

Lung Transplant Index: A Quality Improvement Initiative

Don Hayes, Jr, MD, MS*†‡§; Bob Feeney, BS¶; Donna J. O'Connor§; Kerri L. Nicholson, BSN, RN§; Ashley E. Nance, FNP§; Kelly K. Sakellaris, MS, RD, LD§; Nicole R. Dempster, PhD||; Jaclyn D. Groh, MSW, LSW**§; Stephen E. Kirkby, MD*†§

Abstract

Introduction: Limited long-term survival is a recognized problem in adolescent/young adult lung transplant recipients. A quality improvement (QI) initiative included the development of a Lung Transplant Index (LTI) composed of key elements that we used as a comprehensive approach to screen and identify potential harms in this at-risk patient population. **Methods:** A single-center, uncontrolled QI study was completed from January 2014 to February 2019. The elements of the LTI are events that should have occurred within the most recent 12 months. If an element did not occur, it was counted as a missed element of preventing harm and summated later serving as the LTI score. Implementation of the LTI occurred on January 1, 2015, with a retrospective chart review of patients seen in clinic the prior year serving as baseline measures for comparison. **Results:** The year before implementing the LTI, numerous opportunities failed to identify preventable harm in our adolescent/young adult lung transplant population. The LTI resulted in a sustained reduction of these missed opportunities without negatively influencing patient/family satisfaction with lengthening of the clinic visit. **Conclusions:** A single-center QI initiative identified preventable harms in an adolescent/young adult lung transplant population and reduced the number of preventable harm elements not performed. Future work is needed to determine if this type of QI initiative is associated with less healthcare utilization. (*Pediatr Qual Saf* 2019;4:e209; doi: 10.1097/pq9.000000000000209; Published online September 19, 2019.)

INTRODUCTION

With the introduction of the Preventable Harm Index in 2010, a standard was established at our institution to strive for a goal of zero preventable harm.¹ With this new tool, our hospital had the means to track preventable elements which allowed for the implementation of quality improvement (QI) initiatives. With a higher Preventable Harm Index being undesirable, a lower

value represents a better performance with fewer elements. Upon implementation of this index system, there was an immediate decrease in medical errors, improvement in patient safety and mortality, and initiation of cost savings at our hospital.²⁻⁴ Over time, experts at our institution have realized that the Preventable Harm Index is a component of a more comprehensive and encompassing Clinical Index, which is a longitudinal metric that totals the number of elements with the goal being a lower score compared with the previous period.⁵ Subsequently, individual programs at our hospital have instituted initiatives using a Clinical Index to evaluate and improve their performance.⁵⁻⁸

With adolescent lung transplant recipients having worse long-term survival compared with older adult patients,⁹⁻¹¹ the mechanisms contributing to this age-related disparity are not completely understood. Barriers to adherence of treatment regimens and management recommendations are often a recognized problem in the adolescent patient population^{12,13} and may contribute to the survival differences in younger and older lung transplant recipients. Our multidisciplinary team believes that inadequate adherence is a component of an overarching deficiency of these patients and their families not understanding possible harms, for example not understanding the need to take medications at specific times to maintain immunosuppression or to avoid exposures to others with a viral infection. Therefore, we



From the *Department of Pediatrics, The Ohio State University College of Medicine, Columbus, Ohio; †Department of Internal Medicine, The Ohio State University College of Medicine Columbus, Ohio; ‡Department of Surgery, The Ohio State University College of Medicine Columbus, Ohio; §Section of Pulmonary Medicine, Nationwide Children's Hospital, Columbus, Ohio; ¶Quality Improvement Services, Nationwide Children's Hospital, Columbus, Ohio; ¶¶Department of Psychiatry and Behavioral Health, Nationwide Children's Hospital, Columbus, Ohio; and **The Heart Center, Nationwide Children's Hospital, Columbus, Ohio.

*Corresponding author. Address: Don Hayes, Jr., MD, MS, The Ohio State University, Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 43205

PH: (614) 722-3425; Fax: (614) 722-3426
Email: hayes.705@osu.edu

Copyright © 2019 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the Creative Commons Attribution License 4.0 (CCBY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

To cite: Hayes D, Feeney B, O'Connor DJ, Nicholson KL, Nance AE, Sakellaris KK, Dempster NR, Groh JD, Kirkby SE. Lung Transplant Index: An Quality Improvement Initiative. *Pediatr Qual Saf* 2019;5:e209.

Received for publication April 24, 2019; Accepted August 5, 2019.

