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Pattern and Predictors of Hospital Readmission During the First Year After Lung Transplantation

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Abstract

Hospital readmission after lung transplantation negatively impacts quality of life and resource utilization. A secondary analysis of data collected prospectively was conducted to identify the pattern (incidence, count, cumulative duration), reasons and predictors of readmission for 201 lung transplant recipients (LTR) assessed at 2, 6, and 12 months post-discharge. The majority of LTRs (83.6%) were readmitted, and 64.2% had multiple readmissions. The median cumulative readmission duration was 19 days. The main reasons for readmission were: other than infection or rejection (55.5%), infection only (25.4%), rejection only (9.9%), and infection and rejection (0.7%). LTRs who required reintubation (odd ratio [OR]=1.92; p=.008) or discharged to care facilities (OR=2.78; p=.008) were at higher risk for readmission with a 95.7% cumulative incidence of readmission at 12 months. Thirty-day readmission (40.8%) was not significantly predicted by baseline characteristics. Predictors for higher readmission count were lower capacity to engage in self-care (incidence rate ratio [IRR]=0.99; p=.03) and discharge to care facilities (IRR=1.45; p=.01). Predictors for longer cumulative readmission duration were older age (arithmetic mean ratio [AMR]=1.02; p=.009), return to ICU (AMR=2.00; p=.01), and lower capacity to engage in self-care (AMR=0.99; p=.03). Identifying LTRs at risk may assist in optimizing pre-discharge care, discharge planning, and long-term follow-up.

INTRODUCTION

Hospital readmission is considered an important proxy measure for the quality of care and short-term effectiveness of hospital discharge processes (1, 2). In most cases, readmission has been found to be associated with poorer quality of inpatient care, remediable care deficiencies (3), illness burden, and social determinants of health (4). The Medicare Payment Advisory Commission reported that 75% of readmissions of Medicare beneficiaries were

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DISCLOSURE

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avoidable, resulting in extra cost of US$15 billion annually (5, 6) and negatively impacting patients quality of life. While the Centers for Medicare & Medicaid Services (CMS) have begun limiting reimbursement for higher standardized readmission rates for certain medical conditions (e.g., heart failure, acute myocardial infarction, and pneumonia) (7, 8), these penalties are anticipated to be broadened to include other medical and surgical conditions (9–11), including transplantation (11).

Lung transplantation is becoming a more prevalent treatment option for patients with end-stage lung disease (12–14). Patients who undergo transplantation are expected to have better physical quality of life (15) and longer life expectancy (16–18). Despite the advances and improved survival, lung transplant recipients (LTRs) often experience post-transplant complications (19, 20), and unplanned hospital readmissions. Although it is known that the incidence of readmission is the highest during the first year after lung transplantation (21, 22), there is lack of information about how these readmissions unfold over the course of the first year. Furthermore, factors associated with risk for readmission, such as pre-discharge characteristics (sociodemographic, clinical, self-care), and the reasons for readmission are largely unknown. It is crucial to understand these risk factors in order to allocate health care resources more efficiently, reduce readmission rates, and improve LTRs quality of life (23). Therefore, the purposes of this study were to: 1) describe the pattern (incidence, count, and cumulative duration) and reasons for readmission during first year after lung transplantation and 2) identify predictors of hospital readmission.

METHODS

Design, Setting, and Sample

The study was a secondary analysis of data from a randomized controlled trial (RCT) to evaluate the efficacy of a mobile health (mHealth) intervention for improving capacity for self-care, self-management, and health outcomes during the first year after lung transplantation (24) (ClinicalTrials.gov identifier: NCT00818025). The final sample consisted of all 201 LTRs who were randomized to one of two groups (intervention or usual care) in view of the fact that the original study did not find significant impact of the intervention on readmission. Included LTRs in the parent study were over 18 years old, able to read and speak English, had no history of previous organ or bone marrow transplant, and able to perform their personal care (24). All LTRs received a lung transplant between December 2008 and December 2011 at the University of Pittsburgh Medical Center (UPMC) Cardiothoracic Transplantation Program. All LTRs received clinical management according to the standard UPMC protocol for immunosuppression, infection prophylaxis, routine surveillance biopsies, intravenous steroids in case of acute rejection, and follow-up evaluations as needed. For most patients with acute rejection, readmission to the hospital was required due to logistical challenges with home care and comorbidities, particularly diabetes. However, some patients were treated with intravenous steroids at an outpatient infusion center or at home. The study was approved by the Institutional Review Board of the University of Pittsburgh.

Data Collection and Measures

Pattern of readmission—For the purpose of the present study, readmission was defined as a stay in an inpatient hospital setting for at least 24 hours following the patient's medical discharge after index transplant hospitalization (22). Data related to readmission (incidence, count, cumulative duration, and reasons for readmission) were collected prospectively during each of the intervals 0–2, 2–6, and 6–12 months post-discharge. Medical records were used to extract data for patients readmitted to any hospital within the same healthcare network (UPMC) or from medical records regarding a readmission from outside hospitals (14.8% of total readmissions).

