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Investigating selected patient safety indicators using medical records data

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ABSTRACT

Introduction: Medical errors in hospitals kill more people every year than AIDS, breast cancer and auto accidents combined. Widespread consensus exists that health care organizations can reduce patient injuries by improving the environment for safety from implementing different alternatives from technical and managerial improvements to considering medical record data. Considering the preventability of medical errors, the Agency for Healthcare Quality and Research (AHRQ) developed patient safety indicators (PSIs). This study analyzes the PSIs calculated in Alzahra Hospital of Isfahan. **Materials and Methods:** This study was conducted retrospectively using the inpatient medical record data of hospitalized patients in a six month period, from October 2010 to March 2011. An experienced team in the fields of medical record, health management and health information technology was involved in data reviewing. Based on a prior consultation and reviewing, some PSIs were selected. Indicators were calculated considering AHRQ guidelines. Excel software and hospital information system software were used. **Results:** Across all studied medical records of patients, out of 25,164 discharges, below measures were calculated.

- 8 Foreign Body cases (PSI 5) (0.31 per 1000).
- 30 Postoperative Hemorrhage or Hematoma cases (PSI 9) (2.2 per 1000).
- 5 Accidental Puncture or Laceration cases (PSI 15) (0.3 per 1000).
- 8 Complications of Anesthesia cases (PSI 1) (2.2 per 1000).
- 96 Selected Infections Due to Medical Care cases (PSI 7) (3.8 per 1000).
- 17 cases of Postoperative Wound Dehiscence (PSI 14) (3.7 per 1000).
- 1 Birth Trauma – Injury to Neonate case, and (PSI 17) (1.7 per 1000).
- 18 Obstetric Trauma – Cesarean Delivery cases (PSI 20) (40 per 1000) were flagged by studied PSIs developed by AHRQ.

Conclusion: Comparing with the reported rates by other studies and AHRQ study in 2006, all of calculated indicators have inadequate condition; i.e. these are far from empirical estimated rates. The hospital administrators should be more sensitive to this issue and perform some improvement programs.

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INTRODUCTION

Medical errors in hospitals kill more people every year than AIDS, breast cancer and auto accidents combined. Widespread consensus exists that all of health care facilities can reduce patient injuries by concentrating on safety by implementing technical changes, such as electronic medical record systems, or by improving staff awareness of patient

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safety risks.^[1] WHO has defined patient safety as activities or measures taken by an individual or a health care organization to prevent, remedy or mitigate the occurrence or reoccurrence of a real or potential (patient) safety event; a large part of safety problems in health care facilities are related to errors. An error is a failure to perform a planned action as intended or implementation of an incorrect plan. Errors may be defined as doing the wrong thing (commission) or failing to do the right thing (omission), at either the planning or execution phase.^[2]

There is a worldwide growing consensus to take action to reduce the occurrence of apparently common, serious medical errors. Achieving this goal involves identifying errors in practice and undertaking initiatives to avoid and prevent them.^[3] Medical errors and therefore medical injuries can happen at all stages of the complicated process of care.^[4]

The lack of standard taxonomy in addition to different complicated issues in large part explains why so little is known about the prevalence of adverse outcomes and effective prevention of medical injuries.^[4] In health care, as in other organizations, anything which cannot be measured is difficult to improve. In response to this important issue, Agency for Healthcare Quality and Research (AHRQ) have developed a set of indicators, namely patient safety indicators (PSIs), which provide information on potential of hospital complications and adverse events following surgeries, procedures, and childbirth. The PSIs can be used to help hospitals identify potential adverse events.^[5]

The most important characteristic of PSIs is that readily available and inexpensive hospital discharge data have been identified as a useful source of information on AEs.^[6] AHRQ has published the three modules as a series: The first module – Prevention Quality Indicators, the second module – Inpatient Quality Indicators – and the third module that focuses on potentially preventable complications and iatrogenic events for patients treated in hospitals. The PSIs are measures that screen for adverse events that patients experience as a result of exposure to the health care system; these events are likely amenable to prevention by changes at the system or provider level.^[7]

The PSIs are valid indicators and used in a variety countries and health care facilities worldwide.^[8-11] For example, Cevasco *et al.*, mentioned that PSI 14 or “postoperative wound dehiscence”, one of four PSIs was recently adopted by the Centers for Medicare and Medicaid Services to compare quality and safety across hospitals. They used this measure to determine how well it identifies true cases of postoperative wound dehiscence.^[8]