Published online September 19, 2019

DOI: 10.1097/pq9.000000000000209

implemented an outpatient QI initiative using a Clinical Index to identify preventable harms in adolescent and young adult lung transplant recipients at our program that we termed the Lung Transplant Index (LTI). Our multidisciplinary team developed a comprehensive approach for screening through the LTI, to identify potential harms and to facilitate the education of each patient/family. The elements of the LTI are bundled and completed during clinic visits to achieve a score to identify preventable harm in our patient population. Our multidisciplinary team included 2 pediatric pulmonologists, 2 nurse coordinators, a QI coordinator, a dietician, a licensed psychologist, a licensed social worker, and an administrative associate.

METHODS

Using the Delphi method, our structured group, who were individual experts, completed 3 rounds of questionnaires that was facilitated by the lead author with revisions completed after each round. The final LTI was achieved upon the reaching of the consensus by our panel of experts. Figure 1 is the key driver diagram for our QI initiative with our specific aim being to decrease missed opportunities in providing preventive care through identifying preventable harm as indicated on LTI for outpatient lung transplant recipients from an unknown baseline to 0% by December 31, 2015, and sustain it for 3 years. Our key drivers were to identify comprehensive care, improve our team approach, and optimize information technology support to facilitate implementation and sustainment of our QI initiative. Our interventions

were to create the LTI, define index elements, and perform/complete the LTI at each annual visit. Additional interventions were a pre- and post-clinic review by the treating pediatric pulmonologist the week before and after each clinic visit, communication between all members of the multidisciplinary team (listed above) through a weekly clinic review meeting, identify best processes in how to complete the LTI in an outpatient clinic setting, and assess the impact on patient/family satisfaction. Through the weekly clinic review model, all team members provided feedback about each patient and any concerns regarding harms identified with the LTI. Working with the information technology team, we developed a means to document the completion of the annual LTI for each patient in the electronic medical record to add this to the patient’s record.

Table 1 outlines each element of the LTI that our team felt was a source of possible harm in adolescent and young adult lung transplant recipients. The elements of the LTI included a pre- and post-test of medications including immunosuppression, antimicrobial prophylaxis, and other medications. Due to the importance of accurate medication documentation, the team felt that reconciliation was needed, so that was added to the LTI and was performed by the transplant coordinator at each clinic visit. Although medication reconciliation is a component of the National Patient Safety Goals, our team believed it should be included in the LTI to assess both prescription and nonprescription drugs due to the number of drug-drug interactions. Moreover, the medication reconciliation element was completed at each clinic visit but was only counted for 1 point for the LTI. Each patient

