standardizing and documenting population-specific patient education, there was not a pre-established education plan for either adults or children with asthma. There was no process in either the UH ER or Children’s Hospital for routinely communicating treatment plans back to the child’s provider after an ER visit or a hospital stay. There was no established process to schedule next business day appointments for persons discharged from the ER. Pulmonary consultations had only occurred for the most complex cases, usually reserved for children admitted to the Pediatric Intensive Care Unit. In summary, the gap analysis identified the specific materials and processes to be created and showed the team that significant behavioral and system level changes would be necessary for successful implementation. Materials and processes created and implemented to optimize asthma diagnosis, treatment, access, education, and continuity are now described.

Appropriate Diagnosis and Treatment

Team consensus for best asthma practices was expedited due to the availability of the 1997 NHLBI Guidelines for the Diagnosis and Management of Asthma (NAEPP, 1997a). However, the NHLBI guidelines are almost 150 pages in length and, an official excerpt of the original guidelines, the Practical Guideline for the Diagnosis and Management of Asthma, were also quite long at 50 pages (NAEPP, 1997b). A pediatric-specific version of the guidelines, although using large font and colorful pictures, was 150 pages (American Academy of Allergy, Asthma & Immunology, 1999). In order for clinicians to have access to and follow the guidelines, the CQI team distilled the
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guidelines down to two single page, two-sided reference documents. One version guided outpatient, or preventive, management (see Appendix A); the other addressed emergency, or crisis, management (see Appendix B). Pre-printed physician orders for UH ER and Children's Hospital were created to translate these guidelines into practical hour-to-hour patient care activities.

Once the one-page guidelines were approved, an overall asthma curriculum was developed for educational sessions with (maximally) participating providers. Curriculum emphasis was on diagnostic criteria and appropriate medication therapies. Beginning in September and October 1998 and repeated annually through 2001, the CQI team members used this curriculum for multiple group training sessions until over 100 providers across all participating sites were trained.

Unexpectedly, this massive training effort resulted in the emergence of site leaders (providers) who tried various approaches to systematizing asthma care. For example, in one outpatient clinic, some patients were scheduled for up to four follow-up appointments over a six-week period after an exacerbation. During these appointments, the DCA was asked to return with completed symptom diaries. Follow-up visits allowed the provider to assess the effectiveness of the prescribed medications and to reinforce education about asthma management.

Beyond translation of the guidelines and provider education, the nursing system also 'required' pulmonary consultation in those children whose asthma exacerbation was so severe the child was hospitalized. Ordering the pulmonary consultation was left to the
admitting physician. Pediatric pulmonary consultation for inpatients was an unpopular intervention as many of the residents and attendings felt they had sufficient medical preparation to provide the same standard of care achieved from pulmonary consultations. Many meetings and educational sessions were held to air these concerns. Ultimately, the non-pulmonologist physicians began to recognize the value of the consultation report (specific diagnoses and treatment regimen).

Dissemination of the one-page guidelines to the minimally involved providers occurred through the leadership of the Missouri Care medical director. In 1999, a Missouri Care-sponsored mailing was targeted to all providers who had been assigned to children members 'suspected' of having asthma. The designation of 'suspected' was determined after a very purposeful process of 'case finding'. The case finding method identified suspected children using three data mining approaches. These approaches included (a) the identification of billed claims for either asthma specific utilization or home nebulizer rental, (b) using initial member registration information where the parent had given a documented history of asthma, or (c) manually programmed asthma alerts that had been entered into the child’s membership file by case managers (usually after phone consultations with parents in which asthma care questions had been asked and answered). Using these case finding approaches during the winter of 1999, over 700 children were labeled as possibly having asthma. PCPs of these children (both maximally and minimally involved providers) received a cover letter, signed by the Missouri Care medical director, emphasizing an evidenced-based approach to managing children with
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asthma. The letter introduced five attachments. The five attachments included (a) one copy of the abbreviated (50 page) national guideline (NAEPP, 1997b), (b) one copy of both preventative and crisis one-page MUHC asthma consensus guidelines, (c) names and dates of birth of children assigned to the PCPs who were identified as having a 'suspected' asthma condition from the case finding methods, (d) copies of blank AMPs and (e) symptom diaries for each child on the case finding list. PCPs were informed in the letter that the parents of these children would receive sent an informational letter stating that asthma symptoms could be controlled, especially when an individualized AMP was developed between the provider and parent. The providers were told these parents were being sent a blank AMP and that parents were encouraged to make appointments with their provider to complete the AMP. The provider letter included Missouri Care contact names, phone numbers, and email addresses for questions or to schedule training about either evidence-based asthma management or how to individualize an AMP.

At the same time, a similar letter was prepared by the Missouri Care medical director and mailed to the parents of the 700 children. The letter was intended to be educational, informing parents that if their child had recurrent wheezing or a diagnosis of asthma, an AMP was the best way to control symptoms. The letter informed parents that they could make an appointment with their PCP, at no charge, to individualize an AMP for their child. A blank copy of the AMP and a Missouri Care magnet was included in the mailing.
The third mailing was sent to some maximally involved PCPs in the fall of 2000. Prior to this mailing, all children with UP and FHC providers and health care claims for asthma during a one-year period were identified. Twenty percent of identified children (n = 74) were singled out after ranking total asthma charges during that year from highest to lowest. The claims from the 20% of children with the highest charges were translated into a succinct and meaningful patient profiling report for provider use. The format for the profile, the Pediatric Asthma Utilization Summary (PAUS), was a one-page document with colorful graphics. This format was intended to attract the PCPs attention and to quickly convey symptom control recommendations. In addition to symptom control recommendations, the PAUS included information about demographics, utilization, continuity, missed appointments, and medication refill patterns (see Appendix C). A parent-friendly version was also printed and mailed to the child’s parent with specific messages about what the parent could do to improve their child’s symptoms (see Appendix D). This mailing also included three asthma symptom diaries, one AMP, and, for those children older than 5 years, a peak flow meter.

In summary, strategies to promote appropriate diagnosis and treatment over the 30 months of the nursing system involved UP and FHC providers in a maximal way (regular asthma educational sessions, reminders, meetings, email correspondence, and results of process monitoring). But, for non-UP and non-FHC Missouri Care providers, informative mailings were intended to influence adoption, translation, and dissemination of the
national asthma guidelines, so these providers were at least 'minimally involved' in the nursing system.

Access

The partnership with Missouri Care allowed for dialogue surrounding health plan-specific barriers interfering with optimal care, such as payment for certain medications and treatments. One concern involved the Missouri Care formulary. A formulary is a list of medications and supplies that are reimbursed by the health plan when prescribed. In addition to formulary restrictions, health plans can limit the number of prescriptions covered during health plan defined intervals. All recommendations for revision were ultimately approved by the Missouri Care medical director and included removing and adding certain asthma medications to the formulary, as well as changing certain allowable 'limits' on the number of medication refills and adding coverage for aerosol delivery chambers (spacers). These revision approvals resulted in the availability of multiple asthma medication refills and nebulizers in different households for children who lived in more than one location (e.g., divorced parents who share custody).

The availability of a 24-hour telephone triage nurse line, staffed by MUHC registered nurses, was mandated as part of the Missouri regulations for Medicaid MC+ plans. This regulation was intended to assure access to trained persons who could assist the DCA to make treatment decisions during, in this case, asthma exacerbations. Before implementation of the nursing system, general asthma triage telephone protocols were
reviewed and modified to be consistent with the emergency guidelines adopted by MUHC providers.

For those children who presented to the ER with an asthma exacerbation, a new system was created so that, prior to discharge from the ER, a 'next-business day' appointment could be scheduled for UP providers. For non-UP providers, DCAs were instructed to contact their primary provider at 8 am the next-business day after the ER visit to make an appointment. In order to maximize continuity in the plan of care, DCAs were also given time-limited AMPs that detailed every action to take during the time following ER discharge up to the time of the next business day appointment.

In summary, the literature provided evidence that a number of access barriers interfered with development of DCA competency to control asthma symptoms. The design of the nursing system addressed these access barriers through several processes and activities. These included (a) the overall minimization of financial access barriers that MC+ provides, (b) Missouri Care formulary revisions, (c) consistently written MUHC asthma messages for the 24-Hour 'advice' lines to deliver, and (d) the immediate availability of a next business day appointment following an exacerbation requiring an ER visit.

Dependent-Care Agent and Child Education

During the gap analysis (prior to nursing system design), a large variety and volume of non-standardized asthma educational materials were found at the participating ER, hospital, and clinic sites. This finding prompted a team goal to develop and use
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standardized asthma educational materials across participating sites. Since MUHC baseline data for fiscal year 1997 revealed that 73% of the children treated for asthma and enrolled in Medicaid were younger than six years, materials needed to be relevant for parents with young children (C. Kivlahan, personal communication, February 3, 1998).

Educational materials needed to be structured for simplicity in medical terminology, graphics, and use interactive games where content allowed. Because there are a variety of age-specific medications and delivery devices, separate educational materials that could be used to ‘mix and match’ an individualized treatment plan for different medications, delivery devices, and triggers were developed. A task force had been established to develop standardized asthma materials. The task force decided that the format of educational materials should be one or two page sheets, with lots of white space and graphics, and each material should focus on distinct topics. A total of 26 unique instructional sheets were developed. The task force then determined that all children with asthma (or suspected asthma) had common learning needs, and 8 of the 26 instructional sheets would meet common learning needs. To this end, the task force designed a folder to contain these eight instructional sheets, and it is called the ‘Basic 8’.

Even though the 26 standardized instructional materials seemed thorough, from a SCDNT (Orem, 2001) perspective, two other tools were needed to develop DCA competency. The first, the Asthma Symptom Diary, was intended to serve as a self-monitoring tool to build skills and habits in regular monitoring, quantifying and documenting the child’s symptoms (see Appendix E). The daily symptom diary
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documentation is valuable to PCPs because total days of asthma symptoms are obviously
a quantifiable marker of severity. As asthma severity increases or decreases, asthma
medications are adjusted. Symptom diaries facilitate accurate medication adjustments
(NHLBI, 1997a). The second tool combines self-monitoring instructions about the four
ideal sets of action onto an AMP (see Appendix F). DCAs are encouraged to keep the
AMP in an easy-to-find location. One side of the plan categorizes symptoms according to
the traffic signal metaphor with ‘green light’ indicating ‘a good day’; ‘yellow light’ is a
‘caution day’, and ‘red light’ is a ‘stop and call day’. Terms used for symptom monitoring
across these three traffic signal categories were intentionally created to be simple,
meaningful, and memorable for a variety of age groups. For assessment term examples,
moving from green, to yellow, to red, AMP wheezing terms are “no wheezing”, “some
wheezing”, and “lots of wheezing”. The coughing terms are “no coughing”, “some
coughing”, and “lots of coughing”. Relative to the parent’s assessment of the child’s
activity level, AMP terms are “active and breathing well”, “less active or playful”, and
“too short of breath to run or play”. Once the DCA has assessed the symptom category
(green, yellow, or red light), the AMP guides decision-making.

MUHC added the AMP and symptom diary to the Basic 8 folder. The titles of all
26 Caring for Kids With Asthma instructional sheets and the two self-monitoring tools,
grouped according to the four ideal sets of action, are listed in Appendix G. A system for
stocking and replenishing Basic 8 supplies was established in all participating sites. In the
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30 months between October 1, 1998, and March 31, 2001, over 3200 Basic 8 folders were produced and distributed (A. Reberry, personal communication, April 3, 2001).

Competency-based training for staff in participating sites was scheduled during September and October of 1998 and has been repeated annually through 2001. The specific training objective was to develop staff skills to train parents and children effectively in self-assessment, trigger avoidance, medication knowledge/delivery skills and when/how to contact a provider. The training format included multiple small group sessions educating over 150 nurses and respiratory therapists across participating sites each year.

Staff competency-based training, however, was not enough to ensure the DCA and child received adequate asthma education. Participating sites designed approaches to identify those DCAs who would benefit from asthma teaching. For children presenting to the ER with an asthma exacerbation, the respiratory therapists (RT) took the lead in notifying providers and nurses of parents/children who should be taught. For hospitalized children, nurses have been primarily responsible for teaching and documenting learning outcomes according to the newly created DCA teaching plan, the *Asthma (Ages 0-17)* Patient Teaching Record.

For children treated in the ER or hospital for an asthma exacerbation, outpatient clinics were notified of an ‘asthma follow-up appointment’ using an alert. An alert was entered into the scheduling software when the appointment was scheduled. Thus, the alert was printed on clinic schedules to remind staff of the need to reinforce asthma learning.
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objectives and skills development. The alert also served as a reminder to locate and review ER and hospital post-discharge faxes prior to the patient-provider encounter. Responsibility for outpatient teaching is shared between clinic providers and nurses with documentation of teaching on AMPs.

Continuity

The fifth and final potential health care system gap addressed by the nursing system was continuity. Missouri Care members must select, or be assigned to, a PCP in the Missouri Care network. This 'gate-keeper' model was built into the Missouri Care structure because the establishment of a relationship between an accountable PCP and his or her assigned members is theoretically fostered, allowing precise management and anticipation of typical health care needs and prevention services (Gill & Mainous, 1998). Although the gate-keeper model has been designed to foster continuity, MUHC clinics are staffed by UP providers who have research, teaching and clinical obligations. For children who rapidly develop urgent symptoms, it is difficult to schedule a same-day or urgent appointment with their PCP. Since the CQI team recognized provider continuity was a challenge, the team determined that a reasonable substitute was for the outpatient clinic provider to receive a faxed copy of all asthma-related treatment records after the ER or hospital visit, but before the pre-scheduled follow-up appointment.

Procedure

Figure 9 illustrates a summary of the nursing system implemented on October 1, 1998. The nursing system was simultaneously adopted by 10 participating sites and by
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<table>
<thead>
<tr>
<th>Nursing System Interventions</th>
<th>Participating Sites</th>
<th>Participating Providers</th>
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<tr>
<td><strong>Health Care System Gaps</strong></td>
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<td>1. Appropriate Diagnosis</td>
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<td>2. Optimum Treatment</td>
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<td>3. Access</td>
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<td>Formulary Changes</td>
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<td>• 240 Nurse Triage Phone Line</td>
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<td>• Pre-scheduled F/U Appointments</td>
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<td>4. Parent/Child Education</td>
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<td>• Symptom Diary</td>
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<td>• Patient Teaching Record</td>
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<td>• Parent Utilization</td>
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<td>5. Continuity</td>
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<td>• Treatment plans faxed</td>
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**Figure 9.** Summary of the nursing system.

three groups of health care professionals. The procedures established for day-to-day activities necessary to ensure satisfactory implementation of the nursing system are now described.

**Inclusion Criteria**

Inclusion criteria for implementation of the nursing system were for: (a) children ages 0-17, (b) presenting to either the University Hospital (UH) ER or to any of three Children's Hospital Units (Pediatrics, Pediatric Intensive Care, or Adolescent Unit), (c) treated with albuterol by either nebulizer or metered dose inhaler; and (d) satisfied exclusion criteria. From these, children who had a previous or current diagnosis of
asthma or who had a history of at least one other wheezing episode (as determined by history or home medications that included albuterol) were included. Also, children without an asthma diagnosis but who would be going home on prescriptions for inhaled anti-inflammatory medications were included.

**Exclusion Criteria**

Children with significant chronic respiratory or neurologic disorders were not included. These exclusion criteria were adopted because, while these severe chronic conditions often have an asthma component, these DCAs receive significant training and assistance to manage their home-bound children. Examples of excluded conditions included children with cystic fibrosis, bronchopulmonary dysplasia, or cerebral palsy.

**Emergency Room Procedure**

When a child was identified as meeting the inclusion criteria in the UH ER, physicians, nurses, and respiratory therapists followed certain steps prior to the child’s discharge from the ER. Specifically, children who were treated in the ER and discharged home should have received (a) education about asthma using the Basic 8, (b) a time-limited AMP, and (c) pre-scheduled next business day appointment. This time-limited AMP was completed by both nurse and physician to include (a) the scheduled follow-up visit date, time, location, (b) follow-up provider name, and (c) medication instructions to follow until the next business day appointment. For children who were treated and admitted to the hospital, the ER should have faxed all relevant treatment documents to the child’s provider.
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Hospital Unit Procedure

For children meeting the inclusion criteria and who were placed on any of the three hospital units (Pediatrics, Pediatric Intensive Care, or Adolescent), several steps should have been initiated by the physician, nurse, or respiratory therapist who determined the child met inclusion criteria. These processes were designed so that, prior to discharge, the child would receive (a) a Pediatric Pulmonary consultation, (b) asthma teaching, (c) an AMP, and (d) a follow-up appointment within seven days of discharge. Additionally, the pulmonary consultation and treatment plan should have been faxed to the child’s PCP prior to the follow-up appointment.

Post ER/Hospital Clinic Procedure.

There were three monitored processes for children who had received care from UH ER or Children’s Hospital units. They were: (a) arrival of faxes prior to the follow-up visit, (b) follow-up appointments kept, and (c) revision of AMP during the next business day appointment.

Data Collection Methodology

By October 1, 1998, indicators had been developed and tested to measure the extent to which the nursing system was implemented by the participating ER, hospital units, and clinics sites. Thirteen indicators were ultimately selected for the following reasons: (a) meaningful data could be collected after the child had been discharged, (b) each directly represented specific nursing system components deemed pivotal for
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promoting symptom control (e.g., parent/child education), and (c) each provided reliable evidence of nursing system implementation.

Case Finding

Prior to October 1998, the PI worked with the MUHC Respiratory Therapy (RT) Department to develop an accurate case finding methodology. Since RT provides, documents and bills for all respiratory treatments in the ER and Children’s Hospital, the daily treatment schedule was a reliable source for finding new nebulizer and metered-dose inhaler doses given to patients. All new orders were easily located because they are handwritten additions to a daily computerized activity log. On business days (non-holiday Monday through Friday), the PI examined all handwritten additions to the treatment schedule for children treated in the UH ER or admitted to any of the three Children’s Hospital units from the previous day. Monday case finding identified new orders for children treated with albuterol anytime between 6:00 am Friday and 6:00 am Monday. The medical record from all newly treated children was screened to determine the nature of the presenting medical condition. Regardless of whether the nursing system components had been initiated for the child on the date the child was treated with albuterol, if inclusion criteria had been met, data collection procedures were initiated.

