Adverse Outcomes Among Surgical Patients in a Tertiary Teaching Hospital

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ABSTRACT

Background: The clinical outcome of any surgical patient is dependent on the interplay of a multiplicity of factors. The objective of the study is to examine the factors identified as contributory to the occurrence of morbidities and mortalities among surgical patients at a tertiary teaching hospital.

Methodology: This study involved a descriptive analysis of the records of charity patients seen by the PGH Department of Surgery over a 2-year period (2005-2006) using secondary data obtained from the department's Integrated Surgical Information System (ISIS). All cases that incurred morbidities or who became mortalities were analyzed for contributory factors to the occurrence of the adverse events, as identified by surgeons. Contributory factors analyzed included Institutional Limits, Surgical Team Limits, Other Caregiver Limits, Patient Medical Limits, and Patient Psychosocial Limits. Analysis of data was performed using measures of central tendency using Microsoft Excel.

Results: The department attended to 13,591 patients and performed 15,652 major operations over the study period with a service mortality (SMT) rate of 3.36% (456 cases), an operative mortality (OMT) rate of 2.48% (388 cases), a service morbidity (SMB) rate of 3.22% (437 cases), and an operative morbidity (OMB) rate of 3.51% (550 cases). The most frequently cited contributory factors to patient mortality were patient medical limits (SMT = 98.1%, OMT = 90.8%), followed by surgical team errors (SMT = 43.4%, OMT = 48.0%). The most frequently cited contributory factors to patient morbidity were surgical team errors (SMB = 92.3%, OMB = 78.0%), followed by patient medical limits (SMB = 55.9%, OMB = 42.2%). The most frequently cited surgical team errors for the mortality cases were delayed recognition of the problem (SMT = 28.8%, OMT = 26.7%), inadequate post-op care (SMT = 16.7%, OMT = 17.6%), and poor surgical technique (SMT = 14.6%, OMT = 16.2%). The most frequently cited surgical team errors for the morbidity cases were poor surgical technique (SMB = 75.7%, OMB = 73.9%), inadequate post-op care (SMB = 14.8%, OMB = 9.8%), and intra-op judgment error (SMB = 5.6%, OMB = 5.6%). The most frequently cited institutional limits contributing to mortalities were no antibiotics (SMT = 60.7%, OMT = 54.2%) and lack of blood (SMT = 19.0%, OMT = 20.5%); for the morbidities, it was no antibiotics (SMB = 88.2%, OMB = 92.9%). The most frequently cited other caregiver error for the mortality cases was delayed delivery of care by other services (SMT = 52.2%, OMT = 52.0%), while for the morbidity cases, they were inadequate nursing care (SMB = 52.6%) and poor anesthetic care (OMB = 50.0%).

Conclusions and Recommendations: (a) Majority of the mortalities were affected by severity of the disease condition and presence of co-morbid conditions. Employment of severity stratification and institution of clinical practice guidelines may help reduce the mortality statistics. (b) The surgical team errors may be categorized into cognitive and technical errors. The impact of cognitive errors was greater in the mortality cases, while the impact of technical errors was greater in the morbidity cases. Recommendations that may reduce the commission of surgical errors include employment of deliberate practice, lobbying for training policy change, and getting to the root causes of cognitive deficiencies through focus group discussions (FGDs). (c) Proper dialogue with concerned units should be encouraged to echo relevant issues in order to reduce adverse outcomes in health care delivery.

Key Words: adverse outcome, surgical patients, teaching hospital

Introduction

The United States Institute of Medicine (IOM) in 1999 reported that nearly 100,000 people die in hospitals each year as a result of medical errors that could have been prevented[1]. Other reports estimate that one in 50 hospitalized patients experience a preventable adverse event[2]. In 2002, a prospective examination of surgical patients revealed complication rates that are 2-4x higher than those identified in the IOM report, and almost half of these adverse events were judged contemporaneously by peers to be due to provider error and hence, avoidable[3].

The prevailing paradigm in medicine acknowledges that

error in medical care has two distinct roots: at the "sharp end" is the individual provider who interacts with the patient and makes the mistake. At the "blunt end" are the latent flaws in the health care system that provides the setting, the framework, and the predisposition for the error to occur[4]. Blunt errors include the system's organizational structure and culture, policies and procedures, and performance detractors such as excess provider overload.

Because morbidities and mortalities that result from medical errors levy financial (on top of psychosocial problems) burden to patients as well as to limited hospital resources, it is important to determine the factors that may play a contributory role in the commission of these errors. This study was conducted to (a) determine the factors identified as contributory to the occurrence of adverse outcomes among surgical patients at the Department of Surgery of the Philippine General Hospital and (b) provide recommendations for possible interventions to reduce adverse outcomes among surgical patients.

