History taking and clinical examination form the basis of all clinical assessments. The history enables a short list of differential diagnoses to be generated. Evidence from clinical examination can be used to refine this.

History taking

All clinicians use the same basic history taking template; however, flexibility is essential: be prepared to modify your approach depending on the clinical situation, the patient’s concerns or fears and their level of education and understanding.

History of the presenting complaint

This is the most conversational component of the medical history and it is relatively easy to lose focus or drift off into unrelated areas. Therefore, you need to structure the interview in a way that allows you to extract the relevant information, while remaining relaxed and polite. Never lose your temper with a so-called bad historian; good history takers can get the important points of the story from any patient. Use the following routine:

- correctly identify your patient, checking their name, address, date of birth and who referred them
- start with ‘open’ questions like ‘What has happened over the last few days?’ or ‘When did you last feel well?’
- listen during this first part of the consultation and let the patient talk
- form a differential diagnosis based upon the patient’s original description
- during the next part of the history, use ‘closed’ or direct questions to focus upon the important points and narrow your list of differential diagnoses based on associated features, speed of onset, duration, previous episodes, etc.
- the duration and speed of onset of the patient’s symptoms are particularly important, e.g. if a focal neurological defect develops over the course of a few minutes, this could be due to an acute vascular event; if it develops over a number of days there may be infection or demyelination, while a defect that develops over months could suggest an underlying tumour or subdural haemorrhage
• avoid asking more than one question at once, e.g. ‘Have you had pain or breathlessness?’ should be, ‘Have you had any pain?’ followed by ‘Have you been breathless?’
• throughout the interview, be careful to use language that the patient will understand and avoid medical terminology
• finally, ask if the patient has any worries or concerns: fear and preconceptions often colour the interpretation of symptoms and are always important features of the history.

**Systemic enquiry**

A few further screening questions are sufficient to identify any areas worthy of additional focus:

- **cardiovascular**: chest pain, palpitations, breathlessness, orthopnoea, oedema
- **respiratory**: breathlessness, cough, sputum, haemoptysis, chest pain
- **GI**: abdominal pain or swelling, bowel habit and bleeding, vomiting, swallowing problems
- **GU**: dysuria, frequency, urgency, haematuria
- **neurological symptoms**: headache, weakness or altered sensation, fits, falls and funny turns, change vision, hearing or speech (see Table 1.1)
- **systemic**: anorexia, weight loss, fever, night sweats, fatigue, sore or stiff joints, itch or rash.

**Past medical history**

Enquire about the following common illnesses, remembering that patients often employ informal labels (given in parentheses): asthma, COPD (bronchitis, emphysema), ischaemic heart disease (angina), myocardial infarction (heart attack), cardiac failure (fluid on the lung), diabetes mellitus, previous pulmonary TB, previous surgery, previous admissions especially to the intensive care unit (ICU), stroke, epilepsy (fits), hypertension (high blood pressure), hypercholesterolaemia, venous thromboembolism (thrombosis or clots), previous rheumatic fever or significant childhood illnesses.

**Drug history**

Accurate doses, including the timing of administration, are essential, especially for insulin regimes and patients taking warfarin, along with details of the specific formulation taken, e.g. the type of insulin and the device used; types of inhaler.

<table>
<thead>
<tr>
<th>Defect</th>
<th>Description</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive dysphasia</td>
<td>Difficulty in comprehension</td>
<td>Lesion in the dominant cerebellar hemisphere, commonly due to CVA in older patients or trauma in younger patients</td>
</tr>
<tr>
<td>Expressive dysphasia</td>
<td>Difficulty in word selection, may be isolated to the naming of objects (nominal) or people</td>
<td></td>
</tr>
<tr>
<td>Dysarthria</td>
<td>Difficulty with the motor execution of speech</td>
<td>Slurred, staccato or scanning speech suggests cerebellar disease, e.g. MS. Slurred speech and a weak voice suggests pseudobulbar palsy (e.g. due to CVA)</td>
</tr>
</tbody>
</table>
If the patient is on a lot of medications, ask if they have an up-to-date repeat pres-
scription with them.

Make specific note of drug allergies. Ask what the patient means by ‘allergy’: feeling sick or diarrhoea is often mislabelled as such.

In patients with lung disease, check if they are prescribed inhalers and that they know how to use them. Also ask if they are on long-term oxygen therapy (marker of disease severity). Check if the patient is on long-term oral theophylline or pheny-
toin; if so, you will need to measure a drug level before prescribing any additional IV treatment.

**Family history**

Enquire about conditions affecting family members, e.g. asthma, ischaemic heart disease, stroke, malignancy, diabetes.

