Failure to Rescue Deteriorating Patients: A Systematic Review of Root Causes and Improvement Strategies

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Objectives: "Failure to rescue" (FTR) is the failure to prevent a death resulting from a complication of medical care or from a complication of underlying illness or surgery. There is a growing body of evidence that identifies causes and interventions that may improve institutional FTR rates. Why do patients "fail to rescue" after complications in hospital? What clinically relevant interventions have been shown to improve organizational fail to rescue rates? Can successful rescue methods be classified into a simple strategy?

Methods: A systematic review was performed and the following electronic databases searched between January 1, 2006, to February 12, 2018: MEDLINE, PsycINFO, Cochrane Library, CINAHL, and BNI databases. All studies that explored an intervention to improve failure to rescue in the adult population were considered.

Results: The search returned 1486 articles. Eight hundred forty-two abstracts were reviewed leaving 52 articles for full assessment. Articles were classified into 3 strategic arms (recognize, relay, and react) incorporating 6 areas of intervention with specific recommendations.

Conclusions: Complications occur consistently within healthcare organizations. They represent a huge burden on patients, clinicians, and healthcare systems. Organizations vary in their ability to manage such events. Failure to rescue is a measure of institutional competence in this context. We propose "The 3 Rs of Failure to Rescue" of recognize, relay, and react and hope that this serves as a valuable framework for understanding the phases where failure of patient salvage may occur. Future efforts at mitigating the differences in outcome from complication management between units may benefit from incorporating this proposed framework into institutional quality improvement.

Key Words: failure to rescue, deteriorating patient, escalation

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"Failure to rescue" (FTR) is the failure to prevent inpatient deterioration and death resulting from a complication of medical care or underlying illness.[1] Failure-to-rescue rate should capture inpatient deaths that are deemed avoidable or preventable. An important distinction must be made; that FTR is not a measure of the natural progression of a disease process at the end of life. Accurate estimates of the incidence and impact of FTR are limited as preventability, and its effect on mortality are not accounted for using current measurement strategies. Historically, mortality rates have been used to indicate the quality of inpatient care, despite interinstitutional variation being largely due to unrelated or uncontrollable factors, such as patient population, acuity of disease, and staffing levels.[2] In the United Kingdom, the National Patient Safety Agency first reported that in 2007, 11% of patients died as a result of inaction or a lack of recognition of deterioration.[3]

Reducing the incidence and optimizing the management of inpatient complications are critical goals for healthcare providers worldwide. The current evidence base is replete with studies highlighting the importance of FTR rate as an institutional metric. In the United States, FTR rate was recognized as a patient safety indicator (PSI) by the U.S. Agency for Healthcare Research and Quality (AHRQ) in 2007.[4] An analysis of quality of care disparities among 7.5 million surgical patients[5–8] identified FTR rate as a key improvement area for patient safety.[4,9] The Department of Veteran Affairs' Surgical Quality Improvement Program and the American College of Surgeons National Surgical Quality Improvement Program have systemically advanced the quality of care in surgery after the introduction of FTR as a measure.[4,10] Subsequently, FTR rate is becoming an established metric of hospital quality.[2]

There is, however, a paucity of high-level evidence regarding the root causes of FTR. In 2007, the National Institute for Health and Care Excellence developed a clinical guideline entitled "*Acutely ill adults in hospital: recognising and responding to deterioration*" and identified the lack of evidence surrounding causation and interventions in clinical deterioration.[11] Eliciting the etiologies behind FTR would allow the identification of demonstrable improvement strategies that could be instituted to improve FTR rates.

In this systematic review, we identify the known root causes of FTR and explore the salient factors that lead to failure to recognize evolving or established complications. We present a menu of practical interventions and strategies, beyond specific clinical interventions, drawn from nursing, anesthetic, and medical literature. Our aim is to further the understanding of what underlies the variability in outcomes from complication management and suggest recommendations based on current evidence.

METHODS

The protocol for this review was guided by the preferred reporting items for systematic reviews and meta-analyses guidelines.

Eligibility Criteria

Inclusion:

1. Types of studies: All study types that explored an intervention to improve failure to rescue were considered.
2. Types of participants: Adults older than 18 years

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Medical Subject Headings do not exist for failure to rescue.

A.A. and J.B. conceived the study. J.B. drafted the manuscript, and C.D. and A.A. critically revised the manuscript.

3. Outcome measure: Improvement in FTR rate
4. Setting: Hospital inpatients
5. Published between January 1, 2006, to February 12, 2018 (FTR rate was recognized as a PSI by the U.S. AHRQ in 2007)

Exclusion:

1. Pediatrics (younger than 18 y)
2. Conference abstracts

Information Sources

The following electronic databases published between January 1, 2006, to February 12, 2018, were searched: MEDLINE, PsycINFO, Cochrane Library, CINAHL, and BNI databases. To ensure literature saturation, citations and reference lists of selected studies were reviewed to identify any missed articles.

Search

The search was undertaken on November 2, 2016, and repeated on the February 12, 2018. There are no Medical Subject Heading–specific terms for FTR, so the key word search string "failure to rescue" was used. Results were limited to title and full abstract for the initial search. English language, original articles identified through MEDLINE, PsycINFO, Cochrane Library, CINAHL, and BNI databases were included. Duplicates and conference abstracts were removed.

Study Selection

Studies were selected using a staged review of titles and abstracts, followed by full-text review. J.B. independently retrieved article abstracts with C.D. cross-checking. The search-identified abstracts and those from additional sources were screened independently by J.B. and C.D. to identify studies that potentially met the inclusion criteria outlined previously. Discordance was settled by arbitration by the senior author A.A.

Data Collection Process

Data were compiled in a data extraction spreadsheet in Excel (Microsoft, Redmond, WA), which was tested initially in 10 studies to ensure clarity and completeness. Extracted data included patient characteristics (including disease process) and study settings were recorded. All clinical, nonclinical, and feasibility outcome measures were extracted. The full texts of those potentially eligible studies were retrieved and independently assessed for eligibility by J.B. and C.D. Any disagreement over the eligibility of particular studies was resolved through discussion.

Data Items

Outcomes and Prioritization:

1. What are the root causes of failure to rescue?
2. What clinically relevant interventions have been shown to improve organizational FTR rates?

Risk of Bias in Individual Studies

Because of the heterogeneity of study designs, the use of a single bias scoring tool was deemed inappropriate.

Summary Measures

Binary outcome measures included risk ratios, odds ratios (ORs), and risk difference. Continuous outcomes included difference in means.

Synthesis of Results

Quantitative data synthesis was not attempted to avoid units of variance issues and the anticipated effects of excess heterogeneity. A narrative synthesis approach was chosen to summarize the diverse range of selected studies in a structured manner, following the European Social Research Council Guidance on the Conduct of Narrative Synthesis in Systematic Reviews.[12] The results of the selected studies were tabulated to highlight important similarities and differences between the studies. The studies were then grouped by type of intervention. The evidence was then synthesized to provide a narrative, relevant to the research question.

RESULTS

Study Selection

The initial search returned 1486 references. After the limits of "adult" and "2006–current" were applied, and after duplicates were removed, 842 results remained to be screened. The 842 abstracts for these references were compiled into a database and screened, leaving 55 abstracts for full-paper assessment. Of these 55, a further 3 were not relevant (Fig. 1).