Rosen and Itani described PSIs as specifically designed to screen for potentially preventable adverse events that patients experience as a result of exposure to the acute-care setting. The PSIs are based on ICD-9-CM codes and therefore only require information from hospital administrative discharge

data, making them readily available, cost-efficient, and easy to use.^[9] Borzecki and colleagues suggested that PSIs are indicators which were designed to identify inpatient complications that are clinically significant and potentially preventable.^[12] In Iran there has recently been a growing interest in patient safety initiatives and considerable efforts have been taken to achieve them. One of these is the implementation of Patient Safety Friendly Hospital pilot project in partnership with WHO. This pilot project led to positive results and some hospitals in Iran succeeded to be awarded Patient Safety Friendly Hospital certification. This certification emphasizes on the prevention of complications caused by physicians for patients.^[13] Alzahra Hospital succeeds to be awarded level 1 of this credential.^[14] Regardless of the problems and considering the initiatives, this study through PSIS can enforce other efforts and concerns in patient safety. As Carol *et al.*, said, the intended purpose of the PSIs is to detect potential AEs, prioritize areas of action and to provide a starting point for further analysis to reduce preventable errors through system or process changes.^[15] The PSIs can be used to help hospitals identify potential adverse events that might need further study; provide the opportunity to assess the incidence of adverse events and in-hospital complications using administrative data found in the typical discharge record; include indicators for complications occurring in hospitals that may represent patient safety events.^[5] Alzahra Hospital is a referral hospital which provides services to patients from Isfahan and other provinces near Isfahan. This hospital is the most important educational hospital in the Isfahan province. In this study nine selected measures were investigated using inpatient medical record data of hospitalized patients in the first half of fiscal year 2010 in Alzahra Hospital.

MATERIALS AND METHODS

This study was a retrospective study aimed to detect PSIs developed by AHRQ in Alzahra Hospital, a tertiary care academic medical center in Isfahan. Data gathering was done using medical record data of hospitalized patients in a six month period, from October 2010 to March 2011. The AHRQ-PSIs are based on applying computer algorithms to secondary diagnosis and procedure codes from hospital discharge abstracts to identify potential adverse events during the hospital stay. The codes for diagnosis and procedure were applied to the patient record after a review by the medical record coding unit based on standard administrative coding guidelines.^[16] In the first step, considering the inadequate system of recording medical error in Iran's health care facilities, for assuring, existence of data, practicality and feasibility of study, a preliminary report of hospital information system (HIS) including principal and secondary diagnosis codes were provided, a series of interviews were done with some experts such as hospital medical records personnel, superior nurses of clinical departments, physicians and surgeons. Based on these interviews and HIS report, finally from 20 PSIs, 9 indicators were selected for calculating; i.e. PSI 1 (Complications of Anesthesia), PSI 5 (Foreign Body Left During Procedure), PSI 7 (Selected Infections

Due to Medical Care), PSI 9 (Postoperative Hemorrhage), PSI 14 (Postoperative Wound), PSI 15 (Accidental Puncture or Laceration), PSI 16 (Transfusion Reaction), PSI 17 (Birth Trauma – Injury to Neonate) and PSI 20 (Obstetric Trauma – Cesarean).

An experienced team including of medical record, health management, health information technology experts was involved in data reviewing. Selected PSIs or the number of adverse events per 1000 populations at risk, were calculated. For estimating measures Excel software and HIS software were used.

Calculation of PSIs rates was done based on definition of each indicator notified by AHRQ.^[17]

Thus PSIs were calculated as:

PSI 1 (Complications of Anesthesia): Cases of anesthetic overdose, reaction, or endotracheal tube misplacement per 1000 surgery discharges. Excludes codes for drug use and self-inflicted injury.

PSI 5 (Foreign Body Left During Procedure): Discharges with foreign body accidentally left in during procedure per 1000 discharges.

PSI 7: Selected Infections Due to Medical Care Cases of secondary ICD-9-CM codes 9993 or 00662 per 1000 discharges. Excludes patients with immunocompromised state or cancer.

PSI 9 (Postoperative Hemorrhage): Cases of hematoma or hemorrhage requiring a procedure per 1000 surgical discharges. Excludes MDC 14.

PSI 14 (Postoperative Wound): Cases of reclosure of postoperative disruption of abdominal wall per 1000 cases of abdominopelvic surgery. Excludes obstetric admissions.

