Failure to Rescue and Failure to Perceive Patients in Crisis

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"Failure isn't fatal, but failure to change might be."

—John Wooden

Failure to Rescue and the Context of Surgical Patient Management

Definition

The hallmark of a safe and reliable hospital is the ability to identify, address, and prevent a complication from leading to lasting patient harm and suffering with safety defined as "freedom from accidental injury" [1]. Failure to rescue surgical patients is defined as mortality after a complication occurring in patients who are hospitalized after a surgical procedure or with surgical disease. Initially limited to surgical patients the term has subsequently been used more broadly in the context of patients who suffer avoidable complications despite visible and early warning signs. The original work on failure to rescue focused on coded complications following surgical complications and subsequent mortality and morbidity [2].

Failure to rescue is an important metric from the point of view of patients, health care professionals, and health care organizations. Efforts have been focused on reducing complications of surgical procedures by improving the awareness and performance of the surgical microsystem while optimizing infection risk through better hygiene and preventative measures and optimizing team related processes through usage of checklists [3] and changes in the team culture [4]. At the same time variability in patients, surgical performance, human errors, unpredictable and preventable technical faults, and simple bad luck may mean that a percentage of patients will suffer complications even in a vastly improved system [5]. In these circumstances patients need to be reassured that every effort is being made to detect the complication, treat it and restore them to their full health [6]. Health care professionals would like to be reassured that their errors do not result in fatal outcomes or impact on the chronic health of their patients, both for their own peace of mind and their standing amongst their peers [7]. Healthcare organizations need to reassure themselves that a single error or mishap does not lead to long-term cost implications and legal and professional consequences.

The management of failure to rescue has been seen as the hallmark of the best performing health systems. A 2009 analysis of US Medicare data from the 20 % hospitals with the best adjusted mortality rates and the 20 % hospitals with the worst mortality

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rates demonstrates that the corresponding complication rates in major surgical cases between these two hospital groups seems to be much less different than one would expect [8]. While the difference in mortality was 3 % vs. 8 % (i.e., a factor of nearly 3) the small differences in coded complications was only 3.7 % (32.7 % vs. 36.4 %). While the quality assurance of the coding was not part of the study's objectives it is reasonable to assume that the best hospitals also code better and therefore capture more of their complications, and that the real difference might be even smaller. The difference in failure to rescue rates was, however, 6.8 % vs. 16.7 %, with an odds ratio of 2.43 (O.R. = 2.30–2.58). This difference persisted for different types of patients and complications such as pneumonia, post-operative myocardial infarction, and surgical site infections.

Epidemiology

The seminal report "To Err is Human" is seen as the document that empowered healthcare professionals to open up about the preventable flaws of their work and was key in addressing the importance of creating a culture of safety [1]. The acknowledgement that in hospital patients come to harm as often as 10 % of all admissions is evident from studies in many developed health care systems. The Health Foundation's literature review on "Levels of harm" demonstrated this prevalence [9]. The authors concluded that "people receive only half of the appropriate care for their condition." Unsurprisingly, the highest rates of adverse events are being experienced by older patients, patient with mental health issues, and in those requiring a longer hospital stay. The latter might be simply due to the fact that their exposure time to risk is longer and that there are therefore more opportunities to "get things wrong."

Impact of Culture and Climate of Care

Failure to rescue has been measured in a number of studies from the USA [1], Canada [10], New Zealand [11, 12], Netherlands [13], and the UK [14]. Organizational culture and the working relationships of those caring together might be a key ingredient for improved rate of failure to rescue. Failure to rescue is more common in organizations with steep hierarchical gradients perhaps due to the lack of psychological safety and the inability to assuredly speak up about concerns [15]. Even within healthcare systems and between different procedures significant differences in the rate of failures exist [8, 16]. Variation in failure to rescue in a detailed study from New South Wales, Australia, was largest in hip replacement, knee replacement, and cholecystectomy patients [17]. Larger organizations fared worse in this study in contrast to other previously published work on single disease groups [18–20]. How might the hospital or unit size affect the ability to identify, address, and recover from system failures?

