



Scope of Work

KDIGO Clinical Practice Guideline for Acute Kidney Injury (AKI) and Acute Kidney Disease (AKD) Update 2023

Background

Acute kidney diseases and disorders (AKD) include abnormalities of kidney function and structure present for <3 months. Acute kidney injury (AKI) is defined as a subset of AKD, with onset of development within 7 days due to a variety of causes. While global estimates of the incidence of AKI and AKD have varied, many studies show that these clinical syndromes are common, with recent population-based estimates of AKI/AKD incidence ranging from 114 to 174 people per 10,000 person-years. AKI and AKD often occur in people living with multiple chronic conditions and interactions between susceptibility and the type and extent of exposure to insults determine the risk of occurrence of AKI and AKD. Both AKI and AKD have been associated with high morbidity and mortality, as well as development and progression of chronic kidney disease (CKD).

In 2012, KDIGO published its first clinical practice guideline for AKI. The guideline was derived from systematic reviews of evidence available until February 2011, addressed definition, risk assessment, evaluation, prevention, and treatment of AKI, and was intended to provide recommendations to improve the care of people with or at risk of AKI. Since then, KDIGO has convened 2 conferences that identified areas where knowledge has significantly advanced since the publication of the original guideline. In 2019, the *KDIGO Controversies Conference on Acute Kidney Injury* revisited KDIGO AKI nomenclature and diagnostic criteria, discussed AKI risk stratification and the role of biomarkers in this process, examined the role of resuscitation fluids and nephrotoxins in the critically ill, and addressed timing and modality of kidney replacement therapy (KRT) in AKI. In 2020, KDIGO convened a Consensus Conference on *Harmonizing Acute and Chronic Kidney Disease Definitions and Classification* to develop classification and management recommendations for AKD that harmonized with those for AKI and CKD. The topics covered by the original guideline, accompanied by the conclusions from the subsequent Controversies



and Consensus conferences, provide a foundation for this Scope of Work proposed for an update to the KDIGO Clinical Practice Guideline for AKI and AKD.

Since 2012, new knowledge and evidence has emerged which has important implications for clinical practice and should be considered for integration into an updated guideline for AKI and AKD. New insights related to the epidemiology and risk profile of AKI and AKD (including in middle and low resource countries) are available and new tools have been developed to predict the risk of AKI and AKD (including community acquired AKI and AKD), describe “phenotypes” and “sub phenotypes” of AKI, and stratify risk of downstream clinical outcomes for people with AKI. There has also been substantial research on interventions and strategies to prevent and manage AKI, and the effectiveness of several elements of care outlined in the KDIGO 2012 AKI guideline have been further investigated in recent randomized controlled trials (RCTs). Results of RCTs have provided new data, in particular related to early resuscitation, fluid therapy, and strategies for prevention of contrast-associated AKI and nephrotoxic AKI, as well as timing of acute KRT. Finally, there is increasing evidence that children and adults who experience AKI remain at varying risks of serious long-term health issues, decreased quality of life, and increased mortality. Additional evidence has emerged that is relevant to hospital-to-home transitions and the role that follow-up and individualized models of care may play in improving long-term outcomes.

The updated KDIGO Clinical Practice Guideline for AKI and AKD is intended for a broad range of healthcare providers across the world, including nurses, primary care physicians, and allied healthcare professionals who are involved in the care of people with, at risk, or who have experienced AKI or AKD, and is envisioned to also be relevant to people who have experienced or are at risk of these conditions, as well as health policy-makers. The guideline will also support decision-making for people living with multimorbidity. Development will follow an explicit process of evidence review and appraisal with graded recommendations informed by systematic reviews of the evidence using GRADE methodology. The impact of recommendations on health equity will be considered within the general guidelines and where they focus on disadvantaged populations. Equity considerations will be explicitly incorporated within evidence-to-decision



framework by assessing the potential impact of interventions on equity and incorporating equity considerations when judging or weighing the strength of evidence to recommendation criteria. Topics not supported by systematic reviews will be addressed by ungraded clinical practice points which supplement graded recommendations, often aid in their implementation, and are informed by the judgment of the guideline Work Group. Recommendations for future research will also be provided. The objective is to generate a practical resource for the intended audience that effectively addresses contemporary questions with equitable, actionable, and, where available, evidenced-based statements.

