

# Acute Kidney Injury Care Bundles

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## Key Words

Quality · Bundle · Intensive care · Acute kidney injury · Outcome

## Abstract

Acute kidney injury (AKI) is a common complication that occurs in hospitalized patients and appears susceptible to a wide variability in practice. This may lead to suboptimal quality of care. The concept of a 'care bundle' for AKI has been proposed to improve the reliability and quality of care. A bundle is designed to be a structured method of improving care processes and outcomes. It contains a small set of evidence-based practices intended for a defined population and care setting. The Institute for Healthcare Improvement has developed guidelines for the design of care bundles. Care bundles for critically ill patients focusing on mechanical ventilation, central venous catheters, and sepsis have been widely implemented with modest success in terms of compliance and impact on care processes and outcomes. A care bundle for AKI is highly desired, given the observed practice variation and indication of poor care for AKI patients; however, existing proposals are too comprehensive and have not been focused on a defined population at-risk, clinical context or setting. They have also not engaged local stakeholders in the process.

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## Introduction

Acute kidney injury (AKI) is commonly encountered and it imposes an increased risk for major morbidity, including chronic kidney disease and accelerated progression to end-stage kidney disease and mortality [1, 2]. Patients who have had an episode of AKI utilize heavy resources and incur huge costs, largely from intensified monitoring, investigations, and support and due to long hospital stays [3, 4].

## Quality of Care in AKI

The care of patients with AKI has shown wide variability in practice [5–7]. This may be due to the heterogeneity in susceptibilities for AKI, diversity in providers caring for AKI patients, uncertainty in the evidence-base and limited awareness of the KDIGO clinical practice guidelines for AKI [7]. Undoubtedly, these contribute to

Contribution from the AKI and CRRT 2015 Symposium at the 20th International Conference on Advances in Critical Care Nephrology, Manchester Grand Hyatt, San Diego, Calif., USA, February 17–20, 2015.

**Table 1.** This is an adapted example of the institute for healthcare improvement ‘ventilator bundle’ [11]

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Elevation of the head of the bed (30–45 degrees)
Daily sedation interruption and awakening to assess for readiness for extubation
Stress ulcer prophylaxis to prevent gastrointestinal bleeding
Deep venous thrombosis prophylaxis
Daily oral decontamination with chlorhexidine

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inconsistent and suboptimal care for AKI patients [6]. However, in select circumstances, AKI can be prevented or the burden caused by this condition can be greatly reduced by creating the appropriate awareness and using the right tools for early risk identification and diagnosis [8].

In 2009, the National Confidential Enquiry into Patient Outcome and Death in the United Kingdom performed an audit of the quality of care provided to hospitalized patients who had died with AKI [9]. Key findings suggested that less than 50% of care provided to AKI patients was considered good and 29% had inadequacies in clinical management. This report exposed numerous ‘systematic failings’ and care gaps in the recognition and management of hospitalized patients with AKI.

Shortly thereafter, another study found that the management of hospitalized patients with AKI remained relatively poor [6]. Delayed recognition of AKI or it being completely unrecognized occurred commonly. Contributors to delayed recognition were clinician inexperience, and inadequate monitoring, investigations and clinical review. Significant management deficiencies included failure to monitor urine output; to withhold nephrotoxic drugs; and to recognize and act on abnormal biochemistry. These observations reinforce concern of widespread gaps in the recognition, care processes and overall quality of care received by hospitalized AKI patients. Moreover, these data imply that a significant proportion of the major morbidity observed in AKI may be iatrogenic and attributable to poor quality care.

Among the initiatives aimed at improving the outcomes for AKI patients, starting with the dissemination of the KDIGO guidelines for AKI, the concept of an AKI ‘care bundle’ has been proposed as a tool to improve the quality of care for those with AKI [10]. This review summarizes the principles of care bundles (largely adapted from an Institute of Healthcare Improvement (IHI) [11]), discusses examples of existing care bundles in clinical practice, and provides some context for how a care bundle for AKI may be advanced.