For each interval, readmission incidence was determined based on any readmission, and the count of readmission was the sum of readmissions. The cumulative duration of readmission was the sum of hospital stay days for each interval.

Reasons for readmission—Reasons for readmission were independently classified by two evaluators according to the four categories outlined by the International Society of Heart and Lung Transplantation (ISHLT) (21): 1) infection, 2) rejection, 3) infection and rejection, or 4) other than infection or rejection. The category "unable to determine" was used in cases of lack of sufficient data to make decision. In cases of disagreement between the two evaluators, readmission was discussed until consensus was reached for all admissions.

Predictors—Potential predictors of readmission were measured prior to index hospital discharge and included RCT group assignment, sociodemographic, clinical, and self-care characteristics.

Sociodemographic characteristics included gender (male v. female), age at transplant (years), marital status (married v. unmarried), race (white v. non-white), education (less than high school v. high school or higher) and employment (employed v. unemployed).

Clinical characteristics included underlying lung disease (obstructive v. non-obstructive), type of transplant procedure (single v. double), post-operative ventilation period (< 48 hours v. ≥ 48 hours), return to intensive care unit (ICU) (return v. no return), reintubation (reintubated v. not reintubated), length of hospital stay (days), and hospital discharge destination (home v. any care facility).

Self-care characteristics have a crucial role in promoting patients to control and reduce the physical and psychological consequences of the disease (25, 26), and thus they were hypothesized to predict readmission after lung transplantation. The original study used three measures to assess self-care attributes: 1) Perception of Self-Care Agency (PSCA) (27), a reliable and valid (28) self-report measure of one's capacity for self-care (29). The PSCA includes 53 Likert-type items scored on a scale of 1 to 5 and summed for scores that range from 53 to 265, with higher scores indicating greater self-care agency. Internal consistency reliability (Cronbach's alpha) was .94 in the current sample, well above the acceptable level of (.70) (30). 2) Dyadic Adjustment Scale (DAS) (31), a reliable, self-report measure of the quality of the relationship with patient's primary lay caregiver. Stronger recipient-caregiver relationship was previously reported to be associated with higher capacity for self-care (32).

The DAS includes 15 Likert-type items scored on a scale of 1 to 5 and summed for scores that range from 15 to 75, with higher scores indicating higher quality of caregiver relationship (33). Cronbach's alpha was .83 in the current sample. 3) Health Locus of Control (HLOC), Internality subscale (34, 35), a self-report measure of how strongly individuals believe they are responsible for their own health outcomes (36). The internality measure is reliable (37) and includes six Likert-type items scored on a scale of 1 to 6 and summed for scores that range from 6 to 36 with high scores indicating higher internality. Cronbach's alpha was .75 in this sample.

Statistical Analysis

Descriptive statistics were used to summarize categorical variables by frequencies and proportions, and continuous variables by medians and interquartile ranges (IQR). Distribution differences of LTRs by readmission status during the first year were compared using Wilcoxon rank sum test for continuous and Chi-square test or its exact counterpart (Fisher's test) for categorical variables. The extent of missing data was assessed and only two values were incomplete for the DAS measure; unconditional mean imputation (38) was used to compute scores for these data. The degree of concordance on classification of reasons for readmission between two evaluators was examined by the percentage of agreement before reconciliation and Cohen's kappa (39).

Regression analysis using Generalized Estimating Equations (GEE) models (40) was used to identify predictors of readmission pattern. GEE allows analysis of repeated measurement of readmission incidence for the three study intervals (0–2, 2–6, and 6–12 months); this repeated measures analysis is considered powerful relative to sample size (41) because it allows for studying variability within individuals over time (42, 43). Individual differences in follow-up time during each interval were adjusted using the $\log^e$-transformed of total participation days as offset. To account for attrition over time, the models included the days up to the event (19 deaths, 1 withdrawal) as offset for that time interval and omitted the subsequent intervals from analysis (i.e. censored). Binomial (logistic) and negative binomial distributions were adopted by the GEE regression models for the readmission incidence (dichotomous data) and the count of readmissions (count data), respectively. Another GEE model used gamma distribution to assess predictors of readmission duration in case of readmission (44). For all GEE analyses, univariate regression was first used to identify potential predictors at significance level of $p < .10$ (45). Retained variables were then entered into a multivariate model to identify the final significant predictors ($p < .05$). Effect sizes in form of odds ratios (OR), incident rate ratios (IRR), and arithmetic mean ratios (AMR) were reported with the 95% confidence intervals and p-values for the logistic, negative binomial, and gamma regression models, respectively.

To provide useful information about the likelihood of being readmitted over the course of the first year, competing risk regression analysis was used to calculate and create cumulative incidence plots for the final predictors of readmission incidence identified earlier by the logistic GEE analysis. This method accounts for death as a competing risk for readmission (46, 47). Time-to-event was calculated from the date of index discharge until the date of first readmission. In addition, another competing risk regression analysis was conducted to identify the predictors of 30-day readmission, which is broadly used by hospitals, insurers and payers, and regulatory agencies to measure hospital quality and as a benchmark for reimbursement (4, 48).