Data Collection

Following positive case finding, data on the extent of implementation of the nursing system components were tabulated on the data collection form. There were two sources of data for the 13 nursing system indicators: medical record review and personal
(phone or email) contact with providers or sites of care. Scores were either 'yes' (the indicator was present), 'no' (the indicator was not present), or 'N/A' (the indicator was not applicable; or scoring of the indicator was not relevant for that case, that time; or the score could not be obtained for the indicator that time). The data collection process occurred after the child had been discharged.

Table 3 lists the 13 nursing system indicators by monitored sites of care. Four of the 13 indicators were scored following an ER visit, four were scored following hospitalization, and five were scored after the child was seen during the clinic follow-up appointment. Three of the four ER indicators were only relevant for children who were treated and released from the ER (as opposed to being treated and admitted). Asthma education was scored 'yes' if there was documentation of any kind that DCA educational outcomes had been met. AMP was scored 'yes' if the chart contained a completed copy of the time-limited AMP. Next business day appointment was scored 'yes' if the UP electronic scheduling system listed a next business day appointment. For providers not on this scheduling system, if there was clear documentation in the record the DCA was instructed to contact the child's provider the following morning to schedule a next business day appointment, the next business day appointment was scored 'yes'. Faxes from the ER visit were scored 'yes' if the medical record contained a copy of a completed pediatric asthma fax transmittal memo.
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Table 3

*Nursing System Indicators*

<table>
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<tr>
<th>ER Indicators</th>
<th>Hospital Unit Indicators</th>
<th>Clinic Indicators</th>
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<tr>
<td>1. Asthma plan</td>
<td>5. Pulmonary consultation</td>
<td>9. ER faxes received</td>
</tr>
<tr>
<td>2. Teaching</td>
<td>6. Asthma plan</td>
<td>10. Hospital faxes received</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13. Post hospital appt kept</td>
</tr>
</tbody>
</table>

*Note.* F/U appt = follow-up appointment

For hospitalized children, pulmonary consultation was scored ‘yes’ if there was a documented order for pulmonary consultation in the medical record or if a pulmonary physician made progress note entries. Asthma education was scored ‘yes’ when the medical record contained a completed MUHC Asthma (Ages 0-17) Patient Teaching Record. AMP was scored ‘yes’ if a copy of the plan was contained in the medical record, and it was not blank. Pre-scheduled follow-up appointments (within seven days of discharge) was scored ‘yes’ if the UP electronic scheduling system listed an appointment within seven days of discharge, or if a non-UP appointment had been set and the specific appointment date, time, and provider had been documented as part of the discharge orders and parent instructions.

For children who initially presented to the UH ER and were admitted, and those children directly admitted to the hospital, the five clinic indicators were scored as follows. Both ER fax and hospital fax indicators were scored as ‘yes’ when a clinic staff member
confirmed receipt of the faxes. In some cases, this information could not be retrieved. For these cases, the data collection tool was scored as N/A. Two of the outpatient indicators were scored as ‘yes’ when either the child presented to the clinic for their pre-scheduled next business day appointment or when the child presented for their post-hospital discharge appointment. For UP patients, this follow-up appointment confirmation was available by accessing the clinic scheduling software. For non-UP providers, telephone or fax contact was attempted to confirm follow-up appointments were kept. The final clinic indicator was for the use of AMPs during next business day appointments. This was obtained for children (a) who were treated and released from the ER, and (b) who were scheduled for a next business day appointment, and (c) who came to the next business day appointment. The indicator was scored ‘yes’ when either clinic staff or the provider affirmed use of an AMP during follow-up.

**Reporting**

Data from the completed check sheets for every child who had met the inclusion criteria were entered into the PI’s pediatric asthma data registry. Rates for all indicators were calculated at least monthly. The denominator for each indicator rate was the total of all ‘yes’ and ‘no’ entries. The numerator for each indicator rate was the total of all ‘yes’ entries. ‘N/A’ entries were ignored for all numerators and denominators.

Timely communicating of failures to accountable individuals was required regularly throughout the 30 intervention months. Aggregate results were reported each month to the CQI team, comparing the current month rates with prior months. The
primary business of monthly CQI team meetings was to plan improvements when reported rates were disappointing. Prior to joining the CQI team, each member had agreed to be accountable for a particular implementation site or provider group. Formal discussions and group problem solving occurred to address system factors that could be modified to promote successful implementation of the nursing system. The CQI methodology and team activities were essential for this complex and broad based nursing system implementation. If the nursing system design and the CQI methodology were successful across health care system providers and sites, improvement in symptom control for children with asthma could be expected. The data analysis plan to measure and compare symptom control before and after implementation of the nursing system is now described.

Methodology to Detect Symptom Control in Children With Asthma

This research proposes that, if specific health care system factors known to influence the development of DCA competency for managing symptom control in children with asthma are optimized, asthma symptom control will improve. Fourteen antecedent conditions known to influence a DCA’s ability to control asthma symptoms were identified from the literature (Chapter 2). Twelve of the 14 antecedent conditions are under complete or partial control of the health care system. The 12 health care system antecedent conditions were grouped into five categories, and a nursing system was designed and implemented to reduce health care system gaps within these five categories. The nursing system was monitored for 30 months across a population of children with
Effects of a SCDNT Nursing System on Children With Asthma

asthma in mid-Missouri. Because this intervention was applied across a population, the analysis of intervention effectiveness was from population data, specifically health plan claims data.

Figure 10 illustrates the conceptual model and expected outcomes. The expected outcomes represent a belief that symptom control improvements can be detected from a population using claims data (Halfon & Newacheck, 1993; Marosi et al., 1998; Stempel, Carlson, & Buchner, 1997; Weissman, Gatsonis, & Epstein, 1992; Wennergren, 2016).

Institutional Factors

Health Plan
- access improved as primary care provider established for all enrollees
- financial barriers modified (co-pays for visits, medications, transportation eliminated)
- claims data can identify "at risk" children and primary providers
- letters to "at risk" parents and providers regarding symptom control
- formulary changes made for medications and delivery devices
- availability of case management

Health System Providers
- guidelines developed and disseminated specifying diagnostic criteria and medication management
- competency based education and regular/frequent medical lectures
- educational materials standardized
- parent/child teaching plan developed
- use of symptom diaries and asthma management plans
- follow-up appointments scheduled with faxes of acute visit sent to PCP

Program Evaluation

Process Indicators
- Diagnosis made
- Appropriate medications prescribed
- Teaching about symptoms, triggers, medications, and when to contact the provider completed
- Asthma management plans completed
- Follow-up office visits scheduled
- Continuity relationship established between provider and parent/child

Expected Outcomes
- ↓ hospitalizations
- ↓ ER visits
- ↓ in office visits

Figure 10. Conceptual model for nursing system evaluation.
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Kristjansson, & Strannegard, 1996). As has been described, the nursing system was designed to shift the focus of asthma care from crisis to preventive management. From a claims perspective, when a child’s asthma symptoms are well controlled, there will be reduced emergency visits and hospitalizations for asthma exacerbations with a concurrent increase in asthma clinic visits. Thus, a shift in care from crisis to prevention would be detectable using asthma claims for health care utilization.

Comparison of ER, hospital and clinic utilization for asthma before and after implementation of the nursing system is one component of the analysis plan. The analysis plan also includes a comparison of ER, hospital, and clinic utilization between the group of children who had been assigned to maximally involved providers and those assigned to minimally involved providers. This chapter will conclude after a discussion of the research questions, hypotheses, definition of terms, analytic aims, and analytic procedures.

**Research Questions**

Two research questions are derived from the data analysis plan.

1. Is there a statistically significant difference in asthma health care utilization before and after implementing a nursing system to benefit a population of children with asthma?

2. Is there a statistically significant difference in asthma health care utilization between a group of children with asthma who are assigned to providers maximally
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involved in the nursing system and a group of children with asthma who are assigned to providers minimally involved in the nursing system?

Hypotheses

For comparisons in this study, the null hypothesis (there is no difference in asthma health care utilization) was tested against a one-sided alternative hypothesis (that the nursing system is associated with improved health care utilization). Specifically,

$H_01$: There is no statistically significant difference between asthma health care utilization before and after implementation of the nursing system.

$H_{A1}$: There is a statistically significant difference between asthma health care utilization before and after implementation of the nursing system, with utilization improving after the nursing system was implemented.

$H_02$: There is no statistically significant difference in health care utilization between a group of children with asthma who have maximally involved providers and a group of children with asthma who have minimally involved providers.

$H_{A2}$: There is a statistically significant difference in health care utilization between a group of children with asthma who have maximally involved providers and a group of children with asthma and minimally involved providers in the nursing system, with utilization improving for the group of maximally involved providers.

Data Source

Missouri Care prepared a confidentiality agreement allowing the PI to proceed with the claims analysis (see Appendix H). The PI submitted a request for exemption to
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the University of Missouri’s Health Sciences Institutional Review Board (IRB; see Appendix I); this was approved for an exemption because all Missouri Care identifiers were eliminated prior to analyses. A document was then prepared by the PI to direct Missouri Care staff in the specific queries needed to calculate symptom control rates. The database provided by Missouri Care contained enrollment and claims data from children (born on or after April 1, 1980) between April 1, 1998 and March 31, 2001. From the database, tables were prepared and sent for statistical analysis. All data preparation decisions were made consistent with the following definition of terms used in the research questions.

**Definition of Terms**

**Population of Children**

Although the nursing system had been designed to improve care for all children with asthma who sought treatment from participating providers and sites, the population of children available for data analysis was limited to children enrolled in Missouri Care. Appendix J presents a discussion of the enrollment table variables, the checking and cleaning of errors inherent in the data, decisions about children who were included in the analyses, and file preparation for statistical analysis. In terms of meeting the definition for ‘population of children’, children with more than 180 total enrollment days were included in the analyses. For each of the 19,252 children meeting this criterion, a dichotomous entry was prepared for each of the 36 months: ‘Y’ for positive enrollment on the 15th (mid-point) of the month, or ‘N’ for negative enrollment on the 15th of the month.
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Asthma

All claims submitted to Missouri Care for asthma services were the basis for counting facility visits (ER, hospital and clinic). To determine the nature of each claim, principle and secondary discharge diagnosis codes from the International Classification of Diseases Coding Manual (9th version; 2000; ICD-9) were used. These standardized codes are submitted by the facility based on the provider’s description of the primary (and secondary) reason(s) the patient required treatment. The specific ICD-9 codes that defined asthma utilization is this study are listed in Table 4.

Table 4

Principle and Secondary ICD-9 Diagnostic Codes Defining Asthma Utilization

<table>
<thead>
<tr>
<th>ICD-9: 493.00-493.99 -- Asthma as principle diagnostic code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD-9: 493.00-493.99 -- Asthma as secondary diagnostic code if any of the following were principle diagnostic codes:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>461</td>
<td>Acute sinusitis</td>
<td>462</td>
<td>Acute pharyngitis</td>
</tr>
<tr>
<td>464.4</td>
<td>Croup</td>
<td>465.9</td>
<td>Acute upper respiratory infection NOS</td>
</tr>
<tr>
<td>466.0</td>
<td>Acute bronchitis</td>
<td>466.19</td>
<td>Bronchiolitis organism NEC</td>
</tr>
<tr>
<td>473.9</td>
<td>Chronic sinusitis NOS</td>
<td>480.9</td>
<td>Viral pneumonia NOS</td>
</tr>
<tr>
<td>485</td>
<td>Bronchopneumonia organism NOS</td>
<td>486</td>
<td>Pneumonia; organism NOS</td>
</tr>
<tr>
<td>490</td>
<td>Bronchitis NOS</td>
<td>518.81</td>
<td>Respiratory failure</td>
</tr>
<tr>
<td>7999</td>
<td>Viral infection NOS</td>
<td>786.2</td>
<td>Cough</td>
</tr>
</tbody>
</table>

Health Care Utilization

In this study, the term ‘health care utilization’ refers to specific facility utilization for asthma in any of three sites of care: ER, hospital, and clinic. In order to differentiate which site was utilized, procedure codes, called Current Procedural Terminology (CPT) codes were used (American Medical Association, 2000a). Specific CPT codes are submitted for provider visits. Within the range of provider payment codes, there are CPT codes for provider visits in the ER, hospital, and clinic. These codes ‘count’ utilization by site of care. To determine the most accurate site of care counts, a study comparing known asthma utilization with CPT codes was completed. Appendix K discusses the methodology and results from study. The CPT codes defining a valid ‘count’ of ER, hospital and clinic health care utilization for asthma are specified in Table 5.

Table 5

All CPT Codes ‘Allowed’ In the Count of Facility Utilization By Site of Visit

<table>
<thead>
<tr>
<th>5-Digit CPT Codes</th>
<th>Textual description of CPT code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic visits</td>
<td></td>
</tr>
<tr>
<td>99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99243, 99244</td>
<td>“Office or other outpatient visit for evaluation and management of a patient” or “Office consultation for a new or established patient”</td>
</tr>
<tr>
<td>Emergency visit</td>
<td></td>
</tr>
<tr>
<td>99281, 99282, 99283, 99284, 99285</td>
<td>“Emergency department visit for the evaluation and management of a patient”</td>
</tr>
<tr>
<td>Hospital visit</td>
<td></td>
</tr>
<tr>
<td>99218, 99219, 99220, 99221, 99222, 99223, 99251, 99252, 99253, 99254, 99255</td>
<td>“Initial observation care, per day, for the evaluation and management” or “Initial patient consultation for a new or established patient”</td>
</tr>
</tbody>
</table>

Note. 23° observation visits were counted as hospitalization visits.
Before and After Implementing a Nursing System

Because of the seasonal nature of asthma exacerbations, the ideal pre- and post-comparison would be the immediate 12 months before and after nursing system implementation. However, the Missouri Care Health Plan did not open enrollment until January 1998. The nursing system was implemented on October 1, 1998. This allowed only a maximum eight-month comparison interval before October 1, 1998. Because of the short baseline period, the only suitable ‘pre’ period was the summer months between April 1, 1998, and September 30, 1998. The ‘post’ period was defined as October 1, 1998, through March 31, 2001 (Table 6).

Table 6

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring/Summer</td>
<td>(PRE)</td>
<td>(POST)</td>
<td>(POST)</td>
</tr>
<tr>
<td>04/1/98-09/30/98</td>
<td>04/1/99-09/30/99</td>
<td>04/1/00-09/30/00</td>
<td></td>
</tr>
<tr>
<td>Fall/Winter</td>
<td>(POST)</td>
<td>(POST)</td>
<td>(POST)</td>
</tr>
<tr>
<td>10/1/98-03/31/99</td>
<td>10/1/99-03/31/00</td>
<td>10/1/00-03/31/01</td>
<td></td>
</tr>
</tbody>
</table>

Maximally and Minimally Involved Providers

The nursing system intervention focused on two target groups: the health care system (health plan, providers, sites) and children with asthma. During the 30-month intervention period, children enrolled in Missouri Care were assigned to PCPs who were
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either maximally or minimally involved in the nursing system. To indicate whether an assigned provider was in the maximal or minimal involvement group, the directory of Missouri Care networked providers was used. This directory contained the names of all family practice and pediatrician providers available to new members. Each name listed in the directory was identified as belonging to either the maximally or minimally involved group. Missouri Care used the group listing to assign group-specific unique provider identifiers within the database.

Similar to determination of enrollment by month, the PCP assignment definition was set as the mid-point of the month (15th). There were four possible assignments: (a) maximal PCP involvement in the nursing system (provider group ‘A’), (b) minimal PCP involvement (provider group ‘B’), (c) provider group ‘Both’ (assigned to minimally and maximally involved providers on the 15th of that month), or (d) provider group ‘None’ (no provider assignment on the 15th of that month). In terms of defining children assigned to maximally and minimally involved providers, only those enrollment segments where one provider (either maximally or minimally involved provider group) was named on the 15th of the month were used in the analysis.

**Analysis Plan**

The analysis plan had three specific aims. The first aim was to describe the Missouri Care membership trends over the 36-month study period. This was important since Missouri Care was a new health plan, so was in a growth phase beginning in the fall
of 1997. Beyond describing overall growth of the plan, member demographics (gender, age, and PCP group) were described.

The second aim was to compare asthma ER, hospitalization, and clinic visits before and after nursing system implementation. Calculations were done, with the first 6 ‘summer’ months (April through September of 1998) defined as the pre-intervention baseline compared with the two post-intervention summer intervals (1999 [Year 2] and 2000 [Year 3] April through September). Pre- and post-intervention comparisons for winter intervals (October – March) were not possible for Year 1, Year 2 or Year 3 because there was no pre-intervention baseline representing the winter interval. There was no pre-intervention period because Missouri Care had only been established during eight months before nursing system implementation on October 1, 1998.

Across the 36-month study period (6 month pre-intervention, 30 month post-intervention), there were a total of 19,252 children enrolled in Missouri Care, not all were enrolled throughout this interval. For the analysis, data from these children were organized so that there was one observation for each month that each child was enrolled (hence a child enrolled for five of the months of interest would have five lines of data). This organization resulted in 196,430 observations. Each of the three outcomes (ER, hospitalization, and clinic visits) were analyzed separately.

Each outcome variable was defined dichotomously with ‘1’ representing at least one visit in a month and ‘0’ representing no visits in a month. Ten to fifteen percent of cases had multiple visits in a month. Logistic regression was used to determine whether
the probability of the outcomes (ER, clinic, hospital) were related to the factors of year and month. Due to the large number of observations in the file, an analysis to account for possible dependence among repeated observations could not be completed. Since exact tests for this aim were not critical, the logistic regression model treated repeated observations as independent. Because observations were not independent, results should be considered approximate.

The third aim was to compare rates of health care utilization rates between the maximally and minimally involved providers in the group of children 'known' to have asthma. For this group, a child was defined as 'asthmatic' if, and only if, he or she had at least one claim for asthma utilization (either ER, hospital, or clinic). All utilization visits within the month of the child's initial visit and in the month immediately following the 'index' visit were suppressed. For example, if a child with a maximally involved provider had a clinic visit in January 1999, that child would begin to be counted in the maximally involved provider group denominator in March 1999. This child would continue to be counted in the group specific provider denominator until the child's enrollment was terminated. For this example, all utilization for this child beginning in March 1999 would be counted in the provider-specific numerator. This determination of this definition was necessary in order to allow time for asthma symptom control to be achieved and to compare only children with known asthma.

