# Early Management of Acute Medical Emergencies

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## Key Points

- Acute medical emergencies are those illnesses that can cause organ failures and death within minutes to hours of their presentation.
- These illnesses present with little warning, and affected patients are usually distressed, frightened, and often uncooperative.
- These episodes can occur in any hospital location, and the ability of available staff to deal with them may vary considerably. Given these circumstances, it is unsurprising that management errors occur, resulting in failures of care and poor outcomes.
- Effective, early management of acute medical emergencies requires prompt recognition, immediate correction of life-threatening physiological abnormalities, the methodical application of the Airway, Breathing, Circulation, Disability, and Exposure (ABCDE) approach, and rapid diagnosis and treatment of the underlying condition.
- Endocrine and metabolic disorders are common causes of acute medical emergencies.

## Introduction

Acute medical emergencies are those illnesses that can cause organ failures and death within minutes to hours of their presentation. These illnesses may present with little warning, and affected patients are usually distressed, frightened, and often uncooperative. These episodes can occur in any hospital location, and the ability of available staff to deal with them may vary considerably. Given these circumstances, it is unsurprising that management errors can occur, resulting in failures of care and poor outcomes (1). Effective, early management of acute medical emergencies requires prompt recognition, immediate correction of life-threatening physiological abnormalities and rapid diagnosis and treatment of the underlying condition. Endocrine and metabolic disorders are common causes of acute medical emergencies.

## Recognition of Medical Emergencies

Medical emergencies are usually recognized by clinical signs of severe cardiorespiratory or neurological insufficiency. In a large, multinational, observational study, serious physiological deterioration, most frequently
Table 1-1  Medical emergency: possible clinical signs

<table>
<thead>
<tr>
<th>Medical emergency</th>
<th>Clinical Signs</th>
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<tbody>
<tr>
<td>Skin</td>
<td>mottled; sweaty; cyanosis; warm and vasodilated or cold peripheries.</td>
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<tr>
<td>Neurological</td>
<td>agitation; confusion; depressed level of consciousness; seizures; localizing signs.</td>
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<tr>
<td>Respiratory</td>
<td>stridor; grunting; drooling; use of accessory muscles; tracheal tug; intercostal in-drawing; nasal flaring; respiratory rate (RR) &gt;25 breaths/min. or &lt;8 breaths/min.; audible wheeze or silent chest.</td>
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<tr>
<td>Cardiovascular</td>
<td>capillary refill time &gt;2 seconds; pulse &gt;150 beats/min. or &lt;50 beats/min.; low volume pulse; absent peripheral pulses; systolic blood pressure &lt;90 mmHg; mean arterial pressure (MAP) &lt;70 mmHg; postural hypotension; urine output &lt;0.5 ml/kg/hour or anuria.</td>
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hypotension and a fall in the Glasgow Coma Scale (GCS) score, was documented in 60% of patients prior to cardiac arrest, death, or intensive care unit (ICU) admission (2). Although the underlying diagnosis may initially be elusive, the clinical signs that accompany a medical emergency are readily identified, and include: tachycardia or bradycardia; hypotension; cold peripheries; oliguria; cyanosis; tachypnea or bradypnea; seizures; agitation; confusion; and coma (Table 1-1). These signs are usually detected by simple, bedside observations, such as pulse, blood pressure, respiratory rate, peripheral oxygen saturations, temperature, and conscious level. In the UK, these bedside observations have been used to develop a National Early Warning Score (NEWS). NEWS is derived by aggregating points assigned to increasing deviations from the normal range, in each observation (3). This score is linked to a graded response strategy, such that acutely ill patients who score highly are immediately reviewed by an appropriately trained, rapid-response-team (3). Although intuitively sensible, convincing evidence that rapid response systems like NEWS are effective in preventing adverse outcomes, such as death or intensive care admission is currently lacking (4–6). Deficiencies in rapid response systems include the facts that observations may not be reliably taken and scores miscalculated (7,8). Moreover, the sensitivity and specificity of the NEWS as a test for acute illness will be affected by patient-specific factors such as age, drug therapy, and comorbidity. For example, a severe gastrointestinal bleed may not cause a high NEWS in a previously hypertensive patient, treated with beta blockers because blood pressure and pulse rate may remain in the “normal range” despite significant hypovolemia. Recognition of the emergency nature of these sorts of presentations remains dependent on a high degree of clinical suspicion informed by clinical experience. Nonetheless, over recent years rapid response-systems have been adopted by hospitals worldwide as the default mechanism for the recognition and immediate management of deteriorating patients and medical emergencies (9). Recently, the Third International Consensus Definitions for Sepsis Taskforce have redefined sepsis as “life-threatening organ dysfunction due to a dysregulated host response to infection.” The taskforce recommended the quick-Sepsis-related Organ Failure Assessment (qSOFA) as a bedside prompt to identify patients with suspected infection who may have sepsis or septic shock (10). The qSOFA assigns one point for an altered mental status (GCS <15), a respiratory rate of ≥22 breaths per minute, and a systolic blood pressure of ≤100 mmHg. The score ranges from 0–3 points, and in a large, retrospective analysis of electronic health record encounters a qSOFA of ≥2 was associated with a greater risk of death or prolonged intensive care unit stay (11). Despite the taskforce’s recommendation, early evidence suggests that qSOFA may be inferior to the NEWS as a means of identifying patients at risk of deterioration (12). Once alerted to a medical emergency, the challenge to the responsible clinician is to make the diagnosis while providing supportive care, so that effective treatment can be administered. While most clinicians are familiar with the Airway, Breathing, and Circulation (ABC) approach, these activities may best be coordinated using an Airway,
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Breathing, Circulation, Disability, and Exposure (ABCDE) approach. Application of this approach at the bedside requires that the attending clinician organizes available staff into an effective team. This leadership role is largely understated in widely publicized resuscitation guidelines and yet is crucial to achieving good outcomes. Crisis resource management (CRM) has been defined as: “the ability to translate the knowledge of what needs to be done into effective treatment activity in the complex and real world of medical treatment” (13). It is important that clinicians managing medical emergencies are familiar with CRM principles and adhere to them whenever possible.

