Investigating Electronic Incident Reporting Systems and Its Role Within Healthcare to Improve Patient Safety: An Integrative Literature Review

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Abstract

Incident reporting is a welcomed practice in industries such as aviation for improving safety. This practice is now welcomed in healthcare in many countries (Vincent, 2010). For instance, In the UK, incident reporting is a component of individual hospital risk governance processes and a key requirement for National Health Service (NHS) Organizations (Rooksby *et al.*, 2007). In spite of this, widespread implementation of incident reporting is still not clear even though reporting has resulted in improvements to safety. Vincent *et al.* (2008) cited that recent studies of incident reporting suggest that its role in managing safety has been over emphasized and there should be less emphasis on counting incidents and more emphasis on analyzing the effectiveness of incidents and institutional learning (Braithwaite *et al.*, 2011). Most studies of incident reporting have focused on factors, such as staff willingness to report incidents, barriers to incident reporting, and the culture surrounding reporting. However, few studies have examined the effectiveness of electronic incident reporting systems in improving safety, and there is little evidence regarding how the technology contributes to safety (Anderson *et al.*, 2013). For this reason, the purpose of this study was to investigate electronic incident reporting systems and its role within healthcare to improve patient safety. By focusing on this, the researcher was successful in highlighting a series of behaviors and perceptions around electronic incident reporting. Equally important, the researcher provided several themes that has been known to both inhibit and promote confidence within this technology offering. Thereafter, the researcher then suggested strategies for healthcare leaders to consider when adopting as a means to help bridge the gap between healthcare workers and electronic incident reporting systems.

Keywords: electronic incident reporting, healthcare leadership, patient safety, quality, incident reporting, incident, risk management, healthcare worker

1. Introduction

Florence Nightingale once wrote, "it may seem a strange principle to enunciate as the very first requirement in a hospital that it should do the sick no harm" (Pfettscher, 2021). That was over a hundred and fifty years ago, and yet, today that requirement of "doing no harm" is still identified as an issue in the health system. While the health system has changed since that time, the **"*doing no harm*"** to patients is part of the patient safety agenda worldwide in health care because studies in several countries have shown that 10% of patients admitted to acute settings are harmed (Vincent *et. al*., 2001). By this means, it is not a trivial strategy within the international healthcare community to try to improve incident reporting and the subsequent management of incidents detected (Wachter, 2004). Accordingly, several countries have introduced national or system-wide reporting systems to monitor and analyze incident data (Williams and Osborn, 2006; Spigelman and Swan, 2005).

Because of this observation, there is a growing call of the need to collect and analyze data on adverse incidents in order to facilitate learning and improve patient safety in healthcare. To corroborate this observation, in 2005, The World Health Organization (2005) stated that an effective reporting system is the foundation of safe practice within a hospital. Pittet and Donaldson (2006) held a similar view in stating that incident reporting is generally held to be a core initiative in addressing patient safety. According to proponents, the analysis of incidents (defined as adverse events and near misses) can provide information on which to support policy and practice decisions as a means to reduce future occurrences (Vincent, 2004).

Accumulated together, data on multiple incidents have the potential to help identify patterns, trends and categories of

incidents for follow-up, which produce moments for systems improvements (Wood & Nash, 2005). In essence, reporting systems tend to have the primary goal of improving quality, but they tend to be based on anonymity and with confidentiality safeguards as a means to create opportunities for analysis and feedback, which means that deficiencies can be addressed.

Granted that, the dilemma for healthcare leadership is that reporting systems do not provide a reliable index of the rate of adverse incidents as there are many barriers to incident reporting (Vincent et al., 1999). To this end, in response to address some of these barriers, electronic incident reporting systems have been introduced into many hospitals, but the views from healthcare workers around this technology offering and its role to improve patient safety has produced limited research.

With that said, the purpose of this literature review was to investigate electronic incident reporting systems and its role within healthcare to improve patient safety. Additionally, the goal of this research was to explore any themes and perceptions that has been disclosed to either discourage or strengthen healthcare workers' confidence towards using electronic incident reporting. What's more, the significance of this research was that it provided a different perspective on the already existing problem in healthcare as it relates to the different views that healthcare workers have around electronic incident reporting as to whether or not it improves patient safety.

2. Literature Review

2.1 Overview of Patient Safety in Healthcare

One of the global issues that have affected both developed and developing countries in the recent past is patient safety (Perneger, 2006**).** The modern patient safety movement was launched in the late 20th century and has gained momentum since this time. Major reports from the United States of America and the United Kingdom of Great Britain and Northern Ireland drew attention to the scale of the problem. Around the same time, a series of observational studies in different countries also assessed the extent of so-called "medical errors" in hospital inpatient care (WHO, 2020).

As noted, patient safety has been defined in the Canadian Patient Safety Dictionary as "the reduction and mitigation of unsafe acts within the health care system, as well as through the use of best practices shown to lead to optimal patient outcomes (Davies, 2003). In another view, patient safety has been defined as the avoidance of unexpected harm to people during the offering of care (England, 2019). Donaldson *et al.* (2000) purported a similar definition for patient safety in stating that it is looked upon as impeding and reducing of unfavorable consequences or injuries arising from the processes of healthcare.

Whichever definition is preferred, the ultimate purpose of patient safety is to avert and lessen the chances of injury, errors, and harm that could occur during the offering of healthcare services. Equally important, patient safety is improved when leadership is engaged and committed to patient care, documentation is expected, and reporting system by workers is utilized to prevent potential errors (Amaniyan *et al.*, 2020). Jha (2019) noted that patient safety is an essential component in healthcare because the occurrence of adverse events due to unsafe care is likely to be one of the ten leading causes of death and disability in the world. Fernando *et al.* (2023) held a related view in stating that patient safety forms the foundation of healthcare delivery just as biological, physiological, and safety needs form the foundation of Maslow's hierarchy (Maslow, 1954). Stated differently, if the patient does not feel safe or is not safe, then this creates a negative patient experience.

Each of the above conclusions can be summed up from the study conducted by Perneger (2006) in which the researcher considered patient safety to be a global level problem that calls for global solutions. Nevertheless, the healthcare system is extremely complex which means that in order to ensure patient safety, it will require dedicated team members. With this in mind, patient safety moved to the forefront in health care with the release in 1999 of the Institute of Medicine (IOM) landmark report, To Err is Human: Building a Safer Health System, which estimated that annually in the United States, up to one million people were injured and 98,000 died as a result of medical errors (Kear & Ulrich, 2014). The report estimated that between 44,000 and 98,000 Americans die each year from adverse events at a cost to the nation of US $8.5 to $19 billion annually (Donaldson *et al.*, 2000).

Other countries, including the United Kingdom, Australia, and New Zealand have investigated the extent of the problem, and clearly showed that adverse events are a global patient safety concern (Elliott *et al.*, 2014). Baker et al. (2004) conducted a detailed study of patient safety in Canada, and revealed that 7.5% of adult acute care patients in Canadian hospitals in the year 2000 experienced an adverse event, and 36.9% of these events were deemed to be preventable. The study also estimated that between 9,250 and 13,750 deaths from adverse events could have been prevented. This study also looked at similar studies in other countries (United Kingdom, Australia, New Zealand,

and the United States), and found that adverse event rates ranged from 2.9% to 16.6% of acute care admissions. The report concluded that one of the key steps in advancing patient safety is to have a reporting system that allows adverse events and near misses/close calls to be recorded so that health care workers can learn from them and then implement corrective action plans (Elliott *et al.*, p. 2, 2014).

Dhamanti *et al.* (2019) arrived at this same conclusion in stating that incident reporting is widely accepted as one of the ways of improving patient safety. To reenforce this conclusion, Dhamanti *et al.* (2019) further cited that incident reporting systems have been established in many countries such as Malaysia, Taiwan, Japan, United Kingdom, Denmark, Canada, United States, Netherland and Germany. With this in mind, in 2004, the World Health Organization (WHO) enacted the Patient Safety Program to make possible and spur the international effort on patient safety. The organization expanded several implementation guides to assist countries in creating incident reporting systems as a means to improve patient safety. Implementation guides such as the Draft Guidelines for Adverse Events Reporting and Learning System, the Conceptual Framework for the International Classification for Patient Safety, and the Surgical Safety Check-list were all championed to help keep patients safe (Dhamanti *et al.*, 2019).

