Check for updates

Canadian Society of Nephrology/ Société canadienne de néphrologie CSN/SCN

CANADIAN JOURNAL OF KIDNEY HEALTH AND DISEASE
Journal canadien de la santé et de la maladie rénale

Clinical Research Protocol

Canadian Journal of Kidney Health and Disease
Volume 13: 1–10
© The Author(s) 2026
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/20543581261429009
journals.sagepub.com/home/cjk

Sage

A Multipronged Intervention to Improve Outpatient Care Following Hospitalization With Acute Kidney Injury: An Implementation Study Protocol

Michelle M. Y. Wong[1], Peter Birks[1], Omosomi Enilama[1,2], Janelle S. W. Yu[3], Anurag Singh[4], and Adeera Levin[1,2]

Abstract

Background: Acute kidney injury (AKI)-related hospitalizations are associated with long-term health consequences, but post-AKI management and monitoring in the outpatient primary care setting are suboptimal. Documentation and communication about in-hospital AKI episodes to patients' primary care providers are often inadequate. Awareness of AKI among patients is generally poor.

Objective: To develop a multifaceted intervention package to improve post-AKI care, to evaluate its implementation using feasibility and process metrics, and to observe its short-term effectiveness.

Design: Mixed-methods feasibility study with type 3 hybrid implementation/effectiveness design.

Participants: Kidney specialist physicians on inpatient consultation service at three hospital sites in British Columbia (in New Westminster, Prince George, Vancouver) will deliver the intervention package to patients with AKI and their primary care providers.

Measurements: Implementation outcomes include reach, adoption, fidelity, and sustainment of the intervention. Implementation determinants, including acceptability, adaptability, feasibility, appropriateness, and satisfaction, will be assessed with surveys and focus groups with kidney specialist physicians, primary care providers, and patients/caregivers. Short-term effectiveness outcomes include: patient follow-up visits with primary care providers, and kidney lab testing at three months; AKI awareness and self-efficacy among primary care providers and patients.

Methods: Guided by the Theoretical Domains Framework, we conducted focus groups with interest holders to identify the barriers, challenges, and needs in post-AKI care and then applied this information to develop an intervention package, including an AKI-specific discharge/sign-off template, a post-AKI medication management guide, educational websites for providers and patients, and a patient handout. In this six-month implementation feasibility study, the implementation strategies will be initiated sequentially at each site for four to eight weeks. Quantitative data will be collected via self-report, chart review, surveys, and website hits and analyzed using descriptive statistics. Postimplementation qualitative data will be collected from focus groups/interviews and will be analyzed by identifying codes and categorizing them into themes.

Limitations: The study will take place in the setting of nephrology consultation services. Adaptations to implementation strategies would be required for delivery of the intervention by other inpatient providers.

Conclusions: The study will evaluate feasibility and preliminary effectiveness of a multifaceted intervention aimed at improving care coordination between specialists and primary care providers and care transition following hospital discharge in patients experiencing AKI.

Study Registration: This study is not registered.

Abrégé

Contexte: Les hospitalisations pour insuffisance rénale aiguë (IRA) sont associées à des effets délétères à long terme sur la santé. Or, le suivi en soins primaires après un épisode d'IRA reste insuffisant. Ces épisodes sont encore mal documentés et mal communiqués aux prestataires de soins primaires, et les patients ont généralement une compréhension limitée de la maladie.

Objectifs: Concevoir un programme d'intervention multifacette pour améliorer les soins post-IRA, évaluer sa mise en œuvre à l'aide de paramètres de faisabilité et de processus et observer son efficacité à court terme.

Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 License (https://creativecommons.org/licenses/by-nc/4.0/) which permits non-commercial use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access pages (https://us.sagepub.com/en-us/nam/open-access-at-sage).

