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REVIEW ARTICLE

HEALTHCARE ORGANIZATIONAL FAILURES: CAUSES, ROLE OF HUMAN ERRORS AND SCOPE OF MANAGEMENT INTERVENTIONS

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INTRODUCTION

Organizational failure can be defined as a failure against some pre-set criteria of performance, or a failure to accomplish an objective that is expected to be achieved, either by a person or the system. For example, a healthcare organization (hospital) can be said as failing if does not meet the criteria of treating a pre-set number of patients in an outpatient department in a day, or an industry if it is not cost-effective. Given the resources available, an organization may be highly proficient in its working but for example, if it is not able to match the number of items to be produced (a company), it is considered to be failed. It is often the case when an organization is failing to match its planned criteria; it is also failing in its fundamental system of management (Blackwell Encyclopaedia of Sociology).

Scale of the problem (in terms of clinical errors)

Medical science has witnessed an enormous progress over past decades. On the other face of the coin glory of this achievement had been overshadowed by the clouds of darkness, reasons being overlooked until recently (Reynard *et al*., 2009). Studies have shown an evidence of harm to patients resulting from, e.g. errors by healthcare professionals. Retrospective studies were carried out across seven nations (their healthcare systems). Results suggested that 1 out of every 10 patients suffered from some kind of adverse event during their stay in the hospital. Further evaluation indicated about 50 per cent of these adverse events could have been prevented. Estimation suggested that approximately eight per cent of these patients died and six per cent suffered from permanent disability (Brennan *et al*., 1991; Wilson *et al*., 1995; Schioler *et al*., 2001; Davis *et al*., 2002; Vincent *et al*., 2001; Baker *et al*., 2004; Michel *et al*., 2004). Above analysis further reflects that a huge amount of resources i.e. man power (doctors, nurses, pharmacists, therapists and other healthcare professionals), time and money had been wasted, putting an extra burden on healthcare resources which could have been for the welfare of other patients. A number of disasters in healthcare organizations have come to attention during past years in the UK (Walshe and Higgins, 2002), noticeably

- Cases of preventable inpatient deaths among children in Bristol
- Unsuitable post mortem tissue removal and procurement among paediatric patients in Liverpool
- Gynaecological malpractice in Kent
- Shipman's case- killing of more than 200 patients in Manchester by a general practitioner over a period of 20 years (Smith, 2002)

All of these events have resulted in disbelief of general public and media in healthcare professionals and healthcare organizations further raising concerns about an additional requirement of attention and regulation of current healthcare practices and system management. Anatomical causes of these events seem to be clinical i.e. malpractice, errors in drug prescription and dispensing, clinical negligence, diagnostic and treatment errors; pathological causes are largely organizational (Walshe, 2003), few of them as stated below:

- System failure
- Communication failure
- Poor internal/external system reviews/ audits
- Unmet work pressures among healthcare workers
- Lack of professional culture
- Ill-defined standard operating procedures

Organizational Failure- Accident Causation, Models and Errors

Accident causation in an organization can be understood in two ways: person approach and system approach. There are different models for each approach, therefore, different error management systems (Reason, 2000).

Person approach-focuses on errors of individual people rather than the whole system. It considers individual behaviour of a person to identify the aspects of one's behaviour and that of

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Table 1. The scale of the clinical problem in terms of patients experiencing an adverse event in the Harvard, Australian, Danish, New Zealand, UK, Canadian and French studies (Reynard *et al*., 2009)

Study	No. of hospitals (year)	No. of patient admissions	Percentage of patients suffered from adverse events	Percentage of adverse events that were preventable
USA: (New York) Harvard Medical Practice Study (Brennan *et al*. 1991) [2]	51 (1984)	30121	3.7 (study excluded non preventable events)	Not assessed as the study only involved preventable events
Australia: Quality in Australian Healthcare Study (Wilson *et al*. 1995) [3]	28 (1992)	14179	16.6	51.0
Denmark (Schioler *et al*. 2001) [4]	17 (1998)	1097	9.0	40.4
New Zealand (Davis *et al*. 2002) [5]	13 (1998)	6579	11.2	37.0
UK (Vincent *et al*. 2001) [6]	2 (1999)	1014	10.8	48.0
Canada (Baker *et al*. 2004) [7]	20 (2000)	3745	7.5	36.9
France (Michel *et al*. 2004) [8]	7 (2002)	778	14.5	Not reported

the others to rule out the possible causes of errors. The primary aim of this approach is to identify 'human errors' - thanks to the common belief that it is always easier to blame a person or a group of persons for any mishaps in an organization rather than blaming the system as a whole, as is the case in the UK (at least as per legal convenience) (Reason, 2000).

