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# Readmissions After Lung Transplantation

Jane Simanovski, MScN, NP-C<sup>1</sup> , and Jody Ralph, PhD, RN<sup>2</sup>

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## Abstract

Lung transplantation has evolved to become an acceptable therapy for individuals with end-stage lung disease. Readmissions rates after lung transplantation remain high as compared to other medical surgical populations. The purpose of this review is to synthesize the current body of knowledge about patterns, risk factors, and outcomes of readmissions after lung transplantation. The literature revealed that the most common admission diagnoses linked to lung transplant readmissions are infections followed by tachyarrhythmias, airway complications, surgical complications, rejection, thromboembolic events, gastrointestinal complications, and renal dysfunction. Risk factors for these readmissions include male gender, longer intensive care unit stay, reintubation, prolonged chest tube air leak, frailty, and discharge to a long-term care facility. Outcomes of multiple readmissions after lung transplantation are associated with decreased survival and increased risk of mortality. Further research is needed to better understand which readmission diagnoses are preventable and whether multidisciplinary interventions can reduce readmission rates among patients after lung transplantation.

## Keywords

lung transplant, lung transplantation, hospital readmission, readmission prevention

## Clinical Relevancy to Practice

Lung transplantation has evolved to become an approved treatment modality for individuals with end-stage lung disease. However, current resources attributed to the care of the lung transplant patient amount to US\$236 450 in Medicare costs in the first posttransplant year alone.<sup>1</sup> Complexity of the surgical procedure and the intricacies of immunosuppression lead to a number of potential complications resulting in a higher rate of readmissions after a lung transplant.<sup>2,3</sup> Unplanned readmissions not only impact patient's physical and emotional health but also increase health care cost.

The purpose of this article was to review the current body of literature about patterns, risk factors, and outcomes for readmissions after lung transplantation. This information can inform the design of preventative strategies implemented by the members of the multidisciplinary team to prevent unplanned readmissions after lung transplantation.

## Practice Issues

### Patterns of Readmissions After Lung Transplantation

The literature reviewed confirmed that rehospitalizations were common after lung transplantation. A few single-institution retrospective reviews documented a wide range of readmission rates (30%-92%) at different time trajectories after lung transplant.<sup>2-6</sup> For example, the incidence of readmission within 30 days after lung transplant was reported to range between 29.8% and 45.4%,<sup>4-6</sup> which was higher than the documented 19% in

the cardiac surgery literature.<sup>7</sup> Although the most common admission diagnoses in the first month after lung transplant were infections, respiratory, and pleural space complications in addition to arrhythmias, other causes for subsequent rehospitalizations included surgical complications, allograft rejection, airway complications, thromboembolic events, gastrointestinal events, and renal dysfunction (see Table 1).<sup>2-6</sup>

A retrospective review sought to determine whether there was an association between transplant center volume (low, less than 20 patients per year; intermediate, 20-34; or high, 35 or more) and readmission rate.<sup>1</sup> Individuals from a lower volume transplant hospital had a 14% greater risk for hospital readmission as compared to a high-volume center.<sup>1</sup>

A study by Courtwright et al<sup>8</sup> used a prospective research methodology to examine incidences, causes, direct cost, and preventability of readmissions within 30 days after initial discharge after lung transplant surgery for 90 patients. Their readmission rates were reported as 33% lower as compared to previously documented statistics. Interestingly, 30% of these readmissions were deemed preventable with (1) improved communication between inpatient and outpatient providers and

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**Table 1.** Causes of Readmission Following Lung Transplantation.

Diagnosis	Percent at 30 days	Percent at 1 year
Infection (pneumonia, bronchitis, aspergillosis, CMV, and other)	19%-25% <sup>2,3,6</sup>	22%-36% <sup>2-6</sup>
Respiratory adverse events (airway adverse events, respiratory failure, pulmonary edema)	34% <sup>6</sup>	11%-36% <sup>2-4,6</sup>
Pleural space adverse events	20%-26% <sup>2,3</sup>	6%-14% <sup>2,3</sup>
Gastrointestinal adverse events	3%-15% <sup>2,3,6</sup>	2%-39% <sup>2-4,6</sup>
Allograft dysfunction/rejection	1%-9% <sup>3,6</sup>	10%-15% <sup>3,5,6</sup>
Renal dysfunction	11% <sup>3</sup>	6%-12% <sup>2-4,6</sup>
Cardiac adverse events	6%-18% <sup>2,3,6</sup>	2%-24% <sup>2-4,6</sup>
Thromboembolic event	3% <sup>3</sup>	1%-4% <sup>2-4,6</sup>

Abbreviation: CMV, cytomegalovirus.

(2) prescription of an alternative medical regimen at discharge. Also, unplanned rehospitalizations before 30 days after initial discharge were found to be more preventable than those that occurred after 30 days.

### Risk Factors for Readmissions After Lung Transplantation

The limited literature in the area of readmissions post-lung transplantation primarily focused on the nonmodifiable risk factors such as underlying lung disease, lung allocation score (LAS), gender, age, length of stay in the intensive care unit, and complicated hospital course.<sup>3-6</sup> It was noted that males, patients with higher LAS, and those discharged to a long-term care facility were found to have more readmissions.<sup>3</sup> An additional risk factor for readmissions was a chest tube air leak lasting more than 5 days after the operation.<sup>6</sup> Also, the need for reintubation after initial surgery was associated with unplanned rehospitalizations. This was not an unexpected finding as reintubation is known to be a prognostic indicator for a reduced survival after lung transplantation.<sup>5</sup> Reintubations are often linked to allograft dysfunction and are also associated with other respiratory complications.<sup>5</sup>

Discharge to a long-term care facility was noted to be a risk factor for early readmissions.<sup>3,5</sup> This is congruent with the identified risk factor of higher LAS and hence, longer initial hospitalization for this population of patients as opposed to those who were discharged home.<sup>3</sup> Lung transplant patients who were discharged to an inpatient rehabilitation facility were less likely to be readmitted within the first 30 days<sup>2</sup> highlighting the importance of the intense physical and pulmonary rehabilitation after transplantation.

