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Assessment of the unwell child

Background

Children present to general practitioners with a wide range of problems, but most of the time they are not particularly unwell. Children with a more serious illness often compensate very well initially, so there is a risk that their illness will be overlooked or underestimated.

Objective

To outline the early recognition and management of children who are seriously ill.

Discussion

The initial assessment of an unwell child includes the paediatric assessment triangle: appearance, breathing and circulation to skin; primary survey that focuses on basic life support, patient assessment and immediate management; secondary survey with a detailed history of the event and physical examination; and ongoing assessment. Medical practitioners and their clinic staff must be prepared to undertake initial emergency management of a seriously ill child, and they must have the equipment and supplies available to carry out that management effectively.

Keywords: child health; emergencies; diagnosis, differential

CPD

Seriously unwell children present particular challenges to the medical practitioner. The anatomy and physiology of children is different to that of adults, and this can result in differences in the presentation and severity of a range of conditions (*Table 1*). Children have a great ability for physiological compensation and some of the early signs of illness may not be obvious. The emphasis should be on detecting and treating the seriously ill child at an early stage to prevent deterioration.

A carefully performed clinical assessment, including observation,[1] history and physical examination, will detect serious illness with 90% sensitivity.[2] Each component of the evaluation is effective in identifying serious illness.

Initial assessment

The assessment of a seriously unwell child involves the following:

- paediatric assessment triangle (PAT) (first impression)
- primary survey (ABCDE assessment)
- secondary survey
  - vital signs
  - focused history
  - detailed physical examination
- ongoing assessment.

Paediatric assessment triangle (first impression)

The PAT provides an accurate method for rapid assessment of a child with an emergency condition, through visual and auditory evaluation of the child's: appearance, work of breathing, and circulation to skin.[3,4] This can be completed in less than 60 seconds and no equipment is required.

Appearance

- Include assessing muscle tone and mental status
- Reflects the adequacy of ventilation, oxygenation, brain perfusion, body homeostasis, and central nervous system function
- 'TICLS' is a useful mnemonic used to recall areas to be assessed related to child's appearance (*Table 2*)
- What is the child's state of consciousness?
- Does the child look ill?

Table 1. Physiological differences between children and adults	
Airway	In children <8 years of age the head is proportionately larger and the neck shorter The trachea in infants is also more malleable, and with the large tongue can result in airway obstruction if the head is overextended Infants <6 months are obligate nasal breathers The epiglottis is horseshoe shaped
Breathing	Small diameters throughout the respiratory system increase the risk of obstruction Infants have ribs that lie more horizontally and they rely on the diaphragm for breathing Increased metabolic rate and oxygen consumption contribute to higher respiratory rates
Circulation	Small stroke volume but a relatively higher cardiac output facilitated by higher heart rates Stroke volume increases with age as heart rate falls, but until the age of 2 years the ability of the paediatric patient to increase stroke volume is limited Systemic vascular resistance is lower The circulating volume to body weight ratio of children is higher than adults at 80–100 mL/kg but the total circulating volume is low
Other	The surface area is high, and this results in rapid heat loss Glycogen stores in the liver are limited and hypoglycaemia can be present in any paediatric patient that has been too ill to feed or with high metabolic demands

Table 2. TICLS mnemonic for assessment of appearance in PAT	
Tone	Is the child moving around and active or listless?
Interactivity/ mental status	How alert is the child? Does he/she reach for and grasp a toy, or is the child disinterested in interacting or playing with the care giver?
Consolability	Can the child be comforted by the care giver?
Look/gaze	Does the child fix the gaze on a face or is there a glassy-eyed stare?
Speech/cry	Is the child's speech or cry strong and vigorous or weak or hoarse?

Work of breathing

- Assess body position, visible movements of chest/abdomen and breathing pattern
- Listen for abnormal audible airway sounds (snoring, hoarse speech, grunting and wheezing)
- Look for visual signs of increased work of breathing such as abnormal position or posture (ie. sniffing position, tripod position, head bobbing), retractions, nasal flaring, grunting, gasping and tachypnoea
- Reflects the adequacy of airway, oxygenation and ventilation. Are the airways obstructed? Is the child short of breath?

Circulation to skin

- Assess skin colour
- Look at the skin and mucous membranes for abnormal colour (pallor, mottling and cyanosis)
- Reflects the adequacy of cardiac output and perfusion of vital organs. Is the skin unusually pale, mottled or cyanotic?