So, what is an error?

'An error is an unintentional failure of a plan by which it is intended to achieve a goal, or an unintentional departure of a sequence of mental or physical activities from the sequence planned, except when such a departure is due to a chance intervention- the failure of a planned action to achieve its goal' (Reason, 1995). Management thinks that if the culprit person is dismissed from the organization the problem is also removed and is likely to be never happen again in the future. It is a common belief of the management that after removing that person from the workplace others will be more conscious and afraid and will never make the same mistake again as the other person made. An argument to this approach of error analysis is that if we keep on removing the personnel from the workplace (as every professional will make one error or the other at some point of time and more often it happens on a routine basis!) the organization will be devoid of healthcare professionals, say within a month or so. The organization will hire new people, and as per the human tendency, new personnel will also commit errors (may be more serious this time) leading to a vicious circle of dismissing and recruiting people with the same or even an increased level of errors! The same kind of errors can be made under similar situations, may or may not be the same people involved. Therefore, this approach does not seem to be a good tool for error management. Analyses of organizational accidents and failures from high reliability organizations have demonstrated that failures in a system are attributed to 'system failures' rather than sheer negligence, absent-mindedness and inattentiveness of the individuals (Reason, 2000; Reynard *et al*., 2009).

System approach- this approach is based on the assumption of system defences. The idea is we cannot change the human conditions but we can possibly alter the system or environment in which they work (Reason, 2000). This can be viewed as the Swiss cheese model of accident causation (Daryl Raymond Smith *et al*., 2001; Wilson *et al*., 2002; Tim Amos and Peter Snowden, 2005) which is based on the idea that every system in an organization possesses certain barriers and deference against risks at each level, key idea being not to identify who is at fault but to find the reasons why does the system fail (discussed in later sections). A study by Reason (1995) and Runciman *et al*. (2000) shows that system errors account for 90% of accident causation as compared to human errors.

Models for Accident causation, risk analysis and risk management

The Swiss cheese model

Most organizational failures can be attributed to four basic levels of failures- 'organizational influences, unsafe supervision, preconditions for unsafe acts, and the unsafe acts themselves'. The cheese slices represent an organizational defence or barrier against failures. Holes in the layers indicate weaknesses in different systems of the organization. These holes are subjected to variation in size and position at any point of time. When all of the holes in each slice come in one line permitting (in Reason's words) "a trajectory of accident opportunity", individual hazard passes through all of the holes, giving rise to an accident or a system failure (Daryl Raymond Smith *et al*., 2001; Wilson *et al*., 2002; Tim Amos and Peter Snowden, 2005). The basic controls or defaces in an organization are: Code of ethics/Hippocratic Oath, Peer review, Communication of concerns, Patient complaints, Internal inquiry/disciplinary procedures, Prescribing practice, Accuracy of records, Death certification, Necropsy and Cremation certification & Coroner interventions (Floyd, 2000). The holes can be due to active errors or latent errors or conditions. The unsafe acts (e.g. mistakes, violations, slips and lapses) discussed above are the active conditions which are directly linked to the failure and are committed by the individuals who are in direct contact with the system or the patient (Reason, James 2000). Case study to illustrate the concept:

A 54- year old man was brought to the outpatient department of physiotherapy in hospital. The patient was diagnosed with frozen shoulder. He was assessed by the physiotherapist on duty and he decided to give ultrasonic treatment (a high frequency current) but the therapist forgot to take into account that the patient was having a cardiac pacemaker inserted into his body and any high frequency current is contraindicated in cases of pacemaker. This illustrates an example of an active failure (mistake in this case, where the therapist did not decide the wrong treatment protocol deliberately). This further indicates that active failures usually have a temporary but a direct effect on the defences of the system (cheese slices- in this case prescribing practice). Person approach stops analyzing the accidental causation at this level only as active

failures give a clue about the cause i.e. unsafe acts in this case (Reason, 1997).