Only the observations in which there was exactly one provider (maximally or minimally involved provider) were included; any month listing both groups of providers
were not included. The outcome variables (ER, hospital, clinic) took on the value of ‘1’ every time that resource was utilized one or more times in those months after enrolled children met the definition of ‘asthmatic’; otherwise, the outcome variables were set to zero.

Using logistic regression, facility visit rates by children with maximally involved providers and minimally involved providers were compared over the 30 month post-intervention interval (October 1, 1998 through March 31, 2001). Since rates vary by season, month of service was added to the logistic model to control for seasonal effects. Generalized estimating equations were used to adjust logistic regression estimates for correlation within the data (since children were included multiple times).

This concludes the methods discussion regarding the design, implementation, and evaluation of the nursing system intervention. Chapter 4 presents the results in two sections. First, process results, describing the extent to which the nursing system penetrated the health care system, are presented. The process results are followed by a report of symptom control results.
CHAPTER 4
RESULTS

The focus of this study was to improve symptom control in children with asthma by designing and implementing a multi-faceted intervention that would reduce or remove common health care system barriers that interfere with the DCA’s ability to control asthma symptoms. Proxy indicators that reflect asthma symptom control were from Missouri Care claims for health care system utilization (asthma ER, hospital, and clinic visits). The claims analysis results (or symptom control outcomes) are presented in this chapter, but before these results are presented, the results from the nursing system implementation (health care system process changes) are presented.

Results Defining the Penetration of the Nursing System

Prior to implementation of the nursing system on October 1, 1998, none of the health care system processes had been in place, thus no baseline data was collected. During the 30 months between October 1, 1998, and March 31, 2001, 753 children presented to UH ER or Children’s Hospital with an asthma exacerbation. Data from 13 nursing system (process) indicators were collected and are now reported from these 753 children. The 13 nursing system indicators had been designed to reflect specific health care system alterations designed to optimize the health care system’s contribution to competency development in DCAs. Thus, the results from these 13 indicators reflect the extent to which the nursing system was implemented by participating providers and sites.

Demographic Results About Health Care System Participation

The data are presented for the first 12 months, second 12 months, final 6 months, and cumulative 30 months, Table 7 presents demographic findings from the 753 children
by variables about health plan (Missouri Care versus not Missouri Care), provider
(maximal, minimal, and no nursing system involvement), and entry point and disposition
(treated in the ER and discharged home, treated in the ER and admitted, and direct
admit).

**Table 7**

*Demographic Trends from Children Included in the Nursing System*

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Months 1-12</th>
<th>Months 13-24</th>
<th>Months 25-30</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missouri Care</td>
<td>46%</td>
<td>52%</td>
<td>50%</td>
<td>49%</td>
</tr>
<tr>
<td>(n = 155/334)</td>
<td>(n = 150/294)</td>
<td>(n = 62/125)</td>
<td>(n = 367/753)</td>
<td></td>
</tr>
<tr>
<td>Not Missouri Care</td>
<td>54%</td>
<td>48%</td>
<td>50%</td>
<td>51%</td>
</tr>
<tr>
<td>(n = 179/334)</td>
<td>(n = 144/294)</td>
<td>(n = 63/125)</td>
<td>(n = 386/753)</td>
<td></td>
</tr>
<tr>
<td>Provider</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UP Pediatricians</td>
<td>42%</td>
<td>39%</td>
<td>34%</td>
<td>39%</td>
</tr>
<tr>
<td>(Maximally Involved)</td>
<td>(n = 139/334)</td>
<td>(n = 114/294)</td>
<td>(n = 43/125)</td>
<td>(n = 296/753)</td>
</tr>
<tr>
<td>UP Family Practice</td>
<td>19%</td>
<td>16%</td>
<td>18%</td>
<td>18%</td>
</tr>
<tr>
<td>(Maximally Involved)</td>
<td>(n = 62/334)</td>
<td>(n = 47/294)</td>
<td>(n = 23/125)</td>
<td>(n = 132/753)</td>
</tr>
<tr>
<td>Family Health Center</td>
<td>6%</td>
<td>10%</td>
<td>9%</td>
<td>8%</td>
</tr>
<tr>
<td>(Maximally Involved)</td>
<td>(n = 21/334)</td>
<td>(n = 28/294)</td>
<td>(n = 11/125)</td>
<td>(n = 60/753)</td>
</tr>
<tr>
<td>Other</td>
<td>31%</td>
<td>33%</td>
<td>38%</td>
<td>33%</td>
</tr>
<tr>
<td>(Minimally Involved)</td>
<td>(n = 103/334)</td>
<td>(n = 96/294)</td>
<td>(n = 47/125)</td>
<td>(n = 246/753)</td>
</tr>
<tr>
<td>None</td>
<td>3%</td>
<td>3%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>(Not Involved)</td>
<td>(n = 9/334)</td>
<td>(n = 9/294)</td>
<td>(n = 1/125)</td>
<td>(n = 19/753)</td>
</tr>
</tbody>
</table>
In the first 12 months, 334 children met the nursing system inclusion criteria and 46% (n = 155) were enrolled in Missouri Care. During the second 12 months, 294 children met nursing system inclusion criteria, with 150 (52%) belonging to Missouri Care. During the final six months, (Months 25-30), only 125 met the inclusion criteria, with one-half (n = 62) enrolled in Missouri Care. Cumulatively, 367 of the 753 children (49%) who met nursing system inclusion criteria were enrolled in Missouri Care, a rate that held steady throughout the 30 months.

Five provider groupings are used to describe level of nursing system involvement, the extent to which the PCP group was involved in activities to align the five health care system gaps. Three provider groups presented in Table 7 represent ‘maximally involved’ PCPs, one represents ‘minimally involved’ PCPs, and one represents a small group in which the providers were ‘not involved’ at all. During the 30 months of the study, the three maximally involved PCP groups received regular, usually monthly feedback (by
CQI team members) concerning the results of the 13 nursing system (process) indicators on children assigned to providers within their group.

Of the 753 children seeking treatment at UH ER or Children's Hospital for an asthma exacerbation, 64% had been assigned to a PCP within one of the three maximally involved PCP groups. Specifically, the group of UP Pediatrics accounted for 39% \((n = 296)\); UP Family Practice accounted for 18% \((n = 132)\); Family Health Center PCPs accounted for 8% \((n = 60)\). One-third (33%) of children had a PCP who was in the minimally involved group and, in 30 months, only 19 children did not have an identifiable PCP.

The final demographic indicator reported in Table 6 displays three categories regarding the child's entry point and disposition. The first two, 'ER treated and released' and 'ER treated and admitted' report the proportion of the 753 children who initially presented to UH ER. Of all children initially presenting to UH ER, 63% \((n = 472)\) were treated in the ER and discharged home while 15% \((n = 116)\) were treated and admitted. Cumulatively, 78% presented to UH ER, while 22% were directly admitted to one of the three participating Children's Hospital units. These 165 children had been assessed and treated in clinic, in other ERs or in hospitals prior to transfer to Children's Hospital.

As shown by Table 3 in Chapter 2, there were a total of 13 nursing system indicators that had been developed to monitor care for the 753 children. Depending on the child's entry point and disposition, some of the 13 indicators were relevant while others were not. The results from monitoring the 753 children according to relevant indicators are grouped and presented according to entry point and disposition. Again,
these results reflect the extent to which the nursing system was implemented by participating sites when a child with an asthma exacerbation presented to either UH ER or the three Children’s Hospital units. Results are now reported by the three entry point and disposition sections, specifically “UH Emergency Room Results” (Table 8), “Children’s Hospital Results” (Table 9), and “Follow-Up Clinic Results” (Table 10). All three tables utilize the same format used to report ‘Demographic Trends from Children Included in the Nursing System’ (Table 7). The only difference is that, in each table, each cell contains two results (percentages) along with their corresponding numerator and denominator used to calculate the rate of ‘success’. The numerators are the number of eligible children with positive scores, the denominator is the number of children ‘eligible’ for scoring on that particular indicator during the specified interval. The first percentage and numerator/denominator displayed in BOLD type documents positive adherence to the row-specific indicator. However, it was not always possible or appropriate to collect data for each row-specific indicator. Therefore, a second percentage and numerator/denominator, (shown in Italic type), are reported. The second percentage and numerator/denominator documents the number of children who were ‘eligible’ for scoring on the specific indicator. Eligible children are reported as the denominator for ‘% data collected’; whereas the numerator for ‘% data collected’ documents the number of eligible children in whom data collection was appropriate and possible.

**UH Emergency Room Visits**

During the 30 months of the nursing system, 588 children met inclusion criteria after initially presenting to UH ER. From these children, 472 (62%) were treated in the
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ER and released (discharged home) and 116 (15%) were treated in the UH ER and admitted (refer to Table 7). Table 8 presents the results of the four nursing system process indicators monitored for each of the 588 children who presented to UH ER.

Table 8

Results of Emergency Room Monitoring

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Months 1-12</th>
<th>Months 13-24</th>
<th>Months 25-30</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10/1/98-9/30/99</td>
<td>10/1/99-9/30/00</td>
<td>10/1/00-3/31/01</td>
<td>Months 1-30</td>
</tr>
<tr>
<td>1. Asthma Plan</td>
<td>65% (n = 124/192)</td>
<td>67% (n = 112/168)</td>
<td>53% (n = 44/83)</td>
<td>63% (n = 280/443)</td>
</tr>
<tr>
<td>% data collection</td>
<td>93%</td>
<td>92%</td>
<td>100%</td>
<td>94%</td>
</tr>
<tr>
<td>2. Teaching</td>
<td>73% (n = 141/192)</td>
<td>58% (n = 97/168)</td>
<td>57% (n = 47/83)</td>
<td>64% (n = 285/442)</td>
</tr>
<tr>
<td>% data collection</td>
<td>93%</td>
<td>92%</td>
<td>99%</td>
<td>94%</td>
</tr>
<tr>
<td>3. F/U Appt Made</td>
<td>86% (n = 164/190)</td>
<td>73% (n = 120/164)</td>
<td>65% (n = 54/83)</td>
<td>77% (n = 338/437)</td>
</tr>
<tr>
<td>% data collection</td>
<td>92%</td>
<td>90%</td>
<td>100%</td>
<td>93%</td>
</tr>
<tr>
<td>4. Faxes Sent</td>
<td>93% (n = 211/228)</td>
<td>89% (n = 189/213)</td>
<td>77% (n = 73/95)</td>
<td>88% (n = 473/536)</td>
</tr>
<tr>
<td>% data collection</td>
<td>90%</td>
<td>91%</td>
<td>94%</td>
<td>91%</td>
</tr>
</tbody>
</table>

Indicators #1, #2, and #3 were only relevant for the 472 children who were treated and released from UH ER. Indicator #4 was relevant for all 588 children who initially presented to UH ER. As noted in Table 8, over the cumulative 30 months, data collection on these indicators was successful between 90 and 100% of the time. In terms of results,
280 children received AMPs (63%) and 285 (64%) received teaching prior to discharge from the ER. Next business day follow-up appointments were made for 77% prior to discharge. None of these processes were established prior to October 1, 1998.

Indicator #4 reports the proportion of records that were faxed from the UH ER to PCPs in both these children groups, those treated and released from UH ER and those treated and admitted. Faxing of 88% of ER treatment records was considered extremely successful given this process had never occurred prior to nursing system implementation.

Results over time (Months 1-12, Months 13-24, and Months 25-30) demonstrate a small but gradual decline in ER implementation of the nursing system. Throughout the 30 months, results have been regularly (usually monthly) shared with physician, nurse, and respiratory therapy stakeholders and have served as tools in motivating a renewed focus on necessary system repairs.

Children’s Hospital Stays

Four nursing system process indicators (Indicators #5, #6, #7, #8) were monitored for children who were hospitalized in any of the three participating Children’s Hospital units. Cumulatively, there were 116 of the 753 children (15%) who initially presented to the UH ER for treatment and were admitted to Children’s Hospital and there were 165 children (22%) who were admitted directly to one of the three Children’s Hospital units. Table 9 presents the Children’s Hospital results from the 281 hospitalized children. ‘Percent data collection’ for all four indicators ranged between 98 and 100%.
Table 9

**Children's Hospital Unit Results**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Months 1-12</th>
<th>Months 13-24</th>
<th>Months 25-30</th>
<th>Cumulative Months 1-30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10/1/98-9/30/99</td>
<td>10/1/99-9/30/00</td>
<td>10/1/00-3/31/01</td>
<td>Months 1-30</td>
</tr>
<tr>
<td>5. Pulmonary Consultation</td>
<td>69%</td>
<td>73%</td>
<td>90%</td>
<td>74%</td>
</tr>
<tr>
<td>% data collection</td>
<td>(n = 85/124)</td>
<td>(n = 82/112)</td>
<td>(n = 38/42)</td>
<td>(n = 205/278)</td>
</tr>
<tr>
<td></td>
<td>(n = 124/127)</td>
<td>(n = 112/112)</td>
<td>(n = 42/42)</td>
<td>(n = 278/281)</td>
</tr>
<tr>
<td>6. Asthma Plan</td>
<td>75%</td>
<td>74%</td>
<td>67%</td>
<td>73%</td>
</tr>
<tr>
<td>% data collection</td>
<td>(n = 94/125)</td>
<td>(n = 83/112)</td>
<td>(n = 28/42)</td>
<td>(n = 205/279)</td>
</tr>
<tr>
<td></td>
<td>(n = 125/127)</td>
<td>(n = 112/112)</td>
<td>(n = 42/42)</td>
<td>(n = 279/281)</td>
</tr>
<tr>
<td>7. Teaching</td>
<td>86%</td>
<td>80%</td>
<td>79%</td>
<td>82%</td>
</tr>
<tr>
<td>% data collection</td>
<td>(n = 107/125)</td>
<td>(n = 90/112)</td>
<td>(n = 33/42)</td>
<td>(n = 230/279)</td>
</tr>
<tr>
<td></td>
<td>(n = 125/127)</td>
<td>(n = 112/112)</td>
<td>(n = 42/42)</td>
<td>(n = 279/281)</td>
</tr>
<tr>
<td>8. F/U Appt Made</td>
<td>82%</td>
<td>75%</td>
<td>74%</td>
<td>78%</td>
</tr>
<tr>
<td>% data collection</td>
<td>(n = 102/125)</td>
<td>(n = 82/110)</td>
<td>(n = 31/42)</td>
<td>(n = 215/277)</td>
</tr>
<tr>
<td></td>
<td>(n = 125/127)</td>
<td>(n = 110/112)</td>
<td>(n = 42/42)</td>
<td>(n = 277/281)</td>
</tr>
</tbody>
</table>

Indicator #5, pulmonary consultations, has been steadily improving over time. Initial resistance to pulmonary consultations was moderated within the first year as referring physicians began recognizing the value of this service. Following a pulmonary consultation, referring physicians received faxed copies that outlined a complicated, but thorough stabilizing treatment plan to manage the asthma during the weeks immediately following hospitalization. The pulmonary consultation also provides recommendations for stepping down treatment intensity as symptoms abate. Indicator #6 reveals that,
cumulatively, AMPs were being completed on 73% of children prior to discharge. Along with pulmonary consultations, AMPs are also being faxed to primary providers to ensure continuity in the treatment plan. Indicator #7 reports the results of patient education for hospitalized children. Prior to the nursing system, asthma education was provided sporadically, since nursing system implementation, 82% of parents and children are taught before discharge. Indicator #8 quantifies hospital staff compliance with scheduling follow-up appointments with the child’s PCP prior to the child’s discharge. These data show that almost 8 in 10 children have their one-week follow-up appointment scheduled before discharge.

*Post ER/Hospital Clinic Visits*

For the 753 children who initially presented to UH ER or the three Children’s Hospital units during the 30 months, five process indicators were monitored to reflect out-patient systems of care after discharge. Table 10 reports the nursing system process indicators as measured by the clinic in which these children were seen for follow-up after the ER or hospital visit for asthma. Three of the five indicators (Indicators #9, 11, 12) reflect post-acute care for those children who had been treated and released from the ER; the other two (Indicators #10, 13), reflect post-acute care for those children who were discharged from the hospital. As results of each indicator are presented, an explanation about the sample used and miscellaneous data collection issues are discussed.
Effects of a SCDNT Nursing System on Children With Asthma

Table 10

Follow-Up Clinic Results

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Months 1-12</th>
<th>Months 13-24</th>
<th>Months 25-30</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10/1/98-9/30/98</td>
<td>10/1/99-9/30/00</td>
<td>10/1/00-3/31/01</td>
<td>Months 1-30</td>
</tr>
<tr>
<td>9. ER Faxes Received</td>
<td>87%</td>
<td>88%</td>
<td>79%</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>(n = 183/211)</td>
<td>(n = 162/184)</td>
<td>(n = 53/67)</td>
<td>(n = 398/462)</td>
</tr>
<tr>
<td>% data collection</td>
<td>100%</td>
<td>97%</td>
<td>92%</td>
<td>98%</td>
</tr>
<tr>
<td></td>
<td>(n = 211/211)</td>
<td>(n = 184/189)</td>
<td>(n = 67/73)</td>
<td>(n = 462/473)</td>
</tr>
<tr>
<td>10. Hospital Faxes Received</td>
<td>61%</td>
<td>58%</td>
<td>40%</td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td>(n = 77/126)</td>
<td>(n = 56/97)</td>
<td>(n = 14/35)</td>
<td>(n = 147/258)</td>
</tr>
<tr>
<td>% data collection</td>
<td>99%</td>
<td>87%</td>
<td>83%</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td>(n = 126/127)</td>
<td>(n = 97/112)</td>
<td>(n = 35/42)</td>
<td>(n = 258/281)</td>
</tr>
<tr>
<td>11. Post ER Appt Kept</td>
<td>79%</td>
<td>75%</td>
<td>80%</td>
<td>78%</td>
</tr>
<tr>
<td></td>
<td>(n = 130/164)</td>
<td>(n = 90/120)</td>
<td>(n = 43/54)</td>
<td>(n = 263/338)</td>
</tr>
<tr>
<td>% data collection</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(n = 164/164)</td>
<td>(n = 120/120)</td>
<td>(n = 54/54)</td>
<td>(n = 338/338)</td>
</tr>
<tr>
<td>12. Asthma Plan</td>
<td>27%</td>
<td>55%</td>
<td>41%</td>
<td>39%</td>
</tr>
<tr>
<td></td>
<td>(n = 23/85)</td>
<td>(n = 36/66)</td>
<td>(n = 11/27)</td>
<td>(n = 70/178)</td>
</tr>
<tr>
<td>% data collection</td>
<td>65%</td>
<td>73%</td>
<td>63%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>(n = 85/130)</td>
<td>(n = 66/90)</td>
<td>(n = 27/43)</td>
<td>(n = 178/263)</td>
</tr>
<tr>
<td>13. Post Hosp Appt Kept</td>
<td>88%</td>
<td>91%</td>
<td>84%</td>
<td>88%</td>
</tr>
<tr>
<td></td>
<td>(n = 89/101)</td>
<td>(n = 64/71)</td>
<td>(n = 21/25)</td>
<td>(n = 174/197)</td>
</tr>
<tr>
<td>% data collection</td>
<td>99%</td>
<td>87%</td>
<td>81%</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td>(n = 101/102)</td>
<td>(n = 71/82)</td>
<td>(n = 25/31)</td>
<td>(n = 197/215)</td>
</tr>
</tbody>
</table>

Indicator #9 reports the sample of clinic representatives who confirmed, when asked by email or telephone call, that faxes from the ER were received. The sample of children eligible for data collection about Indicator #9 is actually the numerator of Indicator #4 (refer to Table 8). Specifically, data collection was possible for Indicator #9 from children initially presenting to UH ER (n = 588 [refer to Table 7]) and for whom
Effects of a SCDNT Nursing System on Children With Asthma

data about ER faxes was available \((n = 536)\) and for whom ER faxes were sent \((n = 473)\). In terms of the cumulative results for Indicator #9, 86% of clinic staff confirmed receipt of faxes from the ER prior to the child's follow-up visit. For the 14% in which the ER had documented evidence of faxing but in which the clinic denied receipt of faxes before the follow-up clinic visit, two main problems were identified and addressed. First, for a few clinics, the ER had incorrect fax numbers. Second, when ER faxes was correctly sent, clinic processes broke down and the faxed documents were not placed in the child's medical record prior to the child's arrival for the follow-up appointment.