PSI 15 (Accidental Puncture or Laceration): Cases of technical difficulty (e.g., accidental cut or laceration during procedure) per 1000 discharges. Excludes obstetric admissions.

PSI 16 (Transfusion Reaction): Cases of transfusion reaction per 1000 discharges.

PSI 17 (Birth Trauma – Injury to Neonate): Cases of birth trauma, injury to neonate, per 1000 live born births. Excludes some preterm infants and infants with osteogenesis imperfecta.

PSI 20 (Obstetric Trauma – Cesarean): Cases of obstetric trauma (3rd or 4th degree lacerations) per 1000 cesarean deliveries.

RESULTS

In this study from 20 Provider-Level PSIs published by AHRQ, 9 indicators were calculated. Totally 25,164 discharge

data were investigated of which 794 (3.1%) were dead and 24,370 (96.8%) were discharged; 13,257 (52.6% of total accepted patients) cases were surgical discharges [Table 1].

Selected AHRQ-PSIs (based on Research methodology) were investigated in all of patient discharge data. And the rate of each PSI was calculated and the results are as shown in Table 2.

DISCUSSION

Since the medical error report from the Institute of Medicine has attracted public attention toward patient safety issues, many studies on medical errors have been conducted and reported, including several from the medical informatics and patient data. So far many institutions have developed measures for assuring patient safety. One of the most important developed measures in this issue is AHRQS PSIS. Applying these measures can lead to identifying errors in practice and undertaking initiatives to avoid or prevent them.

This study indicated that, almost all of nine calculated measures, have improper status than optimum base promulgated by AHRQ and values reported in the other studies.^[7,15,17]

The first indicator, Complications of Anesthesia (PSI 1), was calculated as 2.2 (per 1000), whereas in an empirical analysis conducted by an AHRQ project team using Florida State Inpatient Database this indicator was estimated as 0/75.^[7]

Of course, considering the newly introduced nature of safety actions in Iran and specifically in this hospital, this value is somewhat expectable.

The next studied indicator was Foreign Body Left During Procedure (PSI 5) which estimated 0.31; this indicator in the same review was presented as 0/07.^[7]

PSI 14 was defined as Cases of Reclosure of postoperative disruption of abdominal wall per 1000 cases of abdominopelvic surgery excludes obstetric admissions.^[7] This measure in our study was calculated as 3/7 which is higher than AHRQs estimate and must be improved. As per the Zhan and Miller study, postoperative wound dehiscence is a serious surgical complication which is associated with an additional 9 days of hospitalization, \$40,000 in excess charges, and 10% in hospital-attributable mortality.^[4] So it should be scrutinized more.

Table 1: Frequency and percentage of investigated discharge data

Total accepted patients	25,164	Percentage
Dead	794	3.1
Discharged	24,370	96.8
Surgical discharge (from total accepted patients)	13,257	52.6

Table 2: Calculated rates of PSIS in Alzahra Hospital

Patient safety indicators	Definition	Rate per 1000
1-Complications of Anesthesia (PSI 1)	Cases of anesthetic overdose, reaction, or endotracheal tube misplacement per 1000 surgery discharges. Excludes codes for drug use and self-inflicted injury	2.2
2-Foreign Body Left During Procedure (PSI 5)	Discharges with foreign body accidentally left in during procedure per 1000 discharges	0.31
3-Selected Infections Due to Medical Care (PSI 7)	Selected infections due to medical care (PSI 7) cases of secondary ICD-9-CM codes 9993 or 00662 per 1000 discharges. Excludes patients with immunocompromised state or cancer	3.8
4-Postoperative Hemorrhage or Hematoma (PSI 9)	Cases of hematoma or hemorrhage requiring a procedure per 1000 surgical discharges. Excludes MDC 14	2.2
5-Postoperative Wound Dehiscence (PSI 14)	Cases of reclosure of postoperative disruption of abdominal wall per 1000 cases of abdominopelvic surgery. Excludes obstetric admissions	3.7
6-Accidental Puncture or Laceration (PSI 15)	Cases of technical difficulty (e.g., accidental cut or laceration during procedure) per 1000 discharges. Excludes obstetric admissions	0.37
7-transfusion Reaction (PSI 16)	Cases of transfusion reaction per 1000 discharges	0-No code was registered
8-Birth Trauma-Injury to Neonate (PSI 17)	Cases of birth trauma, injury to neonate, per 1000 live born births. Excludes some preterm infants and infants with osteogenesis imperfecta	1.7
9-Obstetric Trauma-Cesarean Delivery (PSI 20)	Cases of obstetric trauma (3rd or 4th degree lacerations) per 1000 Cesarean deliveries	0-No code was registered