Methodology

We studied all patients of the Department of Surgery of the Philippine General Hospital from January 1, 2005 to December 31, 2006. The department is further subdivided into nine divisions according to case mix of patients: (a) Head and Neck, Breast, Stomach and Soft Tissue Surgery (GS 1), (b) Colorectal Surgery (GS 2), (c) Hepatobiliary and Pancreatic Surgery (GS 3), (d) Trauma Surgery, (e) Thoraco-Cardiovascular Surgery (TCVS), (f) Pediatric Surgery, (g) Urologic Surgery, (h) Plastic and Reconstructive Surgery, and (i) Burn Unit. Data of all patients of the department were encoded into the Integrated Surgical Information System (ISIS) Electronic Patient Registry, the computer software developed as the informatics tool of the department. Patient records with adverse outcomes from all divisions were retrospectively obtained from the ISIS registry. The adverse outcomes were defined as follows:

1. For **Service Patients**: (all patients admitted to and occupying a bed in any of the nine divisions of the department).
   a. **Service Mortality**: a service patient who expires. The service mortality rate (SMT) is the proportion of service patients who expire over the total number of service patients during the study period.
   b. **Service Morbidity**: a service patient who develops a complication. The service morbidity rate (SMB) is the proportion of service patients with a complication over the total number of service patients during the study period.
2. For **Operative Patients**: (all patients on whom an operative procedure was performed by surgeons from any of the nine divisions of the department; not necessarily admitted to or occupying a bed in any of the divisions).
   a. **Operative Mortality**: an operative patient who expires. The operative mortality rate (OMT) is the proportion of operative patients who expire over the total number of operative patients during the study period.
   b. **Operative Morbidity:** an operative patient who develops a complication. The operative morbidity rate (OMB) is the proportion of patients with complications over the total number of operative patients during the study period.

A taxonomy on the contributory factors (elements that have been collectively identified by experts in an open discussion of cases with complications as influencing the occurrence of such a complication) to adverse outcomes was devised in 2004, based on a partial list of factors used by the Royal Australasian College of Surgeons. Prior to actual use, the list of contributory factors was discussed, agreed upon, and disseminated to all members of the department. Subsequently, this list was used during divisional and departmental discussions of all patients with adverse outcomes. The contributory factors were categorized into the following (Appendix A.):

1. **Institutional Limits:** These are system limitations, which played a role in the deterioration of the patient's condition. Identification of these factors recognizes the effect of the working environment within which the surgeon rendered care for his patients.
2. **Surgical Team Limits**: These factors include errors committed by any member of the surgical team primarily tasked with caring for a patient. Members of this surgical team include the person who actually performs the surgical procedure, those assessing the surgical condition of the patient, those who prepare the patient for surgery, those who attend to the patient in the postoperative period, and those supervising them
3. **Other Caregiver Limits**: These factors include errors committed by any member of the healthcare team other than the surgeons, including the nurses and the physicians of the other departments who are co-managing the patient.
4. **Patient Limits**: These factors include limitations faced by the caregivers that are inherent to the medical-surgical condition of the patient and the social, cultural, economic and other issues affecting the patient, his family and his support system.
5. **Other Limitations**: These refer to other factors considered as relevant in contributing to the problem but do not fall under any of the categories mentioned above.

Descriptive analysis of data was performed using measures of central tendency. A frequency distribution of the contributory factors to patient mortalities and morbidities is illustrated graphically for clearer presentation of the data. Analysis of data was carried out using Microsoft Excel.

Results

The PGH Department of Surgery admitted a total of 13,591 patients and performed a total of 15,652 major operations from January 1, 2005 to December 31, 2006. It had a service mortality (SMT) rate and an operative mortality (OMT) rate of 3.36% and 2.48% respectively, while its service morbidity (SMB) rate and operative morbidity (OMB) rate were 3.22% and 3.51%, respectively (Table 1).

Among the service patients, the highest SMT rates were reported in the Burn Unit (9.33%), TCVS (7.85%), and Trauma (4.91%), while the lowest SMT rates were reported in Plastic Surgery (0.30%), Pediatric Surgery (1.02%), and Urology ((1.08%). The highest SMB rates were reported in GS 2 (5.60%), TCVS (5.12%), and the Burn Unit (4.00%), while the lowest SMB rates were reported in Plastic Surgery ((0.15%), GS 3 (2.29%), and Pediatric Surgery (2.56%) (Table 2).

Table 1. Proportion of cases with adverse events seen at the PGH Department of Surgery from 2005-2006.

