Strategies to Reduce Rehospitalization in Patients with CKD and Kidney Failure

Simit Doshi and Jay B. Wish

Abstract

Readmissions in patients with nondialysis-dependent CKD and kidney failure are common and are associated with significant morbidity, mortality, and economic consequences. In 2013, the Centers for Medicare and Medicaid Services implemented the Hospital Readmissions Reduction Program in an attempt to reduce high hospitalization-associated costs. Up to 50% of all readmissions are deemed avoidable and present an opportunity for intervention. We describe factors that are specific to the patient, the index hospitalization, and underlying conditions that help identify the “high-risk” patient. Early follow-up care, developing volume management strategies, optimizing nutrition, obtaining palliative care consultations for seriously ill patients during hospitalization and conducting goals-of-care discussions with them, instituting systematic advance care planning during outpatient visits to avoid unwanted hospitalizations and intensive treatment at the end of life, and developing protocols for patients with incident or prevalent cardiovascular conditions may help prevent avoidable readmissions in patients with kidney disease.

Introduction

CKD is present in 8%–10% of Medicare beneficiaries but accounts for a disproportionately higher percentage of expenditure (1,2). Hospitalizations in prevalent dialysis-dependent (henceforth referred to as “kidney failure”) patients account for >$10 billion in annual Medicare spending and increased by 5% in 2016 (2). In patients receiving hemodialysis, over one third of hospitalizations result in readmission within 30 days of discharge (3). United States Renal Data System (USRDS) data reveal about 80% of patients with kidney failure are hospitalized during the last 3 months of life (4,5). The Centers for Medicare and Medicaid Services (CMS) implemented the Hospital Readmissions Reduction Program in 2013 to hold hospitals and dialysis facilities accountable for high readmission rates (6,7). Its effectiveness in decreasing readmissions in patients receiving dialysis has not yet been proven. Strategies such as “hot-spotting” high utilizers have been implemented in a randomized controlled fashion. In a recent study of 800 hospitalized patients, a structured intervention program failed to reduce the rate of readmissions compared with standard of care (8).

Hospitalization is associated with higher morbidity and mortality and poor quality of life. Daratha et al. (9) evaluated the risk of subsequent hospitalization and death in patients with kidney disease in all Washington State admissions in the period April 2006–December 2008. Among patients who survived to discharge, CKD diagnosis was associated with 1.2-fold higher risk for subsequent admission and 1.4-fold higher risk for fatal hospitalization compared with patients without CKD. CKD stages 3 and higher were significantly associated with higher risk of subsequent hospitalization and fatal hospitalization in a graded manner. Patients with kidney failure had 1.8-fold higher risk of hospitalization and three-fold higher risk of fatal hospitalization (9). Circulatory disease and infections account for the majority of hospitalizations and deaths in patients with CKD and kidney failure (9,10). CKD is also associated with longer average hospital stay compared with other disease categories (1).

Understanding the risk factors for hospitalization, specifically those modifiable through intervention, is key to preventing recurrent hospitalizations. Patients receiving hemodialysis present ample opportunity to implement preventative strategies because they are in contact with health care staff multiple times per week.

Strategies to Reduce Recurrent Hospitalization in Patients with Kidney Failure

Readmissions are generally considered to occur within a 30-day period after the index hospitalization, but some studies have expanded the definition to examine 60-day or 90-day outcomes. CMS chose 30 days because readmissions during this timeframe are attributable to the quality of care received at the hospital and how well a discharge plan was developed. Readmissions occurring beyond 30 days might be influenced by outpatient care, individual behaviors, or other factors the hospital cannot control. Dialysis facilities are evaluated by standardized readmission ratios as part of the CMS Quality Incentive Program. This measure excludes reporting of readmissions within 3 days of discharge as the dialysis unit does not have a chance to intervene and excludes facilities with <11
index hospital discharges per year. Readmissions are categorized as planned or unplanned, and unplanned admissions can be further classified as avoidable or unavoidable. Unplanned but avoidable readmissions provide the best opportunity to intervene. A 34-study meta-analysis concluded that a median of 27.1% of unplanned readmissions are avoidable (10). Some of these studies reported rates as high as 79%, likely reflective of the variation in care received across centers.

