
Clinical Assessment and Monitoring in Children

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Preface

Welcome to the first edition of *Clinical Assessment and Monitoring in Children*. Children are no longer considered as little adults; their physiology and response to illness is very different to adults and therefore they need a different approach with regard to assessment and monitoring.

Health care practitioners require a range of examination techniques to choose from depending on the different age groups and clinical presentations. This book provides the reader with a comprehensive range of approaches. I hope that all those caring for children will find it a valuable resource.

Diana Fergusson

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INTRODUCTION

This book is designed for health care practitioners learning to care for sick children. All children routinely have assessment and monitoring performed on them as part of their overall care. Assessment is the collection of data including subjective (what the child/family says) and objective (what the health care practitioner finds with the techniques of inspection, palpation, percussion and auscultation). Monitoring is the recording of specific data, often using a device.

LEARNING OBJECTIVES

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

- ☐ Understand the key components in undertaking a comprehensive health history.
- ☐ Introduce some concepts of assessment and principles of examination techniques in different child age groups.

CHILD AGES

Childhood is a time of growth and development into adulthood and therefore children are not small adults and should not be considered as such. Physiologically, adolescence approaches adulthood and young people may be treated medically within an adult framework. Table 1.1 outlines the terms clarifying different age groups (Wong 1995; Gill & O'Brien 2002).

Young children are unable to articulate clearly their problems and may demonstrate unwellness in other ways. Look for the child who is:

- quiet (abnormally so);
- not eating or refusing food (even when it is a favourite);

- lying down or adopting a position that is most comfortable to him or her.

HISTORY-TAKING

History-taking aims to achieve a complete picture of the child's health status (Jarvis 2003).

Identifying data

Data must adhere to local policy and legal requirements, including:

- name
- parents' details
- address and phone number
- date of birth
- school attended
- ethnicity

Chief complaint and history of presenting illness

Most information about the unwell child will come from the history. Often the mother or the primary carer is the key person to verbalise concerns. The primary carer will know the child best of all and will know when something is not quite right. Ask them what they think is wrong; their intuition is usually good. It is important to document exactly what the child/carer states is wrong with the child as misinterpretation of what has been said can mislead the assessment and management of the problem.

Table 1.1 Classification of age groups.

Classification	Age ranges
Newborn/neonate	0–28 days
Infant	1–12 months
Toddler	1–3 years
Pre-schooler	3–5 years
School age	5–18 years
Early adolescent	10–14 years
Late adolescent	15–18 years

Table 1.2 OLDCART: a model of history taking.

Key issues	Example questions
O = onset	When did it start?
L = location	Where is it (point to it)? Does it go anywhere? Is it superficial or deep?
D = duration	How long does it last? How often does it come?
C = characteristics	What effects does it have on the child (stops him or her playing, eating)? Is it sharp, dull, aching, throbbing, shooting, burning? How strong is it? Is it constant or intermittent? What brings it on? Does it occur in a specific environment or with specific activities or a particular emotional state?
A = associated symptoms	Are there any other symptoms?
R = relieving/aggravating symptoms	What makes it better? What makes it worse?
T = treatments	What have you done to treat it?

Establishing a good relationship, including optimal listening skills, is therefore most important. Clarify what is meant by terms that are used to describe a sign or symptom. Let the child/parent/caregiver talk about concerns, then use a model or framework to capture specific information on the history of present illness. Table 1.2 outlines one model, and taking a history of pain is used as an example (Bickley 2003). Check that you:

- ask only one question at a time;
- refrain from use of jargon;
- are not judgmental;
- are not using vague terms.