**Social history**

This is an essential and often overlooked component of the history, especially in older or disabled patients. Accurately document home circumstances, e.g. living alone; independent at home but has social support; residential or nursing home resident. If the patient receives support at home, quantify this in terms of visits per day and the support provided. Ask if the patient has family nearby and if they see them.

Determine the patient’s functional capacity and whether they are able to perform the activities of daily living (ADLs), e.g. leaving the house, doing the shopping, housework or cooking. This information allows the setting of realistic discharge goals and is useful when considering treatment escalation or referral to intensive care. Ask about quality of life (QoL). Remember that this should be recorded as the patient describes it, not how you judge it; see ‘Performance status and quality of life’, p. 349.

Ask about recreational drug use. Document cigarette use by current and ex-
smokers in pack-years and alcohol consumption in units per week:

- One pack-year equates to a pack of 20 cigarettes per day for a year: someone who has smoked 10-a-day for 50 years has a 25 pack-year history.
- One small glass of wine or one 25 mL measure of spirits is roughly equivalent to 1 unit; 1 pint of ordinary strength lager, beer or cider roughly equates to 2 units; recommended safe limits of alcohol per week for males and females are 21 and 28 units, respectively.

**Psychiatric history**

Formal psychiatric assessment should be performed in specialist units; however, psychiatric illnesses commonly present to other departments where they should be properly assessed and referred to psychiatry, as appropriate. A detailed history is essential and must include the following (in addition to a standard medical history):

- educational background, religion and occupation, as these may influence interview technique and general approach
- reason and source of referral (self-presentation indicates insight)
- history of the presenting complaint: enquire about the patient’s symptoms in their own words, including their effect upon normal function (e.g. work, family, relationships), date of onset, rate of progression and any precipitants identified by the patient
- previous treatments, including drugs, surgery and others, e.g. cognitive behavioural therapy, electro-convulsive therapy
- suicidal ideation.

Personal history should be taken in detail, including:

- childhood problems including parental separation and any history of abuse
- relationships and marital history
- work history, including current level of satisfaction at work and reasons for leaving previous jobs
- illegal activities and any history of violence
- premorbid personality, e.g. anxious, obsessive, solitary
- cognitive assessment should be performed (cognitive dysfunction suggests organic rather than functional pathology)
- abbreviated mental test (AMT) score or the mini-mental state examination (MMSE); see Tables 1.2 and 1.3, respectively
- acute (delirium) and chronic (dementia) cognitive impairment should be distinguished by discussion with family members or social contacts.

Table 1.2 Abbreviated mental test score

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your age?</td>
<td>1 if correct</td>
</tr>
<tr>
<td>What is your date of birth?</td>
<td>1 if complete</td>
</tr>
<tr>
<td>What year is it?</td>
<td>1 for exact year</td>
</tr>
<tr>
<td>What time of day is it?</td>
<td>1 if correct to nearest hour</td>
</tr>
<tr>
<td>What is this place?</td>
<td>1 if correct, e.g. name of hospital or address</td>
</tr>
<tr>
<td>Recall a 3-line address (later in consultation)</td>
<td>1 if correctly and completely recalled</td>
</tr>
<tr>
<td>Who is the current monarch?</td>
<td>1 if correct</td>
</tr>
<tr>
<td>What year was World War I?</td>
<td>1 for either 1914 or 1918</td>
</tr>
<tr>
<td>Count backwards from 20 to 1</td>
<td>1 if no mistakes, or corrects without prompting</td>
</tr>
<tr>
<td>Can you identify these two people?</td>
<td>1 for both names if known, or both jobs if not</td>
</tr>
</tbody>
</table>

Total score recorded out of 10; a score <7 suggests cognitive dysfunction.

Table 1.3 Mini-mental state examination

<table>
<thead>
<tr>
<th>Test</th>
<th>Questions</th>
<th>Maximum score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Day, date, month, season, year</td>
<td>5</td>
</tr>
<tr>
<td>Place</td>
<td>County, country, town/city, building, floor</td>
<td>5</td>
</tr>
<tr>
<td>Registration</td>
<td>Name 3 objects, e.g. bed, table, book</td>
<td>3</td>
</tr>
<tr>
<td>Attention and concentration</td>
<td>Spell &quot;world&quot; backwards or count out five serial 7's</td>
<td>5</td>
</tr>
<tr>
<td>Naming</td>
<td>Show 2 objects</td>
<td>2</td>
</tr>
<tr>
<td>Recall</td>
<td>Ask to recall the 3 objects registered earlier</td>
<td>3</td>
</tr>
<tr>
<td>Repeating</td>
<td>Repeat ‘no ifs, ands or buts’: only correct if word perfect</td>
<td>1</td>
</tr>
<tr>
<td>3-stage task</td>
<td>Instruct the patient to (1) take this paper in your right hand, (2) fold it in half and (3) drop it on the floor</td>
<td>3</td>
</tr>
<tr>
<td>Reading</td>
<td>Write &quot;close your eyes&quot;; ask the patient to read and obey</td>
<td>1</td>
</tr>
<tr>
<td>Writing</td>
<td>Write a sentence: must be complete and grammatically correct</td>
<td>1</td>
</tr>
<tr>
<td>Construction</td>
<td>Draw interlocking pentagons</td>
<td>1</td>
</tr>
</tbody>
</table>

