The confident evaluation of baseline kidney function is a fundamental component of any nephrology consultation. When abnormal kidney function is noted in a hospitalized patient, a clear sense of the patient’s baseline is required to understand the relative acuity and/or chronicity of the process. Contemporary guidelines for the diagnosis and staging of AKI rely heavily on the ability to discern an incremental rise in serum creatinine above a baseline value within a fixed time frame (1–3). However, a standard definition for baseline creatinine does not exist, leading to heterogeneity across research studies (4) and the potential for misinterpreting the true nature of perturbed kidney function in hospitalized patients (5).

The assessment of baseline kidney function involves the integration of hard laboratory data and the art of clinical judgment. A broad working definition could be the degree of kidney function—as expressed via the serum creatinine or the associated estimated GFR—that was recorded when the patient was last in his usual stable state of health. This proposed definition is laden with practical challenges. First, it relies on the subjective assessment by the clinician of what constitutes usual health for the patient. This may not be feasible for a consulting physician whose first encounter with the patient occurs during an acute hospitalization. Moreover, the ability to determine baseline kidney function depends on the availability of predmission values that are often elusive.

The frequent inaccessibility of prehospitalization serum creatinine values has motivated the development of different strategies to estimate baseline kidney function. One approach, advocated by the Acute Dialysis Quality Initiative (1), calls for assumption of a premorbid estimated GFR of 75 ml/min per 1.73 m² and “back-calculation” of the serum creatinine value using the simplified Modification of Diet in Renal Disease Equation (6–8). This assumption has limited applicability to usual clinical practice, where a substantial proportion of patients with AKI have pre-existing CKD (9,10); in such patients, derivation of a baseline creatinine from an arbitrarily chosen estimated GFR in the normal range would lead to artificially low estimates. Underestimation of the baseline serum creatinine would exaggerate the apparent serum creatinine rise, causing an overdiagnosis of AKI and/or an overcall of AKI stage (11,12). Another approach for designation of baseline creatinine is to use the first-available value following admission as the reference point from which excursions are evaluated. Although this may be acceptable when stable patients are admitted for elective procedures (e.g., cardiac surgery, contrast-based interventions), it may be misleading in patients with community-acquired AKI in whom the creatinine may have already risen well above the true baseline by the time of hospital presentation. In this instance, overestimation of the baseline creatinine will lead to an underappreciation of true AKI (12).

The availability of multiple prehospitalization serum creatinine values enables a more robust assessment of baseline kidney function, but this circumstance also presents an important set of caveats. To minimize the influence of outliers, values over variable intervals prior to the hospitalization may be summarized into an average baseline creatinine (13,14). If this approach is taken, what is the optimal look-back period for gleaning creatinine values that will contribute to this average? A longer interval will result in more data points, but as increasingly remote values are included, there is a risk that these will not reflect the true predmission baseline kidney function of the patient. On the other hand, values obtained in close proximity to the index hospitalization may be inflated by the presence of AKI that was in evolution in the days leading up to the hospital admission. A second dilemma relates to whether values used to ascertain the predmission serum creatinine should be limited to certain clinical settings. Based on the assumption that ambulatory readings are more likely to be obtained during periods of clinical stability, some studies have only considered outpatient results (9,15).

In the current issue of CJASN, Siew et al. (16) compare the validity of different strategies for estimating baseline creatinine in the seemingly optimal situation when multiple predmission values are available to the clinician. They studied 379 hospitalized patients who had evidence of kidney dysfunction or frank AKI and at least two serum creatinine values from the 24 months preceding admission. The reference standard for baseline creatinine was established by detailed chart reviews completed by two nephrologists who had access to all retrievable patient records that would help place the creatinine results into context. The final adjudicated baseline creatinine was designated as the mean of readings reported by each nephrologist; in the event of significant disagreement, resolution occurred following input by a third nephrologist. The adjudicated baseline creatinine was compared with four strategies for the
estimation of baseline creatinine: the mean outpatient value, the most recent outpatient value, the nadir outpatient value, and the most recent inpatient or outpatient value. Three different preadmission windows were applied to each of the above strategies: 7–365, 7–730, and 1–730 days. The mean outpatient creatinine obtained during a 7- to 365-day window preceding the index hospitalization had the strongest agreement with the adjudicated value (intraclass correlation coefficient [ICC], 0.91; 95% confidence interval [CI], 0.88–0.92). Performance of the most recent outpatient or inpatient value was almost as robust (ICC, 0.88; 95% CI, 0.85–0.91). This is reassuring, because in the common scenario when only one serum creatinine value is readily accessible, the clinician may still garner a sound estimate of the baseline creatinine. For each estimation method, widening the look-back window to consider values up to 730 days prior to the index hospitalization did not improve the degree of agreement and in some cases worsened it. Incorporation of data from the 7 days preceding admission into each estimation strategy resulted in a substantial reduction in agreement with the adjudicated reference standard. This suggests that serum creatinine values obtained very close to the date of hospitalization often do not reflect the true baseline and should be viewed cautiously, likely because of the impact of the evolving illness on the serum creatinine.

This is the first study to systematically evaluate commonly used strategies for assignment of the baseline creatinine. The adjudicated reference standard for the baseline serum creatinine is the closest to the “truth” as may be conceived, and the rigorous approach taken to establish this value is a key strength of the study. The study population comprised the very subset of hospitalized patients in whom conundrums frequently arise regarding the baseline serum creatinine.

Although the study findings discount the accuracy of baseline serum creatinine derived from values obtained >1 year prior to admission, available creatinine values were highly clustered close to the admission date (median 16 days prior to admission). Even when the look-back window was extended to 730 days prior to admission, the impression of the adjudicators would have still been largely influenced by values that were close to the hospitalization. It is thus perhaps not so surprising that the adjudicated serum creatinine would be more highly correlated with values obtained within the year preceding the hospitalization compared with more remote values. It is unfortunate that serum creatinine values from prior inpatient stays were not tested more comprehensively in relation to the reference standard. Although such values may be impacted by acute illness and hence be misleading, on a practical level, some patients may never get outpatient blood work, thus forcing a reliance exclusively on inpatient data in usual clinical practice. The final or nadir serum creatinine of a previous hospital stay, especially if there is evidence that the acute illness completely resolved, may be useful surrogates for baseline kidney function.

This study has wide-ranging implications. For research involving the retrospective analysis of large administrative databases, the findings will promote a standardized approach to the assignment of a baseline creatinine and decrease the interstudy heterogeneity that currently exists. Application of the study findings may also help inform the conduct of clinical trials. For studies testing a novel intervention for the prevention of AKI, researchers now have a validated systematic approach to establish the participant’s baseline creatinine, which is crucial for the ascertainment of any study outcome that incorporates the biochemical definition of AKI. Similarly, the ability to efficiently identify the presence of some prespecified degree of CKD, frequently an exclusion criterion in trials of AKI prevention or treatment, will inform the screening of prospective study participants. In clinical practice, physicians should continue to evaluate the totality of available ancillary data—as done by the adjudicators in this study—to correctly interpret the significance of prehospitalization creatinine values and arrive at an estimate of the baseline. When such supporting information is unavailable, using mean values from the preceding year or even the most recently available value, while exercising caution with values obtained within days of the current hospitalization, offers a reasonably accurate alternative.

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Disclosures

None.

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