We have a duty to our patients and society to revisit the obvious from time to time. There is inherent value in reiterating what is intuitively apparent, especially with new insights and changing contexts. We commend and thank Lau and colleagues¹ for sharing their work, reminding us of George Orwell's conclusion that "sometimes the first duty of intelligent men [and women] is the restatement of the obvious."

References

1. Lau D, Pannu N, James MT, Hemmelgarn BR, Kieser TM, Meyer SR, et al. Costs and consequences of acute kidney injury after cardiac surgery: a cohort study. *J Thorac Cardiovasc Surg.* 2021;162:880-7.
2. Elmistekawy E, McDonald B, Hudson C, Ruel M, Mesana T, Chan V, et al. Clinical impact of mild acute kidney injury after cardiac surgery. *Ann Thorac Surg.* 2014;98:815-22.
3. Vives M, Wijeysondera D, Marczin N, Monedero P, Rao V. Cardiac surgery-associated acute kidney injury. *Interact Cardiovasc Thorac Surg.* 2014;18:637-45.
4. Petäjä L, Vaara S, Liuhanen S, Suojäranta-Ylinen R, Mildh L, Nisula S, et al. Acute kidney injury after cardiac surgery by complete KDIGO criteria predicts increased mortality. *J Cardiothorac Vasc Anesth.* 2017;31:827-36.
5. Mehaffey JH, Hawkins RB, Byler M, Charles EJ, Fonner C, Kron I, et al. Cost of individual complications following coronary artery bypass grafting. *J Thorac Cardiovasc Surg.* 2018;155:875-82.e1.
6. Dasta JF, Kane-Gill SL, Durtschi AJ, Pathak DS, Kellum JA. Costs and outcomes of acute kidney injury (AKI) following cardiac surgery. *Nephrol Dial Transplant.* 2008;23:1970-4.
7. Kellum JA, Lameire N. Kidney disease: improving global outcomes (KDIGO) acute kidney injury work group. KDIGO clinical practice guideline for acute kidney injury. *Kidney Int Suppl.* 2012;2:1-138.

See Article page 880.

Commentary: Quality metrics are important, but we must also become stewards of health care value

Daniel T. Engelman, MD,^a Allen D. Hamdan, MD,^b and Edward M. Boyle, Jr, MD^c

Hospitals and providers are under increased scrutiny to understand the association between costs and complications by holding them accountable for these additional expenses.¹ Under bundled payment plans, the financial risks of adverse outcomes are shared among all stakeholders, whereas accountable care organizations contractually accept a degree of financial responsibility in exchange for potential gain associated with avoiding complications and enhancing efficiency. Although logic would dictate that clinical

CENTRAL MESSAGE

It is essential to measure the cost of complications, not just their incidence, to properly assess patient-centered value following cardiac surgery.

From the ^aHeart and Vascular Program, Baystate Health, University of Massachusetts, Medical School—Baystate, Springfield, Mass; ^bDepartment of Surgery Beth Israel Lahey Health, Harvard Medical School, Boston, Mass; and ^cDepartment of Thoracic Surgery, St Charles Medical Center, Bend, Ore.

Disclosures: Dr Engelman consults for Edwards Lifesciences. Dr Boyle is a consultant and equity holder in ClearFlow. Dr Hamdan has nothing to disclose with regard to commercial support.

Received for publication Feb 18, 2020; revisions received Feb 18, 2020; accepted for publication Feb 19, 2020; available ahead of print March 4, 2020.

Address for reprints: Daniel T. Engelman, MD, Heart and Vascular Program, Baystate Health, 759 Chestnut St, Springfield, MA 01199 (E-mail: Daniel.Engelman@baystatehealth.org).

J Thorac Cardiovasc Surg 2021;162:889-91
0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery
<http://dx.doi.org/10.1016/j.jtcvs.2020.02.081>

excellence and health care costs are inversely related, the body of literature relating cost to quality is underdeveloped. Many physicians have not considered the financial effects of their care, and those who did frequently felt powerless to impact this positively.

An additional consideration for cardiac surgeons involves the competition from lower-risk, albeit, potentially

less-durable, transcatheter procedures that have become the benchmark for short-term outcomes. The decreased early complications associated with these less-invasive procedures have been transformative by offering hope to patients previously considered too high risk for surgical intervention. However, the long-term results are often superior for surgery. Given the current dual focus on clinical excellence and cost containment, clinicians must concentrate their efforts on preserving the value proposition of surgery by reducing short-term complications. Harvard Business School professor Michael Porter focused our collective attention on the concept of health care value, which is defined as the best-possible clinical outcomes for the lowest-possible price. He rightly defined this from the patient's perspective. He also included in the value calculation a patient's full recovery across an entire episode of care, not just during the index hospitalization.² This can only be achieved through minimizing early complications, especially something as morbid and costly as acute kidney injury (AKI).

