CHAPTER 1
Patients at Risk

By the end of this chapter you will be able to:

- Define resuscitation
- Recognise the importance of the generic altered physiology that accompanies acute illness
- Know that early recognition and management improves outcomes
- Know how to assess and manage an acutely ill patient using the ABCDE system
- Understand the benefits and limitations of intensive care
- Know how to communicate effectively with colleagues about acutely ill patients
- Have a context for the chapters that follow

What is Resuscitation?

When we talk about 'resuscitation' we often think of cardio-pulmonary resuscitation (CPR). CPR is a significant part of healthcare training. International organisations govern resuscitation protocols. Yet, survival to discharge after in-hospital CPR is poor, around 50% if the rhythm is shockable and 10–14% if the rhythm is non-shockable.[1] Public perception of CPR is often informed by television which has far better outcomes than in reality.[2]

A great deal of attention and training is focussed on saving life after cardiac arrest. But the majority of in-hospital cardiac arrests are predictable and preventable. Until the last few decades, hardly any attention was focussed on detecting commonplace reversible physiological deterioration and in preventing cardiac arrest in the first place. Now, we have early warning scores and medical emergency teams – but there still remain problems with the early recognition and management of sick patients in hospital.

In a study published in 1990, 84% of patients had documented observations of clinical deterioration or new complaints within 8 hours of cardio-pulmonary arrest and 70% had either deterioration in respiratory or mental function observed during this time.[3] While

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there did not appear to be any single reproducible warning signs, the average respiratory rate of the patients prior to arrest was 30/min. The investigators observed that the predominantly respiratory and metabolic derangements which preceded cardiac arrest (hypoxaemia, hypotension, and acidosis) were not rapidly fatal and that efforts to predict and prevent arrest would therefore be beneficial. Only 8% patients survived to discharge after CPR. A subsequent similar study observed that documented physiological deterioration occurred within 6 hours in 66% of patients with cardiac arrest, but effective action was often not taken.[4]

Researchers have commented that there appears to be a failure of *systems* to recognise and effectively intervene when patients in hospital deteriorate. A study by McQuillan et al. looked at 100 consecutive emergency ICU admissions.[5] Two external assessors found that only 20 cases were well managed beforehand. The majority (54) received suboptimal care prior to admission to the ICU and there was disagreement over the remaining 26 cases. The patients were of a similar case-mix and APACHE (acute physiological and chronic health evaluation) scores. In the suboptimal group, ICU admission was considered late in 69% cases and avoidable in up to 41%. The main causes of suboptimal care were considered to be failure of organisation, lack of knowledge, failure to appreciate the clinical urgency, lack of supervision, and failure to seek advice. Suboptimal care (failure to adequately manage the airway, oxygen therapy, breathing, and circulation) was equally likely on a surgical or medical ward and contributed to the subsequent mortality of one-third of patients. The authors wrote: 'This...suggests a fundamental problem of failure to appreciate that airway, breathing and circulation are the prerequisites of life and that their dysfunction are the common denominators of death'. Another study of adult general ward patients admitted to the ICU or dying unexpectedly found that both ICU and hospital mortality was significantly increased in patients who had received suboptimal care beforehand (52% vs 35% and 65% vs 42%, respectively).[6] Similar findings have been reported in other studies.

Although things may have improved, these problems have not gone away. The UK National Confidential Enquiry into Patient Outcome and Death (NCEPOD) published a report in 2018: 'Themes and recommendations common to all hospital specialties'.[7] The report stated that:

> Deficiencies in the recognition of ill patients have been identified for many years and the care of the acutely ill hospitalised patient presents ongoing problems for healthcare services. Deficiencies are often related to poor management of simple aspects of acute care – those involving the patient's airway, breathing and circulation, oxygen therapy, fluid balance and monitoring. Other contributory factors highlighted in many NCEPOD reports include organisational failures, such as a lack of knowledge, failure to appreciate the clinical urgency of a situation, a lack of supervision, failure to seek advice, delayed response and poor communication.

