

# Association of Enrollment in an Aerodigestive Clinic With Reduced Hospital Stay for Children With Special Health Care Needs

Swathi Appachi, MD; Anne Banas, CNP; Lisa Feinberg, MD; Douglas Henry, MD; Diane Kenny, CNP; Nathan Kraynack, MD; Amy Rosneck, MA, SLP; John Carl, MD; Paul Krakovitz, MD

**IMPORTANCE** Children with special health care needs (CSHCN) have disproportionate health care utilization. Previous studies have demonstrated that a primary medical home improves health care outcomes for this population.

**OBJECTIVE** To elucidate if enrollment in a multidisciplinary aerodigestive clinic improves outcomes and reduces health care costs by decreasing admissions and inpatient days.

**DESIGN, SETTING, AND PARTICIPANTS** A retrospective medical record review of 113 patients with aerodigestive disorders enrolled in a pediatric multidisciplinary clinic from June 2009 to December 2013 was performed. Of the 113 participants, 58 (51.3%) were male, 59 (52.2%) had a tracheostomy, and 90 (80.5%) had a gastrostomy tube during their enrollment period. Patient ages at enrollment ranged from 0 to 20 years, with 59 (52.2%) ranging from 0 to 5 years, 23 (20.4%) ranging from 6 to 10 years, 18 (15.9%) ranging from 11 to 15 years, and 13 (11.5%) being 16 years or older. Admissions data before and after enrollment in a pediatric multidisciplinary clinic were examined.

**MAIN OUTCOMES AND MEASURES** The main outcomes studied were changes in admissions and inpatient days before and after enrollment. Financial data were also examined to determine the reduction in technical direct cost.

**RESULTS** The admissions data for 113 children were analyzed. No significant difference in number of admissions per year was seen with enrollment with a median difference of  $-0.30$  admissions per year (range,  $-10.6$  to  $6.7$  admissions per year; 95% CI,  $-3.5$  to  $2.9$ ). However, there was a significant decrease seen in inpatient days per year following enrollment, with a median decrease of  $4.1$  inpatient days per year (range,  $-80$  to  $283.3$  inpatient days per year; 95% CI,  $0.33$  to  $91.0$ ). When examining aerodigestive admissions alone, the median number of aerodigestive hospital days avoided per patient was  $0.57$  days per month, or  $6.8$  days per year, representing a 70% reduction in technical direct cost.

**CONCLUSIONS AND RELEVANCE** These findings indicate that for children with special health care needs, enrollment in a multidisciplinary aerodigestive clinic may improve health care outcomes by decreasing technical direct cost by 70% and significantly decreasing patient hospital days by an estimated 1 week per year. Furthermore, coordinated aerodigestive care in a medical home setting may lower health care expenditures from a systems-based perspective.

JAMA Otolaryngol Head Neck Surg. 2017;143(11):1117-1121. doi:10.1001/jamaoto.2017.1743  
Published online October 5, 2017.

**Author Affiliations:** Head and Neck Institute, Cleveland Clinic, Cleveland, Ohio (Appachi, Banas, Rosneck, Krakovitz); Pediatric Institute, Cleveland Clinic, Cleveland, Ohio (Feinberg, Henry, Kenny, Kraynack, Carl).

**Corresponding Author:** Paul Krakovitz, MD, 9500 Euclid Ave, Desk A71, Cleveland, OH 44195 (krakovp@ccf.org).

Children with special health care needs (CSHCN) are defined as those “who have or are at increased risk of a chronic physical, developmental, behavioral, or emotional condition and who also require health care and related services of a type or amount beyond that required by children generally.”<sup>1</sup> Although CSHCN only represent 13% to 19% of all children, they have disproportionate health resource utilization, hospitalization, and need for acute inpatient intensive care.<sup>2,3</sup> Health care expenditures for this population are up to 3-fold higher than those of their peer group, with a large proportion spent on acute inpatient care.<sup>4</sup> Much attention has been focused on improving health outcomes and reducing costs for this population. The pediatric medical home model, defined as accessible, family-centered, continuous, comprehensive, coordinated, compassionate, and culturally effective care, has been a key component of policy discussion as US health care shifts from traditional fee-for-service to value-based health care.<sup>5</sup> Recent studies of primary medical home models have demonstrated improvement in the quality of care and decreased cost for CSHCN.<sup>6,7</sup>

Typically, a medical home is run on a primary care-based model with access to specialty providers. We have been unable to find research on coordinated specialty care for CSHCN. The objective of our study was to elucidate if enrollment in a multidisciplinary aerodigestive clinic with comprehensive and coordinated care reduced frequency of inpatient admissions and overall hospital days for this population.