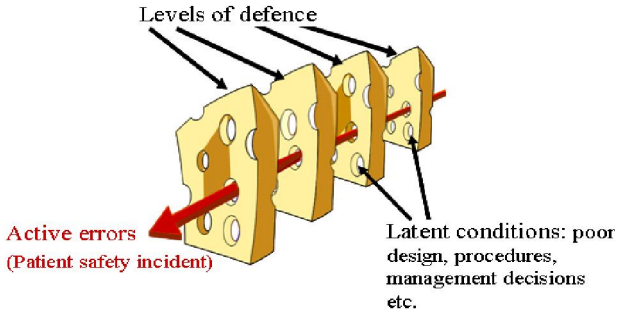

Fig. 1. Swiss Cheese Model of How Health Care Defences, Barriers and Safeguards May be Penetrated by an 'Accident' Trajectory (Adapted from Reason 2000)

Latent errors or conditions are the 'pathogens' which are already present in the system for a long time but remain inactive or dormant until they find a suitable opportunity to interact with an active condition leading to failure. These errors include organizational influences, unsafe supervision, preconditions for unsafe acts (first three layers of the Swiss cheese model). An analogy can be made between active errors as mosquitoes and latent errors as filth (always present) on which they raise. A system can detect and rectify the latent errors prior to a failure, as it is always not the case that the system is unaware of such errors, leading to proactive risk management unlike for the active one which requires reactive management (Reason, 2000). Examples of latent errors in healthcare: Work pressures, lack of staff, undue stress on workers, similar drug packing etc. Almost all of the organizational failures occur as a result of a combination of active and latent errors.

The first three steps of the pyramid in the Mark 3 version, another version of the Swiss cheese model reflect the latent errors as that seen in Swiss cheese model (why does a failure occur), red and white arrows represent causes and relevant investigations respectively, the final step represents what does the error lead to and how can it be rectified; blue rectangles represent defences having holes through which dangers and hazards pass leading to losses and failure http://www.scribd.com/doc/56285076/017-Swiss-Cheese-Model, 2012. Although the Swiss cheese model is one of the widely used models in healthcare industry, however criticism to this model is that it is not able to explain why and where these holes are present, what is the composition of these holes, why are not they consistent in nature and keep on changing their dimensions and place and what are the circumstances or phenomenon which force them to interact in a linear fashion resulting in failure (Dekker, 2002). Answer to these questions basically depends on the situation and types of errors involved in the failure. Another argument is that there is more emphasis on barriers instead of hazards in this model. Therefore, it reflects that this is a more effective tool which prevents the failures by reinforcing organizational barriers rather than by removing the basic causal factors.

Healthcare Error Proliferation Model

This model (Anderson *et al*., 2003) of accidental causation takes its origin from the Swiss cheese model. It explains the causes of errors in a system and their interaction with a series of events leading to failure. Based on the fact that an organization is a complex structure, called as complex adaptive system (http://en.wikipedia.org/wiki/Healthcare_error_proliferation_model, 2012) there exists a nonlinear relationship between its agents (healthcare professionals and patients) and structures (e.g. in patient wards, outpatient departments). The agents process the information and interact with the structure components to answer the problems within and across organizational layers (the cheese slices) (Palmieri *et al*., 2008). This model is an extension of Reason's model in a way that by examining interaction between agents and structures, accident causation might be established which is not a possibility with the Swiss cheese model (Reason, 1990). Another version of this model can be explained in terms of error chain system (de Laval *et al*., 2000). Causes of failure in an organization are analogous to a chain or a series of events, attention should not be focused only on the ends of the chain but throughout the chain- both strong and weaker links of the chain. Weaker links (e.g. communication failures, patient misidentification) are easier to recognize, hence easier to rectify.

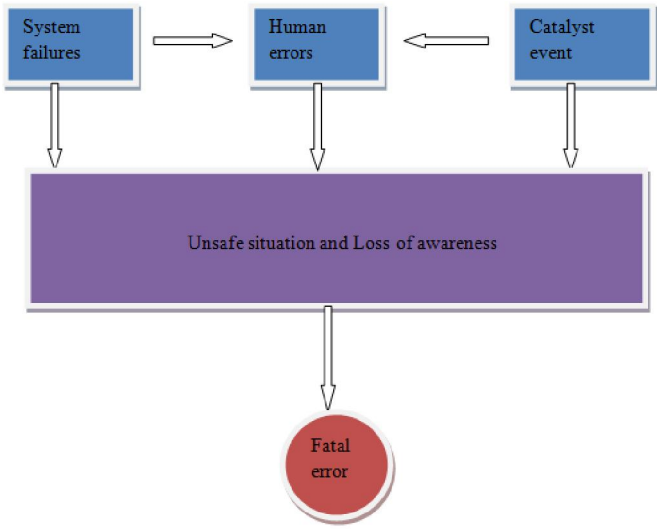

Fig. 2. Healthcare proliferation model

This diagram illustrates how do a series and nonlinear interaction of minor errors lead to a major error (Reynard *et al*., 2009). Major errors can be easily recognized than minor errors, hence easy to rectify. A catalyst event is an event which is beyond the control of an organization (system and human control) but can ignite the overall chain reaction and have an adverse effect on the system's performance. To illustrate the diagram, let's analyse a hypothetical situation below:

