

Financial and Health Impacts of Multidisciplinary Aerodigestive Care

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Abstract

Objectives. (1) Analyze upstream and downstream activity before and after enrollment with the Multidisciplinary Pediatric Aerodigestive Care Team (MPACT). (2) Identify potential demand for MPACT services with ICD-9 data.

Study Design. Retrospective review of financial claims data.

Setting. Tertiary care children's center.

Subjects. Pediatric patients (0-18 years old) enrolled with MPACT (pediatric otolaryngology, gastroenterology, pulmonary, speech-language pathology).

Methods. Case mix data from fiscal years (FYs) 2010-2013 were analyzed for primary, secondary, and tertiary ICD-9 codes in 4 aerodigestive diagnostic categories (ADCs): dysphagia, chronic cough, gastroesophageal disease, and chronic pulmonary disease/asthma. Inclusion criteria included patients <18 years old, seen by MPACT, with FY2010-FY2013 case mix data and ≥ 2 ADCs. Unique outpatient and inpatient encounters and associated charges were evaluated to determine upstream and downstream activity trends.

Results. Of the 126 patients meeting inclusion criteria, 55 (44%) had ≥ 3 ADCs, and 11 (9%) had 4. These 126 patients received outpatient care during 3068 unique encounters. Outpatient total charges were \$282,102 before and \$744,542 after MPACT intervention. Eighty-six (68%) patients received inpatient care during 423 unique encounters. Inpatient charges were \$4,257,137 before and \$2,872,849 after MPACT enrollment. Overall, a net reduction of \$921,848 in total charges, \$7316 per MPACT patient, was noted. FY2010-FY2014 data identified an additional 1728 pediatric patients with ≥ 2 ADCs not enrolled in MPACT.

Conclusion. A cohort of children with aerodigestive disease experienced a shift from inpatient to outpatient care with an overall 20% reduction in patient charges when the years before and after MPACT enrollment were compared. Available ICD-9 data suggest potential demand for MPACT services.

Keywords

aerodigestive, multidisciplinary care, interdisciplinary care, pediatric, care coordination, quality, health care utilization, health care costs

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Despite the emergence of pediatric aerodigestive (AD) programs at tertiary care centers around the country, “aerodigestive disease” remains a nebulous term to describe the complex interrelation among upper airway, pulmonary, gastrointestinal, and feeding/swallowing disorders and diseases. The broad spectrum of symptom severity and the lack of underlying unifying diagnoses significantly contribute to the difficulty in evaluating the quality of such programs. While not an exhaustive inventory, common presenting complaints (**Table 1**) illustrate the complexity involved in defining the typical AD patient. AD patients require care from multiple pediatric subspecialists in the inpatient and outpatient arena. While the prevalence of AD disease as a discrete entity is unknown, the underlying comorbid or contributing conditions are relatively common and are often associated with increased hospital length of stay, morbidity, and mortality.¹⁻⁴ Together, these factors combine to drive health care costs.⁵⁻⁷

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Table 1. Common Aerodigestive Presenting Symptoms and Diagnoses by Subspecialty.

Pulmonary	Otolaryngology	Gastroenterology	Speech-Language Pathology
Asthma/wheezing	Adenotonsillar hypertrophy	Congenital anomalies of the GI tract	Dysphagia associated with prematurity
Bronchopulmonary dysplasia	Chronic cough	Dysmotility	Excessive drooling
Chronic lung disease	Cleft lip and palate, craniofacial anomalies	Esophageal obstruction	Feeding difficulties in the newborn
Congenital cardiopulmonary disease	Laryngomalacia	Gastroesophageal reflux	Feeding refusal and behavioral feeding difficulties
Recurrent pneumonia and respiratory infections	Laryngotracheal anomalies (ie, laryngeal cleft, TEF)	Hiatal hernia	Gastrostomy dependence
Supplemental oxygen dependence	Laryngotracheal stenosis, web	Inflammatory disease, eosinophilic esophagitis	Laryngeal penetration or tracheal aspiration
Tracheobronchomalacia	Tracheostomy dependence	Malabsorption and failure to thrive	Texture-specific dysphagia

Abbreviations: GI, gastrointestinal; TEF, tracheoesophageal fistula.

The Institute of Medicine identified care coordination as a key strategy to address escalating health care costs and quality concerns.⁸ In 2010, the Multidisciplinary Pediatric Aerodigestive Center Team (MPACT; formerly Pediatric Aerodigestive Center) was established in our tertiary pediatric care center and staffed by pediatric gastroenterology, otolaryngology, pulmonology, and speech-language pathology providers to provide interdisciplinary evaluation, ongoing care, and, when indicated, combined operative management of children with AD disease. The MPACT model meets the care coordination criteria set out by the Patient Protection and Affordable Care Act of 2010 as defined by the Agency for Healthcare Research and Quality.⁸ Previous review of the clinic population established a modest out-of-pocket savings to patients who received interdisciplinary care.⁹ While direct savings to the patient are important, the burden of health care costs is more frequently born by insurers and institutions.^{5-7,10} The purpose of this investigation was to determine the overall charges generated by our patient population before and after introduction to MPACT.