Type of patient	Total Number of Patients	Mortality Cases	Morbidity Cases
Service Patients	13,591	456 *(3.36%)*	437 *(3.22%)*
Operative Patients	15,652	388 *(2.48%)*	550 *(3.51%)*

Table 2. Distribution of service patients with adverse events seen at the PGH Department of Surgery according to case mix, 2005-2006.

Division	Total Number of Service Patients	Service Mortality	Service Morbidity
GS 1	2620	54 *(2.06%)*	75 *(2.86%)*
GS 2	1928	86 *(4.46%)*	108 *(5.60%)*
GS 3	2223	62 *(2.79%)*	51 *(2.29%)*
Trauma Surgery	3012	148 *(4.91%)*	90 *(2.99%)*
TCVS	586	46 *(7.85%)*	30 *(5.12%)*
Pediatric Surgery	978	10 *(1.02%)*	25 *(2.56%)*
Urology	1203	13 *(1.08%)*	42 *(3.49%)*
Plastic Surgery	666	2 *(0.30%)*	1 *(0.15%)*
Burn	375	35 *(9.33%)*	15 *(4.00%)*

Table 3. Distribution of operative patients with adverse events seen at the PGH Department of Surgery according to case mix. 2005-2006.

Division	Total Number of Operative Patients	Operative Mortality	Operative Morbidity
GS 1	2251	37 *(1.64%)*	81 *(3.60%)*
GS 2	2314	56 *(2.42%)*	136 *(5.88%)*
GS 3	2107	42 *(1.99%)*	51 *(2.42%)*
Trauma	1326	77 *(5.81%)*	79 *(5.96%)*
TCVS	1673	79 *(4.72%)*	66 *(3.94%)*
Pediatric Surgery	1625	57 *(3.51%)*	47 *(2.89%)*
Urology	2599	26 *(1.00%)*	68 *(1.46%)*
Plastic Surgery	1379	3 *(0.22%)*	9 *(0.65%)*
Burn	378	11 *(2.91%)*	13 *(3.44%)*

Table 4. Distribution of frequency of times the contributory factors were cited according to adverse patient outcome among patients seen at the PGH Department of Surgery from 2005-2006.

Contributory Factor	Service Mortality (456)	Operative Mortality (437)	Service Morbidity (388)	Operative Morbidity (550)
Institutional Limits	84 *(18.24%)*	83 *(18.99%)*	17 *(4.38%)*	14 *(2.54%)*
Surgical Team Limits	198 *(43.42%)*	210 *(48.05%)*	358 *(92.27%)*	429 *(78.00%)*
Other Caregiver Limits	23 *(5.04%)*	25 *(5.72%)*	19 *(4.90%)*	16 *(2.91%)*
Patient Medical Limits	451 *(98.90%)*	397 *(90.85%)*	217 *(55.93%)*	232 *(42.18%)*
Patient Psychosocial Limits	131 *(28.73%)*	110 *(25.17%)*	24 *(6.19%)*	29 *(5.27%)*
Others	18 *(3.95)*	16 *(93.66%)*	23 *(5.93%)*	22 *(4.00%)*

Among the operative patients, the highest OMT rates were reported in Trauma (5.81%), TCVS (4.72%), and Pediatric Surgery (3.51%), while the lowest OMT rates were reported in Plastic Surgery (0.22%), Urology (1.00%) and GS 1 (1.64%). The highest OMB rates were reported in Trauma (5.96%), GS 2 (5.88%) and TCVS (3.94%), while the lowest OMB rates were reported in Plastic Surgery (0.65%), Urology (1.46%) and GS 3 (2.42%) (Table 3).

Analysis of the identified contributory factors among the mortality cases yielded the following observations (Table 4):

1. Patient Medical Limits was cited as the most frequent contributory factor (SMT = 98.90%, OMT = 90.85%).
2. Surgical Team Limits was cited in nearly fifty percent of cases and was the second highest contributory factor to the death of patients (SMT = 43.42%, OMT = 48.05%)(Table 5).
    a. The most frequently cited surgical team errors for both service and operative mortalities were: (Figure 2)
        i. Delayed Recognition of the problem (28.8%, 26.7%)
        ii. Inadequate Post-operative care (16.7%, 17.6%)
        iii. Poor Surgical Technique (14.6%, 16.2%)
        iv. Delayed Intervention (10.6%, 14.3%)
    b. The least frequently cited surgical errors were Lack of Adequate Supervision and Technical Inadequacy.
3. Institutional Limits was cited in nearly 20% of cases (SMT = 18.42, OMT = 18.99). The top two factors cited were No Antibiotics and Lack of Blood. (Table 6)
4. Other Caregiver Limits was the least frequently cited contributory factor (SMT = 5.04%, OMT = 5.27%). However, among those cases where these errors were committed, the delay in the delivery of care by other services was noted in more than 50% of cases (Table 7).