Dr A had to perform a surgery on patient X. Another patient Y, who had delirium, had gone to patient X's bed when patient X was not in the ward. When Dr A came to the ward, he found the patient (Y) on the bed and performed the surgery. Patient Y died after surgery as he had a bleeding disorder. In this case, the catalyst event is delirium, which was not under system's control and initiated the chain reaction. Unsafe situation was bleeding disorder. Human error was doctor's failure not to recognize the correct patient; system failure was lack of adequate training for patient identification (active identification). If the doctor would have been trained to

identify the patient and had he known about the bleeding disorder which the patient had, the accident could have been averted! So, in this case, it's an interaction of minor errors leading to a fatal outcome (Reynard *et al*., 2009). To conclude, we can say that all accidents are different; some are simple others are complex. Therefore, no single model can provide an answer to analyse all the accidents, answer depends on the nature and kind of problem.

Classification of human/operator errors

The classification is based on the 'Skill-rule-knowledge' problem solving approach – the Generic error modelling system of error analysis (Rasmussen *et al*., 1974). There are three categories of human errors:

Slips and Lapses

These are skill based errors (skills that are learnt in due course of time), errors result due to attention failure- errors of memory or execution. For example, during a surgery the surgeon forgets to ensure an important safety procedure i.e. administering an antibiotic to avoid the origin of any infections (as any surgery is prone to infection). This demonstrates an error due to forgetfulness or the error of memory. Technical error is another category of skill based errors which reflects an inappropriate finishing of an appropriate action (Rasmussen *et al*., 1974).

Mistakes

These can be rule based (situation not properly identified or if identified properly, incorrectly solved) or knowledge based (incomplete or inadequate knowledge) errors (Rasmussen *et al*., 1974).

Violations

These include consciously made errors. Violations are necessary or situation specific (Rasmussen *et al*., 1974). For example, a patient has to be administered an intramuscular drug. If a higher dose than recommended is given (nurse does not know the correct dose), it is a mistake, if she gives a higher dose consciously because of any reason, it is a violation. If she gives a higher dose involuntarily because of any interruption during dose calculation, it is a slip.

These human or operator errors when interact with system errors, organizational defences fail to protect against these hazards, they pass through the weaknesses (holes in the Swiss cheese), giving rise to organizational failure.

Communication errors as a cause of organizational failure

An organization's performance depends on the interaction of its workers and different systems. Communication among different departments and professionals is one of the key factors determining the system performance, hence susceptible to errors. In a primary healthcare setting (e.g. clinic), where a professional works almost in isolation, chances of errors are lesser as compared to a large set up; e.g. a hospital, as it requires a team of healthcare professionals and clerical staff. A study in 2000 in Australia acknowledged communication errors as one of the primary causes of organizational accidents (in patient deaths) (Parker and Coiera, 2000). Communication failures were found to be one of the leading causes in 70% of the total 2455 serious healthcare adverse events in a study done in USA (JCAHO, 2004). Communication failure can cause an error either directly with immediate effects or can be a part of the error chain, setting up the conditions that lead to a failure at a later stage (Reynard *et al*., 2009). A case study in USA (Reynard *et al*., 2009) illustrates a direct communication failure and its consequences:

A baby was admitted to a hospital, doctor decided to revive the baby. The doctor instructed the nurse to get calcium chloride but the nurse inadvertently injected potassium chloride as she thought that she heard doctor saying potassium chloride! The baby had deadly outcomes and it cost the hospital million dollars for out of court settlement. This study reflects a direct communication error between the two personnel, in case if the nurse had repeated back or asked the doctor again what she heard (as she was not sure), the incident might not have occurred in first place. Another study in USA (Barenfanger *et al*., 2004) illustrates the rate of communication errors on phone from pathology laboratories to physicians. In order to be sure of the right information the concerned healthcare professional was asked by the lab technician to repeat the patient's name, name of the test performed and the result. In 3.5% of all cases been studied, physicians gave the wrong information. It would have resulted in fatal errors if the physician would have started the treatment based on this wrong information he had received!