## What Is a Care Bundle?

The IHI defines a ‘care bundle’ as [11]:

*A structured method of improving processes of care and patient outcomes; a small, straight-forward set of evidence-based practices, treatments and/or interventions for a defined patient segment or population and care setting that, when implemented collectively, significantly improves the reliability of care and patient outcomes beyond that expected when implemented individually.*

The concept of a care bundle is relatively new to medicine. In 2001, the Volunteer Hospital Association partnered with the IHI on an initiative titled ‘Idealized Design of the ICU’ aimed at critically evaluating and reengineering the structures and processes of care provided in ICUs to improve the reliability of care, outcomes, and address potential gaps in multi-disciplinary teamwork and communication. The initiative initially was focused on care processes in the ICU, where the evidence was deemed robust and where there was little controversy. The initiative piloted two care bundles focused on mechanical ventilation (IHI ventilator bundle) and central venous catheters (CVC; IHI central line bundle; table 1). For both key elements of the bundles were scientifically sound, evidence-based and had broad consensus regarding their relative importance and acceptability for representing standard practice.

## How Are Care Bundles Developed?

The IHI has proposed guidelines for the development of a care bundle (table 2). The general principles are summarized below [11]:

(1) The bundle has 3–5 elements. Each element has strong stakeholder agreement. Ideally, a bundle should contain a small set of practices, processes or treatments (elements) that are evidence based, are already endorsed and/or recommended by guidelines and are broadly accepted as appropriate and/or standard care by local stakeholders.

**Table 2.** Proposed guidelines for bundle design and development from institute for healthcare improvement [11]

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The bundle has 3–5 elements. Each has strong provider agreement
Each bundle element is relatively independent
The bundle is utilized for a defined population in a defined location
The bundle is developed by a multi-disciplinary team
Each bundle element should be descriptive rather than prescriptive in nature, to enable local customization and applicable clinical judgment
Compliance with bundles is measured using as ‘all-or-none’. Ideal target is greater than 95%

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(2) Each bundle element is relatively independent. The bundle is designed such that if one element is not implemented, the remaining elements are not impacted (e.g. for the ventilator bundle, omission of stress ulcer prophylaxis will not disrupt the head of the bed elevation).

(3) The bundle is utilized for a defined population in a defined location. The bundle has a higher likelihood of success when used in a discrete population and setting. This would imply that customized bundles should be developed for different care teams located in different locations (i.e. ICU vs. ward). Importantly, the bundle should be patient-focused, rather than provider- or unit-level focused, such that each element focuses on a practice, process or treatment for the patient.

(4) The bundle is developed by a multi-disciplinary team. Ideally, the development and implementation of a bundle, designed by multi-disciplinary stakeholders, should galvanize local providers to increase the likelihood of success (i.e. acceptance and compliance) and enhance team communication.

(5) Each bundle element should be descriptive rather than prescriptive in nature, to enable local customization and applicable clinical judgment. This would imply that while there may exist evidence and local consensus for including a particular element into a bundle, there may be a variety of acceptable iterations or modifications in how the element is implemented. This is important to enable local customization and to best reflect local practice (e.g. the Surviving Sepsis Guidelines do not specify the ‘type’ of crystalloid fluid for resuscitation). The implementation of a bundle should occur ‘sensibly,’ should not be ‘forced when clinically inappropriate’ and should recognize that there will be circumstances where an ‘opt out’ is acceptable.

(6) Compliance with bundles is measured as ‘all-or-none.’ The ideal target is greater than 95%. If all the elements of a bundle are accomplished (recognizing ‘opt out’ or contraindications to selected elements may occur), the bundle would be classified as completed. If one

or more elements are not performed, the bundle would be classified as incomplete (no partial recognition). This proposed ‘all-or-none’ approach to measuring compliance reinforces the importance that delivering the complete bundle will translate into better outcome than the sum of its elements.

### How Do Care Bundles Improve Outcomes?

There are several theories for how bundles can drive more reliable and higher quality care that improves standardization of practice and outcomes. First, the implementation of a bundle where compliance is systematically measured undermines assumptions among stakeholders that high-quality care is already being delivered, when in fact, measured compliance with all-or-none care bundles are often poor [12]. Second, the implementation of bundles reinforces the importance of the necessity for multi-disciplinary engagement to achieve high compliance and improved outcomes. Third, the implementation of bundles, including mechanisms to measure compliance, promote not only a culture of quality improvement, but also a greater likelihood of local adoption of quality improvement methods and obtaining greater understanding of the unique challenges in a particular setting to optimize care delivery.

### Care Bundles in Clinical Practice

Bundles for ICU patients focused on ventilators, CVCs, and sepsis have been widely implemented with variable success in terms of compliance and impact on outcomes [12–14].

