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RESEARCH BRIEF

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Crash Dialysis Trends Show Potential Areas for Medicare Quality and Cost Improvement

Introduction

Chronic kidney disease (CKD) affects approximately 36 million adults, or about 14% of the U.S. adult population, and contributes substantially to morbidity and mortality.[1] CKD often progresses silently. Many people are unaware of their condition until CKD reaches an advanced stage known as end-stage renal disease (ESRD) or *kidney failure*, where the kidneys can no longer function adequately to sustain life without dialysis or a kidney transplant. This lack of awareness contributes to suboptimal surveillance and management of CKD and underscores the need for earlier interventions.

In 2021, approximately 135,000 people developed ESRD in the United States, requiring maintenance dialysis that is associated with poor quality of life and high morbidity and mortality.[2] Along with severe health consequences, ESRD creates a substantial economic burden. Total expenditures for Medicare fee-for-service (FFS) beneficiaries with ESRD amounted to $33.4 billion in 2021.[3]

The worst outcomes for patients with kidney failure occur among those who initiate dialysis in an unplanned manner—commonly referred to as *crashing into dialysis*. These patients typically begin hemodialysis emergently during an acute hospitalization, via a central venous dialysis catheter—often without prior dialysis education and nephrology care.[4] When compared to patients who start dialysis in a planned manner, those who crash into dialysis are more likely to experience high psychological distress, an increased risk of death, longer hospitalizations, and increased functional impairment.[5,6]

Key Findings

- More than 125,000 Americans annually develop end-stage renal disease, or kidney failure, and need dialysis or a transplant to stay alive. The worst outcomes for patients with kidney failure occur among those who initiate dialysis in an unplanned manner—commonly known as crashing into dialysis.
- Approximately one in three fee-for-service Medicare beneficiaries with kidney failure crashed into dialysis during 2018–2022 based on a new measure developed by AIR. During the COVID-19 pandemic, a higher incidence of crash starts and increased deaths after crash dialysis occurred.
- Consistent screening for chronic kidney disease, especially for people with diabetes and hypertension, would likely reduce the need for crash dialysis and lead to savings for Medicare, reduced deaths, and improved quality of life for beneficiaries.

Studies have also highlighted the association between crash starts with bloodstream infections and rehospitalizations.[7,8] Altogether, evidence indicates that unplanned dialysis contributes to worse outcomes and quality of life for beneficiaries and higher Medicare spending.

Despite the significant health care costs and poor patient outcomes of crashing into dialysis, there has been little research focused on characterizing this phenomenon. Information on crash dialysis is not included among the comprehensive information reported by the United States Renal Data System. Understanding and accurately characterizing the incidence and effects of crashing into dialysis are crucial to develop strategies to improve patient care and reduce associated costs.[9]

The COVID-19 pandemic, which further complicated health care access, potentially increased rates of unplanned dialysis initiation due to disruptions in health care services and delayed diagnoses.[10] However, the impact of the COVID-19 pandemic on patients crashing into dialysis remains unknown. Understanding the impact of the pandemic will help to determine intermediate- and long-term consequences the health care system may face from unplanned dialysis and inform strategies to mitigate future episodes of health care interruptions and shutdowns.

This research brief presents a methodological approach to estimate the proportion of patients who crash into dialysis and provides empirical estimates using 2018–2022 trends from a 5% random sample of Medicare FFS beneficiaries. The primary goal of this research is to establish a claims-based measure that accurately captures crash dialysis—a costly and morbid condition that warrants additional research—and illustrate the measure's use in studying the temporal association of COVID-19 on unplanned dialysis.

Methodology

Data sources. The analysis used Medicare FFS claims data, including all (100% sample) beneficiaries for the years 2017–2022. These data were secured from the Chronic Conditions Warehouse Virtual Research Data Center, through Data Use Agreement #RSCH-2021-57657. Data files included the Master Beneficiary Summary File, inpatient FFS, outpatient FFS, skilled nursing facility FFS, and carrier FFS. For computational purposes, only a 5% random sample of beneficiaries was selected from the original files. The claims data were used to construct an analytic data file at the Medicare FFS beneficiary-year level for 2017–2022. A flow chart is presented in the appendix.