Several publications examined the risk factors for readmissions and its prevalence among patients on dialysis (11–19). Prevalence of readmissions has varied from 12% to 90%, depending on the definition used as well as the clinical setting (20).

Factors Associated with Readmission

Hemodialysis patient–related factors associated with readmission are summarized in Table 1.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Risk Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex (12)</td>
<td>1.03 (1.01 to 1.06)</td>
</tr>
<tr>
<td>Black race (12)</td>
<td>1.06 (1.03 to 1.08)</td>
</tr>
<tr>
<td>Unemployment (12)</td>
<td>1.07 (1.01 to 1.13)</td>
</tr>
<tr>
<td>Drug abuse (13)</td>
<td>1.41 (1.31 to 1.51)</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
</tr>
<tr>
<td>Heart failure (14)</td>
<td>1.87 (1.07 to 3.85)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease (15)</td>
<td>1.34 (1.29 to 1.38)</td>
</tr>
<tr>
<td>Depression (13)</td>
<td>1.10 (1.05 to 1.15)</td>
</tr>
<tr>
<td>≥3 admissions in preceding 12 mo (12)</td>
<td>1.40 (1.36 to 1.45)</td>
</tr>
<tr>
<td>Central venous catheter use (16)</td>
<td>1.82 (1.01 to 3.65)</td>
</tr>
<tr>
<td>Dialysis vintage &lt;1 yr (12)</td>
<td>1.29 (1.25 to 1.33)</td>
</tr>
<tr>
<td><strong>Laboratory parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Serum albumin &lt;3.3 g/dl (16)</td>
<td>4.28 (2.37 to 7.73)</td>
</tr>
<tr>
<td>Hematocrit &lt;30% (17)</td>
<td>1.07 (1.05 to 1.09)</td>
</tr>
</tbody>
</table>

Postdischarge Care. The nephrologist and dialysis facility staff are critical in early assessment of the patient postdischarge and making required changes to medications, dry weight, and dialysis prescription, among others. Plantinga et al. (22) showed that 44% of readmissions occurred within a week of discharge and 6% of patients were readmitted on the day of discharge. Several barriers to adequate implementation of preventative measures exist. Electronic health records are not seamlessly integrated between inpatient facilities and outpatient dialysis units and hamper easy data sharing. Wingard et al. (23) acknowledged the lack in communication and coordination between hospitals and dialysis facilities and implemented a triphasic intervention for better data exchange. Twenty-six dialysis facilities implemented use of post hospitalization checklists (phase 1), telephonic case managers (phase 2), and centralized clinical information call centers (phase 3) over 20 months, leading to a statistically significant reduction in all-cause readmissions (from 0.88 to 0.66 per patient year; P<0.001).

One additional visit by the nephrologist during the month after discharge has been shown to be associated with a significantly lower risk for readmission (24). However, the ability of a nephrologist to attend to patients immediately postdischarge is often limited by schedule inflexibility. Physician extenders stationed at dialysis facilities may help bridge this gap. Patients discharged to an SNF with a low licensed nurse retention rate have significantly higher 30-day readmissions rates (25).

Utilization of Palliative Care Consultation. Utilization of inpatient palliative care services occurs in <1% of patients with kidney failure admitted for >2 days. Chettiar et al. (26) showed, in 723,913 hospitalizations among 232,452 Medicare beneficiaries, a 20% reduction in risk of rehospitalization in patients who received inpatient palliative care.

In a study by O’Connor et al. (27) of over 30,000 hospitalized patients, an inpatient palliative care consultation in which there was a goals-of-care discussion was associated with a lower 30-day readmission rate (adjusted
odds ratio, 0.36; 95% confidence interval [95% CI], 0.27 to 0.48; P<0.001).