This Scope of Work is intended to include adult and pediatric (including neonatal) populations and those cared for in the community and in care facilities as well as hospital settings, including critical care. Further, it is intended to be relevant to people at high risk of AKI and AKD, including those with multimorbidity, complex health care needs, and those with chronic conditions that commonly accompany AKI and AKD, including CKD, liver disease, heart failure, and congenital heart disease. It will also support decision-making in the care of people in high-, middle-, and low-resource countries.

The following topics will be considered outside the scope of this update as these topics require more attention than can be devoted within this guideline update process. Specific topics that are considered out of scope for this guideline update include:

- Management of AKI due to specific glomerular diseases
- Management of AKI due to urinary tract obstruction
- AKI in kidney transplantation
- Extracorporeal blood purification techniques for purposes different from management of AKI, (i.e., treatment of drug intoxication, management of sepsis)
- Hemoadsorption and cell-based therapies
- End of life care in people with AKI
- Recommendations related to drugs that are still under investigation (pre-approval phases of development)



CONTENT AREAS OF UPDATED KDIGO CLINICAL PRACTICE GUIDELINE FOR AKI and AKD

Chapter 1. AKI and AKD definitions, classification, and diagnostic criteria

AKD has been defined by abnormalities of kidney function and/or structure with implications for health with a duration of <3 months and includes AKI. AKI has been defined by changes in kidney function, including serum creatinine (SCr) changes and urine output within 48 hours or 7 days. This section will review the current criteria for AKI and AKD and assess how new information should be incorporated for diagnosis, characterization/phenotyping, and staging of AKI and AKD.

1.1. Addressing limitations of serum creatinine (SCr)

- Should differentiation be made between an absolute 0.3 mg/dL rise and 50% relative rise in SCr for Stage 1 AKI, and should both be applied to people with CKD?
- How should baseline levels of kidney function be defined and how should AKI be determined when no prior SCr results are available?
- Should falling SCr concentrations be used to identify an AKI event (including during recovery and in neonates)?
- How should confounding non-kidney factors, including body composition, liver dysfunction, physiological changes including pregnancy, reduced generation of SCr (e.g., sepsis), and fluid accumulation/overload, be considered within approaches to diagnosis and staging of AKI?
- When should other approaches to evaluate kidney function, including measured glomerular filtration rate (GFR), alternative biomarkers like cystatin C, proenkephalin, and estimation of “real-time” or kinetic eGFR be considered for diagnosis and staging of AKI/AKD?

1.2. Urine output criteria for AKI identification and staging

- Are the urine output criteria provided in the KDIGO 2012 guideline for AKI still appropriate for the definition and staging of AKI?
- Should urine output criteria be based on actual, observed, measured, or ideal body weight?



- Whether and how should urine output be combined with SCr criteria for defining and staging AKI?
 - Given the different risks associated with the different type of a given stage of AKI (urine output, SCr or combined) should urine output criteria be weighted differently than the SCr criteria?
- 1.3. Role of etiology and clinical setting in the identification and description of AKI and AKD
- How should description of the etiology and the clinical settings where AKI is identified (community vs. hospital [including ICU vs. non-ICU] and high vs. middle vs. low resource country) be incorporated within characterization and description of AKI and AKD?
 - Are there other clinically useful ways that phenotypes and subphenotypes of AKI should be described or reported (e.g., cardiorenal, hepatorenal, renal congestion, post-operative, sepsis-associated)?
 - What is the role of ultrasound, including point-of-care ultrasound (POCUS), in determining the etiology of AKI?
- 1.4. Additional biomarkers of kidney stress and damage for the diagnosis and classification of AKI
- How should biomarkers of kidney stress and damage be used to define and stage AKI, including serum and urinary based markers(e.g., albuminuria, neutrophil gelatinase-associated lipocalin [NGAL] and kidney injury molecule-1 [KIM-1], interleukin-18 [IL-18], liver-fatty acid binding protein (L-FABP), insulin-like growth factor–binding protein 7 (IGFBP7), tissue inhibitor of metalloproteinases–2 (TIMP-2))?
 - What is the role of urine sediment analysis, kidney imaging, and kidney biopsy for defining, staging, and phenotyping AKI/AKD?
- 1.5. Trajectories of AKI and AKD (defining transient vs. persistent vs. progressive AKI, kidney recovery, recurrent AKI, and distinction from development or progression of CKD)