Past medical history

Pregnancy and birth details are particularly important for the child who is less than 2 years of age or who has any neurological or developmental problems (Engel 1997). Ask about:

(1) Pregnancies

- number of pregnancies and the outcome of these;
- the pregnancy of this child:
 - nausea and vomiting
 - vaginal bleeding
 - unusual or unexplained weight gain
 - weight loss
 - blood pressure
 - oedema
 - accidents
 - results of any fetal heart scan
 - infections
 - drug-taking: prescribed, over-the-counter and recreational (known teratogens include phenytoin, warfarin, lithium, carbamazepine, trimethoprim, sodium valproate) (Archer & Birch 1998)
 - alcohol use
 - maternal diabetes (increased risk of congenital heart disease (CHD))
 - other maternal medical history (increased risk of CHD with phenylketonuria, systemic lupus erythematosus)
 - rubella in first trimester (known teratogen)
 - age of mother at birth (over 40 years involves increased risk of genetic disorders, e.g. Trisomy 21).

(2) Birth

- spontaneous or induced labour;
- normal vaginal delivery, vertex, breech or caesarean section delivery;
- term or premature;
- APGAR – see Table 1.3 (a tool used at 1 minute and 5 minutes after birth) (Farrell & Sittlington 2003);
- any problems at birth and the outcomes of these;
- birth weight;
- congenital infections;
- respiratory difficulty and the outcome of this.

(3) Neonatal period: if any problems occurred and what the outcome was:

- jaundice
- colic

Table 1.3 APGAR scores.

Measure	Score 0	Score 1	Score 2
Appearance (colour)	Pale or blue	Centrally pink, peripherally blue	Pink
Pulse (heart rate)	Zero	<100	>100
Grimace (response to stimuli, e.g. suctioning of pharynx)	No response	Grimace	Cry
Active (muscle tone)	Limp	Some flexion in extremities	Good flexion
Respirations	Zero	Slow and irregular, weak cry	Normal, good cry

- breathing difficulties
- feeding problems
- seizures
- mother's health.

(4) Feeding (see Chapter 9).

(5) Growth and development (see Chapter 6).

Previous illnesses, operations or injuries

- Childhood illnesses (including measles, mumps, chicken pox) and any recent exposure to illness, foreign travel.
- Accidents and injuries; the extent of injuries, the treatment and any complications.
- Serious illnesses, admissions to hospital/operations; the extent of injuries, the treatment and any complications, the child's reaction to being in hospital.
- Minor illnesses.
- Chronic illnesses; onset, treatment and any complications.

Immunisations

- Specific details of schedule.

Allergies

- Include medications, food and pollen and what symptoms may be suffered.

Medications

- All over-the-counter, prescribed and complementary therapy.
- The use of tobacco, social drugs and/or alcohol.

Family history

- Draw a genogram (also known as a family tree). Figure 1.1 shows an example.

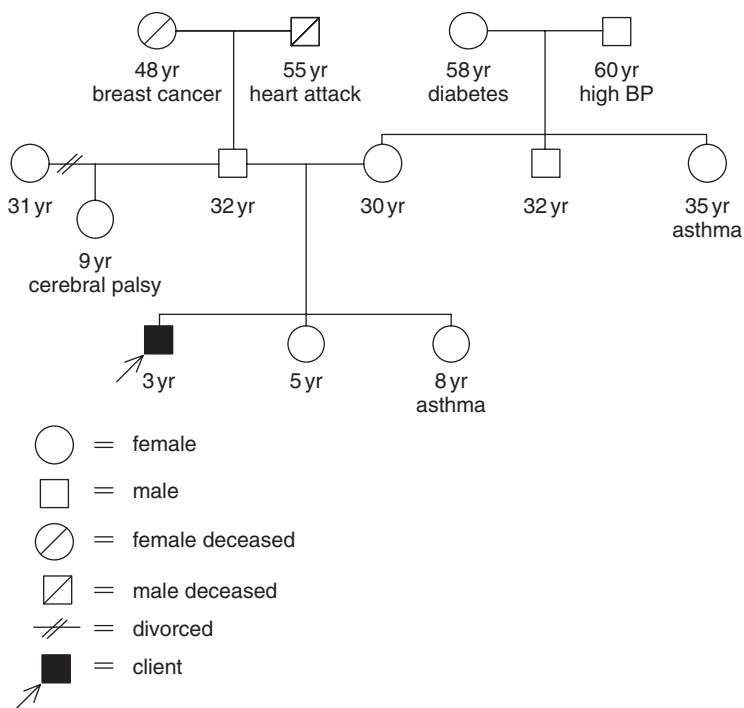


Fig. 1.1 A genogram.

