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# Pneumonia Readmissions: Risk Factors and Implications

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## ABSTRACT

**Background:** Pneumonia continues to be a severe health problem in the United States, responsible for close to 1 million hospital admissions and nearly 140,000 hospital readmissions per year. The literature on this topic suggests that approximately 1 in 5 patients with pneumonia is readmitted to the hospital within 30 days of discharge and that most readmissions are not because of pneumonia-related causes.

**Methods:** Although many pneumonia readmissions may not be preventable, reducing readmissions is feasible, as shown by recent trends in Centers for Medicare & Medicaid Services data.

**Results:** Modifiable patient-, physician-, and system-related factors can be targeted for intervention.

**Conclusion:** Many interventions aimed at reducing hospital readmissions targeting transitional care, care coordination, and postdischarge care have shown potential for reducing readmission rates.

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## INTRODUCTION

Pneumonia continues to be a severe health problem in the United States. It is responsible for approximately 1 million hospital admissions and more than 50,000 deaths annually.<sup>1</sup> Approximately 10%-20% of pneumonia cases require admission to the intensive care unit.<sup>2</sup> Furthermore, pneumonia is responsible for

close to 140,000 hospital readmissions per year, costing more than \$10 billion in hospital expenditures.<sup>3</sup> As a result of an aging population, antibiotic resistance patterns, and an increasing prevalence of comorbidities, the number of pneumonia-related admissions has increased significantly in recent years.<sup>4</sup> In most cases, pneumonia affects already frail populations, including the elderly and those with underlying chronic conditions such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), and congestive heart failure. Readmission to the hospital imposes an additional burden on these vulnerable populations. Not surprisingly, in the era of accountability and cost awareness, pneumonia readmission rates have become an area of increased interest and quality improvement efforts. With the enactment of the Affordable Care Act, the Centers for Medicare & Medicaid Services (CMS) hold hospitals accountable for excess rehospitalizations by linking readmission rates to reimbursement.<sup>5</sup> In 2013, CMS identified 2,225 hospitals for reimbursement reduction based on readmission rates.<sup>6</sup> This review focuses on factors specifically linked to hospital readmissions of pneumonia patients and potential implications for prevention opportunities.

## PNEUMONIA READMISSION RATES

Several studies have assessed the hospital readmission rates for pneumonia; these vary widely depending on the population studied, geographic location, and other factors.<sup>2,4</sup> The literature suggests that readmission to the hospital after an episode of pneumonia is a relatively frequent event, especially among the elderly and patients with multiple comorbidities.

Many studies have focused on the Medicare population with all-cause 30-day readmission rates of 17%-25%.<sup>7-9</sup> For instance, in a 2011 report based on national Medicare data, pneumonia readmission rates hovered around 20% but varied from as low as 8% to as high as 27%.<sup>8</sup> The variability was explained by overall admission rates, patient case mix, quality of discharge planning, and bed supply. In a similar study with nearly 12 million participants, the 30-day readmission rate for patients discharged after a pneumonia hospitalization was 20.1%, consistent with the rate reported in other studies.<sup>10</sup> Interestingly, in this study,

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close to one-third (29.1%) of the readmissions were because of pneumonia-related causes; the rest were because of other active comorbidities. Examples included heart failure (7.4%), COPD (6.1%), and septicemia (3.6%), followed by nutrition-related or metabolic issues, gastrointestinal problems, and urinary tract infections. In another study based on hospital and outpatient Medicare claims data from 2006-2009, the 30-day pneumonia readmission rate was consistent at 18.3%.<sup>11</sup> In this study, the 30-day mortality rate for patients admitted to the hospital with a principal diagnosis of pneumonia was relatively high at 11.6%.

Researchers have also assessed pneumonia readmission rates in the general population. In a retrospective analysis of patients with culture-confirmed bacterial pneumonia, 30-day readmission occurred in 19.3% of patients.<sup>12</sup> In this report, the most common reason for readmission was not pneumonia but COPD and congestive heart failure. Only 7.4% of the patients were readmitted for pneumonia-related causes. In other words, most patients were readmitted to the hospital because of comorbidities and not pneumonia-related causes. Interestingly, neither disease severity nor the rate of initially inappropriate antibiotic therapy correlated with readmission. In a report based on a community sample of patients followed at an academic medical center, only 12% of patients with radiographic evidence of pneumonia were rehospitalized within 30 days, a significantly lower incidence of pneumonia readmission compared to other studies.<sup>13</sup> Most of the pneumonia readmissions in this sample were also related to comorbidities (74%) and not to pneumonia (20%). The most frequent comorbidities responsible for rehospitalization in this particular study were cardiovascular, pulmonary, and neurologic conditions.