2.2 Definition of a Healthcare Incident

A healthcare incident or adverse event is an unfavorable event such as a medical error, patient injury, or equipment failure, which harms a patient, caregiver, or other individuals or has the potential to harm them (England, 2019). From another view, Vincent *et al.* (2001) stated that a patient safety incident is defined as any unintended event caused by health care that either did or could have led to patient harm. Pronovost *et al.* (2006) came to an indistinguishable definition in stating that a healthcare incident is an event that either could or did lead to patient harm. A no-harm event is called a near miss, and an event that involved harm is called an adverse event (p.306). See Figure 1 below for classifications of patient safety incidents (WHO, 2020).

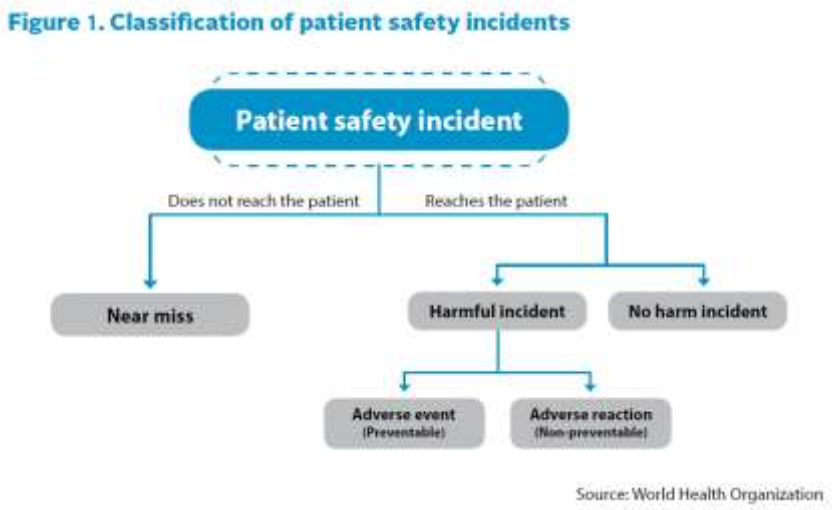

Figure 1. Classification of patient safety incidents (WHO, 2020)

In another study conducted by Milch *et al.*, (2006), a more detailed classification of safety incidents were disclosed within an incident reporting system. See Figure 1A below.

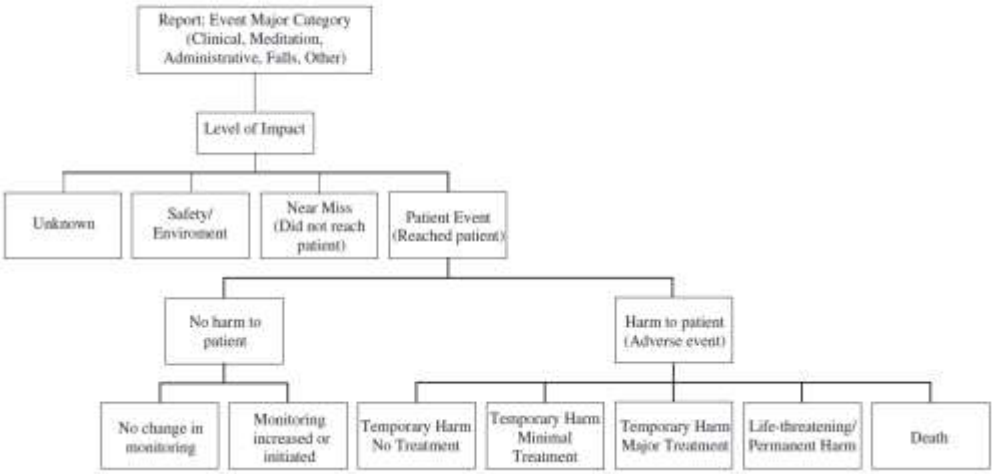

Figure 1A. Diagram of impact level categories and study definitions (Milch *et al.*, p. 166, 2006)

With the above definitions known, it is estimated within developed countries that one in every ten patients are harmed while receiving treatment when in a hospital setting (Slawomirski, 2017). Looking at the numbers more closely, this translates to about 134 million adverse events and 2.6 million deaths are reported from hospitals annually in low- and middle-income countries (LMICs) (National Academies of Sciences, 2018). Hence, the most salient point of a patient safety incident reporting and learning system is that it must be effective towards reducing future harm of the classifications that are being reported. See Figure 2 below (WHO, 2020).

Figure 2. Response levels for responding to patient safety incident report (WHO, 2020)

2.3 Common Categories of Events in Healthcare Incidents

There are many categories that have been come to describe incident events within healthcare. In this study, Milch et al. (2006) reported the categories for each event as: (a) Nonmedication-related clinical (events related to medical management, excluding administration, delivery, or reaction to medications), (b) Medication/infusion (events related

to the administration, delivery, dosing, or reaction to medications), (c) Administrative (including events related to system processes and infrastructure issues), (d) Falls, or (e) Other (Milch et al., 2006).

In a separate study, Pronovost et al. (2006) captured common categories from a study within an Intensive Care Unit Safety Reporting System which were as followed: (a) Medication and therapeutics; (b) Incorrect/incomplete care delivered; (c) Equipment/medical device; (d) Lines, tubes, and drains; (e) Hazardous situations; (f) Orders not completed/delayed; (g) Airway management; (h) Assessment and review; (i) Patient testing Skin integrity; (j) Patient identification; (k) Patient restraint; (l) Patient fall; (m) Information technology.

2.4 Healthcare Incident Reporting

Incident reporting in healthcare refers to collecting health care incident data with the aim of improving quality of patient safety and care. Incident reporting identifies safety hazards and guides the development for proper interventions to mitigate risks, thereby reducing harm (Fernando *et al.*, 2023). Stated another way, Incident Reporting Systems (IRSs) enables healthcare organizations to identify the common errors and their causative factors (Fernando *et al.*, p.1, 2023). At present, IRSs have been implemented within various healthcare regions of many developed countries in the world including the United Kingdom (UK), Australia, United States (USA) and Japan. In many cases, specialist committees have been assigned in some hospitals to analyze the adverse events and in return, to suggest and put in place preventive measures (Fernando *et al.*, 2023). Although these systems have known to experience high costs to the client, IRSs provide valuable insights as to how and why patients could be harmed at the organizational level (Pham *et al.*, 2013).

2.5 Introducing Incident Reporting Systems to Healthcare

As noted, the development of reporting systems for adverse events in health care have been traced back to the late 1970s (Elliott *et al.*, 2014). However, according to Fernando *et al.* (2023), an Incident Reporting System (IRS) was first officially used by the aviation industry as a tool which allowed pilots and other aviation professionals to confidentially report near misses or close call events in the interest of improving aviation safety. As a comparison, the first adverse event assessment in a hospital setting was known to take place in New York in 1984. Granted that, the vaccine adverse event reporting system was established in the USA in 1990 by the Centers for Disease Control and Prevention (CDC), as a national early warning sign to ensure safety (p. 3). Although this is true, a high concern regarding the importance of having IRSs was induced after releasing of the Institute of Medicine (IOM) report on 'To Err Is Human: Build-in a Safer Health System', in 1999.

Considering the value of IRSs, the World Health Organization (WHO) issued a guideline in 2005, to be followed on the establishment of IRSs in healthcare organizations (p. 3). After that, most of the countries around the world including UK, USA, |Australia and Japan adopted IRSs to their health systems and considered it as a national requirement as a means to guarantee patient safety (Fernando *et al.*, p. 3, 2023). Equally important, many countries have since been implementing incident reporting systems and moving to electronic incident reporting systems. Countries such as the United Kingdom, Australia, Japan, and the United States are ahead of other countries, including Canada, particularly as it relates to national reporting systems (Lee, 2005).

3. Electronic Incident Reporting System

3.1 Overview on the Implementation of Electronic Incident Reporting Systems

There has been a focus in healthcare on replacing paper-based reporting systems with electronic systems in order to improve delays associated with data entry and other barriers to reporting. Many of these electronic systems are web-based but some are on personal digital assistants or have been integrated into an electronic patient record system (Walsh *et al.*, 2010). Given this revelation, Heeks *et al.* (1999) argued that health care information systems (HCIS) will fail more often than they succeed because of identified mis-matches between the conceptions in a system's design and the realities into which it is introduced. The research proposed that the mismatch can be assessed along seven dimensions:

(1) information;

(2) technology;

(3) processes;

(4) objectives and values;

(5) staffing and skills;

(6) management and structures; and

(7) other resources.

