Rapid response team diagnoses: frequencies and related hospital mortality

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ABSTRACT

Objectives: To describe the frequency and hospital mortality of problems (diagnoses) encountered by a rapid response team (RRT), and to identify the most common diagnoses for RRT triggers and for treating units.

Design: For each RRT event in 2015 at a tertiary hospital for adults, we chose the diagnosis that best explained the RRT event from a pre-defined list after reviewing relevant test results and clinical notes.

Results: There were 937 RRT events during 700 admissions and there were 58 different RRT diagnoses in 11 diagnosis groups. The largest groups were neurological and consciousness problems (22.9%), circulatory problems (19.0%) and breathing problems (16.0%). The most common diagnoses were rapid atrial fibrillation (7.6%) and oversedation or narcosis (4.8%). When Spo_2 < 90% triggered RRT review, the leading diagnoses were complex respiratory failure (25.9%) and pneumonia (11.4%). When decreased conscious state triggered review, the main problems were neurological, but there were 39 different diagnoses among these cases. The main problems among orthopaedic cases were post-operative hypovolaemia (19.0%) and spinal anaesthetic-related or epidural analgesic-related hypotension (15.2%). Hospital mortality was 101/700 (14.4%). Diagnoses with high mortality included gastrointestinal bleeding (4/17, 23.5%), complex respiratory failure (8/33, 24.2%), intracranial event (8/28, 28.6%), cardiogenic shock or acute heart failure (5/17, 29.4%), pneumonia (7/21, 33.3%), chest sepsis (5/11, 45.5%) and cardiac arrest (18/26, 69.2%).

Conclusions: The RRT activation trigger provides only a general indication of the diagnosis. Some problems appear preventable and could provide a focus for unit-based quality initiatives. The mortality of some diagnoses is substantial, and this may help in setting treatment goals, but more work is needed to understand the association of RRT diagnosis and outcome.

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The rapid response team (RRT) attends hospital patients who have abnormal clinical signs or whose condition is causing serious concern among hospital staff or visitors.[1] Although RRTs are now commonplace in hospitals in many countries,[2,3] the specific problems (diagnoses) they are required to identify and manage, and the frequency of these problems and their outcomes, have not been fully elucidated.[4]

RRT syndromes are broad categories of clinical problems and have been used as a framework for describing the causes of RRT calls.[5-8] Jones and colleagues analysed 400 medical emergency team (MET) calls at a tertiary hospital and identified five syndromes that precipitated MET review, the more common being hypoxia/increased respiratory rate, hypotension and altered conscious state. They reported an average of 1.3 syndromes per call.[6] Mullins and Psirides analysed 795 MET calls at a single hospital and identified 17 different underlying causes for these calls. These included neurological causes, cardiovascular failure and respiratory failure, and there was an average of 1.6 problems per call.[7] A multicentre study described the causes of RRT calls using a combination of the system activation criteria (eg, increased early warning score and staff concern) and broad diagnoses made by the attending RRT (eg, respiratory failure and cardiovascular failure). There were three or more causes in one-quarter of cases.[8] Information relating to RRT aetiology and outcome is limited to retrospective studies that compared cohorts of patients with selected RRT syndromes.[9,10] Downey and colleagues found that RRT callouts due to an acute change in conscious state had a significantly higher hospital mortality than those due to arrhythmia,[9] and Quach and colleagues found no difference in hospital mortality between cases of respiratory distress and cases of hypotension.[10]

During routine review of RRT cases at our institution, we had observed that within a particular syndrome or problem group, there could be a variety of more specific problems. For example, in relation to altered conscious state, some calls were due to narcosis, some to hypoglycaemia and others to intracranial bleeding. In 2014, drawing on the literature and our experience, we formulated a list of diagnoses. Our purpose was to enable the problems encountered by the hospital's RRT to be identified so as to better inform educational and quality initiatives and to shed light on patient outcomes. For each RRT event during 2015, the diagnosis that best explained the patient's presentation was chosen. Our main aims were to describe the frequency and hospital mortality of the diagnoses that the RRT encounters. Other aims were to identify the diagnoses for each of the most common RRT activation criteria and to identify the diagnoses for selected treating units.

Methods

Ethics approval

The project was approved by the St Vincent's Hospital Melbourne Human Research Ethics Committee (QA 022/16), and the requirement to obtain patient consent was waived.

The hospital and its rapid response system

The study was conducted at a university-affiliated tertiary referral hospital for adult patients in Melbourne, Australia. At the time of the study, the hospital had about 400 beds and provided a range of medical and surgical subspecialties, including cardiac surgery and neurosurgery, but did not provide major trauma services.

Since 2002 and throughout the study, two types of rapid response operated at the hospital (Respond MET and Respond Blue), and we included both in our analysis. These services were available 24 hours per day, 7 days per week. A single-parameter trigger system was used, rather than an aggregate, weighted scoring system (early warning score).

The Respond MET activation criteria were respiratory rate < 5 breaths/min or > 36 breaths/min; Spo_2 < 90% despite supplemental oxygen; heart rate < 40 beats/min or > 140 beats/min; systolic blood pressure (BP) < 90 mmHg; repeated or prolonged seizures; unexpected deterioration in conscious state; or serious staff concern. The Respond MET personnel were a medical registrar, an intensive care unit registrar and an ICU nurse.

The Respond Blue activation criteria were cardiac arrest, respiratory arrest or threatened airway. Respond Blue criteria were problems likely to require the assistance of personnel with advanced airway management skills, so the Respond Blue team consisted of the MET personnel and an anaesthetics registrar. Throughout the study period, ward observation charts incorporated features to alert staff when a patient's observations satisfied the criteria for clinical review (a ward-level response to less acute abnormal clinical signs) and for Respond MET and Respond Blue reviews (as described above).[11-13] We did not analyse cases of clinical review for this study.

Rapid response audit data

ICU registrars completed an audit form for every RRT event. The information collected included: date, time and location of the event; treating unit; reasons given by clinicians for activating the system, with the reasons classified according to the calling criteria; presence of a not-for-resuscitation (NFR) order before the event; occurrence of cardiac arrest and, if so, the initial arrest rhythm; interventions performed; outcome of the event (remained on ward, transferred to another specified area or died); and a free-form summary. Cardiac arrest was deemed to have occurred if the patient had clinical signs of cardiac arrest and was treated with cardiac compressions and/or electrical defibrillation. NFR meant that the patient was not to receive cardiopulmonary resuscitation (CPR) in the event of cardiopulmonary arrest.