Surgical Clinical Microsystem and Implications for Rapid Response Success and Impact

Several models of care delivery have emerged as health care institutions face challenges in providing safe, reliable, and effective health care in a complex regulatory and financially burdened environment [21]. Microsystems, small team of providers, based on work of intelligent enterprises by Quinn applies systems thinking to organizational design and represent the smallest replicable organizational unit of change and can be applied to assessing Rapid Response Team (RRT) impact and uptake [22].

The goals of the microsystem are as follows:

The five essential goals (5 Ps) of the microsystem[a]
1. Purpose. What is the purpose of the clinical microsystem and how does that purpose fit within the overall vision?
2. Patients. Who are the people served by the microsystem?
3. Professionals. Who are the staff who work together in the microsystem?
4. Processes. What are the care-giving and support processes the microsystem uses to provide care and services?
5. Patterns. What are the patterns that characterize microsystem functioning?

[a]From Barach P, Johnson JK. Understanding the complexity of redesigning care around clinical microsystem. Qual Saf Health Care 2006;15(Suppl 1):10–6; with permission

Quinn studied companies that achieved consistent growth, high quality, and high margins as well as exceptional reputations with their customers. He found that these smallest replicable units were the key to implementing effective strategy, engendering loyalty, leveraging information technology, and embedding other performance-enhancing practices into the service delivery process. Health care microsystems consist of a small group of people who provide care to a defined set of patients and for a particular purpose, such as the peri-operative care continuum. Microsystems have both clinical and business aims, tightly coupled processes, and a shared information platform. Clinical, service, and financial outcomes are measured systematically and with a view toward continuous improvement [23].

A microsystem's developmental journey toward maturation and improved performance entails five stages of growth [24] (Box 37.1).

The clinical microsystem approach emphasizes identifying and promoting the strengths of both the team and individuals. It maintains a focus on continuous improvement rather than externally imposed targets and initiatives that members think do not directly have an impact on their work. In addition, the microsystem incorporates the experience and perceptions of patients and their families in the strategic development to deliver the most desirable service from the end user's point of views. A surgical microsystem can involve, for example, a pediatric cardiac surgical team that includes the corresponding critical care team, wards, or perhaps a large surgical critical care unit providing services in a defined geographic space [25]. The microsystem includes patients and their family members given the need for real co-production convergence between patients and providers to achieve a patient's full recovery [26–28].

Characteristics of high-performing microsystems applied to assessing RRT teams include—leadership, organizational support, staff focus, education and training, interdependence, patient focus, community and market focus, performance results, process improvement, and information and information technology—and can be linked to specific design concepts, actions and impact, to enhance patient safety in microsystems (Box 37.2).

Rapid Response Systems

Rapid Response Systems (RRS) were introduced in order to reduce the failure to rescue when patients had a cardio-pulmonary arrests and preventable admissions to critical care units [29]. Much of the literature on failure to rescue has been published in the context of these clinical conditions. A short introduction is therefore necessary.

RRS consist of several parts [30]: The afferent limb of the system records physiological abnormalities and escalates care when significant pre-defined abnormalities in a patient's vital signs are evident. The efferent limb responds to calls from the afferent part. The third part, the system is usually supplemented by an administrative limb and structures supporting education (Fig. 37.1).

The afferent limb relies on assessments of vital signs such as blood pressure, heart rate, respiratory rate, oxygen saturations, temperature, and level of consciousness. Alerts triggered by abnormalities in some of all of these parameters are complemented by alerts related to "nurse concerns" acknowledging the fact that not all deterioration is proceeded by measurable abnormalities and the intuition, experience, and "gut feeling" is hugely important, and can supplement the quantifiable abnormalities.

