Int Surg 2015;**100:**1026–1032
DOI: 10.9738/INTSURG-D-14-00212.1

Surgical Mortality Audit–lessons Learned in a Developing Nation

Sandiya Bindroo[1], Rakesh Saraf[2]

[1]*Providence Hospital & Medical Center, Southfield, Michigan, USA*

[2]*Government Medical College, Jammu, India*

Surgical audit is a systematic, critical analysis of the quality of surgical care that is reviewed by peers against explicit criteria or recognized standards. It is used to improve surgical practice with the ultimate goal of improving patient care. As the pattern of surgical care is different in the developing world, we analyzed mortalities in a referral medical institute of India to suggest interventions for improvement. An analysis of total admissions, different surgeries, and mortalities over 1 year in an urban referral medical institute of northern India was performed, followed by "peer review" of the mortalities. Mortality rates as outcomes and classification was done to provide comparative results. Of 10,005 surgical patients, 337 (male = 221, female = 116) deaths were reported over 1 year. The overall mortality rate was 3.36%, while mortality in operative cases was 1.76%. Total deaths were classified into (1) Viable: 153 (45%), (2) Nonviable: 174 (52%), and (3) Indeterminate: 10 (3%). Exclusion of the nonviable group reduced the mortality rate from 3.36% to 1.62%. Trauma was the major cause of mortality (n = 235; 70%) as compared to other surgical patients (n = 102; 30%). Increased mortality was also associated with emergency procedures (3.66%) as compared to elective surgeries (0.34%). In conclusion, audit of mortality and morbidity helps in initiating and implementing preventive strategies to improve surgical practice and patient care, and to reduce mortality rates. The mortality and morbidity forum is an important educational activity. It should be considered a mandatory activity in all postgraduate training programs.

Key words: Surgical audit – Morbidity and mortality meetings – Developing countries – Peer review – Patient safety – Trauma

Corresponding author: Sandiya Bindroo, MD, Providence Hospital & Medical Center, 16500 North Park Drive, Apt. 216, Southfield, MI 48075.
Tel.: +1309 807 2571; E-mail: sandhyabindroo20@gmail.com

Audit is defined as a means of quality control for medical practice by which the profession shall regulate its activities with intention of improving overall patient care.[1] The first ever clinical audit was undertaken by Florence Nightingale during the Crimean War of 1853–1855 in Scutari at Medical Barracks hospital in Turkey. Florence was appalled by the unsanitary conditions and high mortality rates among injured or ill soldiers. She and her team of 38 nurses applied strict sanitary routines and standards of hygiene to the hospital and equipment, and kept meticulous records of the mortality rates among the hospital patients. Following this change the mortality rates fell from 40% to 2%. Her methodical approach is recognized as one of the earliest programs of outcomes management.[2]

Historically, clinical audits were introduced by Ernest Hey Groves (1908) in Great Britain and Ernest Amory Codman (1910) in the United States. In 1900, Dr. Codman conceived an "end result idea" with a vision that each hospital should analyze the results of treatment in every patient and study the long-term outcome with a view of improving its treatment. Codman's ideas contributed to the standardization of hospital practices by the American College of Surgeons in 1916. He reflected a desire to improve medical practice by the examination of experience. In 1935, the Philadelphia County Medical Society continued in this tradition by forming a group initially called the Anesthesia Mortality Committee, which was an early precursor of the mortality and morbidity conference. Mortality and morbidity conferences provide a forum that provides opportunity to discuss medical errors and adverse events. This is an introspective or reactive concept in which we review ourselves without outside influences. Over the years, Mortality and Morbidity Conferences has evolved a forum for resident education. The conference is now a required component of surgical resident training, mandated by the Accreditation Council for Graduate Medical Education (ACGME).[3] Although application was irregular, surgical audit was promoted internationally by 1950. In 1953, the American College of Surgeons, in collaboration with the committee on professional hospital activities, initiated a research program to develop an adequate surgical audit. The audit system was adopted for a range of surgical specialties, and continuing modifications were made and the ability to analyze very large databases were made available. A regional audit committee was first established in Yorkshire in 1989. On February 27, 1989, the inaugural general audit meeting took place.[3] Twenty-five years ago in the UK, the Royal College of Surgeons of England demanded that every hospital involved in the training of surgeons should hold regular M&M meetings.[4]