Event review and diagnosis selection

Experienced ICU research nurses (R S, E F and J H) checked a log of calls to the hospital paging system to ensure that all events were identified. These nurses checked every audit form against the patient's medical records to ensure accuracy and completeness. This included review of test results, observation charts, resuscitation order forms and clinical notes. All events were then discussed with the medical director of the ICU (J S) during weekly meetings, when, after considering all the available information, the RRT diagnosis that best explained the patient's presentation was chosen by consensus. At the end of 2015, all events for the year were reviewed (by R S and J S) to ensure that like events had been coded alike. The diagnoses, with explanatory notes, are shown in Appendix 1 (online at cicm.org.au/Resources/Publications/Journal).

Administrative data

The hospital's administrative database was maintained by trained personnel to permit accurate reporting to government health authorities of the diagnoses and vital outcome of every hospital separation. Every separation was assigned a unique visit number in the RRT database, which enabled the number of RRT events within a hospital visit to be readily determined and facilitated linkage of RRT data to administrative data. The administrative data we analysed for this project included date and time of admission, date and time of discharge, ward of admission, ward of discharge and discharge destination.

A day case was defined as an admission to and discharge from a day ward (eg, for endoscopy, dialysis or chemotherapy) on the same calendar day. Admission for one night into the sleep disorders unit was also classified as a day case.

Study cohort

We analysed all RRT events for acute inpatients admitted and discharged in 2015. This did not include events for patients undergoing rehabilitation or receiving geriatric, psychiatric or palliative care because, compared with acute inpatients, these patients were in geographically separate parts of the hospital, had broadly different clinical care processes and goals and were subject to different administrative procedures.

Statistical analysis

Categorical variables are expressed as frequencies with percentages. Continuous variables were not normally distributed and are expressed as medians with inter-quartile

ranges (IQRs). To ensure there was no double-counting, we analysed hospital mortality for only the first RRT event of each admission. We calculated odds ratios (ORs) for hospital mortality using logistic regression and performed analyses using Stata, version 14.1 (StataCorp).

Results

Cohort size and event rates

There were 937 RRT events that occurred during 700 hospital admissions, and 35 involved cardiac arrest. Of these admissions, 154 patients (22.0%) had more than one event during their admission, including 18 who had four or more events. In total, there were 49 051 hospital admissions and, of these, 24 099 (49.1%) were day cases. Among the day cases, there were no RRT calls for cardiac arrest but there were 11 non-arrest RRT calls. The non-arrest call rate was 902/49 051 (18.4/1000 admissions) and the arrest call rate was 35/49 051 (0.7/1000 admissions). Excluding day cases, the non-arrest call rate was 891/24 952 (35.7/1000 admissions) and the arrest call rate was 35/24 952 (1.4/1000 admissions).

Characteristics of non-arrest cases

Characteristics of the 902 non-arrest RRT cases are shown in Table 1. Patients had a median age of 69 years, and there was a slight preponderance of males. The median hospital length of stay before the event was 3.5 days. Just over two-thirds of cases occurred outside usual work hours. Most events took place on an acute ward, but there was a moderate number in an investigation or procedure area (4.7%) and in the coronary care unit (CCU) (6.1%). Most units had patients who were attended by the RRT but the general medical unit had the largest proportion (20.0%), followed by the general surgical (11.5%) and neurosurgical (9.1%) units. The most common triggers for review (more than one trigger could be recorded) were systolic BP < 90 mmHg (29.8%), unexpected decrease in conscious state (25.3%) and Spo_2 < 90% despite supplementary oxygen (18.1%). There was a pre-existing NFR order in 14.9% of cases, and in another 2.5%, an NFR order was put in place at the time of the event or immediately afterwards. The event concluded with the transfer of the patient to another area in 19.4% of cases and the patient's death in 0.7% of cases.

Characteristics of cardiac arrests

Characteristics of the 35 cardiac arrest cases are also shown in Table 1. In a substantial proportion, the location of the arrest was not an acute ward. The CCU was the location for four (11.4%), and an investigation or procedure area for seven (20.0%). In some cases, the patient was not in cardiac arrest when the RRT was called, but arrest rapidly

Table 1. Characteristics of RRT non-arrest (*n* = 902) and arrest (*n* = 35) events

Characteristic	Non-arrest	Arrest*
Median age, years (IQR)	69 (54–78)	72 (64–77)
Men, *n* (%)	496 (55.0%)	24 (68.6%)
Pre-existing NFR order, *n* (%)	134 (14.9%)	2 (5.7%)
Median LOS before event, days† (IQR)	3.5 (1.1–8.1)	4.0 (1.1–8.8)
Outside usual work hours,‡ *n* (%)	605 (67.1%)	24 (68.6%)
Location, *n* (%)		
Acute ward	793 (87.9%)	22 (62.9%)
CCU	55 (6.1%)	4 (11.4%)
Investigation or procedure area	42 (4.7%)	7 (20.0%)
Other area	12 (1.3%)	2 (5.7%)
Treating unit, *n* (%)		
General medicine	180 (20.0%)	9 (25.7%)
Haematology and oncology	58 (6.4%)	2 (5.7%)
Renal	57 (6.3%)	3 (8.6%)
Cardiology	56 (6.2%)	11 (31.4%)
Other medical specialty	117 (13.0%)	2 (5.7%)
General surgical	104 (11.5%)	5 (14.3%)
Neurosurgical	82 (9.1%)	0
Orthopaedic	79 (8.8%)	0
Cardiothoracic	76 (8.4%)	2 (5.7%)
Other surgical specialty	93 (10.3%)	1 (2.9%)
Most common RRT trigger,§ *n* (%)		
Systolic BP < 90 mmHg	269 (29.8%)	4 (11.4%)
Unexpected ↓ in conscious state	228 (25.3%)	2 (5.7%)
Spo_2 < 90% despite supp. oxygen	163 (18.1%)	3 (8.6%)
Heart rate > 140 beats/min	145 (16.1%)	2 (5.7%)
Staff concern	116 (12.9%)	2 (5.7%)
Initial arrest rhythm VT or VF	–	10 (28.6%)
RRT-initiated investigations, *n* (%)		
Chest radiography	209 (23.2%)	8 (22.9%)
Computed tomography	107 (11.9%)	1 (2.9%)
RRT-initiated interventions, *n* (%)		
Endotracheal intubation	16 (1.8%)	16 (45.7%)
Inotrope or vasopressor	48 (5.3%)	24 (68.6%)
Anti-arrhythmic	82 (9.1%)	6 (17.1%)
Electrolyte	101 (11.2%)	5 (14.3%)
Frusemide	84 (9.3%)	1 (2.9%)
Glyceryl trinitrate	50 (5.5%)	0
Antimicrobial	63 (7.0%)	0
Corticosteroid	39 (4.3%)	0
Red blood cell transfusion	65 (7.2%)	4 (11.4%)
NFR order put in place	23 (2.5%)	5 (14.3%)
Event outcome, *n* (%)		
Remained at location	721 (79.9%)	14 (40.0%)
Transfer to ICU	110 (12.2%)	7 (20.0%)
Transfer to CCU	23 (2.5%)	2 (5.7%)
Transfer to OT/procedure room	26 (2.9%)	1 (2.9%)
Transfer to another area	16 (1.8%)	0
Died at the scene	6 (0.7%)	11 (31.4%)