Results of Individual Studies

Analysis of the selected studies identified 3 critical stages that lead to FTR within an institution: failure to *recognize* complications, failure to *relay* information regarding complications, and failure to *react* in a timely and appropriate manner to a patients' deterioration.

Recognize

Staffing Levels and Education

Failure to recognize a patient's deterioration may result in missing the window of opportunity to rescue them from further decline (Table 1). Nurses and doctors play a vital role in this recognition, and the positive correlation between nurse staffing and patient outcome has been established for the last decade.[15,28] Failure to rescue is highly sensitive to nursing care, and as such, it has been advocated as a nursing-sensitive outcome measure[29] despite many previous studies not including medical staffing as a variable.[30] Some form of serious deviation from normality of vital signs is usually recorded up to 48 hours before ward patients are transferred to the intensive care unit (ICU).[31] In sick patients, poor recognition of their decline has been highlighted as a key process factor in determining their subsequent death by a recent National Patient Safety Agency report in the United Kingdom.[3]

The implementation of regional minimum nurse staffing levels in the United States has reduced FTR rates,[16] and its use as a nurse sensitive quality indicator in the England has been demonstrated.[17] This finding was supported in the United Kingdom, where patients in 30 hospitals with the most favorable staffing levels (lowest patient-nurse ratios) had significantly better FTR outcomes.[18] However, one study found that decreasing workloads by one patient per nurse had virtually no effect on FTR rates in hospitals with poor working environments but decreased the odds of FTR by 4% in average hospital working environments and by 10% in hospitals with the best environments (n = 40,000 staff nurses in 665 hospitals). Increasing nurse staffing by 10% improved FTR rates by 4% independent of quality of working environment.[19] In a cross-sectional analysis of a mixed surgical population, the addition of one extra patient to a nurse's supervision translated to a 7% increase in the likelihood of death within 30 days of admission while adjusting for patient and hospital characteristics.[32]

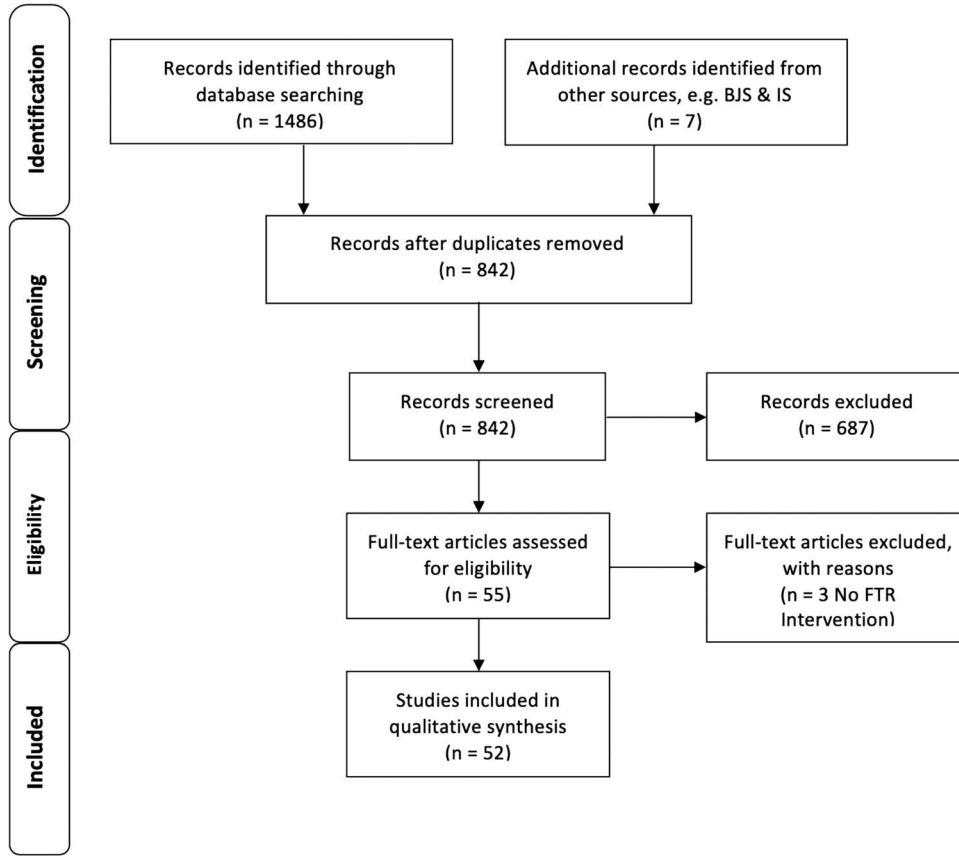

FIGURE 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) Flow Diagram.

One study found that a higher proportion of agency-employed nursing staff was associated with a higher mortality (OR = 1.06) and FTR (OR = 1.05), before controlling for nurse and hospital characteristics.[32] Hospitals with a higher proportion of agency nurses were shown to have poorer working environments. However, when this was accounted for in the analysis, mortality outcomes were rendered insignificant. Furthermore, a retrospective analysis showed a link between nursing education and FTR. Hospitals with higher proportions of nurses with baccalaureate degrees had a reduced rate of FTR ($r = -0.399$, $P < 0.05$).[20] In a separate study, a 5% risk reduction of FTR was demonstrated where 10% of nurses held a bachelor's degree or higher.[14]

Few studies have taken into account healthcare staffing to evaluate outcomes.[15] In the ICU, one multicenter study showed no significance in the relationship between nurse staffing measure and FTR mortality for either ICU and non-ICU discharges with a greater ratio of nurses in ICU environments (n = 14,000).[21] One study revealed that better physician and nurse staffing was independently associated with a lower FTR in general and thoracic cancer surgery, irrespective of hospital volume (n = 130,000, $P < 0.001$).[22] In the United States, no improvement in FTR rates was observed in Medicare patients undergoing surgery after the duty hour reform (restriction to resident duty hours, n = 1.8 million).[23]

A scarcely investigated association between FTR and the interaction of patient turnover and nurse staffing in non-ICUs was investigated and shown to be statistically significant. When patient turnover rates increased from 48.6% (25th percentile) to 60.7% (75th percentile), the effect of nurse staffing on FTR was reduced by 11.5%. At the median value of patient turnover (53.5%), a 1-hour increase in RN staffing per patient day on non-ICUs was associated with a 0.053 decrease in FTR ($P < 0.001$, 95% confidence interval [CI] = 0.020–0.085).[24]

Previous case reports of failure to rescue have suggested simulation as a useful tool to educate medical staff in FTR.[25] This has been reflected in advance practice professionals in established oncology care teams after a 4-hour simulation tutorial delivering at or above the level expected of a critical care nurse as assessed by an expert panel.[26]

Crew resource management is used in the aviation industry was proposed by the Institute of Medicine following their report *To Err is Human: Building a Safer Healthcare System*[5] as a means of mitigating the problems that arise from poor communication and teamwork. This involves clinical leadership taking active roles in developing team training, integration into standard teaching, use of simulation, and investment at the medical and nursing school level.[33] Crew resource management involves situations where the whole team can train in simulated crisis scenarios in a safe environment.[34] Where comprehensive multidisciplinary safety programs have been instituted across units, improved patient outcome has been reported in addition to improvements in healthcare staff perceptions to team working.[35] In a large study of 182,409 patients from Veteran Affairs hospitals, after structured medical team training programs, an 18% reduction in annual mortality was observed in trained facilities compared with a 7% decrease in nontrained hospitals in surgical patients.[36]