AKI has been described as a discrete event that either resolves or reaches a new steady state before 3 months. A time-based definition for the duration of AKI of 7 days has been proposed by some groups to distinguish a period for AKI that



is distinct from AKD thereafter. Multiple episodes of AKI may occur over the course of an illness or with multiple different illnesses, within one individual, with failure to complete recovery in between. After AKI resolves, people may still have abnormalities in kidney function and/or structure. This section will address whether standardized criteria are warranted for defining the duration and resolution/recovery of AKI and distinction from identification of recurrent AKI. Whether GFR and albuminuria should be incorporated within AKD staging for those with AKD without AKI and AKD after AKI will also be addressed.

- How should transient versus persistent AKI versus progressive AKI/AKD be defined?
 - What is the difference between persistent AKI and AKD?
- How should non-recovery versus recurrent AKI be defined and distinguished?
- How do outcomes differ based on these trajectories of kidney function?
- How should inaccuracies in estimation of GFR over time after acute illness be accounted for when considering these kidney function trajectories?
- Should GFR and albuminuria be used for staging AKD?
- How should baseline susceptibilities and etiologies impact descriptions of AKI/AKD definitions and staging?

Chapter 2. AKI prediction, risk stratification, and diagnostic work-up

The 2012 AKI guideline discussed risk models and clinical scores; however, these were limited to models for cardiothoracic surgery, contrast exposure, and aminoglycoside administration. Many other clinical contexts, such as in the settings of sepsis, heart failure, and major non-cardiac surgery, in addition to hospital and community-based settings (particularly in low resource settings) require guidance for risk assessment. Risk models also require validation in external cohorts and trials to evaluate their clinical impact. Since 2012, biomarkers for AKI risk stratification have been approved by the United States Food and Drug Administration and the European Medicines Agency for use in early clinical drug development. The role of the different approved biomarkers in clinical practice in different resource settings needs to be defined. This section will address how risk of AKI should be identified and how people should be risk-stratified for AKI and provide recommendations for diagnostic work-up of AKI.

2.1. Prediction of risk of AKI

- What criteria should be used to assess risk and identify people at risk of AKI (including *de novo* AKI, worsening AKI, severe or persistent AKI), including in acute care settings and in the community, and in people with specific susceptibilities (e.g., comorbidities including pre-existing kidney disease, advanced age, prematurity, diabetes, hypertension, congenital heart disease, heart failure, liver disease, cancer) and acute contributing factors (e.g., sepsis, major surgery, cancer chemotherapy, etc.)?
- How should clinical characteristics including symptom-based risk scores be used to determine AKI risk in the community?
- What are the available tools (e.g., prediction models, including machine learning algorithms and clinical indexes (e.g., renal angina index), and biomarkers (e.g., urinary sediment furosemide stress test) and what is their value for predicting risk of AKI or AKI progression to guide clinical care?
- What clinical actions can be linked with the identification of AKI risk in the following clinical settings, which may be considered common to all scenarios with AKI versus are etiology specific, and are there risk thresholds or other criteria that should prompt actions?
 - Exposure to procedures involving iodinated contrast agents.
 - Exposure to nephrotoxic medications, including antimicrobials in sepsis and chemotherapeutic agents used for cancer patients and recipients of a bone marrow transplant or non-kidney solid organ transplant.
 - Perioperative care, including cardiac and non-cardiac surgery
 - Sepsis, septic shock.
 - Hospitalization, including critical care admission (including common medication exposures such as nonsteroidal anti-inflammatory drug [NSAIDs] and proton-pump inhibitors [PPIs]).
 - Community-based settings (high- and low-resource environments).