As a solution, the research concluded that the starting point for any process of HCIS implementation must be analysis of the conception-reality gap (Heeks *et al.*, 1999). Although a common barrier to reporting associated with both paper-based and electronic systems appears to be the ***lack of feedback***, there is a dearth of research about the implementation of electronic adverse incident reporting systems in hospitals (Walsh *et al.*, 2010).

Although the World Health Organization report concluded that an effective incident reporting system serves as a cornerstone of safe health practices and helps health care organizations to build a culture of safety, studies have shown that incident reporting systems are generally underutilized for many reasons, such as fear of blame, increased workload, forgetting to report an incident, and feeling that incident reporting is not useful (Hwang *et al.*, 2012).

In response to these barriers, many healthcare organizations have looked towards implementing an electronic incident reporting system (e-IRS) (Wu *et al.*, 2008). The main reason for this trend was to replace paper-based incident reporting systems and avoid the common delays that result from manual data entry. With this in mind, an e-IRS may be in two formats, either web-based or integrated with an electronic medical records system (Walsh *et al.*, 2010). In addition, it has been disclosed that certain benefits have been linked to an e-IRS such as an increase in the number of incidents reported; improved tracking, legibility, and confidentiality of incident reports; and decreased the number of missing incident reports.

What is more, it has been found that e-IRSs allow risk managers to view incidents as soon as they occur, respond immediately to mitigate the consequences of an incident, and analyze the reports to identify any existing trends (Al-Rayes *et al.*, 2020). On the other hand, according to Prang and Jelsness-Jørgensen (2014), a lack of electronic confidence and knowledge on the use of technology was reported as one of the main challenges that could affect the successful implementation e-IRS. As per their findings, nurses pointed out that it was easier to report incidents on paper than electronically. In general, health information systems are subject to failure due to users' lack of acceptance (Al-Rayes et al., 2020).

Rahman *et al.* (2023) conducted another study taken place in Sweden towards the implementation of e-IRSs. In this study, three themes surfaced (1) acceptance and the use of the system, (2) functionality and complexity, (3) and challenges at the management level. The first theme presented inconsistency in the functions of the reporting system. This in turn caused the reporters to be confused at the time of reporting. The second theme, the complexity of the systems, was further amplified by the advanced features, which were not fully utilized, and to some extent, not completely understood by the healthcare staff. The third theme involved the challenges regarding the allocation of the roles and the classification of the events. The users found the reporting level simple; however, the managing and investigation level was more complex. Therefore, the logic of the system was not considered user-friendly, which led to further staff frustration (Rahman *et al.*, 2023).

3.2 Challenges and Barriers Linked to Electronic Incident Reporting System

Chittister and Haimes (1993) have argued that e-IRSs have, in many cases, been developed in an ad hoc process. He also reflected that "risk identification and management processes have been by and large also ad hoc". For this reason, The Department of Health (2006) reflects on the key barriers to incident reporting by noting that:

- The poor data quality of incident reports, many of which contain inaccurate or incomplete about the patient harm;
- In many cases, poor engagement from senior clinicians to use the reporting systems;
- Insufficient involvement of local NHS organizations in reviewing and acting upon analysis of their own incident reports; and
- ***Slow rate of feedback*** of identified trends and patterns in incident reports to local NHS organizations, compounded by difficulties in effectively managing a large national database of incident reports (Department of Health, 2006).

Currently, patient safety is largely monitored by mandatory or voluntary reporting systems. Incidents are reported on specific computerized or paper-based forms. However, these are not integrated into Electronic Patient Record (EPR) and require health care professionals to spend extra time and effort to log on to specific computer-based systems to report incidents. Furthermore, most declaration forms require users to fill in extensive sections of narrative free text and are therefore relatively cumbersome to use. Accordingly, this heavily impacts the effectiveness of existing reporting systems. Knowing this, only 4.3% to 23% of the total number of incidents occurring in clinical settings is reported (Haller *et al.*, 2007).

As a comparison, Braithwaite *et al.* (2008) noted various barriers to reporting in this study. First, individual hurdles included concerns about personally admitting a mistake, reluctance to appear foolish or incompetent, discomfort at reporting confidential information, uncertainty as to how to report, fear of litigation and worry about reprisals. Expectations of how others view professionals, reputation management and feelings of personal or job insecurity can each play a part in poor reporting levels. Second, collective constraints included inhibitive reporting cultures, lack of adequate systems and patterns of sociologically implicit or explicit discouragement or blaming mores. There were significant differences found in the attitudes toward incident reporting of various health professions with nurses and allied health staff being more favorably ready than doctors to report. A third set of stumbling blocks beyond the individual and collective was the technical component. This included user dissatisfaction, poor software performance, lack of structured reporting back and running costs (Braithwaite *et al.*, 2008).

In another questionnaire design study, Walsh *et al*. (2010) noted that there were many barriers to incident reporting in healthcare. Studies have identified time constraints, cumbersome forms, lack of knowledge about how and what to report, lack of feedback, and a perceived lack of value in the reporting process. Also, Billings (1998) argued that fear of embarrassment, fear of punishment, and fear of litigation as reasons why healthcare workers did not report adverse incidents. Barach and Small (2000) identified inhibitive reporting cultures and lack of adequate systems as further barriers to reporting.

Walsh and Antony (2007) conducted a documentation and triangulation research study in which the hospital went from a paper-based system to the implementation of an electronic incident reporting. The findings from this study were that the institution, clinicians, and managers continued to have challenges in all aspects of quality and patient safety. The challenges were as followed:

- Directors, managers and staff have seen little or no impact on patient care or staff welfare despite the growing collection of data.
- Adverse incident data, which is being introduced into the electronic adverse incident reporting system is not quality assured by managers and Heads of Departments, especially in the area of not enforcing correct completion of forms.
- The attitude of staff in the completion of the data entry and investigation phase appears not to be seen as a priority in the quality and accuracy of reports.
- The growing awareness of adverse incidents and the benefits to patient safety is being totally undervalued in the clinical care area by the lack of computer expertise and the difficulties of staff to undertake training.
- Staff predominately are not aware of any changes in practice from adverse incidents or investigations (Walsh & Antony, 2007).

In a separate study, Anderson *et al.* (2013) identified challenges at all stages of the incident reporting process: reporting, investigation, implementation of actions, evaluation of actions and feedback to staff. In operating the incident reporting system, staff grappled with the inherent complexity of the organization and the processes involved. In mental healthcare, there was an added layer of complexity involving the challenges of predicting and controlling the behavior of risky patients.

In this final study conducted by Benn *et al.* (2009), it was disclosed that the lack of feedback from incident reporting has been highlighted as inhibiting the willingness of staff to report incidents. Benn *et al.* (2009) cited several factors towards inhibiting reporting such as fear of blame, time pressure, resource constraints, the perception that reporting is unnecessary and a lack of clear definitions as to what constitutes a reportable incident (p. 13).

The overall theme from each of the study's above was that ***effective feedback*** from incident reporting systems in healthcare is essential if institutions are to learn from failures in the delivery of care. Because of this known barrier, Kingston *et al.* (2004) noted other common barriers and then suggested strategies See Figure 3 below.

3 Summary of suggested strategies to facilitate incident reporting, based on barriers identified by focus-group participants

Barriers to incident reporting	Suggested strategies
Lack of knowledge about the process and what constitutes an incident	• Education at orientation • Ongoing education and use of case studies to highlight reportable events at departmental forums • Ability to access a reference manual about what to report
"Nursing Form" by association	• Rename/redesign the form to make it more relevant to medical staff
Time constraints and complexity of reporting form	• Simplify the reporting process — one page being the optimal length • Option of quicker reporting processes (eg, telephone reporting, online submission)
Lack of feedback when report generated	• Risk-assessment tool to prioritise action for follow-up. Type and timing of feedback given dependent on severity of incident or degree of risk to the organisation. Staff informed of follow-up processes
Lack of legal privilege afforded to the reporting process	• Education to explain current legal privilege afforded through Australian federal legislation • Confidentiality guaranteed • Increased confidentiality and security of the reporting process to prevent access to information by unauthorised personnel
Culture of blame	• Option to report anonymously to an independent body, without fear of being identified and with the option to omit identifiers of either self and/or organisation • Education
No value	• Individual/group feedback of action taken

Figure 3. Suggested strategies to address common incident reporting barriers (Kingston *et al.*, 2004)

3.3 Benefits Linked to Electronic Incident Reporting System

Existing reporting systems, such as the Sentinel Event system of the Joint Commission for Accreditation of Health Care Organizations (JCAHO) and the MedMARx system of the

United Sates Pharmacopeia and the Institute for Safe Medication Practices are limited to certain types of errors and adverse events (Suresh *et al.*, 2004). In contrast, hospital-based electronic incident reporting systems (e-IRSs) may facilitate voluntary reporting of all types of medical errors and adverse events through ease of use and accessibility, and may allow real-time review, oversight, and intervention. Additionally, an e-IRS that captures near misses and latent errors may provide further insights into system processes that need to be modified to help reduce the likelihood of error (Milch *et al.*, p.165, 2006).