## Methods

This study examined the role of a multidisciplinary specialty aerodigestive clinic at a tertiary care center for CSHCN. Care is coordinated in this clinic between specialists in pediatric otolaryngology, gastroenterology, pulmonology, physical medicine and rehabilitation, speech pathology, nutrition, and social work. Professionals from each discipline see enrolled patients in a single half-day clinic. Following these appointments, the team meets to discuss medical history and examination findings and jointly develop individualized care plans that include subsequent coordinated follow-up and procedures. This information is provided to the families as well as to their respective community-based primary care physicians.

This study was reviewed and approved by the institutional review board at the Cleveland Clinic. A waiver of consent for study participants was granted owing to the retrospective nature of the study. A retrospective medical record review of all 121 children enrolled in the aerodigestive clinic from June 2009 to December 2013 was performed. Baseline patient data collected included age, sex, medical comorbidities, tracheostomy status, and gastrostomy status. Children who did not have complete admissions data were excluded, resulting in 113 included patients. Admissions data were analyzed for these patients from April 1995 to July 2014, and data collected included reason for admission, length of stay, and if the stay included time in the intensive care unit. Admissions were categorized as “preenrollment” or “postenrollment,” de-

## Key Points

**Question** Does enrollment in a multidisciplinary aerodigestive clinic improve outcomes and reduce health care costs by decreasing admissions and inpatient days?

**Findings** Our findings demonstrate that enrollment in a multidisciplinary aerodigestive clinic may significantly decrease patient hospital days by an estimated 1 week per year per patient.

**Meaning** Coordinated aerodigestive care in a medical home setting improves health care outcomes for children with special health care needs by decreasing length of stay and lowers health care expenditures from a systems-based perspective.

financed when an individual patient began routine ambulatory visits in the aerodigestive clinic. All admissions were examined and further stratified based on aerodigestive and nonaerodigestive hospitalizations. Admissions qualified as aerodigestive if the primary admission diagnosis was for otolaryngological, pulmonary, or gastrointestinal conditions.

The Wilcoxon signed rank test was used to determine if there was a difference in median annual preenrollment and postenrollment admissions and hospital days per year per patient. Particular analysis was performed on aerodigestive admissions. Financial data were analyzed for payer status, technical direct, technical charges, and contribution margin. Microsoft Excel (2013, Microsoft) was used for all analyses.

## Results

### Patient Characteristics

The characteristics of the 113 patients enrolled in the aerodigestive clinic are described in the **Table**. Of these, 58 (51.3%) were male, 59 (52.2%) had a tracheostomy, and 90 (80.5%) had a gastrostomy tube during their enrollment period. Patient ages at enrollment ranged from 0 to 20 years, with 59 (52.2%) ranging from 0 to 5 years, 23 (20.4%) ranging from 6 to 10 years, 18 (15.9%) ranging from 11 to 15 years, and 13 (11.5%) being 16 years or older. Payer mix was varied, with 57 (50.4%) patients having Medicaid, 40 (35.4%) patients having commercial insurance, and 16 (14.2%) patients having other payers. Most patients had multiple comorbidities, with the most prevalent including cerebral palsy (32, 28.3%); extreme prematurity (20, 17.7%), gastroesophageal reflux (15, 13.2%); vertebral defects, anal atresia, cardiac defects, tracheoesophageal fistula, renal anomalies, and limb abnormalities (VACTERL) (5, 4.4%); velocardiofacial syndrome (4, 3.5%); Pierre-Robin sequence (4, 3.5%); cleft lip/palate (4, 3.5%); and subglottic stenosis (4, 3.5%).

### Admissions Data

A total of 967 admissions were analyzed. Analysis of total admissions per year per child demonstrated no significant difference between preenrollment and postenrollment periods, with a median difference of -0.30 admissions per year (range, -10.6 to 6.7 admissions per year; 95% CI, -3.5 to 2.9). A significant decrease in hospital days for all admissions

was demonstrated in the postenrollment period with a median decrease of 4.1 inpatient and observation days per year (range, -80 to 283.3 inpatient days per year; 95% CI, 0.33 to 91.0). Of the 967 admissions examined, 454 (47%) were associated with a stay in the intensive care unit for at least part of the admission.