Amro et al. (28) called for dialysis centers to establish policies to systematically address advance care planning among patients with limited life expectancy. Interventions that can de-escalate care, prevent hospitalizations, provide compassionate end-of-life care, and curtail unnecessary health care expenditures are recommended.

Specific Disease Conditions.

Cardiovascular Disease. Cardiovascular disease remains the leading cause of hospitalizations and accounts for 40% of deaths in patients with kidney failure (3). Wetmore et al. conducted a retrospective cohort study (29) examining readmissions after an index hospitalization for cardiovascular disease in Medicare beneficiaries undergoing hemodialysis. The leading cause for index hospitalization was congestive heart failure (35%), followed by arrhythmias (11%) and acute coronary syndromes (9%). One in six patients was discharged to an SNF, and the mean length of stay was >4 days for the index hospitalization, both known risk factors for readmission (18,21). After an index hospitalization for cardiovascular cause, one in six patients is readmitted within 10 days, one in three is readmitted within 30 days, and 5% of deaths are noted within a 30-day period (29). About half of the readmissions are for cardiovascular causes. Infection was the most common cause for noncardiovascular rehospitalization after index admission for cardiovascular disease. Patients aged <65 years had significantly higher risk of all-cause readmissions, whereas patients aged >69 years had significantly higher risk for death without readmission, using reference category 65–69 years. Younger patients were less likely to be discharged to an SNF. Hemodialysis compared with peritoneal dialysis (PD) was associated with higher risk for all-cause readmission and death without readmission, but lower risk for cardiovascular readmission. Prompt care after discharge, utilization of SNFs for appropriate patients irrespective of age, adjustment of dry weight, and the routine practice of infection prevention measures in the outpatient dialysis unit may help reduce rehospitalization and death.

Infection. Infection is a well-known complication of kidney failure (30–32) and accounts for about a quarter of all hospitalizations (1). Dalrymple et al. (33) studied 30-day outcomes among patients on hemodialysis after index hospitalization for infection. Central venous catheter (CVC)-associated infections were most common causes for hospitalization because of infection. Median length of index hospitalization was 6 (interquartile range, 3–10) days and median time to 30-day readmission was 12 (interquartile range, 6–21) days. Readmission rates were 28%–42%, depending on the type of initial infection, and were highest for cardiovascular or central nervous system infections. The leading causes of readmission were infection/inflammation of vascular access (15%), sepsisemia (9%), and congestive heart failure (7%). Risk factors for readmission included older age (65–84 years), female sex, non-Hispanic ethnicity, serum albumin <3.5 g/dl, CVC for vascular access, body mass index <18.5 kg/m², inability to ambulate, and insufficient nephrology care before initiating dialysis. Comorbidities that are associated with a significantly higher risk for readmission included diabetes mellitus, heart failure, cancer, and chronic obstructive pulmonary disease. Half of the readmissions for fluid volume excess and electrolyte and acid-base problems occurred >2 weeks after discharge from the index admission, suggesting that these readmissions were potentially avoidable if adjustments were made to the dialysis prescription in a timely manner postdischarge. Preventing rehospitalization after index admission for infection requires early adjustment of the dialysis prescription, processes to reduce CVC rates, functional status assessment, and therapy to address potentially modifiable risk factors. The Nephrologists Transforming Dialysis Safety (NTDS) project (34), launched by the American Society of Nephrology and the Centers for Disease Control and Prevention, recommends the nephrologist take the lead with respect to identification and prevention of infections. The aim of the NTDS is to minimize infections by following prevention practices and early identification and treatment, as well as collaboration with state/federal infection prevention programs.

Vascular Access–Related Problems. In the United States, about 80% of patients on incident hemodialysis initiate dialysis with a CVC (3). CVCs are associated with infections and mechanical complications. Lacson et al. (35) evaluated hospitalization risk in patients on hemodialysis who had a change in vascular access. Among 79,545 patients on prevalent hemodialysis, 29% had CVC as their access. The CVC group had lower albumin and hemoglobin and shortest dialysis vintage, all factors associated with hospitalization (15,21,36). In patients who converted from catheter to fistula or graft, the risk for all-cause hospitalization dropped by 31% in the following 12 months. A much more profound effect was noted in vascular access–related hospitalizations and sepsis hospitalizations, with risk reduced by 53% and 69%, respectively.