Indicator #10 reports the findings from the eligible 281 hospitalized children in whom the follow-up clinic confirmed receipt of post-discharge faxes. The specific hospital records that should have been faxed included the history and physical, pulmonary consultations, asthma management plan, and discharge orders/instructions. Cumulatively, clinic representatives confirmed receipt of these faxes in only 147 of the 258 (57%) children for whom data collection was possible. These cumulative results reflect a downward trend from 61% compliance in the Months 1-12 to 40% compliance in Months 25-30.

Both Indicators #11 and 12 apply only to those children who were treated and released from the ER \((n = 472)\). For determining the rates of post-ER discharge follow-up appointments kept, Indicator #11 reflects monitoring activity already reported for Indicator #3 (Table 8). Specifically, of the 472 children who were treated and released from UH ER, data about scheduling follow-up appointments before ER discharge was
Effects of a SCDNT Nursing System on Children With Asthma

only collected from 437 children (Indicator #3, Table 8). In this cumulative sample, 338 children (77%) had appointments scheduled for them. This sample of 338 children with appointments scheduled was used to determine the proportion who 'kept' their scheduled visit. Cumulatively, 78% of these children kept the appointment. This finding of a high rate of kept appointments was surprising given the common perception that lower socio-economic persons prefer treatment in the ER. A proxy of low socio-economic status is Medicaid eligibility. In this nursing system, one-half of children who presented for an asthma exacerbation were enrolled in Medicaid.

Indicator #12 was collected from the 263 children treated and released from UH ER, with follow-up scheduled, and who kept their follow-up appointment (the numerator from Indicator #11). In the 263 children, data collection about whether or not an AMP was developed (or revised) with the PCP was only attempted for UP and FHC providers. Among those providers, a response was provided for only 178 children. Cumulatively, only 70 of the 178 children (39%) had AMPs developed during the post-ER follow-up visit.

Indicator #13 was collected from the group of children discharged from the hospital (direct admits [n = 165] and ER treated and admitted [n = 116]) who were also scheduled for follow-up appointments within one week of discharge (the numerator from Indicator #8, Table 9 [n = 215/277]). From these 215, data could be collected from follow-up clinic offices representing 197 children. From the 197 children, 88% (n = 174) did arrive for the post-hospital discharge follow-up appointment. These unexpectedly high results clearly document that, at least for asthma, DCAs value post-exacerbation
access with their PCP. The timing of these appointments may be ideal for forging a continuity relationship between DCAs and the child’s PCP.

This concludes the ‘results’ from the 13 nursing system process indicators. With the exception of one indicator, AMPs completed during the follow-up appointment after an ER visit, 12 nursing system processes were successfully adopted throughout participating sites between October 1, 1998, and March 31, 2001. One purpose for daily monitoring of these 13 nursing system indicators on behalf of all children (both Medicaid and non-Medicaid) who sought treatment for an asthma exacerbation at UH ER or the three Children’s Hospital units, was to solidify specific health care system changes. These health care system changes were designed to be consistent with national asthma standards (NHLBI, 1997a). Throughout the 30 months, these 13 nursing system indicators were monitored daily, with ongoing results reported regularly through monthly CQI team meetings. However, these 13 nursing system indicators were measured from children interfacing with the changed system. Measurements from these 753 children only reflected three of five identified health care system gaps, specifically access, continuity, and parent/child education. Measurements were not obtained from PCPs regarding knowledge or skills surrounding ‘under-diagnosis’ and ‘under-treatment’. However, multiple provider educational interventions were undertaken during these same 30 months with maximally involved UP and FHC PCPs (and their staffs). All maximally involved provider and staff educational sessions included content on appropriate asthma diagnosis and optimum medical therapies.
Results Determining the Extent To Which Symptoms Were Controlled

A true test of the effectiveness of this multi-faceted nursing system was completed using quantifiable measures of asthma symptom control, specifically claims data from one health plan for asthma utilization. This final section reports the results from three specific analytic aims designed to determine the effectiveness of the nursing system in controlling asthma symptoms. All three analytic aims use Missouri Care enrollment records and asthma utilization claims over the three year period between April 1, 1998, and March 31, 2001. The first aim is descriptive in nature and only uses enrollment records from all Missouri Care children, ages 0 to 18. This aim defines Missouri Care’s enrollment growth and characteristics prior to and during nursing system implementation. The second aim uses enrollment files and asthma utilization claims to compare asthma ER, hospital, and clinic visit rates before and after nursing system implementation. The third aim uses only those children with one or more asthma claim for ER, hospital or clinic to compare utilization claim rates between the group of children assigned to maximally involved providers with the group of children assigned to minimally involved providers. The results of each of these three aims are now presented.

Of the 753 children who presented to either the UH ER or three Children’s Hospital pediatric units, and who were exposed to the nursing system, 367 (49%) were Missouri Care members. The results from the analyses run using Missouri Care enrollment and claims data to achieve the three data analysis aims are now presented and discussed.
Aim 1: Describe Missouri Care Enrollee Patterns Between April 1, 1998 and March 31, 2001

As of March 31, 2001, there were 27,649 children (unique identifiers) in the Missouri Care membership files. Plan growth over the three years was 150%. For purposes of the three analytic aims, only children with a minimum of six months were included. When considering this inclusion criterion, 19,252 children were enrolled at least 181 days. Plan growth in these children was 121% (see Figure 11).

![Figure 11. Enrollment growth during first three years of Missouri Care Health Plan.](image)

Of the 19,252 different children who were enrolled in Missouri Care for at least six months during the 36-month interval, the proportions of males in each month of the study hardly varied, ranging from 0.496 to 0.504.
Using box plots, Figure 12 graphs ages for the 19,252 children enrolled in each of the 36 months. In the data cleaning stage, instances where enrollment dates were set before birth dates was not considered, so the output did have some instances where birth date had negative values. Other than one birth date in which there was a five-month 'negative' age, all negative ages were less than 1 month. The bottom of the box plots correspond to the 25th percentile while the top corresponds to the 75th percentile. The line in the middle joins the medians. All box plots slant mildly upward over the duration of
the study. The mean starts at approximately 7 years 4 months and ends at approximately 8 years 2 months, or a 10-month difference in mean age over the 36-month interval.

The provider group summary, for children 'enrolled' for a given month, is illustrated in Figure 13. Provider group counts are presented as four trend lines for 'Maximal PCPs', 'Minimal PCPs', 'Both' (maximally and minimally involved providers), and 'None' (for cases where no provider information was available).

![Figure 13. Children enrolled by provider group by month of study.](image)

By Month 10 (December 1998), growth of 'Minimal PCPs' surpasses that of 'Maximal PCPs'. According to the Missouri Care medical director, this growth is consistent with a marketing emphasis to expand plan enrollment in all 18 counties served by Missouri Care, thus an increase in 'Minimal PCPs' (non-UP and non FHC providers; T. Cheek, personal communication, October 31, 2001).
Aim 2: Determine if Asthma Utilization Rates In the Missouri Care Population Changed Following Nursing System Implementation

Descriptive findings relative to ‘Aim 2’ are presented. These are followed by the results from the logistic regression tests to determine if there was a statistically significant change in asthma utilization visits after the nursing system was implemented.

For each of the three years, Table 11 reports change over time in terms of annual enrollment for the 19,252 children included in the analysis. Average enrollment increased sharply over the three-year study period from 8,467 to 14,029. Table 11 also reports the number of children with one or more asthma claims (‘asthmatic children’) during each of the three 12 month-intervals. The 7% asthma prevalence is consistent with CDC estimates for children with asthma (CDC, 1998). Table 11 then reports a count of asthma visits (ER, hospital, and clinic) for each of the three years and the average number of visits in children with asthma claims.

Table 12 displays the results of combining the 36 months for a report of unduplicated asthma prevalence and visits. There were a total of 1,730 children with one or more asthma utilization claims from the 19,252 children included in the logistic regression for Aim 2.
Table 11

Prevalence and Visits for Asthma By Study Year

<table>
<thead>
<tr>
<th>Year of study</th>
<th>Asthmatic children</th>
<th>Average enrollment</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>'98 - '99</td>
<td>633</td>
<td>8,467</td>
<td>7%</td>
</tr>
<tr>
<td>'99 - '00</td>
<td>820</td>
<td>12,194</td>
<td>7%</td>
</tr>
<tr>
<td>'00 - '01</td>
<td>931</td>
<td>14,029</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year of study</th>
<th>Total # asthma visits</th>
<th>Asthmatic children</th>
<th>Average visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>'98 - '99</td>
<td>1,407</td>
<td>633</td>
<td>2.22</td>
</tr>
<tr>
<td>'99 - '00</td>
<td>2,124</td>
<td>820</td>
<td>2.59</td>
</tr>
<tr>
<td>'00 - '01</td>
<td>2,005</td>
<td>931</td>
<td>2.15</td>
</tr>
</tbody>
</table>

*Year 1 = April 1, 1998 – March 31, 1999; Year 2 = April 1, 1999 – March 31, 2000; Year 3 = April 1, 2000 – March 31, 2001. *Asthmatic children = number of children with at least one visits (ER, hospital, or clinic) during the measurement year. *Average enrollment = the number of children with more than 180 total enrollment days and who were enrolled at the mid-point day of the measurement year (on July 1). *Prevalence = ‘average enrollment’ divided by number ‘asthmatic children’. *Total # of asthma visits = total count of ‘child months’ in which there was at least one claim during the measurement year. When there was more than one visit for a specific child in a month (e.g., two or more clinic visits for one child in one month), the count of the outcome variable (e.g, clinic visits) was one. For the ‘clinic’ variable, there were 10-15% of ‘child months’ in which multiple clinic visits were counted as one. *Average visits = ‘total # asthma visits’ divided by ‘asthmatic children’.

Table 12

Unduplicated Asthma Prevalence and Visits for All Years Combined

<table>
<thead>
<tr>
<th>All years combined</th>
<th>Children enrolled</th>
<th>Asthmatic children</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years 1-3 ('98 - '01)</td>
<td>19,252</td>
<td>1,730</td>
<td>9%</td>
</tr>
</tbody>
</table>

*Years 1 – 3 = April 1, 1998 – March 31, 2001. *Children enrolled = a count of children with more than 180 total enrollment days. *Asthmatic children = number of children with at least one asthma visits (ER, hospital, or clinic). *Prevalence = children enrolled’ divided by number ‘asthmatic children’.
Figure 14 presents the annual population-based rates for the three outcomes (ER, hospital, clinic asthma visits). When comparing Year 3 with Year 1, there were 21.7 ER visits per 1,000 Missouri Care members compared with 19.7 ER visits per 1,000 members. This reflects a 10% increase by the end of the study period. Clinic visits decreased by 17%. Asthma hospitalizations decreased by 11% to 6.3 visits per 1,000 members (Year 3) from 7.1 visits per 1,000 members (Year 1).

<table>
<thead>
<tr>
<th></th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>19.7</td>
<td>23.1</td>
<td>21.7</td>
</tr>
<tr>
<td>Hosp</td>
<td>7.1</td>
<td>9.9</td>
<td>6.3</td>
</tr>
<tr>
<td>Clinic</td>
<td>139.4</td>
<td>141.1</td>
<td>115.0</td>
</tr>
</tbody>
</table>

*Figure 14. Annual rates for asthma utilization.*

As stated in the methods section for Aim 2, only the first baseline summer interval (Year 1) could be statistically compared with summer post-intervals (Year 2 and 3). Figures 15-17 display illustrations of semi-annual summer and winter rates for ER,
hospital, and clinic visits for asthma. Each chart has three lines, each representing a different year.

Figure 15 displays semi-annual rates for ER visits. During the three six-month summer intervals available for statistical analysis, there were 215 instances where a unique identifier (child) had one or more emergency room visits in one month. These 215 instances represent 29% of all ER instances (n = 753) within a group of 500 children with ER visits during the three year study period.

![Figure 15. Semi-annual rates for asthma emergency visits.](image-url)
Logistic regression was used to determine whether the probability of one or more ER visits was related to the factors of year and month. An interaction between the two factors was included in initial models but was not significant (year * month \( p = 0.57 \)), so a main effects model was applied. Neither the year nor the month factor were significant (Table 13).

**Table 13**

*Results from the Logistic Regression Analysis for ER Visits*

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>Wald Chi-Square</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2</td>
<td>2.09</td>
<td>0.35</td>
</tr>
<tr>
<td>Month</td>
<td>5</td>
<td>8.67</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Figure 16 displays semi-annual rates for hospital visits. During the three six month summer intervals available for statistical analysis, there were 65 instances where a child had one or more hospital visits in one month. These 65 instances represent 24% of all hospital instances (\( n = 269 \)) among 170 children who had hospital visits during the three year interval.
Figure 16. Semi-annual rates for asthma hospital visits.

Logistic regression was used to determine whether the probability of one or more hospital visits was related to the factors of year and month. An interaction between the two factors was included in initial models but was not significant (year * month p = 0.56), so a main effects model was applied. Neither the year nor the month factor were significant (Table 14).
Effects of a SCDNT Nursing System on Children With Asthma

Table 14

Results from the Logistic Regression Analysis for Hospital Visits

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>Wald Chi-Square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2</td>
<td>1.18</td>
<td>0.56</td>
</tr>
<tr>
<td>Month</td>
<td>5</td>
<td>2.63</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Figure 17 displays semi-annual rates for clinic visits. During the three six month summer intervals available for statistical analysis, there were 1,352 instances where a

<table>
<thead>
<tr>
<th></th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yr 1</td>
<td>57.2</td>
<td>78.9</td>
</tr>
<tr>
<td>Yr 2</td>
<td>65.4</td>
<td>75.2</td>
</tr>
<tr>
<td>Yr 3</td>
<td>49.2</td>
<td>65.6</td>
</tr>
</tbody>
</table>

*p = .005* not tested

*The difference from baseline (Yr 1) to Yr 2 was not significant
The difference from baseline (Yr 1) to Yr 3 was significant

Figure 17. Semi-annual rates for asthma clinic visits.
unique identifier (child) had one or more clinic visits in one month. These 1,352 instances represent 30% of all clinic instances (n = 4,514) among 1,569 children who had clinic visits for asthma during the three year interval.

Logistic regression was used to determine whether the probability of one or more clinic visits was related to the factors of year and month. An interaction between the two factors was included in initial models but was not significant (year * month, p = 0.22), so a main effects model was applied. The factor year was significant (p = .005). Summer interval comparisons from Year 1 to Year 2 were not significant, but there was a significant difference in clinic visits from summer Year 1 to summer Year 3 with clinic visits being lower in Year 3 (Table 15). Again, as stated in Chapter 3, these results must be considered approximate since repeated observations were treated as independent.

Table 15

Results from the Logistic Regression Analysis for Clinic Visits

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>Wald Chi-Square</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2</td>
<td>10.40</td>
<td>0.005</td>
</tr>
<tr>
<td>Month</td>
<td>5</td>
<td>42.67</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
**Aim 3: Determine if Utilization Rates Differed Between Those Who Had Maximally Involved Providers and Those Who Had Minimally Involved Providers**

For achieving this aim, a comparison of utilization in ‘asthmatic’ children was performed between maximally and minimally involved providers over the 30-month interval post-nursing system implementation. There were 1,730 children who had at least one asthma claim (clinic, ER, or hospital visit) during this interval (Figure 18). There were two children with a very large total number of visits (50 and 69 total visits). This volume of visits was verified against the original file and was determined to be accurate.

*Figure 18. Volume of ‘asthmatic’ children and comparison interval between maximally and minimally involved provider groups.*
so these children were retained in the study group. Note that one child had a maximally involved provider; the other had a minimally involved provider.

The unit of analysis was ‘child-months’. From the 1,730 children, there were 745 (43%) children with exactly one visit (745 child-months). As stated in Chapter 3, all utilization visits within the month of the child’s initial visit and in the month immediately following the ‘index’ visit were suppressed. As part of this definition, 80 children with their first asthma visit in either month 35 or 36 were ‘lost’ to the analysis. This left 1,650 children with useable data and, of these, 665 children had only one visit. Table 16 reports child-month and utilization volumes for both provider groups.