RRT = rapid response team. IQR = interquartile range. NFR = not for resuscitation. LOS = length of stay. CCU = coronary care unit. BP = blood pressure. supp. = supplementary. VT = ventricular tachycardia. VF = ventricular fibrillation. ICU = intensive care unit. OT = operating theatre. * There were clinical signs of cardiac arrest and the patient was treated with cardiac compressions and/or electrical defibrillation. † Measured in minutes (admit date and time to event date and time). ‡ Mon–Fri before 8 am and after 6 pm; any time Sat and Sun. § > 1 trigger could apply to a single event.

Table 2. Events triggering rapid response team attendance (*n* = 937), by diagnosis group and by diagnosis

Diagnosis group and diagnosis	*n* (%)	Diagnosis group and diagnosis	*n* (%)
Airway	15 (1.6%)	Sepsis, non-septic SIRS	99 (10.6%)
Airway threatened (tracheostomy-related)	7 (0.7%)	Sepsis (abdominal)	16 (1.7%)
Airway threatened (excl. tracheostomy-related)	8 (0.9%)	Sepsis (chest)	19 (2.0%)
Breathing	150 (16.0%)	Sepsis (urinary)	17 (1.8%)
Atelectasis	6 (0.6%)	Sepsis (other, unknown)	40 (4.3%)
Macro-aspiration	8 (0.9%)	Non-septic SIRS	7 (0.7%)
Sputum retention	13 (1.4%)	Adverse reaction	11 (1.2%)
Pneumonia	29 (3.1%)	Adverse reaction (drug)	8 (0.9%)
COPD	10 (1.1%)	Adverse reaction (blood product)	3 (0.3%)
Hypoventilation	4 (0.4%)	Neurological, consciousness	215 (22.9%)
Fluid overload	22 (2.3%)	Seizures (known epilepsy)	16 (1.7%)
Complex respiratory failure	53 (5.7%)	Seizures (excl. known epilepsy)	29 (3.1%)
Other breathing problem	5 (0.5%)	Oversedation, narcosis	45 (4.8%)
Cardiac	106 (11.3%)	Delirium	30 (3.2%)
Angina	5 (0.5%)	Hypoglycaemia	7 (0.7%)
Acute coronary syndrome	5 (0.5%)	Metabolic encephalopathy	7 (0.7%)
Heart block, bradycardia (medication-related)	10 (1.1%)	Vasovagal	20 (2.1%)
Heart block, bradycardia (excl. medication-related)	19 (2.0%)	Intracranial event (eg, bleeding, hydrocephalus)	30 (3.2%)
Cardiac syncope	11 (1.2%)	Transient neurological change (known cause)	11 (1.2%)
Cardiogenic shock, acute heart failure	21 (2.2%)	Transient neurological change (unknown cause)	19 (2.0%)
Cardiac arrest	35 (3.7%)	Neurological problem (other)	1 (0.1%)
Tachyarrhythmia	106 (11.3%)	Pain, psychological	22 (2.3%)
Atrial fibrillation or atrial flutter	71 (7.6%)	Pain	8 (0.9%)
Supraventricular tachycardia	21 (2.2%)	Anxiety or panic attack	2 (0.2%)
Ventricular tachycardia	12 (1.3%)	Behavioural	8 (0.9%)
Tachyarrhythmia (other or unknown)	2 (0.2%)	Pseudoseizure	4 (0.4%)
Circulatory	178 (19.0%)	Death, dying	26 (2.8%)
Bleeding (gastrointestinal)	26 (2.8%)	Dying (pain or distress)	2 (0.2%)
Bleeding (excl. gastrointestinal)	21 (2.2%)	Dying (hypotension, hypoxia, decreased GCS)	18 (1.9%)
Hypovolaemia (post-operative)	30 (3.2%)	Died	6 (0.6%)
Hypovolaemia ¬(excl. post-operative)	44 (4.7%)	Falls, technical, other	9 (1.0%)
Hypotension (spinal anaesthesia, epidural analgesia)	25 (2.7%)	Fall	2 (0.2%)
Hypotension (medication-related)	20 (2.1%)	Technical	3 (0.3%)
Hypotension (other)	8 (0.9%)	Other, unknown	4 (0.4%)
Hypertension	4 (0.4%)		

excl. = excluding. COPD = chronic obstructive pulmonary disease. SIRS = systemic inflammatory response syndrome. GCS = Glasgow Coma Scale.

ensued. The initial arrest rhythm was amenable to electrical defibrillation in 10 cases (28.6%), transfer from the scene occurred in 10 cases (28.6%) and the patient died at the scene in 11 cases (31.4%).

Diagnosis groups

Diagnoses were arranged into 11 groups, with the frequency of each group shown in Table 2. The largest groups were problems of neurological origin and consciousness (22.9%), circulatory problems (19.0%), breathing problems (16.0%), cardiac problems (including arrest) (11.3%), tachyarrhythmia (11.3%) and sepsis or non-septic systemic inflammatory response syndrome (SIRS) (10.6%).

Diagnoses

There were 58 different diagnoses and the frequency of each diagnosis is shown in Table 2. There was a small number of cases in which the airway was threatened by a malpositioned or obstructed tracheostomy tube (0.7%), which represented just under half of all airway problems. The

most common breathing problem was complex respiratory failure (5.7%), in which two or more respiratory conditions were superimposed, followed by pneumonia (3.1%) and fluid overload (2.3%). After cardiac arrest (3.7%), the most common cardiac problem was cardiogenic shock or acute heart failure (2.2%).

The most common of any diagnosis was atrial fibrillation or atrial flutter (7.6%), but other tachyarrhythmia also occurred, including supraventricular tachycardia (2.2%) and ventricular tachycardia (1.3%). Of the circulatory problems, post-operative hypovolaemia (3.2%) and hypovolaemia in other contexts (4.7%) were the most common. There were moderate proportions of patients affected by gastrointestinal bleeding (2.8%), other bleeding (2.2%) and hypotension due to spinal anaesthesia or epidural analgesia (2.7%).