It is critical to identify factors associated with readmissions and differentiate them from surrogates for disease severity. Some factors discussed above may be markers of overall poor health status as opposed to independent risk factors. The former may help identify a high-risk patient, but may not present an opportunity for intervention to prevent readmissions. An example of this may be a low serum albumin level. Low hemoglobin level may be another such marker, but there is some evidence that early correction may lead to a reduction in hospitalization risk (37).

Payment Model. ESRD Seamless Care Organizations (ESCOs) are specialty-oriented, accountable care organizations that assume responsibility for the quality of care and Medicare Part A and B spending of their aligned beneficiaries. This Comprehensive ESRD Care (CEC) model was initiated in 2015 with 13 ESCOs; an additional 24 ESCOs joined in 2017. ESCOs share in the cost savings compared with fee-for-service Medicare Part A and B spending for a comparable case-adjusted patient, providing financial incentive for avoiding hospitalizations (the largest cost) while maintaining quality. In the Performance Year 2 Annual Evaluation Report (38), it was noted that the percent of ESCO beneficiaries with at least one 30-day readmission fell from 29.5% pre-CEC to 28.8% post-CEC, whereas it stayed constant at 29.5% for the comparator non-CEC group. This difference-in-difference of 0.71%
have shown con
risk of readmission for patients on PD versus hemodialysis (39). Studies comparing
alysis therapies has key differences compared with that
Dialysis Modalities.

Examining 27,904 admissions among patients on PD in
observational or have evaluated very speci
findings among patients on
home hemodialysis when compared with in-center
admission during 2011–2014 showed a higher rate of
readmission at 29% compared with prior studies (44).

The authors identi
fi
risk for hospitalization was signi
patients from the Kaiser Permanente Renal Registry, the
higher for patients with eGFR 45
–
higher with lower eGFR (46). In 1,120,295 ambulatory
other diagnoses (diabetes complications, COPD, congestive heart failure)

Table 2. Comprehensive ESRD Care model metrics with relevance to readmissions

<table>
<thead>
<tr>
<th>Category</th>
<th>Evaluation Measure</th>
<th>Stakeholders</th>
</tr>
</thead>
</table>
| Dialysis care                         | Vascular access<sup>a</sup>  
Dialysis modality  
Emergency dialysis sessions<sup>a</sup>  
Missed dialysis sessions               | Nephrologists and APPs (CKD and dialysis care)  
CKD educators  
Vascular access managers/surgeons/interventionalists  
Social workers  
Dialysis facility leadership and direct patient care staff  
Hospice providers and palliative care consultants  
Primary care physicians and appropriate specialists  
Nephrologists and APPs (CKD and dialysis care)  
Dialysis facility nurses  
Extended care facility nurses and other personnel (if applicable)  
Dietitians  
Referring physicians  
Hospitalists and nephrologists/APPs caring for hospitalized patients  
Hospital case managers  
Dialysis unit nephrologists/APPs  
ED physicians/APPs  
Primary care physicians and appropriate sub specialists  
Dialysis facility nurses, dietitians, and social workers  
Extended care facility nurses and other personnel (if applicable) |
| Coordination of care beyond dialysis   | Hospice services  
Evaluation and management office visits<sup>a</sup>  
Medication management<sup>a</sup>  
(reduced opiate use and increase payments for binders)  
Nephrology care before initiating dialysis | CEC, Comprehensive ESRD Care; APP, advanced practice provider; ED, emergency department; COPD, chronic obstructive pulmonary disease.  
<sup>a</sup>Statistically significant difference noted pre- and post-CEC for year 2 of implementation. |
| Hospitalizations and ED visits        | Hospitalizations<sup>a</sup>  
ED visits  
Readmissions<sup>a</sup>  
Observational stays  
Average hospital length of stay  
Hospitalizations for specific complications of kidney failure<sup>a</sup> (volume depletion or overload, hyperkalemia, vascular access complications)  
Hospitalizations for other diagnoses (diabetes complications, COPD, congestive heart failure) | Primary care physicians and other personnel (if applicable)  
Referring physicians  
Hospitalists and nephrologists/APPs caring for hospitalized patients  
Hospital case managers  
Dialysis unit nephrologists/APPs  
ED physicians/APPs  
Primary care physicians and appropriate sub specialists  
Dialysis facility nurses, dietitians, and social workers  
Extended care facility nurses and other personnel (if applicable) |