- Include age and cause of deaths in the family.
- Establish who is the family of this child and any support systems, e.g. neighbour, friend, grandparents.
- Exposure to smoking.
- Any history in the family similar to the symptoms of the child.
- Hypertension, vascular disease (cardiac, cerebral, peripheral), kidney problems, diabetes mellitus, cancer, blood disorders, arthritis, allergies, mental illness, seizures, learning difficulties.
- Genetic or congenital disorders: include enquiry into any dysmorphism to see if there are any congenital underlying causes.

Psychosocial history

- Single or married/de facto relationship.
- Parent employment.
- Housing (Goldbloom 1997).
- Social care assistance.
- Any child protection issues.

Review of systems

This helps to evaluate previous and current status of the body systems and checks that nothing has been missed so far. It may be more useful to write that a symptom is either present or absent rather than labelling a system as 'negative'. In this scenario, it is unclear exactly what has been assessed. Check with the carer/child about any problems they have experienced with each of the systems, including (see subsequent chapters for further details):

- general health: weight (loss, increase), fatigue, general wellness
- skin: eczema
- head and neck: head, eyes, ears, nose, mouth, throat, neck
- breasts
- respiratory: coughs, colds
- cardiovascular: heart disease
- gastro-intestinal: diarrhoea, vomiting

- renal
- genital
- musculoskeletal: fractures
- neurological: any loss of consciousness
- haematological: bleeding
- endocrine: diabetes
- psychiatric

PHYSICAL EXAMINATION

Objective data can be obtained with the use of physical examination techniques. These are fully described for each system in subsequent chapters. Some techniques are considered advanced and will be noted as such. Children have the right to privacy and maintenance of dignity during examination. Although the chapters provide a systematic approach to examination, the health care practitioner needs to be opportunistic in gathering objective data. The following techniques are the cornerstone of comprehensive physical examination and are usually undertaken in the following order. However, flexibility is essential in examining children; taking opportunities and going from least disturbing to most disturbing may provide more information for the health care professional. Age-appropriate distraction and diversion strategies should be used where possible. Use parents/carers where possible and appropriate; do not remove the child from parents unless necessary.

Inspection

This technique includes careful observation of the child and the skills of inspection and observation often provide the most significant data. These skills can be undertaken during the history-taking process. Always compare symmetry and adequate exposure is required.

Palpation

This technique helps to confirm inspection findings and uses the sense of touch to elicit information. Ensure your hands are warm and use a calm and gentle approach.

Percussion

The percussion technique is one whereby the skin is tapped, setting the underlying tissue in motion. The health care practitioner can then determine the density of the underlying tissue, e.g. whether the lung tissue is filled with fluid, air or solid matter (Bickley 2003). The sounds produced are called notes. The location and size of organs can also be determined, as the density of the tissue changes at the organ's borders. It is a difficult technique to master and is not always helpful in examining young children and infants.

Percussion technique (advanced technique) usually involves:

- placing the most distal joint (interphalangeal joint) of the hyper-extended middle finger of the left hand (pleximeter finger) on the body, avoiding bony tissue;
- striking this joint with the flexed middle finger of the right hand with a short, sharp strike, and often two strikes;
- removing the fingers as quickly as possible so that the sound that is generated is not dampened (Bickley 2003).

Auscultation

This technique is used to listen to the sounds of the body. The stethoscope should be:

- of the correct size, i.e. neonatal, paediatric or adult (late adolescents) to achieve skin contact and localise sounds, accessing small areas at a time;
- warm: this may be accomplished by rubbing the diaphragm and bell with a hand or bed clothing;
- clean: clean with alcohol between use.