Conception: Étude de faisabilité par méthodes mixtes fondée sur un modèle hybride de type 3 combinant évaluation de la mise en œuvre et mesure de l'efficacité.
Sujets: Les néphrologues des services de consultation en milieu hospitalier de trois centres en Colombie-Britannique (New Westminster, Prince George et Vancouver) livreront la trousse d'intervention aux patients atteints d'IRA et à leurs prestataires de soins primaires.
Mesures: Les résultats liés à la mise en œuvre incluent la portée, l'adoption, la fidélité et la pérennisation de l'intervention. Les déterminants de la mise en œuvre, notamment l'acceptabilité, l'adaptabilité, la faisabilité, la pertinence perçue et la satisfaction, seront évalués par questionnaires et groupes de discussion auprès des néphrologues, des prestataires de soins primaires et des patients et de leurs aidants. Les indicateurs d'efficacité à court terme incluent la fréquence des suivis en soins primaires, la réalisation d'analyses de laboratoire rénales dans les trois mois, ainsi que le niveau de sensibilisation à l'IRA et le sentiment d'auto-efficacité des prestataires de soins primaires et des patients.
Méthodologie: Des groupes de discussion auprès des parties prenantes, guidés par le *Theoretical Domains Framework*, ont permis d'identifier les obstacles, les défis et besoins relatifs à la prise en charge post-IRA. Ces données ont orienté la conception d'une intervention multifacette comprenant un modèle de sortie hospitalière avec un document récapitulatif du séjour hospitalier spécifique pour l'IRA, une réconciliation médicamenteuse, des ressources éducatives en ligne pour les professionnels et les patients, ainsi qu'un document d'information destiné aux patients. Dans cette étude de faisabilité de six mois, les stratégies de mise en œuvre seront déployées séquentiellement sur les différents sites, chacune durant 4 à 8 semaines. Les données quantitatives, recueillies par auto-déclaration, examen des dossiers médicaux, sondages et consultation des statistiques de fréquentation des sites Web, seront analysées par statistiques descriptives. Les données qualitatives après la mise en œuvre, recueillies à partir de groupes de discussion et d'entretiens, feront l'objet d'une analyse thématique par codification.
Limites: L'étude se déroulera dans les services de consultation en néphrologie. Des stratégies de mise en œuvre modifiées devront être envisagées pour permettre la réalisation de l'intervention par d'autres intervenants en milieu hospitalier.
Conclusion: Cette étude évaluera la faisabilité et l'efficacité préliminaires d'une intervention multifacette visant à améliorer la coordination entre les soins spécialisés et les soins primaires, ainsi que la transition des soins après la sortie de l'hôpital chez les patients ayant vécu un épisode d'IRA.

Keywords
acute kidney injury, implementation, discharge summary, education, transition of care, post-AKI care

Received: August 1, 2025. Accepted for publication January 19, 2026.

Background

Acute kidney injury (AKI), defined as an abrupt decrease in kidney function occurring over seven days or less, occurs in 20% of hospitalized patients. Short-term, AKI contributes to higher risk of in-hospital death and greater healthcare costs.[1,2] The post-AKI period is also associated with longer-term health consequences including increased risks of death, rehospitalization, cardiovascular disease, and progression to chronic kidney disease (CKD), including end-stage kidney disease.[3,4] Survivors of AKI also have increased physical debility and lower quality of life than survivors of critical illness without AKI.[3]

The Kidney Disease Improving Global Outcomes (KDIGO) 2012 guideline for AKI recommends that patients be evaluated three months after AKI for resolution, new onset of CKD, or worsening of pre-existing CKD.[5] A previous prospective study has also noted the three-month post-discharge kidney lab testing (serum creatinine to obtain estimated glomerular filtration rate [eGFR] and urine albumin-to-creatinine ratio [uACR]) provides important prognostic information regarding long-term cardiovascular events and death.[6]

However, while a majority of patients have a primary care visit within 3 months following AKI discharge, numerous studies from North America demonstrated that only ~60% of

[1]Division of Nephrology, University of British Columbia, Vancouver, Canada
[2]BC Kidney Research Unit, BC Renal, Vancouver, Canada
[3]Faculty of Medicine, University of British Columbia, Vancouver, Canada
[4]Division of Nephrology, University Hospital of Northern British Columbia, Prince George, Canada

Corresponding Author:
Michelle M. Y. Wong, Division of Nephrology, University of British Columbia, c/o 6AB Providence Building, 1081 Burrard Street, Vancouver, BC V6Z 1Y6, Canada.
Email: michelle.wong1@ubc.ca

patients hospitalized with AKI have kidney function checked within the KDIGO guideline-recommended three months after AKI discharge, and only ~5% to 10% of patients have urine ACR testing within three months after AKI.[7-9] Given that post-AKI proteinuria is an important prognostic indicator of future kidney disease progression,[10,11] there is a need to address this gap in post-AKI care.

The main challenge to post-AKI care is a lack of awareness about AKI and its associated risks among both patients and primary care providers. Awareness of AKI among patients is generally poor, with ~53% of patients with AKI being unaware they had experienced AKI or had "a problem with their kidneys."[12,13] Documentation and communication about in-hospital AKI episodes to patients' primary care providers is also suboptimal. Two previous Canadian studies found the quality of discharge summaries in patients hospitalized with AKI to be generally poor, with over 50% lacking information on AKI occurrence, etiology, severity, and specific follow-up recommendations for investigations or management.[8,9]

In addition to monitoring of kidney status, post-AKI medication management is an important part of patient follow-up in the primary care setting. Many cardio- and reno-protective medications, such as renin-angiotensin-aldosterone-system inhibitors (RAASi), are often discontinued during hospitalization because of their acute effects on kidney function. However, failure to restart RAASi within the first three months after AKI discharge has been associated with higher long-term risks of death and cardiovascular events, compared with continuation of RAASi after AKI.[14] Post-AKI medication management in the primary care setting has challenges arising from clinical complexity and coordination with hospital physicians, specialists, and allied health professionals.[15]

Strategies to improve post-AKI follow-up have included AKI clinics with interdisciplinary health care providers, including a nurse, pharmacist, and kidney specialist physicians.[13,16] In one study, a specialized post-AKI clinic was associated with a lower risk of death and increased prescriptions for some cardioprotective medications (beta blockers, statins, sodium-glucose cotransport 2 inhibitors [SGLT-2 inhibitors]), but was not associated with a lower risk of major adverse kidney events.[16] AKI survivors who declined study enrollment cited many barriers to having in-person follow-up at a nephologist-led post-AKI clinic, including hospitalization-related fatigue, long travel times, and reluctance to see more doctors.[16] Even if some patients may be seen in AKI clinics or by kidney specialist physicians after hospitalization, primary care practitioners are the main providers for most patients following AKI. Therefore, optimizing resources, support, and education for primary care is of key importance in improving outcomes for patients after AKI.