Another benefit that is linked to an e-IRS is that it allows for the reporting of a wide variety of different types and severities of adverse events and errors in that it does not merely capture the most serious events. For example, as noted by Milch *et al.* (2006), in this descriptive study, nearly 70% of events that reached the patient produced no harm, and one quarter of all reports were either environmental safety issues or near misses. Thus, an e-IRS may be particularly helpful in capturing system defects and near misses that may not be detected by reviews of patient charts or medication records. Importantly, analyses of such near misses may help identify "root causes" of errors and adverse events.

Al-Rayes *et al.* (2020) provided similar benefits in this study in stating that an e-IRS may increase the number of incidents reported; improved tracking, legibility, and confidentiality of incident reports; and decreased the number of missing incident reports. In addition, it has been found that e-IRSs allow risk managers to view incidents as soon as they occur, respond immediately to mitigate the consequences of an incident, and analyze the reports to identify any existing trends (p. 1).

3.4 Perception and Behavior Around Electronic Incident Reporting System Towards Reporting

As the adage goes, perception is reality. From this qualitative study conducted by Walsh *et al.* (2010), consultants, managers, and nurses all had positive attitudes about responsibility for reporting adverse incidents. All respondents indicated that the design of and information collected by the electronic adverse incident reporting system (Datix) was adequate. However, consultants had more negative attitudes and perceptions than managers and nurses about Datix. All respondents expressed negative attitudes about the amount and type of feedback they received from reporting, and consultants expressed more negative attitudes about how Datix is managed than managers and nurses.

In another study of reported events using the same electronic Incident Reporting system (e-IRS), although the e-IRS

was available and accessible to any hospital employee and staff member, physicians contributed less than 2% of all reports. The variation in reporting rates between nurses and physicians was concluded to be possibly attributed to different definitions or perceptions of what was constituted as an error or adverse event. Equally important, different training about reporting was conducted. It was noted that nurses, but not physicians, received training in and were encouraged to report adverse events (Weingart *et al.*, p.168, 2002).

In contrast, Physicians did not receive any education in the systematic evaluation of errors and adverse events, and thus operated within a belief system of self-blame and personal responsibility, rather than viewing such events as the end process of a series of systematic deficiencies. Additionally, it was noted that physicians may not report because of "professional courtesy," concern for implicating colleagues, or fear of repercussions (Leape, 2002).

In a third study, it was determined that outside the discipline of anesthesiology, incident reporting was used predominantly by nurses (Johnson, 2003). Kingston et al. (2004) came to the same conclusion in stating that outside the discipline of anesthesiology, nurses initiated 88% and medical staff only 2% of reports submitted through the Australian Incident Monitoring System (AIMS) between 1998 and 2002. In another study conducted by Milch et al. (2006), it was concluded that out of all reports, registered nurses reported 47%, pharmacists and pharmacy technicians 16%, laboratory technicians 10%, unit clerks/secretarial staff 10%, licensed practical nurses and nursing assistants 3%, and physicians (including house staff) 1.4%. The remainder of reports was entered by a variety of employees including medical assistants, physician assistants, physical therapists, security personnel, social workers, and risk and case managers (p.167).

To reinforce this conclusion, a number of studies have also documented that doctors are less likely to report incidents and/or express glowing attitudes about incident reporting than nurses and other types of healthcare workers. This effect has also been demonstrated with respect to electronic reporting systems (Braithwaite *et al.*, 2008). One reason for doctors' fewer glowing attitudes and lower rates of incident reporting may be due to the culture of medicine (Walsh *et al.*, 2010).

In this final study, Anderson *et al.* (2013) found evidence that incident reporting was perceived by most staff as having a positive effect on safety, not only by leading to changes in the care processes but by changing staff attitudes and knowledge. The knowledge generated by incident reports was used instrumentally to change practices and also led to conceptual changes. Instrumental changes included changes in care processes, management practices and individual behavior. Conceptual changes included changes in risk perceptions and awareness of the importance of good practice. These findings suggest that incident reporting can be viewed as a tool that focuses attention on safety and has multilevel influences on the organization, the team and individual practices, and on the knowledge and attitudes of the healthcare worker. Positive effects on worker awareness and knowledge are likely to be as important for safety as improved processes (Anderson *et al.*, p.148, 2013).

3.5 Association Between Risk Management and Electronic Incident Reporting Systems

As noted by Al-Rayes *et al.* (2020), electronic Incident Reporting systems (e-IRSs) allow risk managers to view incidents as soon as they occur, respond immediately to mitigate the consequences of an incident, and analyze the reports to identify any existing trends. Rahman *et al.* (2023) conducted another study that utilizes the digital incident reporting system to identify the risks related to patient safety and improve healthcare quality by mitigating those identified risks with the help of preventive and corrective strategies.

4. Patient Quality

4.1 Definitions of Quality in Healthcare

A challenge facing health care today is to define quality (Katz & Green, 1992). Granted that, The Institute of Medicine (1994) defines quality in healthcare as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (Cohen & De Back, 1999). According to Feigenbaum (1991), there has been a robust documental importance on quantifying and holding quality costs in industry in order to issue an apparatus to monitor and focus on continuous quality improvement. Feigenbaum (1991) further argues that quality should be determined by the patient and not by leadership or the organization itself.

Oakland and Porter (1994) extended this definition by arguing that quality is meeting customers" requirements in this case the patient. Deming (1986) strengthened the focus on customers' requirements, as he concluded that "quality should be directed at the needs of the customer for the present and the future". Quality then should be a strategic measurement that should be monitored to better position an organization to be more competitive in today's changing environment. Given these various definitions, Parisi (1994) argued that quality measurement is an

important step to raising the importance of patient safety. In addition, by applying the degree of adverse incidents and the detection of quality costs occurring across a health care environment, this provides a potential framework to make sustained measured strategic changes to patient safety and quality.

4.2 Quality Costs in Healthcare

Campanella (1999) highlighted that the main goal of any quality cost system is to make possible quality improvement activities with the aim to drive down quality-related problems. He further considered that this would lead to operating cost reduction activities across the organization. To illustrate, some of the known themes linked to quality costing:

- attack and minimize on failure costs as much as possible to bring them down to zero;
- invest in appropriate prevention activities;
- bring down appraisal costs accordingly; and
- bring about continuous quality improvement and redirect prevention efforts through continuous monitoring of quality costs

With this purpose in mind, Dale (2003) purported that the success of a costing system will depend on how well the system matches and integrates with other systems in the organization. However, as a counter to this conclusion, Duncalf and Dale (1985) reported that quality cost reporting systems have not been widely incorporated all aspects of information.

4.3 Quality Costing and Its Role in Electronic Incident Reporting System

In this organizational research study, the purpose of the introduction of an electronic incident reporting system was to replace a paper system that was both time-consuming and inefficient in raising the awareness of patient safety issues. Leadership conveyed concern that the institution was unable to initiate the level of incidents and near misses being recorded. The data was being collected on separate databases and recorded against a paper system before the introduction of the electronic incident reporting (Walsh & Antony, 2009). The results from this study was that a quality costing approach integrated into electronic incident recording system needs key skills in clinical and managerial knowledge in relation to institution process and patient care mapping as supported (Deming, 2002).

In fact, it requires healthcare institutions to handle a number of critical success factors such as organizational change, effective implementation of adverse incident recording and overcoming cultural barriers of reporting, and blaming culture (Roden & Dale, 2000). As a counter to this dilemma, Roden and Dale (2000) concluded that there needs to be crystalline organizational leadership from the executive level to the patient's bedside in order to fully achieve all the benefits of combining incident reporting and quality costs in the pursual of patient care and decrease the level of harm within the organization's culture.

This method of establishing and preserving quality costing integrated within incident reporting requires thorough and ceaseless commitment from the executive team, with glasslike staff involvement. Leadership must be dedicated to providing incentives for the collection of quality costs and increasing incident reporting in order to ensure that the data collected are proper across all levels of the organization (Campanella, 1999). All institutional strategies must be embraced and connected to highlight the problems that may be related to the patient, healthcare worker, and processes that indirectly or directly cause harm (Campanella, 1999).

