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# Optimum Care of AKI Survivors Not Requiring Dialysis after Discharge: An AKINow Recovery Workgroup Report

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## Key Points

- AKI survivors experience gaps in care that contribute to worse outcomes, experience, and cost.
- Challenges to optimal care include issues with information transfer, education, collaborative care, and use of digital health tools.
- Research is needed to study these challenges and inform optimal use of diagnostic and therapeutic interventions to promote recovery

AKI affects one in five hospitalized patients and is associated with poor short-term and long-term clinical and patient-centered outcomes. Among those who survive to discharge, significant gaps in documentation, education, communication, and follow-up have been observed. The American Society of Nephrology established the AKINow taskforce to address these gaps and improve AKI care. The AKINow Recovery workgroup convened two focus groups, one each focused on dialysis-independent and dialysis-requiring AKI, to summarize the key considerations, challenges, and opportunities in the care of AKI survivors. This article highlights the discussion surrounding care of AKI survivors discharged without the need for dialysis. On May 3, 2022, 48 patients and multidisciplinary clinicians from diverse settings were gathered virtually. The agenda included a patient testimonial, plenary sessions, facilitated small group discussions, and debriefing. Core challenges and opportunities for AKI care identified were in the domains of transitions of care, education, collaborative care delivery, diagnostic and therapeutic interventions, and digital health applications. Integrated multispecialty care delivery was identified as one of the greatest challenges to AKI survivor care. Adequate templates for communication and documentation; education of patients, care partners, and clinicians about AKI; and a well-coordinated multidisciplinary posthospital follow-up plan form the basis for a successful care transition at hospital discharge. The AKINow Recovery workgroup concluded that advancements in evidence-based, patient-centered care of AKI survivors are needed to improve health outcomes, care quality, and patient and provider experience. Tools are being developed by the AKINow Recovery workgroup for use at the hospital discharge to facilitate care continuity.

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## Introduction

AKI affects approximately 13%–18% of hospitalized patients and 30%–70% of critically ill patients.<sup>1–3</sup> According to the United States Renal Data System 2021 Annual Report,<sup>4</sup> the overall incidence of AKI has risen over the past decade especially among patients

with CKD and diabetes. There is a disproportionately higher incidence of AKI among Black patients than White patients.<sup>4</sup> Among Medicare beneficiaries discharged alive after an episode of AKI, the incidence of rehospitalization with AKI by 1 year is 52% and up to 1%–2% of patients are newly diagnosed with ESKD.<sup>4</sup>

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**Table 1. Summary of workgroup recommendations to improve AKI survivor care**

Domain/Action Area	Challenges (Current Status)	Recommendations and Opportunities
Transition of care	Poor flow of AKI information from the acute care to post-acute care setting Issues with EHR interoperability	Use digital health solutions, including alerts, to increase provider awareness of AKI, disseminate requisite information about AKI event, and improve communication of follow-up care recommendations Use software templates to improve completeness of documented AKI information Delineate responsible parties and next steps through an AKI communication plan and survivorship plan
Education	Lack of patient education about AKI, short-term and long-term complications, therapeutic and medication considerations, monitoring requirements, and self-management strategies	Design and test AKI education programs for patients and their care partner(s) Consider the use of text messages and telehealth to increase reach of education
Collaborative care delivery	Multiple care providers and at times competing interests and concurrent priorities Limited access to nephrologists, particularly in resource-limited settings Patient-centered outcomes inadequately prioritized relative to clinical or process outcomes related to AKI Post-AKI care coordinator role not mainstream and reimbursement uncertain	Establish a multidisciplinary well-coordinated care plan before discharge Tailor care plan to patient's goals values and preferences ( <i>e.g.</i> , team members, transportation considerations, comfort with digital health solutions) Use AKI communication plan and survivorship plan to facilitate consistency with patients and care partners and across care providers Design and test clinician education programs with a focus on non-nephrologists
Diagnostic interventions after AKI	Inconsistent evaluation of kidney health after discharge using standard (serum creatinine, urine albumin-to-creatinine ratio) and novel tests (cystatin C, novel urinary biomarkers of kidney stress or injury)	Create standard guidance on which tests to use, when, and in what circumstances for AKI survivors
Therapeutic interventions after AKI	Lack of guidance in best practices for post-AKI therapeutics Hesitancy with initiating medications after AKI event Dynamic kidney recovery requires frequent re-evaluation of therapeutic plan	Create guidelines on post-AKI therapeutics specifically in the domains of <ul style="list-style-type: none"> <li>● BP management</li> <li>● Diuretic titration</li> <li>● Initiation/resumption of kidney protective therapies, including RASi and SGLT2i</li> </ul> Frequently monitor renally cleared therapies for dose adjustment
Digital health applications for post-AKI care	There remains untapped potential to use digital health tools to advance AKI survivor care	Validation of digital health tools for risk classification/subphenotyping, clinical decision support, wearables, biosensors, and mobile health applications to facilitate <ul style="list-style-type: none"> <li>● Enhanced postdischarge AKI care (<i>e.g.</i>, who to follow, when to follow them, and what interventions are most likely to be effective)</li> <li>● Personalized post-AKI risk stratification to identify high-risk groups of patients</li> <li>● Quality care delivery with a focus on patient-centered and equitable models</li> </ul>