The ABCDE Approach

It is axiomatic that outcomes from medical emergencies are improved by early diagnosis and treatment. For example, prompt reperfusion can reduce infarct size and prolong life in myocardial infarction and stroke, while early, effective antibiotics improve survival in septic shock (14–16). However, before a diagnosis is reached, these patients may die from severe physiological disturbances, such as hypoxemia and shock (17). The ABCDE approach can be seen as a mechanism to preserve life, while a diagnosis is sought so that definitive treatment can be administered (18). The process starts at the bedside with a preliminary assessment of the patient’s general condition; this swift assessment focuses on the presence of clinical signs associated with life-threatening cardiorespiratory and/or neurological insufficiency (Table 1-1).

Much of this preliminary assessment can be completed by observation of the patient, inspection of the clinical observation charts, and brief discussion with the bedside nurse. At the conclusion of this assessment, it may be obvious that the patient is moribund or “peri-arrest” and that the “cardiac arrest” or the “rapid-response team” should be called. In the UK, the National Health Service (NHS) Institute for Innovation and Improvement has recommended the situation, background, assessment, and recommendation (SBAR) method for referring acutely ill patients (Table 1-2) (19). Regardless of the hospital system in place, once an emergency is recognized, assistance should be requested immediately. It is rarely the case that these situations can be effectively managed by a single practitioner. At this juncture, the team (or individual clinician awaiting the arrival of assistance) should establish basic monitoring (e.g., electrocardiography [ECG], pulse oximetry, and blood pressure), and calmly and methodically work through the ABCDE approach, correcting life-threatening physiological disturbances as they are discovered. Other measures, such as point-of-care blood glucose testing, should also be performed as clinically indicated.

