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# Efficiency and Cost of a Hospital-Based Medical Home: Children with Special Healthcare Needs

Rebecca Olsen, PhD

## ABSTRACT

*The current study examined two years of pre-post hospital utilization data (the number of emergency room visits, number of unanticipated hospitalizations, and length of stay (LOS)) among forty-nine medically complex children to determine the efficiency and cost effectiveness of a comprehensive Hospital-Based Medical Home Model. Friedman nonparametric analysis was used to examine the pre-post differences for the non-normal distribution. Each of the cost-effectiveness measures (number of emergency room visits, number of unanticipated hospitalizations, and LOS) were found to be significantly lower post enrollment in the Hospital-Based Medical Home Model.*

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## Introduction

In 1992, the American Academy of Pediatrics (AAP) published a landmark statement supporting the establishment of a family-centered “medical home” for all children. A medical home is a conceptual model of care described as “accessible, continuous, comprehensive, compassionate, coordinated, family centered and culturally effective” (AAP, 1992, p. 774). Proponents of the medical home concept have suggested it can result in care that is more effective, efficient, and family centered, particularly for children with special healthcare needs. Researchers have also suggested these children can further benefit from hospital-based medical homes (Cohen, Friedman, Nicholas, Adams, & Rosenbaum, 2008). Hospitals are their primary site for care, and due to the increasing demands driven by a rise in the prevalence of chronic diseases and the complexity of the underlying science and technology necessary to manage them, hospital systems have the resources to meet the challenges of many of these children (Cohen, Friedman, Nicholas, Adams & Rosenbaum, 2008).

Children with special healthcare needs encompasses a wide range of childhood conditions—from those who are managed in a single or a few community-based settings to those whose complexity of care is substantially increased because of the involvement of multiple services in a number of healthcare settings by multiple practitioners. Among the more severely affected children with special healthcare needs is an important group of children defined by their complex health needs and medical fragility.

## Children with Multiple Healthcare Needs

Medically complex children now account for more than half of childhood deaths from medical causes, excluding the prenatal age group (Feudtner,

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<http://health.usf.edu/publichealth/fphr/index.htm>

Silveira, & Christakis, 2002). Improvements in both medical care and technology have resulted in an epidemiologic transition leading to a dramatic increase in the number of children who survive with chronic and complex healthcare needs (Wise, 2004). For example, advancements in neonatal intensive care services have led to considerable improvements in the survival of premature neonates (Lorenz, 2000). Similarly, survival prospects for children with what were once incurable malignancies or fatal genetic conditions have also increased dramatically (Feudtner et al., 2001). Although medically complex children have a heterogeneous group of diseases, collectively they make up a large group with similar health and developmental consequences, such as ongoing functional impairment, neurodevelopmental disabilities, dependence on medical technology, and substantial demands on their families and the healthcare system over many years.

Similar to demographic trends of the increased prevalence of medically complex children, pediatric hospitals have played a growing role in providing care for these children. Despite ongoing efforts to transfer chronic care to community and home settings, recent surveys have suggested that children with chronic conditions now make up 55%–60% of all hospital discharges, more than double the prevalence of 25% recorded in 1962 (Neff & Valentine, 2002; Wise, 2004).

## Hospital-Based Medical Home

For medically complex children, a hospital-based medical home is an important locus for the provision of specialized care. They come to the hospital so frequently as inpatients and outpatients that the family essentially identifies the hospital as providing the major component of the child’s medical care. Hospital-based medical homes can provide the

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technical, logistical, or programmatic resources necessary to provide well-coordinated care for medically complex children (Cohen, Friedman, Nicholas, Adams, & Rosenbaum, 2008).

An increased role for hospitals in care coordination for medically complex children offers a number of potential benefits. First, surveys of families of children with chronic conditions have shown that they prefer “one-stop shopping” for healthcare in the location where the majority of their care is provided (Garwick, Kohrman, Wolman, & Blum, 1998). Second, hospital-based practitioners have the expertise, comfort, and resources to manage substantial aspects of care for children characterized by complex and often rare diseases. Third, most primary care is provided by healthcare personnel who may be overburdened and inappropriately trained to conduct the enormous administrative responsibilities of care coordination for medically complex children. Finally, the financial disincentives often faced by individual practitioners in providing holistic care to medically complex children *may* be offset by the organizational savings on a hospital level from improved efficiency of care coordination for medically complex children (Matlow, Wright, Zimmerman, Thomson, & Valente, 2006).