In prior studies, physician education strategies and AKI-specific discharge summary templates have demonstrated improvements in the quality and completion of discharge summaries for patients hospitalized with AKI.[17,18] Strategies to enhance patient engagement following AKI have also been studied, including patient-centered education and better care coordination upon transition to outpatient primary care.[19]

In the preliminary phase of our study, we gathered contextual information on the quality of discharge summaries for patients with AKI in British Columbia (BC), Canada.[8] We also collected information from knowledge users on the current practices for managing patients following AKI, including barriers and facilitators to optimal post-AKI follow-up. This foundational work provided critical insights into workflow barriers, communication breakdowns, and knowledge gaps across the care continuum, which informed the subsequent codesign of a post-AKI care pathway, including targeted educational interventions for patients and providers, tailored to our regional context. Here we describe the study design for our implementation feasibility study.

The study objectives are:

1. To develop a multifaceted intervention package to improve post-AKI care, informed by preimplementation focus groups ("preimplementation phase");
2. To evaluate the implementation of the intervention package using feasibility and process metrics;
3. To observe short-term effectiveness of the intervention package in improving post-AKI care.

Preimplementation Phase: Understanding Context

Prior to our implementation study, we aimed to understand the local context regarding the quality of discharge summaries of patients admitted with AKI and to build relationships and engage with knowledge users to identify the barriers, challenges, and needs in improving AKI care. Guided by the Theoretical Domains Framework,[20] we conducted focus groups with a multidisciplinary team of health care providers (family medicine, kidney specialist physicians, pharmacists, nurse practitioners) and patient partners (including caregivers) from different health authorities in BC. We focused on AKI knowledge, beliefs about capabilities, beliefs about consequences, professional role, environmental context and resources, and current barriers/gaps in care.

Patient perspectives identified difficulties with being able to comprehend the consequences of AKI and self-management at the time of discharge. Patients mentioned they tend to depend on their family members for assistance. They also indicated the importance of having an information source they could review in the future. Primary care providers described the quality of current hospital discharge summaries as variable. No formal system existed to consistently flag or follow patients with AKI after hospital discharge, despite repeated concerns raised by nephrology clinicians about preventable complications and missed opportunities for early intervention. Discharge summaries tended to be

notoriously slow, delayed, or even nonexistent. Follow-up plans, identification of providers responsible for follow-up, and medication instructions were often unclear.

Overall, the following gaps were identified:

- Lack of formal patient education and resources: Patients may not be aware of the occurrence of AKI or may not be able to comprehend or recall the information they received about their diagnosis. Patients have found it hard to keep track of their medications, when to stop them, and which of their medications they need to restart. Patients usually leave the hospital with little to no education on AKI or resources for self-management of kidney disease and prevention of future episodes of AKI.
- Lack of or insufficient details in hospital discharge summary: Discharge summaries were not sent to primary care providers, were delayed, or did not provide adequate AKI-related information.
- Lack of a follow-up plan: It was often unclear which provider is following up with the patient, the timing of follow-up and outpatient lab testing, when to restart the medications, and when to consider referral to a kidney specialist physician.

Gaps identified during the focus groups were consistent with the current literature. Therefore, we focused on developing resources and tools for patients (including their families and caregivers) and primary care providers to improve AKI awareness and post-AKI management.

Development of Post-AKI Intervention Package and Implementation Strategies

We mapped the information from the focus groups with the Capability, Opportunity, Motivation—Behavior (COM-B) Model for Behavior Change[21,22] to develop the implementation strategies.

Education. A multidisciplinary working group and the Steering Committee developed and reviewed each of the following components.

Provider-facing *(focused on primary care providers).* Post-AKI discharge template: an AKI-specific discharge summary or sign-off template containing the essential information[9] regarding the AKI episode (Supplemental Material). At each study site, the template will be integrated into the electronic medical record (e.g. using a template or a macro). Where possible, the template will auto-populate with relevant lab values and prompts physicians to include clinical details regarding the AKI episode and the follow-up plan.

Post-AKI medication guidance: a guide for health care providers regarding medication considerations in patients with CKD, medications to hold during AKI, and post-AKI medication reinitiation. A link to this guide is included in the post-AKI discharge template.