Nonetheless, several shortcomings of Mortality and Morbidity Conferences and surgical audits were frequently noted and this led to evolution of proactive approach in the form of "Surgical Quality Improvement Program." The National Surgical Quality Improvement Program being the first validated, outcome-based, risk adjusted, and peer-controlled program for the measurement and enhancement of the quality of surgical care.[5]

Audit of surgical mortality provides an overview of the leading causes of death in patients who require surgical care thus identifying system or process error and, trends in deficiency of care, and it helps develop strategies to reduce deaths in the surgical arena. The present study was done to analyze the mortalities, with aim to identify the major reasons of death in a surgical ward. The study provides a snapshot of causes behind mortality associated with surgical patients. Its principal objective is to inform, educate, and facilitate change and improve quality of practice in surgical setting. Therefore, we can devise strategies to preempt and hence prevent the terminal events leading to the expiry of any given patient.

Methods

The study was conducted in the Post Graduate Department of Surgery, Government Medical College, India, for a period of 1 year. All deaths that happened during the 1-year period, total number of admissions to the surgical wards during the 1-year period, and the total number and nature of operations performed in cases of death were included in the study. In this study, "peer review" of all the surgical deaths was done. Patients who died were classified as follows:

1. Nonviable: Death not preventable by surgical intervention or modification of surgical procedure or an alteration in preoperative, intraoperative, or postoperative care. Group was subdivided into those with:
   - Advanced malignancy with surgery per formed for diagnostic or palliative reasons.
   - Advanced malignancy, with no surgery performed.
   - No malignancy, but underlying disease not amenable to surgical intervention.

Table 1 Results of the study

(A) Total admission	10,005
(B) Emergency admission	7531
OPD admission	2474
(C) Total deaths	337
Male	221 (65.57%)
Female	116 (34.42%)
(D) Overall mortality rate in admitted patients	3.36%
(E) Mortality rate excluding nonviable deaths	1.62%
(F) Total no. of trauma patients	3571
Deaths in trauma patients	235
Overall mortality in trauma patients	6.58%
(G) Total no. of head injury admissions	2682
Deaths in head injury patients	110
Overall mortality in head injury patients	4.10%
(H) Total no. of emergency surgeries	1747
Deaths in emergency surgeries	64
Mortality	3.66%
(I) Total no. of elective surgeries	2332
Deaths in elective surgeries	8
Mortality	0.34%
(J) Deaths in operative cases	72
(K) Deaths in nonoperative cases	265
(L) Total no. of surgeries performed	4079
No. of deaths in operative cases	72
Overall mortality in operative cases	1.76%

2. Potentially viable: Group was subdivided into those with:
   - Postoperative deaths due to surgical compli cations/errors.
   - Postoperative deaths due to medical complications/errors.
   - Nonoperative deaths, where surgery offered a chance of cure.
3. Indeterminate group: Group of patients dying in surgical unit who did not fall into viable and nonviable group.

Results

The study was done on 337 deaths that occurred in the Department of Surgery, Government Medical College, India for a period of 1 year. During the period in question a total of 10,005 patients were admitted. A total of 7531 (75.27%) of them were admitted through the emergency and the rest (2474; 24.72%) were admitted on an outpatient basis. Out of these, 337 patients expired and were audited.

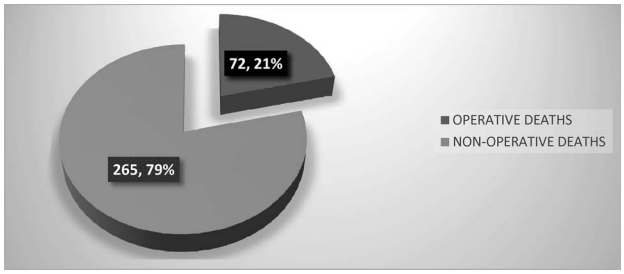

Fig. 1 Representing number of operative and nonoperative deaths.