2.2. Risk stratification

- What is the role of risk-stratification of people at risk of AKI?

- What is the evidence for the effectiveness of clinical risk scores, e-alerts, early warning scores, biochemical biomarkers or other digital health tools to identify people at risk of AKI in hospital and community settings?

2.3. Identification of etiology of AKI

- What is the role for the following diagnostic tools for determining the etiology of AKI in high, middle, and low resource countries?
 - Urinalysis, urine microscopy, urine biochemistry
 - Albumin strip tests, saliva urea nitrogen
 - Additional urinary or serum biomarkers
 - Kidney imaging (ultrasound [US], contrast-enhanced US, doppler US, functional magnetic resonance imaging [MRI])
 - Hemodynamic profiles (intraoperative hypotension)
 - Nephrotoxin exposure burden
 - Kidney biopsy
 - Diagnostic prediction models
 - Testing for infectious diseases such as malaria, leptospirosis, Dengue fever in tropical zones
 - Testing for poisoning (i.e., mushrooms, insecticides) or envenomation (e.g., snake, spider, caterpillar) in tropical zones

2.4. Prediction of outcomes of AKI

- What is the role of prognostic risk prediction models for AKI, including those for the following clinical outcomes?
 - Mortality
 - Requirement for KRT (based on objective criteria for KRT initiation)
 - Development of CKD
 - Kidney failure
 - Hospital admission/readmission
 - Recurrent AKI
 - Subsequent cardiovascular events (including heart failure)
 - Patient-reported outcomes (e.g., quality of life)
- What are the available tools (e.g., prediction models, machine learning algorithms, furosemide stress test, biomarkers), and what is their value for prognostication of AKI to guide clinical care?



Chapter 3. Prevention of AKI

The KDIGO 2012 guideline provided recommendations for the prevention and management of AKI. The set of recommendations included in the 2012 KDIGO guideline consists of key elements aimed at reducing the risk of kidney injury in different clinical settings, including i) assessing and optimizing volume status, ii) avoiding nephrotoxic agents, including radiocontrast, when possible, iii) monitoring and managing hemodynamics, v) appropriate fluid therapy, vi) prevention of hyperglycemia, and vi) changes in drug dosage. Since the publication of the AKI guideline, these recommendations have been evaluated in RCTs (e.g., PrevAKI, BigpAK). In addition, multicenter randomized trials have examined the effects of different types of fluids, fluid strategies, and blood pressure targets on AKI. Cessation of medications to prevent AKI during episodes of acute illness (e.g., sick day guidance) or with procedures have also been proposed and studied. This section will include an updated review of the evidence for elements of the KDIGO recommendations as well as other interventions for the prevention of AKI in acute care settings as well as in the community.

3.1. Fluid management

- What are the most effective fluid management strategies for preventing AKI, including:
 - i. indication for fluid therapy,
 - ii. type of fluid (i.e., crystalloids including saline 0.9% versus balanced crystalloids, synthetic colloids, and albumin),
 - iii. amount of fluid administration (i.e., liberal vs. restricted fluid administration in sepsis, major surgery)
 - iv. method of administration (bolus vs. continuous, volume and frequency of boluses),
 - v. monitoring strategies (i.e., clinical and physiological responses to fluid, and complications of fluid accumulation),
 - vi. goal-directed fluid protocols,
 - vii. fluid/volume assessment and management in the community,
 - viii. fluid removal (e.g., de-escalation)?