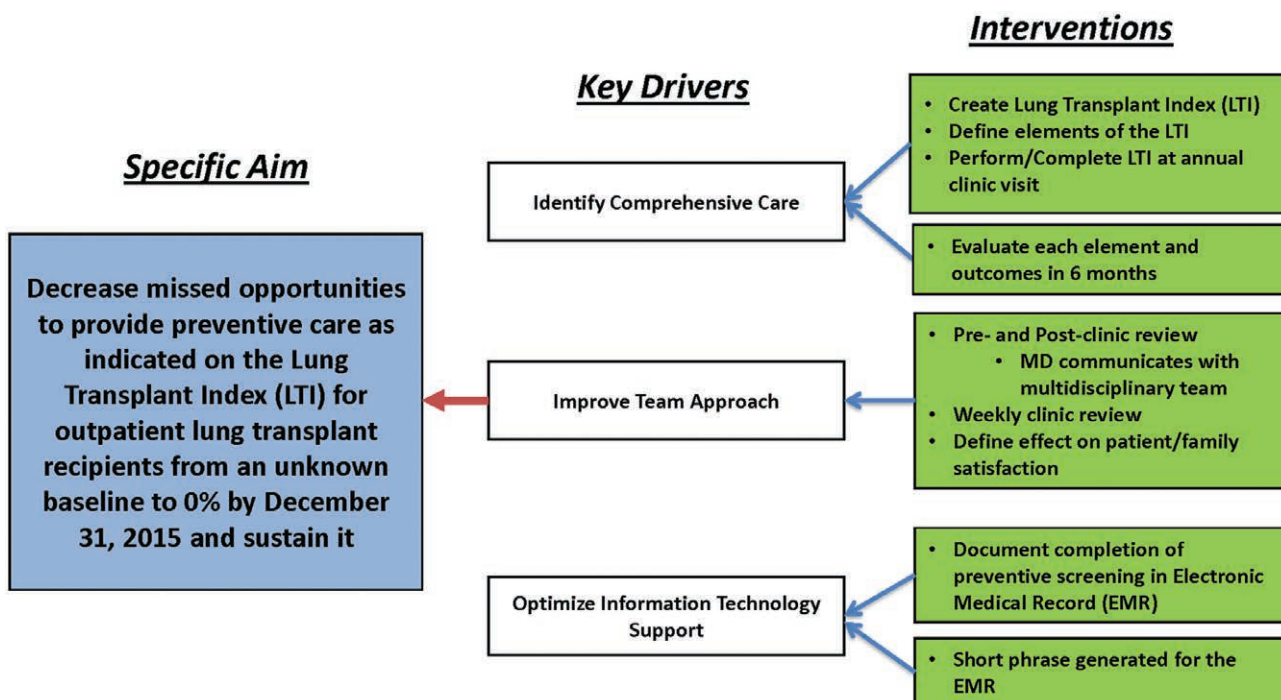


Fig. 1. Key driver diagram for the LTI.

Table 1. Lung Transplant Index Elements

Elements	No. events
Patient medication knowledge	n
Medication reconciliation (prescription and nonprescription)	n
Annual laboratory exams performed	n
Annual diagnostic testing	n
Education on environmental/occupational/school exposures	n
Routine child and adolescent preventive services	n
Annual nutrition assessment	n
Psychosocial assessment	n
Annual social work assessment	n
Check for pain or chronic complaints	n
Sexual education (age ≥13 y)	n
LTI	Sum of n's

undergoes annual laboratory and diagnostic testing as a means to screen for possible comorbidities or complications of lung transplantation, so these were considered separate elements with all testing under each representing 1 score for the LTI. Exposures of various types can cause significant morbidity and mortality in lung transplant recipients, so the LTI focused on specific ones for adolescent and young adult patients, including at school and while working. Preventive screening followed standard guidelines for patients of their age, which primarily focused on vaccinations, counseling for high-risk behaviors and trauma prevention, application of sunscreen during sun exposure, etc. Annual assessments by the multidisciplinary team are vital and were a separate element for the LTI. Finally, we felt that chronic complaints could often be overlooked and a sign of an underlying problem that may be preventable, so we included an assessment for chronic complaints/pain and sexual dysfunction. The LTI included these 11 elements that should have been assessed within the most recent 12 months. If an assessment did not occur, it is counted as a missed element and then added to the LTI with a later summation with each score being collected for each patient on an annual basis. A lower score was considered optimal and represented that our efforts to prevent harm for each patient was optimized. We generated a run chart as a means to assess the time series analysis.

To establish a baseline and for comparison, we retrospectively reviewed all clinic visits for the year before the implementation of the LTI and generated a score. With a start date of January 1, 2015, we reviewed the medical records for each patient included in our QI study from the year before (January 1, 2014, to December 31, 2014) and generated an LTI for that year to represent a baseline measurement for comparison.

With an intent to not significantly lengthen the clinic visit while completing both screening and education, a conscious effort to complete screening and education promptly was the goal. Although total clinic time was not collected, time to complete the entire LTI generally ranged between 4 and 5 minutes, with extension up to 10 minutes in some situations to elicit further important information if we detected harm(s).

RESULTS

Using an uncontrolled before and after study design as described in the medical literature,¹³ we completed a QI study at our institution from January 2014 to February 2019. All patients followed at our program were included in the QI initiative (N = 14) with ages ranging from 13 to 36 years. Figure 2 is the run chart that shows the number of missed opportunities in the identification of preventable harm the year before and then after implementation of the LTI. Upon implementation, the LTI reduced the number of missed opportunities. This effect was sustainable for subsequent years. Although we did not specifically collect clinic times, patients and families believed that the LTI did not negatively influence their clinic experience based on our questioning of them after implementation.