Measure specification. The goal of the crash dialysis measure is to estimate the proportion of Medicare FFS beneficiaries who initiate unplanned maintenance dialysis. Although there is no consensus in the literature on a definition, there is agreement that the conditions under which dialysis starts (e.g., emergently during a hospitalization or in a planned manner) and the type of vascular access at dialysis start are critical factors.[11] Therefore, crash dialysis was defined as receipt of first maintenance dialysis treatment during an inpatient hospitalization or emergency department visit using a central venous catheter (instead of preferred hemodialysis access such as an arteriovenous fistula or graft, which are associated with pre-ESRD nephrology care, longer patency, and lower rates of infection and death). To capture other aspects of unplanned dialysis, other requirements were included (e.g., absence of nephrology visits before the inpatient hospitalization) to examine alternative versions of the measure.

Denominator. Exclusion criteria were applied to arrive at the sample of beneficiaries representing the denominator of the measure for each year. These criteria include:

Complete data. To ensure uniform ascertainment of events, beneficiaries with incomplete data for part of the year were excluded from the sample. *Complete case analysis* was used to ensure uniform "at-risk" time across units of analysis—every beneficiary has had identical duration to develop the events that qualify for inclusion in the numerator. Beneficiaries who joined Medicare after the start of the year were *excluded* from the sample for that specific year. Full enrollment for the entire calendar year was required, as well as for the look-back and look-forward periods (3 months of the previous and subsequent calendar years, respectively). For example, for 2018, only Medicare FFS beneficiaries enrolled for all of 2018 were included (January 1 through December 31, 2018). For all measures, a 90-day look-back period was imposed beginning October 1, 2017, to *exclude* beneficiaries who received maintenance dialysis.[12] For some variations of the measure (as indicated), the look-back period was extended to 6 months, to identify nephrology care *prior to the index* inpatient dialysis. In addition, for some measure variations, a 90-day look-forward window was used, which for performance year 2018 ended March 31, 2019. This look-forward period was introduced to determine whether the unplanned dialysis initiation resulted in either permanent or maintenance dialysis (i.e., ESRD) or adequate recovery of kidney function to stop dialysis (i.e., acute kidney injury, or AKI). This look-forward period was only needed for patients whose dialysis crash occurred within the last 3 months of the end of the performance year.

Deaths. For all measures, for each year, beneficiaries were excluded who died that year for reasons likely unrelated to the dialysis crash (approximated as a death outside the 30-day window after the dialysis crash). This is because a death necessarily shortens the "at-risk" number of days in the year. Measure variations were examined where beneficiaries were excluded who died for any reason (including a dialysis crash) because characterizing the ongoing need for dialysis (i.e., ESRD vs. AKI) can be determined only for beneficiaries who survived the index crash dialysis episode.

Maintenance dialysis or dialysis crash. Measures were examined that included only beneficiaries who received maintenance dialysis, experienced a crash dialysis episode, or experienced both events. In other words, any FFS beneficiary was excluded who did not receive maintenance dialysis or experience a crash dialysis from the denominator population.

Numerator. The numerator includes all beneficiaries who experienced a crash dialysis episode. Crash dialysis was defined as the following conditions occurring during the observation year (including the corresponding look-back and look-forward periods):

- **A.** The insertion of a **central venous catheter** in an inpatient or emergency department setting.[13]
- **B.** **Administration of dialysis in an inpatient or emergency department setting** within 3 days of the insertion of the central venous catheter.[14]

C. **Absence of ESRD diagnosis or treatment** in the 90-day period preceding the date of the insertion of the central venous catheter.[15]

D. **Absence of nephrology care visits** during the 180-day period before the date of the insertion of the central venous catheter.[16]