- What are the optimal methods to assess volume status in different contexts where different levels of monitoring are available, including pre-hospital settings and resource-limited environments?
 - What strategies are effective for assessing volume status and optimizing fluid management based on individual needs (i.e., passive leg-raising test, pulse/stroke volume variation, ultrasound parameters, biomarkers) for both avoiding volume depletion and excessive fluid administration? What are the limitations of these strategies?
 - How does the evidence for the use of individualized strategies for assessing volume status and fluid management optimization differ in pediatric as compared to adult patients?
 - What is the evidence for fluid intervention strategies, based on blood pressure targets, urine output, indicators of perfusion (e.g., capillary refill time) and transfusion strategies for AKI prevention in the perioperative and critical illness settings?
 - What is the evidence for fluid removal interventions based on measures of fluid accumulation or other targets?
 - What health system or policy measures should be recommended for reduction of AKI risk in community care settings (i.e., access to oral replacement solutions, intravenous fluids, availability of protocols in community hospitals).
- 3.2. Cessation of medications that affect kidney function
- What is the evidence for temporary cessation of medicines to prevent AKI during medical and surgical procedures (e.g., prior to surgery and contrast imaging procedures)?
 - What is the evidence with regards to withholding medications during episodes of acute illness (i.e., sick day guidance) to prevent AKI? What should sick day guidance entail?
- 3.3. KDIGO 2012 AKI recommendations
- What is the effectiveness and utility of the KDIGO 2012 AKI recommendations for AKI prevention and how should specific elements of the KDIGO recommendations vary depending on the patient population, case-mix, risk stratification, and clinical context?

- Are there additional interventions that should be included in the KDIGO 2012 AKI recommendations for prevention of AKI?
- Should some elements from the KDIGO 2012 AKI recommendations for AKI prevention be removed from the updated guideline?
- Is surveillance for adherence to these measures warranted, and if so, what should it entail, and how should it be implemented?

3.4. Monitoring and managing hemodynamics

- When and how should blood pressure, cardiac output, kidney perfusion, and venous congestion be monitored and how should hemodynamic management be implemented to reduce the risk of AKI according to setting and context?
- What are appropriate monitoring instruments, physiological targets, and types of vasopressor support strategies?
- How should hemodynamic management be individualized in different patient cohorts?
- How should the monitoring be translated to resource-limited settings?

3.5. Sepsis-associated AKI

Sepsis, the host response to infection, is a common trigger for AKI, and appropriate antibiotic therapy is essential for preventing sepsis-related kidney injury. Early recognition and prompt management of sepsis, including the use of appropriate antimicrobial therapy and source control where applicable, are vital for preventing sepsis-related AKI.

- What infection prevention or intervention strategies can prevent AKI, including tropical infections?
- How should selection, dosing, and duration of antimicrobial agents and other drugs be optimized for prevention of AKI in the setting of sepsis?

3.6. AKI prevention therapeutics

- What is the role of preventive therapies for AKI in specific clinical settings and populations, including cardiac or noncardiac surgery, in liver failure, heart failure, and in people receiving cancer therapies, including biologics (e.g., chimeric antigen receptor [CAR]-T cell therapy)?

Chapter 4. Management of AKI

The KDIGO 2012 guideline presented an AKI stage-based management framework for AKI in which interventions for the prevention of AKI may be extended throughout all stages of AKI for management once it is established. However, fluid and hemodynamic management may differ in the context of AKI prevention, early intervention, and over time once AKI is established. There may be inappropriate attempts to “reverse” established AKI using fluid resulting in complications of fluid accumulation, while fluid overload itself may result in worsening kidney function in some contexts (i.e., systemic venous hypertension; renal congestion) and is associated with poor outcomes. This section will review evidence and recommendations for interventions once AKI has been identified.

4.1. Fluid management

- What are the most effective strategies for fluid management once AKI is established, including:
 - i. type of fluid (i.e., crystalloids, synthetic colloids, and albumin),
 - ii. role of blood products,
 - iii. amount of fluid administration (including restricted vs. liberal fluid strategy and consideration of excessive fluid administration for hypotension vs. use of vasoactive medications),
 - iv. monitoring strategies, (e.g., role of POCUS in fluid assessment and management).
 - v. de-escalation, and
 - vi. fluid removal (diuretics vs. extracorporeal fluid removal)?
 - vii. fluid stewardship, including fluid volumes used for drug administration
- How should fluid balance be measured and how should fluid overload be defined, including criteria for clinically significant or pathological fluid overload as a component of AKI (i.e., incorporating adverse clinical or physiological sequelae)?
- What are the recommendations for management, including the timing and strategy of fluid removal?