Sepsis of abdominal origin affected 1.7%, urinary origin 1.8%, chest origin 2.0% and the site of infection was other or unknown in 4.3% of patients. The few cases of non-septic SIRS (0.7%) were mostly pancreatitis or post-operative. There was a small proportion of adverse drug reactions (0.9%), and these were related to administration of antibiotics, radiocontrast, antipsychotic medications or iron.

Seizures were the most common problem of neurological origin and consciousness and occurred in patients with known epilepsy (1.7%) and in other situations (3.1%). Oversedation or narcosis was also common (4.8%) and in several instances was the result of patient self-administration. Another prominent diagnosis was delirium (3.2%). Among the intracranial events (3.2%), there was new or extended bleeding in nine cases, a new or extended stroke in nine and hydrocephalus in six. A vasovagal event was relatively common (2.1%) and was often precipitated by venepuncture or other invasive procedures, defecation or micturition. In a moderate proportion of cases, the cause of a transient change in neurological state could not be identified (2.0%), and there were several cases where a transient change in neurological state occurred with a stable underlying problem (1.2%).

Of the cases due to pain (0.9%), several were due to non-ischaemic chest pain. Psychological problems included behavioural disturbances (0.9%) and pseudoseizures (0.4%). Technical problems (0.3%) were due to misinterpretation of monitor output and equipment problems.

There was a small proportion of cases in which the patient had died (0.6%) and a moderate proportion in which the patient was dying and exhibiting terminal hypotension, hypoxia or altered conscious state (1.9%).

Triggers and diagnoses

Post-operative hypovolaemia (11.0%), other hypovolaemia (14.3%) and hypotension due to spinal anaesthesia or epidural analgesia (9.2%) were the leading diagnoses when systolic BP < 90 mmHg was a trigger for an RRT review (Table 3, A).

When an unexpected decrease in conscious state was a trigger, the most common problems were neurological, in particular oversedation or narcosis (15.7%), intracranial event (12.2%) and delirium (9.6%), but diagnoses also included sepsis of other or unknown origin (5.2%) and cardiac syncope (3.5%). There were 39 different diagnoses among the 230 cases in which an unexpected decrease in conscious state was a trigger (Table 3, B).

When Spo_2 < 90% was a trigger, the leading diagnoses were complex respiratory failure (25.9%), pneumonia (11.4%) and fluid overload (9.6%), but diagnoses from outside the breathing group were also seen, including sepsis of other or unknown origin (4.2%), cardiogenic shock or acute heart failure (3.0%) and oversedation or narcosis (3.0%) (Table 3, C).

Perhaps unsurprisingly, the most prominent diagnoses when heart rate > 140 beats/min was a trigger were atrial fibrillation or atrial flutter (45.6%), supraventricular tachycardia (14.3%) and ventricular tachycardia (8.2%), followed by sepsis problems and breathing problems (Table 3, D).

Units and diagnoses

The leading diagnoses for patients treated under the neurosurgical unit were broadly different to those under the orthopaedics unit, except for oversedation or narcosis, which featured in both groups (Table 3, E and Table 3, F). For patients under orthopaedics, post-operative hypovolaemia (19.0%), hypotension attributed to spinal anaesthesia or epidural analgesia (15.2%) and atrial fibrillation or atrial flutter (10.1%) were the main problems. Although neurological problems were the leading diagnoses for neurosurgical patients, a spectrum of other conditions was also encountered; 28 different diagnoses were applied to the 82 neurosurgical cases.

Hospital outcome

For the 700 admissions with an RRT attendance, the discharge destination was home for 344 (49.1%) and another health care facility (eg, rehabilitation, palliative care or another acute hospital) for 255 (36.4%). The number of patients recorded as having died was 101 (14.4%), and the total hospital mortality was 320/49 051 (0.7%; 6.5 deaths/1000 admissions).

Hospital mortality by diagnosis group

Hospital mortality of each diagnosis group is shown in Table 4. There were no hospital deaths recorded in some groups, including adverse reactions and pain and psychological problems. For groups with a recorded death, hospital mortality was lowest for tachyarrhythmia (4.9%), followed

Table 3. Diagnoses, by trigger for rapid response team attendence (A–D), and by treating unit (E, F)

A. Trigger, systolic blood pressure < 90 mmHg (*n* = 273)	*n* (%)	B. Trigger, unexpected decr. in conscious state (*n* = 230)	*n* (%)
Hypovolaemia (excluding post-operative)	39 (14.3%)	Oversedation or narcosis	36 (15.7%)
Hypovolaemia (post-operative)	30 (11.0%)	Intracranial event (eg, bleeding, hydrocephalus)	28 (12.2%)
Hypotension (spinal anaesthesia, epidural analgesia)	25 (9.2%)	Delirium	22 (9.6%)
Sepsis (other or unknown)	20 (7.3%)	Transient neurological change (unknown cause)	19 (8.3%)
Bleeding (gastrointestinal)	19 (7.0%)	Vasovagal	17 (7.4%)
Hypotension (medication-related)	17 (6.2%)	Sepsis (other, unknown)	12 (5.2%)
Cardiogenic shock or acute heart failure	15 (5.5%)	Transient neurological change (known cause)	11 (4.8%)
Bleeding (excluding gastrointestinal)	12 (4.4%)	Cardiac syncope	8 (3.5%)
Sepsis (abdominal)	12 (4.4%)	Dying (hypotension, hypoxia, decreased GCS score)	7 (3.0%)
Atrial fibrillation or atrial flutter	12 (4.4%)	Metabolic encephalopathy	6 (2.6%)
Sum of 20 other diagnoses	72 (26.4%)	Sum of 29 other diagnoses	64 (27.8%)
C. Trigger, Spo_2 < 90% despite supplementary O_2 (*n* = 166)	***n* (%)**	**D. Trigger, heart rate > 140 beats/min (*n* = 147)**	***n* (%)**
Complex respiratory failure	43 (25.9%)	Atrial fibrillation, atrial flutter	67 (45.6%)
Pneumonia	19 (11.4%)	Supraventricular tachycardia	21 (14.3%)
Fluid overload	16 (9.6%)	Ventricular tachycardia	12 (8.2%)
Sputum retention	10 (6.0%)	Complex respiratory failure	7 (4.8%)
Macro-aspiration	7 (4.2%)	Sepsis (chest)	7 (4.8%)
Sepsis (other or unknown)	7 (4.2%)	Sepsis (abdominal)	4 (2.7%)
Dying (hypotension, hypoxia, decreased GCS score)	6 (3.6%)	Sepsis (other or unknown)	4 (2.7%)
Atelectasis	5 (3.0%)	Atelectasis	3 (2.0%)
Cardiogenic shock or acute heart failure	5 (3.0%)	Fluid overload	2 (1.4%)
Oversedation or narcosis	5 (3.0%)	Chronic obstructive pulmonary disease	2 (1.4%)
Sum of 18 other diagnoses	43 (25.9%)	Sum of 15 other diagnoses	18 (12.2%)
E. Treating unit, neurosurgical (*n* = 82)	***n* (%)**	**F. Treating unit, orthopaedic (*n* = 79)**	***n* (%)**
Intracranial event (eg, bleeding, hydrocephalus)	13 (15.9%)	Hypovolaemia (post-operative)	15 (19.0%)
Oversedation or narcosis	8 (9.8%)	Hypotension (spinal anaesthesia, epidural analgesia)	12 (15.2%)
Seizures (excluding known epilepsy)	8 (9.8%)	Atrial fibrillation or atrial flutter	8 (10.1%)
Sepsis (other, unknown)	7 (8.5%)	Oversedation or narcosis	7 (8.9%)
Hypovolaemia (post-operative)	5 (6.1%)	Hypovolaemia (other)	6 (7.6%)
Sputum retention	5 (6.1%)	Bleeding (excluding gastrointestinal)	5 (6.3%)
Delirium	4 (4.9%)	Supraventricular tachycardia	4 (5.1%)
Hypotension (medication-related)	3 (3.7%)	Delirium	3 (3.8%)
Transient neurological change (known cause)	3 (3.7%)	Hypotension (other)	3 (3.8%)
Heart block, bradycardia (excluding medication-related)	2 (2.4%)	Cardiogenic shock, acute heart failure	2 (2.5%)
Sum of 18 other diagnoses	24 (29.3%)	Sum of 11 other diagnoses	14 (17.7%)