DISCUSSION

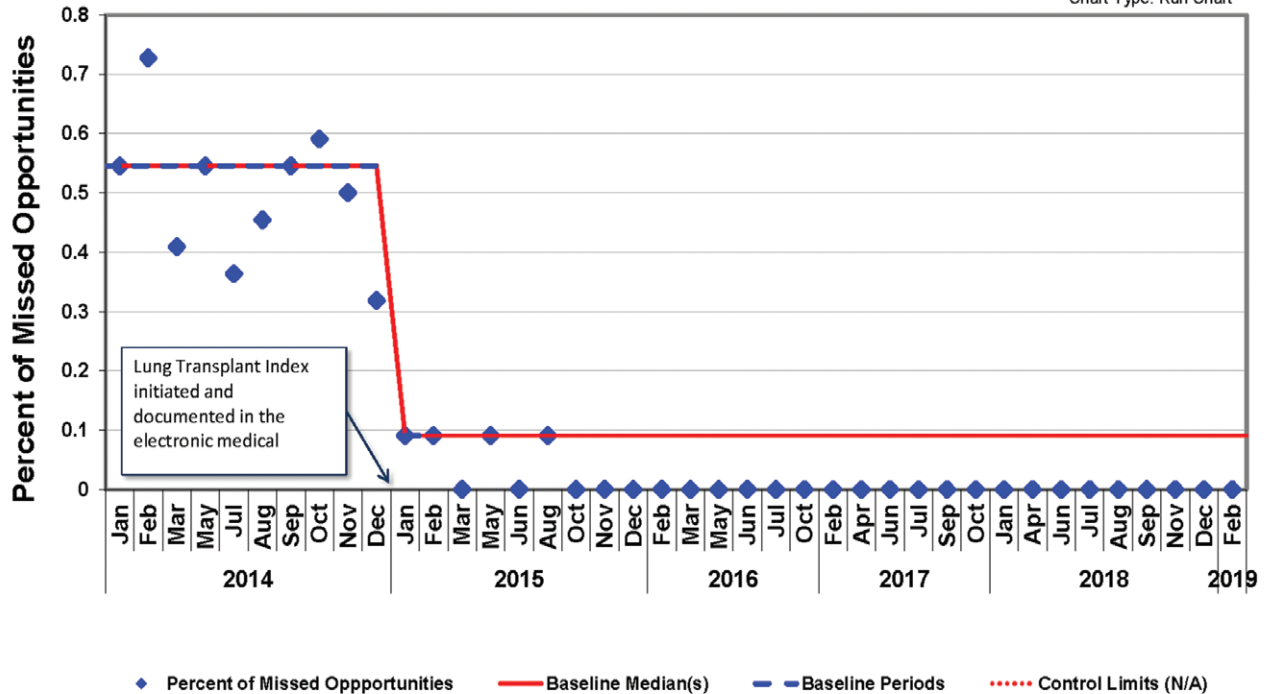
Our key finding is that a patient-centered QI initiative identified preventable harms in adolescent and young adult lung transplant recipients that were being missed. Before implementing the LTI, our approach to patient care was neglecting elements that placed our patient population at risk for harm. Modifying our approach resulted in optimized participation of the entire multidisciplinary team leading to a rapid improvement in the healthcare our team delivered.

We believe that avoiding possible harms in their home and their local community are vital for improving long-term outcomes of lung transplant recipients, especially the younger population. Important areas we addressed were improving patient understanding of their medications and confirming that all medications, both prescription and nonprescription, were being taken correctly. We also focused on timely completion of annual laboratory testing as well as annual diagnostic testing, such as pulmonary function testing and computed tomography imaging of the chest. Importantly, we focused on preventive measures around possible environmental, occupation, and school exposures. We often promoted the need to avoid others with signs and symptoms of a viral infection. From a multidisciplinary approach, we included the assessment of each team member in the LTI as each provider is needed to provide a holistic approach to the care of this patient population. For the chronic complaints, we focused more commonly on the nontransplant issues and chronic pain in this element. Finally, sexual education is rarely reported regarding this patient population, and our team felt it important to address this element on an annual basis. Based on the evidence from our QI initiative, we recommend further work to study the use of our Preventable Harm Index in lung transplant recipients as a means to reduce healthcare utilization for this patient population.



Lung Transplant Index

Chart Type: Run Chart



Month	Missed Opportunities	Available Opportunities
Jan 2014	6	11
Feb 2014	16	22
Mar 2014	9	22
May 2014	24	44
Jul 2014	4	11
Aug 2014	5	11
Sep 2014	6	11
Oct 2014	13	22
Nov 2014	11	22
Dec 2014	7	22
Jan 2015	2	22
Feb 2015	2	22
Mar 2015	0	11
May 2015	2	22
Jun 2015	0	11
Aug 2015	1	11
Oct 2015	0	22
Nov 2015	0	11
Dec 2015	0	11
Feb 2016	0	11
Mar 2016	0	11
May 2016	0	11
Jun 2016	0	22
Jul 2016	0	11
Oct 2016	0	11
Feb 2017	0	11
Apr 2017	0	22
Jun 2017	0	11
Jul 2017	0	11
Sep 2017	0	11
Oct 2017	0	22
Jan 2018	0	33
Apr 2018	0	22
Jun 2018	0	11
Jul 2018	0	11
Aug 2018	0	11
Sep 2018	0	22
Nov 2018	0	11
Dec 2018	0	11
Feb 2019	0	11

Fig. 2. Run chart showing the percentage of missed opportunities for the LTI.