4.4 Aim of Quality in Healthcare

As noted by Morris *et al.* (2013), healthcare quality has yet to meet the aims of the Institute of Medicine (IOM) with respect to safety, effectiveness, patient-centeredness, efficiency, timeliness and equity. Although the six IOM competencies were developed to prepare future healthcare practitioners—including medical laboratory science professionals—to deliver quality healthcare, it would be a benefit to integrate each IOM quality aim into the processes within healthcare to pilot patient safety. See Figure 4 below for the six AIMS of quality in healthcare.

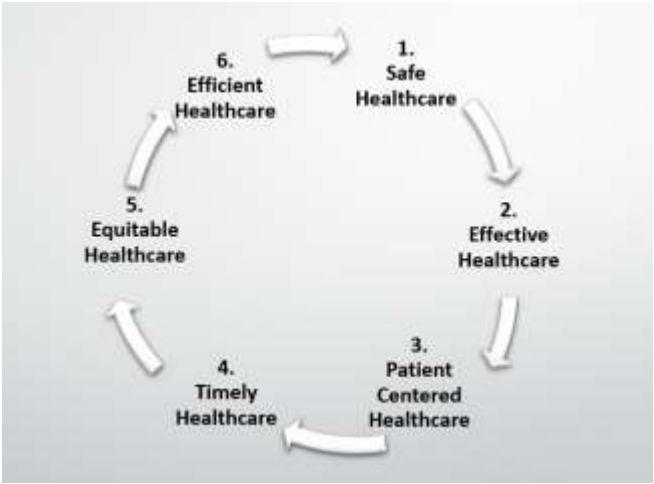

Figure 4. Six aims of quality (Morris *et al.*, 2013).

The takeaway is that Healthcare Workers need to incorporate patient safety concepts into their daily workflows as a means to effectively deliver quality healthcare within the 21st century and beyond (Morris *et al.*, 2013).

5. Implications for Healthcare Leadership Towards Electronic Incident Reporting

➢ *Understand Leadership's Role*

Leadership has been shown to be a crucial success factor for incident reporting in numerous studies (Pfeiffer *et al.*, 2010). Abuosi *et al.* (2022) highlighted leadership's role in overcoming the challenges of adverse events reporting which can be addressed by building policies to regulate the incidence of the events. Additionally, healthcare leadership should invest in high ethical standards within the workplace, which should focus on open communication and blame-free culture. Such initiative will pilot the workforce to openly and transparently report errors associated with healthcare.

Meanwhile, the episodes of adverse events can equally be diminished through better teamwork among the healthcare providers, and human and material resources with a realistic workload. Also, a training program outlined to address the caring behavior of healthcare providers can be launched to serve as a catalyst to address adverse event reporting. Devoting to the value of care can be enhanced if leadership makes possible an environment of judicious documentation and communication of healthcare activities. Advocating empowerment and open dialogue between the healthcare staff will foster a practice environment that advances patient safety (Abuosi *et al.*, 2022).

Moreover, efforts to reduce the obstacles to adverse event reporting can wholly improve patient safety. Barriers reported in past studies include inadequate knowledge of the main incidents and the procedure for reporting them. Launching in-service training on adverse events by healthcare leadership can go a long way in strengthening the reporting culture. Again, data support the idea that the right attitudes toward adverse event reporting begin to develop during the training of health personnel. Because of this, it is therefore recommended that adverse events should be made an integral component of the curriculum of the health workforce (Abuosi *et al.*, 2022).

The final analysis is that electronic adverse incident reporting systems may swell incident reporting by making it easier to report incidents and analyze data. However, ***strong leadership*** within hospital subcultures is still required in order to advocate and endure reporting, to open the door for organizational learning, and ultimately improve patient safety (Walsh *et al.*, 2010). Fernando *et al.* (2023) came to a similar conclusion in stating that in order to implement an efficient and effective IRS, the leaders at each level of the organization must play important roles. Leadership from executives, line managers, and informal network leaders throughout healthcare institutions have to understand their key roles in IRS (Fernando *et al.*, 2023). Echoing similar conclusion, Gryna and Juran (1999) argued that the success of any quality improvement needs high-level management support.

➢ *Standardizing electronic incident reporting system integrated into an EPR*

According to Haller *et al*. (2007), electronic patient record systems (EPRs) are widely used across countries and health care systems. In the United States, for example, 31% of hospital emergency departments have fully implemented EPRs. In the United Kingdom, 58% of primary care physicians use EPRs. In Norway, 77% of hospitals

have purchased an EPR. Initially developed to collect, store, and retrieve clinical information into a digital format, EPR have evolved and include clinical guidelines, order entry, clinical decision support and electronic alerts.

By integrating information into comprehensive systems and allowing easy access to patient information, test results, drug information, published guidelines, and decision support algorithms, these systems provide greater accuracy, accessibility, and completeness of clinical information than their paper-based counterparts (Haller *et al.*, 2007). It has been recently suggested that EPR could also be used for reporting purposes, including those that support disease surveillance and patient safety.

Currently, patient safety is largely monitored by mandatory or voluntary reporting systems. Incidents are reported on specific computerized or paper-based forms. These are not integrated into EPR and require health care professionals to spend extra time and effort to complete forms or to log on to specific computer-based systems to report incidents. Furthermore, most declaration forms require users to fill in extensive sections of narrative free text and are therefore relatively cumbersome to use. This largely impairs the effectiveness of existing reporting systems.

Currently, only 4.3% to 23% of the total number of incidents occurring in clinical settings are reported. These limitations could be potentially addressed by designing a standardized electronic incident reporting system which would be fully integrated into an EPR and include a large selection of predefined categories of incidents together with narrative fields. Incident reporting would be made easier, quicker, and more accessible (Haller *et al.*, 2007).

6. Methodology and Data Collection

6.1 Research Method and Design

The purpose of this literature review was to investigating electronic incident reporting systems and its role within healthcare to improve patient safety Additionally, the goal of this research was to explore themes around benefits and challenges for using electronic incident reporting systems. Because of this, Simon and Goes stated that performing an extensive literature review should be the underlining objective when performing a study (p. 277). What's more, Simon and Goes stated that the literature review is a blended critical essay that examines and unifies the most relevant and current published knowledge on the topic under investigation. Knowing this, the researcher performed a literature review, which resulted with strategies as a suggestion to help bridge the gap between healthcare workers and an electronic incident reporting system.

6.2 Data Collection

The ProQuest database and GOOGLE SCHOLAR was the primary source and EBSCO was the secondary database used in this literature review. The search keywords used were Electronic Incident Reporting, Healthcare Leadership, Patient Safety, Quality, Incident Reporting, Healthcare Incident, Adverse Incident, Risk Management, Healthcare Worker. Articles researched for this literature review provided an overview of incident reporting, healthcare leadership, and incident reporting systems. After researching articles on incident reporting, the researcher continued the review with articles about incident reporting barriers and challenges, quality costs in healthcare, electronic incident reporting, and healthcare leadership role in incident reporting.

The research documents included in this study were published and compiled by various sources. Lastly, this literature review consisted of both U.S. and international journals on incident reporting, electronic incident reporting systems, and healthcare leadership. Specific journals included – International journal of health care quality assurance, BMJ Quality & Safety, Journal of evaluation in clinical practice, The Journal of emergency medicine, Journal of general internal medicine, American Journal of Medical Quality, Quality and Safety in Health Care, BMJ Simulation and Technology Enhanced Learning.

7. Instrumentation and Setting

As for instrumentation, the researcher used secondary data as its main source instrumentation. However, as Creswell (2014) noted, in research, the researcher can also be included as an instrument because the researcher collects data themselves through examining documents, or observing behavior. Therefore, the researcher was the second source of instrumentation used. Furthermore, because research setting is an important component of research design/methodology, the researcher focused on exploring themes and patterns around electronic incident reporting systems, the link between leadership and electronic incident reporting, and the benefits and barriers disclosed with an electronic incident reporting system as a tool within healthcare to improve patient safety.

8. Synthesizing Literature Review

As defined by Bradley *et al.* (2007), taxonomy is a system for classifying multifaceted, complex phenomena according to common conceptual domains and dimensions. Bradley further stated that the purpose of employing taxonomy is to

increase clarity in defining and comparing complex phenomena (p. 1761). As a result, because electronic incident reporting systems identifies safety hazards and guides the development for proper interventions to mitigate risks, thereby reducing harm to patients in healthcare, the researcher used different lenses to look at the complicated problems and social issues within this phenomenon. With that said, the following domains were used to synthesize different views.