An online toolkit for providers: Topics include the definition of AKI, its consequences, a suggested strategy for follow-up and lab monitoring, and criteria for nephrology referral. This toolkit will be accessible to print and download on the BC Renal website. The post-AKI discharge/sign-off template will include a link to the toolkit on the BC Renal website (http://www.bcrenal.ca/health-professionals/clinical-resources/acute-kidney-injury).

Webinars: An educational webinar aimed at primary care providers and allied health professionals will be recorded and added to the toolkit page on the website. We will also have educational webinars (led by the research team and a selected site champion) for the local kidney specialist physicians on how to use the discharge summary/sign-off template

A summary of the provider toolkit will be posted on Pathways (https://pathwaysbc.ca/login), an online resource for clinicians in British Columbia, which will link to the BC Renal toolkit website.

Patient-facing. Patient/caregiver handout: A one-page handout will be provided to patients/family/caregivers at the time of discharge. The handout describes AKI, its health consequences, and the importance of having lab testing and health care provider visits after discharge (Supplemental Material).

Online toolkit for patients/caregivers: Educational material includes the kidney's functions, the definition of AKI, the health consequences of AKI, post-AKI dietary management, mental health resources, and CKD self-management resources. The patient handout will include a link/QR code to the toolkit (http://www.bcrenal.ca/health-info/kidney-care/acute-kidney-injury). This toolkit will be accessible to print and download on the BC Renal website.

Patient webinar: an educational webinar will be recorded and added to the toolkit website.

Hospital site champion. A local physician champion at each site (see Study Design below) will be recruited to support health care providers in managing patients who have experienced AKI. The champion will promote recognition of the importance of AKI and encourage the use of the discharge/sign-off template and educational resources. They will also participate in the educational webinars and in-service training for nephrologists.

Self-monitoring. Hospital physicians/site champions will receive an honorarium for collecting data regarding the number of inpatients with AKI they are following, and the number of patients for whom they have used the discharge/sign-off template and provided the patient handout.

Methods: Implementation Feasibility Study

Study design

During the 6-month feasibility study, a pre-post intervention mixed-methods study is planned at three hospital sites, each located in a different health region in British Columbia: University Hospital of Northern British Columbia, Prince George (Northern Health Authority); Royal Columbian Hospital, New Westminster (Fraser Health Authority); St. Paul's Hospital, Vancouver (Providence Health Care). These sites were purposefully selected to reflect a range of geographic, organizational, and population contexts to enhance the generalizability and relevance and allow for evaluation of the intervention's feasibility and adaptability in both urban and rural settings.

The implementation strategies will be initiated sequentially at each site and continue for four to eight weeks, during which we aim to include approximately 12 to 15 kidney specialist physicians providing consultative care to approximately 75 admitted patients with AKI across all sites. This number was selected pragmatically based on the anticipated nephrology sign-off volumes across the three sites and to enable stable estimation of key feasibility outcomes needed to inform a future definitive hybrid implementation-effectiveness trial. In this feasibility study, kidney specialist physicians doing inpatient consultation service will be consented to participate in the study, and they will be the personnel delivering the following interventions:

a) Completing the AKI discharge/sign-off template, and providing a copy to the patient's primary care provider and the patient/family member/caregiver
b) Providing patient/family member/caregiver with a copy of the one-page patient educational handout on AKI

For unattached patients without an established primary care provider, they will be encouraged to seek alternative primary care follow-up through an urgent care clinic that accepts patients for longitudinal care, or a walk-in clinic. For unattached First Nations patients, they may follow up with the "First Nations Virtual Doctor of the Day" service.[23]

For kidney transplant recipients with AKI, patients already followed by a nephrologist, and patients who remain on kidney replacement therapy at discharge, the participating kidney specialist physicians will be instructed to deliver the AKI package by the time of discharge, but to modify the details in the template note as needed, such as adding information about planned outpatient follow-up by the kidney specialist physician, kidney clinic, transplant clinic and/or dialysis unit.

Prior to the feasibility study, we will engage in process mapping at each site and consult with site administration and health authority representatives to enable integration of the intervention into existing workflows. We will also develop an implementation manual to guide implementation delivery.

Outcomes. The feasibility study will focus on implementation and feasibility outcomes, while observing short-term effectiveness outcomes. The selection of outcomes was based on the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) Framework, which emphasizes reaching the target population, effectiveness, adoption by target staff/settings, implementation consistency, costs and adaptions made during delivery, and maintenance/sustainment of intervention effects in individuals and settings over time.[24]

To understand the implementation of a multi-pronged intervention to improve follow-up care after AKI, we will assess the following implementation outcomes: reach, adoption, fidelity, and sustainability, measured at the level of the hospital health care provider (Table 1).

Implementation determinants, including acceptability, adaptability, feasibility, appropriateness, satisfaction, will be assessed at the level of the hospital providers, primary care providers, and the patient/family if applicable (Table 1).

Effectiveness of the intervention will be observed by the number and percent of patients discharged with AKI who have outpatient follow-up with their primary health care provider within 3 months following discharge. We will also use surveys to assess improvement in AKI awareness, self-efficacy among primary care providers. Patient follow-up visits and lab testing will be assessed by chart review at 3 months following the date of the discharge/sign-off template.