decr. = decrease. GCS = Glasgow Coma Scale.

by circulatory problems (6.4%), problems of neurological origin and consciousness (8.9%), airway problems (9.1%), sepsis and non-septic SIRS (16.9%), breathing problems (21.7%) and cardiac problems (including arrest) (30.8%), and was highest for death and dying (77.8%).

Compared with tachyarrhythmia, hospital mortality was not significantly higher for circulatory problems (OR, 1.3; P = 0.64), neurological and consciousness problems (OR, 1.9; P = 0.27) or airway problems (OR, 2.0; P = 0.57). Hospital mortality was significantly higher for sepsis and non-septic SIRS (OR, 4.0; P = 0.02), breathing problems (OR, 5.4; P = 0.003), cardiac problems (including arrest) (OR, 8.7; P < 0.001), and death and dying (OR, 68.3; P < 0.001) (Table 5). Hospital mortality was also significantly higher for breathing problems compared with circulatory problems (OR, 4.1; P = 0.001).

Table 4. Hospital mortality for first RRT event of hospital stay (*n*/*N* = 101 deaths/700 admissions [14.4%]), by diagnosis group and by diagnosis (deaths per number of cases)

Diagnosis group and diagnosis	*n*/*n* (%)	Diagnosis group and diagnosis	*n*/*n* (%)
Airway	1/11 (9.1%)	Sepsis, non-septic SIRS	12/71 (16.9%)
Airway threatened (excl. tracheostomy-related)	0/6	Sepsis (abdominal)	0/10
Airway threatened (tracheostomy-related)	1/5 (20.0%)	Sepsis (urinary)	0/13
Breathing	23/106 (21.7%)	Sepsis (other or unknown)	5/31 (16.1%)
Other breathing problem	0/4	Non-septic SIRS	2/6 (33.3%)
Atelectasis	0/5	Sepsis (chest)	5/11 (45.5%)
Fluid overload	1/19 (5.3%)	Adverse reaction	0/10
Sputum retention	1/7 (14.3%)	Adverse reaction (blood product)	0/3
Chronic obstructive pulmonary disease	2/9 (22.2%)	Adverse reaction (drug)	0/7
Complex respiratory failure	8/33 (24.2%)	Neurological, consciousness	14/158 (8.9%)
Pneumonia	7/21 (33.3%)	Neurological problem (other)	0
Macro-aspiration	2/5 (40.0%)	Hypoglycaemia	0/6
Hypoventilation	2/3 (66.7%)	Seizures (known epilepsy)	0/12
Cardiac	24/78 (30.8%)	Vasovagal	0/18
Angina	0/4	Oversedation, narcosis	0/29
Acute coronary syndrome	0/4	Seizures (excluding known epilepsy)	1/20 (5.0%)
Heart block, bradycardia (medication-related)	0/5	Transient neurological change (unknown cause)	1/16 (6.3%)
Cardiac syncope	0/8	Delirium	2/17 (11.8%)
Heart block, bradycardia (excl. medication-related)	1/14 (7.1%)	Transient neurological change (known cause)	1/7 (14.3%)
Cardiogenic shock, acute heart failure	5/17 (29.4%)	Metabolic encephalopathy	1/5 (20.0%)
Cardiac arrest	18/26 (69.2%)	Intracranial event (eg, bleeding, hydrocephalus)	8/28 (28.6%)
Tachyarrhythmia	4/82 (4.9%)	Pain, psychological	0/20
Tachyarrhythmia (other, unknown)	0/2	Anxiety, panic attack	0/2
Ventricular tachycardia	0/6	Pseudoseizure	0/4
Supraventricular tachycardia	0/12	Pain	0/6
Atrial fibrillation, atrial flutter	4/62 (6.5%)	Behavioural	0/8
Circulatory	9/141 (6.4%)	Death, dying	14/18 (77.8%)
Hypertension	0/3	Dying (pain or distress)	0/1
Bleeding (other than gastrointestinal)	0/14	Dying (hypotension, hypoxia, decr. GCS score)	9/12 (75.0%)
Hypotension (spinal anaesthesia, epidural analg.)	0/21	Died	5/5 (100.0%)
Hypovolaemia (post-operative)	0/25	Falls, technical, other	0/5
Hypotension (medication-related)	1/18 (5.6%)	Fall	0/1
Hypovolaemia (excl. post-operative)	2/35 (5.7%)	Technical	0/2
Bleeding (gastrointestinal)	4/17 (23.5%)	Other, unknown	0/2
Hypotension (other)	2/8 (25.0%)		

RRT = rapid reponse team. excl. = excluding. analg. = analgesia. SIRS = systemic inflammatory response syndrome. decr. = decreased. GCS = Glasgow Coma Scale.

Hospital mortality by diagnosis

The hospital mortality of each diagnosis is shown in Table 4. Hospital deaths were observed in relation to 27 of the 58 diagnoses, and 11 of these diagnoses accounted for over 75% of the deaths. Most of the diagnoses in the breathing problems group had a high proportion of patients who died in hospital, but, in other groups, including the cardiac problems group and the neurological and consciousness problems group, there were one or two diagnoses with a high mortality that contributed most of the deaths to the group.