All statistical testes were 2-sided and conducted using the software packages of SPSS (version 22; IBM Corp, Armonk, NY) (49) and Stata (version 14; Stata Corp LP, College Station, TX) (50).

RESULTS

Baseline characteristics of the sample are presented in Table 1. Only age (p=.02) and reintubation status (p=.01) were different between the groups of patients who did vs. did not experience a readmission. The RCT group assignment was not significantly associated with readmission (p=.78).

Reasons for readmission

Of the 568 readmissions during the first year, the evaluators agreed on classification of 94.5% of the readmissions (kappa=.91). Figure 1 presents the percentages of reasons for readmission during each study interval. Reasons categorized as ‘other than infection or rejection’ (including, but not limited to, dehydration, nausea, vomiting, diarrhea and acute renal failure) accounted for more than half (55.5%) of readmissions during the first year after discharge; admissions in this category decreased over time (Figure 1). The percentages of readmissions categorized as ‘infection only’ and ‘rejection only’ were 25.4% and 9.9%, respectively; admissions in these categories increased with time. Finally, 0.7% of readmissions were categorized as ‘infection and rejection simultaneously’ and showed little change over time.

Readmission incidence

Of the 201 LTRs, 168 (83.6%) were readmitted to the hospital at least once during the first year. The percentages of readmission incidence are displayed in Table 2 for the study period, which was divided into two intervals of equal duration to facilitate comparison. Results from the logistic regression model examining predictors of readmission incidence are presented in Table 3. After controlling for other variables in the multivariate model, there was a significant decrease in readmission incidence over time (OR=0.88; 95% CI, 0.85–0.92; p<.001). In addition, reintubation during the index admission (OR=1.92; 95% CI, 1.18–3.12; p=.008) and discharge destination to care facilities (OR=2.78; 95% CI, 1.31–5.87; p=.008) were statistically significant risk factors for readmission. Furthermore, 82 (40.8%) of LTRs were readmitted during the first 30-day readmission after lung transplantation discharge. None of the baseline characteristics was identified as a significant predictor of 30-day readmission, and the findings from this analysis are not reported in this article in the interest of brevity. The percentage of total readmissions per each month during the first year after lung transplantation discharge are displayed in Figure 2, which shows a decline in the number of readmissions over time.

Cumulative incidence of readmission

Results from the competing risks regression model shows that the cumulative incidences of readmission, after controlling for reintubation and discharge destination, were 54.5%, 73.7%, and 84.5% at time points 2, 6, and 12 months, respectively. Figure 3 depicts the cumulative incidences of readmission by the combinations of reintubation and discharge destination during the first year following index discharge. Cumulative incidences of readmission at 12 months ranged from 80.8% for non-reintubated LTRs discharged home to 95.7% for reintubated LTRs discharged to care facilities.

Readmission count

Slightly less than two thirds of the sample (64.2%) had multiple readmissions during the first year. The numbers of readmissions for each time interval and for the total study period are displayed in Table 2. Results from the negative binomial regression indicate that LTRs had less readmissions over time (OR=0.92; 95% CI, 0.90–0.95; p<.001), after adjusting for other predictors in the multivariate model (Table 4). LTRs who were discharged to care facilities had 1.45 times higher count of readmissions than those who were discharged home (95% CI, 1.08–1.94; p=.01). Furthermore, for every one point increase in capacity for self-care (PSCA score), the count of readmissions would decrease by 1% (95% CI, 0.99–1.00, p=.03), while holding all other variables in the model constant.

Readmission cumulative duration

Cumulative number of readmission days for the LTRs who were readmitted are presented in Table 2. The median cumulative duration of all first year readmissions was 19 days, and more than one third of LTRs in the sample (37.5%) were readmitted for more than 30 days. Results from the gamma regression shows that cumulative readmission duration decreased over time (OR=0.91; 95% CI, 0.88–0.94; p<.001), after controlling for other predictors in the multivariate model (Table 5). In addition, for every one year increase in age, mean cumulative readmission duration would increase by 2% (95% CI, 1.00–1.03; p=.009). For LTRs who returned to the ICU, the mean cumulative readmission duration was twice the mean cumulative readmission duration for LTRs who did not return to the ICU (95% CI, 1.17–3.43; p=.01), after adjusting for other variables in the model.

DISCUSSION

Little is known about the pattern and predictors of hospital readmissions during the first year following lung transplantation. Here, we described the incidence, count, cumulative duration, and common reasons for readmission and identified certain sociodemographic, clinical and self-care characteristics at the time of transplant as risk factors for readmission within the first year after lung transplantation.