Methods

A retrospective review of financial claims data generated by pediatric patients enrolled with MPACT was undertaken as a quality improvement project and with appropriate approval by the Johns Hopkins institutional review board.

Study Population

Patients <18 years old were identified by review of MPACT attendance data in fiscal years (FYs) 2011-2013.

AD Disease Defined

AD disease was defined according to the presence of diagnoses falling within “aerodigestive disease categories” (ADCs) encompassing dysphagia, chronic pulmonary disease/asthma, chronic cough, and gastrointestinal disease. Patients were considered to have AD disease if they had been assigned primary, secondary, or tertiary diagnoses with

*International Classification of Diseases, Ninth Revision*¹¹ (ICD-9) codes in ≥ 2 ADCs.

For each ADC, ICD-9 codes were identified by consensus review of all potential codes by MPACT providers prior to analysis. A total of 57 AD-related codes were identified as encompassing the “typical” diagnoses encountered among AD patients (**Table 2**). ICD-9 codes were assigned to the most appropriate category so that each ADC contained a unique set of ICD-9 codes. For example, aspiration was assigned to the dysphagia ADC rather than the chronic cough or chronic pulmonary disease ADC. ICD-9 codes that were considered “atypical” or overly broad or specific were excluded. Examples of excluded diagnoses included lung laceration—closed (861.22), malignant neoplasm bronchus/lung not otherwise specified (162.9), obstructive sleep apnea (327.23), and food/vomitus pneumonitis (507.0).

Financial Data

To analyze the year before and year after the patients' admission to the clinic, the Johns Hopkins Financial Analysis Unit queried case mix data from FY2010-FY2014. Following filter for primary, secondary, and tertiary ICD-9 codes in 4 ADCs, the encounters were split into 2 groups: encounters before and after the first outpatient evaluation by MPACT. Inclusion criteria were as follows: patients <18 years, seen by MPACT in FY2011-FY2013, ICD-9 diagnoses inclusive of ≥ 2 ADCs, and case mix charge data for year before and after MPACT evaluation.

Of patients who met inclusion criteria, case mix data were evaluated for total charges in the years prior to and after MPACT enrollment. The encounters were then evaluated to identify unique outpatient and inpatient encounters and associated charges.

Additionally, case mix data (FY2010-FY2014) were analyzed to determine total number of unique patients <18 years with ≥ 2 ADCs seen at our institution who had not been formally evaluated by MPACT.

Table 2. ICD-9 Code Assignment by Each of 4 Aerodigestive Disease Categories.^a

Dysphagia	Chronic Pulmonary Disease/Asthma	Chronic Cough	Gastrointestinal Disease
300.11	491.9	472.2	478.79
438.82	493.xx	473.xx	530.xx
527.7	516.xx	474.01	533.70
748.3	517.8	476.0	536.2
783.3	518.xx	491.xx	787.02
787.xx, V44.1	748.xx	786.xx	789.07
	770.7		
	786.07		
	793.1, V44.0		

Abbreviation: ICD-9, *International Classification of Diseases, Ninth Revision*.

^aICD-9 code format of 123.xx indicates multiple ICD-9 codes with same 3-digit root. Each category contains a unique set of ICD-9 codes. n = 57 codes.

Statistical Methods

Only descriptive statistics were performed.

Results

Demographics

A total of 173 patients were identified from MPACT attendance records. Financial data were available for 169 (98%) patients. Inclusion criteria were met by 126 (70%) unique MPACT patients.

Encounters

Forty-eight (38%) patients had diagnoses in all 4 ADCs, with an additional 57 (45%) having diagnoses falling within 3 ADCs. These 126 patients generated 3068 unique outpatient encounters, and 86 (68%) received inpatient care generating 423 unique encounters.

Financial Charges

Case mix charge data for inpatient and outpatient encounters were evaluated to determine upstream and downstream activity trends. Case mix total charge data from years before and after (excluding year of) MPACT enrollment were evaluated. Outpatient total charges were \$282,102 before and \$744,542 after MPACT intervention. Inpatient charges were \$4,257,137 before and \$2,872,849 after MPACT enrollment. Overall, a net reduction of \$921,848 in total charges, or \$7316 per MPACT patient, was noted.

When the charge data were stratified by number of ADCs, cost reductions were seen in all groups, with greater reduction in per-patient costs seen with fewer diagnoses in ADCs. Specifically, MPACT patients with diagnoses in 4 ADCs had a mean reduction in costs of \$1355 (n = 48), whereas patients with diagnoses in 3 ADCs had a mean reduction of \$9759 (n = 57) and patients with diagnoses in <3 ADCs had a mean reduction of \$14,311 (n = 21).

Demand for Services

FY2010-FY2014 data identified an additional 1728 pediatric patients with ≥ 2 ADCs not enrolled in MPACT.