This QI study had several limitations, including a single-center design and small sample size. However, we successfully implemented a QI initiative that enhanced our identification of preventable harms in our patient population. Due to these limitations, we could not determine the true global clinical impact, so this area needs further research in larger cohorts to determine the relevance of our findings.

With minimal improvement in post-LTx survival for the past 2 decades, patient-centered care may serve as a potential facilitator of better long-term outcomes. Key factors that facilitated the success of our QI initiative were a commitment by a multidisciplinary team and support from an institution committed to improving quality of care.

In conclusion, the current analysis describes the success of an outpatient QI initiative that improved our screening process of preventable harms in adolescent and young adult lung transplant recipients. Currently, there is limited QI work published in solid organ transplantation. We believe that a comprehensive approach to QI initiatives across many centers would help define best practice, with regards to preventing harm and educating patients on health benefits in the younger lung transplant population.

This type of collaboration may allow a platform to help ameliorate the contribution of preventable harm in long-term outcomes of adolescent and young adult lung transplant recipients.

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Brill R, McClelland RE Jr, Davis T, et al. The Preventable Harm Index: an effective motivator to facilitate the drive to zero. *J Pediatr.* 2010;157:681–683.
2. Brill R, McClelland RE Jr, Crandall WV, et al. A comprehensive patient safety program can significantly reduce preventable harm, associated costs, and hospital mortality. *J Pediatr.* 2013;163:1638–1645.
3. McClelland RE Jr, Catt C, Davis JT, et al.; Adverse Drug Event Quality Collaborative. An internal quality improvement collaborative significantly reduces hospital-wide medication error related adverse drug events. *J Pediatr.* 2014;165:1222–1229.e1.
4. Kelleher KJ, Cooper J, Deans K, et al. Cost saving and quality of care in a pediatric accountable care organization. *Pediatrics.* 2015;135:e582–e589.
5. Crandall W, Davis JT, Dotson J, et al. Clinical Indices Can Standardize and Monitor Pediatric Care: A Novel Mechanism to Improve Quality and Safety. *J Pediatr.* 2018;193:190–195.e1.

6. Olshefski R, Vaughan M, YoungSaleme T, Barr D, Frost R, Nuss KE, Wheeler TA, Brady M, Davis JT, Bibart M, Cripe T, Brill R. The Cancer Care Index: A Novel Metric to Assess Overall Performance of a Pediatric Oncology Program. *J Patient Saf* 2016. [Epub ahead of print]
7. Barron CL, Elmaraghy CA, Lemle S, et al. Clinical Indices to Drive Quality Improvement in Otolaryngology. *Otolaryngol Clin North Am*. 2019;52:123–133.
8. Allen ED, Montgomery T, Ayres G, et al. Quality improvement-driven reduction in countywide medicaid acute asthma health care utilization. *Acad Pediatr* 2019;19(2):216–226.
9. Paraskeva MA, Edwards LB, Levvey B, et al. Outcomes of adolescent recipients after lung transplantation: an analysis of the International Society for Heart and Lung Transplantation Registry. *J Heart Lung Transplant*. 2018;37:323–331.
10. Hayes D Jr, Glanville AR, McGiffin D, et al. Age-related survival disparity associated with lung transplantation in cystic fibrosis: an analysis of the registry of the International Society for Heart and Lung Transplantation. *J Heart Lung Transplant*. 2016;35:1108–1115.
11. Hayes D Jr, McCoy KS, Whitson BA, et al. High-risk age window for mortality in children with cystic fibrosis after lung transplantation. *Pediatr Transplant*. 2015;19:206–210.
12. Mehta P, Steinberg EA, Kelly SL, et al. Medication adherence among adolescent solid-organ transplant recipients: A survey of healthcare providers. *Pediatr Transplant* 2017;21(7).
13. George M, Rand-Giovannetti D, Eakin MN, et al. Perceptions of barriers and facilitators: self-management decisions by older adolescents and adults with CF. *J Cyst Fibros*. 2010;9:425–432.
14. Eccles M, Grimshaw J, Campbell M, et al. Research designs for studies evaluating the effectiveness of change and improvement strategies. *Qual Saf Health Care*. 2003;12:47–52.