In a large collaborative study, implementation of a ventilator bundle resulted in a significant reduction in the rate of ventilator-associated pneumonia (VAP) [14]. The largest decrease in VAP rates came from those ICUs

**Table 3.** List of selected potential elements that could be included in the design of an AKI care bundle for patients in the ICU

Care bundle element	Definition
Monitor kidney function	Insert a foley catheter; measure serum creatinine daily (or more often), measure and document fluid balance daily
Daily assessment for the discontinuation or appropriate adjustment of drugs for toxicity	Daily review of all prescribed medications ideally in consultation with a critical care pharmacist
Use balanced crystalloid solutions	Use of balanced crystalloid solutions for fluid therapy. Avoid chloride-rich solutions that will exacerbate metabolic acidosis and synthetic colloids (i.e. hydroxyethyl starch) associated with kidney injury
Discontinue extraneous potassium supplementation	Potassium-containing solutions, medications and nutrition should be discontinued or adjusted

where compliance was >95%. The implementation of a CVC bundle significantly decreased the incidence of bloodstream infection [13]. A national program in 82 ICUs in the Netherlands found improved compliance and survival following the introduction of the Surviving Sepsis Campaign's 'resuscitation' and 'maintenance' bundles [15]. While comparable findings were found in a similar program in Spain, compliance was poor, and improvements were only modest and temporary [12].

A recent study has highlighted the challenges of widespread implementation of evidence-based practices including bundles [16]. First, improved compliance with bundles was not uniform, in part, due to some centers having high baseline compliance with little opportunity for improvement. Second, variable adherence was likely contributed by the 'central' implementation that failed to engage local stakeholders. Finally, the process of implementation and monitoring lacked efficiency and was resource intensive.

### Design of a Care Bundle for AKI

A care bundle for AKI is highly desirable, given existing practice variation and indications of poor quality care [6, 9]. The National Institute for Health and Care Excellence in the United Kingdom developed recommendations for patients with or at risk of AKI [17]. Among the guidelines' principles, those processes and interventions that were likely to significantly impact outcome and likely to reduce practice variation and contribute to more efficient resource use were considered highest priority. Of 51 recommendations, 10 were viewed as key priorities; however, each was relatively broad and lacked the ele-

mental detail that would be needed for integration into a bundle.

The consensus recommendations for the management of AKI patients from the KDIGO guideline have been suggested as an 'AKI care bundle'; however, these collective recommendations do not fulfill the operational definition of a true bundle. Similarly, the London AKI Network has published a proposed AKI bundle (available at <http://londonaki.net>); however, the bundle contains 28 discrete elements, encompassing initial assessment, resuscitation, monitoring, investigations, supportive care and referral. Neither of these proposed AKI bundles has subscribed to essential bundle design principles.

A unique standalone bundle for AKI may be challenging to design and implement for several reasons including heterogeneity of patients who develop AKI; the range in clinical settings in acute care (i.e. surgical or medical ward, emergency, ICU); that the development of AKI often occurs in the context of other more distracting life-threatening conditions; and as aforementioned, uncertainty in the evidence-base for how to optimally diagnose and manage AKI (table 3). However, recent data have suggested that implementation of specifically designed AKI bundles can improve processes, lead to more efficient resource use and potentially improve outcomes [18, 19]. Notably, in the study by Kolhe et al. [19], compliance with the bundle within 24 h of being e-alerted to the biochemical criteria for AKI, while showing improvement after implementation, was poor (only approximately 22%), despite showing reduced risk of worsening AKI and hospital mortality. Individual elements of the bundle that showed variable compliance, however, were higher among those with more severe AKI.

## Conclusion

In summary, 'care bundles' and each element contained within must be supported by a high-quality evidence-base, should be designed to improve the reliability and quality of care, and should not aim to provide a guide for 'comprehensive' care. A bundle for AKI is highly needed and likely to provide measurable benefit given the likely unnecessary practice variation and consistent indicators of poor quality care AKI patients receive. Proposed AKI bundles are too all encompassing, too comprehensive and have not been focused on a defined population at-risk, clinical context or setting, or integrated local stakeholders engagement. This is critical, as the success-

ful implementation of a bundle requires multi-disciplinary endorsement, and may also require strategies to redesign work processes, communication and infrastructure, along with strategies to ensure sustainability.

## Acknowledgments

This study was unfunded. Dr. S.M. Bagshaw holds a Canada Research Chair in Critical Care Nephrology.

## Disclosure Statement

The author has no conflicts of interest to declare.