Discussion

To our knowledge, this is the first investigation to formulate a method to define AD disease, document the financial burden of inpatient and outpatient encounter charges for patients with AD diseases, and identify a potential financial impact of unified multidisciplinary care on patients with AD disease based on encounter charges. We found that following intervention with MPACT, there was an increase in outpatient charges and a reduction in inpatient charges. Although patients with more complex disease (ie, diagnoses in more ADCs) did see a lesser reduction of costs, this may reflect the difficulty in affecting outcomes with more severe disease.

In today's world of attempting "to deliver the right care in the right place at the right time with the lowest costs," we posit that the MPACT model of care meets Institute of Health Improvement's "triple aim" (www.ihl.org) of improving the patient experience of care, improving the health of populations, and reducing per capita health care costs. In our analysis, we believe that the third aim is being met by the MPACT model, and we speculate that the first 2 aims are being met such that care is being shifted from an inpatient to an outpatient setting for MPACT patients, which may be highly beneficial to patients and their families.

Overall, in our study population, charges per patient were reduced by >\$7000 after intervention, suggesting that this multidisciplinary care approach can reduce costs for insurers and society. It may also be beneficial for tertiary care institutions subject to capitated payments, both in real financial terms and also by freeing inpatient capacity for other patients. We identified a large number of patients who meet our defined AD disease criteria who were not seen by MPACT (1728 not seen vs 173 seen). Although many of these patients probably do not require MPACT coordination and care, there is likely to be a substantial number who could benefit from such care. We acknowledge that the costs savings that we saw with patients seen by MPACT may be a function of selection bias, as the 173 patients seen by MPACT may have more severe disease or may have been more difficult to diagnose via conventional care, thus resulting in a greater cost savings. It is also possible that models of care other than MPACT may achieve similar cost savings with a reduction in subspecialist time; one of the limitations of our analysis is that the time and cost of coordination are not captured in patient charges.

As this is a descriptive study, formal causal association cannot be ascribed, and other causes may exist for the trend toward decreased cost after MPACT enrollment or evaluation or the trend from inpatient to outpatient care. Our study examined costs accrued over a period of 3 years, which is a time of tremendous growth and development in the young pediatric population. This period may naturally lend itself to transition from high-acuity inpatient care to outpatient management of chronic disease, or simply "growing out of"

AD disease processes. Additionally, a bias toward increased utilization of inpatient resources in infants and very young children who experience AD disease may be present when compared with older children. It is also possible that communications with primary care providers may aid them in being more comfortable with managing acute illnesses as outpatients; unfortunately, our analysis does not permit us to separate inpatient costs related to acute illness versus costs related to management/diagnosis of chronic disease.

AD disease is complex and with overlapping symptom complexes and underlying disease burden and comorbidities. Our goal was to capture the representative majority of AD patients. Application of *ICD-9* and ADC filters to categorize primary, secondary, and tertiary diagnostic codes appears to be a robust method for identifying AD patients. However, this method may be conservative in estimation of patients who fall under the AD umbrella. By necessity, the number of *ICD-9* codes was limited to only those codes that were felt to capture the typical AD patient. Additionally, application of *ICD-9* codes is provider dependent, and bias is likely. For example, a pulmonologist is more likely to assign pulmonary-related codes, while a gastroenterologist would likely assign gastrointestinal-related codes predominantly. The requirement that ≥ 2 ADCs were required for inclusion identified patients who crossed subspecialty boundaries in their presentations, but it left out patients where multiple comorbidities or diagnoses were not recorded or assigned *ICD-9* codes. Last, the upcoming use of *ICD-10* codes will necessitate a further refinement of codes to define AD disease, as *ICD-10* codes are purported to be more specific than the *ICD-9* codes they replace.

In conclusion, we found that the MPACT model appears to result in overall reduction of charges in the year following the initial visit versus the year before. While this finding does need to be replicated with an appropriate control group and further sensitivity analyses with other definitions of AD disease, we believe that the MPACT model has the potential to reduce health care costs for a more medically complex group of children.

The evolution of AD presentations changes with age, maturation, medical complexity, and underlying diagnostic conditions.^{12,13} Future investigations are needed to track the impact of multidisciplinary care models on the course of AD presentations and their impact on cost and family burdens, particularly with the increased specification of coding associated with *ICD-10*.

Author Contributions

Margaret L. Skinner, study conception and design, drafting, revision and final approval of original manuscript, interpretation of data, accountable for accuracy and integrity; **Seohee K. Lee**, study design, acquisition, analysis and interpretation of data, drafting and final approval of original manuscript, accountable for accuracy and integrity of data; **Joseph M. Collaco**, study conception and design, interpretation of data, drafting, critical revision and final approval of original manuscript, accountable for accuracy and integrity; **Maureen A. Lefton-Greif**, study conception, drafting, critical revision and final

approval of original manuscript, interpretation of data; **Jeannine Hoch**, study conception, critical revision and final approval of original manuscript, accountable for accuracy and integrity of data; **Karla J. Au Yeung**, study conception and design, acquisition, interpretation of data, critical revision and final approval of original manuscript, accountable for accuracy and integrity of data.

Disclosures

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