The initial assessment of the child's overall condition is of crucial importance. If the child exhibits abnormal findings, proceed immediately to the primary survey.

Primary survey (ABCDE assessment)

During the primary survey, assessment and management occur simultaneously. The primary survey should be periodically repeated, particularly after major intervention or when a change in the patient's condition is detected.[5–7]

A: Airway

The goal is to assess if the airway is patent or if there are signs of obstruction (eg. stridor, dyspnoea, hoarse voice). Is the airway noisy (eg. snoring, stridor, wheeze, grunting or hoarse speech)?

Determine if the airway is patent, and able to be maintained with positioning and suction, or not. If cervical spine injury is suspected, manually stabilise the head and neck in a neutral, inline position (jaw thrust without head tilt manoeuvre to open the airway).

If the child is unresponsive and cannot talk, cry or cough, evaluate for possible airway obstruction. Look in the mouth for blood, broken teeth, gastric contents and foreign objects. If solid material is visualised, remove it with a gloved finger covered in gauze under direct vision. If a foreign body is suspected but not visualised, a combination of back blows and chest thrusts is recommended in infants. In an older child back blows in a forward leaning position is recommended. Abdominal thrusts in children are not recommended as their effectiveness and safety have not been established.[8–10]

Insert an airway adjunct (eg. oropharyngeal or nasopharyngeal airway, or laryngeal mask airway) as needed to maintain a patent airway. If airway patency cannot be maintained, perform tracheal intubation. Rapid sequence intubation (RSI) should be considered in all

patients, except those in cardiac arrest, to provide optimum conditions and to minimise the potential for aspiration.

The appropriate tube size can be determined by the following formula: inner diameter (mm) = (age in years/4) + 3 (cuffed tubes) or + 4 (uncuffed tubes).

In practice, estimation of the tube size from the diameter of the patient's little finger has been found to be quite practical.[11] *Table 3* describes tube size according age.

B: Breathing and ventilation

The goal in assessing breathing and ventilation is to determine whether there is adequate gas exchange.[2]

- Will the child lie flat? Are they in the tripod or 'sniffing' position?
- Are accessory muscles being used (head bobbing in infants)? Or is there minimal movement of the chest wall?
- Is there sternal, supraclavicular, substernal, or intercostal recession present?
- Is nasal flaring present?
- Is the respiratory rate fast, slow, or normal?
- Is cyanosis present?
- Is air movement audible on auscultation?
- What is the oxygen saturation ($Sp0_2$)?

Place your cheek near the child's face and mouth and feel/listen for air movement and look at the chest/abdomen for respiratory movement. The child with breathing difficulty often has a respiratory rate outside the normal limits for their age. Normal respiratory rate values according to age are listed in *Table 4*. Initially the child becomes tachypnoeic, and as fatigue begins and hypoxia worsens, the child may progress to respiratory failure and bradypnoea.

On auscultation with a stethoscope over the mid axillary line, try to hear abnormal lung sounds (eg. wheeze, crackles, snoring). Palpate the chest for tenderness, instability and crepitations.

All children with breathing difficulties should receive high flow oxygen through a face mask oxygen as soon as the airway has been assessed and demonstrated to be adequate. Pulse oximetry is an excellent tool to use in assessing a child's breathing. A pulse oximetry reading above 94% indicates that oxygenation is probably adequate.[12,13] A reading below 90% in a child with 100% mask oxygen could be an indication for assisted ventilation.

If the child is breathing adequately but is unresponsive, place the patient in recovery position (lateral recumbent) after assessing ABCD with no other abnormal findings. If breathing is absent or the child is hypoventilating (slow respiratory rate or weak effort), respiration should be supported with oxygen via bag-valve-mask device and an airway adjunct needs to be inserted (eg. laryngeal mask airway, tracheal tube).[7]

C: Circulation

The goals are to assess adequate cardiovascular function and tissue perfusion, ensure effective circulating volume, and in trauma, control of bleeding.

- Is skin colour normal, or is it pale or mottled?
- Is there an increased respiratory rate without increased work of breathing?
- Is it cool peripherally but warm centrally?
- Is the pulse rate fast, slow, or normal?
- Is the pulse volume weak or strong?
- Is the capillary refill time (CRT) normal or prolonged?