EHR, electronic health record; RASi, renin-angiotensin system inhibitors; SGLT2i, sodium-glucose cotransporter-2 inhibitors.

Owing to the heightened severity of illness and greater complications, the annual inpatient cost of caring for patients with AKI may exceed \$5 billion (Table 1).<sup>5,6</sup>

Despite the high prevalence of disease, grave consequences, and evident health disparities,<sup>2</sup> care delivery for AKI survivors is suboptimal.<sup>7</sup> Hospital discharge summaries lack kidney care plans.<sup>8</sup> Patients, even with moderate to severe AKI, are often unaware of its occurrence.<sup>9</sup> Serum creatinine reassessment and clinical follow-up are absent in one third of patients within 30 days of discharge.<sup>10</sup> Urine protein assessment, a key prognostic indicator,<sup>11</sup> is evaluated in <20% of patients in the 6 months after discharge.<sup>4</sup>

Nephrologist follow-up, which has been linked to improved outcomes in patients with severe AKI, occurs variably in only 4%–43% of AKI survivors.<sup>4,12–14</sup> These data highlight the need to improve postdischarge AKI care delivery models.<sup>15</sup>

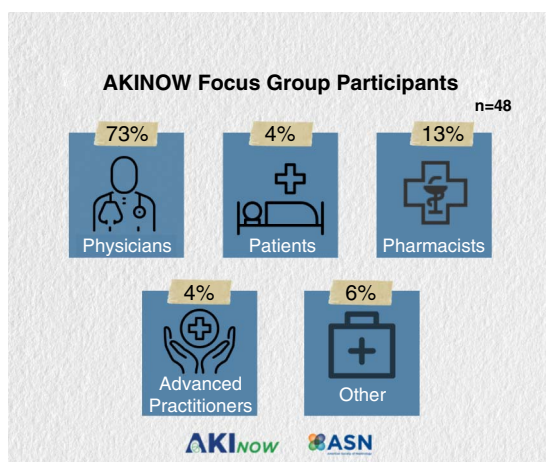
To address these opportunities, in 2019, the American Society of Nephrology (ASN) established the AKINow taskforce.<sup>16</sup> AKINow, through a series of workgroups, aims to lead the effort toward reducing the incidence, severity, and complications of AKI through discovery science, digital health innovations, patient and provider education, and initiatives to promote AKI recovery. The AKINow Recovery

workgroup convened two focus groups to summarize challenges and opportunities in AKI survivor care: one each aimed at dialysis-independent (hereafter referred to as AKI) and dialysis-dependent AKI survivorship. Within this article, we report the methods and findings of the AKI focus group.