The efferent limb responds to calls for help from the afferent part. The efferent limb can take different forms in different health systems. In Australia, this consisted mainly of a team of doctors from intensive care and general wards supported by nurses with critical care skills (Medical Emergency Team (MET) [29]). In the UK, however, critical care trained nurses would respond (Critical Care Outreach [31]), and while in the USA, a teams of doctors, nurses, and respiratory therapists might respond (RRT [30]). This diversity and heterogeneity creates immense challenges in making meaningful comparisons

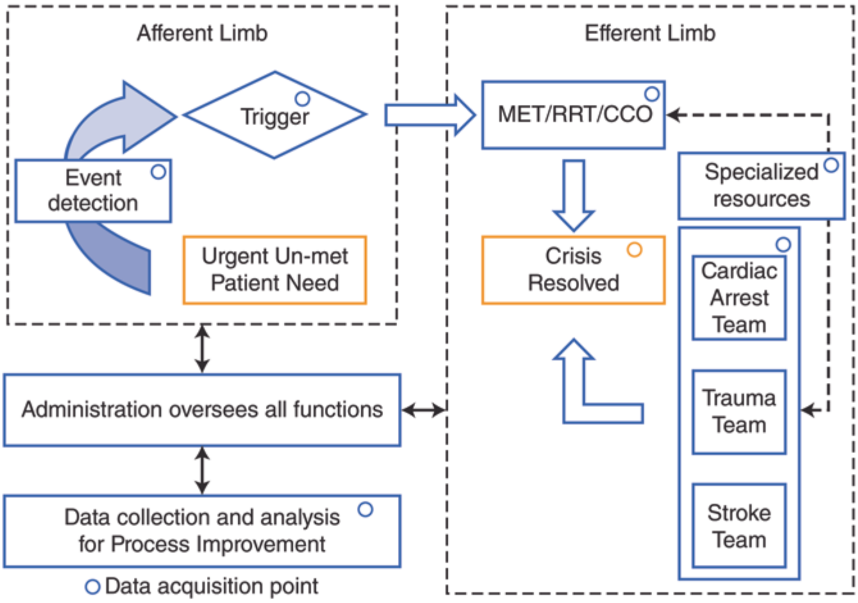

Fig. 37.1 Structure for a Rapid Response System

about the relative effectiveness of each of these staffing models.

Hospitals analyze complications as a means to reduce failure to rescue and improve their patient outcomes [32]. The resulting discussions led quickly to changes in health policy in several countries with RRS becoming a new standard of care, despite many remaining questions about how best to deploy RRS and their effectiveness. In the USA, the 100,000 Lives Campaign chose RRTs in 2005 as one of five interventions to reduce preventable mortality in hospitals. The campaign run by the Institute for Healthcare Improvement (IHI) resulted in some measurable changes in hospital mortality; however, some controversy remains regarding its generalizability and lasting impact [33, 34]. Subsequent spread to the UK (supported by the IHI) resulted in initial pilot projects in small groups of hospitals (Safer Patients Initiative I and II) that followed the pattern of the US campaign. Published results came to mixed conclusions [35, 36]. While there was clear evidence of improvement in processes of care and clinical outcomes in the participating units, these improvements were in line with other organizations that did not take part in the initiative. The UK's Intensive Care Society and the Modernisation Agency published recommendations on the make up of services and funding from the Department of Health following the report "Comprehensive Critical Care" that lead to rapid spread prior to detailed evaluation [37].

The largest interventional trial, a cluster randomized study of 23 hospitals created massive interest and the majority of Australian hospitals adopted METs with limited follow-up. This further impacted objective assessment [38]. The patient safety movements inspired by the IHI have led to spread of national programs through Denmark and the Netherlands. Interestingly these have been often without attempted standardization of the tools used to assess patients at risk or the format of the responding team structure, leading to further confusion as to the effectiveness of these interventions.