Recently, attention has shifted to frailty as a modifiable risk factor for readmissions after lung transplant.<sup>8,9</sup> Courtwright et al<sup>8</sup> demonstrated that frailty was associated with hospital readmissions up to 3 months following discharge. Frailty, a concept which emerged from geriatric medicine,<sup>10</sup> has been gaining increased interest in the transplant literature. Its biology is grounded in physiological states associated with aging such as sarcopenia and diminished activity tolerance resulting

in an increased vulnerability to adverse outcomes and stress states.<sup>9,10</sup> Many screening instruments exist as a measurement of frailty, but few are validated in the transplant population. The Short Physical Performance Battery (SPPB) test was chosen as an objective measure of frailty in the Courtwright et al<sup>8</sup> study. Patients with lower SPPB scores (indicative of more frailty) had considerably higher risk of readmission as compared to those with a higher score (indicative of less frailty). Later, Courtwright et al<sup>11</sup> proceeded to investigate changes in SPPB scores in frail recipients enrolled in an outpatient rehabilitation program with findings that 86% of patients were no longer frail over a median of 6 weeks.<sup>11</sup>

Finally, a finding to be highlighted is that patients who underwent transplant between 2004 and 2010 were at a higher risk for readmissions than those after 2010,<sup>6</sup> which may account for advances in surgical and immunosuppression techniques of the present decade.

### Outcomes of Readmissions After Lung Transplantation

Unplanned rehospitalizations after lung transplantation were correlated with worse survival even after adjusting for factors such as sex, age, underlying lung disease, wait time, and length of stay of the initial hospitalization.<sup>3,6</sup> Unplanned readmissions within the first 60 days,<sup>6</sup> 3 to 9 months,<sup>8</sup> or 38 months<sup>6</sup> were all associated with decreased survival. Individuals who had more than 2 readmissions during the first year had statistically significant worse 3-year (67% vs 89%) and 5-year (48% vs 80%) survival rates.<sup>2</sup> Patients who were readmitted 4 times in the first year following transplant, were 4.5 times more likely to die as compared to those readmitted less or not at all.<sup>6</sup> This is of great significance in the field of lung transplantation, as overall survival is already lower as compared to other solid organs. Any factors that can be contributing to this decreased survival need to be investigated and mitigated.

Readmissions after lung transplantation also account for a substantial price tag with rejection accounting for the highest cost (median US\$10 128) followed by respiratory complications (median US\$9381) and thromboembolic events (median US\$8334).<sup>6</sup> The median direct hospital cost of a readmission was estimated to be US\$5524.<sup>6</sup> In a time where increased emphasis is placed on decreasing health care costs and improving outcomes within patient populations, it has been recognized that lung transplantation demands significant resources and associated expenses.<sup>1</sup> Therefore, it is a necessity to reduce cost without sacrificing outcomes.

### Implications for Practice

This literature review suggested that rates of readmission post lung transplantation were higher as compared to other populations studied in the surgical literature. Although a single readmission was not associated with worse survival, multiple hospital readmissions were associated with a higher mortality.<sup>2</sup> It is unclear from the literature whether deaths were occurring during these readmissions, or after discharge. One may

hypothesize that frequent rehospitalizations are indicative of an increased number of posttransplant complications that ultimately affect posttransplant survival. Mitigating modifiable risk factors would have a role in decreasing preventable hospital readmissions. For example, objective measures of frailty pre- and post-lung transplantation can assist health care providers to identify patients at risk for readmissions. Similarly, timely enrollment in effective rehabilitation programs after transplantation may have direct effect on the future health care utilization. This would be congruent with findings that lung transplant recipients discharged to an inpatient rehabilitation center experienced fewer readmissions.<sup>2</sup>

It was noted that discharges from a higher volume transplant centers correlated with less readmissions as compared to discharges from a lower volume transplant centers.<sup>1</sup> It would be important to identify team practices from these successful institutions and consider including readmissions metrics in the quality data for each individual center. Further studies of risk factors as a result from suboptimal patient care can further improve quality of care and diminish costly strain on the health care system. Further research should also focus on identifying social determinants of health linked to the problem of readmissions. These psychosocial contributors may include lack of caregivers, financial difficulties, poor literacy, problems with transportation, and so on.

The above data on lung transplant readmissions, all from single-institution reviews with small sample sizes, may not fully portray a true burden of readmissions among the lung transplant patient population. Avoidable or preventable readmissions are poorly defined. Additional research is needed to understand which admission diagnoses are preventable and whether interventions studied with other chronic conditions such as discharge follow-up, improved care coordination between inpatient and outpatient providers, postdischarge telephonic management, or other interventions can reduce readmission rates among patients after lung transplantation. Further studies and designs involving multiple transplant centers are needed to evaluate efficacies of the above interventions with transplant populations and design other creative multidisciplinary approaches to reduce readmissions after lung transplantation.

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