Complications such as gastrointestinal problems (diarrhea (51–53), nausea and vomiting (54, 55)) and renal failure (56–58) are common after lung transplantation, often requiring hospital readmission. Many of these complications (e.g., nausea) are likely side effects of immunosuppressants and anti-viral medications (55). Such complications decrease over time and with symptomatic treatments (20), which is consistent with our findings. On the other hand, there was an increase in infections as a reason for readmission after two months. This is likely attributable to changes in the nature of infectious diseases after two months including the emergence of opportunistic infections (59) and multidrug-resistant bacterial infections (60) due to combination of prolonged immunosuppression treatment and viral infections (61).

Reintubation during the index transplant hospitalization was a significant predictor of readmission incidence, which was expected given that reintubation is considered a prognostic factor for lung transplantation survival (62), an indicator for severe graft dysfunction (63), and associated with further complications such as nosocomial pneumonia (64). Novel methods to treat post-transplant respiratory failure and decrease the need for reintubation, such as rapid extubation and noninvasive positive pressure ventilation (NIPPV) (63), may improve health outcomes and reduce the risk for further complications, leading ultimately to lower readmission risk.

We found an association between discharge destination and both readmission incidence and count in the lung transplant population. This result is consistent with findings from other studies reporting that older community-dwelling adults (48, 65), vascular (66) and colorectal (67) surgery patients, and liver transplant recipients (68) who were discharged to care facilities were at significantly higher risk for readmission than those discharged home. This finding likely reflects the lower functional status of such patients (69) and thus higher risk for readmission. Coordination of care between the transplant center and care facilities such as rehabilitation and other skilled residential settings may improve future health outcomes and reduce risk for frequent readmissions.

Of all self-care characteristics, capacity for self-care was the only factor associated with fewer and shorter hospital readmissions, suggesting the importance of LTRs' active involvement in the self-care process. Perceiving oneself to have greater capacity for self-care was previously found to be associated with actual self-care behaviors and thus improved health outcomes (26). This study adds to previous reports that found self-care to be associated fewer hospital readmissions in general (70–73). Employment of evidence-based protocols for transitional care, effective discharge planning, and education about self-care (74) are needed to promote self-care behaviors and reduce readmission count and duration.

Older age and readmission to the ICU were found to place LTRs are at risk for longer readmission duration. Identifying these LTRs at the time of hospital discharge may help modify discharge planning to meet their special needs. For those who require readmission to the hospital, mobilization of resources and targeted interventions, particularly those of older age, may help reduce their duration of the hospital stay.

This study has several limitations. The sample included LTRs from only one transplant center and thus the results may not be generalizable. Although the percentage of single lung transplant procedures in our sample was lower than the respective national average (about 31%), the sociodemographic characteristics of our sample were generally equivalent to US national lung transplant populations during the same period (75). In addition, the study is a secondary analysis, so there was limited control over the previously collected variables and data for some variables of interest were not available, such as characteristics of donors, comorbidities, and medication usage to provide more comprehensive models predicting readmissions. Several of the risk factors for readmission, such as age and need for reintubation, may not be surprising given that patients with higher acuity are likely to have worse health outcomes including readmission profiles. Yet this study is the first to provide empirical evidence of how these factors affect LTRs readmission. Furthermore, while several predictors in this study were interdependent, non-modifiable, they help identify LTR who at greater risk for readmission and thus may benefit from early supportive interventions. Finally, our data were collected for the first year after discharge, limiting our ability to investigate the long-term readmission patterns.

In conclusion, hospital readmission after lung transplantation remains one of the major complications of the procedure. In this study, we described and identified the pattern (incidence, count, duration), reasons, and predictors of readmission during first-year after lung transplantation. While the parent study did not find impact of the mHealth intervention on readmission, the knowledge presented in this study may impact clinical practice as discussed earlier. That is, recognition of the risks for readmission (i.e., the need for reintubation, re-admission to the ICU, discharge to an extended care facility, older patients and those who report of limited capacity for self-care) at the time of discharge may help mobilize resources to vulnerable subpopulations of patients and enhance the discharge process (76, 77), an endeavor that may reduce the cost and effort associated with readmission, and guide the utilization of healthcare resources (78).

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Abbreviations

AMR	arithmetic mean ratio
CMS	Centers for Medicare & Medicaid Services
CI	confidence interval
DAS	Dyadic Adjustment Scale
GEE	Generalized Estimating Equations
HLOC	Health Locus of Control
ICU	intensive care unit
IRR	incidence rate ratio
ISHLT	International Society of Heart and Lung Transplantation
IQR	interquartile range
LTR	lung transplant recipient

mHealth	mobile health
NIPPV	noninvasive positive pressure ventilation
OR	odd ratio
PSCA	Perception of Self-Care Agency
RCT	randomized controlled trial
UPMC	University of Pittsburgh Medical Center