4.2. Hemodynamic management



- How should blood pressure and kidney perfusion be monitored and addressed to reduce the risk of further kidney injury and other complications once AKI is established?
- What are appropriate monitoring strategies, targets, and vasopressor support strategies in people with AKI and how should they be implemented in various settings (high- and low-resource settings, hospital vs. community based, adults vs. children, neonatal vs pediatric vs. adult)?

4.3. KDIGO 2012 AKI recommendations

- What is the effectiveness and utility of the elements of the KDIGO 2012 AKI recommendations once criteria for AKI have been met, and how should specific elements of the KDIGO 2012 recommendations vary depending on the stage of AKI (severity, duration, phenotype)?
- Are there additional interventions that should be included in the KDIGO 2012 AKI recommendations for the management of AKI?
- Are there elements from the KDIGO 2012 AKI recommendations for management that should be removed from the updated guideline?

4.4. Supportive management and specific pharmacological approaches

- What are the specific nutritional aspects of patients with AKI, including patients treated with KRT?
- What is the role of interventions for AKI in specific clinical settings and populations, including those with CKD, liver failure, heart failure, specific malignancies, and pregnancy?
- What is the role of diuretics in the treatment of AKI in settings where KRT may be limited (unavailable, restricted, time limited) and when KRT is broadly accessible?
- What is the evidence for the use of bicarbonate in treatment of AKI?
- What is the efficacy and safety of new drugs for AKI (i.e., targeting cellular metabolism and oxidative stress [like NAD]; inflammation [dexamethasone, reltecimod]; apoptosis [teprasiran]; cellular repair and fibrosis [MSC])?

Chapter 5. Drug and nephrotoxin-associated AKI

Drugs, natural products, pesticides, and environmental toxins can cause AKI in hospital or community settings due to a variety of mechanisms including parenchymal damage by vascular/glomerular damage, tubular injury, interstitial nephritis, or intratubular precipitation of crystals, as well as via hemodynamic effects that lower GFR. Further, drugs that are eliminated by the kidneys may be harmful due to accumulation of the parent drug or metabolites in the setting of AKI or AKD. Failure to adjust drug doses or dosing intervals following recovery of kidney function or due to enhanced clearance by KRT may lead to therapeutic failure. Further, there are drugs that may reduce GFR but confer important long-term benefits (i.e., angiotensin-converting enzyme inhibitors [ACEi] and sodium glucose transporter 2 inhibitors [SGLT2i]). This is particularly relevant to management of patients with heart failure, who may often develop AKI (i.e., types 1 and 3 cardiorenal syndromes), and also to patients with CKD. This section will update the evidence since the KDIGO 2012 AKI guideline regarding the categorization of drugs, AKI susceptibility, prevention, and management, including drug stewardship, to avoid or ameliorate nephrotoxic drug and drug combinations, including iodinated contrast exposure, associated with AKI.

5.1. Categorization and classification of medications that may cause adverse drug reactions in AKI/AKD

- How should drugs that contribute to AKI be categorized and classified (distinguishing mechanisms of parenchymal damage or cumulative dose effects from those having hemodynamic effects that decrease eGFR without causing parenchymal injury, or idiosyncratic effects)?
- How should drugs that are potentially nephrotoxic (i.e., cause parenchymal kidney damage whether glomerular, tubular, or interstitial) be differentiated from drugs that reduce glomerular filtration via functional or reversible, hemodynamic effects but are kidney-protective and have long-term benefits?
- What is the impact of common herbal or alternative remedies in the development of AKI (especially in LICs and LMICs)?

5.2. Prevention of drug-associated AKI

- How should people at risk of drug-associated AKI be identified, and when recognized, what recommendations should be provided to minimize harm and manage drug burden?