### Efficiency and Cost

Although the presence of a medical home should provide improvements in access to and quality of care, there is less agreement about the impact on healthcare costs. In general, costs of healthcare for children with multiple healthcare needs are approximately three times higher than for other children because of the higher need for and use of services (Newacheck & Kim, 2005). As a result of their increased health risks, they experience multiple problems in terms of services, sectors of care, and locations of care (Law & Rosenbaum, 2004). Due to these vulnerabilities, traditional healthcare delivery studies have shown they have a disproportionate impact on health expenditures. Children with special healthcare needs form a relatively small, but growing group, of approximately 15%–18% of all children (Newacheck & Halfon, 1998; Newacheck et al., 1998). However, they consume 80% of all pediatric healthcare expenses (Newacheck et al., 1998). They are at an increased risk of hospitalization, length of stay, and intensive care admission (Cooley & McAllister, 2004), frequent medical errors (Sacchetti, Sacchetti, Carraccio, & Gerardi, 2000; Slonim, LaFleur, Ahmed, & Joseph, 2003), poor care coordination (Dosa, Boeing, & Kanter, 2001), and overwhelming daily challenges for their families (Hastings Center, 1987).

Hospital Administrators and healthcare providers are reluctant to implement medical home models of care when efficiency and cost information has not been firmly established. Despite concerted efforts to apply the medical home concept to the care of children with special healthcare needs, there is simply too little research to reach conclusions (Berman, Rannie, Moore, Elias, Dryer, & Jones, 2005).

Fourteen studies examining utilization and cost data among children with special healthcare needs were found. Only three of the fourteen were in hospital-based medical homes. Of the primary care-based medical home studies, six were comparison group and five were correlation. Three of the six comparison group studies found positive effects of medical home activities (Homer, Klatka, Romm, Kuhlthau, Bloom, Newacheck, Van Cleave, & Perrin, 2009). One randomized control trial studied an intervention targeting high-risk infants, where participants received acute care, well-child care, and social services. Fifty-seven percent fewer infants in the intervention group were admitted into the intensive care unit; infants who were admitted to the intensive care unit spent 42% fewer days there. The increase in follow-up care costs was offset by the decrease in intensive care unit costs but did not result in overall cost savings (Broyles, Tyson, & Heyne, 2000). Two analyses of a single intervention, one short-term and one long-term follow-up, assessed the impact of an intervention in which physicians attended educational seminars focused on the development of provider-family partnerships for children with asthma. The long-term follow-up study found that children in the intervention group had fewer hospitalizations, but neither study found any difference in emergency room visits (Clark, Gong, & Schork, 1998, 2000). A randomized control trial observing the effects of an asthma-focused collaborative intervention resulted in a difference in emergency room visits in children who came from the subset of practices that participated in the full intervention components. Fifty-one percent of children in the intervention group required an emergency room visit before the intervention compared with only 22% after the intervention. However, no difference was found when comparing children from all practices involved in the collaborative with the control group. Hospitalizations did not differ between groups (Homer, Forbes, Horvitz, Peterson, & Heinrich, 2005). No impact on cost was found in a community-based care coordination randomized control trial study (Smith, Layne, & Garell, 1994). A comparison group study examined the effects of another asthma-focused collaborative intervention, and found no difference in

acute service use (Mangione-Smith, Schonlau, & Chan, 2005). Two of three non-comparison intervention studies found associations between medical home activities and efficiency. After an intervention where resources were allocated to subspecialty divisions for care coordination expansion as determined by the division, annual hospital admissions and median hospital length of stay decreased (Liptak, Burns, Davidson, & McAnarney 1998).