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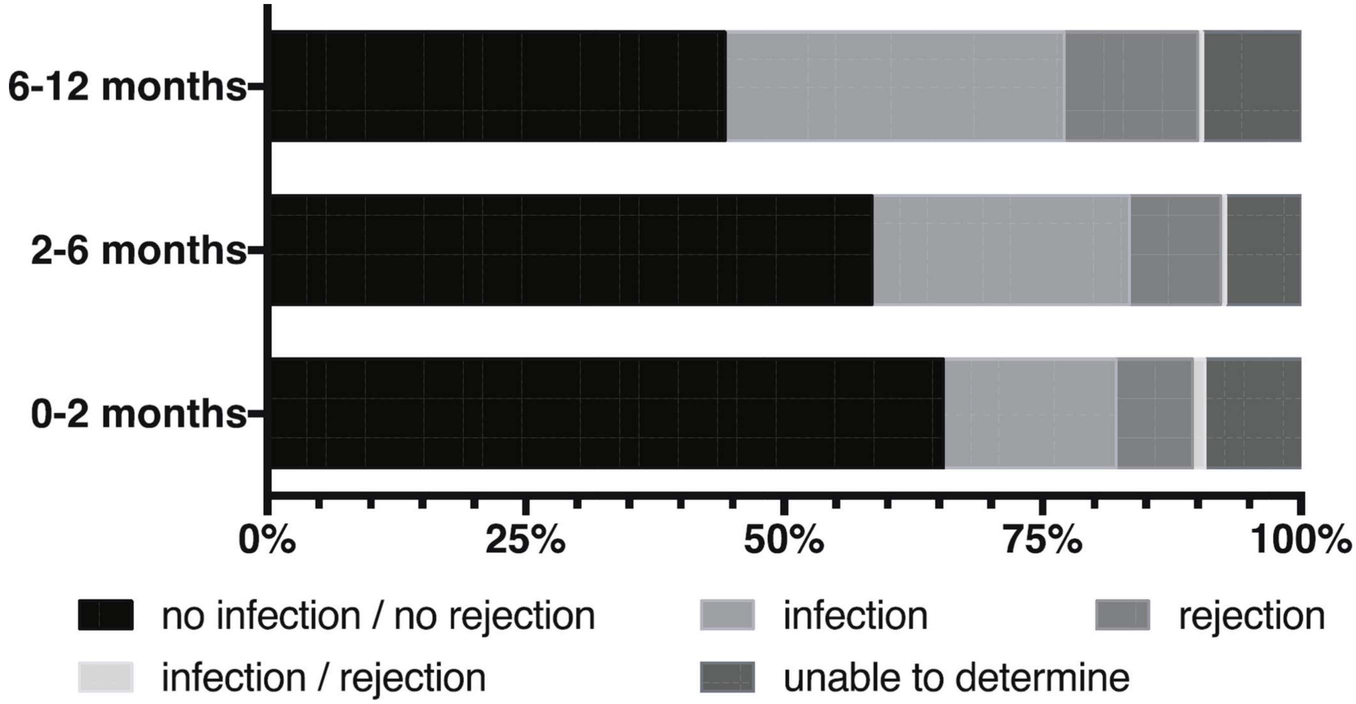

Figure 1.

Reasons for readmission per assessment time interval during the first year after lung transplantation discharge. Categorized as outlined by the International Society of Heart and Lung Transplantation (ISHLT) (21).