Several studies have assessed pneumonia readmissions outside the United States. In a Canadian study, researchers found that the 90-day readmission rate of elderly patients with pneumonia was 11%.<sup>14</sup> However, this study did not assess the 30-day readmission rate, and a large proportion of patients was lost to follow-up after discharge from the hospital. In a study conducted in Spain that included 1,117 adults and used radiographic infiltrates as a diagnostic criterion, the pneumonia readmission rate was only 7.3%, and pneumonia-related causes accounted for 1 in 3 (35.8%) of patients readmitted.<sup>15</sup> Although these studies are not comparable to the studies of US populations, comparing readmission rates between healthcare systems may help identify the contributions of factors such as access to care, practice

styles, and financial issues to pneumonia readmission rates.

## **PREVENTABLE PNEUMONIA READMISSIONS**

What proportion of pneumonia readmissions is preventable? An extensive body of literature exists on the proportion of potentially preventable readmissions for all causes; however, the literature on preventable readmissions after hospitalization exclusively for pneumonia is limited. Klug and Muus analyzed the Medicare Provider Analysis and Review File and outpatient data for years 2006-2007 via Potentially Preventable Readmissions (3M Health Information Systems) software to exclude readmissions for reasons unrelated to patients' initial admissions.<sup>16</sup> They estimated the preventable readmission rate for patients initially admitted with pneumonia to be 14%. Despite the wide range of definitions of preventable readmission, this number is compatible with studies assessing all-cause preventable readmissions. Preventable readmissions from all causes have been estimated at 25% but range from as low as 9% to potentially as high as 75%.<sup>17</sup> This wide variation in all-cause preventable readmission rates can be explained by multiple factors, including the diverse definitions of preventable readmissions and differences in settings and populations. For instance, in a study based on the general population seen at an urban academic medical center, the all-cause readmission rate was estimated to be 22.3%, with 8.5% of total readmissions considered avoidable by the researchers.<sup>18</sup> In a systematic literature review published by van Walraven et al, the estimated proportion of all-cause avoidable readmissions was 27.1%, but the range was wide: 5%-79%.<sup>19</sup> Three study-level factors (teaching status of hospital, whether all diagnoses or only some were considered, and length of follow-up) were significantly associated with the proportion of all-cause admissions deemed to be avoidable. A meta-analysis including 16 studies found an all-cause 30-day readmission rate of avoidable readmissions of 23.1% with a broad range of 5%-58.6%.<sup>20</sup> The main variation was explained by hospital teaching status and number of reviewers for each case. Specifically, studies from teaching hospitals with 1 reviewer determining all-cause preventable readmission status found a rate of 9.3% of avoidable readmissions, while studies from nonteaching hospitals with more than 1 reviewer per case found a rate of 39.9%. In spite of the great variability of results, the literature suggests that between 1 in 10 to 4 in 10 readmission cases may be preventable. The clear lesson is that there is room for improvement.

## **EXPLAINING PNEUMONIA READMISSIONS**

A significant proportion of pneumonia readmissions may be unavoidable. Multiple factors have been

associated with pneumonia readmissions, but many of these are not modifiable or amenable to intervention. Sociodemographic factors such as age, male sex, education level, and the presence of certain comorbidities have been linked to an increased risk for pneumonia readmission, and most of these factors are not modifiable.<sup>13</sup>

Also, some studies have found limited opportunities for pneumonia readmission prevention. For instance, in a retrospective study, the pneumonia readmission rate was reported at 20%, but neither disease severity nor the rate of initially inappropriate antibiotic therapy was correlated with readmission.<sup>12</sup> Patients with healthcare-associated pneumonia in this study were 7.5 times more likely to be readmitted compared to those with community-acquired pneumonia. Four factors in healthcare-associated pneumonia were independently linked with readmission: admission from long-term care, immunosuppression, prior antibiotic administration, and prior hospitalization. The authors concluded that variables associated with readmission are not factors that hospitals can directly control, and most of the pneumonia readmissions they reviewed were not preventable.