These studies demonstrate different facets of communication errors, hence different aspects and categories (Reynard *et al*., 2009):

Unable to communicate at all – It is the failure to pass the right information to the right person at the right time. An article published in a newspaper illustrates this mode of communication failure. The doctor had to carry out drainage for a right pleural effusion in a patient. He started the procedure on patient's left side when he was reminded by the patient that it had to be performed on the right. He then performed the same on right, thereby, forming a pneumothorax in both lungs. The doctor did not tell any of the staff about this. The staffs who were supposed to manage the case was not aware of the condition, hence failed to manage and the patient died. If the doctor would have passed the right information (pneumothorax) to the right person (emergency staff) at the right time (before the condition was manageable), patient might not have died.

Content problems – lack of completeness and accuracy in the information to be passed on to the other person. It can include missing elements, use of non-specific terminology, use of data more than required (receiver has to struggle to look out for the useful information).

Addressing problem – communicating with the wrong person. Considering a hypothetical situation: while treating a patient, doctor instructed to give a particular drug to the patient but did not clarify who was going to give it. One nurse on duty

injected it to the patient. Second nurse, unaware of the fact that the patient had already been given the drug, administered it again to the patient, As a consequence, patient died due to drug related complications. If the doctor would have made it clear that who was going to administer the drug, error might have been prevented!

Untimely communication – disturbing the workers at a time when they are busy with some other important work, leading to mind diversion and error.

Choosing the wrong mode of communication – e.g. using an email where talking face to face is important.

System failures – involves failures due to poor communication facilities and exercises. Estimations suggest that billions of dollars per year can be saved if system communication could be improved in US healthcare system (Little, 1992).

Scope of Management in Error Prevention and Accident Failure

Researches into the causes of organizational failures and the role of human errors have been aimed at developing tools for error prevention at each level of defence in the Swiss cheese model. The admirers of person approach stress on preventing human errors; techniques which can make professional more error free, whereas supporters of system approach stress on more complex adaptive systems (interaction of humans and the environment in which they work) (Reason, 1997). Errors can be managed at three stages w.r.t. time (Reynard *et al*., 2009):

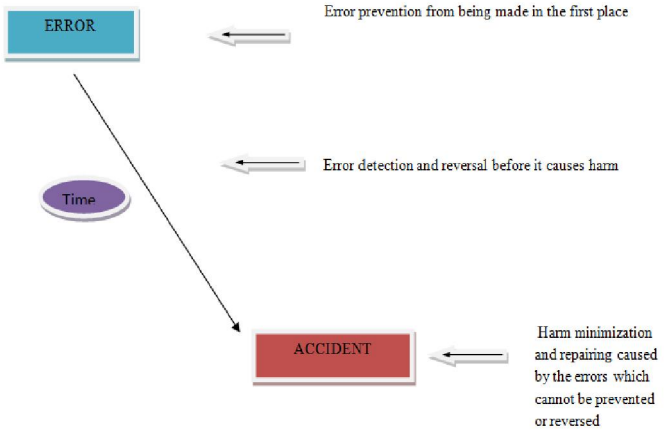

Fig. 3. Stages of error prevention -'Error management opportunities'- adapted from practical patient safety, error management (2009).

Stage 1- Error prevention

It involves errors which need an absolute prevention, e.g. errors which cannot be reversed on a later stage, errors which are not easy to detect, errors which have an immediate fatal outcome (Reynard *et al*., 2009).

Stage 2- Error detection and reversal

High reliability organisations have employed measures to help detect and reverse errors. These measures include adhering to organization's Standard Operating Procedures (SOPs), making use of standard check lists for different systems, using techniques such as meetings and notifications, red flag notification, e.g. communication failure, missing information (Reynard *et al*., 2009).

Stage 3- Harm minimization and repair

It is obvious that despite of detection systems, all errors cannot be captured before an accident. In this case damage caused by an error can be minimized or repaired, e.g. training staff to recuperate the accident and to apply the calculation exercise so learnt in preventing future accidents caused by the similar errors (Reynard *et al*., 2009).