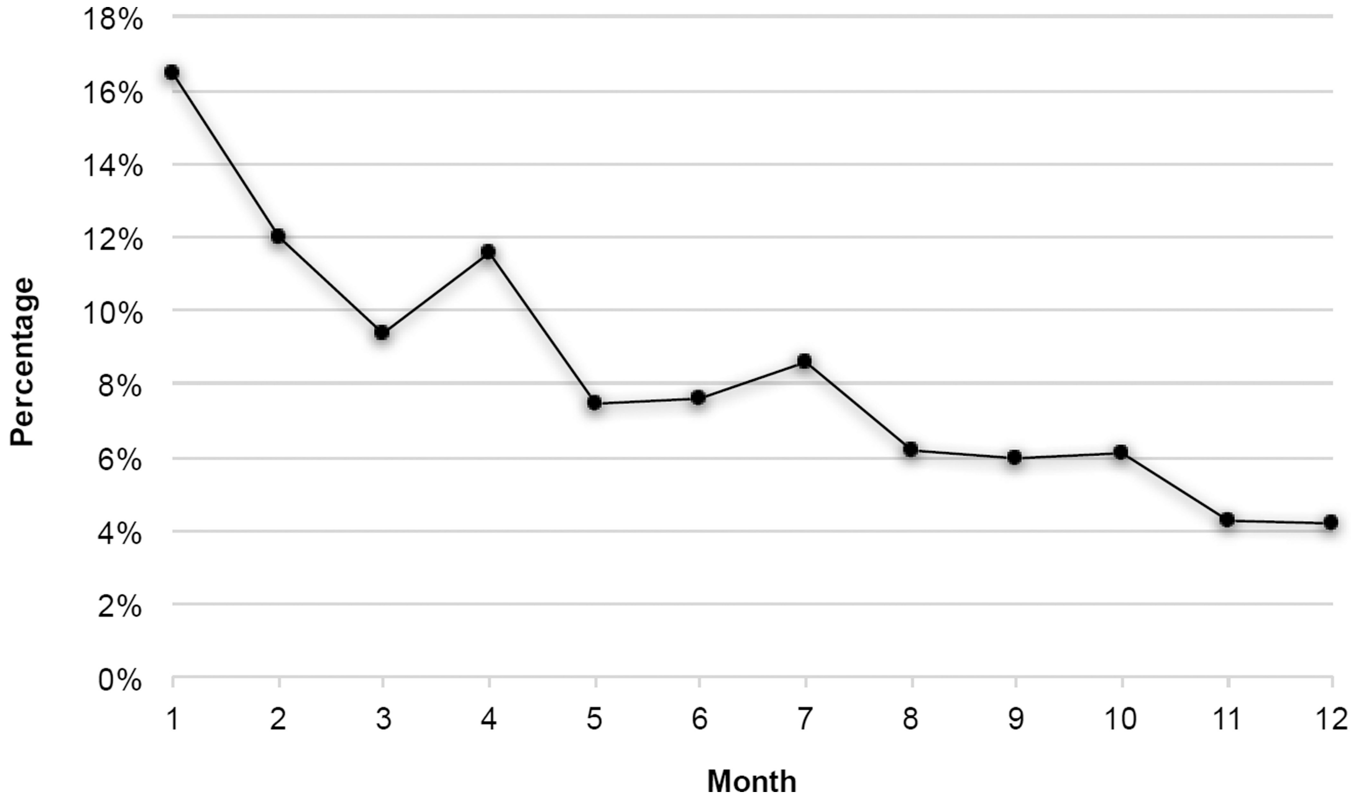

Figure 2.

Percentage of total readmissions per each month during the first year after lung transplantation discharge.