## Methods

The AKINow Recovery Focus Group proceeded with three core objectives: (1) to explore gaps in care for dialysis-independent patients who survive an episode of AKI, (2) to investigate opportunities to improve AKI recovery and transitions of care, and (3) to guide the development of policies and best practice guidelines to advance the care of AKI survivors without dialysis needs. Participants for the focus group were recruited from patients known to have survived an episode of AKI and multidisciplinary clinicians from diverse backgrounds. Invited participants varied in their geographic distribution, years of practice experience, clinical discipline (primary care, nephrology, pharmacy, nursing), and practice setting (academic versus community, urban versus rural, and adult versus pediatric). The project was deemed not human subjects research by the Northwell Health Institutional Review Board (HSRD23-0073 determination).

Those interested in participation were invited to one 3-hour virtual meeting and asked to complete a preparticipation questionnaire to summarize demographics and practice experience (for nonpatient participants). Fifty-seven individuals completed the preparticipation questionnaire, and 48 participated in the focus group on May 3, 2022, supported by nine ASN staff members (Figure 1).



**Figure 1. Distribution of AKI recovery focus group participants according to discipline.** Consistent with the distribution of extended invitations, physicians from the inpatient and outpatient setting were the primary discipline involved with the focus group ( $N=35$ ) including adult nephrologists (28 of the 35 physician participants), adult intensivists and internal medicine providers (five of the 35 physician participants), and pediatric specialists (nephrologist or intensivist, two of the 35 physician participants). Other focus group participants included advanced practice providers ( $N=2$ ), pharmacists ( $N=6$ ), patients ( $N=2$ ), and other individuals ( $N=3$ ).

Proceedings included a patient testimonial, plenary sessions, facilitated small group discussions, and debriefing. The meeting was audio recorded for future review.

Eight to twelve individuals were randomly assigned to each of four small groups and asked to discuss at least one core topic which included (1) optimum discharge planning of dialysis-independent AKI survivors, (2) interventions that affect posthospitalization AKI care, (3) challenges and opportunities in the care of AKI survivors, and (4) longitudinal and multidisciplinary care delivery strategies. Each small group discussion was coordinated by two facilitators from the AKINow Recovery workgroup and one ASN staff partner responsible for note taking. Rather than attempting to achieve consensus, the objective of the small group discussions was to capture the breadth and diversity of participant insights and recurrent themes. Each small group presented a brief summary of their discussion to all participants who were invited to offer additional insights to enrich the summary. AKINow Recovery workgroup members thereafter debriefed and summarized responses according to themes.

## Patient Perspective on AKI Care in the United States

A patient testimonial was shared at the outset of the AKI focus group. She described her course before, during, and after cardiac surgery after which she developed AKI and experienced a challenging kidney recovery. She highlighted two core themes. First, inadequate expectation setting: she felt that the risks of kidney injury associated with the surgery were minimized preoperatively. She recalled expressions, such as “*You are so young, even if the kidneys fail, you will have no problems.*” Her postoperative AKI required treatment with acute dialysis. The absent preoperative dialog about these risks left her feeling confused and inadequately prepared for the complex recovery that was to ensue. The second key theme she noted was the importance of support, from her family/friends and care providers. She credits her recovery to the encouragement from her husband, both during and after the hospitalization, and her nephrologist who explained and supported her on the road to recovery. Her take home message was the importance of keeping the patient at the center of the conversation. Respecting their right to information, avoiding risk minimization, and ensuring a continuous dialog with the patient and family to provide information, hope, and facilitate recovery.