A number of studies have showed that simple physiological observations can identify high-risk hospital in-patients[8,9] and implementing a system whereby junior staff are obliged to

call for help when there are seriously abnormal vital signs improves outcomes for patients and utilisation of intensive care resources.[10,11]

Resuscitation is therefore not only about CPR. It is about recognising and effectively treating patients in reversible physiological decline. This is an area of medicine that is often neglected outside critical care areas in terms of training, organisation, and resources.

Medical Emergency Teams

Medical emergency teams (METs) were developed in Australia and consist of doctors and nurses trained in advanced resuscitation skills. The idea is that seriously abnormal vital signs trigger an emergency call rather than waiting for cardio-pulmonary arrest to trigger an emergency response. Box 1.1 shows the original MET calling criteria. In the UK, early warning scores have been developed to trigger urgent responses (see Table 1.1), usually to the patient's own team or the ICU outreach team. The purpose of a medical emergency team instead of a cardiac arrest team is simple – early action saves lives. As one of the pioneers of resuscitation commented, 'The most sophisticated Intensive Care often becomes unnecessarily expensive terminal care when the pre-ICU system fails'.[13]

Early experience in the UK suggested that medical emergency teams instead of cardiac arrest teams reduced ICU mortality and the number of cardiac arrests, partly through an increase in 'do not attempt CPR' orders.[11] In 1999, the report 'Critical to Success – the place of efficient and effective critical care services within the acute hospital'[14] re-emphasised

Box 1.1 MET Calling Criteria

Airway
If threatened

Breathing
All respiratory arrests
Respiratory rate <5/ min or >36/ min

Circulation
All cardiac arrests
Pulse rate <40/min or >140/min
Systolic blood pressure <90 mmHg

Neurology
Sudden fall in level of consciousness
Repeated or extended seizures

Other
Any patient you are seriously worried about that does not fit the above criteria

Source: Reproduced with permission by Prof Ken Hillman, University of New South Wales, Division of Critical Care, Liverpool Hospital, Sydney, Australia.

Table 1.1 UK National Early Warning Score (NEWS2).

Physiological Parameter	3	2	1	0	1	2	3
Respiratory rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

CVPU = *c*onfused, responds to *v*oice, responds to *p*ain, *u*nresponsive.
Use SpO_2 Scale 2 if target saturations are 88–92% under the direction of a qualified clinician.
Each observation has a score. The total score determines the potential clinical risk and what should happen next. Higher scores also mandate closer monitoring:

- Total score 0–4: low risk, ward-based response
- Score 3 in any single parameter: low–medium risk, urgent ward-based response
- Total score 5–6: medium risk, urgent response by a team with competence in the assessment and management of acutely ill patients and in recognising when the escalation to a critical care team is appropriate
- Total score 7 or more: high risk, urgent response by a team which must include staff with critical care skills, including airway management.

Source: Reproduced with permission from Royal College of Physicians.[12]

Table 1.2 UK severity of illness classification.

Level 0	Patients whose needs can be met through normal ward care in an acute hospital
Level 1	Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team
Level 2	Patients requiring more detailed observation or intervention including support for a single failing organ system or post-operative care and those stepping down from higher levels of care
Level 3	Patients requiring advanced respiratory support alone or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure

Level 2 is equivalent to HDU care.
Level 3 is equivalent to ICU care.
Source: Reproduced with permission from the Department of Health.[15]

the concept of the patient at risk, advocating for better training of medical and nursing staff and 'outreach' critical care. The report commented that intensive care is something that tends to happen within four walls, but that patients should not be defined by what bed they occupy, but by their severity of illness (see Table 1.2).

Following this, 'Comprehensive Critical Care – a review of adult critical care services'[15] was published and reiterated the idea that patients should be classified according to their severity of illness and the necessary resources mobilised. With this report came funding for critical care outreach teams and an expansion in critical care beds. In the USA and parts of Europe, there is considerable provision of level 1 and 2 facilities. In most UK hospitals it is recognised that there are not enough[16,17] even with the 10% increase in critical care beds that has taken place in England between 2011 and 2018.[18]

Although there are many different variations of early warning scores in use, it is probably the recognition of abnormal physiology, however measured, and a protocol that requires inexperienced staff to call for help that makes a difference, rather than the score itself. Patients at particular risk are recent emergency admissions, after major surgery, and following discharge from intensive care.