It is important to determine the heart rate, pulse quality, skin temperature, CRT, and blood pressure (BP). Normal heart rate varies with age (as noted in *Table 4*); tachycardia can be an early sign of hypoxia or low perfusion, but it can also reflect less serious conditions (eg. fever, anxiety, pain). Bradycardia (rate <60/min in children or <100/min in newborns) indicates serious illness and poor myocardial perfusion.[1,6]

Table 3. Appropriate diameter and length of endotracheal tube and type of laryngoscope, by height of patient

Height (cm)	58–70	70–85	85–95	95–107	107–124	124–138	138–155
Age (years)	0–1	1–2	2–3	3–4	4–7	7–9	9–12
Inner diameter of uncuffed endotracheal tube	3.5–4.0	4.0–4.5	4.5	5.0	5.5	6.0	6.5
Length from mouth (cm)	10	12	13	14	15	17	18
Laryngoscope blade	1 straight	1 straight	2 straight	2 straight or curved	2 straight or curved	2–3 straight or curved	3 straight or curved

Table 4. Normal respiratory rate, heart rate and blood pressure for age

Age	Respiratory rate (breaths/min)	Heart rate (beats/min)	Minimum systolic blood pressure (mmHg)
Infant	30–60	100–160	>60
Toddler	24–40	90–150	>70
Preschooler	22–34	80–140	>75
School aged child	18–30	70–120	>80
Adolescent	12–16	60–100	>90

Pulse quality reflects the adequacy of peripheral perfusion. A weak central pulse may indicate decompensated shock, and a peripheral pulse that is difficult to find, weak or irregular suggests poor peripheral perfusion and may be a sign of shock. Check the femoral pulse in infants and young children, or the carotid pulse in an older child or adolescent. If no pulse is felt, and there are no, or minimal signs of life, commenced cardiopulmonary resuscitation (CPR).`

Next, evaluate the CRT, skin colour and temperature. Normal CRT is less than 2 seconds. The CRT should be done centrally (eg. on the chest) to minimise the impact of environmental factors.

Blood pressure determination and interpretation can be difficult. Normal BP values in children vary according to age and are difficult to remember. (Tables such as *Table 4* can be very useful in clinical practice.) A low BP indicates decompensated shock.[14–16]

An easy formula for determining the lower limit of acceptable BP is: minimal systolic blood pressure = 70 + [2 x age in years].

Blood pressure trends are useful in determining the child's condition and response to treatment.

Vascular access

Obtaining venous access in a child can be a challenge. Commonly used venepuncture sites are the dorsum of the hand or foot, the medial surface of the ankle, the forehead, and the scalp. The current guidelines of the European Resuscitation Council (ERC) recommend intraosseous (IO) puncture as the method of choice.[5] All of the intravenous emergency medications currently in use can be given through an IO needle. The recommended first line puncture site in children is the medial side of the proximal portion of the tibia, 1–2 cm below the tibial tuberosity. The recommended strategy is an IO approach after a maximum of three unsuccessful attempts to obtain venous access, or after 90–120 seconds of trying. If the child is having active CPR the IO access is the method of first choice in gaining vascular access.[3,17]

D: Disability (mental status)

Assess the patient by looking at appearance as part of PAT and at level of consciousness with the AVPU (Alert, response to Verbal stimuli, response to Pain, Unresponsive) scale.

The Paediatric Glasgow Coma Scale is a second option (*Table 5*).[18,19] Evaluate the brainstem by checking the responses in each pupil to a direct beam of light. A normal pupil will constrict after a light stimulus. Evaluate the motor activity by looking for symmetrical movement of the extremities, seizures, posturing or flaccidity.

- What is the child's AVPU score?
- Is the child mobile? Or is there limited movement with poor muscle tone?
- If the child is crying or speaking, is this strong or weak?
- If crying, can the child be consoled?
- Does the child fix their gaze on the carer(s), or does he/she have a 'glazed' appearance?
- Is the child's behaviour normal for their developmental age?
- Is the child fitting, stiff or floppy?