Another reason many pneumonia readmissions are not preventable is because even with appropriate treatment, approximately 1 in 6 pneumonia cases fails to resolve completely, and these patients may develop complications that require readmission to the hospital.<sup>21</sup> Host factors such as age, immunodeficiency, malignancy, heart failure, and chronic debilitating conditions increase the proportion of pneumonia cases that fail to resolve. In other words, a significant proportion of pneumonia readmissions because of pneumonia-related causes may be unavoidable. However, under current CMS regulations, penalties are issued for excess all-cause 30-day readmissions, regardless of whether the pneumonia readmissions are due to pneumonia-related causes or not. This is relevant because the most frequent cause for 30-day readmission to the hospital in pneumonia cases is not pneumonia but decompensation of associated comorbidities.<sup>12</sup> Patients with medical conditions characterized by multiple exacerbations, such as COPD, heart failure, diabetes, and malignancy, will increase the proportion of unavoidable 30-day readmission rates for pneumonia.<sup>21</sup>

Furthermore, in many cases, the pneumonia readmission may be unrelated to the initial pneumonia or to comorbidity decompensation but instead may be related to other causes such as trauma, acute illness, or conditions acquired in the hospital during the index case. A recent analysis of hospital readmissions found that a hospital-acquired condition, such as falls, deep vein thrombosis and pulmonary embolism, or catheter-

associated infections, was associated with a 33% increase in the odds of being readmitted within 30 days.<sup>22</sup> With improved care, the number of readmissions because of hospital-acquired conditions may decrease; however, a portion of these may still remain potentially unavoidable.

## POTENTIALLY AVOIDABLE PNEUMONIA READMISSIONS

Although many pneumonia readmissions—whether because of pneumonia-related causes, decompensated comorbidities, or other unrelated factors—are not preventable, the evidence suggests room for improvement. Multiple reasons support the notion that pneumonia readmission rates can be reduced. A decline in all-cause readmission rates has occurred in the United States. From 2007-2011, the national, 30-day, all-cause, hospital readmission rate was 19%. During calendar year 2012, the readmission rate averaged 18.4%.<sup>23</sup> Also, controlled studies have shown that some interventions can reduce the rate of readmission for some medical conditions.<sup>24</sup> The literature on the topic has identified several potentially modifiable factors that can be targeted for interventions. These factors can be patient, physician, or system related.

Adherence to medications or discharge plans is a potentially modifiable patient-related factor that has been linked to hospital readmissions in general.<sup>25</sup> Financial or other barriers may prevent patients from obtaining prescribed antibiotics at discharge. The patient may not understand the discharge plan or may lack adequate social support to adhere to the medication regimen. Interventions aimed at addressing these barriers and improving transitions of care may positively impact pneumonia readmissions.

Multiple physician-related factors such as poor quality of care and premature discharge may be related to 30-day readmissions. Poor quality of care during the index pneumonia case—failure to follow evidence-based treatment guidelines—has been highlighted in several studies as a potentially modifiable factor leading to readmission. Ferrer et al showed that adherence to pneumonia treatment guidelines had a positive impact on multiple outcomes, including mortality, length of stay, time to stability, and readmission.<sup>26</sup> In a study based on Medicare claim data, Dean et al<sup>27</sup> found pneumonia guideline implementation was associated with a statistically significant lower 30-day readmission rate. Menéndez et al provided further evidence in a prospective cohort study among 271 patients with community-acquired pneumonia who were admitted to a tertiary-care hospital in Spain.<sup>28</sup> The mortality and pneumonia readmission rates in the study were significantly lower in the adherent-to-guidelines

group. Clear, evidence-based pneumonia treatment guidelines are widely available;<sup>29</sup> further research on best strategies for universal utilization can have an impact on quality of care and pneumonia readmissions. At the practical level, several interventions have shown the potential to improve healthcare provider adherence to guidelines and may help decrease pneumonia readmission rates. A systematic review by Bosso and Drew showed that antibiotic stewardship strategies such as education on guidelines, the creation of local clinical pathways, formulary restrictions, and computer assistance programs created by antimicrobial committees increased physician awareness of pneumonia guidelines, improved appropriate antimicrobial use, and reduced unnecessary antimicrobial prescriptions.<sup>30</sup> In addition, these strategies had a favorable impact on community-acquired pneumonia patient outcomes, including decreased 30-day mortality and in-hospital mortality rates, reduced length of hospital stay, reduced treatment failure rates, and reduced healthcare costs.