Chain of Survival

Principles of Reliable and Safe Care

Failure to rescue patients in hospital is often due to a systems failure and breakdown in care at a number of levels which we have described as a

Box 37.1: Clinical Microsystems: Five Stages of Growth

1. Awareness as an interdependent group with the capacity to make changes
2. Connecting routine daily work to the high purpose of benefiting patients
3. Responding successfully to strategic challenges
4. Measuring performance as a system
5. Juggling improvements while taking care of patients

Box 37.2: Questions to Ask When Assessing an RRT Team's Performance [39]

- Is the team the right size and composition?
- Are there adequate levels of complementary skills?
- Is there a shared goal for the team?
- Does everyone understand the team goals?
- Has a set of performance goals been agreed on?
- Do the team members hold one another accountable for the group's results?
- Are there shared protocols and performance ground rules?
- Is there mutual respect and trust between team members?
- Do team members communicate effectively?
- Do team members know and appreciate each other's roles and responsibilities?
- When one team member is absent or not able to perform the assigned tasks, are other team members able to pitch in or help appropriately?

"chain of survival" [40]. Safe care of deteriorating patients depends on robust and reliable recording of vital signs, recognition of abnormalities, reporting of patient deterioration as soon as detected, an appropriate and timely response, and more often than not a repeat cycle to check whether interventions have had the desired effects (Fig. 37.2). All elements of the chain need to function seamlessly in order to provide reliable and safe care [41]. The following sections will describe the elements of the chain of survival, the reasons for failure and possible mediating mechanisms.

Failure to Record

Deterioration of patients is often clear in hindsight from the characteristic changes in vital signs [42, 43] or pathology results [44]. The majority of patients admitted to Intensive Care Units or suffering cardio-pulmonary arrests demonstrate signs of deterioration for a minimum of 6 h prior to the "event" [45]. In the majority of patients failure to rescue is therefore not due to a failure to record vital signs but failure *to recognize* the trend in the patient status. It is unclear how many patients have cardiac arrests without physiological abnormalities purely due to the fact that no observations or no complete set of observations were recorded in the hours prior to the event. In general terms, a full set of vital signs could comprise respiratory rate, oxygen saturations, blood pressure, heart rate, temperature, level of consciousness, and possibly urine output. The most powerful parameter predicting patient deterioration, and at the same time the most often missed vital sign, is the respiratory rate [46]. Respiratory rate (RR) changes with thoracic cage and lung conditions, metabolic acidosis, infection, fever, etc. RR is measured manually and not electronically like other key measured parameters and is more time consuming. The optimal frequency of observations for acutely unwell patients is not clear from the literature. A report about "Standardising the assessment of acute-illness severity in the NHS" by the Royal College of Physicians [47] recommended at least 4 h vital signs on general wards. In Dutch hospitals the frequency is often less [48]. In many other systems vital signs might only be assessed by healthcare providers once or twice per day and consist of blood pressure, heart rate, and temperature only, thus potentially

Fig. 37.2 The chain of survival for the deteriorating patient on a general ward

missing opportunities to capture deterioration through a full set of vital signs.

Standardization of vital sign recordings might improve the number of opportunities for intervention. Standardization of vital sign recordings and analysis of abnormality is described in the literature as Medical Emergency Criteria [49] (Table 37.1. Medical Emergency Team criteria) and as Early Warning Scores [50] (Table 37.2. Modified Early Warning Score). Triggers of abnormal physiological signs are complemented by nurse concerns as an important safety net for those patients who do not or not yet exhibit gross abnormalities [51].

Validation of Early Warning Scores has been undertaken predominantly in acutely unwell medical patients [47] and to a lesser extent in surgical patients [52]. Standardization can be anchored in clinical teams through training using a common model to describe severity of illness [48]. Automated monitoring can also improve monitoring of post-surgical patients [53–55].