Two of five associational studies found positive relationships between medical home and efficiency. Decreased continuity of care was related to increased hospitalizations among children seen at a health maintenance organization (HMO) (Christakis, Mell, Koepsell, Zimmerman, & Connell, 2001). Emergency room risk decreased with each asthma-related primary care physician visit in children seen at a large multi-specialty group (Lafata & Xi, 2002). No association was found between having a usual source of care and emergency room visits for children with asthma (Kieckhefer, Greek, Joesch, Kim, & Baydar, 2005). A survey of Iowa Medicaid enrollees found no relationship between degree of medical home-ness and cost (Smith, Layne, & Garell, 1994; Damiano, Momany, Tyler, Penziner, & Lobas, 2006). Connection with a primary care physician was not associated with adherence to keeping a follow-up appointment after an asthma-related emergency room visit (Finkelstein, Burstin, & O'Neil, 1996). Ratings on a physician-family goal alliance scale were not associated with ED use or hospitalizations (Gavin, Wambo, Sorokin, Levy, & Wambo, 1999).

Three cost-effectiveness studies of a hospital-based medical home intervention are known to exist. First, a medical home model for children with special healthcare needs was shown in a pre-post study to improve parental satisfaction with multiple aspects of care and to decrease hospitalization rates and parental absence from work (Palfrey et al., 2004). Second, a recent study has shown that this model provided dramatic cost savings in hospital-based expenditures (Gordon et al., 2007). Third, Berman, Rannie, Moore, Elias, Dryer, and Jones (2005) examined the effect of enrollment in a hospital-based medical home for children with special healthcare needs and found that children with multisystem disorders are medically fragile and require frequent hospitalizations and ED visits even with improved primary care. Enrollment in the comprehensive primary care program was associated with a decreased length of stay for non-intensive care hospitalizations and with increased use of surgical services. They found that a decrease in inpatient costs immediately after the implementation of a hospital-based primary care intervention did not offset an increase in outpatient costs to the hospital

resulting in overall increased hospital costs. Also, no differences were found in emergency room visit or hospitalization rates (Berman, Rannie, Moore, Elias, Dryer, & Jones, 2005).

Additional research on the impact of hospital-based medical homes on children with multiple healthcare needs is recommended. More research should be conducted on interventions that encompass the full medical home construct, and on key outcomes not yet studied, efficiency and cost (Homer, Klatka, Romm, Kuhlthau, Bloom, Newacheck, Van Cleave, & Perrin, 2009). This study attempts to contribute to the economic feasibility data of hospital-based medical home delivery of care for children with multiple healthcare needs.

## Methods

### *Study Setting*

The Children's Chronic Complex Center is housed in the 164-bed Tampa Children's Hospital, Physician's Specialty Center. The Chronic Complex Center developed a comprehensive hospital-based medical home model to meet the educational, medical, rehabilitation, emotional, developmental, and social services needs of medically complex children and their families.

### *Data Collection*

Patient utilization data were provided by the hospital. A group of physicians and nurses examined the pediatric diagnoses codes to identify all medically complex children who received care two years prior to- and post medical home enrollment. Forty-nine children met the criteria for inclusion. To allow for equal comparison, utilization which occurred outside 24 months before and after enrollment was eliminated from the analysis.

### *Sample*

*Age:* The children ranged from 2 years to 18 years of age.

*Diagnoses:* The most common diagnoses among the participants included asthma, convulsions, cerebral palsy, cystic fibrosis and lack/delay of physiological development.

*Race and Ethnicity:* Twenty-three children were Hispanic, 19 were Caucasian, and seven were African-American.

*Length of Enrollment:* Pre-Enrollment was measured from the first date of hospital utilization to the date of Complex Chronic Center enrollment. The range of all medically complex children was from 1.5 months to 52 months, with the overall average of 15.3 months. Post-enrollment utilization was at least 24 months, with an average of 29 months. As previously mentioned only 24 months of pre-and post utilization were used in the analysis.

**Caretakers:** Five of the children were cared for by foster parents. One child was taken care of by an aunt, and two children by their grandparents. The remaining 41 children were taken care of by their parents. The majority of children (62%) lived in households with at least two adults as caregivers for the child.

**Parent Employment:** Of the partial employment data provided, 35% of the families reported having full-time employed male caretakers. Thirteen percent of the families reported having full-time employed female caretakers.