8.1 The Behavioral Component Associated With Adopting Electronic Incident Reporting

In this Descriptive study of reported events using the same electronic Incident Reporting System (e-IRS), although the e-IRS was available and accessible to any hospital employee and staff member, physicians contributed less than 2% of all reports. The variation in reporting rates between nurses and physicians may be attributed to different definitions or perceptions of what constitutes an error or adverse event, and, importantly, different training about and attitudes toward reporting them. Nurses, but not physicians, receive training in and are encouraged to report adverse events and complications arising from medical treatment (Weingart *et al.*, p.168, 2002).

In another study, it was determined that outside the discipline of anesthesiology, incident reporting was used predominantly by nurses (Johnson, 2003). Kingston et al. (2004) came to the same conclusion in stating that outside the discipline of anesthesiology, nurses initiated 88% and medical staff only 2% of reports submitted through the Australian Incident Monitoring System (AIMS) between 1998 and 2002. In another study conducted by Milch et al. (2006), it was concluded that out of all reports, registered nurses reported 47%, pharmacists and pharmacy technicians 16%, laboratory technicians 10%, unit clerks/secretarial staff 10%, licensed practical nurses and nursing assistants 3%, and physicians (including house staff) 1.4%.

8.2 Leadership

Leadership is a known crucial component to drive success within healthcare. The same can be said when the focus is on electronic incident reporting systems. To reinforce this conclusion, as noted by the WHO (2005), all reporting and learning systems, whether large or small scale, must create a positive culture in which reports are encouraged and valued, and staff are praised for participating, which can only take place with leadership's commitment (p. 19). Amaniyan *et al.* (2020) came to a similar conclusion in stating that patient safety is improved by leadership, commitment, documentation, and using a reporting system by workers to learn to prevent potential errors. Fernando *et al.* (2023) echoed a similar conclusion in stating that in order to implement an efficient and effective IRS, the leaders at each level of the organization must play important roles. Leadership from executives, line managers, and informal network leaders throughout organizations have to understand their key roles in IRS (Fernando *et al.*, 2023).

9. Literature Review Results

The purpose of this literature review was to collect relevant and timely research on electronic incident reporting systems and then synthesize it into a cohesive summary of existing knowledge, which would better prepare the researcher to critically asses what former studies lacked and how this study will make a difference going forward. As for themes that have resulted from this literature review they were as followed: (1) Lack of feedback has been one of the consistent barriers plaguing electronic incident reporting systems; (2) Doctors are less likely to report adverse events using electronic incident reporting systems than Nurses; (3) One of the key benefits of electronic incident reporting systems is that it may allow real-time review, oversight, and intervention; (4) As for perceptions, most staff looked at electronic incident reporting as a tool for having a positive effect on safety, not only by leading to changes in care processes, but by changing staff attitudes and knowledge; and (5) there is a direct association between leadership and electronic incident reporting systems.

Given these themes, what former studies lacked was making the argument that it is time for healthcare leadership to start to dare to do things differently. In other words, leaders of tomorrow will need to have more vision and courage to conclude that radical innovation is needed to combat the ongoing missteps of causing harm to patients. Equally important, although this literature review found that ***strong healthcare leadership*** is needed to improve electronic incident reporting systems, the researcher also highlighted that opportunities exist for integrating electronic incident reporting systems into electronic patient records (EPRs) to improve patient safety.

In closing, the final analysis of this critical assessment is that currently, only 4.3% to 23% of the total number of incidents occurring in clinical settings are reported. These limitations could be potentially addressed by designing a standardized electronic incident reporting system which would be fully integrated into an EPR and include a large selection of predefined categories of incidents together with narrative fields, which would make incident reporting easier, quicker, and more accessible (Haller *et al.*, 2007).

10. Bridging the Gap Between Healthcare Workers and Electronic Reporting Systems

10.1 Simulation Research

Much as it has played a key role in the aviation industry's pursuit of safety over the past 40 years, simulation could have an important role in achieving these goals in healthcare. Numerous mechanisms have been already adapted from the aviation world for medicine, among them preoperative checklists and crew resource management training. Simulation may therefore have benefits across multiple domains of a learning healthcare system, from improved education with abbreviated learning curves and reduced complication rates, to pre-implementation trials of interventions, to pre hoc and post hoc systems analysis to identify weaknesses in healthcare systems.

Ultimately, these may culminate in improved patient safety and outcomes, with the cost of such programs at least partially offset but reduced expense from avoidable adverse events. To deliver on these benefits, however, the research evidence base needs to improve, and the healthcare infrastructure needs to evolve to support the conduct of this research and implementation of findings (Pucher *et al.*, 2017). See Figure 5 below for examples of simulation within the components of a learning healthcare system.

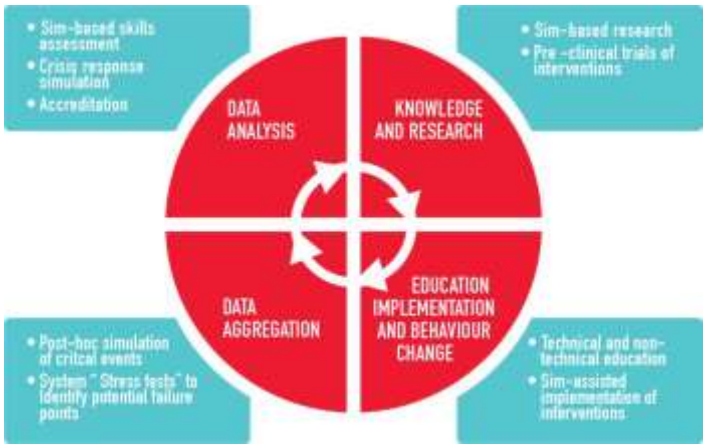

Figure 5. Simulation within the components of a learning healthcare system. (Pucher *et al.*, 2017)

10.2 Facilitate Adequate Training Sessions for Healthcare Professionals

One of the barriers to the digital incident reporting system includes reporters' lack of knowledge about reporting and managing incidents. As indicated by the findings of this study, training session should build a hands-on learning environment for the reporters to compare the manufacturer's conclusion for some of the incidents they have reported. This process would provide some context for the decision the reporter concluded and encourage the reporters to think outside of the proverbial box, leading to local quality improvement (Rahman *et al.*, 2023).

10.3 Further Work to Refine the Existing Classification Systems

Another prominent barrier to reporting incidents is the lack of consistency and validation of incident data classification**.** The already existing classification should be refined and reinforced for incident categorization, and healthcare professionals should be adequately trained before they are assigned the task of reporting incidents. Overall, there should be more detailed reporting before the incidents reach the investigation level, which will also prevent confusion between the roles at the reporting and investigation levels (Rahman *et al*., 2023).

10.4 Further Work to Agree on Standard Terms and Definitions for the HIT Systems

It is often impossible to devise preventive and corrective strategies for most of these technical problems due to inadequate or vague information in the incident reports. The researchers propose further necessary work to agree on common definitions and preferred terms to frame standard health information technology (HIT) systems and the existing classification systems to bring cohesion to identifying and solving HIT-related issues (Rahman *et al.*, 2023).

10.5 Enforce 'Mini' Root Cause Analysis at the Reporting Level

Incident reporting remains the only practical way to capture information about what goes wrong and why it goes wrong, particularly for rare events, to improve healthcare quality and safety. Such reporting systems should be online,

nonpunitive, accessible, valuable, and useable, and they may already exist in most jurisdictions. Ideally, the reporters should ensure the 'cues' used in the existing classification system, as discussed in the prior section. A structured 'mini' root cause analysis instead of an informal description should be included to ensure the completeness of the report (Rahman *et al.*, 2023).

10.6 Explore Implementing a Standard Incident Reporting System at the National Level

Reporting systems are not liable to any accustomed healthcare quality standard, which paves the way to being under operational oversight of the system used in healthcare. This can be resolved by reinforcing the quality standard of the incident reporting systems at the national level; thus, viable management is the only way to overcome the challenges encountered at regional levels (Rahman *et al.*, 2023).

10.7 Explore Utilizing DMAIC (Define, Measure, Analyze, Improve, Control) Methodology

The method noted as best practice to utilize towards procuring a vendor for an electronic incident reporting system is based on the DMAIC (Define, Measure, Analyze, Improve, Control) methodology. A roadmap for problem solving and process improvement developed by the quality improvement model Six Sigma (Borror, 2009). See Figure 6 below.