- What drug combinations (pharmacokinetic and pharmacodynamic?) warrant warnings for AKI and how should recommendations be implemented (such as by leveraging electronic medical records or pharmacy systems) to balance risks versus benefits for other conditions (sepsis, heart function, cancer treatment)?
- When should drugs that reduce GFR but offer long-term kidney protection be restarted following an episode of AKI?
- How can potential drug interactions be avoided?
- What is the role of e-alerts for drug associated AKI?
- How should novel biomarkers be used for early identification or identification of drug culprits?

5.3. Management of drugs eliminated by the kidneys

- How should the risk of other adverse drug events related to reduced drug clearance be prevented in the setting of AKI and AKD, and how should issues of recovery of kidney function, clearance via KRT, and drug withdrawal and reinitiation be addressed to avoid therapeutic failures?
 - Use of Therapeutic Drug Monitoring for antimicrobials and antiseizure medications
 - Drug dosing for patients with unstable kidney function.
 - Drug dosing during the AKI recovery phase

5.4. AKI following nephrotoxic exposures

- What should the contemporary recommendations be for the prevention of contrast-associated AKI, including intravenous and intra-arterial routes of administration, patient characteristics, including risk factor status, and settings (inpatient vs. outpatient), and strategies for prophylaxis?
- What should the recommendations be for the prevention of AKI following exposure to pesticides or environmental toxins?
- What should the recommendations be for the prevention of AKI following radiopharmaceuticals?

Chapter 6. Kidney replacement therapy (KRT) for AKI

The KDIGO 2012 AKI guideline provided 24 recommendations related to KRT interventions for management of AKI, addressing initiation and discontinuation,

KRT modalities, medical cointerventions, anticoagulation, vascular access, dialyzers, dialysis buffers and replacement fluids, and dose of KRT. Since publication of the KDIGO 2012 AKI guideline, several RCTs have been published on timing of acute KRT, which provide an important opportunity to update the previous 4 ungraded suggestions for KRT initiation/discontinuation in the 2012 guideline. New evidence has also emerged in the field of anticoagulation. This section will update the evidence related to KRT for AKI using updated terminology and incorporating approaches that are feasible and applicable across high-, middle-, and low-resource settings. Further, this section will address the use of KRT in the context of multiorgan support.

6.1. Supportive care for kidney failure

- What supportive care for kidney failure should be provided in resource limited settings where KRT is not available, KRT capacity has been reached, or for patients whose goals of care are not consistent with KRT?

6.2. Initiation of KRT

- What is the optimal timing for the initiation of KRT. What criteria should be used to guide decision-making for the initiation of KRT for AKI?
- How should patients and families be involved in shared decision-making related to the initiation of KRT for AKI?

6.3. Modality of KRT

- What are the optimal strategies, including selection of KRT modality (e.g., continuous KRT, intermittent hemodialysis, prolonged intermittent KRT, acute peritoneal dialysis), for providing acute KRT and how should they be applied across high-, middle-, and low-resource countries where availability of infrastructure, resources, educational programs, training, reimbursement, and expertise of personnel may vary?
- What is the role of acute peritoneal dialysis in resource-limited setting?
- How and when should peritoneal dialysis be used as a bridge to intermittent hemodialysis or continuous KRT in low resource settings?
- What is the role of isolated ultrafiltration for management of volume overload and heart failure?

- When should transition between KRT modalities be considered in people with AKI? How should transition between modalities be managed (e.g., continuous KRT to intermittent hemodialysis [HD]; intermittent HD to continuous KRT etc.)?