TABLE 1. Staffing Levels and Education

RECOGNIZE—Recognizing Complications

Authors	Date	Study Type	Level of Evidence (Fig. 4)	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
Aiken et al[14]	2003	Cross-sectional study	III	230,000 surgical patients from 168 hospitals	Examined whether the proportion of hospital nurses educated to baccalaureate level or higher was associated with failure to rescue within 30 d of admission.	Study period April 1998–November 1999	A 10% increase in the proportion of nurses holding a bachelor's degree was associated with a 5% decrease in the OR of FTR (0.95, 95% CI = 0.91–0.99).
Kane et al[15]	2007	Meta-analysis	I	N/A	Meta-analysis to test the consistency of the association between nurse staffing and patient outcomes. Higher registered nurse staffing was associated with reduced FTR rates. Limited evidence suggested that a greater proportion of BSN degree nurses were associated with lower FTR rates.	Search period 1990–2006	Increased nurse staffing in hospitals is associated with lower failure to recue rates. It is suggested that a greater proportion of BSN degree nurse may result in lower FTR rates.
Mark et al[16]	2007	Retrospective cohort study	IIa	36.2 million patient discharges in 600 hospitals	Aimed to determine whether acuity-adjusted nurse staffing and quality of care (measure through FTR) changed after implementations of California's minimum nurse staffing legislation (comparing 175 California hospitals with implementation to 475 without)	Study period 2000–2006	After implementation of minimum nurse staffing levels, mixed effects on quality of care were found. FTR decreased significantly more in California quartile 1 and 4 in final periods of implementation by 30.7%, $P < 0.05$, and 32.9%, $P < 0.05$, respectively.
Griffiths et al[17]	2013	Cross-sectional observational	III	66 million admissions from 146 trusts	Explored change in coding practice over time and measured associations between FTR and nursing and nonnursing staffing levels.	1997–2009	Higher total clinically qualified doctors and nurses were independently associated with lower FT ($P < 0.05$). Higher total number of staff (doctors and nurses) and a greater doctor-nurse ratio was also associated with decreased rate of FTR ($P < 0.05$)
Rafferty et al[18]	2007	Cross-sectional study	III	3984 nurses, 120,000 surgical patients, 30 English trusts.	Examined the effect patient-nurse ratios on failure to rescue. In trusts with 8.6–10 patients per nurse FTR OR = 1.2 (1.03–1.04), 10.1–12.0 patients per nurse FTR OR = 1.16 (0.99–1.34), and 12.4–14.3 patients per nurse FTR OR = 1.29 (1.12–1.49).	Study period April–July 1999	The larger the patient-nurse ratio the worse the trust FTR rate.
Aiken et al[19]	2011	Cross-sectional study	III	665 U.S. hospitals, 1.2 million patients, 40,000 staff nurses.	Determined the conditions under which the impact of nurse staffing, education, and work environment are associated with FTR.	Study period 2005–2007	Increasing nurse-patient ratios has no effect on FTR rate in hospitals with poor working environments but decreases the odds of FTR with "average" environments by 4% and in hospitals with the "best" environments by 10%.
Blegen et al[20]	2013	Cross-sectional study	III	21 hospitals	Examined the effect of nurse education on FTR rate with regression and clustering by hospital. Outcomes adjusted for risk and ratio of "observed" to "expected."	Study period—4 quarters, 2005	As nurse education increased, patient adverse events decreased including FTR ($r = -0.0399$)
Talsma et al[21]	2014	Cross-sectional study	III	19,500 patients	Using AHRQ Patient Safety Indicator PSI software nursing variables, the association with FTR was investigated in 7 hospitals.	3 y, 2003–2005	After fixed effects multilevel logistics analyses, no association between nurse staffing variables and FTR was observed.
Yasunaga et al[22]	2011	Cross-sectional study	III	130,000 surgical patients	Investigated the association between cancer surgical outcomes and physician/nurse staffing in relation to hospital volume.	July 2007–December 2008	After adjustment for hospital volume FTR rate in the group with high physician per bed and nurse per bed ratios was significantly lower than in the group with low ratios (9.2% versus 14.5%, OR = 0.76, 95% CI = 0.68–0.86, $P < 0.001$)
Scally et al[23]	2015	Case-control study	IIa	1.8 million patients	Investigated the impact of ACGMA on patient safety comparing outcome measures 3 y before and 18 mo after the change.	January 2009–December 2012	No improvement in FTR rates in Medicare patients undergoing surgery after the duty hour reform (restriction to resident duty hours) was observed.

Park et al[24]	2012	Cross-sectional study	III	1 million patients	Examined how the relationship between nurse staffing levels and FTR varied with patient turnover levels using data from the University HealthSystem Consortium.	Not explicitly stated	When patient turnover rates increased from 48.6% (25th pc) to 60.7% (75th pc), effect of nurse staffing on FTR was reduced by 11.5%. Median patient turnover (53.5%), a 1-h increase in RN staffing/patient day on non-ICUs was associated with a 0.053 decrease in FTR ($P < 0.001$, 95% CI = 0.020–0.085).
Acquaviva et al[25]	2013	Case report	IV	1	Case report concerning a 15-y-old child who dies 4 d after surgical correction of a congenital chest wall deformity due to failure to rescue.	N/A	Explanatory model for the events with several recognized phenomena: (1) the failure of dual process theory; (2) anchoring and belief perseverance; (3) the role of power and authority; and (4) the fragmented care delivery system in the hospital setting.
Blackburn et al[26]	2014	Descriptive project	IV	14 advanced practice professionals	Test group of advanced practice professionals underwent 4-h simulation tutorial delivering at or above the level expected of a critical care nurse as assessed by an expert panel.	N/A	All of the advanced practice professionals scored at or above the level of a critical care nurse with 1-y experience.
Rao et al[27]	2017	Cross-sectional	III	20,648 staff nurses for 570 hospitals	Examined relationship between nurse autonomy and 30-d mortality and FTR using American Hospital Association annual survey.	30-d mortality. 2006–2007	For every +1 point on the nurse autonomy scale resulted in app. 19% lower odd of 30-d mortality ($P < 0.001$) and 17% lower odds of FTR ($P < 0.01$)

ACGMA, Accreditation Council for Graduate Medical Education.

Detection, Early Warning Score Systems, and Check Lists

The widely adopted[37] Royal College of Physicians (RCPL) National Early Warning Score (NEWS) is used by nurses to escalate care to a doctor or more senior nurse at NEWS scores ≥5 and for any single vital sign ≥3 (Table 2).[43] The ability of this system to discriminate adverse outcome has been evaluated, but variable escalation protocols and thresholds are often described.[44] It has been suggested that aggregate EWSs are more important than high scores for a single vital sign parameter in discriminating adverse outcome risk and that current escalation protocols may produce an increased workload for bedside nurses and the responding senior, which is disproportionate to the modest increased detection of adverse outcomes. For example, one study showed that when escalating care to a doctor when any single component of a "NEWS = 3" compared with when aggregate NEWS values were 5 or greater, this increased doctors' workload by 40% with only a 3% improvement in detection. This discrepancy may distort patient safety focus, risk alarm fatigue, and result in misallocation of precious staffing resources.[38] It is uncertain as to whether simpler binary NEWS systems would be more effective. It has been suggested that these may be used with fewer errors, but with uncertainty surrounding the perceived extra workload burden, this may have on the staff implementing it.[39]