Analysis of the identified contributory factors among the morbidity cases yielded the following observations: (Table 4)

1. Surgical Team Limits was cited as the most frequent contributory factor (SMB = 92.27%, OMB =78.00%).
    a. The greatest majority of the surgical errors committed was due to Poor Surgical Technique (SMB = 75.7%, OMB = 73.9%) (Table 5).
    b. The next most frequently cited among the surgical errors for both SMB and OMB cases were Inadequate Post-op Care (14.8%, 9.8%) and Intra-op Judgment Error (5.6%, 5.6%).
    c. Failure to Refer and Lack of Adequate Supervision were never cited for both service and operative morbidity cases.

Figure 1. Frequency of contributory factors to mortality and morbidity outcomes among surgical patients seen at the PGH Department of Surgery, 2005-2006.

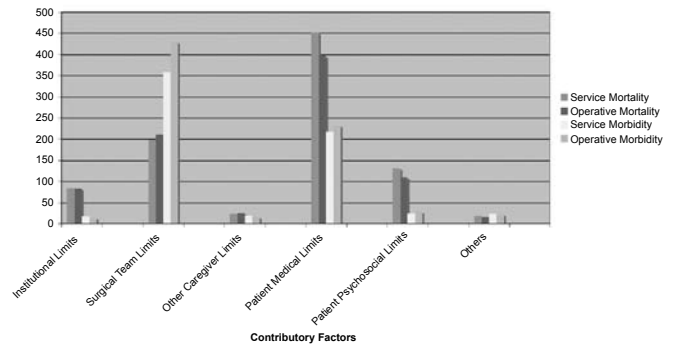

Figure 2. Frequency of surgical team errors among surgical patients with adverse outcomes seen at the PGH Department of Surgery, 2005-2006.

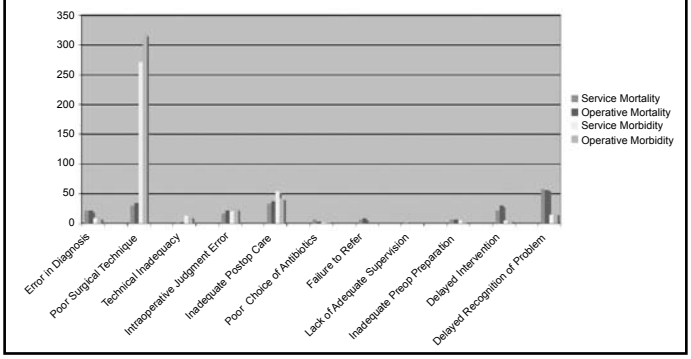

Figure 3. Frequency of Institutional limits among surgical patients with adverse outcomes seen at the PGH Department of Surgery, 2005-2006.

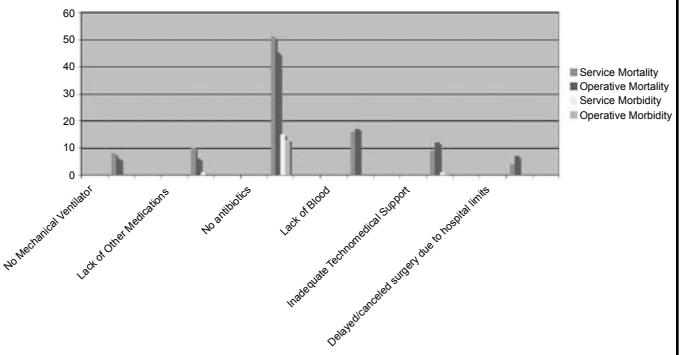

Figure 4. Frequency of other caregiver limits among surgical patients with adverse outcomes seen at the PGH Department of Surgery, 2005-2006.

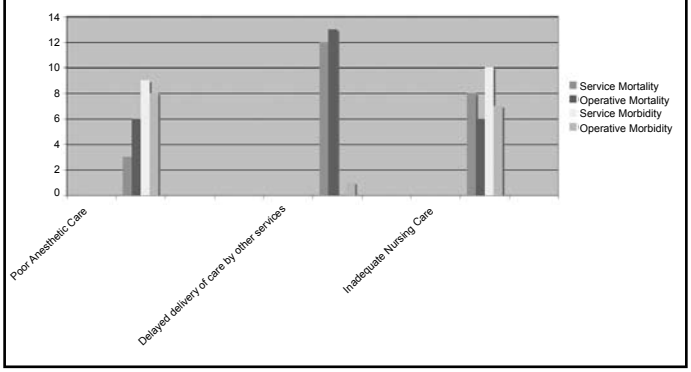

Table 5. Distribution of frequency of times the Surgical Team Limits Errors were cited according to adverse patient outcome among patients seen at the PGH Department of Surgery from 2005-2006.