Data were then specifically examined for aerodigestive admissions, including for pulmonary, gastroenterology-related, or otolaryngology-related admissions. Prior to enrollment in the aerodigestive clinic, patients had a median of 0.81 hospital admission days per month. Following enrollment, this decreased to 0.24 days per month. This postenrollment decrease of 0.57 hospital admission days per month represents a decrease of 6.8 aerodigestive hospital days per year, a 70% change.

### Financial Data

Our institution's current payer mix was examined. Medicaid was the payer source for 57 (50.4%) patients, 40 (35.4%) had commercial insurance, and 16 (14.2%) had other means of payment. The technical direct net income for patients insured by Medicaid per admission was negative for our hospital when analyzed by the financial team. The technical direct net income for patients using other payers was positive at our institution.

## Discussion

This retrospective medical chart review suggests that coordinated care in a pediatric multidisciplinary aerodigestive clinic for CSHCN may improve health care outcomes by significantly decreasing patient hospital days by almost 1 week per year. The consensus of clinic participants is that the clinic structure provides both development of a coordinated systems approach that improves provider communication as well as discharge coordination. Therefore, we believe the reduction in hospital stay seen in this study is likely a direct result of this improved communication that facilitates unified anticipatory care plan development by multiple professionals.

Care coordination efforts are in effect at most institutions in an effort to contain health care expenditures. Based on the estimated 6.8-day reduction per patient per year, financial data were examined. Publicly available data indicate that the daily average technical direct cost (the cost incurred by the hospital) for a nonprofit hospital in the United States in 2015 is \$2289 (California has the highest daily average technical direct cost of \$3500, and Montana has the lowest cost of \$1394).<sup>8</sup> Owing to the private nature of our institution's finances, we used the average daily technical direct cost for a nonprofit hospital in Ohio, \$2502, to extrapolate our institution's technical direct cost. When multiplying this cost by 6.8 days avoided by 113 patients after enrollment, this equals an extrapolated reduction of \$1.9 million per year in hospital costs.

This is not the first study to suggest that care coordination decreases costs and hospital stay for CSHCN. However, most previous studies have focused on primary care medical with case management and education provided by nonphy-

**Table. Patient Characteristics**

Patient Characteristics	No. (%)
Male	58 (51.3)
Tracheostomy dependent	59 (52.2)
Gastrostomy tube dependent	90 (80.5)
Age at enrollment, y	
0-5	59 (52.2)
6-10	23 (20.4)
11-15	18 (15.9)
16 or more	13 (11.5)
Payer	
Medicaid	57 (50.4)
Commercial	40 (35.4)
Other	16 (14.2)
Comorbidities	
Cerebral palsy	32 (28.3)
Prematurity	20 (17.7)
Gastroesophageal reflux	15 (13.2)
Velocardiofacial syndrome	4 (3.5)
VACTERL	5 (4.4)
Pierre Robin sequence	4 (3.5)
Subglottic stenosis	4 (3.5)
Cleft lip/palate	4 (3.5)

Abbreviation: VACTERL, vertebral defects, anal atresia, cardiac defects, tracheo-esophageal fistula, renal anomalies, and limb abnormalities.

sician providers for an individual disease process. For example, 2 studies<sup>9,10</sup> that focused on case management for high-risk children with diabetes demonstrated increased compliance and decreased hospital and emergency department utilization. Similarly, 2 randomized clinical trials<sup>11,12</sup> that focused on asthma patients demonstrated that scheduled visits with specialty-trained nonphysician providers resulted in reduction in emergency department visits and admission length of stay. A separate study<sup>13</sup> similar to ours examined the effects of enrollment in a coordinated primary care clinic that included coordination between general pediatrics, neonatology, child psychiatry, and genetics. This study demonstrated decreased length of hospital stay. In addition, a randomized clinical trial<sup>7</sup> focusing on comprehensive care in a primary care medical home model demonstrated that estimated hospital and clinic costs were lower in the group randomized to the medical home. Care in this medical home was also primary care-based with professionals in nutrition, gastroenterology, neurology, and allergy/immunology available once monthly. Similar hospital cost avoidance has been shown using primary care- or nurse practitioner-based models for CSHCN.<sup>14-16</sup> To our knowledge, ours is the first study to suggest a decrease in hospital stay for patients with multiple aerodigestive comorbidities treated by a physician-led, multidisciplinary, specialty care model that emphasizes partnership with community-based primary care pediatricians.