E. **Confirmation of ESRD after the index hospitalization for crash dialysis,** defined as evidence of the continued need for maintenance ESRD dialysis at the 90-day threshold following the dialysis crash.[17]

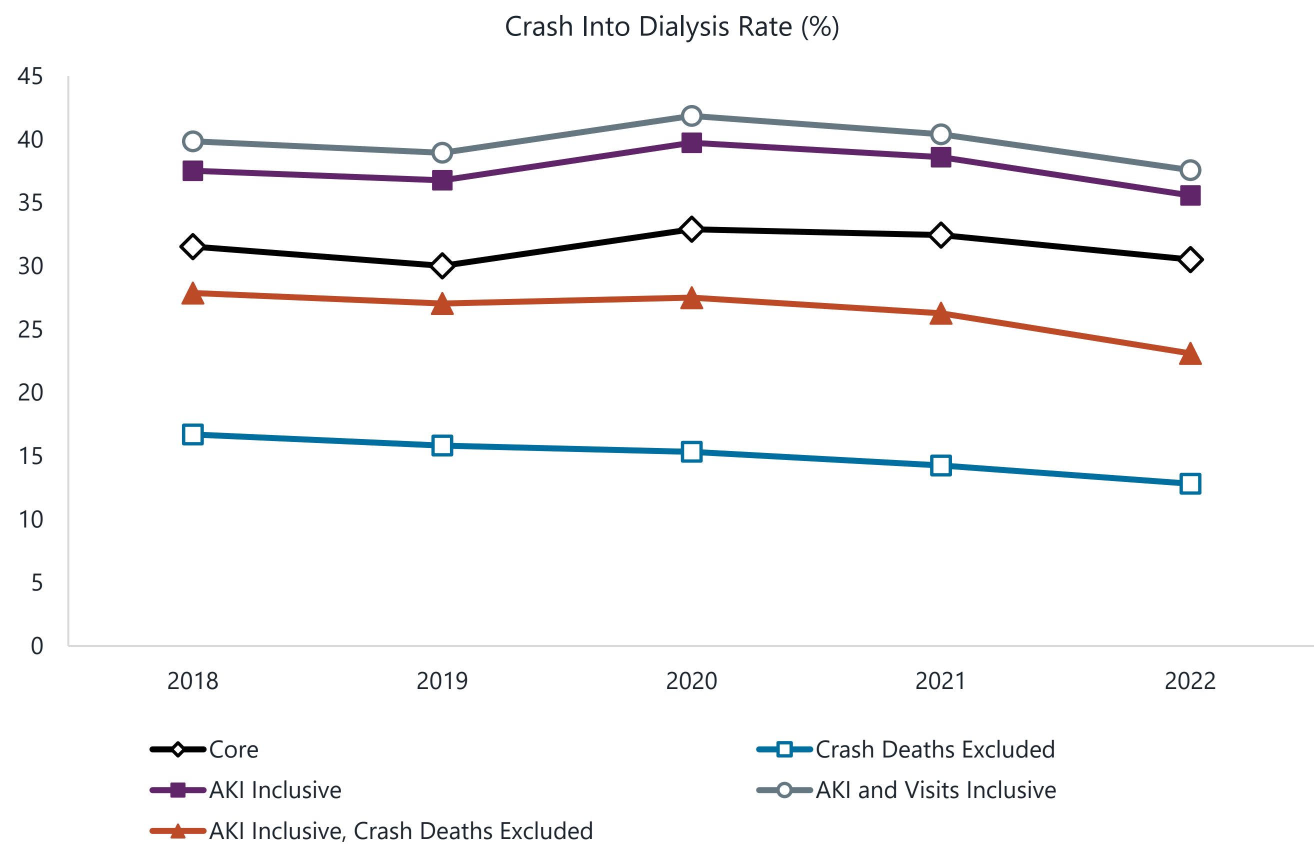
The core measure defines crash dialysis as meeting conditions A through E. However, additional analyses were conducted to explore different definitions of crash dialysis, which excluded conditions D and E.