Failure to Recognize Pathophysiological Changes

Perception of "illness" and mental models of providers about the disease severity can have a major influence on behavior and decisions of healthcare professionals. In the words of Peter Senge [56]: "Mental models are deeply held internal images of how the world works, images that limit us to familiar ways of thinking and acting. Very often, we are not consciously aware of our mental models or the effects they have on our behavior." Mental models are subtle but powerful. Subtle, because we usually are unaware of their effect. Powerful, because they determine what we pay attention to, and therefore what we do. For example, if a young patient *"looks well"* with red cheeks and a smile despite a systolic blood pressure of 70 mg than the nursing staff is much less likely to trip the alarm than in an elderly patient who has been unwell for several days with the same vital signs. The perception that young patients are usually well and can't really be that ill remains an ongoing recognized risk and a form of normalized deviance [57]. Recognition of physiological abnormalities is often in the context of what is expected: it is easier to spot "abnormal" in a patient in whom staff expect this abnormality. For example, in a post-operative patient hypotension might be expected; a patient with chronic obstructive pulmonary disease might post-operatively be more short of breath because of metabolic acidosis or volume overload but his or her respiratory rate will be interpreted in the context of their previous condition. Furthermore, we know that elderly patients' physiological response to acute illness is attenuated [58]. This might make it more difficult for staff to classify changes in vital signs as "critical" and requiring further action. Age might, however, not be the defining factor for prognosis. Crucial to the understanding of acute physiology is the underlying degree of frailty. Frailty is a syndrome with measurable metrics [59] based on pathophysiological modeling and epidemiological data from large cohorts of aging patients (Fig. 37.3).

Increased levels of frailty are associated with higher mortality, higher levels of complications after surgery, and higher mortality after admission

Table 37.1 Modified Early Warning Score

	3	2	1	0	1	2	3
Systolic blood pressure (mmHg)	<70	71–80	81–100	101–199		≥200	
Heart rate (bpm)		<40	41–50	51–100	101–110	111–129	≥130
Respiratory rate (bpm)		<9		9–14	15–20	21–29	≥30
Temperature (°C)		<35		35–38.4		≥38.5	
AVPU score				**A**lert	Reacting to **V**oice	Reacting to **P**ain	**U**nresponsive

Table 37.2 The Medical Emergency Team is activated according to the following criteria

Acute physiology change in
• Airway Threatened
• Breathing All respiratory arrests
• Respiratory rate ≤5
• Respiratory rate ≥36
• Circulation All cardiac arrests
• Pulse rate ≤40
• Pulse rate ≥140
• Systolic blood pressure ≤90 mmHg
• Neurology Sudden fall in level of consciousness
• Fall in GCS
• ≥2 points
• Repeated or prolonged seizures
• Other Any patient who you are seriously worried about that does not fit into the above criteria

to ICU. The majority of patients with physiological deterioration and those experiencing failure to rescue are frail [60] (Fig. 37.4).

Failure to Report

Reporting on patient abnormalities or staff concerns are an important function of communication between professional groups. Real or perceived hierarchy plays a major role in acting on available warning signs [61]. Professionals might hesitate to discuss abnormalities if they fear and lack psychological safety or have a non-supportive recipient of the information. In the context of activation of RRS nurses might be hesitant to call a physician if they fear that the physician will not take their concerns seriously or will be short on the phone because of real or perceived pressures of work. The failure to report can be "simple forgetfulness" when workflow pressures and conflicting priorities over-ride the need to escalate care. It can be a conscientious decision that the reporting of abnormalities is not a priority for the patient or workflow. Nursing staff might judge abnormalities to be within the expected range for a given patient or hope that they are transient and resolve without further intervention.

Failure to Treat

Failure to treat can be the consequence of a failure to record or recognize or equally a failure despite recording and recognizing. Correct treatment will depend on the clinical competencies (i.e., knowledge, skills, and attitudes) of the treating clinician and their mental model of the patient's disease and situation [62]. Reliability of treatment can be enhanced by using "care bundles" [63] and by making available a RRT with critical care skills [64].