### Table 16

**Asthma Facility Visit Volume By Maximally and Minimally Involved Provider Groups**

<table>
<thead>
<tr>
<th>Provider group</th>
<th>Child-months</th>
<th># Hospitalizations</th>
<th># ER visits</th>
<th># Clinic visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal</td>
<td>11,239 (48%)</td>
<td>26</td>
<td>135</td>
<td>685</td>
</tr>
<tr>
<td>Minimal</td>
<td>12,362 (52%)</td>
<td>58</td>
<td>173</td>
<td>809</td>
</tr>
<tr>
<td>Total</td>
<td>23,601</td>
<td>84</td>
<td>308</td>
<td>1,494</td>
</tr>
</tbody>
</table>

The comparisons to determine if the rate of utilization differed for maximally involved and minimally involved providers were adjusted for month of the study (to account for seasonal variation) and year. The interaction for provider by year was not significant ($p = 0.73$). The crude rate (not adjusted for month or year) for provider groups was examined initially (Table 17)
Table 17

Crude Utilization Rates By Provider Group Per 1,000 Members

<table>
<thead>
<tr>
<th>Provider group</th>
<th>Hospitalizations</th>
<th>ER visits</th>
<th>Clinic Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal</td>
<td>2.3</td>
<td>12.0</td>
<td>60.9</td>
</tr>
<tr>
<td>Minimal</td>
<td>4.7</td>
<td>13.9</td>
<td>65.4</td>
</tr>
</tbody>
</table>

The crude rate analysis was followed by a logistic regression analysis that allows for a month and year adjustment. Within the generalized linear model procedure, the generalized estimating equations account for dependency among responses from the same subject from observation to observation (GENMOD in SAS). The results from the logistic regression are displayed in Table 18.

Table 18

Relative Risk of Asthma Outcomes Between Two Groups of Providers

<table>
<thead>
<tr>
<th>Utilization outcomes (Maximal relative to Minimal)</th>
<th>Parameter estimate</th>
<th>Adjusted odds ratio (p value) (Confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>-0.7088</td>
<td>0.492 (p = 0.013) (0.281, 0.862)</td>
</tr>
<tr>
<td>ER</td>
<td>-0.1382</td>
<td>0.871 (p = 0.37) (0.644, 1.18)</td>
</tr>
<tr>
<td>Clinic</td>
<td>-0.1217</td>
<td>0.885 (p = 0.15) (0.751, 1.04)</td>
</tr>
</tbody>
</table>
The odds of hospitalization with a maximally involved provider relative to a minimally involved provider was 0.492. This value was found by exponentiating the parameter estimate of $-0.7088$ associated with the provider indicator variable. Since the probability of hospitalization is small, this odds ratio can be interpreted as the relative risk of hospitalization. Therefore, children with asthma were half as likely to be hospitalized if they had a provider who was maximally involved with the nursing system than children who had minimally involved providers. Additionally, children with maximally involved providers had fewer ER and clinic visits for asthma, but these were not statistically significant.
CHAPTER 5
DISCUSSION

The objective of this study was to test Orem’s Self-Care Deficit Nursing Theory (2001) in a population of patients to determine if quantifiable improvements in patient outcomes could be identified. The population chosen was children with asthma. The intervention was a nursing system. The outcomes were symptom control. No other exemplars surrounding the application and testing of SCDNT in populations could be found. The integration of the asthma literature with Orem’s estimative, transitional, and productive self-care operations revealed five health care system barriers that interfere with a DCA’s ability to successfully manage his or her child’s condition. These barriers are under-diagnosis, under-treatment, difficulty accessing care, low provider continuity, and incomplete or ineffective parent/child education.

The multi-faceted nursing system was implemented across three professional groups (physicians, nurses, and respiratory therapists) within one ER, three hospital units, and six outpatient clinic sites. One component of the nursing system involved formal annual training of maximally involved participants on appropriate diagnosis and optimal treatment. An educational curriculum was presented each September because the ‘asthma exacerbation season’ predictably begins each October and lasts through March. The foci of the curriculum was appropriate diagnostic criteria, optimum medication options, and skill mastery so that effective parent/child education, using the Basic 8, AMPs, and symptom diaries, would be the norm. Although regular training across all participants and
sites was completed, process data were not collected from PCPs or their staff relative to knowledge and skills about asthma diagnosis and treatment.

In terms of the other three health care system gaps (DCA knowledge; access, and continuity), other nursing system components were designed to focus attention on those children who had failed outpatient management. Specifically, children involved in intensive nursing system components were those who presented to the participating ER or one of the three Children's Hospital Units for an asthma exacerbation. Daily process monitoring occurred to determine if these nursing system components had been implemented. Feedback about implementation successes and failures was presented regularly (no less often than every month) to clinical and administrative leaders. Results from the 13 daily nursing system monitors confirmed the nursing system was implemented to a sufficient, but not perfect, degree. Specifically, the nursing system was implemented correctly for approximately 75% of 753 children who presented with an asthma exacerbation between October 1, 1998, and March 31, 2001. These 13 nursing system monitors had been designed to measure behavior change in the health care system.

The symptom control analysis demonstrated a remarkably lower rate of asthma hospital visits in children whose providers had been maximally involved in the SCDNT nursing system. Although not statistically different, the trend was toward lower ER and clinic visit volume in those children with maximally involved providers. These findings suggest the application of SCDNT to a population of children with asthma can result in quantifiable improvements in patient outcomes.
Effects of a SCDNT Nursing System on Children With Asthma

When comparing pre- and post-nursing system implementation across all Missouri Care members (ages 0-18), there was no change in ER or hospital visits, but there was a statistically significant decrease in asthma clinic visit rates ($p = .005$). However, this finding was contrary to the expectation that more clinic visits would result post-nursing system implementation. There were two analytic problems that could explain weak findings if, in fact, the nursing system was accountable for improved asthma symptom control. The first analytic problem was the absence of one full year as a baseline (pre-implementation) period. The baseline interval for the statistical analysis was the six summer months when asthma activity is lowest. If the 753 children who had been treated for an asthma exacerbation during the 30 months reflected usual asthma utilization activity throughout mid-Missouri, then only 30% of all exacerbations occur during the summer months. As previously illustrated (Figure 14), annual rates for asthma utilization in the Missouri Care population dropped 17% for clinic visits and 11% for hospitalizations between Year 1 and Year 3. Had there also been a drop in ER visits, rather than a 10% increase, these data would have strongly supported a conclusion that the nursing system was associated with improved symptom control within the entire Missouri Care population.

The second analytic concern in the population-based rate comparisons (Aim 2, Chapter 4) was that during almost all of the 30 months post nursing-system implementation, more children had minimally involved providers (refer to Figure 13). Recognizing this analytic concern, Aim 3 (Chapter 4) was designed to perform statistical
tests using only those children with ‘known’ asthma. Within this analysis, utilization outcomes could be compared for the two provider groups (maximal and minimal nursing system involvement groups). As just discussed, when examining outcomes in only those children ‘known’ to have asthma, the risk of being hospitalized for asthma was remarkably lower (one-half that of minimal providers \( p = .013 \)).

Application of Orem’s SCDNT (2001) to other populations is bound to reveal other similar critical factors in both self-care/dependent-care agents and the health care system that could be examined for improvement. From this study, there is clear evidence that health care leaders would serve our nation well by adopting a philosophy that values development of care-giver competency while ensuring prompt access to experienced and knowledgeable providers who have continuity relationships with their patients.

To achieve quantifiable improvements across an entire health plan, strategies must be formulated for sustainability. In some participating sites in this study, system re-design did not occur, thus, sustainable behavior change by health care system members did not occur. In one specific example, despite compliance problems almost every other month, no system was ever designed to forward copies of the treatment plan to the follow-up PCP after a child was discharged. Only after publicly sharing internal reports of poor compliance, temporary improvements would be made as a result of staff reminders or individual counseling. In contrast, another area developed and staffed a system whereby treatment plan records were forwarded to follow-up providers for all discharged patients. In these areas, leaders understood that only a re-designed strategy, one that would affect
Effects of a SCDNT Nursing System on Children With Asthma

all patient populations (not just children with asthma), would provide sustainable successes.

Implementing and sustaining clinical improvement programs across the health care system takes redesign, commitment, and resources. These investments are both clinically and financially prudent, especially when, in this case, it is clear that hospitalizations for children were significantly reduced. Modifying the health care system to reduce and eliminate health care system gaps required a sustained commitment to daily process monitoring. When organizational improvement is required and an implementation strategy designed, daily monitoring and feedback of results may be the single strongest action that will lead to organizational behavior change. When results from intensive monitoring are disappointing, appropriate leaders must be held accountable for the creation and implementation of innovative systems that will result in organizational change.

As important as system redesign, the development of interventions that are practical is a must. Expecting providers to individualize AMPs during the next business day appointment proved to be impractical. This intervention was challenged as impractical throughout the 30 months of the nursing system, and the data validated this challenge (refer to Table 10, Indicator #12). Typical reasons included insufficient time during clinic visits to develop an AMP since, during the winter, many of the next business day appointments were ‘double-booked’ (scheduling the child to be seen even though the schedule had no available openings). Another reason for poor rates of AMP
use after an ER visit was that the standard appointment duration of only 10-15 minutes was too short to do an adequate job. Specifically, the 10-15 minute office visit was perceived as problematic because, in order for a DCA to understand an individualized AMP, a significant amount of asthma teaching was required. Providing asthma teaching to DCAs with little or no prior knowledge about asthma requires much more time than 10-15 minutes allows.

Another rationale for not individualizing AMPs during the next business day appointment was that the child was still too ill for the DCA to comprehend all of the learning requirements necessary for usual day-to-day symptom control. In terms of redesign, however, a team from one participating clinic did spend an entire summer working on a system to schedule children for a total of three clinic visits over a six-week period following an ER visit for an asthma exacerbation. Results from this process redesign were not formally monitored, but the PI did note scheduling software evidence that this re-designed process was successful as several children did have all three follow-up visits scheduled. For these children, the scheduling of three follow-up appointments does suggest compliance with the specific clinic-based ‘practical’ plan for the development of competency through the generation of an individualized AMP. This clinic-based plan to develop AMPs for parents could be a practical model for use in other clinics, as long as health plan payment for multiple clinic visits is not denied.

One other systematic approach for achieving a goal that every child with asthma has an individualized AMP is to establish a clinic-based commitment to ‘tagging’ the
charts of children with an ‘asthma alert’. Once tagged, the AMP would be placed in the
chart in an easy-to-find location. Regardless of the reason for a clinic visit, once the chart
was tagged, this would alert the staff to ask the DCA (and child) about the child’s
symptom pattern and staff would be expected to assess DCA competency. Based on the
symptom and competency assessments, AMPs would then be updated and revised as
necessary. This strategy was presented early in the nursing system implementation phase
but was rejected by all participating clinics.

One completely unexpected finding in these data was the surprisingly high rate of
return to clinic for pre-scheduled follow-up appointments after ER and hospital discharge
(n = 545/720; 82%). During project planning in the spring and summer of 1998, a process
had not been in place for scheduling next business day appointments prior to discharge. A
process was established for UH ER staff to schedule follow-up appointments 24 hours a
day. This process was met with a great deal of resistance because it was believed that,
after spending several hours in an ER with a very sick child, parents would not return to a
PCP clinic appointment. Further, ER physicians believed that a next business day PCP
visit was not necessary because the post-ER discharge plan would be successful in
reversing the exacerbation. However, once convinced that establishing continuity with the
child’s PCP was a priority, ER providers and nurses agreed to try the new scheduling
process, but insisted on being appraised of ‘no show’ rates. The ‘no show’ rate was
consistently between 0% and 25%, much lower than the 80% expected ‘no show’ rate.
This high rate of kept appointments has helped dispel an MUHC perception that parents
would rather take their children to the ER for treatment rather than to a clinic. These data suggest that DCAs will meet with PCPs to learn how to competently manage the child’s illness, especially during an acute exacerbation.

Limitations

This study had three limitations. First, the six-summer month baseline comparison interval was sub-optimal. A decision to wait until a 12-month baseline could be quantified was rejected by the entire CQI team because it was agreed that the priority was improving symptom control in children with asthma, not establishment of a quantifiable baseline.

Second, from a population perspective, claims are a reasonable proxy to asthma symptom control in the population, but claims data do carry the risk of systematic errors. Specifically, it is well known that asthma is under-diagnosed. Thus, if the analysis depends on a code for asthma utilization and a true asthma condition is not recognized as such, these visits will not be coded as asthma, thus asthma utilization will be under-counted. In instances where asthma codes are submitted but health plan payment is denied, these claims would never be entered into the billing system, thus another source of under-counting (systematic error).

Finally, there were no controls in this study for either DCA competency, asthma severity, or visit time of day. Although a large focus of this study was to improve the competency of DCAs, there was no attempt to measure either a baseline or a change in DCA competency. Severity of the child’s asthma was also not measured. It is possible
that minimally involved providers had children with higher severity asthma, thus were at increased risk for hospitalization. This premise can not be dispelled using claims data, even though logically, this premise does not hold given the usual patterns of high-risk populations cared for by university-affiliated specialists and providers.

In terms of visit time of day, the ER is open 24 hours each day, 7 days a week. Access to clinic providers may have been limited simply because of the 40-hour work week. Research shows that asthma symptoms worsen during the middle of the night (NAEPP, 1997a). If seeking medical advice after hours for an asthma exacerbation, a typical parent would have two choices: (a) try to contact the provider by telephone, or (b) take the child to the ER. At MUHC, providers are contacted by telephoning the nurse triage line. Using protocols, the nurse asks the caller to provide information from assessment and treatment questions. Based upon the answers, the nurse provides protocol-driven advice. Sometimes this advice is to take home-based action and sometimes it is to take the child to the ER. Other than reviewing and revising the asthma-related telephone advice protocols, the nursing system did not alter the MUHC system for either PCP access or referral to the ER. The ideal system would allow the DCA to contact his or her child’s PCP any time of the day or night, and this provider would have a continuity relationship with the child. With group practice models such as that of UP Family Practice and UP Pediatrics, direct access to the child’s continuity provider is not always possible.
Implications

This study has demonstrated the utility of examining the scientific literature from the perspective of SCDNT (Orem, 2001), specifically the self-care/dependent-care actions that must be taken to competently manage an illness condition. After articulating estimative, transitional, and productive self-care operations into four competent action sets, the review of the asthma literature clearly demonstrated five health care system barriers that interfere with a DCA’s ability to control asthma symptoms on behalf of their child. Both the identified health care system barriers and the four competency action sets have applicability with other chronic illness populations.

In this study, the nursing system components were designed to remove or reduce the five health care system barriers. Several of the nursing system components would be relatively simple to adopt for any patient condition. Specifically, standardized discharge processes should always include teaching about self-care/dependent-care actions. Follow-up appointments should be scheduled prior to discharge. Communicating treatment plan information to the patient’s continuity provider should become a standard activity.

For asthma specifically, the single best ‘marker’ bearing evidence of a health care system’s commitment to development of DCA competency is the presence of an individualized AMP. From a financial perspective, the health plan is likely to benefit the most when DCAs are competent. The health plan can not individualize the AMP with the DCA and child. Only providers can accomplish this and only after substantial DCA education. Yet ‘payment’ for asthma teaching by providers is not reimbursed. The results
of this study could support a movement to provide payment to providers who submit evidence that an AMP was individualized with the patient.

When improvements in patient-specific outcomes such as asthma symptom control are linked with theoretically-driven interventions, nurse researchers validate the substance and contributions of our profession. This study has clearly demonstrated this link with a population of children with asthma. One nurse researcher, working in concert with a committed health care team, has quantified symptom control improvements when health care system factors were aligned so that gaps interfering with development of DCA competency were reduced or removed. However, this intervention was not without costs. In March 2001, the health care system investment for the 30-month intervention was estimated at $227,433 (C. Kivlahan, personal communication, March 12, 2001). These costs were incurred solely by MUHC even though Missouri Care would have reaped all financial savings resulting from reduced utilization. It will be difficult to achieve optimum health outcomes in U.S. citizens until health care delivery models move away from profitability when patients are in crisis toward one that is truly integrated and financially aligned so that health is valued and promoted.
## Outpatient Pediatric (Age 0-17) Asthma Guidelines

With Initial Diagnosis: Start 2 week treatment of continuous age appropriate bronchodilator therapy (MDI or nebulizer) consisting of one adrenergic agent (i.e., albuterol) and one anti-cholinergic (i.e., Atrovent). After first 2 weeks, decrease bronchodilators to pm with albuterol given before exercise. Patient to keep symptom diary. Reevaluate 6-8 weeks after beginning treatment. Teach patient to resume bronchodilator therapy at first sign of URI (before wheezing starts). On 2nd visit, evaluate severity of disease (as below). If mild intermittent, reschedule visits q 4 months

If on anti-inflammatory agents, satisfactory control is defined as symptoms (cough, wheezing, or dyspnea) present on three or less days per week and use of bronchodilators (except to prevent exercise-induced asthma) on three or less days per week and no limitation on school and exercise tolerance.