* Total score recorded out of 30; <23 suggests cognitive impairment.
Recording the history

Many hospitals now provide an admission pack, which includes a history taking proforma for all new admissions. These documents often form part of a unified case record (UCR) or integrated care pathway (ICP). While these tools are useful, there is a danger that they encourage a highly protocolized, ‘tick-box’ approach to history taking. Take time to work beyond the boxes and fully explore what the patient is trying to tell you.

When recording the history of the presenting complaint, include the main problem and mode of referral. This should be followed by a short paragraph that covers the relevant additional positive or negative points from the history with regard to this presenting problem, e.g. onset, duration, precipitating and relieving factors, previous similar events, as well as relevant admissions or outpatient attendances.

Examination

The guidance given here is necessarily brief. For more detail see Macleod’s Clinical Examination.

Consider whether you need a chaperone and ensure that the patient’s need for privacy is met. Ask for permission to examine them and check if there is any area that is sore to touch. Ensure that the patient is comfortable and in the correct body position for the system you aim to assess:

- cardiovascular and respiratory: 45° semi-recumbent
- abdominal: lying supine
- neurological: semi-recumbent position in bed or sitting in chair, depending on the particular examination performed.

Begin with a general examination, then follow the principles of inspection, palpation, percussion and auscultation as you work through the relevant body systems. Table 1.4 (overleaf) highlights important signs to look for during your examination of each body system (the nervous system is addressed separately). Note that when palpating, you should start with the least painful side first and work slowly towards the site of worst pain.

Neurological examination

A flexible approach is essential, especially in patients with receptive dysphasia or cognitive impairment. A working knowledge of basic neuroanatomy is helpful in allowing you to interpret your clinical findings.

A simple neurological examination scheme is summarized below. The order of the tests performed will vary depending on the clinical situation, but should include assessment of cranial nerve function, the motor and sensory components of cerebral function, and cerebellar function.

Inspection

Note any abnormality of resting limb position (contracture or palsy), involuntary movements (seizure activity, tremor and chorea), muscle wasting, fasciculation and gait.

Cranial nerves

Examine cranial nerves II–XII; see Table 1.5. Cranial nerve I (olfactory nerve) is not routinely assessed.

Motor examination

For motor examination, assess tone, power and reflexes, starting proximally and moving distally; compare right with left. Give the patient clear instructions when examining power. It is important to distinguish between upper and lower motor neurone weakness; see Focal neurology, p. 226.
### Table 1.4 System examination aid

<table>
<thead>
<tr>
<th>Cardiovascular</th>
<th>Respiratory</th>
<th>Abdomen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hands</strong></td>
<td>Clubbing, temperature of peripheries, pulse rate, rhythm, character</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nicotine staining</td>
<td>Palmar erythema</td>
</tr>
<tr>
<td></td>
<td>Splinters</td>
<td>Interosseous wasting</td>
</tr>
<tr>
<td></td>
<td>Capillary refill</td>
<td>CO₂ flap</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liver flap</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leuconychia</td>
</tr>
<tr>
<td><strong>Face</strong></td>
<td>Conjunctival pallor or suffusion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Corneal arcus</td>
<td>Central cyanosis</td>
</tr>
<tr>
<td></td>
<td>Xanthelasma</td>
<td>Horner’s syndrome</td>
</tr>
<tr>
<td></td>
<td>Malar flush</td>
<td>Sclerae (jaundice)</td>
</tr>
<tr>
<td><strong>Neck</strong></td>
<td>Jugular venous pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carotid pulsation</td>
<td>Lymphadenopathy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trachea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accessory muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spider naevi</td>
</tr>
<tr>
<td><strong>Torso</strong></td>
<td>Scars</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thrills and heaves</td>
<td>Chest expansion</td>
</tr>
<tr>
<td></td>
<td>Heart sounds</td>
<td>Percussion note</td>
</tr>
<tr>
<td></td>
<td>Murmur</td>
<td>Breath sounds ± added vocal resonance</td>
</tr>
<tr>
<td></td>
<td>Radiation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accentuation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiofemoral delay</td>
<td></td>
</tr>
<tr>
<td><strong>Additional areas</strong></td>
<td>Pedal oedema</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Listen at lung bases</td>
<td>Sputum pot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PR exam</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 1.5 Cranial nerves