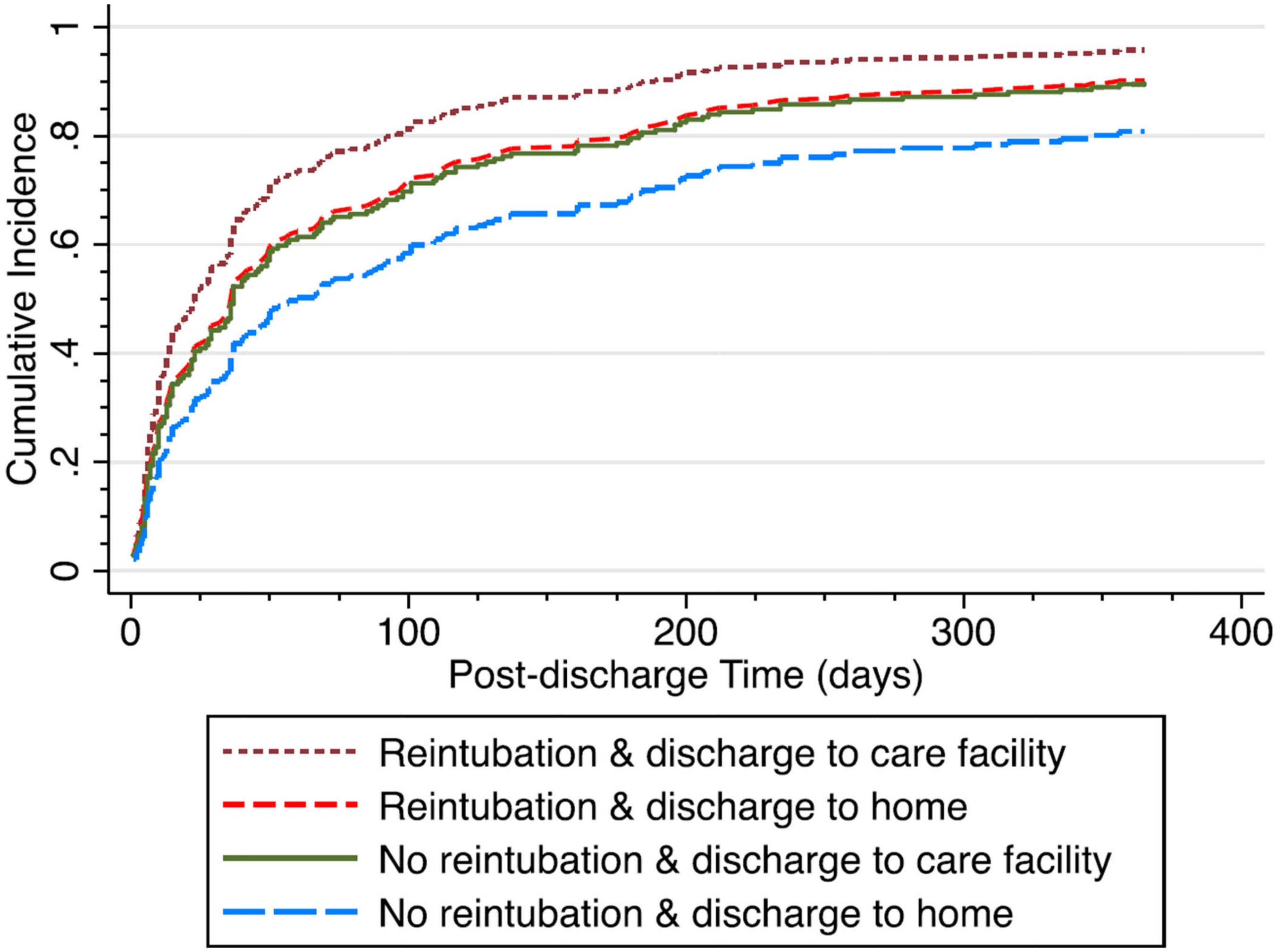

Figure 3.

Cumulative incidence of readmission by reintubation status and discharge destination during the first year after lung transplantation discharge.

Table 1

Characteristics of the Sample by Readmission Status

Characteristics	Total (N=201) [a]	Readmission Status: Not Readmitted (n=33)	Readmission Status: Readmitted (n=168)	*P*
RCT intervention, % (n) mHealth Group	49.3 (99)	51.5 (17)	48.8 (82)	.78
Sociodemographic				
Gender, % (n) male	55.2 (111)	63.6 (21)	53.6 (90)	.29
Age, years, median (IQR)	62 (51,67)	57 (41,63)	63 (52,68)	**.02**
Marital status, % (n) married	71.6 (144)	78.8 (26)	70.2 (118)	.32
Race, % (n) white	91.0 (183)	90.9 (30)	91.1 (153)	1.00
Education, % (n) ≥ high school	94.0 (189)	97.0 (32)	93.5 (157)	.70
Employment, % (n) yes	11.4 (23)	18.2 (6)	10.1 (17)	.23
Clinical Health Status				
Lung disease, % (n) obstructive	49.8 (100)	60.6 (20)	47.6 (80)	.17
Type of transplant, % (n) single	18.4 (37)	9.1 (3)	20.2 (34)	.13
Post-op ventilation need, % (n) <48 hours	65.2 (131)	60.6 (20)	66.1 (111)	.55
Return to ICU, % (n) yes	20.9 (42)	24.2 (8)	20.2 (34)	.61
Reintubated, % (n) yes	23.4 (47)	6.1 (2)	26.8 (45)	**.01**
Length of stay, days, median (IQR)	27 (19,44)	28 (20,42)	27 (18,44)	.94
Hospital discharge destination, % (n) home	86.6 (174)	93.9 (31)	85.1 (143)	.26
Self-Care Attributes				
Self-care agency, median (IQR)	224 (207,241)	221 (201,248)	222 (207,241)	.97
Caregiver relationship quality, median (IQR)	67 (63,71)	67 (63,71)	68 (63,71)	.94
Internal locus of control, median (IQR)	24 (20,29)	23 (21,26)	24 (20,30)	.35

[a]The number of LTRs who were alive at the start of the study

Table 2

Pattern of Readmission per Assessment Time Interval During the First Year After Lung Transplantation Discharge

	Time Interval		
	0–6 months [a] **(n=201)** [b]	**6–12 months (n=190)** [b]	**First Year (n=201)**
Readmission, yes	75.1%	50.5%	83.6%
Readmission count			
0	24.9%	49.5%	16.4%
1	26.4%	24.2%	19.4%
2–3	32.8%	17.9%	33.3%
>= 4	15.9%	8.4%	30.9%
Readmission duration [c]	Median= 13 days	Median= 10 days	Median= 19 days
<=10 days	41.1%	51.0%	33.3%
11–20 days	20.5%	20.8%	19.0%
21–30 days	10.6%	11.5%	10.1%
>30 days	27.8%	16.7%	37.5%

[a]The original first two time intervals (0–2 and 2–6 months) were combined to create intervals of equal duration

[b]The number of LTRs who were alive and did not withdraw at the start of the time interval

[c]Calculated based on the number of LTRs who were readmitted for each time interval

Table 3

Predictors of Readmission Incidence During the First Year After Lung Transplantation Discharge