The use of EWS systems have been shown to be up to 75% sensitive in predicting patients who required escalation of care to a high-dependency unit (HDU) or ICU.[40] However, a recent Cochrane review of outreach teams and EWS systems could not find a significant impact benefit in units after their implementation.[41] The authors reported that reasons for this may have included poor study design but also the actual implementation of EWS systems is likely to be unit specific and highly variable. In a study by Donohue and Endacott[45] it was found that systems such as EWS are not necessarily valued by clinical staff and that EWSs were more commonly used to quantify deterioration once a patient's condition had been recognized as failing. It has been suggested that the introduction of checklists to guide patient management in potential FTR situations may reduce the variability of ward based care.[46] When this is applied to postoperative surgical patients; checklists used by general surgical registrars (n = 20) on a simulated surgical ward round significantly improved standardization, ward round quality, and evidence-based management of postoperative complications.[42]

In one study, hospitals failed to rescue elderly surgical patients (>75 y) at higher rates than younger patients after infection ($P < 0.01$) and pulmonary complications ($P < 0.01$, n = 23,000).[47] Findings were not replicable in cardiovascular complications, which may suggest that age is less of a determinant of FTR than the complication itself in this sample and that there may be other factors, which may contribute to FTR but have yet to be recognized in the literature. These may include cognitive function, differing organ baseline, nutritional status, polypharmacy, and do-not-resuscitate orders.[31]

Surveillance, Communication, and Electronic Monitoring

It is thought that an increase in nursing surveillance results in a decrease in failure to rescue. Most studies to date have used nurse staffing levels as a proxy for nurse surveillance (Table 3). In one study, the Nursing Interventions Classification was used to record nursing care and these classifications were matched to propensity scores based on confounding variables. In 10,000 hospitalizations, results indicated that if nursing

TABLE 2. Detection, EWS Systems, and Checklists

RECOGNIZE—Recognizing Complications

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
Hillman et al[17]	2002	Prospective follow-up study	III	551 patients	551 patients admitted to ITU from general wards, operating theaters, and the emergency department.	From presentation admission to ITU	More than 60% of study cohort showed potentially life-threatening abnormalities up to 8-h before admission to ITU. A greater proportion of patients dies from the general wards (47.6%) than from the OR (19.3%) of the emergency department (31.5%).
Smith et al[38]	2013	Observational study	III	198,000 observation sets in 35,000 consecutive acute medical admission	This study tested the ability of NEWS to discriminate patients at risk of cardiac arrest, unanticipated ICU admission or death within 24 h of a NEWS value, and compared its performance with that of 33 other EWSs currently in use at the time of the study.	Until death or discharge from ICU	NEWS has a great ability to discriminate combined outcome of cardiac arrest and unanticipated ICU admission and death when compared with 33 other EWS scoring systems.
Jarvis et al[39]	2015	Cross-sectional study	III	10,000 sample sets, 142,000 individual NEWS scores	Calculated the 24-h risk of serious clinical outcomes for vital signs observation sets with NEWS values of 3, 4, and 5, separately determining risks when the score did/did not include a single score of 3.	24 h after NEWS observation set	Escalating care to a physician when any single component of NEWS scores was 3 compared with when aggregate NEWS values ≥5 would have increased doctors' workload by 40%. This is with only a 3% improvement in detection of adverse outcomes.
Jarvis et al[40]	2015	Observational study	III	1.5 million vital sign observation sets	Attempted to convert 36 published EWS scoring systems into a binary trigger system using only 0 and 1 values.	N/A	The binary form of the NEWS suggested in this study had significantly better discrimination than all standard EWSs, except for NEWS.
Gardner-Thorpe et al[40]	2006	Cross-sectional study	III	320 patients	Investigated the use of the Modified Early Warning score system in surgical patients.	Transfer to ITU or HDU	Modified Early Warning score system with a threshold of ≥4 was 75% sensitive and 83% specific for patients who required transfer to ITU or HDU.
Mcgaughey et al[41]	2007	Systematic review (Cochrane)	I	N/A	Outreach and EWS for the prevention of intensive care admission and death of critically ill adult patients on general hospital wards.	Variable search dates	Showed diverse and poor quality of study investigating outreach and use of NEWS. Suggested that further multisite RCTs are required to determine potential effectiveness.
Pucher et al[42]	2014	Observational study	III	69 ward rounds for 37 d for 50 patients	Ward rounds were observed for patients on a surgical HDU. Thoroughness of assessment was recorded as a marker of ward round. Complications were recorded from patient notes and preventability was defined as per Agency for Healthcare and Research Quality guidelines. The relationship between ward round quality and incidence of preventable complications was analyzed.	N/A	Observed morbidity rate was 60%. 74% complications occurred on the HDU. Significant quality in ward rounds observed. Low-quality ward rounds resulted in a greater incidence of patients experiencing preventable complications and 41% of complications were preventable or could have been diagnosed earlier.
Pucher et al[42]	2014	Randomized clinical trial	I	120 patient assessments	Surgical trainees randomized to intervention or control groups. Ward round were conducted with or without checklists	N/A	The intervention group demonstrated improved patient management (SWAT-M, $P < 0{\cdot}001$) and nontechnical skills ($P = 0{\cdot}043$) between baseline and final ward rounds, whereas controls did not ($P = 0{\cdot}571$ and $P = 0{\cdot}809$, respectively). A small learning effect was seen with improvement in patient assessment (SWAT-A) in both groups ($P < 0{\cdot}001$)

ITU, intensive therapy unit; RCTs, randomized controlled trials.