<table>
<thead>
<tr>
<th>Cranial nerve</th>
<th>Tests routinely performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>II (Optic)</td>
<td>Acuity, pupillary reflexes (ipsi- and contralateral), visual fields</td>
</tr>
<tr>
<td>III (Oculomotor)</td>
<td>Considered together: ocular movements</td>
</tr>
<tr>
<td>IV (Trochlear)</td>
<td></td>
</tr>
<tr>
<td>VI (Abducent)</td>
<td></td>
</tr>
<tr>
<td>V (Trigeminal)</td>
<td>Ophthalmic (V₁), maxillary (V₂) and mandibular (V₃) sensory branches; motor function (masseter muscle) rarely tested</td>
</tr>
<tr>
<td>VII (Facial)</td>
<td>Five sensory branches (raise eyebrows, close eyes tight, show teeth, puff out cheeks and whistle); taste rarely tested</td>
</tr>
<tr>
<td>VIII (Vestibulocochlear)</td>
<td>Rarely tested; hearing deficits best assessed by audiometry</td>
</tr>
<tr>
<td>IX (Glossopharyngeal)</td>
<td>Considered together: gag reflex (IX afferent, X efferent); movement of the soft palate (uvula)</td>
</tr>
<tr>
<td>X (Vagus)</td>
<td></td>
</tr>
<tr>
<td>XI (Accessory)</td>
<td>Shrug shoulders and resist: rotate head to one side against resistance to test the contralateral sternomastoid muscle</td>
</tr>
<tr>
<td>XII (Hypoglossal)</td>
<td>Ask patient to protrude tongue, look for wasting asymmetry and fasciculation</td>
</tr>
</tbody>
</table>
• **tone**: ‘normotonia’ varies; if hypertonia is genuine, check whether symmetrical or generalized; look for cog-wheeling or associated clonus (hard clinical sign if sustained)

• **power**: grade 0–5, e.g. MRC scale; compare right with left testing individual muscle groups (shoulder, elbow, wrist, fingers, hip, knee and ankle); it is often better to ask the patient to resist you moving their limb than to move it in a certain direction, e.g. when assessing triceps and biceps ‘Bend your arms like this and keep them there’

• **reflexes**: strike the tendon, not the muscle; test biceps, triceps, supinator, knee and ankle jerks; an extensor plantar indicates a pyramidal tract lesion; if there is no response, consider using a distraction manoeuvre at the time of striking the tendon, e.g. ask the patient to pull apart inversely clasped hands.

**Sensory examination**

Sensory examination involves an assessment of pain, light touch, proprioception and vibration sense. Assess pain using a Neurotip® (spinothalamic tract) and light touch using a cotton ball (dorsal columns). Determine whether any abnormality is symmetrical or isolated, whether it corresponds to a particular area on the dermatome map (Fig. 1.1) or is suggestive of a sensory level (spinal cord lesion). Proprioception and vibration sense should be assessed at the distal joints first, moving proximally if an abnormality is detected.

![Dermatomes](Image)
Cerebellar function
The cerebellum has an important role in the coordination of movement:
- perform the finger–nose test looking for ataxia, past pointing and intention tremor (tremor on approach to the finger); heel–shin test should be performed in lower limb examination
- test rapid alternating movements (dysdiadochokinesias)
- compare right with left
- remember that these tests are unreliable if the limb is weak
- look for nystagmus: horizontal nystagmus suggests cerebellar disease with the fast phase towards the affected side
- assess speech: disjointed and explosive (staccato) speech.

ASSESSMENT OF THE ACUTELY ILL PATIENT

It is vital that the assessment of the acutely ill patient is carried out in a logical and expeditious manner. On arriving at the scene, first check that it is safe to assess and treat the patient on site. This is particularly important in an out-of-hospital environment. Then proceed according to the ABCDE acronym (Airway, Breathing, Circulation, Disability, Exposure).

Airway
Partial airway obstruction may present as stridor, gurgling or wheeze, while a silent chest may indicate complete airway obstruction. Airway compromise is common in acutely ill patients and may be due to:
- CNS depression
- upper airway secretions, blood or vomit
- disruption of upper airway anatomy by trauma
- foreign body
- pharyngeal swelling or laryngospasm.

If the patient’s airway appears threatened or unprotected, it is imperative that airway patency be restored and maintained. Inspect the airway; if it is not patent or likely to be compromised in the near future, proceed as outlined in ‘Basic life support’, p. 12. Remember to protect the cervical spine in any patient with traumatic injuries.

Breathing
While keeping the airway open, look, listen and feel for evidence of spontaneous respiration.
- if the patient is not breathing, put out an arrest call and check whether a cardiac output is present; see ‘Circulation’ below
- if the patient is breathing, assess the rate and pattern of respiration, and note the extent and symmetry of any chest wall movement; listen to the chest.