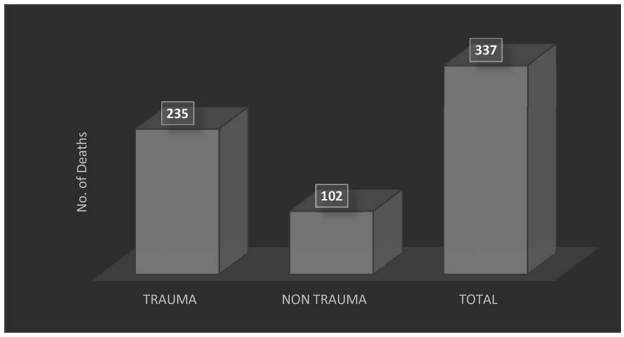

Fig. 2 Representing groups of total deaths.

Findings included the following: (Table 1, Fig. 2)

1. Of the 337 audited deaths, the maximum deaths were in the age group of 20–30 years.
2. Minimum age was 24 hours, death of an infant with omphalocele, who was planned for surgery, but expired because of difficult intubation.
3. Men represented 65.57% of deaths.
4. The majority of deaths (70%) occurred in patients admitted as emergencies.
5. Trauma (n = 235; 70%) especially head injuries (n = 110; 46.80%) contributed major cause of death.
6. 22% (n = 72) of patients who died underwent a surgical procedure (Fig. 2), with 88.88% (n = 64) being emergency operations and 11.11% (n = 8) being elective.
7. The most common postoperative complication over the 1-year period were irreversible shock (24.92%), and procedure-related sepsis (14%).
8. Autopsies were performed in 43.32% (n = 146).
9. Increased mortality was associated with emergency procedures (3.66%) as compared to elective surgeries (0.34%).

Elective surgeries that led to death involved 3 cases of terminal malignancy in patients in which some form of palliation was done. The remaining 2 cases were of elderly individuals with associated comorbidities in the form of hypertension and respiratory infections who underwent open prostatectomy and expired during the postoperative period. Both of these were not given deep venous thrombosis prophylaxis and died suddenly following respiratory arrest. One case developed septice-

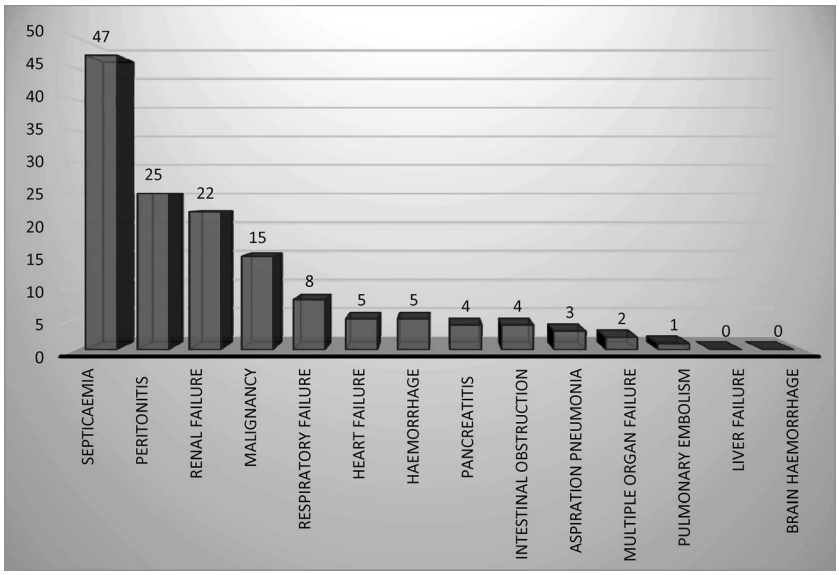

Fig. 3 Representing frequency of complications contributing to mortalities in the nontraumatic group in the study.

mia following laparotomy for intestinal obstruction. Two developed myocardial infarction in the post-operative period.