Other studies have looked at clinical instability at discharge as a potential reason for readmission in pneumonia patients. Halm et al<sup>31</sup> found that the presence of 1 or more factors linked to clinical stability in the 24 hours prior to discharge (temperature >37.8°C, heart rate >100 bpm, respiratory rate >24/min, systolic blood pressure <90 mmHg, oxygen saturation <90%, inability to maintain oral intake, and abnormal mental status) increased the risk of 30-day hospital readmission. The presence of 1 of these factors increased the 30-day readmission rate to 11.9%, and the presence of 2 or more of these factors increased the readmission rate to 30.8%. Interestingly, 1 in 5 patients in this study left the hospital with at least 1 of these factors. Although more research is needed, at a practical level, these parameters can serve as guidelines to ensure clinical stability and readiness for discharge in patients with pneumonia. However, in many cases, the patient may be stable for discharge from the pneumonia perspective but not from the comorbidities perspective.

Previous studies have shown the majority of pneumonia readmissions are not because of pneumonia-related causes but because of unstable comorbidities.<sup>32</sup> Therefore, interventions aimed at improving all-cause readmission rates would have a significant impact on pneumonia readmission rates. A study among 10,731 discharges from an urban teaching medical center found that patients with neoplasms, heart failure, and chronic kidney disease had a higher risk of potentially avoidable readmissions than patients without those comorbidities.<sup>33</sup> Almost all of the top 5 diagnoses of potentially avoidable readmissions for each comorbidity were

possible direct or indirect complications of that comorbidity. For instance, in patients with heart failure, diabetes, ischemic heart disease, atrial fibrillation, or chronic kidney disease, the most common diagnosis of potentially avoidable readmission was acute heart failure. At a more practical level, ensuring the stability of comorbidities at discharge in patients at higher risk of potentially avoidable readmission, such as patients with cancer, heart failure, and chronic renal failure, would impact all-cause readmission rates and also pneumonia readmission rates. Further work is needed to explore potential interventions to assess and ensure clinical stability at discharge, particularly in patients with multiple, active, and interrelated comorbidities.

Fragmentation of healthcare and variation in practice style also have an impact on pneumonia readmission rates. A study based on Medicare administrative data found that half of all patients readmitted to the hospital had no associated bill for an outpatient visit; they did not have a follow-up visit.<sup>10</sup> Several studies have documented regional variations in practice style that may influence the rate of readmissions for pneumonia.<sup>8</sup> Overall readmission rates and pneumonia-specific readmission rates vary widely according to geographic location within the United States.<sup>11</sup> A cross-sectional study of hospital and outpatient Medicare claims from 2006-2009 found extensive variation in pneumonia readmission rates, ranging from 13.6%-26.7%. The readmission rates were higher in the eastern portions of the United States (parts of West Virginia, Kentucky, Tennessee, Mississippi) and in Central California. The lowest readmission rates were seen in most regions west of the Mississippi River.<sup>11</sup> This finding may be explained by local variations in practice style, bed availability, and quality of pneumonia care but highlights the feasibility of reducing pneumonia readmission rates.

Interventions aimed at addressing fragmentation of care and transitions have been successful in decreasing all-cause readmission rates. One example is Project RED (reengineered discharge).<sup>24</sup> In this intervention, a nurse discharge advocate worked with patients during their hospital stay to arrange follow-up appointments, confirm medication reconciliation, and conduct patient education with an individualized instruction booklet that was sent to their primary care provider. A clinical pharmacist called patients 2-4 days after discharge to reinforce the discharge plan and review medications. This intervention decreased hospital utilization (combined emergency department visits and readmissions) within 30 days of discharge by about 30%. One limitation of the study is that the cohort was relatively young with a mean age of 49. Older patients have higher rates of pneumonia and/or



comorbidities and may need additional support to understand discharge instructions, making the intervention potentially less effective. Another successful intervention is Project BOOST (Better Outcomes for Optimizing Safe Transitions) that targets hospital discharge care transitions.<sup>34</sup> This multifaceted intervention showed a 30-day readmission decrease from 14.7% prior to implementation to 12.7% 12 months later, reflecting an absolute reduction of 2% and a relative reduction of 13.6%. The potential effectiveness of these and other interventions highlights the feasibility of decreasing pneumonia readmission rates.

## CONCLUSION

Although many pneumonia readmissions may not be preventable, reducing readmissions is feasible, as shown by recent trends in CMS data. Modifiable patient-, physician-, and system-related factors can be targeted for intervention. Many interventions aimed at reducing hospital readmissions targeting transitional care, care coordination, and postdischarge care have shown potential for reducing readmission rates.

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