Characteristics	Univariate			Multivariate		
	OR [a]	95% CI	*P*	OR [b]	95% CI	*P*
Time, per month increase	0.88	0.85–0.92	<.001	0.88	0.85–0.92	**<.001**
Sociodemographic						
Gender, male	0.90	0.60–1.36	.62			
Age at transplant (years)	1.01	1.00–1.03	.26			
Marital status, unmarried	1.61	1.00–2.61	.05			
Race, white	1.08	0.52–2.22	.84			
Education, < high school	1.79	0.77–4.17	.18			
Employment, unemployed	2.07	1.10–3.88	.02	1.59	0.88–2.87	.12
Clinical						
Underlying disease, obstructive	1.10	0.73–1.66	.64			
Type of transplant, single	1.56	0.91–2.69	.11			
Post-op vent days, < 48 hours	1.16	0.76–1.79	.49			
Length of stay days, per 1 day increase	1.01	1.00–1.02	.11			
Reintubated, yes	2.71	1.67–4.42	<.001	1.92	1.18–3.12	**.008**
Return to ICU, yes	1.36	0.78–2.37	.28			
Hospital discharge destination, facility	3.97	1.91–8.25	<.001	2.78	1.31–5.87	**.008**
Self-Care						
Self-care agency (PSCA) [c]	0.99	0.99–1.00	.20			
Caregiver relationship quality (DAS) [c]	1.00	0.98–1.03	.74			
Internal locus of control (HLOC, internality) [c]	1.01	0.98–1.04	.56			

[a] OR= unadjusted odds ratio

[b] OR= adjusted odds ratio

[c] PSCA= Perceived Self-Care Agency score; DAS= Dyadic Adjustment Scale; HLOC= Health Locus of Control score.

Table 4

Predictors of Readmission Count During the First Year After Lung Transplantation Discharge

Characteristics	Univariate			Multivariate		
	IRR [a]	95% CI	*P*	IRR [b]	95% CI	*P*
Time, per month increase	0.93	0.91–0.95	<.001	0.92	0.90–0.95	**<.001**
Sociodemographic						
Gender, male	0.98	0.77–1.25	.88			
Age at transplant (years)	1.00	0.99–1.01	.53			
Marital status, unmarried	1.25	0.97–1.62	.09	1.19	0.94–1.52	.15
Race, white	1.01	0.65-1.57	.96			
Education, < high school	1.51	0.95–2.40	.08	1.28	0.87–1.87	.21
Employment, unemployed	1.33	0.87–2.05	.19			
Clinical						
Underlying disease, obstructive	1.26	0.99–1.60	.06	1.27	0.99–1.63	.06
Type of transplant, single	1.17	0.86–1.57	.31			
Post-op vent days, < 48 hours	1.07	0.82–1.40	.63			
Length of stay days, per 1 day increase	1.00	1.00–1.01	.25			
Reintubated, yes	1.44	1.13–1.83	.003	1.25	0.97–1.61	.09
Return to ICU, yes	1.14	0.85–1.52	.39			
Hospital discharge destination, facility	1.68	1.28–2.21	<.001	1.45	1.08–1.94	**.01**
Self-Care						
Self-care agency (PSCA) [c]	0.99	0.99–1.00	.01	0.99	0.99–1.00	**.03**
Caregiver relationship quality (DAS) [c]	0.99	0.98–1.01	.46			
Internal locus of control (HLOC, internality) [c]	1.00	0.98–1.02	.94			

[a] IRR= unadjusted incidence rate ratio

[b] IRR= adjusted incidence rate ratio

[c] PSCA= Perceived Self-Care Agency score; DAS= Dyadic Adjustment Scale; HLOC= Health Locus of Control score.

Table 5

Predictors of Cumulative Readmission Duration During the First Year After Lung Transplantation Discharge

Characteristics	Univariate			Multivariate		
	AMR [a]	95% CI	*P*	AMR [b]	95% CI	*P*
Time, per month increase	0.92	0.88–0.95	<.001	0.91	0.88–0.94	**<.001**
Sociodemographic						
Gender, male	1.16	0.83–1.61	.38			
Age at transplant (years)	1.02	1.00–1.03	.01	1.02	1.00–1.03	**.009**
Marital status, unmarried	0.94	0.65–1.36	.73			
Race, white	0.80	0.41–1.57	.52			
Education, < high school	0.85	0.54–1.34	.49			
Employment, unemployed	0.96	0.56–1.65	.87			
Clinical						
Underlying disease, obstructive	1.30	0.94–1.79	.11			
Type of transplant, single	1.45	1.01–2.07	.04	0.97	0.65–1.44	.86
Post-op vent days, < 48 hours	1.16	0.82–1.66	.40			
Length of stay days, per 1 day increase	1.01	1.00–1.01	.04	0.99	0.99–1.00	.24
Reintubated, yes	1.28	0.89–1.84	.18			
Return to ICU, yes	1.65	1.15–2.37	.006	2.00	1.17–3.43	**.01**
Hospital discharge destination, facility	1.41	0.98–2.04	.07	1.19	0.73–1.92	.49
Self-Care						
Self-care agency (PSCA) [c]	0.99	0.99–1.00	.06	0.99	0.99–1.00	**.03**
Caregiver relationship quality (DAS) [c]	1.00	0.98–1.02	.71			
Internal locus of control (HLOC, internality) [c]	1.00	0.98–1.02	.84			

[a] AMR = unadjusted arithmetic mean ratio

[b] AMR = adjusted arithmetic mean ratio

[c] PSCA= Perceived Self-Care Agency score; DAS= Dyadic Adjustment Scale; HLOC= Health Locus of Control score.