Findings

Exhibit 1 shows trends in crash dialysis during 2018–2022 using the core definition of the measure and four alternate definitions (to test the sensitivity of the findings). Each is described below.

- **Core Measure** (black line with open diamond marker): Meets all conditions A–E. This core measure includes beneficiaries who died following the index crash dialysis and excludes beneficiaries who did not require maintenance dialysis (i.e., who experienced dialysis-requiring AKI and recovered kidney function) after the index crash dialysis. (Note: A subset of beneficiaries who died after the index crash dialysis may have suffered AKI as opposed to ESRD).
- **Crash Deaths Excluded Measure** (blue line with open square marker): Meets conditions A–E but excludes all beneficiaries who died after experiencing crash dialysis. This exclusion enables identification of only beneficiaries who are known to have experienced crash dialysis because of ESRD (because AKI vs. ESRD condition cannot be ascertained for beneficiaries who died after the index crash dialysis).
- **AKI Inclusive Measure** (purple line with solid square marker): Meets conditions A–D but drops condition E (the requirement of evidence of maintenance dialysis after the index crash dialysis). Beneficiaries who crashed into dialysis but recovered kidney function (AKI) may be captured by this measure.
- **AKI and Visits Inclusive Measure** (gray line with open circle marker): Meets conditions A–C but drops condition D (the requirement for absence of nephrology provider visits) and condition E (the requirement of maintenance dialysis after the index crash dialysis).
- **AKI Inclusive, Crash Deaths Excluded** (orange line with solid triangle marker): Meets conditions A–D but drops condition E (the requirement of evidence of maintenance dialysis after the index crash dialysis) and excludes beneficiaries who died after experiencing crash dialysis.

Exhibit 1: Trends of Crash Dialysis Rates, 2018–2022



Notes. Estimates based on a 5% sample of Medicare fee-for-services (FFS) beneficiaries. Main conditions for inclusion in denominator: receiving maintenance ESRD dialysis, having a dialysis crash, or both; and complete enrollment in Medicare throughout the year or until death during crash dialysis event. **Core** (black line with open diamond marker): includes beneficiaries who died because of the crash dialysis and excludes beneficiaries who did not have maintenance ESRD dialysis after the index crash dialysis. **Crash Deaths Excluded** (blue line with open square marker): differs from black only in excluding beneficiaries who died after experiencing crash dialysis. **AKI Inclusive** (purple line with solid square marker): differs from the core measure in including beneficiaries who did not have maintenance ESRD dialysis after the index crash dialysis. **AKI and Visits Inclusive** (gray line with open circle marker): differs from the core measure in including beneficiaries with nephrology provider visits and those who did not have maintenance ESRD dialysis after the index crash dialysis. **AKI Inclusive, Crash Deaths Excluded** (orange line with solid triangle marker): differs from the core measure in including those who did not have maintenance dialysis after the index crash dialysis and excluding those who died after experiencing crash dialysis. All these inclusions and exclusions refer to both numerator and denominator. Year 2022 estimates combine actual and projected data for the Core and Crash Deaths Excluded measures.

The core measure (black line) shows a downward trend between 2018 and 2019 that was interrupted in 2020 by the COVID-19 pandemic. Between 2019 and 2020, there was a 9.7% relative increase (absolute increase from 30.1% to 32.9%) in the proportion of FFS Medicare beneficiaries who crashed into dialysis. In the second year of the pandemic (2021), the core measure rate decreased slightly from the 2020 peak but remained above prepandemic levels at 32.4%. In 2022, the core measure rate further decreased to 30.5%, but this value remained above the corresponding value for 2019, the last prepandemic year.[18]

The core measure suggests that the onset of the COVID-19 pandemic was associated with an increase in the number of beneficiaries who crashed into dialysis, mainly during the first pandemic year. However, even 3 years after the start of pandemic, the absolute rate of crash dialysis remained slightly higher than in the last prepandemic year (30.5% in 2022 vs. 30.0% in 2019). Moreover, the reductions (slopes) in the rate of crash dialysis in 2021 and 2022 were less pronounced than that observed before the pandemic during 2018–2019. This suggests potential lingering effects of the pandemic such as patient access backlogs and fewer CKD screenings during the pandemic years, which may have delayed identification of advanced CKD and reduced the fraction of beneficiaries prepared for dialysis initiation compared with prepandemic years.