Airway Assessment and Management

Upper airway obstruction (UAO) must be diagnosed and treated quickly; complete
obstruction will lead to cardiac arrest within minutes, while partial obstruction can impair ventilation and cause hypoxemia. UAO may be recognized by impaired or absent speech; stridor; grunting; drooling; severe respiratory distress; paradoxical chest wall movement (“see-saw” movements); prominent neck veins; facial swelling, and absent breath sounds. In general terms, the aim of management is to provide a secure, patent airway but specific therapy will be determined by the underlying cause.

When the diagnosis is obvious, interventions to clear and support the airway can proceed immediately. For example, oral-pharyngeal inspection and removal of an easily accessible foreign body or application of simple, airway-opening manoeuvres, such as a chin-lift or jaw-thrust, for coma. When the diagnosis is unclear, manipulation of the airway and insertion of airway adjuncts should be avoided as these interventions may precipitate complete UAO, for example, in the setting of epiglottitis. Generally, if conscious, patients with UAO should be allowed to assume the position that they find most comfortable to breathe in. Forcing these patients into the recovery or supine position can precipitate cardiac arrest. All patients with UAO should be assessed by an anaesthetist as endotracheal intubation is frequently required to definitively secure the airway. Occasionally the airway can only be secured by a surgical technique such as cricothyroidotomy or tracheostomy. Computed tomography (CT) of the neck and chest and/or flexible bronchoscopy may be required for diagnosis of the underlying cause of the UAO, but for safety, the airway should be secured prior to these investigations being undertaken.

Breathing Assessment and Management

Once the airway is deemed to be safe or secured, then breathing should be assessed for signs of respiratory insufficiency (Table 1–1). Auscultation is important both diagnostically and as a means to assess response to treatment; bronchial breath sounds may help confirm the diagnosis of pneumonia, while the detection of breath sounds, following drainage of a pneumothorax suggests that the lung has re-inflated.

Peripheral oxygen saturations should be routinely measured in all patients with respiratory distress and hypoxemia rapidly corrected. A wide variety of oxygen delivery devices are available, but in the setting of acute illness the most appropriate device to use is a non-rebreathing face mask with reservoir and one-way valve. When connected to wall oxygen at a flow rate of 15 L/minute, this device may provide an inspired oxygen concentration (FiO₂) of up to 90%. High-flow nasal oxygen therapy is increasingly being used postoperatively and in both ward-based and critical care areas. A number of commercial devices are available and provide high gas flow rates (up to 60 L/minute) of blended gas up to 100% oxygen (20). Gases are warmed and humidified increasing patient comfort and compliance, and the high flow rates generate a small degree of continuous positive airway pressure (CPAP). Expert consensus guidance suggests that in the setting of critical illness, oxygen saturation targets should generally be 94–98% (21). In some patients with chronic obstructive pulmonary disease (COPD) and carbon dioxide retention, supplemental oxygen therapy is associated with worsening hypercapnia and respiratory failure (22). In these patients, inspired oxygen should be titrated to achieve saturations of 88–92%, and non-invasive ventilation (NIV) considered (23).

Mechanical ventilation should be considered for those patients with reversible disease and persistent failure of oxygenation and/or ventilation (i.e., carbon dioxide clearance). NIV is particularly indicated in patients with COPD and respiratory acidosis (pH 7.25–7.35) and hypercapnic respiratory failure secondary to chest wall deformity or neuromuscular disease. It is important to recognize when a patient is failing on NIV and requires intubation and invasive mechanical ventilation, as delayed intubation in this setting is associated with worse outcomes (24,25). Generally, invasive ventilation (i.e., tracheal
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intubation), is indicated in those patients with respiratory failure and impaired consciousness or copious pulmonary secretions (23).