High flow oxygen (60–100%) by trauma mask should be given to all critically ill patients pending urgent arterial blood gas results; these results are particularly important in patients with previous type 2 respiratory failure, e.g. COPD. Proximal, upper airway secretions should be removed using a Yanker suction catheter.

Circulation
Impalpable pulse
If the radial pulse is absent, check a more proximal artery, e.g. femoral, carotid; if you still cannot feel a pulse, put out an arrest call and start cardiopulmonary resuscitation (CPR), p. 13.
Initial assessment and emergency management

**Palpable pulse**
- immediately attach a cardiac monitor, measure the blood pressure, heart rate and rhythm
- look for evidence of poor peripheral perfusion (pallor, cool cyanosed peripheries, a prolonged capillary refill time); prompt treatment of shock is essential; insert at least 2 wide-bore cannulae and start a rapid IV infusion; take routine bloods, including a cross-match and cultures, and follow the guidance given in ‘Shock’, p. 250
- listen to the heart, perform a 12-lead ECG, identify and treat any arrhythmia; see p. 132
- check for evidence of haemorrhage; if present, this must be controlled following adequate resuscitation; if necessary, contact the relevant on-call surgical team.

**Disability**

Perform a rapid neurological evaluation of the patient. Quantify the level of consciousness using the Glasgow Coma Scale (GCS); see p. 11. Assess pupillary size, symmetry and responses. Look for any lateralizing neurological signs, or evidence of a spinal cord level.

Look for any reversible causes of neurological abnormality; check the blood glucose and the drug cardex.

**Exposure**

Expose the relevant parts of the body and examine the patient fully; always preserve the patient’s dignity where possible and avoid hypothermia. Take a history, if possible, and ask nursing staff or other witnesses about recent events. Review the case-notes and observation charts: look for trends in pulse, blood pressure, respiratory rate and temperature.

**Acute clinical scoring systems**

Objective scoring systems are essential tools in identifying patients who are deteriorating clinically, in need of urgent treatment or referral to intensive care. They are also helpful in clinical research, allowing meaningful comparison between patients with varying types of clinical presentation.

**Early warning systems**

There is a clear correlation between markers of disease severity and subsequent in-hospital mortality. However, the identification of ‘sick’ patients is a largely subjective process, which is often performed poorly. Early warning systems combine several simple and measurable physiological variables, e.g. respiratory rate, to predict clinical worsening. These systems allow nursing and other staff objectively to assess and monitor ward-level patients, identifying those who need medical review, transfer to HDU/ICU or treatment escalation. The modified early warning score (MEWS) is a commonly used example in UK hospitals; see Table 1.6. Thresholds for action vary between 3 and 5, depending on local policy. Another commonly used example is the patient at risk (PAR) score.

**Conscious level**

**Glasgow Coma Scale**

The Glasgow Coma Scale (GCS) is an objective and universally comparable way of quantifying the conscious level of a patient. It can be used as a single point value or monitored over time, and combines scores assigned to three physiological responses: eye opening, verbal responsiveness and motor responsiveness; see Table 1.7.
<table>
<thead>
<tr>
<th>Table 1.6 The modified early warning score (MEWS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
</tr>
<tr>
<td>&lt;70</td>
</tr>
<tr>
<td>Heart rate</td>
</tr>
<tr>
<td>&lt;40</td>
</tr>
<tr>
<td>Respiratory rate</td>
</tr>
<tr>
<td>≤9</td>
</tr>
<tr>
<td>Temperature (°C)</td>
</tr>
<tr>
<td>&lt;35</td>
</tr>
<tr>
<td>Urine output (mL/h for 2 h)</td>
</tr>
<tr>
<td>≤10</td>
</tr>
<tr>
<td>AV/PU</td>
</tr>
<tr>
<td>Confused</td>
</tr>
</tbody>
</table>
Initial assessment and emergency management

The GCS was originally used to stratify immediate clinical risk in patients with head injuries. Of those with moderate (9–12) and severe (<9) scores, 63% and 85% respectively remain disabled at 1 year. It is now used in any condition associated with neurological sequelae and has been incorporated into other scoring systems, including APACHE (see below), and standard neurological observations.

**AVPU**

The AVPU score is an abbreviated scoring system for the assessment of consciousness. It assigns a letter (A, V, P or U) to the patient, depending on whether they are alert, responsive to verbal commands, responsive to pain or unresponsive, respectively. It is commonly used by ambulance crews and forms part of the MEWS; see above. However, it has less of an evidence base than the GCS and is not suitable for longitudinal neurological scoring.

**Critical illness**

**APACHE**

The acute physiology and chronic health evaluation (APACHE) scoring system is used to predict in-hospital mortality in patients admitted to ICU. APACHE IV is the most recent version and combines values assigned to acute physiology, age and chronic health. It is extremely accurate, but also complicated to define, and most ICUs use a computer programme for this purpose.

