Reducing hospital readmissions in patients with end-stage kidney disease

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ESKD patients have a large burden of disease, with high rates of readmission to hospital compared with the general population. A readmission after an acute index hospital discharge is either planned or unplanned. A proportion of unplanned readmissions are potentially avoidable, and could have been prevented with optimized transitional care. Readmissions pose financial cost to the health care system and emotional cost to patients and caregivers. In other chronic diseases with high readmission risk, such as congestive heart failure, interventions have improved transitional care and reduced readmission risk. In reviewing the existing literature on readmissions in ESKD, the definition and risk of readmission varied widely by study, with many potentially associated factors including comorbid diseases such as anemia and hypoalbuminemia. An ESKD patient's requisite follow-up in the outpatient dialysis facility provides an opportunity to improve transitional care at the time of discharge. Despite this, our review of existing literature found no studies which have tested interventions to reduce the risk of readmission in ESKD patients. We propose a framework to define the determinants of avoidable readmission in ESKD, and use this framework to define a research agenda. Avoidable readmissions in ESKD patients is a topic prime for in-depth study, given the high-risk nature in this patient population, financial and societal costs, and potential for risk modification through targeted interventions.

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End-stage kidney disease (ESKD) patients have a large burden of disease, with subsequent high rates of mortality and hospitalization compared with the general population. Mortality rates for prevalent ESKD patients vary widely worldwide, in part related to country-specific dialysis practice patterns, patient comorbid characteristics, and prevalence of background heart disease.[1] Although the lowest mortality rates are seen in Southeast and East Asian countries, and the highest seen in North America and some European countries, ESKD patients in all countries have a strikingly higher mortality rate than the general population.[1] For example, in the United States dialysis patients are expected to live less than one-third as long as their counterparts without ESKD.[2]

Compared with patients without renal disease, ESKD patients are also at high risk for hospitalization and subsequent readmission to the hospital. In the US general Medicare population, 19% of patients are readmitted to the hospital within 30 days after discharge.[3] Readmission to the hospital poses a significant emotional burden to patients and their caregivers. Research has demonstrated that anxiety and poor quality-of-life indicators are correlated with a higher risk of readmission to the hospital.[4–6] The hospitalized ESKD patient is also at risk for hospital-acquired infections and a measured decline in weight, hemoglobin, and albumin.[7] In addition, hospital readmissions are costly, and in the United States an estimated $17 billion may be saved annually with appropriate patient care.[8] In the US dialysis population, the overall hospitalization rate in 2012 was 1.73 per patient year and 35.2% of prevalent hemodialysis patients were readmitted within 30 days of discharge.[2] These readmission rates are unduly high and are twice that of the general Medicare population. In addition to the emotional costs to patient and caregivers, hospitalizations in dialysis patients pose a significant financial cost. In the United States, of nearly $30 billion spent by Medicare in 2010 on ESKD care, 38% was spent on acute inpatient care.[2] Given the societal, emotional, and financial costs, research in other patient populations has focused on the prediction and prevention of avoidable 30-day readmissions to the hospital. Risk prediction scores have been validated[9–13] and interventions have been studied, which

effectively reduce the risk of 30-day readmission to the hospital and improve transitional quality of care.[14–16]

Definitions

Readmissions to the hospital are generally defined to occur within 30 days of an index hospitalization and can be categorized as planned or unplanned. A planned readmission is defined as a non-acute readmission to the hospital for a planned procedure, chemotherapy, transplant, or rehabilitation. This readmission is usually planned during the index hospitalization or shortly after discharge. In the United States, ~10% of all readmissions are estimated to be planned.[3] Of the remaining unplanned readmissions, there is variability in the literature as to the proportion of potentially avoidable readmissions to hospital. A recent systematic review by Vest *et al.*[17] considered potentially avoidable readmission as 'an unintended and undesired subsequent postdischarge hospitalization, where the probability is subject to the influence of multiple factors'. For example, if a patient is discharged from the hospital after an acute myocardial infarction and then readmitted within 30 days with a leg cellulitis, this readmission would be considered unplanned and also unavoidable. On the other hand, if the same patient discharged from the hospital after an acute myocardial infarction is then readmitted within 30 days with an episode of congestive heart failure (CHF), this would be considered an unplanned, but potentially avoidable readmission to the hospital. A recent meta-analysis of studies deemed approximately one quarter (27.1%) of readmissions in the general population as potentially avoidable.[18] The same readmission definitions can be applied in the ESKD population. Although some readmissions to hospital are unavoidable, a proportion of conditions in dialysis patients are ambulatory sensitive (e.g., volume overload, electrolyte imbalance, and vascular access infections) and may have been avoided with the appropriate transition of care from index hospital discharge and care coordination among outpatient care providers.