**Health Insurance:** Approximately 88% of the children are primarily insured through Medicaid. Children’s Medical Services (CMS) were reported as a secondary insurance resource by 47% of the families. One child had no health insurance and five had private insurance.

*Measures and Analysis*

Three cost effectiveness measures were used in the analysis: the number of emergency room visits two years pre- and post-medical home enrollment; number of unanticipated admissions two years pre- and post medical home enrollment; and length of stay (LOS) two years pre-and post-medical home

enrollment. Although paired sample t-tests are generally used to assess single sample, pre-and post-interval data, the Friedman non-parametric test was used, due to the non-normal distribution. Once the data was examined, it became clear with the high kurtosis, skewness, and standard deviation the nonparametric test was the most appropriate method.

Survey data were entered and analyzed in Excel and SPSS. As previously mentioned the utilization data reflects pre- and post-enrollment utilization at Tampa Children’s Hospital. The differences between the pre- and post-enrollment data for all three variables were compared for statistical significance using the nonparametric Friedman test. Table 1 compares the pre-enrollment data with the post-enrollment data.

**Normality of Data:** All three variables were examined for normality. A strong indication of a non-normal distribution is when the kurtosis is higher or lower than  $\pm 2$ , and skewness is far from zero. The non-normal distribution violates the assumption of using paired sample t-tests, which supports the decision to use the nonparametric Friedman test. A summary of descriptive statistics is provided in Table 2.

**Table 1. Pre-and Post Enrollment Utilization Data**

Utilization Measure	Pre-Enrollment	Post-Enrollment
Total ER Visits	107	67
Total Hospital Admissions	77	50
Total Hospital Days	528	352

**Table 2. Descriptive Statistics for Normality of Data**

Statistics	Pre-Enrollment Emergency Room Visits	Post-Enrollment Emergency Room Visits	Pre-Enrollment Unanticipated Admissions	Post-Enrollment Unanticipated Admissions	Pre-Enrollment Length of Stay	Post-Enrollment Length of Stay
Mean	2.89	.69	2.37	.51	27	3.6
Standard Deviation	4.35	.756	4.17	.77	98.7	8.72
Kurtosis	13.02	3.64	15.84	4.24	40.94	21.57
Skewness	3.46	1.78	3.66	1.95	6.24	4.26

**Results**

The number of emergency-room visits, number of unanticipated hospitalizations, and length of stay were all found to be significantly lower for medically complex children, after receiving care through the hospital-based medical home at the Complex Chronic

Center. Table 3 indicates the statistical results and level of significance. The results suggest once the medically complex children are enrolled in the hospital-based medical home center, the number of emergency room visits, number of unanticipated

hospital admissions, and length of stay significantly decrease.

**Table 3. Pre- and Post-Enrollment Comparisons**

Variables	Mean Rank	Level of Significance
Pre-Enrollment Emergency Room Visits	1.84	P < .000
Post-Enrollment Emergency Room Visit	1.16	
Pre-Enrollment Unanticipated Admission	1.80	P < .000
Post-Enrollment Unanticipated Admission	1.21	
Pre-Enrollment Length of Stay	1.77	P < .000
Post-Enrollment Length of Stay	1.23	

The average cost data were also provided by the hospital database. The average cost per pediatric hospital day is \$1,026, and Emergency Department visit is \$1,128.53. These average costs were applied to provide cost savings data post medical home enrollment. The pre-enrollment emergency room data reflects 107 visits and post-enrollment reflects 67. The difference between the two (40) was multiplied to the average costs (\$1,128.53) to provide emergency room cost savings. The difference between the pre- (528) and post- (352) enrollment cost per day was (177), and multiplied by the average cost per hospital day (\$1,026) to provide unanticipated hospital admission cost savings. The cost savings information below reflects only the 49 medically complex children who participated in the study. Results are displayed in Table 4.