The bell is used for low-pitched sounds:

- heart sounds: S3, S4;
- when using the bell, do not press hard as the membrane may then come in contact with the skin, thereby producing a diaphragm-like technique.

The diaphragm is used for high-pitched sounds:

- breath sounds;
- heart sounds: S1, S2, ejection click, opening snap, friction rubs;
- bowel sounds.

APPROACHES

When examining an infant:

- position the baby on the parent's lap or at least in close proximity to the parent;
- have the baby fed an hour or so prior to the examination;
- keep the environment warm;
- use a soft 'baby' tone of voice;
- smile at the baby and play;
- use a pacifier (with parental consent).

When examining a toddler:

- position the child on the parent's lap;
- ask and then instruct the parent to help with positioning for more disturbing procedures;
- promote the presence of a favourite toy/item;
- do not give a choice to the child where there is no choice; however, do give plenty of choice where there is a choice, e.g. you need to listen to the child's chest and the child's choice might consist of whether this is undertaken on the parent's lap or on the bed, before or after you listen to teddy's chest.

When examining the pre-schooler:

- the child may prefer a parent's lap or the examination table;
- pre-schoolers are usually co-operative but may not like invasive procedures;
- allow them to play with and examine any equipment you are using;
- they require short and simple explanations;
- do not give a choice to the child where there is no choice; however, do give plenty of choice where there is a choice, e.g. you need to listen to the child's chest and the child's choice

might consist of whether it is undertaken on the parent's lap or on the bed, before or after you listen to teddy's chest;

- use games to undertake examination where possible, e.g. blowing up a balloon when listening to the chest;
- tell them how well they are doing during the examination.

When examining the school-age child:

- it is usually undertaken on the examination table;
- be mindful of their increasing modesty;
- start with getting to know the child, e.g. ask about school and their friends;
- let the child examine any equipment;
- allow the child to hear or feel your findings, e.g. listen to heart beat.

When examining a young person:

- they usually do not want a parent present;
- take care not to treat as a child but also not as an adult;
- body image is important.

DOCUMENTATION

It is important to write up findings so that it is clear what you have assessed (NMC 2002) as well as to use language that is understood by the multi-disciplinary team. Notes must adhere to local policy and legal requirements:

- Write in black or blue pen.
- Write comprehensively yet succinctly, stating facts and findings.
- Record date and time.
- Provide signature and printed name of the health care professional along with designation.
- Avoid unapproved abbreviations.

SUMMARY

History-taking, physical examination and monitoring provide a comprehensive tool to assist the health care practitioner in clinical decision-making when caring for sick children and their families. Comprehensive history-taking provides a significant

amount of subjective data and this is then objectively defined through the examination techniques of inspection, palpation, percussion and auscultation. Advanced communication skills and knowledge of child growth and development are essential. Accurate documentation provides the multi-disciplinary team with information on the extent of the assessment. It is commonly considered that if it is not written, it has not been done.

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INTRODUCTION

Respiratory assessment in infants and children is critical in evaluating severity of illness. The history and physical assessment techniques of inspection, palpation, percussion and auscultation can be used to determine efficacy of breathing, work of breathing and adequacy of ventilation. Respiratory distress occurs primarily when there is a respiratory problem (there are other secondary causes) and the child is using all compensatory techniques available to maintain adequate ventilation and oxygenation. Once these techniques become ineffective at maintaining adequate ventilation and oxygenation (i.e. blood oxygen levels fall and blood carbon dioxide levels increase), respiratory failure occurs. Respiratory failure is the most common pathway to cardiorespiratory arrest from which there is a poor outcome (Resuscitation Council (UK) 2004). The aim of this chapter is to understand the principles of respiratory assessment for different age groups.

LEARNING OBJECTIVES

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

- ☐ Appreciate the importance of taking a history.
- ☐ Outline the steps of a comprehensive assessment.
- ☐ Recognise symptoms of respiratory distress and respiratory failure.