**SOFA**

The sequential organ failure score (SOFA) is an alternative critical care score that assesses the function of six different organ systems: respiratory, cardiovascular, renal, hepatic, neurological and haematological.

### CARDIAC ARREST MANAGEMENT

The UK Resuscitation Council produces regularly updated, evidence-based treatment guidelines for the management of cardiac arrest. Any doctor working in an acute clinical environment should be fully acquainted with them and UK trainees must attend either Basic, Intermediate or Advanced Life Support (BLS, ILS or ALS) training as part of the requirements of their post. If you have not attended such a course, contact your local resuscitation officer who will advise on the appropriate level.

#### The chain of survival

Survival following cardiac arrest is dependent on four fundamental factors. Arranged chronologically, these are commonly referred to as links in the ‘chain of survival’:
- early recognition and immediate summoning of help
- early and effective BLS to maintain the perfusion of vital organ systems

<table>
<thead>
<tr>
<th>Table 1.7 The Glasgow Coma Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye opening</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

The GCS was originally used to stratify immediate clinical risk in patients with head injuries. Of those with moderate (9–12) and severe (<9) scores, 63% and 85% respectively remain disabled at 1 year. It is now used in any condition associated with neurological sequelae and has been incorporated into other scoring systems, including APACHE (see below), and standard neurological observations.
• early defibrillation of shockable arrhythmias; see ALS below
• planned, organized and coordinated post-resuscitation care.

### Basic life support

On arrival at the scene, first check that the environment is safe for you to assess the patient. If you are the first to discover the patient, check whether they are responsive. If they are, put them into the recovery position and go for help. If they are not, shout for help, but stay with the patient and begin your assessment with ABC.

#### Airway

Maintenance of adequate tissue oxygenation requires airway patency and the delivery of adequate inspired oxygen to the lungs. Formal intubation of the trachea may not be necessary and is a procedure that requires both skill and practice.

If the patient’s airway is occluded and they are not breathing, put out an arrest call. Turn the patient onto their back; clear any obstructing material from the oropharynx by performing a gloved finger sweep. Be cautious in patients with possible head or neck trauma in whom the cervical spine must be protected (see below) and a set of McGill’s forceps, rather than a finger sweep, should be used.

#### Airway manoeuvres

The goal of these manoeuvres is to restore and maintain airway patency. Their effectiveness must be constantly reassessed throughout any resuscitation attempt. The airway should be managed by the most experienced person in the situation at the time.

**Head tilt, chin lift**

In the absence of suspicion or definite damage to the cervical spine, this is the most effective way in which to open the airway of an unconscious patient. Proceed as follows:

• place the palm/heel of one of your hands on the patient’s forehead
• place the fingers of your other hand under their chin (avoid soft tissue)
• gently lift the chin and maintain position by gentle pressure on chin and forehead
• remember that an unconscious patient will always re-occlude their airway if this support is not sustained.

**Jaw thrust**

Used where cervical spine damage is suspected; see below. Remember that some patients are predisposed to neck trauma at low energy because of osteoporosis or rheumatoid arthritis. Proceed as follows:

• place the middle fingers of both hands under the angle of the mandible
• gently push the mandible forward, opening the mouth with the thumbs.

#### Airway management in cervical spine injury

If there is a high index of suspicion of cervical spine injury, the head and neck should be immobilized using a semi-rigid collar, lateral head support and taping. Oxygen should be administered via a non-rebreathing facemask or, if necessary, with bag-valve-mask ventilation. If an airway manoeuvre is required, a jaw thrust should be performed, as this will open the airway with minimal chance of cervical spine damage. If this fails to open the airway, you may perform a chin lift without head tilt, with an assistant immobilizing the cervical spine. If basic airway manoeuvres fail to establish airway patency and restore adequate ventilation, intubation may be required; see ‘Advanced life support’, p. 14.
**Initial assessment and emergency management**

**Airway adjuncts**

Oropharyngeal and nasopharyngeal airways can be used with minimal training and practice, and will be available on most ‘cardiac arrest’ trolleys in the hospital setting and many GP surgeries. These are adjuncts, not alternatives, to standard airway manoeuvres.

**Oropharyngeal (Geudel®) airway**

This helps to prevent occlusion of the pharynx by the tongue, and maintains patency of the upper airway. Select an airway equivalent in length to the distance from the patient’s incisor to the angle of their jaw.

In adults, the airway is inserted upside down until gentle contact with the soft palate is felt. At this point it is rotated into position. In young children, the oropharyngeal airway should be inserted in the orientation that it will sit in the airway; a tongue depressor can be used to hold the tongue out of the way first. An oropharyngeal airway can induce vomiting and aspiration in patients with a preserved gag reflex but a depressed conscious level. In this situation, a nasopharyngeal airway may be safer.