Complications from surgery fall into a small number of distinct groups which have been labeled MET syndromes [65]. Common complications of surgical care are sepsis, acute kidney injury, and hypovolemic shock. Sepsis is the combination of suspected or confirmed infection and Systemic Inflammatory Response Syndrome [66]. Reliability of sepsis treatment can be enhanced using a "sepsis-bundle" that combines key elements of diagnostics (cultures and serum lactate level) with key treatments (fluids, antibiotics) and monitoring (urine output) [67] (Table 37.3. "Sepsis six" response bundle).

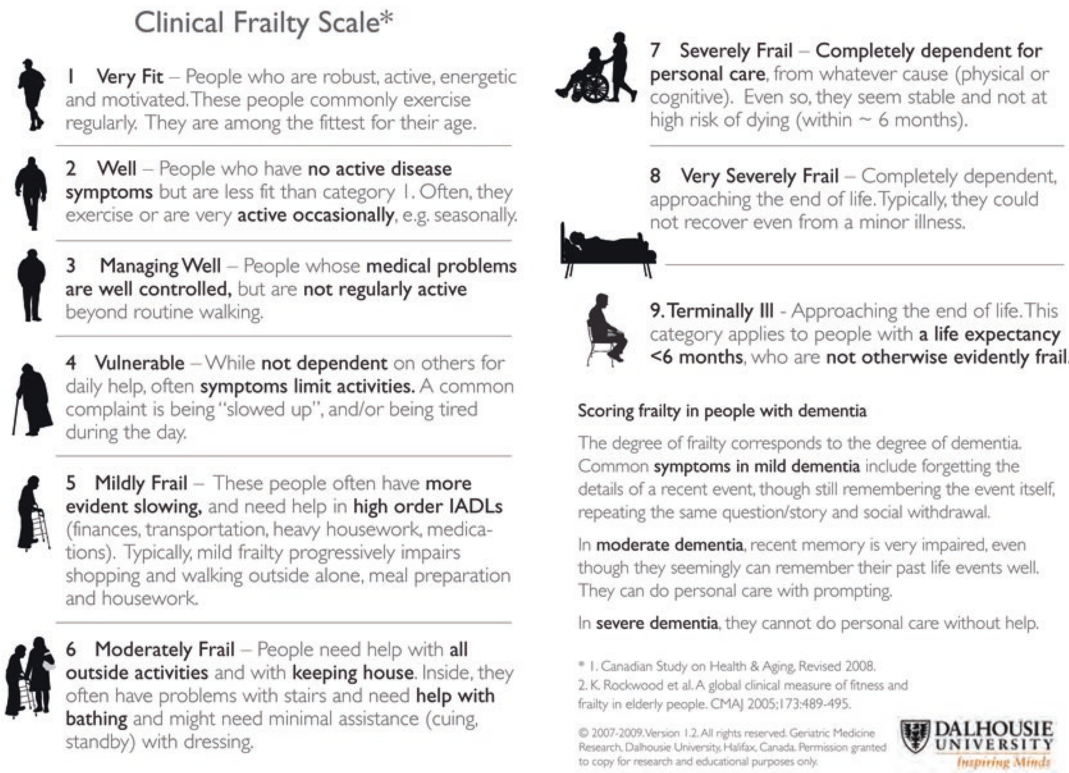

Fig. 37.3 Clinical frailty scale (reprinted with permission from CFS©)

