Surgical morbidity and mortality are rightly considered public health concerns. It has been estimated that more than 200 hundred million major surgical procedures are performed annually worldwide\(^1\). Risks vary widely, related to the procedure involved, as well as patient and provider factors. Across these clinically diverse populations, at least a million patients die and an order of magnitude more experience serious complications after surgery every year.

Fortunately, recent evidence from the USA suggests trends toward improvement. Despite largely flat mortality rates for most high-risk cancer and cardiovascular procedures during the 1990s\(^2\), risks associated with these procedures began to fall steadily after the turn of the millennium\(^3\). These trends cannot be explained by case mix. In fact, most reports indicate that patients undergoing major inpatient procedures have become older and, by most measures, less healthy over time. Technological innovation may help explain declining mortality for some procedures, such as endovascular repair of abdominal aortic aneurysms, but for many procedures, basic surgical techniques have changed little in the past two decades.

So why is surgery becoming safer? In the simplest terms, there are two basic mechanisms for improving patient outcomes: direct patients to hospitals and surgeons with the best results, and improve care everywhere. With regard to the former, the past decade has seen significant concentration of complex cancer procedures in many Westernized healthcare systems. In the USA hundreds of low-volume hospitals stopped performing procedures such as pancreatectomy and oesophagectomy, and median hospital volumes rose sharply\(^3\). Redistribution of surgical patients to higher-volume, lower-mortality hospitals was a significant factor underlying declining mortality for many cancer operations. It, nevertheless, explained less than half of the overall effect. Concentration of patients and expertise played no role in safer cardiovascular surgery. Mortality after cardiac and peripheral vascular procedures declined just as much as that after cancer surgery, despite trends toward fewer overall procedures dispersed across an increasing number of hospitals in the USA.

Such evidence indicates that surgical mortality is falling at hospitals across the entire performance spectrum. Their respective contributions remain speculative, but several factors may be responsible.

**Heightened awareness**

It is perhaps no coincidence that the seminal report from the Institute of Medicine, *To Err is Human: Building a Safer Healthcare System*, was issued in 1999, around the same time as surgical mortality rates began to fall\(^4\). Highlighting 44 000–98 000 deaths each year from medical errors prompted unprecedented scrutiny of hospital safety, with possible ‘trickle down’ effects on a safety culture, levels of staffing and other aspects of surgical care.

**Outcomes measurement**

Although initiated at various times, clinical registries, institutional and national audits, providing regular performance feedback to hospitals and surgeons, have been launched by several specialty societies, local and regional health agencies and national health ministries. A growing literature supports the idea of a ‘surgical Hawthorne effect’, whereby the act of performance measurement and feedback leads to improved outcomes in advance of specific, measurable changes in practice. In northern New England, for example, the mortality rate after coronary artery bypass grafting fell by more than 25 per cent within 6 months after feedback of mortality data to hospitals and surgeons\(^5\). After implementation of the National Surgical Quality Improvement Program, surgical morbidity rates in Department of Veterans Affairs hospitals fell by over 40 per cent in 2 years\(^6\).

**Performance-related payment**

Beginning in the early 2000s, many payers began providing financial rewards (payment by results) to providers for compliance with evidence-based practices associated with reduced complications, including surgical-site infection and venous thromboembolism. Current research in both surgery and general medical
practice suggests that such programmes are often successful in increasing compliance with targeted practices, but do little to improve outcomes\(^7\). These data indicate the complexity of high-quality surgical care and suggest that focusing on a shortlist of measurable processes of care is insufficient.

Checklists

Following successful checklist interventions to reduce catheter-related bloodstream infections\(^8\), two large studies demonstrated significant reductions in surgical morbidity and mortality after implementation of comprehensive checklists during and/or after surgery\(^9,10\). In one of the studies, outcomes improvement was largely unrelated to how compliant hospitals were with the specific components of the checklists\(^9\), implying that checklists may exert their salutary effects by inspiring teamwork, communication and a culture of safety, rather than through the direct effect of the specific processes of care they target.

Getting to the next level of surgical safety

In some respects, many of the above improvement strategies target ‘low-hanging fruit’. Checklists help surgeons to avoid making simple mistakes, such as surgery at the wrong site. Payment for performance leads to more consistent perioperative care and suggests that focusing on a shortlist of measurable processes of care and correlate strongly with complication rates in bariatric surgery. These data suggest that optimizing surgical outcomes after some procedures may require better tools for measuring and improving the performance of surgeons themselves, not just the systems in which they operate.

References