Surgical Team Limits	Service Mortality (198)	Operative Mortality (210)	Service Morbidity (358)	Operative Morbidity (429)
Error in Diagnosis (S-EDX)	21 *(10.6%)*	21 *(10.0%)*	9 *(2.5%)*	9 *(2.1%)*
Poor Surgical Technique (S-PST)	29 *(14.6%)*	34 *(16.2%)*	271 *(75.7%)*	317 *(73.9%)*
Technical Inadequacy (S-TXI)	2 *(1.0%)*	2 *(0.9%)*	12 *(3.4%)*	11 *(2.6%)*
Intraoperative Judgment Error (S-IJE)	16 *(8.1%)*	21 *(10.0%)*	20 *(5.6%)*	24 *(5.6%)*
Inadequate Postop Care (S-IPC)	33 *(16.7%)*	37 *(17.6%)*	53 *(14.8%)*	42 *(9.8%)*
Poor Choice of Antibiotics (S-PCA)	6 *(3.0%)*	3 *(1.4%)*	1 *(0.3%)*	1 *(0.2%)*
Failure to Refer (S-FTR)	6 *(3.0%)*	8 *(3.8%)*	0	0
Lack of Adequate Supervision (S-LAS)	1 *(0.5%)*	1 *(0.5%)*	0	0
Inadequate Preop Preparation (S-IPP)	6 *(3.0%)*	6 *(2.9%)*	5 *(1.4%)*	4 *(0.9%)*
Delayed Intervention (S-DIN)	21 *(10.6%)*	30 *(14.3%)*	4 *(1.1%)*	5 *(1.2%)*
Delayed Recognition of Problem (S-DRP)	57 *(28.8%)*	56 *(26.7%)*	14 *(3.9%)*	16 *(3.7%)*

Table 6. Distribution of frequency of times the Institutional Limits factors were cited according to adverse outcome among patients seen at the PGH Department of Surgery from 2005-2006.

Institutional Limit	Service Mortality (84)	Operative Mortality (83)	Service Morbidity (17)	Operative Morbidity (14)
No Mechanical Ventilator (I-NMV)	8 *(9.5%)*	6 *(7.3%)*	0	0
Lack of Other Medications (I-LOM)	10 *(11.9%)*	6 *(7.3%)*	1 *(5.9%)*	0
No antibiotics (I-NAB)	51 *(60.7%)*	45 *(54.2%)*	15 *(88.2%)*	13 *(92.9%)*
Lack of Blood (I-LOB)	16 *(19.0%)*	17 *(20.5%)*	0	0
Inadequate Technomedical Support (I-ITS)	9 *(10.7%)*	12 *(14.5%)*	1 *(5.9%)*	1 *(7.1%)*
Delayed/ canceled surgery due to hospital limits (I-DSHL)	4 *(4.8%)*	7 *(8.4%)*	0	0

Table 7. Distribution of frequency of times the Other Caregiver Limits factors were cited according to adverse outcome among patients seen at the PGH Department of Surgery from 2005-2006.

Other Caregiver Limits	Service Mortality (23)	Operative Mortality (25)	Service Morbidity (19)	Operative Morbidity (16)
Poor Anesthetic Care (0-ANE)	3 *(13.0%)*	6 *(24.0%)*	9 (47.4%)	8 (50.0%)
Delayed delivery of care by other services (0-OTH)	12 *(52.2%)*	13 *(52.0%)*	0	1 (6.3%)
Inadequate Nursing Care (0-NUR)	8 *(34.8%)*	6 *(24.0%)*	10 *(52.6%)*	7 *(43.8%)*

2. Patient Medical Limits was the second most frequently cited contributory factor (SMB = 55.93%, OMB 42.18%).
3. Institutional Limits was the least frequently cited contributory factor to the department morbidities.

Discussion

Patient Medical Limits was cited as the most frequent contributory factor to both service (98.90%) and operative (90.85%) mortality cases. This means that most patients who eventually expire already have severe conditions from the onset or have complicating co-morbid diseases that worsen their chances for survival. Patient factors and disease characteristics are variables that do not lend themselves easily to alterations and are thus considered as "givens" when they enter the equation. At best, the health care provider can only hope to optimize these variables, and with the aid of research and processes that define and improve the negative aspects of these variables, patients may be optimally prepared for surgical interventions.