In our study, the most common single etiology was trauma group (Fig. 2) excluding cases of burn, which included road traffic accident, fall, assault, cut throat injuries, and firearm injuries. The second most common cause was burn, which involved 67 of the total cases (females = 40, males = 27). Mortality rate because of burn was 20%. Percentage of burns varied from 15% to 100%. The leading cause of female burn cases was mostly the atrocities committed by their in-laws, and male burn cases were mostly work-related injuries.

In our study since 2 or more complications contributed to the fatal outcome, these instances were listed separately (Fig. 3).

Shock was a major cause of death in 84 patients under study. Four cases were associated with pancreatitis. Nineteen cases followed peritonitis; 5 cases followed hemorrhage leading to hypovolemic shock; 4 cases followed intestinal obstruction with electrolyte imbalance; 34 cases associated with trauma that included head injuries, blunt trauma, cut throat injuries, assault, etc.; 7 cases followed renal failure; and 1 case involved advanced malignancy. The remaining 11 cases had burns involving more than 80% of the body.

Septicemia contributed to 47 deaths out of 337, of which 22 were seen in cases of burn, 12 cases followed operative procedures, the majority of which were done in emergency, and 1 case developed in case of advanced malignancy. The remaining 12 cases had no operative procedure and were seen associated with comorbid conditions.

Peritonitis contributed to deaths in 24 cases out of a total of 337. Fourteen had had operations. The remaining 10 had generalized peritonitis on admission to the hospital. In addition, bilateral extensive bronchopneumonia was present. In 1 of the cases, generalized peritonitis developed following mesenteric thrombosis and gangrene of the intestine. In 19 cases, peritonitis was associated with irreversible shock in which patients were put on inotropic support from the beginning. Peritonitis in these cases resulted either from gut or colon perforations, mostly duodenal and ileal. One case developed iatrogenic caecal perforation, leading to peritonitis. One case was associated with acute pancreatitis and pancreatic necrosis.

Pulmonary complications contributed significantly among the 337 patients, resulting in the death of 23 patients. Excluding the instances of pulmonary embolism and infarction, aspiration asphyxia contributed to 3 deaths. In each of these 3 cases, aspiration asphyxia was due to massive aspiration of vomitus secondary to head injury associated with influence of alcohol. Pulmonary embolism contributed to 2 deaths.

Renal failure was seen frequently among the 337 cases. Out of 337 deaths, renal failure contributed to 21 cases out of which 4 followed percutaneous nephrostomy in view of deranged renal function test in obstructive uropathy. The remaining 17 did not undergo any form of surgery but developed gradual

Table 2 Classification of death

Viable (n = 153)	Nonviable (n = 174)	Indeterminate (n = 10)	Total[a–c] (n = 337)
45%	52%	3%	100%

[a]Total deaths = 337.

[b]Overall mortality rate: 3.36%.

[c]Mortality rate excluding nonviable deaths: 1.62%.

failure either following sepsis, obstructive uropathy, or advanced malignancy.

Hemorrhage among the 337 patients contributed to fatal outcomes in 5.3 of the cases following blunt trauma to the abdomen and chest. In 2 of these cases hemorrhage was not detected clinically. In 1 case, the patient was admitted following gunshot wounds of the right thigh, left wrist, and abdomen. At laparotomy several intestinal perforations were repaired and cecostomy was done; 5 days later the patient died from peritonitis, bilateral pleural effusion with massive retroperitoneal hemorrhage, and hemoperitoneum. Another case was of trauma to the chest in which intercostal tube drainage was massive and, by the time open thoracotomy was planned, the patient collapsed. Out of 5 cases, 1 case had torrential bleed following removal of the liver pack. One case deserves particular mention. This patient had been shifted from medicine with diagnosis of cholecystitis with bleeding per rectum. Patient was planned for sigmoidoscopy and while undertaking the same had a massive bout of rectal bleed, causing shock and sudden death.