Some of the less frequently encountered diagnoses had substantial mortality, including chronic obstructive pulmonary disease (2/9, 22.2%), non-septic SIRS (2/6, 33.3%), macro-aspiration (2/5, 40.0%) and hypoventilation (2/3, 66.7%). More frequently encountered diagnoses

Table 5. Hospital mortality, by diagnosis group (compared with tachyarrhythmia as reference)

Diagnostic group	*n/n* (%)	OR*	*P**	95% CI*
Tachyarrhythmia (reference)	4/82 (4.9%)	1.0	–	–
Circulatory	9/141 (6.4%)	1.3	0.64†	0.4–4.5
Neurological, consciousness	14/158 (8.9%)	1.9	0.27†	0.6–6.0
Airway	1/11 (9.1%)	2.0	0.57†	0.2–19.2
Sepsis, non-septic SIRS	12/71 (16.9%)	4.0	0.02	1.2–12.9
Breathing	23/106 (21.7%)	5.4	0.003	1.8–16.3
Cardiac (including arrest)	24/78 (30.8%)	8.7	< 0.001	2.8–26.4
Death, dying	14/18 (77.8%)	68.3	< 0.001	15.3–305.3

OR = odds ratio. SIRS = systemic inflammatory response syndrome. * Calculated using logistic regression. † Not statistically significant.

that had high mortality included gastrointestinal bleeding (4/17, 23.5%), complex respiratory failure (8/33, 24.2%), intracranial events (8/28, 28.6%), cardiogenic shock or acute heart failure (5/17, 29.4%), pneumonia (7/21, 33.3%), chest sepsis (5/11, 45.5%), cardiac arrest (18/26, 69.2%) and dying (terminal hypotension, hypoxia or altered Glasgow Coma Scale [GCS] score) (9/12, 75%).

Of the diagnoses when a patient died in hospital, the lowest mortality rate was for seizures (excluding known epilepsy) (1/20, 5.0%). Using this group as the baseline comparator, hospital mortality showed a trend towards significance for complex respiratory failure (OR, 6.1; P = 0.10), intracranial events (OR, 7.6; P = 0.07), cardiogenic shock (OR, 7.9; P = 0.07), non-septic SIRS (OR, 9.5; P = 0.09) and macro-aspiration (OR, 12.7; P = 0.06). Hospital mortality was significant for pneumonia (OR, 9.5; P = 0.045), chest sepsis (OR, 15.8; P = 0.02), hypoventilation (OR, 38.0; P = 0.02), cardiac arrest (OR, 42.8; P = 0.001) and dying (terminal hypotension, hypoxia or altered GCS score) (OR, 57.0; P = 0.001) (Table 6).

Hospital mortality and NFR

NFR meant that the patient was not to receive CPR in the event of cardiopulmonary arrest; this did not imply that the patient was necessarily actively dying. There were 116 patients (16.6%) who had an NFR order in place before their first RRT call or who had an NFR order instituted during or immediately after their first RRT call. The hospital discharge destination for these patients was home for 21 (18.1%) and another health care facility for 47 (40.5%); 48 of these patients (41.4%) died.

Table 6. Hospital mortality, by diagnosis (compared with seizures [excluding known epilepsy] as reference)

Diagnostic group	*n/n* (%)	OR*	*P**	95% CI*
Seizures, excluding known epilepsy (reference)	1/20 (5.0%)	1.0	–	–
Complex respiratory failure	8/33 (24.2%)	6.1	0.10†	0.7–52.9
Intracranial event (eg, bleeding, hydrocephalus)	8/28 (28.6%)	7.6	0.07†	0.9–66.7
Cardiogenic shock	5/17 (29.4%)	7.9	0.07†	0.8–76.3
Pneumonia	7/21 (33.3%)	9.5	0.045	1.0–86.3
Non-septic SIRS	2/6 (33.3%)	9.5	0.09†	0.7–132.0
Macro-aspiration	2/5 (40.0%)	12.7	0.06†	0.9–186.9
Sepsis (chest)	5/11 (45.5%)	15.8	0.02	1.5–163.5
Hypoventilation	2/3 (66.7%)	38.0	0.02	1.7–870.5
Cardiac arrest	18/26 (69.2%)	42.8	0.001	4.8–376.9
Dying (hypotension, hypoxia, decr. GCS)	9/12 (75.0%)	57.0	0.001	5.2–627.1

OR = odds ratio. SIRS = systemic inflammatory response syndrome. decr. = decreased. GCS = Glasgow Coma Scale. * Calculated using logistic regression. † A trend toward statistical significance.

Discussion

Summary of findings

For each of 937 consecutive RRT cases at a teaching hospital in 2015, the diagnosis that best explained the patient's RRT presentation was selected from a pre-defined list. There were 58 different diagnoses in 11 diagnosis groups. The group with the largest number of events was neurological and consciousness problems, followed by circulatory problems and then breathing problems. The most common diagnoses were rapid atrial fibrillation and oversedation or narcosis, and diagnoses covered a range of problems from obstructed or malpositioned tracheostomy tube to pseudoseizures. Cardiac arrest accounted for fewer than 4% of cases, and only 1% of cases were a cardiac arrest with a presenting rhythm amenable to electrical defibrillation. The trigger for RRT review provided only a general indication of the RRT diagnosis, particularly in relation to an unexpected decrease in conscious state. There were important differences between treating units in the diagnoses of their patients, and some diagnoses appeared to represent potentially preventable problems. Although there were 58 RRT diagnoses, just 11 of these accounted for more than three-quarters of hospital deaths for RRT patients. Several of the diagnoses in the breathing problems group had a substantial proportion of patients who died

in hospital. Relatively common diagnoses that had high mortality included complex respiratory failure, intracranial event, cardiogenic shock or acute heart failure, pneumonia, chest sepsis, cardiac arrest and dying (terminal hypotension, hypoxia or altered GCS score).

Comparison with previous studies

In contrast to earlier studies, only one diagnosis was selected for each RRT event. Jones and colleagues identified five MET syndromes, with an average of 1.3 syndromes per call. They reported over 30 different causes for the syndromes, with some causes, such as sepsis and hypovolaemia, implicated in several syndromes.[6] Mullins and Psirides identified 17 different problems at MET calls, with an average of 1.6 problems per call.[7] Despite differences in methodology, some findings are similar to those of earlier work. Like Mullins and Psirides,[7] the largest diagnosis group was neurological problems, followed by circulatory problems and breathing problems.