TABLE 3. Surveillance, Communication, and Electronic Monitoring

RECOGNIZE—Recognizing Complications

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
Charlton et al[48]	2008	Literature review	IV	7 studies	Review of the literature describing nurse-patient interactions to determine best practice and enhance patient outcomes.	1995–2005	Patient-centered (biopsychosocial) communication incorporated into the NPs' practice is associated with improving patient outcomes such as (*a*) improved patient satisfaction, (*b*) increased adherence to treatment plans, and (*c*) improved patient health.
Shever et al[49]	2011	Retrospective cohort	IIb	N/A	Data extracted from clinical data suppositories to analyze "high dose" (nursing surveillance >12 times a day) and "low dose" (<12) with propensity scoring.	N/A	When nursing surveillance is performed an average of ≥12 times a day, there is a significant ($P = 0.0058$) decrease in the odds of experiencing failure to rescue (OR = 0.52) compared with when surveillance was delivered an average of <12 times a day.
Passot et al[50]	2017	Cross-sectional	III	666	Complication rates were compared before and after new standardized perioperative clinical pathway introduction for cytoreductive surgery.	2009–2014	Complication rates were similar before and after pathway introduction. FTR rate was 4.4% for entire study period but significantly decreased after pathway introduction (9.02% versus 1.02%, $P < 0.001$). However, on a multivariate analysis, renal complications were associated with failure to rescue.
Pyke et al[51]	2012	Observational pilot	IIb	N/A	Pulse oximeters with disposable fingertip probes are used to collect oxygen saturation and heart rate at a rate of one reading per second from all patients on the monitor. These data are aggregated in centralized vendor-configured servers, and the system has the capability to alert a patient's nurse via pager when patient physiologic data violate a preconfigured threshold. The PSS is currently in place in 7 units covering 175 patient beds, including both surgery and medicine services.	N/A	Successful use of physiological database composed of a patient monitoring system and a data storage system has described in a noncritical 36 bed surgical unit
Hravnak et al[52]	2008	Prospective, single-blind, observational	IIb	326 patients	Evaluation of all patients in a 24-bed step down unit in a university medical center. An IMS (BioSign; OBS Medical, Carmel, Indiana) was inserted into the standard noninvasive hardwired monitoring system and used heart rate, blood pressure, respiratory rate, and peripheral oxygen saturation by pulse oximetry to develop a single neural networked signal, or BioSign Index (BSI). Data were analyzed for cardiorespiratory instability according to BSI trigger value and local medical emergency team activation criteria. Staff were blinded to BSI data collected in 326 patients.	8 wk	Use of electronic monitoring equipment that incorporates neural networking and probabilistic modeling can reduce adverse events necessitating admission to intensive care facilities and overcome some of the problems of the actual implementation of EWS systems. All medical emergency team events were detected by the system in advance (mean = 6.3 h).
Jones et al[53]	2011	Retrospective, observational study with control	IIb	1481	Bedside electronic capture of observations and automated clinical alerts. Between baseline and intervention, 1481 consecutive patients were recruited generating 13,668 observation sets. There was a reduction in hospital LOS between the baseline and alert phase (9.7 d versus 6.9 d, $P < 0.001$). EWS accuracy improved from 81% to 100% with electronic calculation. Clinical attendance to patients with EWS 3, 4, or 5 increased from 29% at baseline to 78% with automated alerts ($P < 0.001$). For patients with an EWS > 5, clinical attendance increased from 67% at baseline to 96% with automatic alerts ($P < 0.001$).	N/A	Electronic recording of patient observations linked to a computer system that calculates patient risk and then issues automatic graded alerts can improve clinical attendance to unstable general medical ward patient

PSS, patient safety system.

surveillance is performed greater than or equal to 12 times a day compared with surveillance less than 12 times a day, there is a significant decrease in failure to rescue (OR = 0.52, $P = 0.0058$).[49]

Nursing style of communication can influence patient outcome, with more patient-centered communication methods leading to improved outcomes over more traditional biomedical styles.[48] (Biomedical styles are described as "*patriarchal, authoritative styles that focus only on signs and symptoms of patients' complaints,*" whereas biopsychosocial styles are described as encouraging the *"sharing of patients' ideas, establishing patients and providers as partners and the taking of patients' emotional and social environments into account."*) The introduction of perioperative standardized clinical pathways may help reinforce increased nursing surveillance and FTR rates with one study showing a ninefold reduction in FTR rates before and after pathway introduction (9.02% vs 1.02%, $P < 0.001$).[50]

Previous approaches to the evaluation and prevention of FTR have been limited to manual vital sign checks.[54] The application of continuous monitoring has the perceived benefits of immediate detection but also implies improved data collection and storage through the use of automated systems. The use of a physiological database composed of a patient monitoring system and a data storage system has been described in a noncritical 36-bed surgical unit.[51] Use of electronic monitoring equipment that incorporates neural networking and probabilistic modeling can reduce adverse events necessitating admission to intensive care facilities and overcome some of the problems of implementation of EWS systems.[52] Electronic EWS systems have been shown to improve doctors' attendance to patients that score above predefined thresholds and concurrently a reduced length of stay was observed in a mixed population of 1481 patients in a study in England.[53]

Medical Emergency and Rapid Response Teams

The importance of recognition is illustrated by the unanticipated results of a large multicenter randomized prospective study of medical emergency team (MET) or rapid response team (RRT) implementation (Table 4).[47] The implementation of these teams was expected to reduce complications and preempt admissions to the ICU. The study showed no significant reduction in a composite outcome of cardiac arrest, unplanned ICU admission, and unexpected death. The main criticism of the trial is that in many cases, deteriorating patients had not been recognized and the MET had not been called in time rather than the MET teams being ineffective per se.[55] Early recognition of deteriorating patients was seemingly central and cited as an important determinant of eventual outcome irrespective of subsequent intervention.

There is wide variation in RRT structure and process.[62] In 2014, it was shown in a survey-based study that intensivists used on RRTs ($P = 0.005$) and internists in the ICU ($P = 0.04$) are predictors of high performance and may be one strategy to improving FTR.[56] However, before this in 2012, Karvellas et al[57] found that as the MET team structure progressed from being ICU resident led to ICU attending-led to having a dedicated intensivist-led team, there was no accompanying decrease in hospital mortality or length of stay.[57] In the same year, Morris et al[58] compared outcomes between MET responses during the day (led by the ICU attending) and MET responses at night (led by a postgraduate year 2/3 resident) and found no difference in hospital outcomes. A retrospective review by Scherr et al[59] compared outcomes between RRTs led by an intensivist and one led by a nurse practitioner at 2 hospitals. No differences in outcomes were found. However, there was also no difference in outcomes before and after the implementation of their rapid response system, which could indicate a larger implementation problem beyond the skills of the team leader.[59] It has been suggested that the effects of an implemented RRT may not be seen until RRT calls reach a sufficient threshold and that short-term studies may underestimate the impact of MET/RRT systems.[60]

RELAY

Relaying Information About Complications

Relaying information regarding patient deterioration can involve different types of communication (Table 5). Intraprofessional communication between nursing staff relies on good working relationships with other colleagues. Fear of criticism may deter nursing staff from relaying potential concerns. A culture, which may be rigidly hierarchical, thus discouraging open communication, collaboration, or empowerment of junior staff, may lead to FTR.[71]

Interprofessional communication, such as that between the nursing staff and a junior doctor, has been shown to be associated with good surgical outcome as demonstrated in a study undertaken in 13 tertiary hospitals in the United States.[72] The nurse-physician relationship can be optimized in a number of ways including interactive multidisciplinary rounds, maintaining professional standards, and fostering constructive conflict resolution strategies.[64]

All staff should be empowered to challenge decisions without intimidation.[63] When evaluating surgical teams in 3 London hospitals, a paradox was observed where seniors were found to actively encourage escalation, whereas the juniors and nurses feared criticism, intimidation, and humiliation.[65] This finding coincides with internal medicine clinician experiences requesting senior support in one U.S. study.[66] Degradation or dilution of information (information relay from person to person) during the care process of surgical patients has been implicated in development of clinical adverse events.[67] It is likely to have implications for managing patients once complications are established, and thus, there is a need for emphasis on the importance of relaying information in a timely and faithful manner. Patients are exposed to significant harm because of poor escalation attempts, and interventions are required to improve this safety-critical process.