Do Early Warning Scores and Medical Emergency Teams Make a Difference?

Early warning scores are based on the use of aggregate weighting scoring systems, whereas the original MET calling criteria were based on single parameters, including the concern of 'worried' ward staff. The idea behind these trigger systems is very simple: patients often have a prolonged period of physiological instability prior to admission to the ICU, and the earlier this can be identified, the better the overall outcome.

There does not seem to be evidence that implementation of a single parameter trigger system alone improves patient outcomes, but there is evidence that the introduction of aggregate weighting scoring systems (e.g. NEWS2) improves survival and reduces unplanned ICU admissions and cardiac arrests. Likewise, when compared with standard care, medical emergency teams improve hospital survival, reduce unplanned ICU admissions, and reduce cardiac arrests, although their effect on hospital length of stay and ICU mortality remains unclear.[19]

The UK has focussed on identifying the deteriorating patient using aggregate weighting scoring systems, but the response to patients identified as being sick requires significant improvements. In Australia, where medical emergency teams are established, the identification of deteriorating patients using a single parameter trigger system has been less successful. Overall, for a rapid response system to be effective, it appears that a whole system approach is needed which includes trigger systems that identify deteriorating patients, clinician-led medical emergency teams, and continuing education programmes.

ABCDE – An Overview

History, examination, differential diagnosis followed by treatment will not immediately help someone who is critically ill. Diagnosis is irrelevant when the things that kill first are literally A (airway compromise), B (breathing problems), and C (circulation problems) – in that order. What the patient needs is resuscitation not deliberation.

Box 1.2 Markers of Severe Illness

Physiological

- Signs of sympathetic activation e.g. tachycardia, hypertension, pale, shut down
- Signs of hypoperfusion (see Chapter 5)
- Signs of organ failure (see Chapter 6)

Biochemical

- Metabolic (lactic) acidosis
- High or low white cell count
- Low platelet count
- High creatinine
- High C-reactive protein (CRP)

Patients can be alert and 'look' well from the end of the bed, but the clue is often in objective vital signs and key test results. Box 1.2 summarises the physiological and biochemical markers of severe illness. A common theme in studies is the inability of hospital staff to recognise when a patient is at risk of deterioration, even when these abnormalities are documented.

The most common abnormalities before cardiac arrest are hypoxaemia with an increased respiratory rate and hypotension leading to hypoperfusion with an accompanying metabolic acidosis and tissue hypoxia. If this is left untreated, a downward physiological spiral ensues. With time, these abnormalities may become resistant to treatment with fluids and drugs. Therefore, early action is vital. The following chapters teach the theory behind ABCDE in more detail. Practical courses also exist which use scenario-based teaching on how to manage patients at risk (see further resources). These are recommended because the ABCDE approach described below requires practical skills (e.g. assessment and management of the airway) which cannot be learned adequately from a book.

ABCDE is the initial approach to any patient who is acutely ill:

- A – assess airway and treat if needed
- B – assess breathing and treat if needed
- C – assess circulation and treat if needed
- D – assess disability and treat if needed
- E – expose and examine patient fully once A, B, C, and D are stable. Further information gathering and tests can be done at this stage
- *Do not move on* without treating an abnormality. For example, there is no point in doing an arterial blood gas on a patient with an airway obstruction

A more detailed version of the ABCDE system is shown in Box 1.3.

Patients with serious abnormal vital signs are an emergency. The management of such patients requires proactivity, a sense of urgency, and the continuous presence of the

Box 1.3 The ABCDE System

Airway
Examine for signs of upper airway obstruction
If necessary, do a head tilt-chin lift manoeuvre
Suction (only what you can see)
Simple airway adjuncts may be needed
Give oxygen if needed (see Chapter 2 for more details)

Breathing
Look at the chest
Assess rate, depth, and symmetry of movement
Measure SpO_2
Quickly listen with a stethoscope (for air entry, wheeze, crackles)
You may need to use a bag and mask if the patient has inadequate ventilation
Treat wheeze, pneumothorax, fluid, collapse, infection, etc. (is a physiotherapist needed?)