Figure 6. DMAIC Methodology (Borror, 2009)

10.8 Ensure Healthcare Leadership Engagement

As purported by Walsh *et al.* (2010), although an electronic incident reporting system may be able to increase incident reporting and facilitate organizational learning by making it easier to report incidents and analyze incident reporting data, strong leadership within healthcare professions is still required in order to promote and sustain incident reporting to improve patient safety. The WHO (2005) held a similar conclusion in stating that it requires leadership commitment to create a positive culture in which reports are encouraged and valued, and staff are praised for participating.

11. Limitations of Research

Although every effort was made to capture all relevant papers and documents in the various reviews using comprehensive search strategies, some may have been missed as this area is complex. Also, although this is a phenomenon in the form of real life, this research did not consist of using human subjects to conduct interviews or ask questions, so findings may not be as robust towards exploring and understanding the behavioral factors of individuals or groups within an organization (Augustine, 2022).

12. Conclusion

Although there have been increased efforts over the years to improve the functionality of electronic incident reporting systems to help keep patients safe, evidence shows that there is much work to be done. In fact, a key contributing factor that was identified as being a barrier around electronic incident reporting was the ***Lack of feedback*** (Benn *et al.*, 2009). Equally important, when the focus turned to behavioral actions among Healthcare Workers, nurses overwhelmingly used the system more than doctors.

On the other hand, although one of the benefits of electronic incident reporting systems was that it allowed risk

managers to view incidents as soon as they occur and respond immediately to mitigate the consequences of an incident, when all was said and done, it still boiled down to having ***strong leadership presence*** to champion the usage of electronic incident reporting systems. Fernando *et al.* (2023) came to a similar conclusion in stating that in order to implement an efficient and effective IRS, the leaders at each level of the organization must play important roles. Leadership from executives to line managers throughout the institutions have to understand their key roles in IRS (Fernando *et al.*, 2023).

As a result, the objective of this research was to investigate electronic incident reporting systems and its role within healthcare to improve patient safety. For this reason, the final analysis is that the time has come for healthcare leaders to make solid investments into electronic incident reporting systems as a practice in healthcare to help fulfill the promise that Florence Nightingale so envisioned centuries ago, which was to ***"do no harm"*** to any patient when they come into a hospital setting for care.

13. Recommendations for Future Research

The integration of an electronic incident reporting system into an Electronic Patient Record (EPR) used on a day-to-day basis by clinicians should be explored more. Future development should consider more often the use of fully integrated systems. Also, the importance of seeking clinicians and managers views in relation to further understanding electronic adverse incident recording and reporting within an acute health setting deserves more research study. For this study, the researcher should employ a quantitative correlational design utilizing statistical methods, which would add rigor and reliability and will thus make the conclusions more generalizable.

As for simulation research to enhance patient safety and outcomes, broad implementation of simulation is lacking, and the full potential of simulation-based interventions for patient safety has yet to be exhausted. To enable this, standardization of taxonomies and further strengthening of the existing evidence base should be sought, and the development of an integrated model of learning healthcare systems pursued (Pucher *et al.*, 2017). Finally, additional research should focus on the phenomenal on why nurses are more committed towards incident reporting than doctors and then craft strategies to minimize the chasm between the two.

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Authors' contributions

Dr. Lyndon Augustine is the sole responsible researcher for this study design.

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Competing interests

The author declares that there is no known competing financial interests that could have appeared to influence the work reported in this paper.

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Obtained.

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The Publication Ethics Committee of Sciedu Press.

The journal and publisher adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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References

Abuosi, A. A., Poku, C. A., Attafuah, P. Y., Anaba, E. A., Abor, P. A., Setordji, A., & Nketiah-Amponsah, E. (2022). Safety culture and adverse event reporting in Ghanaian healthcare facilities: Implications for patient safety. *Plos one*, *17*(10), e0275606.

Al-Rayes, S. A., Aldar, F. A., Al Nasif, N. S., Alkhadrawi, Z. I., Al-Fayez, A., & Alumran, A. (2020). The use of electronic incident reporting system: Influencing factors. *Informatics in Medicine Unlocked*, *21*, 100477.

Amaniyan, S., Faldaas, B. O., Logan, P. A., & Vaismoradi, M. (2020). Learning from patient safety incidents in the emergency department: a systematic review. *The Journal of Emergency Medicine*, *58*(2), 234-244.

Anderson, J. E., Kodate, N., Walters, R., & Dodds, A. (2013). Can incident reporting improve safety? Healthcare practitioners' views of the effectiveness of incident reporting. *International journal for quality in health care*, *25*(2), 141-150.

Augustine, L. G. (2022). Whistleblowing in Healthcare for Patient Safety: An Integrative Literature Review. *International Journal of Human Resource Studies*, *12*(1), 1531-1531.

Baker, G. R., Norton, P. G., Flintoft, V., Blais, R., Brown, A., Cox, J., & Tamblyn, R. (2004). The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. *Cmaj*, *170*(11), 1678-1686.

Benn, J., Koutantji, M., Wallace, L., Spurgeon, P., Rejman, M., Healey, A., & Vincent, C. (2009). Feedback from incident reporting: information and action to improve patient safety. *BMJ Quality & Safety*, *18*(1), 11-21.

Billings, C. E. (1998). Some hopes and concerns regarding medical event-reporting systems: lessons from the NASA Aviation Safety Reporting System. *Archives of pathology & laboratory medicine*, *122*(3), 214.

Borror, C. (2009). The Define Measure Analyze Improve Control (DMAIC) Process.

Braithwaite, J., Westbrook, M. T., Robinson, M., Michael, S., Pirone, C., & Robinson, P. (2011). Improving patient safety: the comparative views of patient-safety specialists, workforce staff and managers. *BMJ quality & safety*, *20*(5), 424-431.

Braithwaite, J., Westbrook, M., & Travaglia, J. (2008). Attitudes toward the large-scale implementation of an incident reporting system. *International journal for quality in health care*, *20*(3), 184-191.

Campanella, J. (1999). Principles of quality costs: Principles, implementation, and use. In *ASQ World Conference on Quality and Improvement Proceedings* (p. 507). American Society for Quality.

Chittister, C., & Haimes, Y. Y. (1993). Risk associated with software development: a holistic framework for assessment and management. *IEEE Transactions on Systems, Man, and Cybernetics*, *23*(3), 710-723.

Cohen, E. L., & De Back, V. (1999). The Outcome Mandate: Case Management in Health Care Today, Mosby, St Louis, MO.

Dale, B. (2003). *Managing Quality*. Blackwell Publishing, Chichester.

Dale, B. G., & Wan, G. M. (2002). Setting up a quality costing system: an evaluation of the key issues. *Business Process Management Journal*, *8*(2), 104-116.

Davies, J. M. (2003). *The Canadian patient safety dictionary*. CPSI: Institut canadien pour la sécurité des patients.

Deming, E. W. (1986). *Out of Crisis*. Massachusetts Institute of Technology, Cambridge, MA.

Deming, E. W. (2002). *Out of Crisis* (2nd ed.). Massachusetts Institute of Technology, Cambridge, MA.

Department of Health. (2006). *Safety First: A Report for Patients, Clinicians and Healthcare Managers*. The Stationary Office, London.

Dhamanti, I., Leggat, S., Barraclough, S., & Tjahjono, B. (2019). Patient safety incident reporting in Indonesia: an analysis using World Health Organization characteristics for successful reporting. *Risk management and healthcare policy*, 331-338.

Donaldson, M. S., Corrigan, J. M., & Kohn, L. T. (Eds.). (2000). To err is human: building a safer health system.

Elliott, P., Martin, D., & Neville, D. (2014). Electronic clinical safety reporting system: a benefits evaluation. *JMIR Medical Informatics, 2*(1), e3316.

England, N. H. S., & Improvement, N. H. S. (2019). The NHS patient safety strategy. Safer culture, safer systems, safer patients.

Feigenbaum, A. V. (1991). *Total Quality Control* (3rd ed.). McGraw-Hill, New York, NY.

Fernando, G. H. S., Bandara, T., & Purva, M. (2023). Are Incident Reporting Systems in Healthcare Systems a Requirement for Improving Patient Safety? A Review.

Gryna, F. M., & Juran, J. M. (1999). *Quality and costs.* New York: McGraw-Hill.