## Current Challenges and Recommendations for AKI Survivor Care

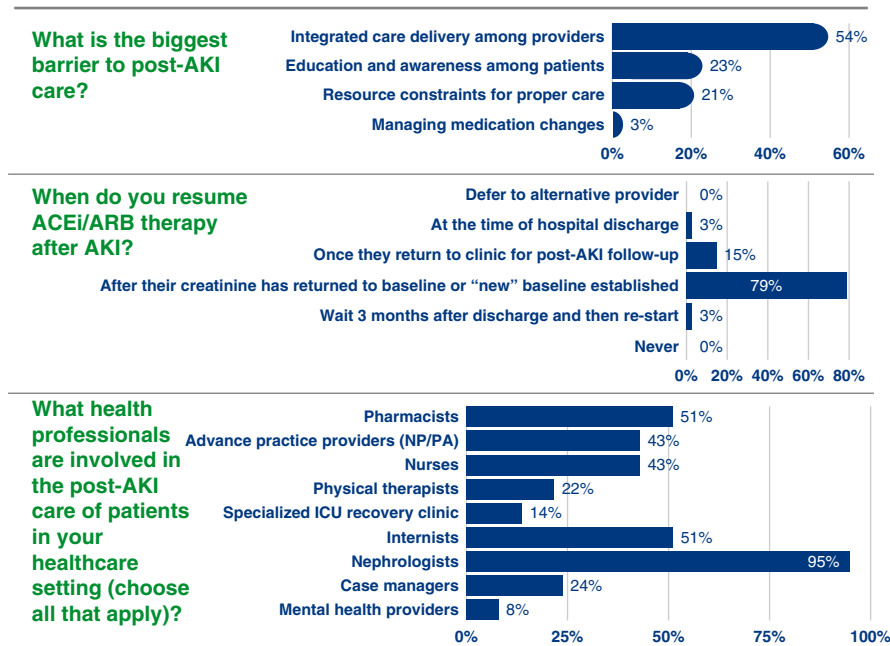
The focus group revealed several gaps in knowledge and care of AKI survivors (Table 1, Figure 2). Key themes related to the transition of care experience, the need for improved patient and provider education, collaborative care delivery, greater evidence to guide the use of diagnostics and therapeutics during recovery, and the role of technology and digital health.

### Transition of Care

Unlike dialysis-dependent AKI patients, dialysis-independent AKI survivors often lack an outpatient group of professionals dedicated to their kidney health. During transitions of care, information regarding the AKI event and

## Determining Gaps in Care of AKI Survivors

### Focus Group polling question summary (n=48)



**Figure 2. Participant perspectives on health care delivery challenges for AKI survivors.** During the virtual focus group, audience polling was used to probe select gaps in care for AKI survivors. Findings revealed a breadth of individuals involved with post-AKI care, a variety of barriers to care delivery most notably cross-collaboration among multiple providers, and moderate heterogeneity in how interventions, such as RASi, are used in these patients. ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; RASi, renin-angiotensin system inhibitor.

recommended follow-up may be lost, particularly if AKI goes unrecognized by the inpatient providers.<sup>8</sup> The timing, type (nephrology versus non-nephrology specialty care versus primary care), and intensity of follow-up at care transitions are also controversial. While nephrology follow-up has been linked to improved mortality in AKI survivors,<sup>12,17,18</sup> it is relatively uncommon.<sup>4,12–14</sup> The traditional in-person model of nephrology follow-up has been reported as a significant barrier for patients.<sup>19</sup> Patients often face hospitalization-related fatigue and are reluctant to add more doctors to their health care teams. Patients and their caregivers have also reported needing to prioritize conditions other than AKI, having variable comprehension of their AKI diagnosis, and feeling overwhelmed by competing health plans.<sup>20</sup>

**Recommendations.** Several tactics have been suggested to improve the transition of care for AKI survivors. Digital AKI alerts may increase provider awareness of AKI, improve communication of an AKI event, and encourage appropriate laboratory testing.<sup>21,22</sup> Documentation templates could improve the accuracy and completeness of dismissal summary information about AKI staging, medication changes, and recommended follow-up testing.<sup>23,24</sup> Care continuity from the acute to post-acute care setting also requires clear delineation of responsible parties and next steps. One strategy could use treatment and survivorship care plans, which have been shown to be successful in other disciplines.<sup>25</sup> The AKINow Recovery workgroup is developing two tools for use at the hospital discharge to

facilitate care continuity. The *AKINow Communication Plan* provides a template for inpatient providers to share relevant information with patients and their outpatient providers about the AKI event, including a description of kidney function throughout the hospitalization including whether dialysis was required, suspected etiology of AKI, adjusted medications given the AKI, and future care considerations. The *AKINow Survivorship Plan* organizes information for the patient and their outpatient providers with focus on the recommended follow-up care, including check-ups, laboratory tests, and medications that may need to be adjusted as AKI recovers. Discussion prompts are included to facilitate kidney health communication. These plans are intended to facilitate systematic and thorough communication between patients and providers at care transitions.