Our study suggests that similar cost decreases can be achieved with an academic medical center multidisciplinary specialty aerodigestive program. Certainly, there are measurable start-up and maintenance costs of an ambulatory

specialty clinic,<sup>15</sup> but this study suggests that once established, the reduction in hospital length of stay as seen with enrollment in our clinic leads to decreased system costs. Medicaid enrollment is rapidly increasing, particularly for pediatric patients with complex medical conditions. Acute inpatient services represent the highest fraction of overall health care expenditures for CSHCN. This was reflected in our study: 50% of the patients were enrolled in Medicaid, and net income per admission for these patients was negative as opposed to those patients with other payers. Therefore, systemic changes in delivery methods that will achieve cost avoidance without compromising patient outcome will be critical as the move toward value-based health care continues.

### Limitations

There are some limitations to this study. Owing to confidentiality of specific institutional health contracting, we are unable to share specific costs or net revenue data. Consequently, we used published costs for Ohio hospitals as a surrogate. In addition, this study is retrospective and historical admissions data for some patients date over 19 years. During this time, there have been widespread efforts to decrease length of stay and hospital utilization. Moreover, health care advances and standards of care that may reduce length of stay may have occurred. These could all contribute to the reduction in hospital days seen in this study. In addition, there was no true control group in this study because it compared patients to themselves across many years. As children mature, they may experience natural improvement in their condition and recovery times that would be unrelated to improvements

attributable to delivery models. Thus, this could be a major source of bias. Finally, we are unable to account for any care the children may have had at other institutions prior to enrollment as well as admissions that may have occurred outside of our health care system.

Given that almost half of all admissions included a stay in the intensive care unit (ICU), future studies will be directed to analyze the effect of this clinic on ICU stay. A previous randomized clinical trial<sup>17</sup> focusing on a primary-care based medical home did show that there was a reduction both in ICU admissions and length of stay. In addition, many studies have shown that medical homes and coordinated primary care result in increased patient and family satisfaction.<sup>14,18-20</sup> We hope to demonstrate that enrollment in a coordinated aerodigestive clinic also increases patient and family satisfaction in future studies. Finally, future studies could examine system-specific clinics to see if similar results can be achieved with even more focused, coordinated outpatient care.

### Conclusions

This study suggests that coordinated care between multiple pediatric specialty professionals in an aerodigestive clinic may be associated with improvement of health care outcomes in CSHCN by potentially contributing to decreased length of hospital stay. Moreover, for aerodigestive-specific admissions, enrollment in this clinic results was associated with decreased inpatient hospital costs for these patients.

#### ARTICLE INFORMATION

**Accepted for Publication:** July 11, 2017.

**Published Online:** October 5, 2017.  
doi:10.1001/jamaoto.2017.1743

**Author Contributions:** Drs Appachi and Krakovits had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** Appachi, Banas, Kenny, Kraynack, Rosneck, Carl, Krakovitz.

**Acquisition, analysis, or interpretation of data:** Appachi, Banas, Feinberg, Henry, Kenny, Carl, Krakovitz.

**Drafting of the manuscript:** Appachi, Carl.

**Critical revision of the manuscript for important intellectual content:** Banas, Feinberg, Henry, Kenny, Kraynack, Rosneck, Carl, Krakovitz.

**Statistical analysis:** Appachi.

**Administrative, technical, or material support:** Banas, Kenny, Carl, Krakovitz.

**Study supervision:** Henry, Kraynack, Krakovitz.

**Conflict of Interest Disclosures:** All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

**Additional Information:** All information and materials in the manuscript are original.

#### REFERENCES

1. van der Lee JH, Mokkink LB, Grootenhuys MA, Heymans HS, Offringa M. Definitions and

measurement of chronic health conditions in childhood: a systematic review. *JAMA*. 2007;297(24):2741-2751. doi:10.1001/jama.297.24.2741

2. Bethell CD, Read D, Blumberg SJ, Newacheck PW. What is the prevalence of children with special health care needs? Toward an understanding of variations in findings and methods across three national surveys. *Matern Child Health J*. 2008;12(1):1-14. doi:10.1007/s10995-007-0220-5

3. Dosa NP, Boeing NM, Ms N, Kanter RK. Excess risk of severe acute illness in children with chronic health conditions. *Pediatrics*. 2001;107(3):499-504.