<table>
<thead>
<tr>
<th>STEP 1</th>
<th>LONG TERM CONTROL</th>
<th>QUICK-RELIEF</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILD INTERMITTENT (Symptoms 0-1 time/week)</td>
<td>No daily medications needed PRN use of bronchodilators (Albuterol and/or Atrovent)</td>
<td>see STEP 2 Quick-Relief</td>
</tr>
<tr>
<td>STEP 2</td>
<td><strong>MILD PERSISTENT</strong> (Symptoms &gt;1 time/week)</td>
<td>age 0-5: q 4-6° - use pre-mixed</td>
</tr>
<tr>
<td></td>
<td>Regular use of anti-inflammatories</td>
<td>Albuterol or mix Albuterol 0.5% by</td>
</tr>
<tr>
<td></td>
<td>age 0-5: qid nebulized Cromolyn x 1 month (can 1 to q4°). If controlled after 1 month, can 1 to tid</td>
<td>nebulizer 0.03 ml/kg/ dose (min of 0.25</td>
</tr>
<tr>
<td></td>
<td>age &gt; 5: qid MDI Cromolyn 2 puffs x 1 month (can 1 to q4°). If controlled at 1 month, 1 to tid OR</td>
<td>mL/dose — max of 0.5 ml/dose) AND</td>
</tr>
<tr>
<td></td>
<td>if age &gt; 12: qid MDI Nedocromil 2 puffs qid x 1 month; then 2 puffs bid can be given</td>
<td>Atrovent 1.25 mL (½ vial) by nebulizer (For</td>
</tr>
<tr>
<td></td>
<td>instead of Cromolyn</td>
<td>office therapy only, may repeat q 20</td>
</tr>
<tr>
<td></td>
<td>IF ABOVE TREATMENT FAILS TO CONTROL SYMPTOMS:</td>
<td>minutes x 1 hour. Home management should not</td>
</tr>
<tr>
<td></td>
<td>Inhaled Steroids — Low Dose (see page 2) Consider specialty consultation</td>
<td>exceed q 4-6°)</td>
</tr>
<tr>
<td>STEP 3</td>
<td><strong>MODERATE PERSISTENT</strong> (Daily Symptoms)</td>
<td>age &gt; 5 with mild to moderate attack: q</td>
</tr>
<tr>
<td></td>
<td>Cromolyn OR</td>
<td>4-6° Albuterol MDI 2 puffs AND</td>
</tr>
<tr>
<td></td>
<td>Inhaled Steroids — Medium Dose (see page 2)</td>
<td>Atrovent MDI 2 puffs</td>
</tr>
<tr>
<td></td>
<td>If age &gt; 12, Nedocromil AND</td>
<td>age &gt; 5 with severe attack: q 4-6° — mix</td>
</tr>
<tr>
<td></td>
<td>Inhaled Steroids — Medium Dose Specialty consultation recommended</td>
<td>Albuterol 0.5% by nebulizer 0.5 mL AND</td>
</tr>
<tr>
<td></td>
<td>Consider Theophylline, Salmeterol, Nedocromil*, or systemic steroids for additive</td>
<td>Atrovent as follows: If age 5-12 = 1.25 mL (½</td>
</tr>
<tr>
<td></td>
<td>effect</td>
<td>vial); If age &gt; 12 = 2.5 mL (1 vial)</td>
</tr>
<tr>
<td></td>
<td>IF ABOVE TREATMENT FAILS TO CONTROL SYMPTOMS:</td>
<td>IF ABOVE TREATMENT FAILS TO CONTROL SYMPTOMS:</td>
</tr>
<tr>
<td></td>
<td>Inhaled Steroids — Medium to High Dose (see page 2)</td>
<td>Systemic steroids prednisone or prensolone 2 mg/kg/day with a maximum of 60 mg/day in 2-4 divided doses for 5-7 days (Close follow-up by phone or office visit within a week as determined by the PCP)</td>
</tr>
<tr>
<td>STEP 4</td>
<td><strong>SEVERE PERSISTENT</strong> (Continual Symptoms)</td>
<td>see STEP 2 Quick-Relief</td>
</tr>
<tr>
<td></td>
<td>Inhaled Steroids — Medium to High Dose (see page 2)</td>
<td>Consider systemic steroids or admission</td>
</tr>
<tr>
<td></td>
<td>Obtain specialty consultation</td>
<td></td>
</tr>
<tr>
<td>Inhaled Steroid</td>
<td>Low Dose</td>
<td>Medium Dose</td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>Daily Dose</td>
<td>Dosing Regime</td>
</tr>
<tr>
<td>Beclomethasone dipropionate</td>
<td>8 puffs/day</td>
<td>4 puffs BID</td>
</tr>
<tr>
<td>Beclovent</td>
<td>4 puffs/day</td>
<td>2 puffs BID</td>
</tr>
<tr>
<td>Vanceril = 42 mcg/puff</td>
<td>Vanceril DS = 84 mcg/puff</td>
<td></td>
</tr>
<tr>
<td>Fluticasone propionate</td>
<td>4 puffs/day</td>
<td>2 puffs BID</td>
</tr>
<tr>
<td>Flovent = 110 mcg/puff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triamcinolone acetonide</td>
<td>8 puffs/day</td>
<td>4 puffs BID</td>
</tr>
<tr>
<td>Azmacort = 100 mcg/puff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budesonide</td>
<td>1-2 doses/day</td>
<td>1 dose QD or BID</td>
</tr>
<tr>
<td>Pulmicort = 200 mcg/dose</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Indications for referral to specialist:**
1. Unsatisfactory control (as defined above) on non-steroidal anti-inflammatory drugs (cromolyn or nedocromil) or low dose inhaled corticosteroids.
2. Diagnosis of asthma uncertain.
3. Clinical entities complicating asthma: sinusitis, severe chronic rhinitis, nasal polyps, aspergillosis.
4. Need for further diagnostic testing: skin tests for allergy, complete pulmonary function tests, provocation tests (exercise or methacholine).
5. Compliance problems, environmental control problems, complications of therapy.
6. Two or more courses of prednisone per year.

Spirometry should be performed at least once/year in children over 5 years. If values of FEV$_1$ are less than 80% of predicted or if FEF$_{75}$ less than 70% predicted (at stable state, not in an exacerbation), the patient should also be referred to specialist care.

**Reference:**
Management of Asthma Exacerbation (age 0-17): Emergency Department

**Initial Assessment:** History, physical exam, PEF, SaO2, & other tests as indicated

**Mild Exacerbation**
(May be agitation, increased RR, possible use of accessory muscles, suprasternal retractions, wheeze, increased HR, PEF 80%-99%)
- Standing orders:
  - PEF at assessment then after third HFN
  - Add Atrovent at physician discretion
  - HFN albuterol/NS x 1
  - PEF at physician discretion after 1st HFN
  - PEF at physician discretion after third HFN
  - HFN albuterol q20 min for a total of 3 treatments
  - Automatic reevaluation by respiratory therapist 20 min after each HFN
  - SaO2 spot checks q20 min & PRN
  - Oxygen to keep SaO2 >90%
  - Ongoing assessment

**Moderate Exacerbation**
(May be agitation, increased RR, use of accessory muscles, prolonged expiratory phase, suprasternal retractions, wheeze, increased HR, PEF 50-80%, SaO2<91%)
- Standing orders:
  - PEF at assessment then after third HFN
  - Add Atrovent at physician discretion
  - HFN albuterol/NS x 1
  - PEF at physician discretion after 1st HFN
  - Add Atrovent at physician discretion after 3rd HFN
  - HFN albuterol q20 min for a total of 3 treatments
  - Oxygen to keep SaO2 >90%
  - Ongoing assessment
  - Repeat HFN q1* for 1-3* if there is continued improvement

**Severe Exacerbation**
(Agitation, dyspnea @ rest, high RR, use of accessory muscles, suprasternal retractions, tachypnea, & wheeze; HR>120, pulse paradoxous often present, PEF<50%, SaO2<91%)
- Standing orders:
  - PEF at assessment & at physician discretion
  - HFN high dose albuterol/Atrovent q1 then if poor response start continuous nebulization with albuterol
  - Close supervision by physician
  - Continuous supervision by respiratory therapist or nurse
  - SaO2 continuous
  - Oxygen to keep SaO2 >90%
  - Start IV corticosteroids
  - Ongoing assessment
  - If no improvement after initial HFN, admit to ICU ASAP

**Good Response**
- PEF ≥ 70%
  - If back to baseline after one HFN, consider discharge, however if more than one HFN, monitor sustained response for 3-4* after last treatment
  - Normal to mild symptoms, normal expiratory time/effort

**Incomplete response**
- PEF 50%-70%
  - Mild to moderate symptoms

**Poor response**
- PEF <50%
  - PCO2 >42 mmHg
  - SaO2 <90% on O2
  - Continued symptoms

**Discharge Home**
- Continue HFN or MDI albuterol/Atrovent for 24-48* or until seen by PCP
- Course of oral corticosteroids if indicated
- Give enough medicines until pharmacy is available to fill prescriptions
- Give asthma management plan for the next 24*
- Fax progress note/standing orders to PCP
- Call Health Connect 884-2401 to schedule flu appointment with PCP for the next working day.

**Individualized decision re: admission**
- ability of caregiver or patient to manage continued treatment at home.
- Follow-up appointment with PCP within 24*
- Review medication use
- Give instruction on when to call if condition worsens

**Admit to Hospital Ward or ICU**
(Impatient is on a continuous nebul or on q1* HFN for more than 3*, admit to ICU)
- Continue HFN q1-4*
- Oxygen to keep SaO2 >90%, IV corticosteroids, & other treatment as needed

Consider Peds Pulmonary Consult
## DOSAGES OF DRUGS FOR ASTHMA EXACERBATIONS IN EMERGENCY MEDICAL CARE OR HOSPITAL

### Inhaled short-acting beta2-agonists

<table>
<thead>
<tr>
<th>Medications</th>
<th>Children</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nebulizer solution</td>
<td>0.15 mg/kg (minimum dose 2.5 mg)</td>
<td>Only selective beta 2-agonists are recommended. For optimal delivery, dilute aerosols to minimum of 4 mL at gas flow of 6-8 L/min.</td>
</tr>
<tr>
<td>(5 mg/mL)</td>
<td>every 20 min. for 3 doses, then 0.15-0.3 mg/kg up to 10 mg every 1-4 hours as needed, or by continuous nebulization at 5 mg/hr, 10 mg/hr OR 15 mg/hr.</td>
<td></td>
</tr>
<tr>
<td>MDI (90 mcg/puff)</td>
<td>4-8 puffs every 20 min. for 3 doses, then every 1-4 hours as needed. As effective as nebulized therapy if patient is able to coordinate inhalation maneuver. Use spacer/holding chamber.</td>
<td></td>
</tr>
</tbody>
</table>

### Systemic (injected) beta 2-agonists

<table>
<thead>
<tr>
<th>Medications</th>
<th>Children</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine -</td>
<td>0.01 mg/kg up to 0.3-0.5 mg every 20 min. for 3 doses sq.</td>
<td>No proven advantage of systemic therapy over aerosol.</td>
</tr>
<tr>
<td>1:1000 (1mg/mL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terbutaline (1 mg/mL)</td>
<td>0.01 mg/kg every 20 min. for doses, then every 2-6 hours as needed sq.</td>
<td>No proven advantage of systemic therapy over aerosol.</td>
</tr>
</tbody>
</table>

### Anticholinergics

<table>
<thead>
<tr>
<th>Medications</th>
<th>Children</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipratropium bromide -</td>
<td>0.25 mg every 20 min. for 3 doses, then every 2 to 4 hours. May mix in same nebulizer with albuterol. Should not be used as first line therapy; should be added to beta 2-agonist therapy.</td>
<td></td>
</tr>
<tr>
<td>Nebulizer solution (0.25 mg/mL)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Corticosteroids

<table>
<thead>
<tr>
<th>Medications</th>
<th>Children</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prednisone</td>
<td>1 mg/kg every 6° for 48° then 1-2 mg/kg/day (maximum=60 mg/day) in 2 divided doses maximum 60 mg/day) for 3-10 days, until PEF 70% of predicted or personal best.</td>
<td>For outpatient “burst”, use 40-60 mgm in single or 2 divided doses (children = 1-2 mg/kg/day)</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prednisolone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** No advantage has been found for higher dose corticosteroids in severe asthma exacerbations, nor is there any advantage for intravenous administration over oral therapy provided gastrointestinal transit time or absorption is not impaired. The usual regimen is to continue the frequent multiple daily dosing until the patient achieves an FEV, or PEF of 50 percent of predicted or personal best and then lower the dose to twice daily. This usually occurs within 48 hours. Therapy following a hospitalization or emergency department visit may last from 3 to 10 days. If patients are then started on inhaled corticosteroids, studies indicate there is no need to taper the systemic corticosteroid dose. If the followup systemic corticosteroid therapy is to be given once daily, one study indicates it may be more clinically effective to give the dose in the afternoon at around 3:00 p.m. (Beam et al. 1992).
These data represent claims submitted to Missouri Care which were coded as asthma visits. For clinical concerns regarding information in this report, you may wish to consult the medical record.

Name: A, ALPHA
MR Number: 0
Primary Provider: PURPLE, DR.
DOB: 05/21/1987

<table>
<thead>
<tr>
<th>12 months as Missouri Care enrollee</th>
<th>Ideal Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ER visits for asthma..............</td>
<td>0 ER visits</td>
</tr>
<tr>
<td>3 hospitalizations for asthma........</td>
<td>0 hospitalizations</td>
</tr>
<tr>
<td>6 clinic appointments kept...............</td>
<td>high continuity</td>
</tr>
<tr>
<td>1 did not keep clinic appointment (DNKA). 0 DNKAs</td>
<td></td>
</tr>
<tr>
<td>13 rescue (bronchodilator inhaler) refills...........</td>
<td>1 rescue refill for every</td>
</tr>
<tr>
<td>7 control (anti-inflammatory inhaler) refills. 2 control refills</td>
<td></td>
</tr>
<tr>
<td>4 clinic visits with pediatric pulmonary primary doc sees pt. also</td>
<td></td>
</tr>
</tbody>
</table>

Emergency/Inpatient Treatment for Asthma (ICD-9 493)

<table>
<thead>
<tr>
<th>Date</th>
<th>Visit Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/19/1998</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>08/19/1998</td>
<td>Hospitalization</td>
</tr>
<tr>
<td>08/20/1998</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>08/20/1998</td>
<td>Hospitalization</td>
</tr>
<tr>
<td>08/21/1998</td>
<td>Hospitalization</td>
</tr>
<tr>
<td>11/12/1998</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>03/01/1999</td>
<td>Emergency Room</td>
</tr>
<tr>
<td>03/02/1999</td>
<td>Emergency Room</td>
</tr>
</tbody>
</table>

Clinic Appointments for Asthma (ICD-9 493) and DNKAs

<table>
<thead>
<tr>
<th>Date</th>
<th>Provider</th>
<th>DNKA</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/09/1998</td>
<td>GREEN, DR.</td>
<td></td>
</tr>
<tr>
<td>09/02/1998</td>
<td>RED, DR.</td>
<td></td>
</tr>
<tr>
<td>10/12/1998</td>
<td>GREEN, DR.</td>
<td></td>
</tr>
<tr>
<td>01/11/1999</td>
<td>GREEN, DR.</td>
<td></td>
</tr>
<tr>
<td>02/16/1999</td>
<td>BLUE, DR.</td>
<td></td>
</tr>
<tr>
<td>02/17/1999</td>
<td>RED, DR.</td>
<td></td>
</tr>
<tr>
<td>03/02/1999</td>
<td>YELLOW, DR.</td>
<td></td>
</tr>
</tbody>
</table>

Number of Asthma Med Refills

- [Sum of Control (Intal, Vancoril DS)]
- [Sum of Rescue (Albuterol, Maxair)]

Asthma Medications

<table>
<thead>
<tr>
<th>DateFilled</th>
<th>DrugDescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/09/1998</td>
<td>ALBUTEROL</td>
</tr>
<tr>
<td>07/09/1998</td>
<td>ALBUTEROL SULFATE</td>
</tr>
<tr>
<td>07/09/1998</td>
<td>ATROVENT</td>
</tr>
<tr>
<td>07/09/1998</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>07/09/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>08/04/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>09/03/1998</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>09/03/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>09/25/1998</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>09/25/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>10/02/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>11/09/1998</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>11/09/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>12/09/1998</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>12/09/1998</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>01/22/1999</td>
<td>FLOVENT</td>
</tr>
<tr>
<td>01/22/1999</td>
<td>SEREVENT</td>
</tr>
<tr>
<td>02/03/1999</td>
<td>ALBUTEROL SULFATE</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS

- Be sure the patient has an asthma management plan and knows how to use it
- Prescribe appropriate CONTROL medications
- For multiple ER visits or hospitalizations, consider contacting Missouri Care (573) 441-2100 to speak with one of the case managers
Hi, I'm Dr. Purple. I, as part of our Pediatrics Green Meadows team, am assigned as Angie’s primary doctor by Missouri Care. As part of Angie’s health care team, we want to help keep Angie well. We believe that asthma can be controlled.

I have reviewed Angie’s medical records and have these ideas about optimal control of her asthma.

- Angie had 5 ER visits and 3 hospital stays in one year for asthma. When asthma is in good control, there should be no ER visits or hospital stays for asthma.
- The right drugs can keep asthma under control. QUICK-RELIEF (or RESCUE) drugs such as Albuterol can stop asthma attacks. CONTROL drugs such as Flovent, Beclometh, Pulmicort or Veceril keep your child from having problems in the future. ANGIE HAD 13 QUICK-RELIEF REFILLS AND ONLY 7 CONTROL REFILLS IN ONE YEAR. IDEALLY, THERE SHOULD BE MORE CONTROL REFILLS THAN QUICK-RELIEF REFILLS.
- In one year, Angie saw four different doctors for her asthma. Ideally, Angie should see her primary care doctor for routine asthma visits but we do understand that this is not always possible during an acute exacerbation.
- Angie did not keep 1 clinic visit. Missing visits can hurt how well we keep Angie's asthma in control. If you need help with transportation to clinic visits, please call Missouri Care at 441-2100.
- Every child with asthma should have an Asthma Action Plan. The Asthma Action Plan tells what to do for your child’s asthma. If Angie does not have an Asthma Action Plan, please schedule an appointment with me by calling 882-4730. We’ll develop an Asthma Action Plan that we all can use.
- You can help control your child’s asthma. Keep Angie away from things that make her asthma worse such as cigarette smoke or dust.
- With this letter is an asthma symptom diary and peak flow meter. For at least one month, write down Angie’s symptoms and peak flow meter results each day. Bring this with you the next time you visit me.

If you have questions, please schedule a routine appointment to go over this by calling 882-4730. Bring this summary and Angie’s symptom diary to Angie’s next visit, and we will discuss ways to better control her asthma.