In this review article, we first review the existing literature on readmissions in ESKD. We provide a narrative overview of the literature on strategies and interventions, which have been studied to reduce readmission risk in chronic diseases other than ESKD. We then propose a framework to understanding the determinants of avoidable readmission risk in ESKD. Finally, we identify evidence gaps in the ESKD literature and key research priorities to move forward and bridge these gaps.

READMISSIONS IN ESKD: LITERATURE REVIEW

To inform this review, we conducted a systematic search of the literature on readmissions in ESKD. We performed a comprehensive search strategy to identify cohort studies exploring prevalence of readmissions in hemodialysis, cohort studies exploring predictors of readmission in hemodialysis, and randomized trials of interventions to prevent readmissions in hemodialysis.

Studies were eligible if they were published full-text cohort studies and randomized controlled trials that described original data with all of the following: (1) 10 or more adults (age $\geqslant$ 18 years) with ESKD on chronic dialysis, (2) follow-up time of $\geqslant$ 1 month, and (3) reported outcome of readmission to hospital within 120 days of an index hospitalization. Abstracts were excluded because of difficulty with complete data extraction.

Searches were conducted in MEDLINE (1946 to March Week 3 2015) and CENTRAL (Issue 2 of 12, February 2015). Citations considered potentially relevant based on the prespecified inclusion criteria were retrieved in full text. See Appendix 1 for search terms used. A standardized form was used to extract data on study design, number of patients, study duration, determinants of readmision, and definitions of readmission outcomes. We identified 714 citations (681 from MEDLINE and 33 from CENTRAL). Of these, 640 citations were excluded as duplicates ($n = 33$) or not relevant ($n = 607$). The remaining 74 citations were retrieved as full text and reviewed in detail. Fifty-six articles were then excluded, as they did not meet predefined inclusion criteria. Reasons for exclusion were as follows: did not study the outcome of readmission ($n = 46$), did not include hemodialysis patients ($n = 6$), and were not relevant ($n = 4$). The remaining 18 studies were included in the final review (Figure 1).

Seven studies evaluated the prevalence of readmission,[19–25] nine studies evaluated factors associated with readmission,[7,26–33] and the remaining two studies assessed both associated factors and prevalence of readmission.[34,35] The studies were conducted in Italy, USA, Taiwan, and Canada, and included a total of 490,835 participants. All studies were observational and only 6 of the 18 studies were prospective in nature. One study reported infection as the most prevalent primary diagnosis for hospitalization (0.22 new hospitalizations per patient-year), with a 25.3% probability of 30-day readmission.[7] One randomized controlled trial assessing the effect of calcium and non-calcium-based phosphate binders on hospitalization was retrieved in the initial search, but was excluded, as the outcome of readmission was not clearly defined.[36]

In studies evaluating the prevalence of readmission, definitions of readmission were varied, ranging from 72 hours after an intensive care unit discharge to any first readmission after a hospital discharge (timing unspecified). Two studies[23,34] did not state the definition of readmission. There were no studies that evaluated 'avoidable' or 'preventable' readmissions. Prevalence of readmission also varied widely, ranging from 11.8% within 12 weeks after an index hospitalization[21] to 90.3% for any readmission after index hospitalization with time unspecified[34] (Table 1).

In studies evaluating factors associated with readmission, a wide range of factors were studied and were found to be of potential significance. In a US-based longitudinal cohort study of 49,326 patients with ESKD, Powe *et al.*[31] found a variety of comorbid disease to be associated with readmission with relative risks ranging from 5.2 to 43.3, including seizure, heart failure, volume overload, myocardial infarction, angina,