In this issue of the *Journal*, Lau and colleagues³ found that AKI was independently associated with greater inpatient mortality, longer length of stay, and greater total costs after cardiac surgery. Their data, yet again, demonstrated worse outcomes for even mild degrees of kidney injury. In health care economic parlance, AKI lowers the health care value of cardiac surgery. After adjusting for comorbidities, they have identified AKI-associated cost ratios ranging from 1.2 to 2.5 across the spectrum of AKI severity. The median total cost of the index hospital admission was \$15,000 greater in patients with AKI. On average, this translated to adjusted cost increments ranging from \$10,000 per patient for stage 1 AKI to \$115,000 per patient for those requiring acute dialysis, compared with patients with no AKI. Rehospitalization occurred in 36% of patients with AKI, compared with 23% of those without. The median postdischarge additional cost for a patient requiring 1 or more readmissions was \$17,000. Similar data have recently been reported following ventricular assist device placement, which demonstrated that costs were \$56,000 greater among patients with AKI not requiring dialysis and \$133,000 greater among patients with AKI and dialysis.⁴

This manuscript further supports the notion that ANY perioperative AKI, no matter how minor, and despite its apparent complete resolution during the index hospitalization as determined by a normalized serum creatinine, significantly increases postoperative morbidity, mortality, and cost.⁵ The study was limited by using 10-year-old data and thus may not have captured recent changes in AKI-related outcomes. It also did not capture other postoperative complications that commonly coexist with AKI and may contribute to overall costs. Despite the compelling findings, it remains unclear whether

AKI has a causal effect on mortality and costs on its own or whether it is a high-risk marker for other postoperative complications.

We now have multiple means to reduce the incidence of AKI following cardiac surgery, thereby increasing value by improving outcomes and lowering costs. Goal-directed fluid⁶ and perfusion therapy,⁷ novel biomarkers,⁸ coupled with a multidisciplinary acute kidney response team,⁹ and active clearance of chest tube to reduce retained blood collections,¹⁰ have each been demonstrated to reduce AKI following cardiac surgery. In our quest for continuous quality improvement, we must standardize evidence-based best practice to produce an "aggregation of marginal gains." This concept, popularized by Sir David Brailsford, a British cycling coach, involves finding and exploiting small margins for improvement. Enhanced recovery after surgery programs have capitalized on this concept and demonstrated that a reduction in apparently insignificant imperfections in patient care provides cumulative benefits and improved outcomes.¹¹ Enhanced recovery after surgery programs have consistently documented an earlier return to preoperative physiologic functions after surgery than with traditional methods.¹²

We applaud Lau and colleagues for bringing the often-neglected cost element into the equation and supporting the hypothesis that clinical excellence and cost containment are the flip sides of the same coin. Focusing on clinical excellence, at least in the AKI realm, automatically achieves the much-needed financial benefits. Given the aforementioned data, the paradigm is clear: clinical excellence equals financial prudence. If we, as clinical care providers, are not stewards of quality, cost containment is impossible and in the very near future this will likely be forced on us by insurers and politicians.

References

- Engelman DT. Value-based health care: how to succeed in a bundled care APM. *Bull Am Coll Surg*. 2017;102:24-8.
- Engelman DT, Boyle EM Jr, Benjamin EM. Addressing the imperative to evolve the hospital new product value analysis process. *J Thorac Cardiovasc Surg*. 2018;155:682-5.
- Lau D, Pannu N, James MT, Hemmelgarn BR, Kieser TM, Meyer SR, et al. Costs and consequences of acute kidney injury after cardiac surgery: a cohort study. *J Thorac Cardiovasc Surg*. 2021;162:880-7.
- Walther CP, Winkelmayer WC, Niu J, Cheema FH, Nair AP, Morgan JA, et al. Acute kidney injury with ventricular assist device placement: national estimates of trends and outcomes. *Am J Kidney Dis*. 2019;74:650-8.
- Engelman DT, Schwann TA. Commentary: a little is way too much ... what we have learned about perioperative AKI. *J Thorac Cardiovasc Surg*. January 21, 2020 [Epub ahead of print].
- Zarbock A, Engelman DT. Commentary: should goal-directed fluid therapy be used in every cardiac surgery patient to prevent acute kidney injury? *J Thorac Cardiovasc Surg*. April 29, 2019 [Epub ahead of print].
- Ranucci M, Johnson I, Willcox T, Baker RA, Boer C, Baumann A, et al. Goal-directed perfusion to reduce acute kidney injury: a randomized trial. *J Thorac Cardiovasc Surg*. 2018;156:1918-27.e2.
- Hayek SS, Leaf DE, Samman Tahhan A, Raad M, Sharma S, Waikar SS, et al. Soluble urokinase receptor and acute kidney injury. *N Engl J Med*. 2020;382:416-26.