Reduction in perceived professional hierarchies can to some degree be achieved by using standardized communication protocols: the implementation of a "flattened hierarchy."[73] In a study of information transfer between attending and resident physicians regarding 80 unwell surgical patients, most attendings (76%) did not feel it necessary to involve their seniors; however, when seniors were involved, the management plan was altered in a third of cases.[69]

Tools such as "SBAR" can be used to assist staff in calling for help. SBAR is an acronym for Situation, Background, Assessment and Recommendation.[74] This tool allows for structured and succinct relay of salient information ending with expectations of when the respondent may arrive. The use of this tool has been shown to reduce order entry errors including duplicated, canceled, and wrong patient orders in a surgical setting when comparing general surgery residents before and after being taught how to practically implement SBAR.[68] Some centers have introduced "ISBAR" where introductions are placed at the start of the conversation to ensure that accurate identification of those participating in the handover and the patient is established.[75]

TABLE 4. Medical Emergency and Rapid Response Teams

RECOGNIZE—Recognizing Complications

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
Hillman et al[47]	2005	Cluster randomized controlled trial	I	23 hospitals	23 hospitals in Australia were randomized to a new Medical Emergency team system or to continue to function as normal. Primary outcome measures were cardiac arrest, unexpected death or unplanned ICU admission	6-mo post-MET activation	Introduction of the medical emergency team increased the overall calling incidence for an emergency team (3.1 versus 8.7 per 1000 admissions, $P = 0.0001$). During the study, we recorded similar incidence of the composite primary outcome in the control and MET hospitals (5.86 versus 5.31 per 1000 admissions, $P = 0.640$), as well as of the individual secondary outcomes (cardiac arrests, 1.64 versus 1.31, $P = 0.736$; unplanned ICU admissions, 4.68 versus 4.19, $P = 0.599$; and unexpected deaths, 1.18 versus 1.06, $P = 0.752$). A reduction in the rate of cardiac arrests ($P = 0.003$) and unexpected deaths ($P = 0.01$) was seen from baseline to the study period for both groups combined.
Buist et al[55]	2007	Retrospective audit	IV	400-bed hospital	Single-center audit after implementation of orientation program for first-year doctors, professional development course for medical registrars, and introduction of liaison ICU nurses.	6 y	Incidence of cardiac arrests decreased 24% per year, from 2.4/1000 admissions in 2000 to 0.66/1000 admissions in 2005
Wakeam et al[56]	2014	Cross-sectional survey	IV	67 hospitals	144 outlier hospitals with significantly better or worse performance than the national average. ICU directors and nurse managers were surveyed regarding physical structures, patient composition, staffing, care protocols, and RRTs.	N/A	After controlling for performance, proportion of Medicare patients and trauma center status; an intensivist on the RRT (adjusted OR =, 4.27, CI = 1.45–23.02, $P = 0.005$) and an internist on staff in the ICU (adjusted OR =, 2.13, $P = 0.04$) were predictors of high performance (lower FTR rate).
Karvellas et al[57]	2012	Case control	IIa	1920 patients	An evaluation of dedicated intensivist-led medical emergency teams in ICU. The after periods were analyzed: period 1 (control); period 2: (partial MET without dedicated intensivist); and (hospital-wide IL-MET).	2002–2009	During all 3 periods, there were no significant differences in length of stay or mortality (IL-MET versus non-IL-MET hours, $P > 0.1$ for all).
Morris et al[58]	2012	Retrospective observational	IV	1404 events	Single-center retrospective study of ICU attending and senior resident led medical emergency response teams. Where day shifts are led by an ICU attending and nights and weekends by a senior resident physician.	4 y	After RRT activation activation, no difference was noted between day and nights/weekend periods in the incidence of progression to cardiac arrest, transfer to ICU, or hospital mortality.
Scherr et al[59]	2012	Descriptive/ comparative	IV	255 patients	Comparison of 255 patients who received an RRT call compared with data from the previous year after including of nurse-led RRTs.	1 y	Patients who received an RRT call compared with the patient data for the previous year, no significant differences in the number of cardiorespiratory arrests, unplanned ICU admissions, and hospital mortality were found. In addition, no significant differences in patient outcomes were identified between the NP-led and intensivist physician-led RRT calls.
Moriarty et al[60]	2014	Longitudinal	IV	2 Canadian institutions	Evaluated the implementation of an RRT. Used a modified version of AHRQ FTR measure.	5 y	Reduction in the FTR rate was associated with a substantial increase in the number of RRT calls. Effects of RRT may not be seen until RRT calls reach a sufficient threshold.
Chen et al[61]	2016	Interrupted time series, population based	IV	9.7-m admissions in 232 hospitals	Evaluation of statewide standardized between-the-flags rapid response system, which uses a 5-component intervention strategy in New South Wales, Australia.	2007–2009 and 2010–2013	6.11% reduction in FTR rate (RR = 0.65, 95% CI = 0.62–0.69, $P < 0.001$) after introduction of Rapid Response Team.

TABLE 5. Relaying Information About Complications

RELAY

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up Period/ Search Period	Main Finding Demonstrated
Knaus et al[63]	1986	Cohort study	III	5030 patients in 13 tertiary hospitals	Patients were stratified by individual risk of death using diagnosis, indication for treatment, and APACHE II score. Actual and predicted death rates were compared using group results as the standard. Differences in results were related more to the interaction and coordination of each hospital's ICU staff than to the unit's administrative structure, amount of specialized treatment used, or the hospital's teaching status.	N/A	Degree of coordination of intensive care significantly influences its effectiveness, communication being a vital strand.
Schmalenberg et al[64]	2009	Literature review	IV	6 studies, 20,000 nurses	Review of the literature concerning nurse-physician relationship, in particular magnetism, autonomy, and work place structure.	N/A	The nurse-physician relationship can be optimized in a number of ways including interactive multidisciplinary rounds, maintaining professional standards, and fostering constructive conflict resolution strategies
Tabak et al[63]	2007	Cross-sectional survey	IV	17 nurses	Examined nurse tactics in conflict resolution with doctors and its effect on stress generation.	N/A	The integrating and dominance approaches to conflict resolution are associated with low occupational stress levels, whereas the obliging and avoidance approaches are linked to higher stress. There is evidence that the seniority and status of nurses affect both their choice of conflict-resolution tactics and the associated stress and job satisfaction level.
Johnston et al[65]	2014	Multicenter Qualitative	IV	41 subjects	Subjects submitted to semi structured interviews analyzed using grounded theory methodology surrounding the escalation process based on 5 themes.	N/A	A decision to escalate was based upon 5 themes, (1) patient, (2) individual, (3) team, (4) environmental, and (5) organizational factors. Supervision and escalation of care were problematic in all 3 hospitals, with unclear escalation protocols and poor availability of senior surgical staff the most common concerns. Transparent escalation protocols, increased senior clinician supervision, and communication skills training were highlighted as strategies to improve escalation of care.
Kennedy et al[66]	2009	Observational	IV	124 subjects	Physician subjects were observed during regular clinical activities and completed baseline interviews. After this, in-depth interviews were completed to probe influences on clinical decision making	216 h	Trainees perceived that requesting frequent/inappropriate support threatened their credibility and used rhetorical strategies to preserve credibility. These strategies included building a case for the importance of requests, saving requests for opportune moments, making a plan before requesting support, and targeting requests to specific team members.
Nagpal et al[67]	2010	Observational	IV	20 patients	Patients were followed through their entire surgical care case. Information and transfer was checked in 4 phases.	Patient discharge	Preprocedural teamwork and postoperative handover phases have the maximum number of information and transfer and communication failures (61.7% and 52.4%, respectively). It was also found that information degrades as it crosses from one phase to another. Of patients, 75% had clinical incidents or adverse events because of information transfer and communication failures
Telem et al[68]	2011	Cross-sectional survey	IV	45 general surgery residents	Evaluation of SBAR handover system into surgical curriculum	N/A	Most of the residents indicate that the SBAR curriculum addressed frequently encountered communication issues and taught clinically beneficial communication skills. A 2.3% decrease in pretraining and posttraining order entry errors (14.5% versus 12.2%, $P = 0.003$) was demonstrated. No difference was demonstrated in controls who did not undergo SBAR training (12.9% versus 13.6%, $P = 0.47$).
Elbardissi et al[69]	2009	Prospective observational	IV	80 critical patient events across 4 hospitals	Evaluation of surgical services with prospective collection of predefined surgical critical events and communications, patient interview, sporadic clinical questioning of junior clinicians and their escalation.	N/A	Of 80 critical patient events identified, 26 (33%) were not communicated to attending surgeons. Although residents felt that attending contact was unnecessary for safe patient care in 61 (76%) of these events, discussions with attending physicians changed management in 33% (18/54) of cases in which they occurred.
Parker et al[70]	2014	Observational, questionnaire based	IV	87 acute care nurses	An international study looking at RRT activation; the use of analytic decision making during problem identification was a constant for all nursing specialties and countries studied	N/A	Of the 87 nurses in this study, 70.1% (n = 61) used an analytic/intuitive decision-making model, 21.8% (n = 19) used an analytic decision-making model, and 8% (n = 7) used an intuitive decision-making model during RRT activation.