Circulatory Assessment and Management

Once appropriate steps have been taken to address any breathing difficulties, attention should be directed to the assessment and management of circulatory insufficiency (Table 1-1). Acute or chronic fluid loss is usually followed by peripheral vasoconstriction and a compensatory tachycardia in order to preserve perfusion of vital organs. There is a wide spectrum in the ability of patients to compensate for fluid loss; unsurprisingly, young, fit patients can compensate for greater fluid losses than older patients, particularly those with significant cardiovascular comorbidity. Typically, after 30–40% of circulating volume has been lost, decompensation occurs, manifested by marked hypotension and multi-organ dysfunction, characteristic of shock (17). Treatment of shock requires the restoration of an effective circulating blood volume to reverse decompensation and restore organ perfusion. This process depends on the diagnosis of the underlying condition so that specific therapies can be administered. A useful aide-memoire for the differential diagnosis of shock is to classify this condition into four groups according to the main mechanism of decompensation: (a) hypovolemia; (b) cardiogenic; (c) obstructive (e.g., pulmonary embolism, cardiac tamponade); or (d) distributive (e.g., sepsis, anaphylaxis) (17). In the setting of infection, patients with septic shock can be clinically identified by a vasopressor requirement to maintain a mean arterial pressure of 65 mmHg or greater and serum lactate level greater than 2 mmol/L in the absence of hypovolemia (10).

As always, accurate history is the most important determinant of the diagnosis, physical examination, aside from confirming the presence of a shock state, may be less rewarding; particularly in advanced disease. Patients with shock require urgent resuscitation, a useful mnemonic to describe the important components is the VIP rule: ventilate (oxygen administration), infuse (fluid resuscitation), and pump (administration of vasoactive agents) (17). Generally, patients with shock require intravenous (IV) fluid resuscitation; a caveat to this are those patients with pulmonary oedema as gas exchange may deteriorate in these individuals. If there is diagnostic uncertainty, a fluid challenge can be helpful in identifying those patients who are likely to be fluid-responsive. A fluid challenge can be delivered by administering 250 ml of IV fluid over 2 minutes; hypovolemic patients will show an improvement in their blood pressure and pulse rate (26).

There has been considerable debate in the literature as to the optimal resuscitation fluid – over the years, a variety of fluids, including crystalloids, colloids, and human albumin solutions, have been used and a number of problems identified. Current evidence would seem to support the use of balanced electrolyte solutions, such as Ringer’s lactate or Hartmann’s solution as appropriate first line resuscitation fluids. Regardless of the type of resuscitation fluid selected, frequent patient reassessment against relevant clinical end-points such as peripheral perfusion, pulse, blood pressure and urine output is essential so that therapy can be titrated and inadvertent fluid and electrolyte overload can be averted (27). Hyperlactatemia (>1.5 mmol/L) is also typically present in acute circulatory failure and can be monitored (17). Vasoactive drugs may be necessary if blood pressure and cardiac output remain low, these patients need to be transferred to the ICU for further management.

Disability Assessment and Management

Neurological dysfunction is frequently implicated in medical emergencies and is due either to primary neurological disease or arises as a consequence of non-neurological illnesses. For example, coma may arise as a consequence of an intracerebral hemorrhage,
severe hypoglycemia, severe hyponatremia, or severe circulatory shock. Disability refers to emergency neurological assessment and management and starts with a basic assessment of level of consciousness. AVPU and the GCS are two systems that standardize the assessment of consciousness. AVPU is simple to remember and apply: A = the patient is alert; V = the patient only responds to voice; P = the patient only responds to pain; and U = the patient is unresponsive. The Glasgow Coma Scale provides a more detailed description of consciousness in terms of eye opening, verbal response, and motor response and can be summarized using an aggregate numerical score ranging from 3, deeply unconscious, to 15, alert and cooperative. An individual patient is best described using the Glasgow Coma Scale rather than the score, which was originally designed for audit and research purposes (28). On the Glasgow Coma Scale, a patient is arbitrarily defined as being in a coma if they can perform no better than eye opening to pain (E2), incomprehensible sounds (V2), and withdraw to a painful stimulus (M4). Generally, if the GCS score is <8/15, or if the patient only responds to pain, or is unresponsive on the AVPU scale, the ability of the patient to maintain a patent airway might be impaired. This can cause partial airway obstruction, reduced ventilation, and an increased vulnerability to pulmonary aspiration. Adherence to the ABCDE approach should ensure that the airway is secured in these patients (see section on Airway above).

