International Journal of Pediatric Otorhinolaryngology 113 (2018) 119–123

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Interdisciplinary aerodigestive care model improves risk, cost, and efficiency

R. Paul Boesch[a,*], Karthik Balakrishnan[b], Rayna M. Grothe[a], Sherilyn W. Driscoll[a], Erin E. Knoebel[a], Sue L. Visscher[c], Shelagh A. Cofer[b]

[a] Department of Pediatric and Adolescent Medicine, Mayo Clinic Children's Center, Rochester, MN, USA
[b] Department of Otolaryngology, Head and Neck Surgery, Mayo Clinic, Rochester, MN, USA
[c] Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic, Rochester, MN, USA

ARTICLE INFO

Keywords:
Aerodigestive
Multidisciplinary
Cost
Efficiency

ABSTRACT

Objective: This study sought to evaluate the impact of an interdisciplinary care model for pediatric aerodigestive patients in terms of efficiency, risk exposure, and cost.
Methods: Patients meeting a standard clinical inclusion definition were studied before and after implementation of the aerodigestive program.
Results: Aerodigestive patients seen in the interdisciplinary clinic structure achieved a reduction in time to diagnosis (6 vs 150 days) with fewer required specialist consultations (5 vs 11) as compared to those seen in the same institution prior. Post-implementation patients also experienced a significant reduction in risk, with fewer radiation exposures (2 vs 4) and fewer anesthetic episodes (1 vs 2). Total cost associated with the diagnostic evaluation was significantly reduced from a median of $10,374 to $6055.
Conclusion: This is the first study to utilize a pre-post cohort to evaluate the reduction in diagnostic time, risk exposure, and cost attributable to the reorganization of existing resources into an interdisciplinary care model. This suggests that such a model yields improvements in care quality and value for aerodigestive patients, and likely for other pediatric patients with chronic complex conditions.

1. Introduction

Improvement in the care administered to critically ill children and neonates has resulted in an expanding population of children with complex chronic multi-system diseases [1]. Children with aerodigestive disease represent a subset of this population with interrelated conditions affecting the airway, breathing, and feeding and swallowing. A recent consensus statement on pediatric aerodigestive care defines a pediatric aerodigestive patient as, "a child with a combination of multiple and interrelated congenital and/or acquired conditions affecting airway, breathing, feeding, swallowing or growth that require a coordinated interdisciplinary diagnostic and therapeutic approach to achieve optimal outcomes. This includes (but is not limited to) structural and functional airway and upper gastrointestinal tract disease, lung disease due to congenital or developmental abnormality or injury, swallowing dysfunction, feeding problems, genetic diseases, and neurodevelopmental disability [2]." The care of these patients is costly and complex, characterized by multiple procedures, heavy reliance on technology and multi-specialist care. Pediatric aerodigestive programs provide interdisciplinary care, coordinating evaluation and management among otolaryngologists, pulmonologists, gastroenterologists, speech language pathologists and other disciplines within a compressed timeframe, resulting in a summary plan of care. This process requires substantial institutional organization, dedication of resources, and cultural practice change amongst providers to be successfully implemented. Typically patients are referred to the aerodigestive program, an intake interview is conducted, a pre-scheduled itinerary is developed, multidisciplinary clinic consultations, testing and combined endoscopic procedures are performed, and a single unified care plan is developed and given to the family and referring physicians[2]. Recent publications have demonstrated clinical effectiveness, estimated decreased cost, reduction in anesthetic episodes and resource utilization, and reduced care-giver burden by aerodigestive programs [3–7]. Specifically, Collaco et al., estimated reductions in outpatient clinic charges based on median reduction in number of center visits achieved by coordinating appointments, documented a 41% reduction in anesthetic

* Corresponding author. Division of Pediatric Pulmonology, Department of Pediatric and Adolescent Medicine, Mayo Clinic Children's Center, 200 First Street SW, Rochester MN 55905, USA.
E-mail address: Boesch.Paul@mayo.edu (R.P. Boesch).

https://doi.org/10.1016/j.ijporl.2018.07.038
Received 7 April 2018; Received in revised form 20 July 2018; Accepted 21 July 2018
Available online 25 July 2018

episodes by coordinating procedures, and estimated a reduction in perioperative charges of $3490 for those patients undergoing combined procedures [3]. They followed up this study with a retrospective analysis of the costs of delivering care to clinically-defined aerodigestive patients in the two years before and after their inclusion in the multidisciplinary program [4]. They found a shift to increased outpatient costs which was dwarfed by much greater reduction in inpatient costs, which agrees with what has been found in other complex pediatric populations [8].

The Pediatric Aerodigestive Program (PAP) at the Mayo Clinic Children's Center was founded in 2012, based on the structure and ideals presented above. The PAP is unique in that it utilizes a formal set of inclusion criteria. This allowed us to identify a cohort of similarly-defined patients before and immediately after launch of the program. This created pre-aerodigestive and post-aerodigestive cohorts of patients whose outcomes could be expected to differ only based on the structural organization and implementation of the program itself, as there were no other changes in staff, resources, treatments technologies, or techniques. This study sought to compare the effect of multidisciplinary clinic reorganization on time to completion of aerodigestive workup, risk reduction in terms of number of radiologic studies and episodes of general anesthesia, and reduction in standardized costs for the care cycle. This is the first such study to utilize standardly-defined pre and post cohorts to directly evaluate the impact of the aerodigestive organizational structure on efficiency, risk reduction, and cost.