HISTORY

There is often an overlap with head and neck review (see Chapter 11). The specific respiratory symptoms to ask about include:

- any previous respiratory illnesses, e.g. bronchiolitis or croup;
- any previous respiratory tests and investigations (including results), e.g. chest X-ray;
- sore throat or any difficulty swallowing;
- rhinorrhoea;
- cough: including when it occurs most, whether it is productive and if so a description of the content;
- haemoptysis: may indicate cystic fibrosis, foreign body aspiration, respiratory infection;
- fever (how often) or night sweats;
- difficulty in breathing including wheeze, croup, stridor, grunting, snoring;
- 'shortness of breath': may indicate obstruction, pulmonary oedema, pneumothorax or asthma.

(Hughes 1997)

PHYSICAL ASSESSMENT

Physical examination of the respiratory system should where possible include examination of both the anterior and posterior chest (Bickley 2003). Most of the information required in the respiratory system is gathered by effective inspection skills, particularly in the young child and infant (Gill & O'Brien 2002). Whilst maintaining adequate dignity and privacy, the child's chest needs to be naked for effective examination. It may be appropriate to ask teenage girls to displace their breasts for examination if necessary.

Inspection

(All basic skills)

Position

Observe and support the child's position of comfort. A wide variety of positions can be adopted to promote ventilation and decrease the work of breathing, e.g.

- epiglottitis – sitting upright, slightly forward and with neck extended;

- cystic fibrosis – sitting forward with arms supported on an overbed table.

Facial expression

Note the child's facial expression. When there is inadequate gas exchange even young infants can look:

- tense
- tired
- anxious (Gill & O'Brien 2002)

The child's ability to speak normally can also indicate level of 'shortness of breath', tiredness and consciousness; assess response to questions and note if the child is using stilted sentences.

Level of consciousness (see Chapter 7)

The child's level of consciousness may provide further information on:

- hypoxia – demonstrated by anxiety, restlessness, irritability;
- hypercapnoea – demonstrated by drowsiness, obtundation (Curley & Thompson 2001)

Colour

Evaluate the colour of the skin, which should be consistent with the child's ethnic background. The mucous membranes of the mouth are assessed for central colour (indicating a respiratory aetiology), whilst the nail beds of fingers and toes are observed for peripheral colour (indicating a cardiovascular aetiology). The normal colour is pink. Note that:

- cyanosis is a late sign of respiratory failure;
- mottling of the skin over the trunk and extremities often indicates inadequate tissue oxygenation;
- newborn babies may have a normal peripheral cyanosis as they adapt to extra-uterine life.

Respiratory rate and rhythm

Infants may normally have a slightly irregular breathing pattern and/or short periods of apnoea (less than 15 seconds) and

Table 2.1 Range of normal respiratory rates for different ages.

Age	Respiratory rates (per minute)
Newborn	30–60
Infant	30–60
Toddler	24–40
Child	18–30
Older child (>12 years)	12–16

Table 2.2 Definitions of abnormal respiratory patterns.

Abnormal respiratory pattern	Definition
Tachypnoea	Respiratory rate too fast
Bradypnoea	Respiratory rate too slow
Apnoea	Absent breathing
Dyspnoea	Difficult or laboured breathing
Hyperpnoea	Deep and rapid breathing
Ataxic	Unpredictable and irregular breathing

therefore respirations need to be counted for a full minute in this age group. However, apnoeas lasting longer than 15 seconds accompanied by other signs of respiratory distress are significant. Table 2.1 shows the normal range of respiratory rates (Curley & Moloney-Harmon 2001).

Tachypnoea is usually the first sign of respiratory distress (Kerem 1996), and as the child tires, the respiratory rate will decrease. Therefore a 'normalising' respiratory rate may be an ominous sign of respiratory failure. Table 2.2 outlines the definitions of abnormal respiratory patterns.

The ratio of inspiration to expiration time (I:E) ratio is normally 1:2. However:

- prolonged inspiration occurs with upper airway obstruction, e.g. croup;
- prolonged expiration occurs with lower airway obstruction, e.g. asthma.