Pancreatitis was the cause of death in 4 cases in our study. **Intestinal obstruction** with shock contributed to 4 deaths in our study.

Massive infarction of bowel resulted in the death of 1 patient. This patient had metastatic mass, which was partly adherent to the superior mesenteric vein. The patient underwent right colectomy for obstruction but succumbed in the immediate postoperative period due to development of venous thrombosis with hemorrhagic infarction of the major portion of the small intestine and peritonitis.

With this analysis, patients were classified at the time of death into viable and nonviable groups as explained earlier. Once deaths are separated in viable and nonviable groups, this corrects a number of false impressions that might have been created by the use of overall death rate alone. Exclusion of nonviable group reduced mortality rate by half, from 3.36% to 1.62% (Table 2).

Discussion

Audit can be effective in improving professional practice although the effects are generally small to moderate and more likely to be larger when baseline adherence to recommended practice is low. To sustain audit in the long term, surgeons should view it as an important and useful activity. It is also vital that surgeons have input into the audit process and development. It is integral that surgeons appreciate the audit's "culture of reflection rather than blame."[6] A surrogate marker of the value placed on this meeting by consultants is attendance over time. From the analysis it reflected attendance remained unchanged. In our audit it was more than 89%.

In similar voluntary mortality audits, consultant participation was 73% and 91% in western Australia and Scotland.[7] Some aspects of the study have given cause for satisfaction and some for concern. Among the former is the number of patients (10,005 inpatients) we have been able to treat, sometimes under difficult conditions because of shortage of nursing staff and resources. We must acknowledge the work of the nursing staff that was almost always able to respond not only to the demands made by our increasingly specialized surgery, but also to the apparently endless stream of patients requiring their care.

Patient management is a very critical issue. It is literally a matter of life and death. Hence the pertinent questions to be raised are the following: Is the quality of care what it should be and are they doing as well as the other comparable centers? These questions may only be answered if an effective system of audit is in place. Since the inception of an effective audit and analysis system in Scotland,[8] the mortality figures have continued to fall. The current analysis is a step toward this very direction.

Our analysis revealed various systems or process errors such as delay from admission to surgery, delay in recognizing complications, and delay in transfer to a surgical unit. In addition, lack of facilities like shortage of high dependency units, less transfer of patients to intensive care units due to shortage of beds over there, nonavailability of blood or blood-related products at times, and inadequate nursing staff were some of the system-related shortcomings. Provision and appropriate use of high-dependency facilities will reduce cardiovascular, renal, and respiratory complications and reduce the risk of death. We need to strengthen our high-dependency units and increase the number of beds in intensive care units.

As in in the past septicemia and irreversible shock have returned with force. We had more than half of the deaths due to direct or indirect result of septicemia. Aside from the burn victims, in the remaining patients, sepsis could not be controlled despite repeated explorations and/or debridement and culture-directed antibiotic therapy. The well-recognized cycle of systemic inflammatory response syndrome leading to multi-organ failure was the final common pathway. A well-functioning Infections Committee in the hospital is recognized as absolutely necessary for the enforcement of guidelines in infection control. The hospital Infection Committee should have among its responsibilities the constant review of methods and system of infection control throughout the hospital, the overseeing of effective reporting of offenses, and review of classes of all medical and supportive staff not only in the operating room, but also in the other part of the hospital. Isolation techniques, clean-up techniques, and repetitive educational techniques should be under constant review. An important activity of the Hospital Infection Committee should be maintenance of an accurate record of all infections of the hospital. It is only through accurate statistics-keeping that strict self-assessment can be validated.

We need to develop stringent actions regarding asepsis and fluid management. The surgeon and his team must know the disciplines of asepsis and antisepsis and must adhere to it. Discipline and efficiency should be maintained. The study revealed that fluid management problems were recurring in the audited deaths and thus a detailed guideline document for resuscitative fluid care should be made and emphasis should be laid on junior staff for its proper documentation.