However, Surgical Team Limits were cited in nearly fifty percent of all mortality cases as contributory to the death of both service (43.42%) and operative (48.05%) patients. While the frequency of these citations is only half of the Patient Medical Limits, these figures are consistent with reports of medical errors committed in the care of patients (1,2,3). Further analysis of the data shows that an average of 2 surgical errors were reported among the mortalities where these were committed. The most frequently cited surgical team errors for both service and operative mortalities were delayed recognition of the problem (28.8%, 26.7%), inadequate post-operative care (16.7%, 17.6%), poor surgical technique (14.6%, 16.2%), and delayed intervention (10.6%, 14.3%). Delayed recognition of the problem and delayed intervention are cognitive problems, while inadequate post-operative care and poor surgical technique are technical in nature. It is worthwhile to note that Lack of Adequate Supervision and Technical Inadequacy were the least frequently cited surgical errors; both these factors are operational in nature, suggesting that a system of guidance from trainers is in place in the department training activities.

Other Caregiver Limits was the least frequently cited contributory factor for both service (5.04%) and operative (5.72%) mortalities. However, among those cases where these errors were cited, the delay in the delivery of care by other services was noted in more than fifty percent of cases. This suggests that since it was already noted that most of these patients had severe conditions from the outset, any form of delay in health care delivery levies a heavy toll on the eventual clinical outcome.

In contrast, for the morbidity cases of the department, Surgical Team Limits was cited as the most frequent contributory factor in both service (92.27%) and operative (78.00%) morbidity cases. Patient Medical Limits is the second most frequently cited factor for the morbidity cases (SMB = 55.93%, OMB = 42.18%). Further analysis of the data reveals that an average of 5 surgical team errors was reported among the morbidity cases where these were committed. The greater majority of surgical errors cited among the morbidity cases was Poor Surgical Technique for both service (75.7%) and operative (73.9%) cases, followed by Inadequate Post-operative Care (14.8%, 9.8%) and Intra-operative Judgment Error (5.6%, 5.6%).

The roster of surgical errors enumerated in the checklist (Appendix) classifies these errors into cognitive, technical, and operational in nature. This study shows that cognitive errors have a greater impact on patient's mortality, while technical errors more frequently lead to morbidities. As morbidities lead to protracted hospital stays and use of more hospital resources, a reexamination of the teaching of technical skills in surgery may be worth going into, with the following issues to be considered: (a) surgical residents are novices when they are recruited, and most are technically unprepared to participate in a manner that is meaningful to their training; (b) many of the skills that novices lack could be taught and learned in a training environment that is less demanding and more productive than the operating room; (c) the operating room is an outcome-oriented environment and might not be the proper place for residents to go through their performance learning curve; (d) improvement in technical performance not only leads to optimal patient safety but also to increased operating room efficiency, and in effect, the hospital saves money by reducing cost and expenses; and (e) there is an existing lack of standardization on the part of the skills to be acquired by the individual resident-in-training with the traditional methods of teaching surgery. On the other hand, training improvements targeted to increase cognitive skills of residents are more difficult to device primarily because the underlying root causes for cognitive deficiencies were not elicited by this study.

The multiplicity of mechanisms and causes of errors (internal and external, individual and systemic) dictates that there cannot be a simple or universal means of reducing errors. As this study shows, the outcome of surgical intervention is not solely dependent on the abilities of the surgeon in isolation. The patient's physiologic status, the disease that requires surgical correction, the nature of the operation, and the pre-operative and post-operative support services have major effects on the ultimate outcome[5]. Moreover, one of the main conclusions of the IOM report is that medical errors are caused by faulty systems, processes and conditions that lead people to make mistakes or fail to prevent them[1]. Health care has safety and quality problems because it relies on outmoded systems of work, and the desire of safer, higher-quality care requires us to redesign systems of care[6].

Conclusions and Recommendations:

1. Majority of the department's mortality cases are patients with severe disease conditions or those with co-morbid conditions that further aggravate the patient's surgical condition. Employment of a severity stratification scoring system for patients may guide health care providers in equitable distribution of limited hospital resources. Institution of clinical

practice guidelines may minimize delays in health care delivery by the entire team of caregivers.

2. This study documents the magnitude of surgical errors committed in health care delivery. Employment of Deliberate Practice such as training modules on cadaveric, animal and inanimate models in the acquisition of expert performance may have a role in the surgical training curriculum. A review of current surgical training curricula should also be undertaken to consider possible policy changes in the teaching of surgical skills.
3. Focus group discussions (FGDs) should be undertaken to further investigate why cognitive problems exist among surgical trainees and how these may be addressed.
4. Many of the institutional and other caregiver limits are preventable. Proper dialogue with concerned units should be encouraged to echo relevant issues in order to reduce adverse outcomes in health care delivery.