### Education

Focus group participants highlighted the inadequacy of AKI education both before and after hospital discharge among patients and care partners.<sup>9</sup> There is a lack of understanding about the short-term and long-term complications of AKI, nephrotoxic drugs to avoid, optimal fluid intake, and the need to monitor kidney function to ensure safe and effective dosing of medications.<sup>9,20</sup> Given that AKI that does not require dialysis is typically asymptomatic, self-management is often neglected or deprioritized. Clinicians also would benefit from education to increase awareness and understanding of AKI and its implications.



**Recommendations.** Education must be accessible and straightforward for both patients and care partners and be focused specifically on AKI. Frequent and interactive teaching sessions, although more resource intensive, are more effective than printed kidney education materials.<sup>26</sup> The use of education delivered through telephone text messages has improved adherence to positive health behaviors and improved health outcomes in other disease states, including CKD,<sup>27–29</sup> but has not yet been tested in AKI.<sup>30</sup> We envision the potential of text messages and telehealth to provide patient-centered education on AKI and reminders for follow-up.

More effort needs to be placed on clinician education, especially for non-nephrologists. There is a lack of clarity about when to refer, investigate, or intervene for AKI survivors.<sup>14,19,31,32</sup> To date, research on AKI education for clinicians has been limited to a few quality improvement studies.<sup>33,34</sup> AKI education for clinicians needs to tailor materials and mode of instruction to the level of training, experience, and subspecialty. Thus, AKI education for clinicians will be an important area of research for the AKI scientific community.

#### *Collaborative Care Delivery*

The care experienced by AKI survivors is complex often involving multiple, at times, competing interests and concurrent priorities. Most preparticipation questionnaire respondents (31/57 [54%]) identified the lack of integrated care delivery among providers as the biggest barrier for AKI survivor care. Those hospitalized in the intensive care unit may be offered participation in a postintensive care clinic<sup>35</sup> where clinicians may defer kidney health care<sup>30</sup> and laboratory evaluations may be performed after the encounter. Patient-centered outcomes, such as quality of life, fatigue, weakness, and cognitive and emotional health, are rarely evaluated in AKI survivors.<sup>36,37</sup> Engagement of allied health practitioners, including nurses, pharmacists, and dietitians, may be beneficial, but the best approach to their involvement is uncertain.<sup>31,38,39</sup>

**Recommendations.** Optimal postdischarge care of AKI survivors should be multidisciplinary and well-coordinated. Before discharge, follow-up should be established in alignment with the patient's comprehensive care needs. Care providers responsible for kidney health should be assigned. The *AKINow Communication Plan* can aid in role delineation. The *AKINow Survivorship Plan* can be shared with patients, families, and care providers to guide coordinated follow-up care. Patient goals, values, and preferences should be kept central in care coordination. As an example, rural patients may be better reached with virtual rather than in-person visits to limit transportation burden.<sup>15,31,40</sup> A care coordinator could be an important resource for survivors of AKI; however, the availability and reimbursement for such a dedicated individual is uncertain and center-specific.

#### *Diagnostic and Therapeutic Interventions*

Recovery from AKI is often incomplete at hospital discharge. An estimated 41% of patients with stage II/III AKI still meet criteria for at least stage I AKI at discharge.<sup>41</sup> Even among patients with recovery of serum creatinine to the prehospitalization baseline, increased risk for future

development of CKD persists.<sup>42</sup> Therefore, postdischarge laboratory follow-up is required to assess postdischarge kidney function. Serum creatinine is the test most often used to define baseline kidney function, incident AKI, and degree of AKI recovery. Cystatin C may be used as an adjunct or alternative to creatinine to assess kidney function, particularly in patients who have lost skeletal muscle mass and/or experience prolonged hospitalizations.<sup>43–45</sup>