Circulation
Assess limb temperature, capillary refill time, blood pressure, pulse, urine output
Insert a large bore cannula and send blood for tests
Give a fluid challenge if needed (see Chapter 5 for more details)

Disability
Make a note of the AVPU scale (*a*lert, responds to *v*oice, responds to *p*ain, *u*nresponsive)
Check pupil size and reactivity
Measure capillary glucose

Examination and Planning
Are ABCD stable? If not, go back to the top and call for help
Complete any relevant examination e.g. heart sounds, abdomen, full neurological exam
Treat pain
Gather information from notes, charts, and eyewitnesses
Do tests e.g. arterial blood gases, X-rays, ECG
Do not move an unstable patient without the right monitoring equipment and staff
Make ICU and CPR decisions

You should have called a senior colleague by now, if you have not done so already.

attending doctor. For example, if a patient is hypotensive and hypoxaemic from pneumonia, it is not acceptable for oxygen, fluids, and antibiotics simply to be prescribed. The oxygen concentration may need to be changed several times before the PaO_2 is acceptable. More than one fluid challenge may be required to get an acceptable blood pressure – and even then, vasopressors may be needed if the patient remains hypotensive due to septic shock. Intravenous antibiotics need to be given immediately. ICU and CPR decisions need to be made at this time – not later. The emphasis is on both rapid and effective intervention.

Integral to the management of the acutely ill patient is the administration of effective analgesia. This is extremely important to the patient but also has a range of physiological benefits and is discussed further in Chapter 10.

Special Considerations in the Geriatric Population

The proportion of older people in the population is increasing. Around 80% of people aged over 80 years function well and relatively independently and only 13.7% of people aged over 85 years live in institutions in the UK.[20] However, there are important physiological differences in this age group which are important for healthcare staff to understand. The interpretation of symptoms and signs and the management of acute illnesses may be different in the elderly population.

The following are important physiological differences in older people:

- Reduced homeostatic reserve: ageing is associated with a decline in organ function with a reduced ability to compensate. The following are reduced – normal PaO_2, cerebral blood flow, maximum heart rate and cardiac reserve, maximum oxygen consumption, renal blood flow, maximum urinary concentration, and sodium and water homeostasis
- Impaired immunity: older patients commonly do not have a fever or raised white cell count in infection. Hypothermia may occur instead. A rigid abdomen is uncommon in the older people with an acute abdomen – they are likely to have a soft, but generally tender abdomen despite perforation, ischaemia, or peritonitis. A lower threshold for imaging is therefore required
- Different pharmacokinetics and pharmacodynamics: a different approach to anaesthesia is required, and iatrogenic disease is more common in the older population
- Acute illnesses present atypically e.g. with delirium or falls
- Quiescent diseases are exacerbated by acute illness e.g. heart failure may occur due to pneumonia, old neurological signs may become more pronounced with an acute infection
- Some clinical findings are not necessarily pathological in older people: neck stiffness, fine crackles at the lung bases, reduced skin turgor, and bacteriuria. A urinary tract infection cannot be diagnosed on the basis of urinalysis alone.

Clinical decision-making should always be made on an individual basis and never on the basis of age alone. However, one has to balance the right to high-quality care without age discrimination with the wisdom to avoid aggressive but ultimately futile interventions. Involving an experienced physician in difficult decision-making is often helpful.

The Benefits and Limitations of Intensive Care

Physiological derangement and the need for admission to the ICU is not the same thing. It would not be in the best interests of all patients to be admitted to an ICU. Instead, optimising ward care or even palliative care may be required.[21] This decision is based on evidence

about prognosis, clinical experience (e.g. recognising when someone is dying), and takes in to account any expressed wishes of the patient. Intensive (level 3) care supports failing organ systems when there is potentially reversible disease. It is appropriate for patients requiring advanced respiratory support alone or support of at least two failing organ systems. High dependency (level 2) care is appropriate for patients who require detailed observation or intervention for a single failing organ system.