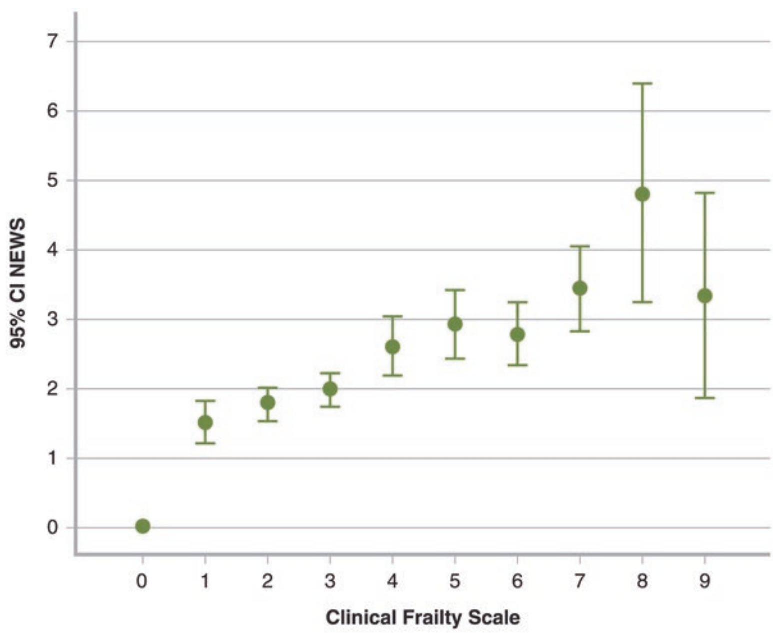

Fig. 37.4 Breakdown of patients who trigger a National Early Warning Score by degree of frailty

Table 37.3 "Sepsis six" response bundle according to [68]

The sepsis six to be delivered within 1 h
1. Deliver high-flow oxygen
2. Take blood cultures
3. Administer empiric intravenous antibiotics
4. Measure serum lactate and send full blood count
5. Start intravenous fluid resuscitation
6. Commence accurate urine output measurement

Implementing these tools facilitates education and improves clinical results [68].

Checklists have been widely accepted for peri-operative care. Similarly check lists could be used for antibiotic choice [69]. The World Health Organization (WHO) checklists represent a "normal checklist" [3]: "Normal" checklists in aviation are performed as routine procedures to anticipate complications. Peri-operative checklists can anticipate complications and improve mortality and peri-operative morbidity. The impact of surgical checklists is likely to be mediated through engaging the staff's attention and changes in their safety culture: Improved communication, flattening of hierarchies, and better social functioning within teams rather than the mechanical ticking of boxes [70]. The absence of these social changes in short term studies might explain why some trials have found little to no improvement in clinical outcomes despite checklist usage [71].

Adaptive lists can be further used for the majority of surgical patients [72]. Crisis checklists are "emergency checklists" that are only applied during an expected impending catastrophe. Experience is currently limited to complications in the operating room [73, 74]. The concept can be further developed to improve standardization or harmonization of care for patients experiencing "MET syndromes" in general wards.

Evidence for Impact of Rapid Response Teams in Surgical Patients

The impact of RRTs on outcomes in surgical patients has been largely part of generic evaluation of RRS [75]. A meta-analysis of published literature suggests a reduction in cardio-pulmonary arrests and a trend toward improved mortality in units utilizing RRS [64]. However, it is not clear whether certain sub-groups of patients or certain hospital specialties benefitted more or less from the RRS interventions.

Properties of track-and-trigger systems in surgical patients have been described: The Modified Early Warning Score (MEWS) was originally created for deteriorating surgical patients [76]. In a cohort of patients from a UK university hospital the reliability of an Early Warning Score for identifying patients at risk on surgical wards is comparable to that described in medical cohorts [52]. The United Kingdom's National Early Warning Score [47] was found to have similar sensitivity and specificity in surgical and medical patients (G. Smith, personal communication).

Two studies have reported data on the effect of these interventions: The impact of implementing an Early Warning Score coupled to an RRT and a call-out algorithm has been evaluated in a 6-month before and after study [77]: An RRT saw 273 patients on four surgical wards. The author reports a reduction in the proportion of emergency admissions to intensive care from 58 % to 43 % with a reduction of mortality in this patient group from 29 % to 24 % during the study period. However, detailed data about the patient cohort and inclusion criteria was not reported.

A second interventional study of surgical patients comes from Australia: A single center 4 months control and intervention period with just over 1000 patients each were compared [78]. A reduction in both mortality and a broad range of complications including myocardial infarction, stroke, and acute renal failure were reported. The rational for the reduction in complications is not clear. Better renal outcomes might be due to more pro-active peri-operative fluid therapy, and this would be expected to be associated with an increased rate of pulmonary edema and possibly myocardial infarction which was not observed. The complication rate decreased from 1 in 3–1 in ten patients. It would be unusual to associate all of these with abnormal MET triggers. It is therefore possible to hypothesize that the presence of a Rapid Response practitioner might have triggered discussions about management of non-crisis patients with improvements in complications.