The AKI Inclusive (purple line) and AKI and Visits Inclusive (gray line) measures show patterns similar to the core measure but with slightly flatter trends prepandemic and quicker returns to prepandemic levels in 2021 and 2022. These two measures show a much higher percentage of beneficiaries crashing into dialysis across years relative to the core measure. Indeed, the average rates across years are 37.6% and 39.7% for the AKI Inclusive measure and the AKI and Visits Inclusive measure, respectively, compared to 31.5% for the core measure. This difference in magnitude between measures plausibly relates to the complexity for clinicians (including nephrology providers) in predicting which patients will develop AKI and how best to prepare these patients to avoid dialysis crashes. In 2022, these two measures showed a quicker return to prepandemic levels compared to the core measure, which is probably related to the fact that COVID-19 contributed to an excess number of dialysis-requiring AKI among Medicare beneficiaries.[19] The fact that the AKI and Visits Inclusive measure shows a very similar dynamic to the core measure and the AKI Inclusive measure suggests that even patients who were in the care of nephrology providers may have been unable to access services such as dialysis education or vascular surgeons during the pandemic peak to adequately prepare them for kidney failure.

The AKI Inclusive, Crash Deaths Excluded measure (red line) excludes all beneficiaries who died—even those who died after the index crash dialysis hospitalization. As such, this measure is subject to survival bias and likely underestimates the impact of the COVID-19 pandemic on crash dialysis. Compared with the core measure (and other already-discussed measures), it shows a much flatter increase during the COVID pandemic years, suggesting extremely high mortality among beneficiaries who crashed into dialysis during the pandemic.

The Crash Deaths Excluded measure (blue line) is closest in pattern to the AKI Inclusive, Crash Deaths Excluded measure. However, unlike all other measures, it shows a decline during pandemic years. This reflects the fact that this measure excludes two main sources of excess dialysis crashes during the pandemic: AKI that did not require subsequent maintenance dialysis and AKI that was followed by death. As such, this measure shows no increase during pandemic years but is highly subject to survival bias. The change in slope compared to the prepandemic period potentially suggests that the health care disruptions during the pandemic slowed improvements observed in prepandemic years.

Overall, based on the core measure of crash dialysis using Medicare claims, approximately one in three Medicare FFS beneficiaries in need of maintenance dialysis crashed into dialysis during the observation period. Also, the findings show that the COVID-19 pandemic was associated with a higher incidence of crash starts. This result held irrespective of the definition of crash dialysis used except for the definition that excludes deaths and AKI-related crashes. The analysis also found evidence of increased incidence of dialysis-associated AKI and increased incidence of deaths after crash dialysis compared with prepandemic levels. It remains unclear whether survival bias following the COVID-19 pandemic (i.e., a potentially healthier Medicare population) is driving current downward trends in crash dialysis and whether these trends (observed before and in the last year of the pandemic) will persist.

Implementing policies such as consistent screening for CKD, especially when comorbidities such as diabetes and hypertension are observed, would likely lead to substantive savings for Medicare, reduce deaths, and improve the quality of life for beneficiaries with CKD and ESRD.

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Endnotes

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[12] Coded as absence of any non-AKI 72x claims (i.e., no evidence of outpatient dialysis for ESRD) during the 90-day period preceding the catheter insertion.

[13] Coded as a carrier claim for inpatient or emergency department care (Place of Services = 21, 23) with HCPCS 36555-36571 (catheter insertion).