APPENDIX
List of Contributory Factors to Patient Mortality and Morbidity

1. Institutional Limits: These are system limitations which played a role in the deterioration of the patient's condition. Identification of these factors recognizes the effect of the working environment within which the surgeon rendered care for his/her patients. It is anticipated that when these limitations are minimized or overcome, a surgeon is able to deliver better quality of care to his/her patients.
    a. No Mechanical Ventilator
        i. Definition: The absence of a mechanical ventilator contributed to the problem.
        ii. Example: Pneumothorax from too vigorous manual ambubagging
        iii. Code: I-NMV
    b. No antibiotics
        i. Definition: Antibiotics appropriate for the management of the case is not available in the hospital pharmacy.
        ii. Example: ETA C/S showed *Staphylococcus aureus* sensitive only to Vancomycin, a drug not available in our pharmacy, in a patient with hospital-acquired pneumonia.
        iii. Code: I-NAB
    c. Lack of other medications
        i. Definition: Unavailability in the hospital of particular medications/drugs, other than antibiotics, contributed to the problem.
        ii. Example: Amioradone for arrhythmia
        iii. Code: I-LOM
    d. Lack of blood
        i. Definition: Unavailability of blood and its components required by the patient.
        ii. Example: A trauma patient dies of hypovolemic shock because of lack of type O blood
        iii. Code: I-LOB
    e. Inadequate techno medical support (Lab and therapeutic equipment)
        i. Definition: The absence of a laboratory test, monitoring/therapeutic equipment other than a ventilator contributed to the problem.
        ii. Example: Inaccessibility of a bronchoscope during weekends contributed to the problem brought about by failure to adequately address mucus plugging and atelectasis
        iii. Code: I-ITS
    f. Delayed, Cancelled or Prolonged Surgery due to hospital limitations
        i. Definition: The delay in the performance of a surgical procedure in a patient, or prolongation of a procedure, because of unavailability of an operating room, linen, instruments, or personnel, including nurses, anesthesiologist, and x-ray technician, contributed to the problem.
        ii. Example: A patient, initially consulting for uncomplicated appendicitis, whose surgery had to be delayed because of non-availability of an operating room, develops sepsis from a ruptured appendicitis
        iii. Code: I-DSHL

2. Surgical Team Limits: These factors include errors committed by any member of the surgical team primarily tasked with caring for a patient. Members of this surgical team include the person who actually performs the surgical procedure, those assessing the surgical condition of the patient, those who prepare the patient for surgery, those who attend to the patient in the postoperative period, and those supervising them. Identification of these factors should allow better insight regarding knowledge gaps especially among the trainees, deficiencies or inadequacies in the training system, or individual shortcomings among the members of the surgical team.
    a. Erroneous diagnosis/Missed Diagnosis/Failure to diagnose
        i. Definition: A faulty identification of the clinical problem(s) of the patient. Or, an inability to identify a clinical problem in a patient despite clinical signs and symptoms pointing to said problem.
        ii. Example: A patient presenting with fever, abdominal pain and jaundice was erroneously diagnosed to have septic cholangitis and was subsequently operated on, only to find out later that the patient was suffering from typhoid ileitis.
        iii. Code: S-EDX
    b. Delayed Recognition of the Problem
        i. Definition: There is considerable delay in the correct identification/detection of a clinical problem leading to a delay in timely intervention/management.
        ii. Example: A patient who undergoes intestinal anastomosis postoperatively develops signs and symptoms of an anastomotic leak but is erroneously treated

as ileus. The patient is scheduled for re-exploration only after fascial dehiscence with succus coming out of the wound is observed.
iii. Code: S-DRP

c. Inappropriate Preoperative Preparation
i. Definition: Deficiencies in optimizing the condition for a patient in anticipation of a surgical procedure.
ii. Example: A septic elderly patient is inadequately hydrated prior to induction of anesthesia.
iii. Code: S-IPP

d. Poor surgical technique
i. Definition: Unsatisfactory execution in the delivery of a surgical maneuver or the mode of style of performance of a surgical procedure is wanting. In such cases, it is presumed that the surgeon, at the level of his training, is expected to be skilled in the performance of the procedure or maneuver in question.
ii. Example: Non-gentle handling of tissues during dissection causes an iatrogenic injury to the bowels during laparotomy.
iii. Code: S-PST

e. Technical Inadequacy
i. Definition: A resident surgeon operated on a case whose level of difficulty is above his level of capability, without the supervision or assistance from a more experienced surgeon. The complication that is incurred is identified as related to the technical aspect of the surgery.
ii. Example: A junior resident performs a common bile duct exploration for the first time without assistance by a senior.
iii. Code: S-TXI

f. Intraoperative Judgment Error
i. Definition: Miscalculations or mis-interpretations of certain intraoperative findings in the course of an operation, resulting in the performance of a procedure or arriving at a decision that is inappropriate for the case at hand.
ii. Example: Bowels misinterpreted to be viable after reduction during a herniorrhaphy and the patient later develops an acute abdomen for intestinal gangrene.
iii. Code: S-IJE