Haller, G., Myles, P. S., Stoelwinder, J., Langley, M., Anderson, H., & McNeil, J. (2007). Integrating incident reporting into an electronic patient record system. *Journal of the American Medical Informatics Association, 14*(2), 175-181.

Heeks, R., Mundy, D., & Salazar, A. (1999). Why health care information systems succeed or fail. *Information Systems for Public Sector Management Working Paper,* (9).

Hwang, J. I., Lee, S. I., & Park, H. A. (2012). Barriers to the operation of patient safety incident reporting systems in Korean general hospitals. *Healthcare Informatics Research, 18*(4), 279.

Jha, A. K. (2019). Presentation at the "Patient Safety—A Grand Challenge for Healthcare Professionals and Policymakers Alike" a roundtable at the grand challenges meeting of the Bill & Melinda Gates Foundation. Retrieved 18 Oct. 2018, from https://globalhealth.harvard.edu/qualitypowerpoint

Johnson, C. W. (2003). How will we get the data and what will we do with it then? Issues in the reporting of adverse healthcare events. *BMJ quality & safety, 12*(suppl 2), ii64-ii67.

Katz, J. M., & Green, E. (1992). *Managing Quality: A Guide to System-wide Performance Management in Health Care* (2nd ed.). Mosby-Year Book, St Louis, MO.

Kear, T., & Ulrich, B. (2014). Patient safety and patient safety culture: Foundations of excellent health care delivery. *Nephrology nursing journal, 41*(5), 1.

Kingston, M. J., Evans, S. M., Smith, B. J., & Berry, J. G. (2004). Attitudes of doctors and nurses towards incident reporting: a qualitative analysis. *Medical Journal of Australia, 181*(1), 36-39.

Leape, L. L. (2002). Reporting of adverse events. *New England Journal of Medicine, 347*(20), 1633-1638.

Lee, R., Cooke, D., Lorenzetti, D., & Simon, A. (2005). Institutional Medical Incident Reporting Systems-A Review.

Maslow, A. (1954). *Motivation and personality.* New York, NY: Harper.

Milch, C. E., Salem, D. N., Pauker, S. G., Lundquist, T. G., Kumar, S., & Chen, J. (2006). Voluntary electronic reporting of medical errors and adverse events: an analysis of 92,547 reports from 26 acute care hospitals. *Journal of general internal medicine, 21*, 165-170.

Morris, S., Otto, C. N., & Golemboski, K. (2013). Improving patient safety and healthcare quality in the 21st century—competencies required of future medical laboratory science practitioners. *American Society for Clinical Laboratory Science, 26*(4), 200-204.

National Academies of Sciences, Medicine Division, Board on Health Care Services, Board on Global Health, & Committee on Improving the Quality of Health Care Globally. (2018). Crossing the global quality chasm: improving health care worldwide.

Oakland, J. S., & Porter, L. J. (1994). *Cases in total quality management.* Oxford: Butterworth-Heinemann.

Parisi, L. L. (1994). Incident reporting within the framework of CQI: data collection or finger pointing. Improving Quality and Performance: Concepts, Programs, and Techniques.

Perneger, T. V. (2006). A research agenda for patient safety. *International Journal for Quality in Health Care, 18*(1), 1-3.

Pfeiffer, Y., Manser, T., & Wehner, T. (2010). Conceptualising barriers to incident reporting: a psychological framework. *Quality and Safety in Health Care, 19*(6), e60-e60.

Pfettscher, S. A. (2021). Florence Nightingale: modern nursing. *Alligood, MR Nursing theorists and their work*, 52-70.

Pham, J. C., Girard, T., & Pronovost, P. J. (2013). What to do with healthcare incident reporting systems. *Journal of public health research, 2*(3), jphr-2013.

Pittet, D., & Donaldson, L. (2006). Challenging the world: patient safety and health care-associated infection. *Int J Qual Health Care, 18*, 4-8.

Prang, I. W., & Jelsness-Jørgensen, L. P. (2014). Should I report? A qualitative study of barriers to incident reporting among nurses working in nursing homes. *Geriatric Nursing, 35*(6), 441-447.

Pronovost, P. J., Thompson, D. A., Holzmueller, C. G., Lubomski, L. H., Dorman, T., Dickman, F., ... Morlock, L. L. (2006). Toward learning from patient safety reporting systems. *Journal of critical care, 21*(4), 305-315.

Pucher, P. H., Tamblyn, R., Boorman, D., Dixon-Woods, M., Donaldson, L., Draycott, T., ... Aggarwal, R. (2017). Simulation research to enhance patient safety and outcomes: recommendations of the Simnovate Patient Safety Domain Group. *BMJ Simulation and Technology Enhanced Learning, 3*(Suppl), S3-S7.

Rahman Jabin, M. S., Steen, M., Wepa, D., & Bergman, P. (2023). Assessing the healthcare quality issues for digital incident reporting in Sweden: Incident reports analysis. *Digital Health, 9*, 20552076231174307.

Rooksby, J., Gerry, R. M., & Smith, A. F. (2007). Incident reporting schemes and the need for a good story. *International journal of medical informatics, 76*, S205-S211.

Slawomirski, L., Auraaen, A., & Klazinga, N. S. (2017). The economics of patient safety: strengthening a value-based approach to reducing patient harm at national level.

Spigelman, A. D., & Swan, J. (2005). Review of the Australian incident monitoring system. *ANZ Journal of Surgery, 75*, 657-61.

Suresh, G., Horbar, J. D., Plsek, P., Gray, J., Edwards, W. H., Shiono, P. H., ... NICQ2000 and NICQ2002 investigators of the Vermont Oxford Network. (2004). Voluntary anonymous reporting of medical errors for neonatal intensive care. *Pediatrics, 113*(6), 1609-1618.

Vincent, C. (2010). Reporting and learning systems. *Patient safety*, 2.

Vincent, C. A. (2004). Analysis of clinical incidents: a window on the system not a search for root causes. *BMJ Quality & Safety, 13*(4), 242-243.

Vincent, C., Aylin, P., Franklin, B. D., Holmes, A., Iskander, S., Jacklin, A., & Moorthy, K. (2008). Is health care getting safer?. *Bmj, 337*.

Vincent, C., Neale, G., & Woloshynowych, M. (2001). Adverse events in British hospitals: preliminary retrospective record review. *Bmj, 322*(7285), 517-519.

Vincent, C., Stanhope, N., & Crowley−Murphy, M. (1999). Reasons for not reporting adverse incidents: an empirical study. *Journal of Evaluation in Clinical Practice, 5*(1), 13-21.

Wachter, R. M. (2004). The End of the Beginning: Patient Safety Five Years After 'To Err Is Human' Amid signs of progress, there is still a long way to go. *Health affairs, 23*(Suppl1), W4-534.

Walsh, K., & Antony, J. (2007). Improving patient safety and quality: What are the challenges and gaps in introducing an integrated electronic adverse incident and recording system within health care industry?. *International Journal of Health Care Quality Assurance, 20*(2), 107-115.

Walsh, K., & Antony, J. (2009). An assessment of quality costs within electronic adverse incident reporting and recording systems: A case study. *International Journal of Health Care Quality Assurance, 22*(3), 203-220.

Walsh, K., Burns, C., & Antony, J. (2010). Electronic adverse incident reporting in hospitals. *Leadership in Health Services, 23*(4), 292-303.

Weingart, S. N., Davis, R. B., Palmer, R. H., Cahalane, M., Beth Hamel, M., Mukamal, K., & Iezzoni, L. I. (2002). Discrepancies between explicit and implicit review: physician and nurse assessments of complications and quality. *Health services research, 37*(2), 483-498.

Williams, S. K., & Osborn, S. S. (2006). The development of the national reporting and learning system in England and Wales, 2001-2005. *Medical Journal of Australia, 184*, 65-68S.

Wood, K. E., & Nash, D. B. (2005). Mandatory state-based error-reporting systems: current and future prospects. *American Journal of Medical Quality*, *20*(6), 297-303.

World Health Organization. (2005). World alliance for patient safety: WHO draft guidelines for adverse event reporting and learning systems: from information to action (No. WHO/EIP/SPO/QPS/05.3). World Health Organization.

World Health Organization. (2020). Patient safety incident reporting and learning systems: technical report and guidance.

Wu, J. H., Shen, W. S., Lin, L. M., Greenes, R. A., & Bates, D. W. (2008). Testing the technology acceptance model for evaluating healthcare professionals' intention to use an adverse event reporting system. *International Journal for Quality in Health Care*, *20*(2), 123-129.