Pat Purple, MD

PEDIATRIC ASTHMA CONTINUOUS QUALITY IMPROVEMENT
### ASTHMA SYMPTOM DIARY

**Name:**

**Medical Record Number:**

**Date of Birth:**

**Month:**

<table>
<thead>
<tr>
<th></th>
<th>DATE:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Cough</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Occasional</td>
<td>1</td>
</tr>
<tr>
<td>Frequent</td>
<td>2</td>
</tr>
<tr>
<td><strong>2. Wheeze</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Little</td>
<td>1</td>
</tr>
<tr>
<td>Moderately Bad</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>3</td>
</tr>
<tr>
<td><strong>3. Activity</strong></td>
<td></td>
</tr>
<tr>
<td>Quite Normal</td>
<td>0</td>
</tr>
<tr>
<td>Can run short distance</td>
<td>1</td>
</tr>
<tr>
<td>Limited to walking</td>
<td>2</td>
</tr>
<tr>
<td>Off school or indoors</td>
<td>3</td>
</tr>
<tr>
<td><strong>4. Shortness of Breath</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Occasional</td>
<td>1</td>
</tr>
<tr>
<td>Part of Day</td>
<td>2</td>
</tr>
<tr>
<td>Most of Day</td>
<td>3</td>
</tr>
<tr>
<td><strong>5. Sleep Disturbance due to cough, wheeze or shortness of breath.</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Heard, does not wake</td>
<td>1</td>
</tr>
<tr>
<td>Awake</td>
<td>2</td>
</tr>
<tr>
<td>Unable to Sleep</td>
<td>3</td>
</tr>
<tr>
<td><strong>6. Peak Flow</strong></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td></td>
</tr>
<tr>
<td>After School</td>
<td></td>
</tr>
<tr>
<td><strong>7. Drugs (No. of doses/24 hours)</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>
### ASTHMA ACTION PLAN FOR:

<table>
<thead>
<tr>
<th>Date of birth</th>
<th>Medical Record Number</th>
</tr>
</thead>
</table>

#### Goals of Asthma Care

"Your asthma can be controlled—expect nothing less." - N.I.H.

- Be free from severe breathing problems day & night; sleep not bothered by asthma
- Be able to run or play hard without breathing problems; not missing school or work
- No need for emergency care or hospital stays due to asthma
- Uses asthma medicines correctly with good results and no side effects

#### AVOID TOBACCO SMOKE!
Tobacco smoke worsens asthma and puts you at risk for serious breathing problems. Stay away from ALL tobacco smoke at home & in the car!

#### Watch for things that make your asthma worse. Stay away from these triggers:

- house dust & cockroach
- indoor animals
- mold and mildew
- viral infections & colds
- spring pollen
- summer & fall pollen
- very cold air
- weather changes

#### Daily Control Medicines to Prevent Breathing Problems

(MUST be taken EVERY day as often as ordered to be effective!)

<table>
<thead>
<tr>
<th>name of medicine</th>
<th>how much to take</th>
<th>when to use it</th>
</tr>
</thead>
</table>

#### Quick Relief for Cough, Wheeze, or Shortness of Breath

<table>
<thead>
<tr>
<th>name of medicine</th>
<th>how much to take</th>
<th>when to use it</th>
</tr>
</thead>
</table>

#### Medicine to be Used Before Running or Playing Hard

<table>
<thead>
<tr>
<th>name of medicine</th>
<th>how much to take</th>
<th>when to use it</th>
</tr>
</thead>
</table>

- 2 puffs
- 20 minutes before exertion

**THESE MEDICINES ARE TO BE GIVEN BY:**

- NEBULIZER
- INSPIREASE
- AEROCHAMBER

**TECHNIQUE DEMONSTRATED & CONFIRMED BY**

Please, CALL if you need quick relief medicines more often than every 4 hours or for more than 5 days in a row. (See warning signs on next page.)

(Doctor or Nurse Practitioner signature)            (Clinic phone number)            (Date - Plan is valid for one year)

- A zone plan for asthma control is needed & was explained to the family. See reverse side.

Original & 1 copy to family, copy for chart, fax to PCP
| **GREEN** = Good Day  
Use only Daily Control Medicines | **YELLOW** = Caution  
Use Quick Relief Medicines | **RED** = Stop & Call  
Use Quick Relief Medicines 
& Call Doctor |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Flow above</td>
<td>Peak Flow _____ to _____</td>
<td>Peak Flow below</td>
</tr>
</tbody>
</table>
| *No wheezing*  
*No coughing*  
*Active and breathing well*  
*Sleeping well*  
**"Normal" rate of breathing (count breaths per minute when your child is resting or asleep):**  
Infant: 20-40 breaths/minute  
Toddler: 18-30 breaths/minute  
Child: 16-25 breaths/minute  
Adult: 12-20 breaths/minute | *Some wheezing*  
*Some coughing*  
*Less active or playful*  
*Having breathing problems*  
*Cough or breathing problems wake you up*  
*Eating less or not hungry* | *Lots of wheezing*  
*Lots of coughing*  
*Too short of breath to run or play*  
*Cannot sleep due to breathing problems*  
*Might have rapid breathing at rest if rate is more than:*  
50 breaths/minute—Infant  
40 breaths/minute—Toddler  
30 breaths/minute—Child  
20 breaths/minute—Adult |

**Plan:**  
1. Continue Daily Control medicines.  
2. Call if free of asthma symptoms for 6 weeks. Your Daily Control medicine dose might need to be decreased.  
3. Treat and control related problems as needed (i.e., allergy, sinus infections, acid indigestion): |

**Plan:**  
1. Use Quick Relief medicines.  
2. Look for and avoid triggers.  
3. Call if:  
   a. Quick Relief medicines don’t help OR  
   b. Quick Relief medicines are needed more often than every 4 hours OR  
   c. Quick Relief medicines are needed for more than 5 days  
4. Increase the dose of your Control Medicines, as written below: |

**Plan:**  
1. Use Quick Relief medicines and CALL your doctor right away.  
2. Repeat the Quick Relief medicines one time if not feeling better.  
3. Ask about starting oral steroids: |

<p>| | | |</p>
<table>
<thead>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Return to see your doctor for follow-up on the following date: |

**COMPLICATING CONDITIONS**  
*Allergy (allergic rhinitis, "hay fever")*  
*Sinus infections (sinusitis)*  
*Reflux (acid indigestion)*  
*Colds (upper respiratory infections)*  

**URGENT SIGNS/ SYMPTOMS**  
*Sucking in of the chest wall with breathing (retractions)*  
*Unable to catch breath after Quick Relief medicines*  

**EMERGENCY SIGNS**  
*Unable to talk, walk or eat due to breathing problems*  
*Blue or purple lips or fingernails*  
*Severe breathing problems*  

**DISCUSS WITH YOUR DOCTOR**  
**SEE YOUR DOCTOR TODAY**  
**GO TO THE EMERGENCY ROOM OR CALL "911"**
Appendix G

Asthma Instructional Sheets and Self-Monitoring Tools

A. Detecting, Interpreting and Monitoring Symptoms

*Questions and Answers About Breathing and Lungs

*What is Asthma?

*How to Know If You’re Having An Asthma Episode

*What to Do If You Have An Asthma Episode

B. Regulation and Administration of Medications

*Albuterol

Asthma Medicines: Medicines You Swallow To Prevent Airway Swelling

Asthma Medications: Control Medicines that PREVENT Airway Swelling

Asthma Medications: Control Medicines that REDUCE Airway Swelling

Asthma Medications: Control Medicines that REVERSE Airway Swelling

Ipratropium Bromide

Theophylline

Salmeterol

Inspirease

How to Use Your Metered Dose Inhaler

How To Use Your Nebulizer

How To Use Your Peak Flow Meter

C. Identification and Avoidance of Environmental Triggers

*What Makes Asthma Worse?

How to Control Triggers: Animals

How to Control Triggers: Cockroaches

How to Control Triggers: Cold Air

How to Control Triggers: Dust Mites

*How to Control Triggers: Infections
Effects of a SCDNT Nursing System on Children With Asthma

How to Control Triggers: Mold & Mildew

How to Control Triggers: Pollens

*How to Control Triggers: Smoke, Fumes & Strong Odors

How to Control Triggers: Strong Feelings

D. Appropriately Seeking Medical Advice in a Timely Manner

*Asthma Symptom Diary

*Asthma Action Plan

Note. The eight instructional materials and the two self-monitoring tool contained in the Basic 8 folder are denoted by an asterisk before the title.
LETTER OF AGREEMENT

This Agreement is entered into this 1st day of March, 1998 by and between Missouri Care, LLC, The Curators of the University of Missouri, on behalf of the University of Missouri-Columbia Health Sciences Center, and Family Health Center.

WITNESSETH:

WHEREAS, Missouri Care, LLC, and The Curators of the University of Missouri, on behalf of the University of Missouri-Columbia Health Sciences Center ("University") have co-sponsored a Continuous Quality Improvement Initiative for the purpose of improving the quality of care to children with asthma; and

WHEREAS, Family Health Center ("the Center") provides medical care services to pediatric asthma patients who are members of the health plan sponsored by Missouri Care, LLC;

NOW, THEREFORE, in consideration of the mutual promises contained herein, the parties hereto agree as follows:

A. FAMILY HEALTH CENTER RESPONSIBILITIES

1) Family Health Center will provide Missouri Care, LLC, and the University with certain information and data specifically related to its patients enrolled in the pediatric asthma project, as follows:
   * whether or not the patient was seen at the Center following an Emergency Room visit or hospitalization at the University, and
   * whether or not the Center's provider developed an asthma action plan in conjunction with the patient/family.

B. MISSOURI, LLC, AND THE UNIVERSITY RESPONSIBILITIES

1) The University will analyze the information and data provided to it by the Center, and

2) The University will provide periodic reports to the Center and Missouri Care regarding its findings.

3) The timing of these reports will be agreed upon by and between Andy Quint, MD, Medical Director, Family Health Center; Sara Viessman, MD, Medical Director, Missouri Care, LLC; and Bernard Ewigman, MD, Pediatric Asthma Quality Improvement Project.

4) Missouri Care LLC, and all of its employees, and the University and all of its employees providing services under this Letter of Agreement agree to maintain the confidentiality of any
and all information and data provided.

5) Missouri Care, LLC, and all of its employees, and the University and all of its employees providing services hereunder further agree that the information and data provided by the Center to the University under this agreement shall be used solely for the purpose of providing the Center and Missouri Care, LLC, with quality improvement reports as set forth herein, and may not be used for any other purpose, including research or publication, without the prior written consent of the Center.

C. TERM AND TERMINATION

1) The term of this Agreement shall begin on the date set forth above and shall continue for an indefinite term; provided, however, that either party may terminate this Agreement at any time, with or without cause, by giving the other party thirty (30) days prior written notice of its intent to so terminate this Agreement.

D. MISCELLANEOUS

1) This Agreement shall be governed by and construed in accordance with the laws of the State of Missouri.

2) In the event any term, condition, provision or paragraph of this Agreement is held to be invalid and/or unenforceable by any Court of competent jurisdiction or any other authority vested with jurisdiction, the remaining provisions of this Agreement shall remain in full force and effect.

In Witness Whereof, the parties hereunto have caused this Agreement to be duly executed on the date documented below.

MISSOURI CARE, LLC

By: [Signature]

Title: President

Date: __________________________

FAMILY HEALTH CENTER

By: [Signature]

Title: Executive Director

Date: 12/4/98

By: [Signature]

Title: Medical Director

Date: 12/4/98

THE CURATORS OF THE UNIVERSITY OF MISSOURI on behalf of the University of Missouri-Columbia Health Sciences Center

By: [Signature]

Title: Assistant Vice President Management Services

Date: 1/8/99
REQUEST FOR EXEMPTION
HEALTH SCIENCES INSTITUTIONAL REVIEW BOARD

1. Name of Investigator: Karen R. Cox, RN, MS(N), PhD(c)

Investigator’s Title: Doctoral Student

Department: SCHOOL OF NURSING C194

Campus Address: DC 103.40 1W-22 University Hospital

2. Name of Project: Health Care Utilization Before and After Implementation of a Pediatric Asthma CQI Program

5. Brief Summary of the Project:
On 10/1/98, a nurse-led multidisciplinary continuous quality improvement (CQI) program was implemented at UH to improve asthma symptom control in children (ages 0-17). This program is designed to improve patient/parent competency via teaching about asthma and providing individualized plans for monitoring and managing exacerbations. This program also provides education to providers and changed health system factors (assuring appropriate follow-up and communication between ER, hospital, and clinic).

4. Using the categories 1 to 5 on the back of this form, list the category of research activity that you believe applies to your research: [ ]

5. Briefly describe the nature of the involvement of the human subjects (personal interview, mailed questionnaire, telephone questionnaire, observation, etc.) and the reason you believe this is an exempt project:
The impact of the CQI intervention will be evaluated from billing claims for both asthma treatment (hospitalizations, ER visits, clinic visits) and asthma medications refills. Billing claims will be scrubbed of identifiers before the analysis.

6. Are the data recorded in such a manner that subjects can be identified by a name or code? Yes ☐ No ☑

If yes: a) Who has access to the data and how is it being stored?

b) If you are using an assessment tool (e.g. the Beck Depression Inventory) what is your procedure for referring the subject for follow-up if his/her scores are significant?

[ ]

c) Will the list of names and codes be destroyed at the end of the study? Yes ☐ No ☑

7. Age of subjects:
Adults (persons age 18 and older) Yes ☑ No ☐
Minors (persons under age 18) Yes ☑ No ☐

8. If your project uses a questionnaire or structured interview, attach a copy of the questionnaire or interview questions to this form.

9. Signature of Investigator: [ ]

Date: 4/9/01

To Be Completed By The IRB - Room M230 HSC. 692-3181

(Project is exempt under 45 CFR 46.101(b) ☑)

Date: 4/28/2001

Authorized Signature (Health Sciences IRB)
APPENDIX J

PREPARATION OF THE ENROLLMENT TABLE FOR STATISTICAL ANALYSES

The purpose of Appendix J is to discuss findings and decisions surrounding preparation of the Missouri Care enrollment table for statistical analyses, and as such, serves as a continuation of the “Methods” section. This appendix presents a discussion of the enrollment table variables, the checking and cleaning of errors inherent in the data, decisions about which children should be included in the analysis, and preparation of the file for statistical analysis.

Variables in the Enrollment Table

The enrollment table contained 68,194 rows of data, representing ‘enrollment segments’. Each enrollment segment contained eight different data fields. These fields include: (a) a unique identifier for each member, (b) date of birth, (c) gender, (d) beginning date of the enrollment segment, (e) termination date of the enrollment segment, (f) beginning date of the ‘PCP assignment segment’, (g) termination date of the PCP assignment segment, and (h) a unique PCP identifier for the enrollment segment.

When a child is enrolled in any Medicaid health plan in the state of Missouri, a unique identifier, one that follows the member throughout their life (i.e., similar to a social security number), is assigned by an administrator at the state level (S. Koenig, personal communication, May 25, 2001). Missouri Care receives downloads of unique identifier activity on a regular basis. Prior to statistical analyses, all state-defined unique identifiers were replaced with study-specific unique identifiers. PCP identifiers were also
converted into either Group ‘A’ (maximal involvement) or Group ‘B’ (minimal involvement) provider identifiers.

Data Checking and Cleaning Procedures

Error detection procedures were applied to the initial 68,194 enrollment segments. Because the child’s name was removed, it was not possible to verify that each unique identifier represented a single child. Queries were written to find and correct a variety of errors.

Corrections To Newborn Ten Digit Unique Identifiers

A Missouri Care member identifier has eight digits. During examination of initial data tables received from Missouri Care in May 2001, there were several 10 digit member identifiers. When a newborn has a claim, the mother’s member identifier is used with the “01” extension (as 9th and 10th digits). When the identifier has been assigned for the infant by the state, the 10 digit member identifier should be corrected and all old data converted to the infant’s newly assigned eight digit identifier. In the May 2001 file, there were 367 member identifiers with 10 digits, rather than 8. Three hundred eleven of the 367 identifiers (85%) had an enrollment duration of zero days. The finding of zero days enrollment demonstrated the approach used by Missouri Care to make ‘corrections’ in the data. Corrections are handled by ‘zeroing out’ enrollment segments rather than deleting them. Missouri Care corrected information relative to all claims with 10 digit identifiers and lengths of enrollment greater than zero days.
Effects of SCDNT Nursing System on Children With Asthma

Gender Corrections

Variable attributes identified for gender were ‘M’ for male; ‘F’ for female, and ‘null’ (blank). All blank entries were investigated and corrected.

Date of Birth Corrections

The attributes for the variable date of birth (DOB) were checked; the DOB date correctly ranged between April 1, 1980 and March 31, 2001. A total of 34 member identifiers had multiple enrollment segments listing different dates of birth. Missouri Care was notified and corrected the information.

Removal of Some Enrollment Segments

From the initial 68,194 enrollment segments, a query for duplicates revealed that there were 265 segments that were identical on all variables (0.04%); these were eliminated, leaving 67,929 segments. From these segments, the next step was to design a query that would manage enrollment segments in children who turned 18 years of age during the 36 month interval. This was done by converting the child’s termination date to that of their 18th birthday if the termination date exceeded the 18th birthday.

Total enrollment days were then calculated for each enrollment segment. The equation used was: enrollment termination date minus enrollment beginning date. Several thousand enrollment segments were zero days in length, which reflected data management corrections rather than true enrollment activity. Three thousand two-hundred twelve enrollment segments (4.7%) were removed because, either the child was older
than 18 years or total enrollment days were zero. This left 64,717 enrollment segments, representing 27,649 unique children.

Children (Unique Identifiers)

Table J1 contains demographic findings from the 27,649 unique children, each child with one or more enrollment segments, anytime during the 36 months. This table demonstrates Missouri Care’s growth as measured at the mid-point of six-month summer/winter intervals. The growth from 7,169 members on July 1, 1998 to 15,023 members on January 1, 2001, reflects an enrollment increase of 110%. Gender was equally distributed.

