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Classification Systems for Acute Kidney Injury

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Background

Acute kidney injury (AKI), formally called acute renal failure (ARF), is commonly defined as an abrupt decline in renal function, clinically manifesting as a reversible acute increase in nitrogen waist products measured by blood urea nitrogen (BUN) and serum creatinine over the course of hours to weeks. The vague nature of this definition has historically made epidemiologic study on and around AKI difficult to generalize to patient populations and compare between scholarly works. Several classification systems were developed to streamline research and clinical practice with respect to AKI.[1, 2, 3, 4] For more information, see Acute Kidney Injury and Acute Tubular Necrosis.

RIFLE Classification

In 2002, the Acute Dialysis Quality Initiative (ADQI) was created with the primary goal of developing consensus and evidence-based guidelines for the treatment and prevention of acute kidney injury (AKI). The first order of business was to create a uniform, accepted definition of AKI; hence, the RIFLE criteria were born (see the table below). RIFLE is an acronym of Risk, Injury, and Failure; and Loss; and End-stage kidney disease.Table 1. RIFLE Classification System for Acute Kidney Injury[5]

(Open Table in a new window)

Stage	GFR^a Criteria	UO^b Criteria
Risk	SCr^c increased 1.5-2 times baseline or GFR decreased >25%	UO < 0.5 mL/kg/h < 6 h
Injury	SCr increased 2-3 times baseline	UO < 0.5 mL/kg/h >12 h

	or	
	GFR decreased >50%	
Failure	SCr increased >3 times baseline	UO < 0.3 mL/kg/h 24 h
	or	(oliguria)
	GFR decreased 75%	or
	or	anuria 12 h
	SCr ≥4 mg/dL; acute rise ≥0.5 mg/dL	
Loss of function	Persistent acute renal failure: complete loss of kidney function >4 wk (requiring dialysis)	
ESRD[d]	Complete loss of kidney function >3 mo (requiring dialysis)	

[a] GFR = glomerular filtration rate.

[b] UO = urine output.

[c] SCr = serum creatinine.

[d] ESRD = end-stage renal disease.

Note: Patients can be classified either by GFR criteria or by UO criteria. The criteria that support the most severe classification should be used. The superimposition of acute on chronic failure is indicated with the designation RIFLE-F$_C$; failure is present in such cases even if the increase in SCr is less than 3-fold, provided that the new SCr is greater than 4 mg/dL (350 µmol/L) and results from an acute increase of at least 0.5 mg/dL (44 µmol/L).

When the failure classification is achieved by UO criteria, the designation of RIFLE-F$_O$ is used to denote oliguria.

The initial stage, "risk," has high sensitivity; more patients are classified in this mild category, including some who do not actually have renal failure. Progression through the increasingly severe stages of RIFLE is marked by decreasing sensitivity and increasing specificity.

Acute Kidney Injury Network

In September 2004, the Acute Kidney Injury Network (AKIN) was formed. AKIN advised that the term acute kidney injury (AKI) be used to represent the full spectrum of renal injury, from mild to severe, with the latter having increased likelihood for unfavorable outcomes (eg, loss of function and end-stage renal disease [ESRD]).[6]

A report by the AKIN proposed the following criteria for AKI[6, 7] :

- Abrupt (within 48 h) reduction in kidney function currently defined as an absolute increase in serum creatinine of 0.3 mg/dL or more (≥26.4 µmol/L) **or**
- A percentage increase in serum creatinine of 50% or more (1.5-fold from baseline) **or**
- A reduction in urine output (documented oliguria of < 0.5 mL/kg/h for >6 h)

The AKIN criteria differ from the RIFLE criteria in several ways. The RIFLE criteria are defined as changes within 7 days, while the AKIN criteria suggest using 48 hours. The AKIN classification includes less severe injury in the criteria and AKIN also avoids using the glomerular filtration rate as a marker in AKI, as there is no dependable way to measure glomerular filtration rate and estimated glomerular filtration rate are unreliable in AKI.

AKIN notes that the diagnostic criteria proposed only after volume status has been optimized and urinary tract obstructions must be excluded when using oliguria as diagnostic criteria.

KDIGO Clinical Practice Guidelines

In 2012 the Kidney Disease Improving Global Outcomes (KDIGO) released their clinical practice guidelines for acute kidney injury (AKI), which build off of the RIFLE criteria and the AKIN criteria.[8]

KDIGO defines AKI as any of the following:

- Increase in serum creatinine by 0.3mg/dL or more within 48 hours **or**
- Increase in serum creatinine to 1.5 times baseline or more within the last 7 days **or**
- Urine output less than 0.5 mL/kg/h for 6 hours

The KDIGO has also recommended a staging system for the severity of the AKI.

The KDIGO consensus classification has yet to be validated.

Table 2. KDIGO Staging for AKI Severity (Open Table in a new window)

Stage	Serum Creatinine	Urine Output
1	1.5-1.9 times baseline or ≥0.3 mg/dL increase	< 0.5 mL/kg/h for 6 h

2	2-2.9 times baseline	< 0.5 mL/kg/h for 12 h
3	3 times baseline or Increase in serum creatinine to ≥4 mg/dL or Initiation of renal replacement therapy	< 0.3 mL/kg/h for 24 h or Anuria for ≥12 h

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