4. Newacheck PW, Kim SE. A national profile of health care utilization and expenditures for children with special health care needs. *Arch Pediatr Adolesc Med*. 2005;159(1):10-17. doi:10.1001/archpedi.159.1.10

5. American Academy of Pediatrics Ad Hoc Task Force on Definition of the Medical Home. The medical home. *Pediatrics*. 1992;90(5):774.

6. Cohen E, Jovcevska V, Kuo DZ, Mahant S. Hospital-based comprehensive care programs for children with special health care needs: a systematic review. *Arch Pediatr Adolesc Med*. 2011;165(6):554-561. doi:10.1001/archpediatrics.2011.74

7. Mosquera RA, Avritscher EBC, Samuels CL, et al. Effect of an enhanced medical home on serious illness and cost of care among high-risk children with chronic illness: a randomized clinical trial. *JAMA*. 2014;312(24):2640-2648. doi:10.1001/jama.2014.16419

8. Rappleye E. Average Cost per Inpatient Day Across 50 States. Beckers Hosp Rev. May 2015. <http://www.beckershospitalreview.com/finance/average-cost-per-inpatient-day-across-50-states.html>. Accessed July 10, 2016.

9. Howe CJ, Jawad AF, Tuttle AK, et al. Education and telephone case management for children with type 1 diabetes: a randomized controlled trial. *J Pediatr Nurs*. 2005;20(2):83-95. doi:10.1016/j.pedn.2004.12.010

10. Svoren BM, Butler D, Levine B-S, Anderson BJ, Laffel LMB. Reducing acute adverse outcomes in youths with type 1 diabetes: a randomized, controlled trial. *Pediatrics*. 2003;112(4):914-922.

11. Hughes DM, McLeod M, Garner B, Goldbloom RB. Controlled trial of a home and ambulatory program for asthmatic children. *Pediatrics*. 1991;87(1):54-61.

12. Harish Z, Bregante AC, Morgan C, et al. A comprehensive inner-city asthma program reduces hospital and emergency room utilization. *Ann Allergy Asthma Immunol*. 2001;86(2):185-189. doi:10.1016/S1081-1206(10)62689-0

13. Berman S, Rannie M, Moore L, Elias E, Dryer LJ, Jones MD Jr. Utilization and costs for children who have special health care needs and are enrolled in a hospital-based comprehensive primary care clinic. *Pediatrics*. 2005;115(6):e637-e642. doi:10.1542/peds.2004-2084

14. Hawkins MR, Diehl-Svrjcek B, Dunbar LJ. Caring for children with special healthcare needs in the

managed care environment. *Lippincotts Case Manag.* 2006;11(4):216-223.

15. Gordon JB, Colby HH, Bartelt T, Jablonski D, Krauthoefer ML, Havens P. A tertiary care-primary care partnership model for medically complex and fragile children and youth with special health care needs. *Arch Pediatr Adolesc Med.* 2007;161(10):937-944. doi:10.1001/archpedi.161.10.937

16. Liptak GS, Burns CM, Davidson PW, McAnarney ER. Effects of providing comprehensive ambulatory

services to children with chronic conditions. *Arch Pediatr Adolesc Med.* 1998;152(10):1003-1008.

17. Broyles RS, Tyson JE, Heyne ET, et al. Comprehensive follow-up care and life-threatening illnesses among high-risk infants: A randomized controlled trial. *JAMA.* 2000;284(16):2070-2076.

18. Sutton D, Stanley P, Babl FE, Phillips F. Preventing or accelerating emergency care for children with complex healthcare needs. *Arch Dis Child.* 2008;93(1):17-22. doi:10.1136/adc.2007.117960

19. Palfrey JS, Sofis LA, Davidson EJ, Liu J, Freeman L, Ganz ML; Pediatric Alliance for Coordinated Care. The Pediatric Alliance for Coordinated Care: evaluation of a medical home model. *Pediatrics.* 2004;113(5)(suppl):1507-1516.

20. Grossman LK, Rich LN, Michelson S, Hagerly G. Managed care of children with special health care needs: the ABC Program. *Clin Pediatr (Phila).* 1999; 38(3):153-160.