Data collection. Quantitative and qualitative data will be collected using the following methods:

1. System level
   Use of the AKI toolkit on the BC Renal website will be tracked by number of hits, downloads, or views (clicks on links in the discharge summary and links in Pathways).
2. Health care provider level
   a) Hospital providers (kidney specialist physicians on consultation service): A survey administered at baseline (preintervention) will address discharge summary reporting and satisfaction with current communication with primary care providers regarding AKI. At the end of the implementation period, they will be asked the same questions as the presurvey, plus additional questions about implementation (satisfaction, ease, time needed to deliver the intervention). They will self-report the number of patients for whom they used the AKI discharge/sign-off template and gave the patient handout. These aggregate data will be collected weekly from their patient

Table 1. Outcomes for Post–Acute Kidney Injury Study (based on McKay et al.)[25].

Outcome	Definition of the outcome	Data collection
Reach	Number (%) and representativeness of patients with AKI (followed by and signed off by the nephrology inpatient service) who receive the AKI discharge summary and educational material	Inpatient physician/site champion collects aggregate data from chart review/patient lists Patient survey Patient toolkit website visits/hits
Adoption	Number (%) and representativeness of physicians who use the AKI template for discharge/sign-off documentation	Inpatient physician survey
Fidelity	Extent to which interventions were implemented by the delivery team as prescribed in the protocol	Fidelity checklists Inpatient physician survey
Sustainability	Whether the intervention continues to be delivered/behavior change is maintained (at t=3 months)	Inpatient physician survey
Effectiveness	Number (%) of patients with AKI who follow up with health care provider and have lab testing within 3 months of discharge	Chart review
Knowledge	Improved awareness and understanding of AKI and its consequences	Primary care provider survey Patient survey
Context	Aspects of social, political, and economic environment that may influence intervention implementation	Provider and patient surveys and focus groups/interviews
Acceptability	Perceptions among the delivery team that the intervention is agreeable/satisfactory	Provider survey and focus groups/interviews
Adaptability	Extent to which the intervention can be adapted, tailored, refined, or reinvented to meet site needs	Provider survey and focus groups/interviews
Feasibility	Perceptions among delivery team that the interventions can be successfully used/carried out in their setting	Provider survey and focus groups/interviews
Compatibility	Extent to which an intervention fits with mission, priorities, values of the organization	Provider survey and focus groups
Culture	Organization's norms, values, basic assumptions that influence implementation of the intervention	Provider survey and focus groups
Satisfaction	Delivery team's and primary care providers' satisfaction with the intervention and with the interactions with the support system. Patient satisfaction with clinical care, access to healthcare information, educational resources	Provider survey and focus groups Patient survey (QR code on patient handout)
Complexity	Delivery team's perceived difficulty in implementing the intervention; number of different intervention steps/components	Provider survey and focus groups/interviews
Self-efficacy	Delivery team's belief in its ability to execute actions to achieve implementation goals	Provider survey and focus groups/interviews

lists by the participating kidney specialist physician/site champion.

b) Primary care providers: A baseline (preintervention) survey will ask about knowledge level regarding AKI and post-AKI medication management, confidence in managing/supporting patients who experienced AKI, and access to AKI educational resources. At three months postintervention, a follow-up survey will ask which resources were accessed (discharge template, online toolkit, medication guide) and ask them to rate each resource on ease of use, relevance, usefulness, and influence on patient care. Providers who attend educational webinars will also be asked to fill out prewebinar and postwebinar surveys.

c) End-of-project focus groups or interviews with leads at each hospital site, primary care providers, and the core research team will address implementation determinants listed in Table 1.

3. Patient-level

a) Patient surveys will be administered via using a QR code/link provided on the patient educational handout which will be provided to the patient before discharge. This short survey will ask questions about general demographics, access to a primary care provider, as well as elicit feedback on AKI education resources, including clarity, satisfaction, and improvement in ability to self-manage their condition. A follow-up survey, administered three months postdischarge, will ascertain follow-up care including health care provider visits, lab tests, and medication changes. This data may also be ascertained by chart review.

b) Focus groups/interviews: At the end of the study, patients will be asked to provide feedback on the

educational resources, and to discuss facilitators and barriers to following recommendations.

b) Chart review data: With the support of physician champions at each site, participating nephrologists will report deidentified aggregate data from a chart review, that includes AKI-related demographics for patients they've signed off (reason for AKI, AKI severity, AKI recovery, comorbidities). These data will be collected weekly. Postimplementation, nephrologists/site champions will also be asked to report deidentified aggregate data from a chart review on follow-up metrics for their consult list patients whom they have signed off (i.e., number of patients with AKI who had follow-up primary care visits and kidney lab tests, number of patients with AKI with rehospitalization three months after sign-off).