(90% CI, −1.4 to −0.03) calculates to a statistically signifi
2.4% reduction in readmissions. The major driver
to this improvement in readmissions is thought to be im
proved coordination of care between hospital, extended
care facility, dialysis unit, and emergency department, but
many other factors are likely at play. The CEC model
metrics relevant to reducing readmissions are summarized
in Table 2.

Risk Factors for Readmission in Patients on Home Dialysis Modalities. The population utilizing home di
alysis therapies has key differences compared with that
receiving in-center hemodialysis (39). Studies comparing
risk of readmission for patients on PD versus hemodialysis
have shown conflicting results (40–42). These studies are
observational or have evaluated very specific populations.
Examining 27,904 admissions among patients on PD in
2013, Chan et al. (43) found a 30-day unplanned readmission rate of 15%. The most common cause of index admission associated with readmissions was acute myocardial infarction. Similar to the findings among patients on in-center hemodialysis, the cause of index admission and readmission were discordant with only 22% of patients readmitted for the same diagnosis. Risk factors for readmission included older age, female sex, diagnosis of liver disease, depression or peripheral vascular disease, and longer length of stay (>5 days) during index admission. Another report of 10,505 patients on PD with index admission during 2011–2014 showed a higher rate of readmission at 29% compared with prior studies (44).

The authors identified diagnoses of congestive heart fail
ure and peripheral vascular disease to be independent risk factors, along with hospital stay ≥4 days. In an analysis of a Canadian cohort of 4013 patients on PD who were propensity score–matched to patients on in-center hemodialysis, the risk for 30-day admission was noted to be higher by 19% (95% CI, 8% to 31%) for patients on PD (41). Closer supervision of in-center patients was cited as the main reason for this unexpected finding. This difference disappeared when patients who switched modalities were censored. A 4% reduction in risk was noted with daily home hemodialysis when compared with in-center hemodialysis (45).

Strategies to Reduce Recurrent Hospitalization in Patients with CKD

In patients with CKD, the risk of hospitalization is higher with lower eGFR (46). In 1,120,295 ambulatory patients from the Kaiser Permanente Renal Registry, the risk for hospitalization was significantly and sequentially higher for patients with eGFR 45–59 ml/min per 1.73 m² (hazard ratio [HR], 1.1; 95% CI, 1.1 to 1.1), eGFR 30–44 ml/min per 1.73 m² (HR, 1.5; 95% CI, 1.5 to 1.5), eGFR 15–29 ml/min per 1.73 m² (HR, 2.1; 95% CI, 2.0 to 2.2), and eGFR <15 ml/min
per 1.73 m² (HR, 3.1; 95% CI, 3.0 to 3.3) when compared with patients with eGFR > 60 ml/min per 1.73 m² (46). Average length of hospital stay is longer with each CKD stage (46). Annual Medicare spending for patients with CKD has been just over $50 billion compared with just over $30 billion for patients with kidney failure. Readmissions account for 18%–33% of all inpatient costs for patients with CKD stage 3–5. By comparison, readmission costs for patients without CKD are around 10%–12% of the total inpatient expenditure (47). Factors influencing readmissions in patients with CKD have not been as extensively researched as in those with kidney failure. The literature cited in CKD populations is not as robust, with limitations in sample size and study design.