For the majority of healthcare workers who have never worked in an ICU, the benefits and limitations of what is available may be poorly understood. Patients with acute reversible disease benefit most from intensive care if they are admitted sooner rather than later. Waiting for someone to become even more seriously ill before contacting the ICU team does not make physiological sense and is not evidence-based. On the other hand, admission to the ICU does not guarantee a successful outcome. Some patients may be so ill they are unlikely to recover at all, even with intensive organ support. The overall mortality of patients admitted as an emergency to the ICU in the UK is around 25%, but this varies between units and different patient populations.[14,22] All potential admissions should be assessed by an experienced doctor. Patients who are not admitted to intensive care should have a clear plan and their ward care optimised.

Communication and the Critically Ill

In recent years, healthcare has increasingly focussed on systems and processes that improve patient safety. One important facet of patient safety is 'human factors' – how people interact with each other and technology. Good communication, teamwork, and situation awareness can be as important in successfully managing an acutely ill patient as having good medical knowledge and skills.

A new doctor once asked his senior how to treat a patient who had had too much β-blocker. The senior was half listening, writing in some notes. Another senior was nearby and asked, 'What do you mean – what is the pulse and blood pressure?' The new doctor replied, 'Pulse 30, blood pressure unrecordable'. Both seniors dashed to the patient's bedside. Good communication is important. SBARR is a simple system to follow when communicating about a seriously ill patient with colleagues, particularly over the phone. It is illustrated in Box 1.4.

Clearly communicating the patient's current vital signs and key test results is the only way to give the listener a sense of how urgent the situation is. Your colleague may have heard all he needs to know and be on his way, or he may want to go through some more details first. Either way, it is important to communicate clearly what help is required, particularly if you want your colleague to come and see the patient. The senior resident doctor should always be informed about any seriously ill patient, *whether or not* his expertise is required.

The following chapters describe the theory behind the assessment and management of acutely ill adults. They are intended as a foundation on which experience and practical

Box 1.4 The SBARR System of Communication

***S**ituation*
State who you are, where you are, and why you are calling

***B**ackground*
Summarise the patient's relevant history

***A**ssessment*
Communicate the patient's vital signs and key test results

***R**ecommendation*
State clearly what you want to happen next

***R**eadback*
The listener should summarise what they think you have said and what they are going to do now

Example:

Hi – I am Dr X calling from Ward 1 about a sick patient I think may need ICU. Joe Bloggs, 45 years old, no past medical history, was admitted with community acquired pneumonia this morning with a NEWS2 of 3. Over the course of the day, his oxygen requirements have been going up and his blood pressure is now low despite fluid challenges.

His current vital signs are: Alert, BP 90/50, HR 110, SpO_2 89% on 15 L oxygen via reservoir bag, RR 26, temperature 38°C. A repeat chest X-ray shows worsening consolidation of the right lung and a repeat blood gas shows … I'd be really grateful if you can come and assess him urgently.

training can be built. Understanding and practising the basics well is the essence of good acute care. Good acute care can even be summed up as 'the right oxygen, the right fluid and the right help at the right time'. Hopefully by the end of this book, you will have a better idea of what this means and have a better understanding of the significance of common clinical findings. These simple things can make a big difference to your patients.

Key Points – Patients at Risk

- Resuscitation is about recognising and effectively intervening when patients have seriously abnormal vital signs
- There is a wealth of research to show that our systems fail when patients in hospital deteriorate
- Early effective intervention can improve outcome and utilisation of intensive care resources
- Physiological derangement and the need for admission to the ICU is not the same thing. All patients should be assessed by a senior doctor
- In order to communicate clearly to colleagues about acutely ill patients, use SBARR
- Always inform the senior resident doctor about a seriously ill patient.

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Further Resources

IMPACT course (ill medical patients acute care and treatment) recommended by the UK Joint Royal Colleges of Physicians Training Board. https://impactmedical.org/ (Accessed October 2019).

CCrISP course (care of the critically ill surgical patient) by the Royal College of Surgeons of England and Edinburgh. https://www.rcseng.ac.uk/education-and-exams/courses/search/care-of-the-critically-ill-surgical-patient-ccrisp/ (Accessed October 2019).