Table 2.3 Physiology of abnormal respiratory sounds.

Abnormal respiratory sounds	Inspiratory/ expiratory	Physiology
Stridor Suggestive of upper airways disease, e.g. croup	Inspiratory	High-pitched noise due to air forced through a narrowed upper tracheal airway
Grunting Suggestive of diseases causing alveolar collapse, e.g. pneumonia (Gill & O'Brien 2002) or atelectasis <i>Grunting is an ominous sign</i>	Expiratory	Infants and young children breathe out against a partially closed glottis, attempting to increase end-expiratory pressure in the alveoli, and thereby keeping them open longer. This attempt is similar to the older child who breathes with pursed lips
Wheezing Suggestive of lower airway narrowing, e.g. asthma (SIGN/BTS 2003)	Expiratory (inspiratory and bi-phasic may also be heard)	Air is being forced out through narrowed lower airways

Respiratory sounds

The child's breathing should be quiet and effortless. When noises occur, note their characteristics and where they occur in the respiratory cycle. Table 2.3 outlines the physiology of abnormal respiratory sounds.

Chest wall shape

Infants have round chests because of the horizontal position of ribs and this imposes limitations on expansion. By school age, the chest cage resembles that of an adult. Other deformities can also limit adequate ventilation and gas exchange (Hughes 1997; Bickley 2003). Table 2.4 shows the definitions of chest deformities.

Chest expansion

Early in infancy, diaphragmatic breathing is usually observed. This means that the abdomen rises with inspiration and chest

Table 2.4 Chest deformities.

Chest deformity	Definition
Scoliosis	Lateral curvature of spine
Kyphosis	Exaggeration of normal posterior convexity of thoracic spine
Pectus carinatum	Also known as pigeon chest Sternum is more anterior Indicates chronic lung disease, e.g. asthma (SIGN/BTS 2003) or cystic fibrosis
Pectus excavatum	Also known as funnel chest Sternum is depressed
Harrison's sulcus	Depressions just below the subcostal margins Due to diaphragmatic contractions Associated with chronic airways disease
Hyperinflation	Chest becomes more barrel shaped Associated with gas trapping in the airways, e.g. bronchiolitis

expansion is minimal and then vice versa on expiration. This paradoxical breathing becomes exaggerated if the lungs become less compliant. This is often known as 'seesaw' breathing. In infancy, if there is only thoracic breathing, diaphragmatic function may be impaired.

Normal diaphragmatic breathing slowly reverses and by about 7 years of age the abdomen and chest should move together (Engel 1997). At this age if abdominal breathing becomes predominant, lung disease may be indicated.

Observe that chest expansion is equal and symmetrical and note that unequal symmetry can be associated with:

- pneumothorax
- pneumonia
- chest trauma
- atelectasis
- inhaled foreign body

Accessory muscles

When gas exchange is inadequate due to increased airway resistance (increased pressure in the airways, e.g. obstruction) or

decreased lung compliance (decreased ability of the lung to expand, e.g. pneumonia), accessory muscles are used to increase the work of breathing to improve the gas exchange.

Note any of the following muscle use:

- internal and external intercostal muscles contract;
- abdominal muscles contract, causing 'abdominal breathing';
- scalene and sternocleidomastoid muscles in the neck contract to produce 'head bobbing' in infants;
- scalene and sternomastoid muscles in the neck contract in children (Hughes 1997);
- enlarging the nostrils on inspiration helps reduce airways resistance and maintains airway patency, and is known as 'nasal flaring';
- pursing of the lips in expiration maintains end-expiratory pressure within the alveoli (keeping them open) – occurs in the older child.

Chest recession

Also known as retractions, chest recession occurs in both infants and children (Curley & Thompson 2001) as a result of the increased work of breathing. The infant's soft and compliant rib cage collapses inward on inspiration with diaphragmatic contraction and then moves outward on expiration with diaphragmatic relaxation.