Factors Associated with Readmission
The most frequent diagnoses for hospitalization in a large Canadian cohort were heart failure, hyperkalemia, and volume overload (48). Presence of albuminuria is associated with an independently higher risk for hospitalization (48). In another study of 184 patients with CKD that evaluated patterns of readmission in patients with common comorbidities, the most frequent primary diagnoses for the index admission were heart failure, infection, and kidney failure (49). Interestingly in this study (49), CKD was the only comorbidity that was associated with a higher risk of readmission as well as risk of readmission being deemed “avoidable.” The presence of CKD is associated with a higher risk for 30-day readmission after hospitalization for myocardial infarction (19), percutaneous coronary intervention (50), total hip arthroplasty (51), and heart failure (52). In 259 patients with CKD, higher serum albumin by 1 g/dl is associated with a lower risk for hospitalization by 52%, whereas 1% higher hematocrit is associated with a lower risk by 11% (53).

About 50% readmissions in patients with CKD are avoidable, so interventions can be designed to identify

<table>
<thead>
<tr>
<th>Table 3. Risk factors for readmission by type of kidney disease</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kidney Disease / Injury</strong></td>
</tr>
<tr>
<td>Kidney failure</td>
</tr>
<tr>
<td>CKD</td>
</tr>
</tbody>
</table>
| | Index hospitalization: Longer stay (>4 d) 
H/O recurrent admissions 
Medication errors
Dialysis related: Central venous catheter access
Inadequate nephrologist contact | |
| | Index hospitalization for: Heart failure, hip or knee arthroplasty, myocardial infarction, percutaneous coronary intervention AKI Infections Presence of albuminuria | |

COPD, chronic pulmonary disease; Hct, hematocrit; H/O history of.

**Figure 1.** Modifiable factors to reduce the number of planned and avoidable readmissions.
patients at risk (49). Early nephrology consultation after discharge of patients with CKD admitted for myocardial infarction, heart failure, or hip arthroplasty may change the current trends in 30-day readmissions and reduce cost of care. Coordination of care after hospital discharge with involvement of the primary care physician and other specialists, as well as utilization of home health care services, is equally important. In a randomized controlled trial that enrolled patients with heart failure who were aged ≥75 years at discharge, the cost-effectiveness of three different transitional care models was evaluated. All models were more costly but also more effective than standard care, with nurse home visits being the most cost-effective strategy (54). The effectiveness of optimizing risk factors such as serum albumin level and hemoglobin to reduce readmissions will require further study, as in patients with kidney failure.

Summary

Patients with CKD and kidney failure are at high risk for recurrent hospitalizations, leading to high morbidity, mortality, and costs. The burden of readmissions increases with worsening CKD stage and is disproportionately high in patients with kidney failure. Unplanned readmissions are avoidable in almost half of patients. Risk factors for recurrent hospitalization have been identified and many are shared across the spectrum of kidney disease. Patients with cardiovascular disease, those discharged to an SNF, and those with inadequate follow-up by a nephrologist after discharge form the highest risk groups. Laboratory parameters are markers of high-risk patients, but further clinical studies are required to determine if they present an opportunity for intervention. Interventions such as optimizing volume status, medication reconciliation, and post-discharge communication among providers are key to avoiding readmissions. These risk factors and possible interventions are summarized in Table 3. Figure 1 displays several potential target areas to reduce unplanned but avoidable readmission by proactive management before, during, and after hospitalization. Hospitals, outpatient clinics, dialysis facilities (for patients with kidney failure), nephrologists, and patients themselves all must be vested in efforts to develop and implement strategies to prevent repeated hospitalizations.

Disclosures

All authors have nothing to disclose.

Funding

None.

References

3. United States Renal Data System: USRDS Annual Data Report: Epidemiology of Kidney Disease in the United States, Bethesda, MD, National Institutes of Health NIDDK, 2018

Strategies to Reduce Rehospitalization, Doshi and Wish 333


Published online ahead of print. Publication date available at www.cjasn.org.