**Nasopharyngeal airway**

Less rigid than the oropharyngeal airway, the nasopharyngeal airway is less likely to induce vomiting when a gag reflex is present, or the patient is more awake. It is useful in situations where the jaw cannot be opened, or where there are facial injuries. However, nasopharyngeal airways are contraindicated in patients with actual or suspected basal skull fracture or nasal fracture.

Choose an airway equivalent in length to the distance between the patient’s incisor and the tragus of the ear. The diameter of the airway should also be similar to that of the patient’s little finger. To insert the airway:

- Choose the correct size of airway and the largest nostril
- Lubricate the outer surface
- Attach a safety pin to the flange of the tube to prevent complete entry into the nose
- Insert perpendicular to the face along the nasal floor
- Stop if there is any resistance
- Use a rotating movement back and forth as you insert the tube
- If it does not fit, try the other nostril.

**Breathing and circulation**

While keeping the airway open, look, listen and feel for breathing and check for a pulse. If there are no signs of life, call for help and ensure that an arrest call has been put out. If you are alone, you will have to leave the patient to do this. Return immediately and commence CPR.

**Cardiopulmonary resuscitation**

The aim of CPR is to maintain oxygenation and the perfusion of vital tissues until defibrillation is possible or reversible factors can be addressed.

**Chest compressions**

The blood oxygen content remains high in the first minutes after an arrest, so effective chest compressions to restore perfusion are the most critical component. They should be performed as follows:

- Your hands should be placed in the centre of the chest
- Compress the chest at a rate of around 100/min and to a depth of around 4–5 cm, in an adult
- Between compressions, the chest must be allowed to recoil completely to allow cardiac filling.
**Ventilation**

Immediate ‘rescue breaths’ are no longer advised. Instead, 30 compressions should be followed by 2 ventilations and this ratio continued until help, or a defibrillator, arrives. Always use a pocket resuscitation mask if one is available. If mouth-to-mouth ventilation is not possible due, for example, to facial trauma, mouth-to-nose is an effective alternative.

In the hospital environment, the patient should be ventilated with the available bag and mask system entraining high flow oxygen. This is preferential to mouth-to-mouth resuscitation, as the oxygen concentration of a rescuer’s expired breath is only 16–17%. When using a bag and mask, one person should perform a jaw thrust/chin lift and maintain a good facial seal while another person squeezes the bag. When performing ventilation:

- deliver each breath over approximately 1 s
- aim to ventilate the chest to what would be an approximately normal volume for the size of the patient
- deliver 2 ventilations after each sequence of 30 chest compressions during CPR with an unprotected (unintubated) airway.

**Advanced life support**

As soon as the defibrillator arrives, attach the leads or pads, and assess the rhythm (see ‘ECG Interpretation’, p. 78, and ‘Arrhythmias’, p. 132). Depending on whether the rhythm is shockable (ventricular tachycardia (VT) or ventricular fibrillation (VF)) or non-shockable (pulseless electrical activity (PEA) or asystole), proceed down the appropriate limb of the ALS algorithm (Fig. 1.2). If the rhythm is shockable, defibrillation must not be delayed.

It is important that the most senior member of the arrest team coordinates the resuscitation attempt. They should direct other team members as indicated below, clinically assess the patient and decide upon the immediate treatment priorities. They should also determine, in consultation with the team, when resuscitation should be discontinued (see ‘Decisions regarding resuscitation’, p. 399).

**Defibrillation in VF or VT**

It is essential that you are familiar with the defibrillators used in your hospital (see ‘Defibrillation and electrical cardioversion’, p. 58). VF and VT should be managed immediately by delivery of a single shock (at 150 J for biphasic defibrillators or 360 J for monophasic machines), followed by immediate resumption of CPR for 2 min (30 compressions: 2 ventilations). Do not reassess the rhythm or feel for a pulse after the first shock. This should be done only after 2 min of CPR, when a further shock can be delivered if indicated. Second and subsequent shocks from a biphasic defibrillator should be delivered at 150–360 J. For all shocks from monophasic defibrillators, 360 J should be used.

If there is doubt as to whether the rhythm is asystole or fine VF, do not attempt defibrillation, but proceed down the non-shockable side of the ALS algorithm.

**Intravenous access**

IV access should be secured early; this allows fluid resuscitation and the administration of cardiotropic and vasopressor drugs. If at least one large-bore peripheral cannula cannot be sited, a central venous line should be inserted (see ‘Procedures’, p. 50). In the meantime, 3 mg boluses of adrenaline (epinephrine) should be administered during ALS via the endotracheal (ET) tube (see below), rather than the 1 mg boluses that would have been used IV. In children, intraosseous access should be considered, but this requires appropriate training and competence.
**Advanced airway management and endotracheal intubation**

Airway patency should be restored and maintained as discussed in ‘Basic Life Support’, p. 12. In the hospital environment, the patient should initially be ventilated using a bag and mask system connected to high flow oxygen, as above.