Measures to Prevent Errors

Speaking up strategy- Based on the analysis of the world's worst ever disasters, e.g. the Chernobyl accident, 1986; it was concluded that at least one of the team members recognized the error in first place but there was a failure to 'speak up' efficiently to the team leader who was unaware of the error (Medvedev, 1991). Learning lessons from these accidents, high reliability organizations have developed 'speaking up' strategy which is termed as PACE: Probe, Alert, Challenge, Emergency (designed by an American pilot Captain Robert Besco) (Reynard *et al*., 2009). Probing- The concerned individual should always cross check with other team members the probability of recognizing the error which he thinks can happen in first place and should find out what others think about the same. Alerting- If he is not satisfied with probing results, he should clearly inform the team head that he is not satisfied with the proposed plan which might lead to an accident in his opinion. Challenging- In case where team leader wants to continue with the proposed plan, the concerned team member should challenge the decision and should explain how the plan could lead to an accident.

Emergency- Any team member should immediately stop an ongoing plan where there is a possible issue of an accident, declaring it as an emergency. In healthcare organizations, it is often seen that a junior team member is always hesitant to address these kinds of problems to his team leader. In such cases, he should discuss the matter with a more senior colleague, who can speak to the higher authorities on his behalf. The practice seems to be beneficial in terms of patient safety, e.g. in hospitals, there is often a discrepancy between the diagnostic reports and doctor's notes such as a particular procedure has to be carry out by a junior doctor on left lung according to X- ray or MRI report but the senior doctor mentioned right side in his notes inadvertently. In this case, the junior doctor can always follow this protocol and can speak up to some other team member (e.g. anaesthetist) who can then cross check the notes with the senior doctor and prevent a possible accident.

Use of accident and incident reporting data- A survey was carried out in a Canadian cancer care centre in 2007 to measure the effectiveness of accident and incident data as a tool for error management (Reynard *et al*., 2009; David *et al*., 2007). Results show that cause of the failure cannot always be answered by the data itself but provide a framework for the

management to probe the weaker areas that might have resulted in accident. Data must be collected into a database which can then be probed to look for the weaker links which are not predictable otherwise e.g. trends in organization set up (different departments), status of adverse events (David *et al*., 2007).

Communication failure prevention- Lack of awareness of the importance of communication among personnel and if failed, its consequences i.e. accidents and events has always been an issue in healthcare settings. Often no managerial efforts have been made to educate healthcare professionals about communication failure and its damaging effects (Reynard *et al*., 2009). If medical schools can incorporate a short duration course on communication for their students, the problem can be improved from there itself. Solutions at organizational level may include regular communication trainings, e.g. speaking up strategy; briefings and record keeping, use of incident data, active identification of patients, preparing a mental summary of discussion and read it back to the concerned person to minimize errors.

Healthcare Failure Mode and Effect Analysis (HFMEA) - an approach for stage 1, Figure 4. It involves a step by step process: define the process, assemble the team, draw a flow chart to graphically represent the problem, analysis of the harm, actions and measures to be carried out. For example; a lab test has been ordered by a physician for a patient. First step is to collect the information how does the process works, graphically represent the problem, analyse the potential weak area from the chain which can lead to a failure (e.g. at the level of sample analysis in this case), further categorize the weakest link and analyse the scope of the problem, determine a hazard score and list all potential causes of the failure [35].

Discussion and Conclusions

With the advent of new and improved medical technologies, the focus has been shifted from the problem of human errors in healthcare organizations. As compared to failures in other safety organizations, e.g. aviation and railways, majority of accidents and failure happen in individual hospitals making them less noticeable to general public and media, often hided and are not subjected to investigations and inquiry (Rosenthal, 1995). The cases are often subjected to 'out of court settlements' and 'non disclosure agreements' e.g. the cases of medical negligence. There are no policies in most countries which can provide a better definition to the components of error chain on the basis of which a formal investigation can be started in case of an organizational failure. Therefore, a vigorous and logical error detection system has to be established by the management to set up a formal inquiry on the first basis (Walshe, 2003). The techniques used to rule out the causes of failure are inadequate and restricted. For example, in UK, there is more reliability on individual case studies and individual causes of error detection. Management is often unable to implement strategies which could provide required changes in the organization itself in order to prevent future accidents of the same kind. There is a lack of vigour in the investigation process and its expensive too, often there is a lack of expertise which fails to provide solution to the problem. There are few mechanisms which ensure follow up and learning by the organizations from past failures and that same errors which could harm patient safety and the system as a whole, would not be committed in future (Walshe, 2003). All accidents are different; some are simple others are complex. Therefore, no single model can provide an answer to analyse all the accidents, answer depends on the nature and kind of problem. Healthcare organizations should help their staff to learn modes of safety oriented communication, how to build up better team spirit, how to learn from their own experiences, routine training of the staff and adherence to standard operating procedures. A further research is needed for better understanding of organizational failures, causes and methods to prevent them in future.

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