Investigating selected patient safety indicators using medical records data

Hedayatalah Asgari, Sakineh Saghaieiannejad Esfahani, Maryam Yaghoubi’, Marzieh Javadi, Saeed Karimi
Health Management and Economics Research Center, Isfahan University of Medical Sciences, University of Isfahan, Isfahan,
’Health Management Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

ABSTRACT

Introduction: Medical errors in hospitals kill more people every year than AIDS, breast cancer and auto accidents combined. Widespread consensus exists that all 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 safety. 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 per1000).
- 8 Complications of Anesthesia cases (PSI 1) (2.2 per 1000).
- 96 Selected Infections Due to Medical Care cases (PSI 7) (3.8 per1000).
- 17 cases of Postoperative Wound Dehiscence (PSI 14) (3.7 per1000).
- 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.

Key words: Health care, hospital, patient safety, quality indicators, safety

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 safety.
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.[5] 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.[6]

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.[7] 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] Borzechki 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.[9] 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.[12] 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 PSI, 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. 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 codes for drug use and self-inflicted injury.

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 AHRQ’s 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.

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.

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.

PSI 14 was defined as Cases of Reclosure of postoperative disruption of abdominal wall per 1000 cases of abdominopelvic surgery excludes obstetric admissions. 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. 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       |
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. Webster et al., pointed that surgeon experience level and technical factors have also been shown to affect the rate of wound dehiscence.

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. Health care-associated infections are one of the most frequent adverse events in health care. 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, 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. 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. In a study conducted by Carol in United States reported this indicator as 0.206%, 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 and 0.31, 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, which is lower than our study finding. Another study points that major birth trauma occurs in 3% of all live-born infants, although in a study carried out in Iran this rate was reported as 41.16 per 1000 vaginal deliveries. 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.

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 another study conducted by AHRQ has reported it as 4.4. 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, 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. 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).

ACKNOWLEDGMENT

We would like to thank those who assisted us in doing this research: Especially our colleagues in medical record unit and the managers and executives of Alzahra Hospitals for facilitating data gathering.