Data analysis. Evaluation of implementation and effectiveness outcomes listed in Table 1 will involve quantitative and qualitative data. Descriptive analyses of quantitative data (means/medians, frequencies) from surveys and clinical data will be performed using SAS 9.4M8 (SAS Institute Inc., Cary, NC, USA). Qualitative data from surveys, focus groups/interviews will be recorded and transcribed. Two research team members will independently identify codes and categorize them into themes using NVivo 12 software (Lumivero).

For the feasibility study, our goal will be to have adoption of the intervention by 75% of kidney specialist physicians on inpatient service, and a reach of 75% of relevant patients receiving the intervention. Regardless of the actual adoption and reach rates achieved, qualitative data on the implementation determinants will identify the core components of the implementation strategies that are essential to the delivery of the intervention, and any adaptations that are required at each site.

Subgroup analyses

- By health authority/rural *vs.* urban, using the Statistics Canada definitions (urban areas are defined as having a minimum population concentration of 1000 persons and population density of at least 400 persons per square kilometer).
- Patients attached to a primary care provider before hospitalization *vs.* unattached patients
- By patient age group
- By sex and gender

Ethical considerations. Ethics approval for study planning, including focus groups, has been approved by the University of British Columbia Research Ethics Board (REB # H20-03310). Ethical approval for the feasibility study was obtained from the Fraser Health Research Ethics Board and also reviewed and approved by the Providence Health Care Research Ethics Board and Northern Health (Study H24-01739).

Governance. Our Steering Committee consists of two kidney specialist physician co-leads, a primary care co-lead, a pharmacist, a kidney specialist physician from the Northern Health Authority, 2 patient partners with lived experience of AKI, and the Executive Director of BC Renal.

Multidisciplinary working group members include kidney specialist physicians, primary care providers, pharmacists, dietitians, and patient/caregiver partners. Additionally, administrative and information technology personnel, evaluation specialists, implementation science mentors, and the provincial funder are consulted on an ongoing basis (Figure 1).

Equity considerations. We are incorporating equity considerations by codesigning and piloting educational materials and implementation strategies for patients and providers in various health authorities in diverse communities. For example, in the Northern Health Authority is mainly comprised of rural or remote areas, with a large First Nations population. First Nations primary care provider and patient inputs have indicated the importance of involving the "First Nations Virtual Doctor of the Day" service in our implementation strategies, as many First Nations people seek primary care through this service. This has informed our approach and highlighted the need for adaptation to each setting.

People at greater risk of AKI include those who are older and have pre-existing comorbidities. Therefore, to optimize the communication strategy, our patient-facing material will be accessible using both online and print formats, and will be provided to the patient's family/caregiver if needed. For our study outcomes, we will assess equity and representativeness of reach within our target patient population, and representativeness of hospital physicians who use/do not use the AKI template for discharge/sign-off documentation.

Dissemination/engagement activities. Our findings will be shared at conferences (including nephrology, primary care, and quality improvement/implementation meetings), published in academic journals, and presented at webinars for physicians, allied health professionals and patients, as well as infographics/newsletters for patients.

Discussion

Post-AKI care is an area ripe for quality improvement. There are currently significant gaps in (1) communication about AKI at the transition of care from inpatient to outpatient, (2) knowledge among primary care providers regarding