Table 5. Paediatric Glasgow Coma Scale

Child	Infant	Score
Eye opening		
Spontaneous	Spontaneous	4
To speech	To speech	3
To pain	To pain	2
No response	No response	1
Verbal response		
Oriented	Coos, babbles, fixes, follows	5
Confused	Irritable, cries but consolable	4
Inappropriate words	Cries to pain, inconsolable	3
Incomprehensible sounds	Moans to pain	2
No response	No response	1
Motor response		
Obeys	Moves spontaneously	6
Localises	Withdraws to touch	5
Withdraws	Withdraws from pain	4
Decorticate to pain	Decorticate to pain	3
Decerebrate to pain	Decerebrate to pain	2
No response	No response	1

Table 6. SAMPLE mnemonic – secondary survey: obtaining complete history, including mechanism of injury or circumstances of the illness

Signs/symptoms	Onset and nature of symptoms Age appropriate signs of distress
Allergies	Known drug reactions of allergies
Medications	Exact names and doses of drugs, timing and last dose
Past medical history	Previous illness or immunisations
Last food or liquid	
Events	Leading to the injury or illness

With knowledge of the child's appearance from the PAT and AVPU scale, if the disability assessment demonstrates altered level of consciousness, begin with general life support/monitoring with oxygen, cardiac monitoring, and pulse oximetry.

E: Exposure

Proper exposure of the child is necessary for completing the initial physical assessment. The PAT requires removal of part of the child's clothing to allow careful observation. Be careful to avoid rapid heat loss, especially in infants and children in a cold environment.

- Is there fever?
- Is there a nonblanching rash present?
- What is the blood glucose level?

Secondary survey

The secondary survey focuses on advanced life support interventions and management.[5,6,20] It is important to perform an additional assessment with a focused history and physical examination in stable patients. Generally, the initial assessment is aimed at detecting immediate life threatening problems that can compromise basic life functions, as in the primary survey. The secondary survey is intended to detect less immediate threats to life and has several specific objectives:

- obtaining a complete history, including mechanism of injury or circumstances of the illness. The SAMPLE mnemonic can be helpful (*Table 6*)
- performing a detailed physical examination
- establishing a clinical diagnosis
- performing laboratory investigations and imaging.

Table 7. Recommended equipment for paediatric office emergencies

	Priority
Airway management	
Oxygen delivery system	E
Bag-valve-mask (450–1000 mL)	E
Clear oxygen masks, breather and nonbreather, with reservoirs	E
Suction device, tonsil tip, bulb syringe	E
Nebuliser (or metered dose inhaler with spacer and mask)	E
Oropharyngeal airways (00–5)	S
Pulse oximeter	S
Vascular access and fluid management (butterfly needles, catheters, intraosseous devices, intravenous tubing)	S
Miscellaneous equipment and supplies	
Sphygmomanometer (infant, child, adult, thigh cuffs)	E
Splints, sterile dressings	E
Spot glucose test, heating source, stiff neck collar	E

E = indicates essential; S = strongly suggested (essential if emergency services response time is more than 10 minutes)

Ongoing assessment

Always reassess the patient; the purpose is to assess the effectiveness of the emergency interventions provided and identify any missed injuries or conditions. This should be performed in every patient after the detailed physical examination and after ensuring completion of critical interventions.[21]

Preparing for an emergency in the office

The physician caring for children must be prepared to recognise, stabilise and manage paediatric emergencies in the clinic setting. This requires familiarity with the symptoms and signs of serious illness.

The medical practitioner must have the necessary equipment and supplies available in the clinic to effectively assess and care for a child with a potential emergency. Studies have shown that physicians' offices are not well prepared for the emergently ill child, although emergencies do present to the office.[22,23]

In addition to equipment, the practice office must have a plan for how a paediatric emergency will be managed. The front desk staff must know how to recognise an emergently ill child and how to get that child immediate medical attention. The office should have a planned location, such as a treatment room, where emergencies are handled and where supplies are available. Care providers should regularly review paediatric advanced life support procedures and protocols. For GPs who practise in an office located in or near a hospital, basic airway equipment may be all that is needed. However, for practices that have prolonged emergency response times, stabilisation efforts may need to be maintained for up to 30 minutes before emergency medical services arrive.[23,24]

A list of recommended equipment for office emergencies is provided in *Table 7*, and a list of recommended medications is provided in *Table 8*. Equipment and medications should be checked on a regular basis to ensure that all essential items are present, operating properly and not expired.

Table 8. Recommended office emergency drugs

	Priority
Drugs	
Oxygen	E
Salbutamol (inhalation)	E
Adrenaline (1:1000)	E
Anticonvulsant agents (eg. midazolam, diazepam)	S
Corticosteroids	S
Adrenaline (1:10 000)	S
Atropine sulphate (0.1 mg/mL)	S
Naloxone (0.4 mg/mL)	S
Ceftriaxone	E
Fluids	
Normal saline solution	S

E = essential; S = strongly suggested (essential if emergency services response time is more than 10 minutes)

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