Failure to Repeat

Failure to rescue in clinical practice often occurs after an initial successful activation of the chain of survival and a transient improvement in patient status. Notably, in patients with complex surgical pathology sustained monitoring and re-evaluation is required. Electronic systems might provide more reliable ways to remind clinicians of unstable patients. There is some indication that this might lead to a safer patient environment [79–81].

Failure to System Design

The design and human factors of systems in hospitals frequently do not follow principles of safe design [82, 83]. High reliability industries rely on the fact that safety critical steps rely on redundant systems [84]. In case one component or a system (or a member of a team) commits an error other components are able to fully compensate for this error and thus prevent catastrophe [83]. Most high reliability industries employ systems that have in-built redundancy: safety critical interventions always exist in duplicate or triplicate [84]. Important parts of procedures are being performed by a least two operators following a scripted process of call and re-call [39]. The principle of redundancy can be introduced into hospitals on a number of levels. Computerized alerts for abnormal laboratory tests and vital signs in electronic patient records can alert staff to deteriorating patients that were missed by the primary care team [85].

Failure to Measure

Establishing safe systems requires defining what safety "looks like." The literature on RRS has often focused on reduction of cardio-pulmonary arrests (CPA). These have been significantly reduced over the last decade. While a reduction of admissions to intensive care has also been attempted it is less clear whether this is achievable given the variation in judgment on what is an appropriate, bed availability, and timely intensive care admission. In VITAL I [79] the admission to ICU increased in US units and fell in Australian units when employing the seemingly same intervention. Decisions to admit to an intensive care unit are variable [86] and might depend on the numbers of intensive care beds and providers available [87] and on the availability to provide high levels of care such as ventilation and inotropic support outside intensive care. On the other hand, it is comparatively easy to time processes from first physiological deterioration to clinical outcomes such as admission to critical care ("Score-to-Door time" [88]) and this can be used as a marker of functional processes [89]. The financial cost of failure to rescue is often difficult to measure for individual patients and might only be evident in the comparison of systems with different levels of adverse events.

There are some limitations to the metrics of failure to rescue: cardio-pulmonary arrests might not be relevant outcomes for the majority of patients. Failure to rescue in patients with advanced cancer or those nearing the expected end of life might take different priorities that are less easy to measure. It is therefore essential that patients at risk of catastrophic deterioration receive a robust assessment by an experienced clinician and a frank and open discussions of likely outcomes of the range of available interventions.

In this chapter we have focused on the detection and prevention of deterioration by analysis of abnormal vital signs. These are more difficult to gauge in patients with chronic conditions such as chronic obstructive pulmonary disease or congestive cardiac failure. These patients will often suffer with abnormal vital signs even in times of being well. As a consequence reliable care is more difficult to define and might require more complex monitoring interventions. In patients with multiple conditions the correct course of treatment is also often not immediately obvious. The failure to identify protocols for conditions such as sepsis that work in randomized controlled trials illustrate the importance of clinical decision makers in deciding which treatments might be beneficial for a given patient. Consultation with colleagues might reduce the risk to administer treatments that are harmful.

Conclusions

Failure to rescue is a key phenomenon at the heart of patient safety. Its resolution requires understanding of the physiology of deteriorating patients as well as the sociology of hospitals and the psychology of individuals. Serious social science, confirmed by statistical analysis and experiment indicates that vital signs will pinpoint the majority of patients at risk and needs to be supplemented by regular and recurring assessments of physiological reserve. RRS are a means to drive safer care across organizations. In order to thrive they require a change in the underlying safety culture with an acceptance that the individual clinician is always fallible and requires redundancy for safety critical steps.

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