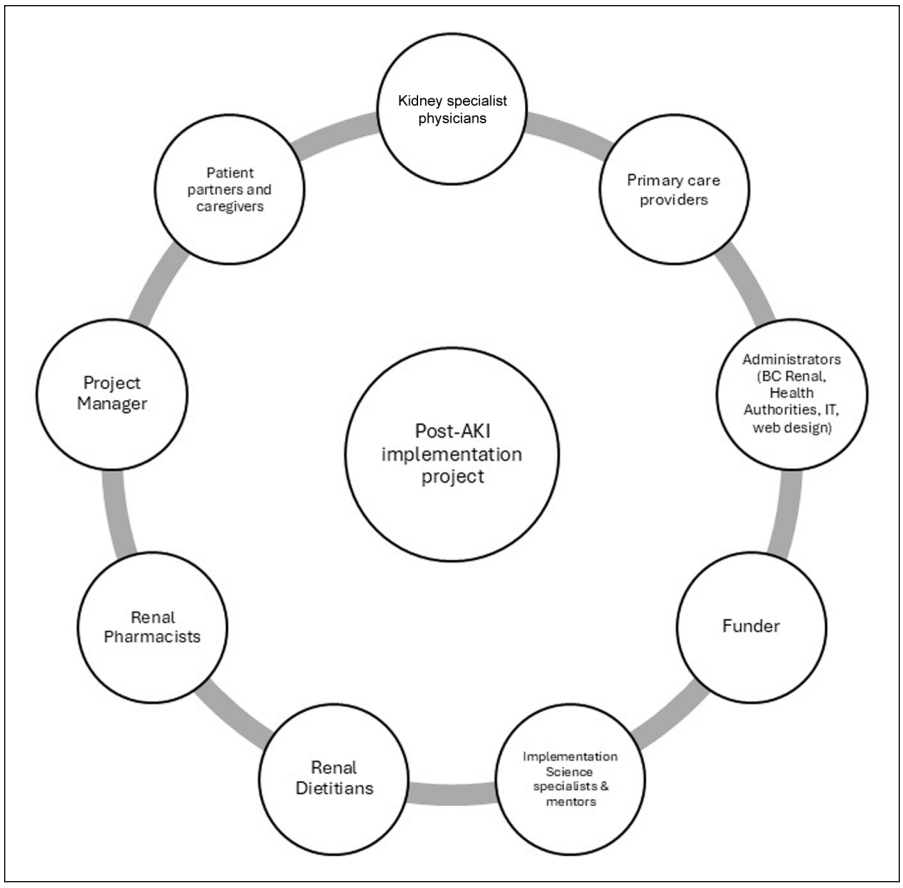


Figure 1. Interest holders in post-AKI implementation project.

managing patients after AKI, and (3) awareness among patients about the importance of AKI and follow-up care. We described the design of our feasibility implementation study encompassing the development and evaluation of AKI educational strategies directed at patients and primary care providers.

One strength of the study is that we obtained broad knowledge user input from multidisciplinary health care professionals from multiple health regions in BC, to ensure relevance in the design of the educational components of the intervention in both urban and rural settings. Another strength is the established infrastructure of BC Renal, the organization that administers kidney care in BC using province-wide clinical standards and guidelines. This support will ensure sustainability of the project and facilitate future scale-up across the province. Additionally, the study is informed by engagement with Indigenous populations and patient partners through resources and partnerships developed through the CanSOLVE CKD Network, including KidneyLink, an online platform to connect researchers with patient partners,[26] and KidneyPro, a training module for patient partners in research.[27] These relationships have helped shape tools that support culturally safe care and ensure that the intervention is aligned with the principles of respect, relevance, and reconciliation when working with Indigenous communities.

A limitation of the feasibility study will take place in the setting of nephrology consultation service. Delivery of the intervention by other inpatient providers (e.g. general internists, hospitalists, surgeons) will likely require minor adaptations to the implementation strategies. In particular, more background education on the recognition of AKI and its health consequences would likely be needed. Additional engagement with focus groups of other types of hospital providers will be essential to ensure successful implementation in broader hospital settings. However, the current study will allow us to optimize the core components of the intervention and it will inform a future study in which we will scale up to province-wide implementation. This future study will be a pragmatic, stepped-wedge clinical trial with a type 2 effectiveness-implementation hybrid design.

In summary, the present study will evaluate educational strategies aimed at improving follow-up care after AKI hospitalization, and identify barriers and facilitators to their implementation. The study will inform implementation strategies to deliver a post-AKI intervention, with the goal of improving care coordination between specialists and primary

care providers, and care transition following hospital discharge in patients experiencing AKI.

Acknowledgments

The authors would like to thank Drs. Megan Borkum and Mohammad Atiquzzaman for reviewing the manuscript. The authors also acknowledge Dr. Linda Li who provided mentorship on implementation science aspects, and members of the International Society of Nephrology Emerging Leaders Program cohort 1 who developed early versions of post-AKI educational tools.

ORCID iDs

Michelle M. Y. Wong https://orcid.org/0000-0002-1334-0763
Peter Birks https://orcid.org/0000-0002-6418-4676
Omosomi Enilama https://orcid.org/0009-0009-8072-3711
Anurag Singh https://orcid.org/0009-0006-0497-5771

Authors' Contributions

All authors contributed to the design and protocol of the study and to obtaining funding. MMYW drafted the manuscript. PB, OE, JSWY, AS, and AL reviewed the manuscript and provided comments and reviews. All authors read and approved the final manuscript.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study is funded by the Shared Care Committee, a partnership of the government of British Columbia and Doctors of BC, and UBC Health.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Supplemental Material

Supplemental material for this article is available online.