Measurement of a urine albumin-to-creatinine ratio after AKI is currently recommended by Kidney Disease Improving Global Outcomes for prognostication<sup>11,46–48</sup> and to guide therapy (e.g., nephroprotective drugs). Only 10%–15% of patients currently have albuminuria checked within 6 months after post-AKI discharge.<sup>4</sup> Novel urinary biomarkers, such as C-C motif chemokine ligand 14<sup>49</sup> and tissue inhibitor metalloproteinase 2-insulin growth factor-binding protein 7,<sup>50,51</sup> may 1 day be useful for predicting AKI recovery. While numerous tests are available, focus group participants reiterated the lack of clarity on which tests to use and when and the resultant practice variation.

Related is the lack of standardization in the use of therapeutic interventions after an episode of AKI. One area of focus is BP management. AKI may directly cause BP increases long-term,<sup>52</sup> and antihypertensive regimens may be modified during the hospitalization. The optimal BP target after an episode of AKI is uncertain, but intensive BP control does not seem to worsen rehospitalization or kidney function in the post-AKI population.<sup>53,54</sup> Another focus of post-AKI care is the assessment of fluid status and diuretic dosing, which strongly depends on evolving kidney function throughout recovery.<sup>55</sup> Diuretics may be underdosed after AKI due to concern for the small increases in serum creatinine often observed with diuretic exposure. Providers may recognize that mild to moderate increases in creatinine from diuretic therapy are paradoxically associated with improved outcomes.<sup>56–59</sup> Another important piece of post-AKI care includes the initiation or reinitiation of long-term nephroprotective therapies, such as renin-angiotensin system inhibitors (RASi) and sodium-glucose cotransporter-2 inhibitors (SGLT2i). Although RASi and SGLT2i result in a hemodynamic, reversible, early decrease in GFR, they preserve kidney function long-term and have proven mortality benefits in heart failure and proteinuric CKD. Evidence indicates that resuming RASi after an AKI event is not associated with recurrent hospitalization with AKI<sup>60,61</sup> and significantly lowers mortality.<sup>62</sup> Some nephrologists even advocate RASi continuation throughout an AKI event or at a minimum resumption before discharge even in incomplete recovery.<sup>63,64</sup> Seventy-nine percent of respondents to our preparticipation questionnaire ( $n/N$ , 45/57) indicated a preference for resuming RASi once the creatinine returns to pre-AKI baseline (Figure 2). Others preferred to wait until post-AKI follow-up or 3 months before reintroducing RASi. Less is known about SGLT2i use specifically after AKI, but meta-analyses have indicated that SGLT2i use decreases the risk for subsequent AKI.<sup>65</sup> Post-AKI follow-up is also another opportunity for nephrotoxin stewardship, including deprescription of potential nephrotoxins (e.g., supplements, nonsteroidal anti-inflammatory drug, Proton-pump inhibitors if not strongly indicated).<sup>66</sup> Practice

variation is high in the handling of renally active medications in AKI survivors, and clinical guidelines are scarce.

**Recommendations.** Focus group participants advocated for the need for evidence-based recommendations for how to approach diagnostic and therapeutic interventions after an episode of AKI. At a minimum, all patients who survive an episode of moderate to severe AKI should have their kidney function assessed once after discharge by serum creatinine and urine protein measurement. Clinical visits with nephrologists, non-nephrology specialists (*e.g.*, cardiologists, endocrinologists), and primary care providers should include postdischarge individualized BP assessment and goal setting. New introduction (or reinitiation) of therapeutic interventions, such as RASi and SGLT2i, should be considered for AKI survivors with compelling indications. These drugs should be reintroduced in a timely fashion, in AKI survivors with baseline use, ideally by discharge if clinically stable.