REFERENCES

1. Agency for Healthcare Research and Quality (AHRQ). Available from: http://www.qualitymeasures.ahrq.gov/content.aspx?id=26524 [Last accessed on 2013 Sep. 11].
2. World health organization, World Alliance for Patient Safety, WHO. 2009. Available from: http://www.who.int/patientsafety/en/brochure_final.pdf [Last accessed on 2013 Feb 13].
3. Agency for Healthcare Research and Quality (AHRQ) Department of Health and Human Services. Measures of Patient Safety Based on Hospital Administrative Data The Patient Safety Indicators. Available from: http://www.archive.ahrq.gov/downloads/pub/evidence/pdf/psi/psi.pdf. [Last accessed on 2014 April 5].
4. Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. JAMA 2003;290:1868-74.
5. Agency for Healthcare Research and Quality (AHRQ). Available from: http://www.qualityindicators.ahrq.gov. [Last accessed on 2013 Feb 13].
6. Agency for Healthcare Research and Quality (AHRQ). AHRQ’s patient safety initiative: Building foundations, reducing risk. Interim report to the Senate Committee on Appropriations. AHRQ Publication No. 04-RG005. Rockville, MD: AHRQ; December 2003. Available from: http://www.ahrq.gov/qual/pscongrpt. [Last accessed on 2013 Feb 13].
7. Agency for Healthcare Research and Quality (AHRQ). Quality Indicators, Guide to Patient Safety Indicators March 2003 Version 3.0 [February 20, 2006]. Available from: http://www.qualityindicators.ahrq.gov. [Last accessed on 2013 Feb 13].
8. Cevasco M, Borzecki AM, McClusky DA 3rd, Chen Q, Shin MH, Itani KM, et al. Positive Predictive Value of the AHRQ Patient Safety Indicator “Postoperative Wound Dehiscence”. J Am Coll Surg 2011;212:962-7.
9. Chen Q1, Rosen AK, Cevasco M, Shin M, Itani KM, Borzecki AM. Detecting patient safety indicators: How valid is “foreign body left during Procedure” in the Veterans Health Administration? J Am Coll Surg 2011;212:977-83.
10. Utter GH, Cuny J, Sama P, Silver MR, Zrelak PA, Baron R, et al. Detection of postoperative respiratory failure: How predictive is the Agency for Healthcare Research and Quality’s Patient Safety Indicator? J Am Coll Surg 2010;211:347-54.
11. Utter GH, Zrelak PA, Baron R, Tacnredi DJ, Sadeghi B, Geppert JJ, et al. Positive predictive value of the AHRQ accidental puncture or laceration patient safety indicator. Ann Surg 2009;250:1041-5.
12. Borzecki AM1, Cevasco M, Chen Q, Shin M, Itani KM, Rosen AK. How valid is the AHRQ Patient Safety indicator “postoperative physiologic and metabolic derangement”? J Am Coll Surg 2011;212:968-76e1-2.
13. Available from: http://www.behdasht.gov.ir/index.aspx?siteid=1&andpageid=127&andnewsview=15217. [Last accessed on 26 Nov 2012].
14. Alzahra medical center. Available from: http://www.alzahra.mui.ac.ir/1389-06-13-07-02-36/431-142.html. [Last accessed on 2013 Oct 18].
15. Masheter CJ, Hougland P, Xu W. Detection of Inpatient Health Care Associated Injuries: Comparing Two ICD-9-CM Code Classifications. Advances in Patient Safety: Vol. 1, In: Henriksen K, Battles JB, Marks ES, Lewin D editors. Rockville (MD): Agency for Healthcare Research and Quality (US); 2005.
16. ICD-9-CM Guidelines, Conversion Table, and Guidelines. Available from: http://www.cdc.gov/nchs/icd/icd9cm_addenda_guidelines.htm. [Last accessed on 2013 Oct 18].
17. Agency for Healthcare Research and Quality (AHRQ). AHRQ Quality Indicators. Guide to Patient Safety Indicators Department of Health and Human Services Agency for Healthcare Research and Quality. Available from: http://www.qualityindicators.ahrq.gov March 2003Version 3.1 [Last accessed on 2007 Mar 12].
18. van Ramshorst GH, Niewenhuizen J, Hop WC, Arends P, Boom J, Jeekel J, et al. Abdominal wound dehiscence in adults: Development and validation of a risk model. World J Surg 2010;34:20-7.
19. Webster C, Neumayer L, Smout R, Horn S, Daley J, Henderson W, et al. Prognostic models of abdominal wound dehiscence after laparotomy. J Surg Res 2003;109:139-70.
20. Van Dyke K. Eliminating infections, saving lives. Available from: http://www.hhnmag.com/hhnmag_app/jsp/articledisplay.jsp?dcrpath¼HHNMAG/Article/data/100CT2009/091009HNN_Online_VanDykeNamedomain¼HHNMAG. [Last accessed on 2010 Feb 5].
21. McFee RB. Nosocomial or hospital-acquired infections: An overview. Dis Mon 2009;55:422-38.
22. Sheng WH, Wang JT, Lu DC, Chie WC, Chen YC, Changa SC. Comparative impact of hospital-acquired infections on medical costs, length of hospital stay and outcome between community hospitals and medical centres. J Hosp Infect 2005;59:205-14.
23. Kaaferani HM1, Borzecki AM, Itani KM, Loveland S, Mull HJ, Hickson K, et al. Validity of selected patient safety indicators: Opportunities and Concerns. J Am Coll Surg 2011;212:924-34.
24. Gresham EB. Birth trauma. Pediatr Clin North Am 1975;22:317-28.
25. Borna H, Rad SM, Borna S, Mohseni SM. Incidence of and risk factors for birth trauma in Iran. Taiwan J Obstet Gynecol 2010;49:170-3.
26. Blendon RJ, DesRoches CM, Brodie M, Benson JM, Rosen AB,
Schneider E, et al. Views of practicing physicians and the public on medical errors. N Engl J Med 2002;347:1933-9.

27. Cima RR, Lackore KA, Nehring SA, Cassivi SD, Donohue JH, Deschamps C, et al. How best to measure surgical quality? Comparison of the Agency for Healthcare Research and Quality Patient Safety Indicators (AHRQ-PSI) and the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) postoperative adverse event at a single institution. Surgery 2011;15:943-9.

Source of Support: This article was derived from research No 290105 which was approved and supported by medical university of Isfahan, Conflict of Interest: None declared