PSI=Patient safety indicators

Postoperative wound dehiscence may be prevented through appropriate surgical technique, optimizing modifiable patient risk factors prior to elective surgery, and close monitoring of perioperative conditions.^[18] Webster *et al.*, pointed that surgeon experience level and technical factors have also been shown to affect the rate of wound dehiscence.^[19]

Selected Infections Due to Medical Care (PSI 7) or Health care-associated infections is another important measure in patient safety issue. Rates of infections due to medical care have risen over the past decade and this malpractice now kills as many people as AIDS, breast cancer, and auto accidents combined.^[20] Health care-associated infections are one of the most frequent adverse events in health care.^[21] This indicator (PSI 7) rate was calculated in our study as 3.8, compared to AHRQ estimation in 2006 which was reported as 2.4,^[7] it must be improved. This problem leads to many ill outcomes for health care system. As Sheng pointed the average increased length of hospital stay due to hospital-acquired infections (HAIs) was about 20 days.^[22] On the basis of the same research HAI burden costs about US\$10,000 to health care facility, then if it is prevented it can lead to a saving of about 50%.

The next investigated indicator was Postoperative Hemorrhage or Hematoma (PSI 9) which was estimated at 2.2 per 1000. The postoperative hemorrhage or hematoma indicator is intended to capture cases of hemorrhage or hematoma following a surgical procedure.^[1] In a study conducted by Carol in United States reported this indicator as 0.206%,^[15] which is nearly in accordance with our finding.

Accidental Puncture or Laceration (PSI 15) also is another potentially preventable complication of health care system. Results of this study reveal this indicator at 0.37.

This indicator in two other studies conducted by Carol and by Haytham *et al.*, was reported as 0.32^[15] and 0.31,^[23] respectively, which are consistent with this study finding.

Birth Trauma – Injury to Neonate which was clarified as (PSI 17) was estimated in this study as 1.7. This measure in other studies was reported as 0.667,^[15] which is lower than our study finding. Another study points that major birth trauma occurs in 3% of all live-born infants,^[24] although in a study carried out in Iran this rate was reported as 41.16 per 1000 vaginal deliveries.^[25] In the same study, induction of labor, premature rupture of membranes, academic degree of attending physician at delivery, higher birth weight, and gestational age associated with fetal injuries were introduced as risk factors of birth trauma.^[25]

In two PSIs 16 (Transfusion Reaction) and 20 (Obstetric Trauma – Cesarean Delivery) there were not recorded any codes. While Carol has reported these two indicators as 0.0004 and 0.593^[15] another study conducted by AHRQ has reported it as 4.4.^[17] This contradiction may be associated to not reporting malpractices in the patient's medical record in our studied hospital. This may be due to a fact that physicians also strongly oppose public reporting of information on medical errors perhaps because of worries about malpractice lawsuits,^[26] and also economic and legal consequences.

CONCLUSIONS

The assessment and reporting of quality medical outcomes has become a key factor of health care improvement and efforts in cost reduction.^[27] Despite of, all studied measures were an underestimate of actual rate, but, in almost all calculated PSIs Alzahra Hospital have a worse situation comparing other health care facilities measures which were studied in literature review. Observed gap may be attributed to this hospital being

young in safety and patient safety actions in Iran. However the more important problem is that, all of malpractices and events occurring in medical practices are not reported completely. This condition may be associated with problems such as lacking internal systems to identify events, a culture of non-reporting due to fear of publicity and fear of liability, a lack of enforcement and bureaucratic burdens.

Despite the fact that calculated measures are underestimate but, considering the initial aim of this study, i.e. sensitizing hospital managers to Adverse events importance, detect potential Adverse events, prioritize areas of action, it is suggested the Alzahra safety managers should be more active in safety and improving quality performance. They should firstly have a serious concern to reporting malpractices and events occurred during medical practice, and then have a more tendency to Postoperative Wound Dehiscence (PSI 14) and Selected Infections Due to Medical Care (PSI 7).

Generally it should be pointed that in spite of objections to PSIs, these indicators are useful starting points for improving health care quality and patient safety. So these can provide an accessible, low cost, and efficient means of detecting AEs in hospitals. Hence it is suggested that such studies will be conducted in the other hospitals and inpatient care services, because conducting and publishing these studies can increase awareness of errors in, and injuries due to, medical management (AEs).

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