#### Digital Health Applications

To date, most of the work has focused on using artificial intelligence (AI) (*e.g.*, machine learning) to predict and prognosticate short-term outcomes after AKI with less work investigating specific interventions related to the care of AKI survivors.<sup>67,68</sup> While availability of electronic health record data underpins opportunities for personalized risk stratification, complex syndromes, such as AKI, may require more precise biologic subphenotyping for tailored interventions. For example, AKI linked to systemic inflammation in a critically ill patient may have different pathobiological recovery processes than other types of AKI with minimal inflammation.<sup>69</sup> In this context, the use of AI applied to health care expands from electronic health record data signatures to biological signatures from the genome, metabolome, and circulating biomarkers.<sup>70</sup> Beyond AI-informed AKI risk scores, other digital health applications including wearables, biosensors, and mobile health technologies each have a potential role in the AKI survivor care continuum. Although these applications are promising, prospective testing and validation have been stagnant due to challenges with data access, biospecimens, privacy and security concerns, and acceptability among patients and providers. There are also valid concerns about the potential for bias inherent to these tools, particularly for patients poorly represented in large datasets or with limited health care access.<sup>71</sup>

**Recommendations.** The use of digital health to enhance post-AKI discharge care is still in its infancy but represents an area of considerable potential. Among the areas with greatest potential include (1) the ability to generate multimodal data repositories from diverse patient populations, (2) external and prospective validation of risk classification tools and AKI subphenotypes, (3) the use of AI-based tools to guide specific interventions of postdischarge care (*e.g.*, time to kidney function evaluation), (4) the use of AI for enrichment of clinical trials and adaptive trial design, and (5) the evaluation and further development of digital health technologies customized for patients with kidney disease (*e.g.*, interactive apps that educate and collect symptom, laboratory, and vital sign data of survivors of AKI after discharge).

#### Summary

AKI is a prevalent condition with significant short-term and long-term consequences. To limit the avoidable burden of chronic disease and decreased quality of life patients experience, greater attention must be devoted to the science and quality of AKI survivor care. We identified, through a diverse focus group of clinicians and patients, core challenges and opportunities for post-AKI care in the domains of transitions of care, education, collaborative care delivery, evidence and guidance for diagnostic and therapeutic interventions, and digital health applications. The summary findings we reported were limited by the convenience sample recruited for participation in the focus group. Those involved in the focus group were motivated to participate and thus may have a preexisting familiarity with AKI and enthusiasm for care optimization. Engagement of a larger or more generalizable sample of individuals for participation in future focus groups may reveal additional challenges associated with AKI survivor care. In summary, proactive attention to developing, testing, and implementing evidence-based practices in the identified areas is needed to improve the health outcomes of AKI survivors, the care quality they receive, and the health care experience encountered by themselves, their loved ones, and their clinician team.

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Leadership Role: Editorial Board, *Advances in Chronic Kidney Disease*, *American Journal of Kidney Diseases*, and *Kidney360*; Guest Editor, *Critical Care Nephrology in Advances in Chronic Kidney Disease*; and Section Editor, *Clinical Nephrology*. J.H. Ng reports the following: Employer: Northwell Health; Consultancy: Vifor Pharmaceuticals; Ownership Interest: PublishedMD Consulting LLC; Research Funding: NIH/NIDDK, Award number: 1K23DK132459-01; Honoraria: Advocate Christ Medical Center; Advisory or Leadership Role: Editorial Board Member of *Advances in Chronic Kidney Disease* (unpaid) and Editorial Board Member of *ASN Kidney News* (unpaid); and Other Interests or Relationships: Founder of PublishedMD Consulting LLC. S.A. Silver reports the following: Employer: Queen's University; Consultancy: AstraZeneca; Honoraria: Baxter, Novo Nordisk, and Otsuka; and Advisory or Leadership Role: Canadian Society of Nephrology Board Member. A. Vijayan reports the following: Employer: Washington University in St. Louis; Consultancy: Astute and NxStage; Research Funding: Spectral; Honoraria: Baxter, Medscape, and NxStage; and Other Interests or Relationships: Member, National Kidney Foundation. The remaining author has nothing to disclose.

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**Writing – review & editing:** Erin F. Barreto.

#### Data Sharing Statement

There are no data underlying this work.

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