TABLE 6. Reacting to a Patient in Good Time With the Correct Evidence-Based Management

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
REACT							
Pronovost et al[35]	2005	Audit	IV	Single center—2 units	Implementation of an 8-step safety program in an ITU and SICU. Steps; (1) culture of safety assessment; (2) sciences of safety education; (3) staff identification of safety concerns; (4) senior executives adopt a unit; (5) improvements implemented from safety concerns; (6) efforts documented/ analyzed; (7) results shared; and (8) culture reassessment.	N/A	Safety culture improved post versus preintervention (35% to 52% in WICU and 35% to 67% in SICU). The implementation also saw length of stay reduced from 2 to 1 d and in ICU and 3 to 2 d in SICU ($P < 0.05$), with reduced medication errors and nursing turnover.
Neily et al[36]	2010	Retrospective cohort with contemporaneous control group	IIa	74 training facilities. 180,000 procedures.	Study date obtained from the VHA Surgical Quality Improvement Program. Mortality rate of change 1 y after facilities enrolled formalized medical team training program for operating room personnel on a national level was investigated.	2006–2008	Participation in the medical team training program was associated with lower surgical mortality. The risk-adjusted mortality rates at baseline were 17 per 1000 procedures per year for the trained facilities and 15 per 1000 procedures per year for the nontrained facilities
Silber et al[76]	2010	Retrospective cohort	III	4.5 million unique Medicare patients in 3065 hospitals	Aimed to determine association between aggressive treatment style and surgical outcomes. For elderly surgical patients, aggressive treatment style was not associated with significantly increased complications, but it was associated with significantly reduced odds of mortality and FTR.	2000–2005	Hospitals with more aggressive treatment styles are more likely to rescue surgical patients from complications than less aggressive hospitals. Odds ratio for complications in hospitals at the 75th percentile of aggressive treatment style compared with those at the 25th percentile (a U.S. $10,000 difference) was 1.01 (1.00–1.02), $P < 0.066$, whereas the odds of mortality was 0.94 (0.93–0.95), $P < 0.0001$, and for FTR, it was 0.93 (0.92–0.94), $P < 0.0001$.

SICU, Surgical Intensive Care Unit; VA, Veterans Affairs; WICU, Weinberg Intensive Care Unit.

REACT

Reacting to a Patient in Good Time and With Correct Evidence-Based Management

Once a complication has been relayed to the clinical team, there must be an appropriate reaction, both in timeliness, role designation (the seniority and the speciality) of the respondent, and the correct choice of management (Table 6). Once a plan is formulated, the team must react in an effective and meaningful manner within the limits and resources designated by the organization. Timely interventions including the administration of antibiotics in septic patients have been shown to significantly improve outcomes if given within specific time critical windows in septic patients.[77]

A hospital proactive attitude can be reflected in how much it spends, for how long it hospitalizes, and how many investigations or procedures it performs on patients in the last 2 years of their lives.[78] Hospitals with more aggressive treatment styles are more likely to rescue surgical patients from complications than less aggressive hospitals.[76]

RESOURCE

Appropriate Resource Should Be in Place to Deal With FTR

In the United States, hospitals who fully comply with safe practices (National Quality Forum) report lower FTR rates despite having higher rates of postoperative complications (Table 7). A cross-sectional analysis compared with hospitals with complete and partial NQF compliance. Hospitals with full NQF compliance were found to have an increased likelihood of diagnosing a complication after 6 high-risk operations (OR = 1.13, 95% CI = 1.03–1.25) but had a decreased likelihood of failure to rescue (OR = 0.82, 95% CI = 0.71–0.96) and decreased odds of mortality (OR = 0.80, 95% CI = 0.71–0.91).[79] Patients in teaching hospitals with high teaching intensity had better FTR rates when compared with lesser intensity teaching hospitals according to a study conducted in 3270 U.S. centers.[80] Specific causal factors that relate to this are unclear, but intensity of teaching may well be an important factor. Barriers to effective care can be mitigated by so called executive walk rounds where clinical team members regularly engage with executives to whom concerns or patient safety strategies can be discussed. Such methods have been described to improve the safety climate attitude of institutions.[81]

In a recent review of the impact of team improvement strategies in hospitals, many have been shown to have positive associations or improvements in subjective measures and measures of nontechnical skills.[82] However, as outcomes are reliant on a multitude of factors throughout the patient journey, it is likely that direct causal improvement because of team training exercises will always be difficult to demonstrate.

DISCUSSION

Mortality and FTR rates have significantly declined in all hospitals because its inception postoperative respiratory and septic complications are estimated to account for 22% of avoidable postoperative deaths. Estimated costs associated with postoperative respiratory and septic complications are U.S. $53,502 and $57,727, respectively, with a prolonged length of stay of 9 to 11 days.[2,4,30,83] Identifying sepsis early and applying effective and complete treatment are imperative in FTR. We have demonstrated undoubtedly that the earlier markers of sepsis are discovered, the better patient outcomes.[6,84–86] Similar findings have led to healthcare payers,

TABLE 7. Appropriate Resource Should be in Place to Deal With FTR

RESOURCE

Authors	Date	Study Type	Level of Evidence	Study Size	Study Overview	Follow-up/ Search Period	Main Finding Demonstrated
Brooke et al[79]	2012	Cross-sectional	IV	658 hospitals in 79,462 patients	This cross-sectional analysis compared with hospitals with complete and partial National Quality Forum compliance.	N/A	Hospitals with full NQF compliance were found to have an increased likelihood of diagnosing a complication after 6 high-risk operations (OR = 1.13, 95% CI = 1.03–1.25) but had a decreased likelihood of failure to rescue (OR = 0.82; 95% CI = 0.71–0.96), and decreased odds of mortality (OR = 0.80, 95% CI = 0.71–0.91)
Silber et al[80]	2009	Retrospective observational	IV	3270 hospitals	Investigated patient outcomes and teaching intensity using logistic regression models, with and without adjusting for hospital fixed and random effects.	N/A	Patients in teaching hospitals with high teaching intensity had better FTR rates when compared with lesser intensity of teaching hospitals. Combining all surgeries, compared with nonteaching hospitals, patients at very major teaching hospitals demonstrated a 15% lower odds of death ($P < 0.0001$), no difference in complications, and a 15% lower odds of death after complications (FTR, $P < 0.0001$).
Thomas et al[81]	2005	Randomized	I	23 clinical units, single site	Investigated the effectiveness of executive walk rounds in 23 clinical units at a single site. Care providers questioned surrounding concerns and risk and safety climate was assessed before and after the event.	N/A	When analyzed by exposure to EWRs, nurses in the control group who did not participate in EWRs (n = 198) had lower safety climate scores than nurses in the intervention group who did participate in an EWR session (n = 85, 74.88 versus 81.01, $P = 0.02$; 52.5% positive versus 72.9% positive).
Buljac-Samardzic et al[82]	2010	Systematic review	I	48 articles	Systematic review on interventions to improve team effectiveness and identify their "evidence-based" level	1990–2008	There are limited studies published with high quality evidence team effectiveness improvement interventions. These studies show that team training can improve the effectiveness of multidisciplinary teams in acute (hospital) care. Most studies found a positive association between the intervention and nontechnical team skills. The highest level of evidence was found in specific interventions such as simulation training.