[14] Dialysis in inpatient setting identified based on HCPCS 90935, 90937, 90945, 90947. When catheter and dialysis were received on different days, we considered the dialysis following the catheter within next 3 days as an instance of a crash dialysis.

[15] Coded as absence of any non-AKI 72x claims (i.e., no evidence of outpatient dialysis for ESRD) during the 90-day period preceding the catheter insertion

[16] Coded as no care visits with nephrologists (specialty code 39) during the 180 consecutive day period preceding the catheter insertion.

[17] Coded as one or more non-AKI 72x claims.

[18] For both the Core and Crash Deaths Excluded measures, the 2022 values are based on a mix of actual and projected figures; to confirm the ESRD Post-Crash requirement (condition E) for beneficiaries who crashed in October–December 2022, we would need 2023 data that was not available for this study. Therefore, we projected this number by calculating the ratio of 2021 beneficiaries who crashed into dialysis and satisfied this requirement and applying it to beneficiaries who crashed in October–December 2022. Ratios obtained using previous years were similar, which suggests this projection is reliable.

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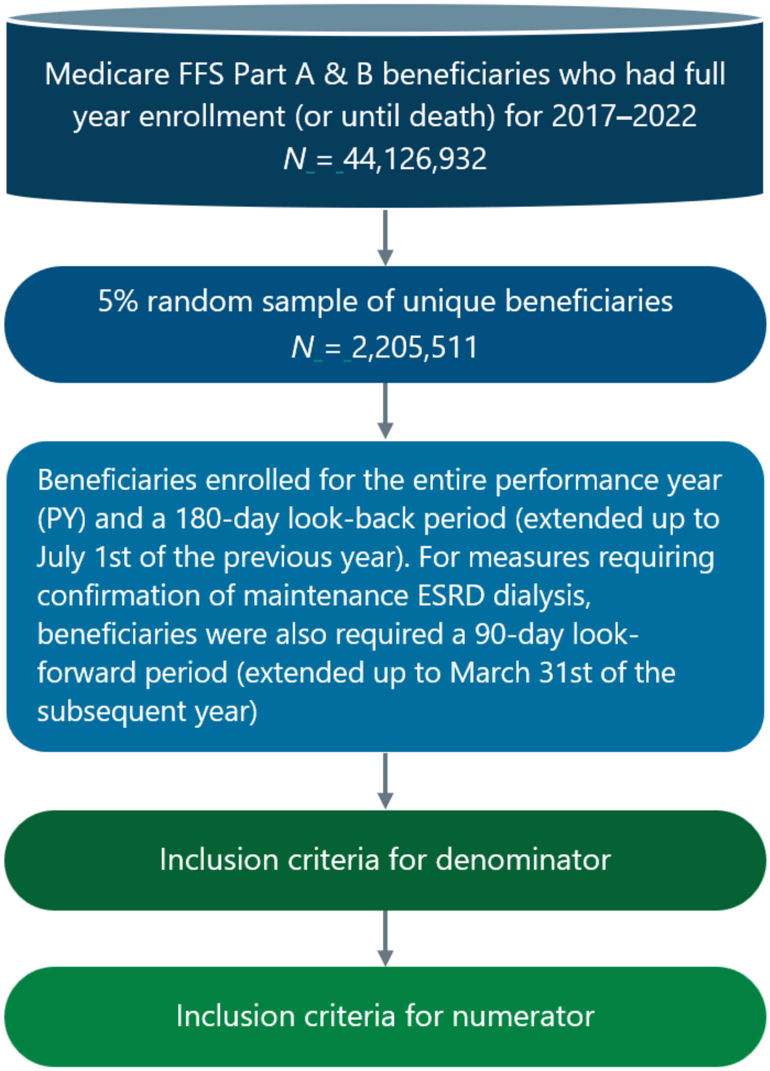
Appendix: Flow Chart



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