Upper airways disease is often associated with upper chest recession and lower airways disease with lower chest recession (Curley & Thompson 2001). Ventilation can become ineffective and therefore chest recessions are a significant sign of respiratory distress. Figure 2.1 shows where recessions can be found.

Clubbing of the finger and toe nails

Clubbing is caused by a proliferation of nail bed tissue that raises the nail's base towards the skin (Engel 1997). The finger end becomes rounded and the nail fold becomes spongy. It is associated with chronic hypoxia from either a respiratory cause or cardiac condition. The severity of clubbing is measured by the degree to which the nail bed is lifted up by the proliferation (Bickley 2003). Observe:

- the nail–skin junction and assess the angle from the lateral aspect of the digit, as shown in Fig. 2.2a (clubbing evident);
- for a diamond-shaped gap formed when the older child/young person lays the distal phalangeal joints of opposite fingers together, as shown in Fig. 2.2b (no clubbing evident).

Cough

The characteristics of a cough are important (Hughes 1997). Note the following:

- sudden or gradual onset;
- productive or non-productive;
- progressive or stagnant;
- sputum examination for colour, consistency, odour and amount. Note that infants and young children usually swallow their secretions (Gill & O'Brien 2002).

Coughing is often associated with other abnormalities, as shown in Table 2.5.

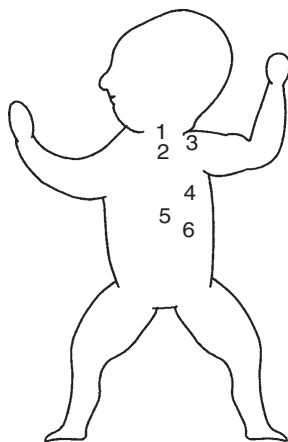


Fig. 2.1 Sites of chest recessions. 1 Tracheal tug (infant and child); 2 suprasternal (infant and child); 3 clavicular (infant and child); 4 intercostal (infant and child); 5 substernal (infant); 6 subcostal (infant and child).

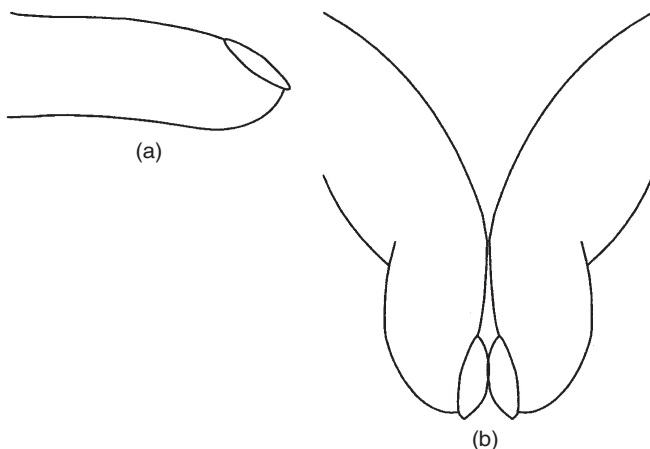


Fig. 2.2 Clubbing of the fingers. (a) Clubbing evident; (b) no clubbing evident.

Table 2.5 Cough associations.

Cough description	Indication	Sputum may be
Barking with stridor and hoarseness	Croup	
Laryngeal with hoarseness	Viral	
Dry, prolonged	Asthma	Absent, minimal
Dry, becoming rattling	Bronchitis	Large amount, smelly
Deep, unproductive	Lobar pneumonia	Absent, minimal
Deep, chesty, productive	Bronchopneumonia	Discoloured, purulent
Spasmodic, repetitive, with sudden 'whoop' on inspiration, followed by vomiting	Pertussis	Large amounts, thick, tenacious
Worse at night	May be due to a change in temperature and/or humidity	

Palpation

In infants and young children, some aspects of palpation (using hands to feel) may not be easily performed or interpreted and therefore examination must be considered within the context of the whole physical examination. Ensure that hands are warm and nails are short.