**Table 4. Cost Savings of Post Center Enrollment**

Cost Savings Post Medical Home Center Enrollment	
Emergency Room Visits	\$45,141
Hospital Days	\$181,602
<b>Total Savings</b>	<b>\$226,743</b>

#### *Limitations of the Study*

There are a number of limitations to this study. First, there was not an independent ascertainment of

the accuracy of the hospital administrative database. Although the administrative data may not be totally accurate, these systems provide the best available information, and are used for basic financial decision making. Second, it is not possible to generalize these findings to other children's hospitals because of variations in patient conditions, payer mix, methods of calculating direct and total costs, and payment levels for Medicaid, Child's Medical Services, and private insurers. In addition, cost allocation methods that are used to determine costs differ considerably from one institution to another. Third, inpatient and outpatient services received at other facilities were not identified or included in the analyses. Fourth, as with any pre- and post-design, factors other than the medical home center may influence outcomes. Fifth, the sample size is small, creating additional difficulty in generalization. Finally, missing diagnoses information for each emergency room and hospital visit limits the ability to eliminate visits that could not have otherwise been prevented by the Center (i.e., poisons, rapes, burns, automobile accidents). The ability to remove utilization which could not have otherwise been prevented by the Center would have provided a more precise data set.

#### **Implications for Florida Children with Multiple Healthcare Needs**

Florida families with medically complex children could benefit tremendously by the implementation of hospital-based medical homes throughout the state. The National Chartbook (2005-2006) suggests the state of Florida lags behind the nation in serving families of medically complex children. According to the National Survey of Children with Special Healthcare Needs, Florida families with medically complex children experience: (1) higher unmet needs for healthcare services, (2) higher unmet needs for family services, (3) greater difficulty in obtaining referrals when needed, (4) higher rates of acute care situations without a regular/usual source/provider of care, (5) higher rates without a personal doctor or nurse, (6) higher rates without family-centered care, (7) greater difficulty in either providing or coordinating their child's healthcare needs, (8) higher prevalence of conditions which cause them to cut back or stop working, (9) more conditions which cause financial problems for the family, and (10) higher rates of \$1,000 or more out of pocket medical expenses per year for the child than the national average. Florida and National Chart Book Indicators are represented in Table 5.

**Table 5. Florida and National Chart Book Indicators**

<b>Access to Care</b>	<b>Florida %</b>	<b>National %</b>
CSHCN with any unmet need for specific health care services	21.8	16.1
CSHCN with any unmet need for family support services	6.0	4.9
CSHCN needing a referral who have difficulty getting it	26.9	21.1
CSHCN without a usual source of care when sick (or who rely on the emergency room)	6.0	5.7
CSHCN without any personal doctor or nurse	8.4	6.5
<b>Family Centered Care</b>		
CSHCN without family-centered care	38.3	34.4
<b>Impact on Family</b>		
CSHCN whose families pay \$1,000 or more out of pocket in medical expenses per year for the child	23.9	20.0
CSHCN whose conditions cause financial problems for the family	21.9	18.1
CSHCN whose families spend 11 or more hours per week providing or coordinating child's health care	10.0	9.7
CSHCN whose conditions cause family members to cut back or stop working	30.0	23.8

Most families and professionals agree that children need access to a medical home. The medical home is a health care model for all children, but for children with special health care needs, it assumes greater importance as a centralizing "headquarters" for necessary information, care coordination, advocacy, and support. As defined by the U.S. Maternal and Child Health Bureau (MCHB) and the American Academy of Pediatrics (AAP), the medical home provides care that is accessible, family centered, continuous, comprehensive, coordinated, compassionate, and culturally effective. The AAP endorsement of the medical home concept is reiterated in its latest policy statement, and highlighted as a strategic priority for the organization. The medical home is a critical element of U.S. public health policy for CSHCN as a major element of the 2010 action agenda of the MCHB.

The results of this study show a significant decrease in emergency room visits, unanticipated hospitalizations, and length of stay among medically complex children enrolled in a hospital-based medical home. A hospital-based medical home is a promising model for improving outcomes for children with multiple healthcare needs and their families. Medically complex children need a portal to care in the setting where they receive the majority of their care, most likely in the hospital. The increase in the complexity of healthcare provided to medically complex children necessitates that hospitals be primed to incorporate innovative models of family-centered care coordination. One of the most significant barriers to implementing a hospital-based medical home is the lack of cost effectiveness data.

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