There is a wide differential diagnosis for coma and its evaluation requires a comprehensive history, general physical examination, and neurological assessment (Table 1-3).

**Exposure**

The ABCDE approach concludes with E = exposure, which is a prompt to complete a full physical examination. At this stage, life-threatening abnormalities have been addressed and the patient is better able to tolerate and cooperate with the demands of the examination.
Diagnostic errors usually arise because of over-reliance on pattern recognition and intuition rather than analytical reasoning. Diagnostic uncertainty should be managed by mental reversion to a highly analytical approach, rigorously analyzing available data against diagnostic hypotheses. In the setting of severe shock, the aide-memoire (i.e., hypovolemia; cardiogenic; obstructive; or distributive) provides the full range of diagnostic possibilities against which available clinical data can be analyzed.

Physical Examination
Physical examination is completed at the conclusion of the ABCDE approach, and is focused on those systems which are likely to be diagnostically helpful. For example, a comprehensive abdominal examination is essential in a patient with peritonitis and shock but not immediately required in a patient with an acute myocardial infarction. The physical examination should be modified to minimize patient exertion and the deleterious effects of re-positioning. It is important to note that breathing difficulties and hypoxemia are exacerbated by movement from the semi-recumbent to supine position, particularly in obese patients.

Investigations
These are guided by diagnostic impressions but basic blood tests such as arterial or venous blood gases, complete (full) blood counts, blood urea nitrogen (BUN) or urea, electrolytes, blood glucose, and blood cultures are usually helpful.

Illness severity can be assessed with a blood lactate; one prospective study reported an 83% mortality in patients with a blood lactate of $>5$ mmol/L (31); while bedside investigations such as ECG, plain radiology, ultrasound, and echocardiography may be diagnostic.
It may be necessary to transfer patients for other tests such as CT. In these circumstances patients should be stabilized (as much as possible), and the transfers undertaken by suitably trained personnel. It is important to consider the risks and benefits of all investigations, as over-investigation may delay definitive treatment.

**Treatment**

Generally medical emergencies will be managed in an emergency department, acute medical unit (AMU) or equivalent, as well as more advanced step-up facilities such as high dependency unit (HDU), or ICU. Many therapies, such as blood and blood products, drugs (e.g., antimicrobials, antiplatelet agents, analgesics, diuretics), and, of course, oxygen and IV fluid, should be given at the bedside prior to transfer to HDU or ICU if required. International guidelines have recommended the administration of broad-spectrum antibiotics within one hour of recognizing sepsis or septic shock (32). Definitive management of this condition may require surgical, source control (e.g., drainage of an abscess or resection of ischemic bowel).

ICU admission is indicated for patients who require organ support, most commonly mechanical ventilation and close nursing observation. The decision to admit a patient to the ICU is informed primarily by clinical factors, such as the potential reversibility of the illness, and the wishes of the patient or their surrogates. Old age in itself is not a reason to refuse ICU admission but old age undoubtedly reduces physiological reserve and is more likely to be accompanied by serious comorbidity. Severity of illness scoring systems such as the acute physiology and chronic health evaluation II (APACHE II) and the simplified acute physiology score (SAPS) are used to estimate hospital mortality for groups of patients and cannot be used to predict individual outcomes. Moreover, these systems do not provide any information about longer-term survival, for example, 6–12 months following critical illness, or quality of life or functional status. Frailty is a multifaceted syndrome characterized by a demise in physical and cognitive reserves and increasing vulnerability (33). Although yet to be evaluated in critically ill patients, it has been suggested that clinical measures of frailty, may help identify those elderly patients who would most benefit from ICU admission (34).

Medical emergencies should not be confused with the natural process of dying, the distinction is not always straightforward, but where there is clear evidence of terminal illness, such as advanced cancer, the treatment imperatives are comfort and dignity not aggressive resuscitation.

**Conclusions**

Acute medical emergencies can arise at any time and effective early management depends on prompt recognition, good teamwork, and the methodical application of the ABCDE approach.

**References**

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