g. Inadequate Post-operative Care
i. Definition: Omission or commission of certain steps in the after-care of a patient recovering from surgery leading to the undesired outcome.
ii. Example: Failure to perform aggressive pulmophysiotherapy in a post-laparotomy patient who later develops pneumonia.
iii. Code: S-IPC

h. Poor choice of antibiotic coverage
i. Definition: The utilization of an antibiotic that is outside the sensitivity pattern of the pathogen involved in the patient's condition or that is commonly deemed inappropriate or insufficient for the type of condition and common pathogen involved in such diseases. This should not be cited when the limiting factor in the administration of the proper antibiotic is its availability in the hospital (I-NAB) or that the patient could not afford the drug (PP-FIN).
ii. Example: A patient with Fournier's disease is maintained on co-amoxiclav alone.
iii. Code: S-PCA

i. Failure to Refer Accordingly
i. Definition: A clinical problem is correctly identified but is not brought to the attention of others who can assist in the correction of the problem while failing to correctly address the problem himself.
ii. Example: A first year surgical resident who upon dressing a post-operative wound observes erythema around the wound but fails to refer to the surgeon. The patient subsequently develops necrotizing fascitis.
iii. Code: S-FTR

j. Delayed Intervention
i. Definition: A considerable time period has elapsed between seeing and diagnosing the patient's condition and rendering a service that is critical to the care of the patient.
ii. Example: A patient with acute cholangitis requiring biliary drainage does not have the procedure done on him within the critical 8-hour period from diagnosis.
iii. Code: S-DIN

k. Lack of Adequate Supervision
i. Definition: A surgical resident performed a procedure without the required guidance from a more experienced surgeon. The resident causes a complication due to lack of such guidance or direction.
ii. Example: A resident performing his first cholecystectomy, unassisted by a more experienced surgeon, causes an inadvertent transection of the patient's common bile duct.
iii. Code: S-LAS

3. Other Care Giver Limits: These factors include errors committed by any member of the healthcare team other than the surgeons, including the nurses and the physicians of the other departments who were co-managing the patient. Identification of these factors emphasizes the need for better liaison between the surgical department and the other caregiving units to elevate the quality of care rendered to the patient, focusing on a multidisciplinary and holistic approach.

a. Inadequate Nursing Care
i. Definition: Appropriate care, under the responsibilities of the nursing staff, was not rendered or was delayed, contributing to the morbidity or death of the patient.
ii. Example: A patient develops a cautery burn during the surgery.
iii. Code: O-NUR

b. Poor anesthetic care or anesthesia error
   i. Definition: Inappropriate care related to the anesthetic management of the patient was rendered, contributing to the morbidity or death of the patient.
   ii. Example: A patient develops hypoxia intraoperatively because a partially pulled out endotracheal tube was undetected.
   iii. Code: O-ANE
c. Delayed delivery of care by other services
   i. Definition: Appropriate care, particularly therapeutic maneuvers, were not performed at the appropriate time by healthcare providers other than the surgical, nursing and anesthesia staff, contributing to the morbidity or death of the patient.
   ii. Example: A limb fracture problem was not appropriately addressed because of a delay in the response of the Orthopedic team and the patient developed pulmonary embolism.
   iii. Code: O-OTH

4. Patient Limits: These factors include limitations faced by the caregivers that are inherent to the medical-surgical condition of the patient and the social, cultural, economic and other issues affecting the patient, his family and his support system. Identification of these factors should provide the proper insight and context upon which surgical care is rendered to the patient.
   a. Severity of the disease condition
      i. Definition: The magnitude and severity of the patient's medical/surgical condition contributed to the problem.
      ii. Example: Patients with third-degree burns affecting a large surface area.
      iii. Code: PM-DIS
   b. Co-morbidities
      i. Definition: Disease/s, other than the surgical condition, contributed to the problem.
      ii. Example: A hypertensive patient had a stroke while awaiting surgery.
      iii. Code: PM-COM
   c. Immune Deficiency
      i. Definition: The depressed ability of the patient to mount an adequate response to infection and injury contributed to the problem.
      ii. Example: A patient undergoing chemotherapy developed hospital-acquired pneumonia.
      iii. Code: PM-IMD
   d. Immobilization
      i. Definition: The poor mobility of the patient contributed to the problem.
      ii. Example: A patient on traction developed bedsores.
      iii. Code: PM-IMM

5. Others:
   a. Other factors considered as relevant in contributing to the problem but do not fall under any of the categories mentioned above.
   b. Code: X-ETC

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