Table J1

Demographics from All Children Enrolled Anytime During the 36 Months

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Summer</th>
<th>Winter</th>
<th>Summer</th>
<th>Winter</th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1/98-</td>
<td>10/1/98-</td>
<td>4/1/99-</td>
<td>10/1/99-</td>
<td>4/1/00-</td>
<td>10/1/00-</td>
<td></td>
</tr>
<tr>
<td>9/30/98</td>
<td>3/31/99</td>
<td>9/30/99</td>
<td>3/31/00</td>
<td>9/30/00</td>
<td>3/31/01</td>
<td></td>
</tr>
<tr>
<td>(Midpoint)</td>
<td>(7/1/98)</td>
<td>(1/1/99)</td>
<td>(7/1/99)</td>
<td>(1/1/00)</td>
<td>(7/1/00)</td>
<td>(1/1/01)</td>
</tr>
<tr>
<td>Unique IDs</td>
<td>7,169</td>
<td>9,180</td>
<td>10,737</td>
<td>12,030</td>
<td>13,267</td>
<td>15,023</td>
</tr>
<tr>
<td>Male</td>
<td>3,603</td>
<td>4,574</td>
<td>5,408</td>
<td>6,017</td>
<td>6,586</td>
<td>7,483</td>
</tr>
<tr>
<td>(50%)</td>
<td>(50%)</td>
<td>(50%)</td>
<td>(50%)</td>
<td>(50%)</td>
<td>(50%)</td>
<td>(50%)</td>
</tr>
<tr>
<td>0-2 years</td>
<td>1,717</td>
<td>2,149</td>
<td>2,484</td>
<td>2,751</td>
<td>2,941</td>
<td>3,376</td>
</tr>
<tr>
<td>(24%)</td>
<td>(23%)</td>
<td>(23%)</td>
<td>(23%)</td>
<td>(22%)</td>
<td>(22%)</td>
<td>(22%)</td>
</tr>
<tr>
<td>3-5 years</td>
<td>1,498</td>
<td>1,787</td>
<td>2,042</td>
<td>2,211</td>
<td>2,426</td>
<td>2,685</td>
</tr>
<tr>
<td>(21%)</td>
<td>(19%)</td>
<td>(19%)</td>
<td>(18%)</td>
<td>(18%)</td>
<td>(18%)</td>
<td>(18%)</td>
</tr>
<tr>
<td>6-12 years</td>
<td>2,600</td>
<td>3,434</td>
<td>4,042</td>
<td>4,633</td>
<td>5,137</td>
<td>5,805</td>
</tr>
<tr>
<td>(36%)</td>
<td>(37%)</td>
<td>(38%)</td>
<td>(39%)</td>
<td>(39%)</td>
<td>(39%)</td>
<td>(39%)</td>
</tr>
<tr>
<td>13-17 years</td>
<td>1,354</td>
<td>1,810</td>
<td>2,169</td>
<td>2,436</td>
<td>2,763</td>
<td>3,157</td>
</tr>
<tr>
<td>(19%)</td>
<td>(20%)</td>
<td>(20%)</td>
<td>(20%)</td>
<td>(21%)</td>
<td>(21%)</td>
<td>(21%)</td>
</tr>
</tbody>
</table>
The proportion of children between newborn and two years of age ranged between 22-24%; ages 3 to 5 years ranged between 18-21%; children ages 6 to 12 accounted for 36 to 39%; and children between 13 and 17 years accounted for 19-21% of plan membership.

**Determining Inclusion Criteria for Analysis**

Continuous enrollment is a term used for calculating certain managed care quality measures from claims data. The Health Plan Employer Data and Information Set (HEDIS) defines continuous enrollment as the interval between January 1 and December 31, with an allowance for a one time gap in enrollment as long as that gap does not exceed 45 days (National Committee for Quality Assurance, 2000).

In employer-based commercial health plans, calculation of HEDIS quality measures are fairly straightforward since commercial plans have members with stable enrollment, thus long and continuous enrollments. In Medicaid plans, however, multiple and frequent enrollment gaps are common (K. Weiss, personal communication, September 2, 1998). Gaps occur with changes in Medicaid eligibility and from forced administrative terminations (e.g., continued benefit eligibility verification). Given no clear guidelines for defining continuous enrollment for Medicaid populations, an analysis of enrollment segments was conducted so that decisions could be made about which Missouri Care children to include for statistical analyses.
Children Without Enrollment Gaps

From the original 27,649 unique identifiers, 16,591 (60%) had one enrollment segment, thus were continuously enrolled (without gaps). Table J2 presents enrollment duration for these children. Total enrollment days in children without gaps was 5,816,274 days; the average enrollment was 351 days with a median of 217 days. For children without gaps, the inclusion criterion for statistical analysis was set at total enrollment days of > 180 days (six months). Using this definition, 55% (9,145) of children without gaps met this criterion. Interestingly, at least 35% of children without gaps would have met the HEDIS definition for continuous enrollment.

Table J2

Total Enrollment Days For Children Without Gaps In Enrollment

<table>
<thead>
<tr>
<th>Total enrollment days</th>
<th># Unique identifiers</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 16,591)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-7 days</td>
<td>199</td>
<td>1%</td>
</tr>
<tr>
<td>8-45 days</td>
<td>2,497</td>
<td>15%</td>
</tr>
<tr>
<td>46-90 days</td>
<td>1,947</td>
<td>12%</td>
</tr>
<tr>
<td>91-180 days</td>
<td>2,803</td>
<td>17%</td>
</tr>
<tr>
<td>181-270 days</td>
<td>1,803</td>
<td>11%</td>
</tr>
<tr>
<td>271-364 days</td>
<td>1,423</td>
<td>10%</td>
</tr>
<tr>
<td>&gt;= 365 days</td>
<td>5,919</td>
<td>35%</td>
</tr>
</tbody>
</table>

Note. Average enrollment was 351 days; median was 217 days.

Children With Enrollment Gaps

There were 11,058 children with gaps in enrollment. These 11,058 children had 18,595 gaps in enrollment, or an average of 1.68 gaps per child. Table J3 documents the distribution for total enrollment day ranges. The average enrollment duration for these
Effects of SCDNT Nursing System on Children With Asthma

children was 246 days, with a median of 177 days. Ninety-two percent of children with gaps (n = 10,107) had enrollment durations longer than six months.

*Table J3*

**Total Enrollment Days for Children With Gaps in Enrollment**

<table>
<thead>
<tr>
<th>Total enrollment days</th>
<th># Unique identifiers</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 11,058)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-7 days</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>8-45 days</td>
<td>57</td>
<td>1%</td>
</tr>
<tr>
<td>46-90 days</td>
<td>219</td>
<td>2%</td>
</tr>
<tr>
<td>91-180 days</td>
<td>675</td>
<td>6%</td>
</tr>
<tr>
<td>181-270 days</td>
<td>777</td>
<td>7%</td>
</tr>
<tr>
<td>271-364 days</td>
<td>968</td>
<td>9%</td>
</tr>
<tr>
<td>&gt;= 365 days</td>
<td>8,362</td>
<td>76%</td>
</tr>
</tbody>
</table>

*Note.* Average enrollment days were 246 with a median of 177.

For children with enrollment gaps, *Table J4* documents the total gap day distribution.

*Table J4*

**Total Gap Days for Children With Enrollment Gaps**

<table>
<thead>
<tr>
<th>Total gap days</th>
<th># Unique identifiers</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 11,058)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-7 days</td>
<td>5,964</td>
<td>54%</td>
</tr>
<tr>
<td>8-45 days</td>
<td>1,637</td>
<td>15%</td>
</tr>
<tr>
<td>46-90 days</td>
<td>1,171</td>
<td>11%</td>
</tr>
<tr>
<td>91-180 days</td>
<td>875</td>
<td>8%</td>
</tr>
<tr>
<td>181-270 days</td>
<td>429</td>
<td>4%</td>
</tr>
<tr>
<td>271-364 days</td>
<td>293</td>
<td>3%</td>
</tr>
<tr>
<td>&gt;= 365 days</td>
<td>689</td>
<td>6%</td>
</tr>
</tbody>
</table>

*Note.* Average gap days was 44 with a median of 1 gap day.
The total gap day average was 44; but the median was 1 day. More than one-half of the gaps were less than a week. Short gaps such as these reflect administrative terminations from the plan with almost overnight re-enrollment.

For children with gaps, various inclusion/exclusion decisions, considering total enrollment days and total gap days, were examined. Actual enrollment table scenarios were tested. Enrollment scenarios were: “if total enrollment days are at least X and total gap days exceed Y, keep or remove unique ID”. After studying several dozen index cases, it was determined that total enrollment days were the most meaningful indicator of whether or not the child had access to preventive care than enrollment gaps, since most gaps were one day long. Given this understanding, gaps were ignored and inclusion criterion for children with gaps was also set at total enrollment days of greater than 180.

In the final enrollment table prepared for statistical analysis, 19,252 children were included. This volume represented 70% of the original unique identifiers from the October 3rd enrollment table.

Membership File Prepared for Statistical Analysis

Three spreadsheets, each identical in layout and representing a 12 month interval between April 1 and March 31 were prepared. Each spreadsheet contained 19,252 rows that documented unique identifier enrollment and PCP activity relevant to the statistical analysis. Spreadsheet variables were:

1. UNIQUE_ID – The unique identifier for each child.
2. GENDER – ‘F’ for female; ‘M’ for male.
3. DOB – Month, day, and year of birth.

4. ENROLLED_‘MonthX’ – For each month (e.g., Month 1, Month 2, Month 3, etc.), this variable was coded ‘1’ if the child was enrolled on the 15th day of the specific month; otherwise the cell was left blank.

5. PROV_X‘MonthX’ – For each month, a set of four variables were prepared to define the PCP group on the 15th day of the specified month. The ‘PROV_A‘MonthX’ variable was set to ‘1’ if the unique identifier had a PCP assignment with a maximally involved provider from Group A; otherwise PROV_A‘MonthX was left blank. These same rules applied to the variable for the minimally involved Group B PCPs (PROV_B‘MonthX). When, because of Missouri Care database errors, both Group A and B providers had been listed on the 15th of a specific month, PROV_BOTH‘MonthX, was reported as ‘1’. When membership files did not list a provider for the child on the 15th of the month, the code ‘1’ was used for the variable PROV_NONE‘MonthX.
APPENDIX K

BILLING CODE VALIDITY STUDY TO DIFFERENTIATE SPECIFIC SITES OF CARE FOR FACILITY VISITS

The purpose of Appendix K is to discuss the background, methodology, and results from a study conducted to derive valid 'counts' for asthma ER, hospital and clinic health care utilization.

Billing Code Background

For facility utilization, every claim with a principle diagnosis of asthma (493.00-493.99) was obtained in one file. Missouri Care did not have specific identifying codes to differentiate between the three sites of care (clinic, ER, or hospital). The Missouri Care medical director and PI contacted a national Medicaid analyst, Neil West, M.D., for assistance. West recommended a range of provider payment codes to calculate site-specific utilization rates, but could not provide literature citations for this recommendation (N. West, personal communication, May 4, 2001).

The recommended provider payment codes come from five-digit Current Procedural Terminology (CPT) codes (American Medical Association, 2001a) or Health Care Procedure Codes (HCPC; American Medical Association, 2001b). These codes are submitted with claims when specific activities are performed during the visit. Many health plans base payments and make judgements about medical necessity from these CPT/HCPC codes. When a provider files for payment after seeing a patient, there are 58 possible CPT payment codes; all 58 with the first two digits of “9” (99---). The 58 CPT 99--- codes are used to define both site of care and visit complexity. One child may be
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seen (and billed) during one clinic visit by more than one provider, each provider filing a different CPT '99---' code, resulting in two CPT 99--- codes for a single visit. In another example, a three day hospital visit can generate at least two distinct CPT 99--- codes; one for the initial day of hospital treatment and one for the two subsequent days, resulting in a minimum of three CPT 99--- codes for a three day hospitalization. Consequently, when using 99--- CPT codes for counting facility utilization, precautions must be taken so that over counting of facility utilization does not occur. In order count facility visits from claims data as accurately as possible, a validity study comparing true facility utilization with the filed CPT 99--- code claims was completed.

Known Groups Technique

For a one year period, all Missouri Care billing activity involving children with asthma claims who had been assigned to UP or FHC PCPs were studied for true facility utilization. Between July 1, 1998, and June 30, 1999, there were 367 children with asthma claims (for UP and FHC providers). The total billed amounts for each child was summed and the total amount for each child ranked from highest to lowest. The highest total charges for 20% of children \((n = 70)\) were selected for validity comparisons. All claim dates were matched with known MUHC and FHC activity. This matching activity was accomplished by locating the actual site of care for each claim date by reviewing medical records, dictated reports, and electronic scheduling information. For the 70 children assigned to UP or FHC PCPs in one year, there were a total of 432 total visits in ERs, hospitals or clinics.
As part of the validity procedures, claims from the 70 children were split into two comparable groups. One group was used to study and learn about commonly used CPT 99--- coding patterns, and to ultimately propose final query rules. The other group was used to 'blindly' calculate validity of the coding rules after they had been established in the first group. For group assignment, the children were ranked according to the total sum of asthma charges. Those children who had been assigned an odd number in the ranking (every other child; n = 35) were the group from whom all CPT 99--- data was viewable and studied against known utilization. The children who had been assigned an even number in the ranking (n = 35) had all their CPT 99--- codes and known utilization set aside until the proposed queries from the first 35 children were ready for testing.

Coding Decisions for Determining Site of Care

To determine the most valid query rules, a number of possible CPT 99--- code queries were tested. Table K1 represents the most valid CPT 99--- codes selected to count each type of facility visit. All queries were grouped by 'date of service' so that over-counting of multiple ‘allowable’ CPT 99--- codes would be avoided. But multiple visits among the three sites of care on the same date were allowed.

Referring to Table K1, two examples of queries and their results are now given. If two claims had been submitted for the same visit by two providers, one with a CPT 99--- code of 99204 (clinic) and the other with a CPT code of 99244 (clinic), both clinic codes would be combined and counted as one clinic visit because site-specific visits were grouped together by date of service to avoid double-counting. In another example, two
claims from different sites had been received for the same date of service, one with a CPT code of 99214 (clinic) and the other with a CPT code of 99254 (hospital). Each would count; one for a clinic visit and one for a hospital visit, even though these occurred on the same date of service. Using CPT 99— codes, the validity comparisons ranged between 61% and 93%.

Table K1

*All CPT Codes 'Allowed' In the Count-of Facility Utilization By Site of Visit*

<table>
<thead>
<tr>
<th>5-Digit CPT Codes</th>
<th>Textual description of CPT code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic visits</td>
<td></td>
</tr>
<tr>
<td>99201, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99241, 99243, 99244</td>
<td>“Office or other outpatient visit for evaluation and management of a patient” or “Office consultation for a new or established patient”</td>
</tr>
<tr>
<td>Emergency visit</td>
<td></td>
</tr>
<tr>
<td>99281, 99282, 99283, 99284, 99285</td>
<td>“Emergency department visit for the evaluation and management of a patient”</td>
</tr>
<tr>
<td>Hospital visit</td>
<td></td>
</tr>
<tr>
<td>99218, 99219, 99220, 99221, 99222, 99223, 99251, 99252, 99253, 99254, 99255</td>
<td>“Initial observation care, per day, for the evaluation and management” or “Initial patient consultation for a new or established patient”</td>
</tr>
</tbody>
</table>

*Note. 23° observation visits were counted as hospitalization visits.*

During the validity tests, meaningful codes other than CPT codes were identified. ‘Location’ codes had been assigned during the billing process and reflected specific sites of care. These codes were also tested for validity. Location codes in the Missouri Care utilization tables were contained in three columns. The three columns were “Bill Class Code”, “Facility Code”, and “ER Code”. A clinic visit location was given a ‘3 1– ’ code
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(3 on variable “Bill Class Code” and 1 on “Facility Code”). A hospital location code was ‘1 1’ (1 on “Bill Class Code” and 1 on “Facility Code”). An ER location code was ‘3 1 1’ (1 on “Bill Class Code”, 1 on “Facility Code”, and 1 on “ER Code”; S. Koenig, personal communication, June 20, 2001).

The results from the final validity tests are presented in Table K2. CPT only code accuracy ranged between 61% and 93%. Location only code accuracy ranged between 33% and 86% accurate. When combining CPT 99--- codes with location codes (using “or” and controlling by date of service), the validity comparisons ranged between 78% and 104% accurate. It is not clear why there was known facility visits without provider payment CPT 99--- codes, but it suggests ‘under-billing’ for provider visits. It is also not clear if this finding reflects specific administrative issues for UP and FHC providers, but since very different UP and FHC ‘billing systems’ were tested, both with CPT 99--- ‘misses’, this finding may, in fact, be generalizable.

Table K2.

Results of Validity Comparisons Between Known Utilization and Billing Codes for Clinics, ER, and Hospital Visits In 70 Children

<table>
<thead>
<tr>
<th>Development of rules group (n = 35)</th>
<th>Known Visits for Asthma</th>
<th>CPT Codes</th>
<th>Location Codes</th>
<th>CPT and Location Codes</th>
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</thead>
<tbody>
<tr>
<td>Validity test group (n = 35)</td>
<td>Clinic (n = 144)</td>
<td>134 (93%)</td>
<td>69 (48%)</td>
<td>150 (104%)</td>
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<td>ER (n = 29)</td>
<td>26 (90%)</td>
<td>25 (86%)</td>
<td>28 (97%)</td>
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<td>Hospital (n = 18)</td>
<td>11 (61%)</td>
<td>6 (33%)</td>
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<td>Clinic (n = 184)</td>
<td>163 (89%)</td>
<td>76 (41%)</td>
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<td>ER (n = 30)</td>
<td>24 (80%)</td>
<td>24 (80%)</td>
<td>29 (97%)</td>
</tr>
<tr>
<td></td>
<td>Hospital (n = 18)</td>
<td>13 (72%)</td>
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<td>18 (100%)</td>
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Facility Utilization File Prepared for Statistical Analysis

For calculation of facility utilization (hospital, ER, and clinic visits), one Microsoft Excel file, containing three spreadsheets was prepared. Each of the three spreadsheets were identical in layout, each representing a 12 month interval between April 1 and March 31. Like the enrollment file, each row in a spreadsheet contained utilization data for one unique identifier. Unlike the enrollment file, the utilization file only contained information from unique identifiers with at least one asthma facility claim during the specific 12 month interval. The following variables were defined for each unique identifier in the utilization file:

1. UNIQUE_ID – An identical match to the UNIQUE ID from the enrollment file.
2. HOSP‘MonthX’ – The sum of all asthma hospital claims by month. When HOSP cells are blank, there were no hospital asthma claims for that month.
3. ER‘MonthX’ – The sum of all asthma ER claims by month. When ER cells were blank, there were no ER asthma claims for that month.
4. CLINIC‘MonthX’ – The sum of all asthma clinic visit claims by month. When CLINIC cells are blank, there were no clinic visit claims for that month.
REFERENCES


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Tinkelman, D., Raum, M., & Lung, C. L. (1997). Take control of high cost asthma; Turning patients into partners. Strategic Medicine, 1, 42-61.


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Karen Rose Cox was born December 6, 1956, in Pasadena, California. After attending public schools in San Marino, California, she received the following degrees: B.S. in Nursing from Humboldt State University in Arcata, California (1979); M.S. in Nursing from the University of Missouri-Columbia (1990); Ph.D. in Nursing from the University of Missouri-Columbia (2001). She is married to Theodore R. Cox, and is the mother of one daughter, Jesse Alice Reinhold. She is presently employed with University of Missouri Health Care in the Office of Clinical Effectiveness.
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