2. Methods

This study was reviewed and approved by the Institutional Review Board of the Mayo Clinic (IRB# 15–008116). The Pediatric Aerodigestive Program at the Mayo Clinic was launched in September 2012. Prior to this organization, complex pediatric patients were followed by multiple specialists with care coordinated virtually through the medical record, phone, and email. Hallmarks of the PAP include 1. pre-visit intake performed over the phone by the program coordinator, 2. development of evaluation itinerary based on best-practice guidelines applied to information obtained from intake, 3. shared clinic and operating room time for combined procedures, 4. post-evaluation team meeting to develop unified care plan, and 5. summary wrap up visit with patient and family. To facilitate efficient scheduling, dedicated appointment slots are held in reserve for aerodigestive patients including clinic appointments, operating room time, instrumental swallow studies, radiography, and polysomnography. The PAP utilizes a standard rubric of inclusion criteria for program entry [Table 1]. This study retrospectively identified a cohort of 16 patients who met these inclusion criteria in the 8 years prior to program launch, and is defined as the “pre-Aero cohort”. This was a convenience sample of complex pediatric patients who met the inclusion criteria. The first 23 consecutive patients who were evaluated in the PAP within 6 months of launch were identified as the “post-Aero cohort”. This study evaluated patients seen from 9/29/2004–2/13/2013. The electronic medical record and billing records were then retrospectively reviewed to determine the elements of the diagnostic evaluation, based on the presenting complaints. These elements were then tallied in terms of number of consultations, number and type of radiographic evaluations, number of anesthetic episodes, time required to complete the aerodigestive evaluation, and total standardized cost of all selected billed services. The time to complete the aerodigestive evaluation was defined as time from initial consultation until completion of diagnostic work up for the presenting problem.

Standardized costs were created by applying the Mayo Clinic Rochester Cost Data Warehouse methodology to the selected billed services [9]. All Current Procedural Terminology, 4th Edition (CPT4©) codes and approximately 90% of internal charge master codes were mapped to their 2013 equivalent values. Medicare 2013 reimbursement was assigned to all professional billed services identified by CPT4 codes, and the appropriate 2013 Medicare Cost Report cost-to-charge ratios were multiplied by the equivalent 2013 charges for all hospital billed services. Year of service hospital charges and cost-to-charge ratios were used for the approximate 10% of hospital services that could not be mapped to equivalent 2013 charge master codes. The resulting year of service standardized costs were inflated to 2013 with the Gross Domestic Product implicit price deflator.

Table 1
Inclusion criteria, Pediatric Aerodigestive Program, Mayo Clinic Children's Center.

Core Services	“Major” conditions	“Minor” Conditions
At least 2 needed, plus:	Either 2 major, or 1 major and 2 minor	
Otolaryngology	Airway stenosis¥	Developmental Delays
Pulmonology	Aspiration (known or suspected)	Feeding problems
Gastroenterology	Chronic lung disease	GERD
	Global CNS impairment	Laryngomalacia
	Chiari malformation	Noisy breathing
	Esophageal dysmotility	Recurrent chest infections
	Esophageal stricture	Tracheomalacia/ Bronchomalacia
	Genetic condition (listed)*	
	Laryngeal cleft (current or prior)	
	Sleep disordered breathing	
	Tracheoesophageal fistula (current or prior)	
	Tracheostomy	
	Vocal cord paralysis	

¥Subglottic stenosis, glottic stenosis, laryngeal web, laryngeal atresia, tracheal stenosis, complete tracheal rings
*Trisomy 21, CHARGE, 22q11, VATER/VACTERL, Pfeiffer, Opitz, craniofacial syndromes, Cornelia deLange, Crit du Chat

Mean ages between cohorts was compared using unpaired *t*-test for samples of unequal variance. Categorical variables were evaluated by chi square test or Fischer's exact test, depending on frequency. Due to the small sample size in each group, non-parametric tests were used, including the Mann-Whitney *U* test. Bonferroni corrections were used for multiple testing; repeating the testing with the more powerful Sidak correction produced identical results. Statistical analysis was done using Stata/SE 9 (StataCorp, College Station, TX).

3. Results

Sixteen pre-Aero and 22 post-Aero patients were included in this study. One post-Aero patient was excluded from the study as the patient's parents had not signed Minnesota Research Authorization for use of medical records.

No significant differences were found between study cohorts for gender, age, and referring complaints [Table 2].

The median time to completion of aerodigestive evaluation was dramatically reduced from 150 to 6 days ($p < 0.001$) [Fig. 1]. Median number of radiation exposures was reduced from four to two ($p < 0.001$) with a similar degree of reduction regardless of study type (CT, fluoroscopy, chest/abdominal plain radiography) [Fig. 2]. Median anesthetic exposures decreased from two to one ($p < 0.001$). Median number of specialists consultations also dropped from eleven to five ($p < 0.001$). The median standardized cost for aerodigestive evaluation was substantially reduced from $10,374 in the pre-Aero cohort to $6055 in the post-Aero cohort, which is a reduction of 41.6% ($p = 0.003$) [Table 3, Fig. 3]. Significant decreases were seen across most cost categories, including anesthesia ($p = 0.002$), clinic office visits and tests ($p = 0.02$), and radiology ($p = 0.001$). Laboratory/pathology ($p = 0.52$) and operating room (OR) facility ($p = 0.83$), and recovery room ($p = 0.08$) were not significantly different between the