Identifying a single RRT diagnosis is not always straightforward. The diagnosis of complex respiratory failure recognises that the aetiology of respiratory failure is often multifactorial. It is also the case that one acute problem can arise from another acute problem; an example being rapid atrial fibrillation in sepsis. In this situation, rapid atrial fibrillation was selected as the diagnosis if the main focus of management was control of heart rate and rhythm, and sepsis was selected if there were signs of significant systemic inflammation and management included elements such as adjustment of antimicrobial therapy and fluid or vasopressor administration. The principle was to select the diagnosis that best explained the patient's presentation. This approach is probably the main reason why a diagnosis of sepsis was selected in 10% of cases in a recent study, when sepsis criteria were found to be present in the 24 hours before or 12 hours after RRT events in around 40% of cases.[14]

Earlier studies of RRT aetiology and outcome are limited to retrospective cohort studies that compared patients with selected RRT syndromes.[9,10] Downey and colleagues found that RRT cases due to an acute change in conscious state had significantly higher hospital mortality compared with cases due to arrhythmia,[9] but Quach and colleagues found no difference in hospital mortality between cases of respiratory distress and cases of hypotension.[10] Similarly to Downey and colleagues, we observed higher mortality in the neurological and consciousness problems group than in the tachyarrhythmia group, although this did not reach statistical significance. Within the neurological and consciousness problems group, we found that a diagnosis of an intracranial event had hospital mortality close to 30%, which was higher than for other diagnoses in the group and contributed the most deaths to the group. Unlike Quach and colleagues, we found that breathing problems were associated with higher mortality than were circulatory problems, but circulatory problems in our study did not include diagnoses of sepsis, SIRS or cardiogenic shock, and this might explain the lower mortality for circulatory problems in this study.

Implications for educators and policy makers

It is recognised that many patients attended by the RRT are approaching the end of life.[4,15,16] In our study, about 3% of RRT callouts were to patients who had died or were experiencing terminal physiological decline. These patients probably represented a failure on the part of the usual treating unit to recognise that death was approaching or to adequately plan for it. Patient safety and quality improvement is an integral component of rapid response systems.[1] The heads of treating units should be informed of the problems that give rise to RRT calls for patients in their care, especially when potentially preventable RRT attendances are identified, because this information could be used to guide quality improvement and educational activities. Post-operative hypovolaemia, oversedation or narcosis, spinal anaesthetic-related hypotension and medication-related bradycardia are further examples of relatively common problems we identified that might be preventable. We have observed investment of considerable resources in training RRT personnel to manage cardiac arrest. This training should not occur at the expense of training personnel to recognise and manage non-arrest problems, because non-arrest problems occur more frequently and are associated with considerable mortality. It is important to remember that more RRT patients die in hospital after a non-arrest problem than after a cardiac arrest.

Strengths, limitations and future research

Our study strengths included our robust procedures for data collection. ICU registrars completed an audit form for each event, the audit information and test results were carefully checked by a small group of research nurses, every case was discussed with the ICU director during weekly meetings, and there was a pre-defined list of diagnoses. This approach should lead to a high level of internal validity. A limitation of our study was its single-centre design; diagnoses and outcomes could be different at other hospitals. The non-arrest and arrest call rates that we observed were in keeping with a mature RRT system.[17] Although ours is the first study to describe the hospital mortality, in relation to their RRT diagnosis, of a large cohort of patients experiencing RRT callouts, we made no adjustment for patient comorbidity, duration of hospitalisation, pre-existing NFR order or other factors associated with a poor outcome,[18-20] and more work is needed to understand the association of RRT diagnosis and hospital mortality. Finally, the large proportion of patients

experiencing RRT callouts who were discharged from the acute hospital to another health care facility suggests that hospital mortality might not adequately reflect morbidity in this population, so study of other patient outcomes is also warranted.

Conclusions

Identifying a single RRT diagnosis is complex and requires considerable commitment. There is often more than one problem and it is often necessary to await results of investigations initiated by the RRT before the diagnosis can be made. The signs that trigger RRT review provide only a general indication of the main problem driving the event. Our findings may inform the training of RRT personnel, particularly in relation to understanding differential diagnoses of altered conscious state. Our findings may also provide a focus for educational and quality initiatives of treating units about common problems among patients in their care, some of which may be preventable. The hospital mortality associated with some diagnoses is substantial, especially in relation to breathing problems, and this knowledge is important as it may help in setting treatment goals. More work is needed to understand the association of RRT diagnoses and outcomes.

Competing interests

None declared.

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Appendix

This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Appendix 1. Rapid Response Team diagnoses

- **Airway**

Airway threatened (tracheostomy-related)
Examples include a blocked, dislodged or malpositioned tracheostomy tube**.**

Airway threatened (excluding tracheostomy-related)
The airway was threatened by some other problem. Examples include epistaxis or bleeding into the airway, compression of the airway from a haematoma, subcutaneous emphysema or ligature, obstruction of the airway by food or a foreign body, and swelling in the airway due to allergy, prolonged surgery or inhalation injury.

- **Breathing**

Atelectasis
Pulmonary atelectasis.

Macro-aspiration
Gross aspiration of food or vomit with soiling of the large airways, but without obstruction of the airway. It is different to aspiration pneumonia in that the main problem is soiling of the airways; aspiration pneumonia may or may not develop after macro-aspiration.

Sputum retention
Accumulation of airway secretions or plugging of sputum in the airways. It has been observed in patients with an impaired cough or with copious sputum or with particularly tenacious sputum.

Pneumonia
Infection of the lung parenchyma. Where there were also significant signs of systemic inflammation such as hypotension, high temperature or tachycardia, it should be classified as sepsis (chest).

COPD
Exacerbation of COPD.

Hypoventilation
It can occur in contexts including morbid obesity, obstructive sleep apnoea, severe chest wall deformity and advanced neuro-muscular disorders such as multiple sclerosis and muscular dystrophy. An elevated CO_2 and decreased GCS are common features; hypoxaemia can also occur. It is not the same as oversedation or narcosis.

Fluid overload
Contexts where this can arise include excessive fluid administration, blood transfusion, chronic heart failure and ischaemic heart disease. If it occurs in the context of an acute coronary artery problem it should be classified as an acute coronary syndrome. If it occurs in the context of cardiogenic shock it should be classified as cardiogenic shock.

Complex respiratory failure
Some combination of pneumonia, fluid overload, pleural effusion, pneumothorax, exacerbation of underlying pulmonary disease or another respiratory problem, and no one item could be identified as the main cause of the patient's deterioration.

Breathing (other)
Another breathing problem. Examples include exacerbation of asthma and pulmonary embolus.