## References

- 1 Nisula S, Kaukonen KM, Vaara ST, Korhonen AM, Poukkanen M, Karlsson S, et al: Incidence, risk factors and 90-day mortality of patients with acute kidney injury in Finnish intensive care units: the FINNAKI study. *Intensive Care Med* 2013;39:420–428.
- 2 Chawla LS, Amdur RL, Amodeo S, Kimmel PL, Palant CE: The severity of acute kidney injury predicts progression to chronic kidney disease. *Kidney Int* 2011;79:1361–1369.
- 3 Hobson C, Ozrazgat-Baslanti T, Kuxhausen A, Thottakkara P, Efron PA, Moore FA, et al: Cost and mortality associated with postoperative acute kidney injury. *Ann Surg* 2015;261:1207–1214.
- 4 Kerr M, Bedford M, Matthews B, O'Donoghue D: The economic impact of acute kidney injury in England. *Nephrol Dial Transplant* 2014;29:1362–1368.
- 5 Hsu RK, McCulloch CE, Ku E, Dudley RA, Hsu CY: Regional variation in the incidence of dialysis-requiring AKI in the United States. *Clin J Am Soc Nephrol* 2013;8:1476–1481.
- 6 Aitken E, Carruthers C, Gall L, Kerr L, Geddes C, Kingsmore D: Acute kidney injury: outcomes and quality of care. *QJM* 2013;106:323–332.
- 7 KDIGO AKI Work Group: KDIGO clinical practice guideline for acute kidney injury. *Kidney Int Suppl* 2012;2:1–138.
- 8 Goldstein SL, Kirkendall E, Nguyen H, Schaffzin JK, Bucuvalas J, Bracke T, et al: Electronic health record identification of nephrotoxin exposure and associated acute kidney injury. *Pediatrics* 2013;132:e756–e767.
- 9 National Confidential Enquiry into Patient Outcome and Death (NCEPOD): Adding insult to injury: a review of the care of patients who died in hospital with a primary diagnosis of acute kidney injury (acute renal failure), 2009. [http://www.ncepod.org.uk/2009report1/Downloads/AKI\\_report.pdf](http://www.ncepod.org.uk/2009report1/Downloads/AKI_report.pdf) (accessed March 27, 2015).
- 10 Hoste EA, De Corte W: Implementing the kidney disease: improving global outcomes/acute kidney injury guidelines in ICU patients. *Curr Opin Crit Care* 2013;19:544–553.
- 11 Resar R, Griffin FA, Haraden C, Nolan TW: Using Care Bundles to Improve Health Care Quality. IHI Innovation Series White Paper. Cambridge, Massachusetts, Institute for Healthcare Improvement, 2012. <http://www.ihl.org/resources/Pages/IHIWhitePapers/UsingCareBundles.aspx> (accessed March 27, 2015).
- 12 Ferrer R, Artigas A, Levy MM, Blanco J, González-Díaz G, Garnacho-Montero J, et al: Improvement in process of care and outcome after a multicenter severe sepsis educational program in Spain. *JAMA* 2008;299:2294–2303.
- 13 Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al: An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med* 2006;355:2725–2732.
- 14 Resar R, Pronovost P, Haraden C, Simmonds T, Rainey T, Nolan T: Using a bundle approach to improve ventilator care processes and reduce ventilator-associated pneumonia. *Jt Comm J Qual Patient Saf* 2005;31:243–248.
- 15 van Zanten AR, Brinkman S, Arbous MS, Abu-Hanna A, Levy MM, de Keizer NF, et al: Guideline bundles adherence and mortality in severe sepsis and septic shock. *Crit Care Med* 2014;42:1890–1898.
- 16 Scales DC, Dainty K, Hales B, Pinto R, Fowler RA, Adhikari NK, et al: A multifaceted intervention for quality improvement in a network of intensive care units: a cluster randomized trial. *JAMA* 2011;305:363–372.
- 17 National Institutes for Health and Care Excellence (NICE): Acute kidney injury: prevention, detection and management of acute kidney injury up to the point of renal replacement therapy: National Institutes for Health and Care Excellence (NICE), 2013. <http://www.nice.org.uk/guidance/cg169> (accessed March 27, 2015).
- 18 Tsui A, Rajani C, Doshi R, De Wolff J, Tennant R, Duncan N, et al: Improving recognition and management of acute kidney injury. *Acute Med* 2014;13:108–112.
- 19 Kolhe NV, Staples D, Reilly T, Merrison D, McIntyre CW, Fluck RJ, et al: Impact of compliance with a care bundle on acute kidney injury outcomes: a prospective observational study. *PLoS One* 2015;10:e0132279.