The lack of effective accident prevention strategies in our social setup lead to an inordinately high number of trauma victims. Traffic accidents were the most frequent mechanisms of injury. In our center more than half of the mortalities were due to trauma. The typical trauma victim was a young healthy adult male with no comorbidities. This is the result of a total disregard of safety precautions. To date, several countries, such as the United States, Canada, the United Kingdom, and Australia, have attempted to improve the care of severely injured patients by implementing designated (certified) trauma centers and trauma systems.[9–12] Similar centers need to be established and courses like Advanced Trauma Life Support System should be included in resident training so that an adequate workforce is generated. We need to put emphasis on development of trauma centers, and staff should be designated for the same in order to decrease heavy pressure on emergency staff.

Among the 67 burn victims most had greater than 50% burn surface. There is a need to develop a system of achieving a substitute skin cover in patients with extensive burns to prevent the overwhelming sepsis that eventually leads to mortality. This is one area that needs to be addressed on an urgent basis. We need to put forward foundations for development of skin banks.

Regarding the death from strangulated hernia, it has been shown that death in a surgical ward or within 30 days of surgery for patients with an inguinal, femoral, or incisional hernia occurs in an elderly, unfit population. This was the case with our patient who died of the consequences of pushing massive hernia contents back in the abdomen. The Scottish Audit of Surgical Mortality Report suggest that elderly patients if ASA 3 or greater undergoing hernia surgery should be anaesthetized and operated upon by consultant staff within normal working hours for best outcome.[10]

Failure to use DVT prophylaxis was a deficiency of care noted, this finding was disseminated to surgeons through seminars, regular case-note review booklets and reports on individual management relative to that of their de-identified peers. Two seminars were held specifically addressing this issue.

Late presentation of rural patients, dirty surgeries with contamination, patients' comorbidities, pressure on theatre staff due to scanty numbers of old instrument sets available for emergency procedures; substandard theatres, scrub, and autoclaving areas; and lack of staff nurses are some of the practical ground realities that had affected the poor outcome in emergency procedures compared to elective procedures. We need to introduce more stringent measures for controlling nosocomial infections such as proper sterilization of instruments, mandatory hand wash, barrier nursing care, regular and proper observation of all sick patients, and proper documentation of records. Most of these could be addressed with implementation of regular and productive educational programs of junior staff, commission of evidence-based review, and development of departmental pathways and guidelines.

Educational opportunities resulting from surgical audits are not solely limited to identifying individual or departmental underperformance. Educational opportunities can also include gaining knowledge of new technologies and procedures, or focusing

educational meetings on topics where up-to-date evidence-based practice is unclear. Surgical audits and peer review are essential components of Continuing Professional Development; when presented appropriately, audit and feedback can be effective in improving professional practice. We need to emphasize regular educational presentations and ward meetings so as to improve the quality of care. Surgical training should be emphasized and repeated educational meetings and presentations should be encouraged. These meetings should be properly supervised by the senior staff.

Conclusions

Audit of surgical mortality is a powerful tool to help identify deficiencies of care leading to surgical mortality. The results point to a global urban healthcare dilemma of managing trauma for improving patient outcomes. Especially in a developing world, preventive strategies along with allocation of increased and focused resources for manpower development and equipment for trauma management is required. The morbidity and mortality forum is an educational activity that has stood the test of time and continues to be the cornerstone of postgraduate education. It should be considered a mandatory activity in all postgraduate training programs. It is hoped that it will kindle the idea of regular practice of quality assurance by surgeons working in the young developing nations and engender a sustainable interest. The outcomes of the process will be seen in coming years in the form of reduced mortality rates, thus addressing the issue of patient safety in the developing world.

Acknowledgments

The authors report no disclaimers for this paper. The authors' work was supported by The Department of Surgery, Government Medical College India.

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