- **Cardiac**

Angina
Pain due to myocardial ischaemia. Chest pain due to gastric reflux, pleurisy etc. is not angina.

Acute coronary syndrome
There was evidence of an acute problem with a coronary artery such as compelling ECG changes or a significant troponin rise. A small troponin rise after a period of hypotension or after a tachyarrhythmia is not sufficient to indicate an acute coronary syndrome.

Heart block or bradycardia (medication-related)
Examples include overdose of beta-blocking or antiarrhythmic drugs.

Heart block or bradycardia (excluding medication-related)
Examples include problems with mechanical pacemakers and problems with the patient's conduction system.

Cardiac syncope
Collapse or near collapse due to cardiac insufficiency as may occur in contexts such as severe cardiomyopathy and severe aortic stenosis.

Cardiogenic shock or acute heart failure
Acute deterioration in cardiac function resulting in compromised systemic organ perfusion.

Cardiac arrest
There were clinical signs of cardiac arrest and cardiac compressions and/or electrical defibrillation were provided.

- **Tachyarrhythmia**

When there is a tachyarrhythmia and there are also significant signs of another problem (e.g. sepsis, hypovolaemia, pulmonary embolus) the event could be classified according to that other problem. Choose the diagnosis that best explains the patient's presentation.

Atrial fibrillation (AF) or atrial flutter (AFl)
Examples of possible contexts include new-onset, paroxysmal and chronic where usual medications had been omitted.

Supraventricular tachycardia
Supraventricular tachycardia. It is not sinus tachycardia, AF or AFl.

Ventricular tachycardia
Ventricular tachycardia. If there was associated cardiac arrest the event should be classified as cardiac arrest.

Tachyarrhythmia (other or unknown)
There was another type of tachyarrhythmia or the mechanism of the tachyarrhythmia was unknown. Sinus tachycardia is usually a normal response to physiological stress and is not an arrhythmia. However, it could be regarded as a tachyarrhythmia if the rate is inappropriately high.

- **Circulatory**

Bleeding (gastrointestinal)
Gastrointestinal bleeding.

Bleeding (excluding gastrointestinal)
Examples include retroperitoneal bleeding and bleeding from an operation site.

Hypovolaemia (postoperative)
Inadequate blood volume in the postoperative period due to postoperative fluid shifts, fasting status or normal surgical blood loss.

Hypovolaemia (excluding postoperative)
Examples of contexts where it can occur include inadequate oral intake, anaemia without active bleeding, and large gastrointestinal losses.

Hypotension (spinal-anaesthesia-related or epidural-analgesia-related)
Hypotension that is due to the effects of spinal anaesthesia or epidural anaesthesia.

Hypotension (medication-related)
Examples include hypotension due to the effects of cardiovascular medications or analgesics. If the patient was over-sedated or narcotised the event should be classified as over-sedation or narcosis.

Hypotension (other)
Examples include postural hypotension and chronic hypotension.

Hypertension
The focus of management is on blood pressure control. If the hypertension was due to acute respiratory distress or to acute cardiac ischaemia or to an acute intra-cranial event or to severe pain it should be classified according to that problem.

- **Sepsis and non-septic SIRS**

Sepsis (abdominal)
Sepsis or septic shock arising from the abdomen, which includes the gut, liver, pancreas and gall bladder.

Sepsis (chest)
Sepsis or septic shock arising from the chest.

Sepsis (urinary)
Sepsis or septic shock arising from the urinary tract, which includes the bladder, prostate, ureters and kidneys.

Sepsis (other or unknown)
Sepsis or septic shock arising from another source or from an unknown source.

Non-septic SIRS
Non-septic SIRS can occur after a significant non-septic inflammatory insult. It may give rise to injury to organs, such as the kidneys and lungs. Vasopressors and/or respiratory support might be required.

- **Adverse Reactions**

Adverse reaction (drug)
The adverse reaction could be a histamine/anaphylactic/allergic-type reaction or some other adverse reaction, such as acute back pain or dyskinesia. Common precipitants are antibiotics, iron infusions, monoclonal antibodies, radiocontrast, metoclopramide and anti-psychotics.

Adverse reaction (blood product)
Common precipitants are packed cells, platelets and immunoglobulin.

- **Neurology & Consciousness**

Seizure (known epilepsy)
Seizures in a patient already diagnosed with epilepsy.

Seizure (excluding known epilepsy)
Seizures in a context other than known epilepsy. Examples of contexts include alcohol withdrawal, brain tumours, CNS infections and neurosurgery.

Oversedation or narcosis
Oversedation or narcosis due to medically-sanctioned or patient-initiated opiates or sedatives.

Delirium
The key feature is inattention. It can be agitated or hypoactive.

Hypoglycaemia
The blood glucose level is too low and brain function is impaired.

Metabolic encephalopathy
Accumulation of metabolic wastes or toxins and brain function is impaired.

Vasovagal
Slowing of the heart rate is a key characteristic. There is often pallor, dizziness, diaphoresis or nausea prior to transient loss of consciousness. Precipitants can include venepuncture, the sight of blood, painful or invasive procedures, sudden psychological or emotional stress, straining with micturition or defecation, prolonged sitting, prolonged standing and warm rooms. It is not the same as cardiac syncope, delirium or seizures.

Acute intracranial event
Examples include new or extended intracranial bleeding, new or extended stroke and new or extended hydrocephalus. Fluctuant GCS without a new or extended problem does not count.

Transient neurological change (known cause)
For example, there was fluctuant GCS in a patient who had had a stroke but there was no worsening or extension of the underlying stroke.

Transient neurological change (unknown cause)
There was a transient change in neurological signs but the cause was not clear.

Neurological problem (other)
There was another type of neurological problem.

- **Pain & Psychology**

Pain
Examples of contexts where pain can occur include chronic pain syndromes, post-operative pain and non-ischemic chest pain.

Anxiety or panic attack
Acute anxiety or panic attack.

Behavioural episode
Abnormal behaviour that is not due to organic pathology.

Pseudoseizure
Seizure-like behaviour.

- **Death & Dying**

Dying (pain or distress)
A dying patient in pain or distress.

Dying (terminal hypotension, hypoxia or altered GCS)
A dying patient experiencing terminal hypotension, hypoxia or altered conscious state.

Deceased
The patient was deceased and no attempt was made to resuscitate.

- **Falls, Technical & Other**

Fall

There was a ‘mechanical’ fall. Typically the patient will trip or stumble. It is not the same as collapse due to cardiac syncope or vasovagal syncope.

Technical

Possible examples include misinterpretation of monitor output and faulty equipment.

Other

There was some other problem.