Position of trachea

(Advanced skill)

Using one finger in young children and two in older children, check that the trachea is in the midline. Deviation is not common in infants and toddlers due to mobility of trachea (Gill & O'Brien 2002). See Table 2.6 for indications of a tracheal shift.

Chest expansion

(Basic skill)

This is usually assessed adequately visually, especially in the infant and young child. However, placing hands circumferentially along the lower costal margins and assessing inspiratory expansion for adequacy and symmetry may provide further information. Ask the co-operative child to take a deep breath.

Tenderness and observed abnormalities

(Advanced skill)

Palpate over the chest and note any areas of tenderness. Assess any observed findings of lesions, bruises, scars or masses. When air enters the subcutaneous tissue, crackling, known as subcutaneous emphysema, is palpated (Hughes 1997). Causes include:

- tracheostomy formation;
- chest wound or drainage;
- severe pulmonary air-leaks, e.g. pneumomediastinum or pneumothorax.

Rhonchi or secretions may be palpated over the chest as the chest wall in younger children and infants is thin. Note any grating sensations that may indicate a pleural friction rub as the pleural layers become inflamed and rub against each other with respiration (Bickley 2003).

Table 2.6 Tracheal deviation.

Tracheal shift to the left	Tracheal shift to the right
Atelectasis on left side	Atelectasis on right side
Large pleural effusion on right side	Large pleural effusion on left side
Large pneumothorax on right side	Large pneumothorax on left side

Tactile or vocal fremitus

(Advanced skill)

You can feel the vibrations (fremitus) transmitted from the bronchopulmonary tree to the chest wall when the child speaks (ask them to say '99') or cries. To feel these vibrations:

- Place either the palms or the ulnar surface of your hands on the child's chest:
 - each side of the sternum for anterior chest examination;
 - each side of the vertebral column for posterior chest examination.
- Move symmetrically down the chest wall and then laterally to the mid-axilla line.
- Fremitus (vibrations) should be felt symmetrically (Bickley 2003).

Table 2.7 outlines increased and decreased fremitus.

Percussion

(Advanced skill)

In infants and young children, percussion may not be easily performed or interpreted and therefore examination must be

Table 2.7 Abnormal fremitus.

Increased vibrations	Decreased or absent vibrations
Over areas of consolidation, e.g. pneumonia or atelectasis	Over areas of decreased air flow, e.g. asthma, pneumothorax, pleural effusion or foreign body

considered within the context of the whole physical examination. Percussion determines whether the lung tissue is filled with fluid, air or solid matter (Bickley 2003). See Chapter 1 for the technique of percussion. Always compare sides by moving systematically from one side to the other, then to the mid-axilla region, to evaluate all lobes.

Table 2.8 shows the different percussion notes, their characteristics, where they are found normally in the body and pathological examples. Only light percussion is needed (Gill & O'Brien 2002). The sound or percussion note produced from the vibrations is usually resonant in the lungs (Bickley 2003). However, the infant's round chest normally produces a hyper-resonant pitch and resonance is reached by age 6. Therefore in the child less than 6 years of age lung resonance may indicate consolidation, e.g. atelectasis, pneumonia or pleural effusion.

Auscultation

(Basic skill)

In infants and young children, findings from auscultation may not be easily interpreted and therefore must be considered within the context of the whole physical examination.

Stethoscope

Use the diaphragm to:

- listen over the main bronchus for bronchial sounds;
- listen for the higher pitched normal bronchovesicular (in infancy) and vesicular (toddlers and children) sounds over the chest;
- auscultate the anterior and posterior chest;
- auscultate symmetrically (allows the child to act as his/her own control) and systematically over each lobe from apex to base (Hughes 1997). Figure 2.3 indicates auscultation sites in infants and children.

Breath sounds

Breath sounds are:

- usually louder in infants and young children because the thinner chest wall brings the stethoscope closer to the origin of the sounds (Engel 1997);