NQF, National Quality Forum.

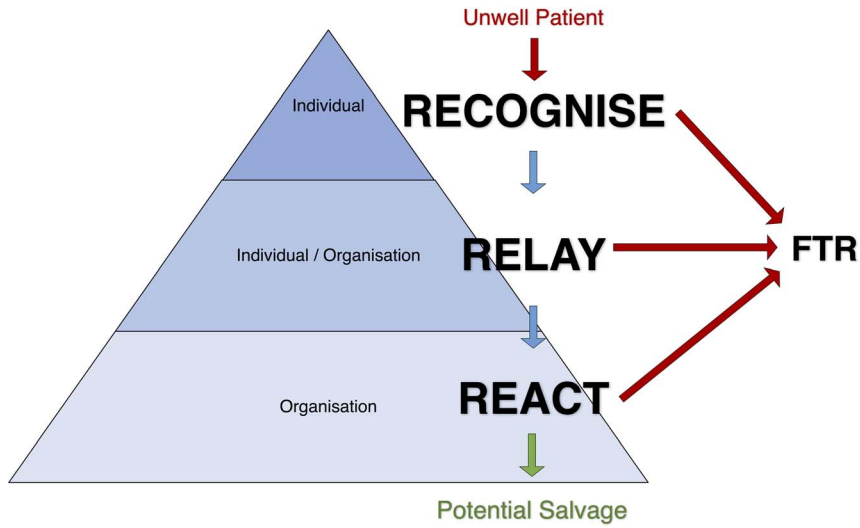

FIGURE 2. The 3Rs Paradigm Underpinning Failure to Rescue.

such as Medicare, reducing or withdrawing funding for never events and complications deemed to be avoidable.[87,88]

We have demonstrated that better nurse staffing is associated with lower FTR. However, above a certain nurse-patient ratio, FTR rates remain unaffected.[15] Beyond this point it, determination of FTR rate may be multifactorial and lie in the working environment or system, which individuals operate within. Current evidence has been unable to suggest where this point lies. The relationship between hospital complication rates and patient outcome is not straightforward. Current evidence suggests that complications occur at similar rates in comparable high- and low-mortality hospitals after major surgery[89] and that the difference between high- and low-mortality units seems not to be the complication frequency, but the capacity of a unit to respond to and manage these complications.[90,91] Differences in FTR rates between hospitals suggest variability in *how* complications are managed; thus, high FTR rates are undesirable. Barriers to rescue lie in the 3Rs and can occur in any tier (Fig. 2) with strong levels of evidence (Tables 1–7) in each of the 6 identified areas of intervention (Fig. 3).

Since the inception of End Results Cards,[92] there has been vast improvement in the quality of patient care. Some authors suggest that this is a direct result of the "Hawthorne effect," that of a "watched system."[93] Although this is almost certainly an

3Rs	Area of Intervention	Barriers Identified	Suggested Interventions Based on Current Evidence Base
RECOGNISE	**1. Staffing Levels & Education**	1.1 Recognition of antecedent signs or symptoms in a timely manner is likely to be central to patients surviving their complication and being 'rescued'.[15,18,21] 1.2 Adequate staffing of wards by well-trained nurses increase the chances of timely recognition of complications.[13,18,19,21]	A. Establish appropriate minimum physician and nurse staffing levels.[13,20,26] B. Improve work environments for healthcare staff. [21] C. Encourage and facilitate nursing staff to undertake post graduate degrees.[23,24] D. Implement minimum review times to reduce voids in care due to patient flow/turnover.[28]
	2. Detection, Early Warning Score Systems and Check Lists	2.1 Failure to recognise observations, signs and symptoms of deterioration.[28] 2.2 Lack of familiar, standardised early warning score system.[38,39]	E. Initiate Failure to Rescue training with formal teaching on effective utilisation of EWS.[38,39,91]
	3. Surveillance, Communication & Electronic Monitoring	3.1 Current lack of evidence of efficacy of electronic monitoring systems.[51,52] 3.2 Communication barriers between patients and healthcare professionals.[47]	F. Implement patient centric communication styles and communication training.[47] G. Consider implementation of electronic EWS systems.[51,52]
	4. Medical Emergency & Rapid Response Teams	4.1 Significant variations in the design and reporting of published METs/RRTs.[44,55,56,58,59]	H. METs/RRTs may be nurse led with a senior intensivist available to review upon the request.[44,55,56,58,59]
RELAY	**5. Relaying Information**	5.1 Lack of integration of handover/escalation tools such as SBAR.[70,92,93] 5.2 Lack of concordance in decision-making models used by nursing staff.[70,92,93]	I. Implementation of agreed escalation protocols Integration multidisciplinary teams into ward rounds.[70,92,93] J. Implement the use of SBAR and allied handover tools.[70,92,93]
REACT	**6. Reaction and response to a deteriorating patient**	6.1 Capability of the team, institution and resource to support necessary response to FTR.[33,34,74] 6.2 Institutional culture to investigation when recovery deviates from normal trajectory. E.g. 'threshold to scan'[75–78]	K. Implement agreed response times reflective of clinical severity of patient deterioration.[33,34,74] L. Implement team scenario based simulation.[78]

FIGURE 3. Barriers and interventions.

unavoidable confounder, the evidence suggests that our ability to recognize, relay, and react to a patient who is failing to rescue, both at an individual level and through the development of structural characteristics and alterations to safety cultures of healthcare organizations, is paramount to drive improvement in patient outcome and FTR.

CONCLUSIONS

Complications occur consistently within healthcare organizations. They represent a huge burden on patients, clinicians, and healthcare resources. Organizations vary in their ability to manage such events. Failure to rescue is a measure of institutional competence in this context. We propose "The 3 Rs of Failure to Rescue" of recognize, relay, and react and hope this serves as a valuable framework for understanding the phases where failure of patient salvage may occur. Future efforts at mitigating the differences in outcome from complication management between units may benefit from incorporating this proposed framework for quality improvement purposes.

Implications for Clinical Practice

By following the step-wise framework of *recognize*, *relay*, and *react*, with the correct resource, clinical teams and institutions can identify distinct steps in which improvement in service provision may be implemented and audited. This will allow for focused quality improvement.

Future Work

Future research should attempt to quantify the impact on outcomes from investment in improvements in recognition of the deteriorating patient, intraprofessional and interprofessional communications and appropriate clinical response. It is undertaken on a large scale in a properly controlled evaluation. This information would be invaluable in justifying potential additional resources and costs required to make positive impacts in rescuing failing patients.

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