Efforts should then be made to intubate the patient as soon as possible (chest compressions should be ongoing and stopped only to allow the ET tube through the cords). This protects the airway and reduces the risk of aspiration. However, failed intubation can lead to profound hypoxaemia and the procedure should be attempted only by someone who is trained and competent to do so. Otherwise,
Basic principles of patient care

Bag and mask ventilation should be continued. Intubation attempts should never delay appropriate defibrillation.

Once the airway has been secured and protected by endotracheal intubation, ventilate the lungs at approximately 10 breaths/min. Note that a laryngeal mask airway (LMA) is not considered a protected airway; see below.

Endotracheal intubation: procedure

- perform checks of breathing and obvious obstruction, as above
- look for signs of possible difficult intubation and seek expert help if necessary, e.g. child, facial trauma, receding jaw, small mouth opening, protruding or diseased teeth, large tongue, previous history of difficult intubation
- obtain a selection of handles and blades (varying size and shape) and a selection of tubes of different sizes
- check the laryngoscope and suction bag are working
- wear gloves and consider the need for eye protection
- select a blade – this should reach between lips and larynx, when held against the face
- pre-oxygenate the patient with high flow oxygen
- position the head: assuming no cervical spine injury suspected, choose a central position with a pillow under the occiput and extend the neck slightly
- remove any dentures and check for loose teeth
- stand behind the head and hold the laryngoscope in your left hand and the ET tube in your right
- insert the laryngoscope over the right side of the tongue using the blade to sweep around the tongue
- put the blade between the epiglottis and the base of tongue and lift (up and away from you, using the whole handle rather than pivoting on the teeth or gums) until you can see the glottis
- slide the ET tube along the right side of the mouth and between the vocal cords; make sure the cuff is beyond the cords
- if the procedure takes more than 30 s, STOP and seek help; bag and mask meantime
- otherwise, inflate the cuff and ventilate with high flow oxygen
- secure the tube by passing a cord from the tube around the patient’s neck
- assess for correct position: verify that there is inflation of both sides of the chest; listen for breath sounds on both sides and ensure that there is no gurgling in the stomach on ventilation; obtain CXR.

Laryngeal mask airways

A laryngeal mask airway (LMA) is inserted and inflated blindly into the hypopharynx around the posterior perimeter of the larynx, forming a low-pressure seal around the lumen of the larynx. Positive pressure ventilation can then take place. Although the LMA is a universally used and effective piece of equipment when used properly, it has some limitations:

- it does not guarantee protection of the airway
- high inflation pressures or over-zealous bagging can lead to inflation of the stomach with an increased risk of aspiration of gastric contents, especially during a cardiorespiratory arrest, when chest compressions are ongoing.

Identification of precipitants

Throughout any resuscitation attempt, precipitating factors must be aggressively sought and corrected. The 4 Hs and 4 Ts (see foot of Fig. 1.2) are particularly relevant in patients presenting with non-shockable arrhythmias, but may also be important in those with VF or VT. It is important that the coordinating member of the cardiac arrest team assesses ABC and performs a rapid clinical survey, using whatever information is available:
• examine the neck veins, chest and abdomen; look specifically for evidence of a tension pneumothorax, tamponade or blood loss (e.g. melaena or blood staining around the mouth)
• check a BM and tympanic membrane temperature
• check FBC, U&E, Ca, Mg, Coag, cross-match, ABG and other clinically relevant tests, e.g. level of digoxin or other potential toxins
• speak to nursing or medical staff who know the patient; enquire about recent events and symptoms, e.g. breathlessness, increasing oxygen requirements.

Management of precipitants
Unless there is a good reason to suspect cardiac failure, and particularly in patients with PEA, start a rapid IV infusion of colloid and respond to the results of the initial blood tests as appropriate. Specific causes should be addressed as directed in the relevant sections of this book. Treatments may include:
• insulin–dextrose infusion (10 units Actrapid in 50 mL 50% dextrose) for hyperkalaemia (see p. 204)
• magnesium sulfate (8 mmol IV over 5 min) for VF/VT associated with hypomagnesaemia or torsades de pointes (see ‘Arrhythmias’, p. 132)
• sodium bicarbonate (50 mL 8.4% IV), e.g. for profound acidosis, tricyclic overdose
• calcium gluconate for hyperkalaemia (see p. 204), hypocalcaemia (see p. 207), calcium channel blocker overdose
• thrombolytics for suspected MI or PTE, e.g. tenecteplase 500–600 µg/kg IV over 10 s.