6.4. Delivery and dose of KRT

- How and where should vascular access be obtained and maintained for continuous and intermittent KRT for AKI?
- What are the recommendations for anticoagulation with continuous and intermittent KRT for AKI, and how should anticoagulation be addressed in people with bleeding risks, impaired coagulation, and in people with heparin induced thrombocytopenia (HIT)?
- What are the recommendations for use and monitoring of regional citrate anticoagulation, unfractionated and low molecular weight heparin, direct thrombin inhibitors (e.g., argatroban), factor Xa inhibitors (e.g., Danaparoid, fondaparinux), epoprostenol, or nafamostat?
- What dialyzer and membranes are recommended for continuous and intermittent KRT for people with AKI?
- What are the recommendations for standards and composition of dialysate and replacement fluids for continuous and intermittent KRT for AKI?
- What is the appropriate dose of KRT based on solute removal (e.g., urea removal, Kt/V , replacement fluid/effluent volume), electrolyte and acid-base balance, and volume status. Can and should the dose of KRT be individualized based on a patient's condition?
 - What should be the starting dose of KRT upon initiation of KRT?
- Should the dose of KRT be adjusted during the course of KRT, and if so, how, and when?
- How can adverse events (e.g., hypotension, arrhythmias, seizure, bleeding, allergy, electrolytes abnormalities, catheter-related) during KRT be anticipated and prevented?
- What are the strategies to promote kidney recovery during KRT?
- What methods should be used for assessing fluid removal goals and rates of fluid removal with KRT?
- What quality control measures should be used to achieve solute and volume control?

- 6.5. Discontinuing or withdrawing KRT
- What indicators should be used to predict and guide successful de-escalation or discontinuation of KRT?
 - Should different modalities be used with de-escalation of KRT?
 - How should appropriateness for ongoing KRT be determined, including approaches (weaning protocols) to de-escalation, transition to chronic maintenance KRT where required, and time limited approaches (e.g., end-of-life care)?
- 6.6. KRT in the context of multi-organ support
- How should KRT be combined with extracorporeal respiratory and cardiac support (e.g., extracorporeal membrane oxygen [ECMO], extracorporeal carbon dioxide removal [ECCO₂R], and other mechanical circulatory supports [e.g., Impella, ventricular assist device [VAD]])?
- 6.7. Monitoring of key performance indicators
- Should key performance (quality) indicators for KRT (e.g., delivered dose, filter lifetime, ultrafiltration goal, sieving coefficient, down-time during the day, waiting time) be monitored?

Chapter 7. Follow up care after AKI

AKI has been associated with short and increased long-term risks of mortality, readmission, cardiovascular events, and progression of kidney disease, although these risks may vary substantially for individuals. The KDIGO 2012 guideline promoted the evaluation of people 3 months after AKI for resolution, new onset, or worsening of pre-existing CKD. Since that time, many additional studies have refined knowledge on strategies to improve follow-up and long-term outcomes after AKI. This section will address evidence-based follow-up recommendations that could be integrated into the updated KDIGO guideline.

- How should risk stratification be used to guide follow-up and for whom, with whom (role of specialists, primary care), for what reasons/outcomes, and when should follow-up care processes occur?



- What elements should be included in AKI and AKD follow-up recommendations [e.g., identification, communication, frequency of assessment, duration of follow-up and relationship to CKD care, specific management guidance (medicine management, monitoring kidney health status, assessment of social needs)]?
- What are the key elements of effective patient and caregiver education?
- What are the different models of care for AKI follow-up, including different providers (primary care, internal medicine specialists, nephrologists, pharmacists, and nurse practitioners) and ways of providing care (role of virtual care/telemedicine, specialized AKI clinics) and what is the evidence supporting their use?

General approach to AKI in specific populations

Several areas of the KDIGO 2012 guideline and the subsequent KDIGO AKI Controversies Conference publications have highlighted that some criteria, strategies, and interventions may not be broadly applicable across all clinical contexts and patient groups and that specific or tailored approaches may at times be required for some groups and settings. Although separate chapters are not intended for the AKI guideline in specific patient groups or clinical settings, this section draws attention to important groups and settings where considerations should be made regarding the relevance and tailoring of recommendations to clinical context or specific patient groups where existing evidence may or may not be generalizable. Sex and gender differences will also be addressed where relevant.

- Pregnancy
- People with CKD
- People with liver disease (i.e., specific prevention and treatment approaches for hepatorenal syndrome)
- People with heart failure (cardiorenal syndromes, renin-angiotensin system (RAS) blockade, decongestion/diuretic strategies)
- Pediatrics, including neonates
- Older or frail persons
- People with cancer
- People with multimorbidity
- People identified as Indigenous



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- Vulnerable people (e.g., lower socioeconomic status/disadvantaged/housing insecurity)