References

1. Silver SA, Chertow GM. The economic consequences of acute kidney injury. *Nephron*. 2017;137(4):297-301. doi:10.1159/000475607.
2. Sohaney R, Yin H, Shahinian V, et al. In-hospital and 1-year mortality trends in a national cohort of US veterans with acute kidney injury. *Clin J Am Soc Nephrol*. 2022;17(2):184-193. doi:10.2215/CJN.01730221.
3. Silver SA, Harel Z, McArthur E, et al. Causes of death after a hospitalization with AKI. *J Am Soc Nephrol*. 2018;29(3):1001-1010. doi:10.1681/ASN.2017080882.
4. Schulman IH, Chan K, Der JS, et al. Readmission and mortality after hospitalization with acute kidney injury. *Am J Kidney Dis*. 2023;82(1):63-74.e1. doi:10.1053/j.ajkd.2022.12.008.
5. Khwaja A. KDIGO clinical practice guidelines for acute kidney injury. *Nephron Clin Pract*. 2012;120(4):c179-c184. doi:10.1159/000339789.
6. Ikizler TA, Parikh CR, Himmelfarb J, et al. A prospective cohort study of acute kidney injury and kidney outcomes, cardiovascular events, and death. *Kidney Int*. 2021;99(2):456-465. doi:10.1016/j.kint.2020.06.032.
7. US Renal Data System. *2022 USRDS Annual Data Report: Acute Kidney Injury*. Bethesda, MD: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases; 2023.
8. Birks P, Al-Zeer B, Holmes D, et al. Assessing discharge communication and follow-up of acute kidney injury in British Columbia: a retrospective chart review. *Can J Kidney Health Dis*. 2024;11:20543581231222064. doi:10.1177/20543581231222064.
9. Giles C, Novakovic M, Hopman W, et al. The quality of discharge summaries after acute kidney injury. *Can J Kidney Health Dis*. 2023;10:20543581231199018. doi:10.1177/20543581231199018.
10. Hsu CY, Chinchilli VM, Coca S, et al. Post-acute kidney injury proteinuria and subsequent kidney disease progression: the assessment, serial evaluation, and subsequent sequelae in acute kidney injury (ASSESS-AKI) study. *JAMA Intern Med*. 2020;180(3):402-410. doi:10.1001/jamainternmed.2019.6390.
11. Su L, Li Y, Chen R, et al. Epidemiology and outcomes of post-AKI proteinuria. *Clin Kidney J*. 2023;16(11):2262-2270. doi:10.1093/ckj/sfad129.
12. Siew ED, Parr SK, Wild MG, et al. Kidney disease awareness and knowledge among survivors of acute kidney injury. *Am J Nephrol*. 2019;49(6):449-459. doi:10.1159/000499862.
13. Ortiz-Soriano V, Alcorn JL III, Li X, et al. A survey study of self-rated patients' knowledge about AKI in a post-discharge AKI clinic. *Can J Kidney Health Dis*. 2019;6:2054358119830700. doi:10.1177/2054358119830700.
14. Janse RJ, Fu EL, Clase CM, et al. Stopping versus continuing renin-angiotensin-system inhibitors after acute kidney injury and adverse clinical outcomes: an observational study from routine care data. *Clin Kidney J*. 2022;15(6):1109-1119. doi:10.1093/ckj/sfac003.
15. Phipps DL, Morris RL, Blakeman T, Ashcroft DM. What is involved in medicines management across care boundaries? a qualitative study of healthcare practitioners' experiences in the case of acute kidney injury. *BMJ Open*. 2017;7(1):e011765. doi:10.1136/bmjopen-2016-011765.
16. Silver SA, Adhikari NK, Bell CM, et al. Nephrologist follow-up versus usual care after an acute kidney injury hospitalization (FUSION): a randomized controlled trial. *Clin J Am Soc Nephrol*. 2021;16(7):1005-1014. doi:10.2215/CJN.17331120.
17. Nye C, Lake S. Acute kidney injury; improving the communication from secondary to primary care. *BMJ Qual Improv Rep*. 2017;6(1):u211147.w6661. doi:10.1136/bmjquality.u211147.w6661.
18. Reschen ME, Vaux E. Improving the completeness of acute kidney injury follow-up information in hospital electronic discharge letters. *BMJ Open Qual*. 2017;6(2):e000022. doi:10.1136/bmjoq-2017-000022.
19. Siew ED, Liu KD, Bonn J, et al. Improving care for patients after hospitalization with AKI. *J Am Soc Nephrol*. 2020;31(10):2237-2241. doi:10.1681/ASN.2020040397.
20. Atkins L, Francis J, Islam R, et al. A guide to using the Theoretical Domains Framework of behaviour change to inves-

tigate implementation problems. *Implement Sci*. 2017;12(1):77. doi:10.1186/s13012-017-0605-9.
21. The Decision Lab. The COM-B model for behavior change. https://thedecisionlab.com/reference-guide/organizational-behavior/the-com-b-model-for-behavior-change/. Published March 25, 2025. Accessed February 23, 2026.
22. The Center for Implementation. StrategEase tool. https://the centerforimplementation.com/strategease-tool. Published May 7, 2025. Accessed February 23, 2026.
23. First Nations Health Authority. First Nations virtual doctor of the day. https://www.fnha.ca/what-we-do/ehealth/virtual-doctor-of-the-day. Accessed March 27, 2025.
24. RE-AIM. https://re-aim.org/. Accessed September 6, 2024.
25. McKay H, Naylor PJ, Lau E, Gray SM, Wolfenden L, Milat A, Bauman A, Race D, Nettlefold L, Sims-Gould J. Implementation and scale-up of physical activity and behavioural nutrition interventions: an evaluation roadmap. *Int J Behav Nutr Phys Act*. 2019;16(1):102. doi: 10.1186/s12966-019-0868-4.
26. CanSOLVE CKD Network. KidneyLink. https://cansolveckd.ca/resources/kidneylink/. Accessed March 25, 2025.
27. CanSOLVE CKD Network. KIDNEY PRO: promoting kidney research in Canada. https://kidneypro.ca/#/. Accessed March 25, 2025.