9. Engelman DT, Crisafi C, Germain M, Greco B, Nathanson BH, Engelman RM, et al. Using urinary biomarkers to reduce acute kidney injury following cardiac surgery. *J Thorac Cardiovasc Surg*. October 17, 2019 [Epub ahead of print].
10. Baribeau Y, Westbrook B, Baribeau Y, Maltais S, Boyle EM, Perrault LP. Active clearance of chest tubes is associated with reduced postoperative complications and costs after cardiac surgery: a propensity matched analysis. *J Cardiothorac Surg*. 2019;14:192.

11. Fleming IO, Garratt C, Guha R, Desai J, Chaubey S, Wang Y, et al. Aggregation of marginal gains in cardiac surgery: feasibility of a perioperative care bundle for enhanced recovery in cardiac surgical patients. *J Cardiothorac Vasc Anesth*. 2016;30:665-70.
12. Engelman DT, Ben Ali W, Williams JB, Perrault LP, Reddy VS, Arora RC, et al. Guidelines for perioperative care in cardiac surgery: enhanced recovery after surgery society recommendations. *JAMA Surg*. 2019;154:755-66.

See Article page 880.

Commentary: Acute kidney injury, a multi-billion-dollar issue

Thomas S. Metkus, MD,^a and
Glenn J. R. Whitman, MD^b

Acute kidney injury (AKI) is a devastating, common complication of critical illness in general and cardiac surgery in particular. Knowledge gaps remain in defining the epidemiology and associated outcomes. Lau and colleagues¹ present an analysis addressing some of these unknowns. In more than 10,000 cardiac surgical patients, 25% experienced AKI, by Kidney Disease: Improving Global Outcomes (KDIGO) criteria.² The 3% requiring dialysis suffered a 37-fold increase in mortality risk and an almost 3-fold increase in hospital costs. Even those with AKI stage 1 and 2 experienced a 3- to 9-fold increase in mortality and a 20% to 50% increase in cost. Moreover, poor outcomes and high costs persisted out of hospital out to 1 year after. These results are in keeping with those found by Cho and colleagues,³ confirming that any AKI places cardiac surgical patients at high risk even in the months after surgery. These data highlight the urgent need for action from surgeons, health care systems, and all those participating in the

CENTRAL MESSAGE

Acute kidney injury is associated with high costs and poor outcomes in-hospital and beyond, providing an impetus for both clinicians and health care systems to dedicate resources aimed at its prevention.

preoperative, perioperative, and postoperative phases of care (Figure 1).

Is AKI a preventable injury⁴? Both intraoperative as well as postoperative goal-directed protocols^{5,6} can significantly reduce AKI. Other results corroborate the authors⁷; assuming roughly 400,000 patients undergoing cardiac surgery per year, the incremental cost of AKI is on the order of several billion dollars.

The impact of AKI illustrated by Lau and colleagues serves as a clarion call to reduce the burden of AKI, thereby improving patient and health system outcomes. Novel biomarkers to identify high-risk patients are emerging. Hayek and colleagues⁸ recently identified soluble urokinase plasminogen activator receptor as strongly associated with AKI after cardiac surgery. This work also suggests a novel therapeutic approach—in an experimental mouse model, pretreatment with a urokinase plasminogen activator

From the ^aDepartment of Medicine and Department of Surgery, The Armstrong Institute for Patient Safety and Quality, and ^bDepartment of Surgery, Division of Cardiac Surgery, Johns Hopkins University School of Medicine, Baltimore, Md.

Disclosures: Dr Metkus performs consulting unrelated to this subject matter for Best-Docors Inc and Oakstone/EBIX. Dr Metkus receives royalties for a textbook publication for McGraw-Hill publishing, unrelated to this subject matter. Dr Whitman reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication May 15, 2020; accepted for publication May 17, 2020; available ahead of print June 5, 2020.

Address for reprints: Glenn J. R. Whitman, MD, Division of Cardiac Surgery, Department of Surgery, Johns Hopkins School of Medicine, 1800 Orleans St, Zayed Tower, Suite 7107, Baltimore, MD 21287 (E-mail: gwhitman@jhmi.edu).

J Thorac Cardiovasc Surg 2021;162:891-2

0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2020.05.070>