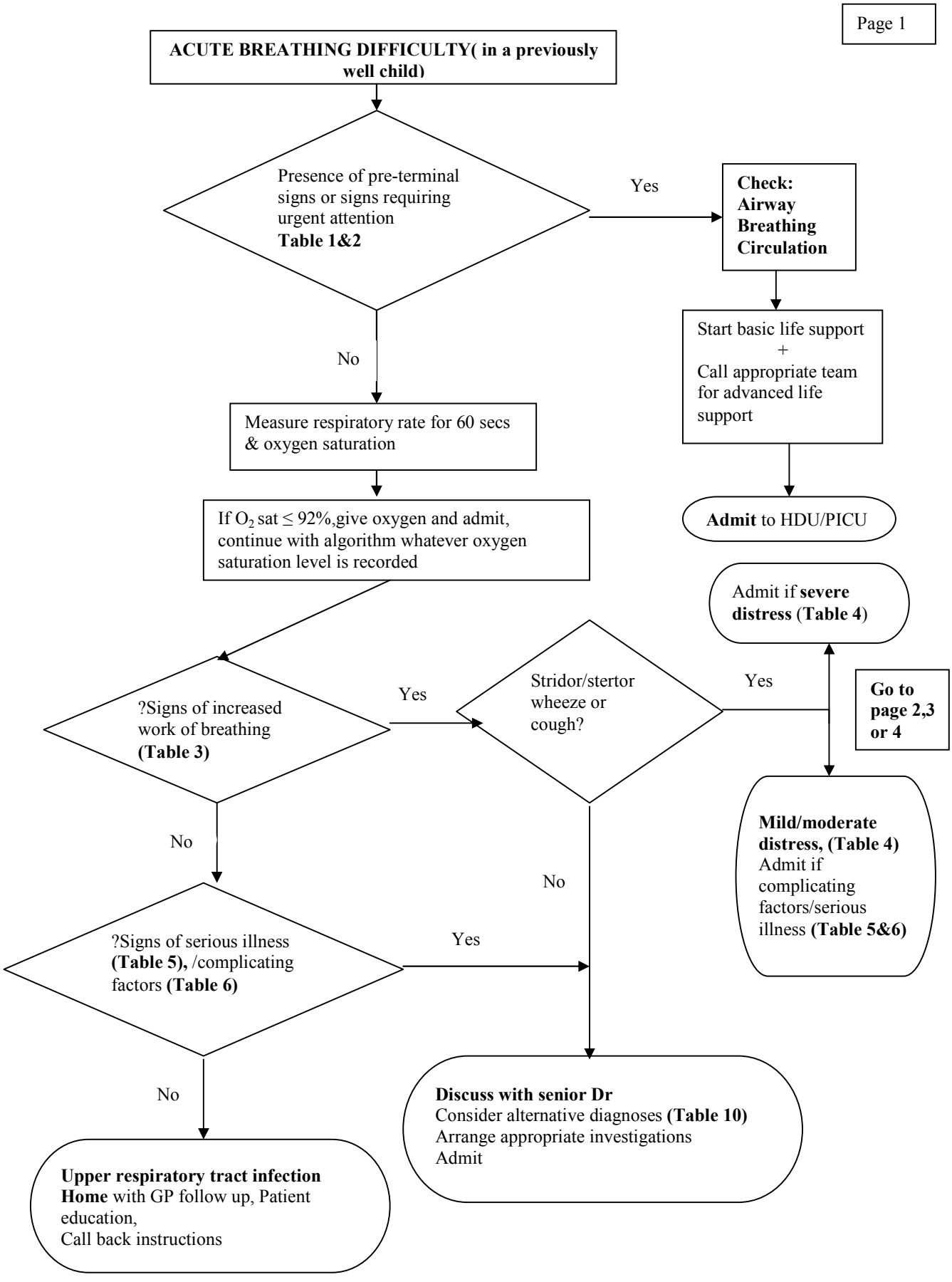
Algorithm for the management of children with acute breathing difficulty

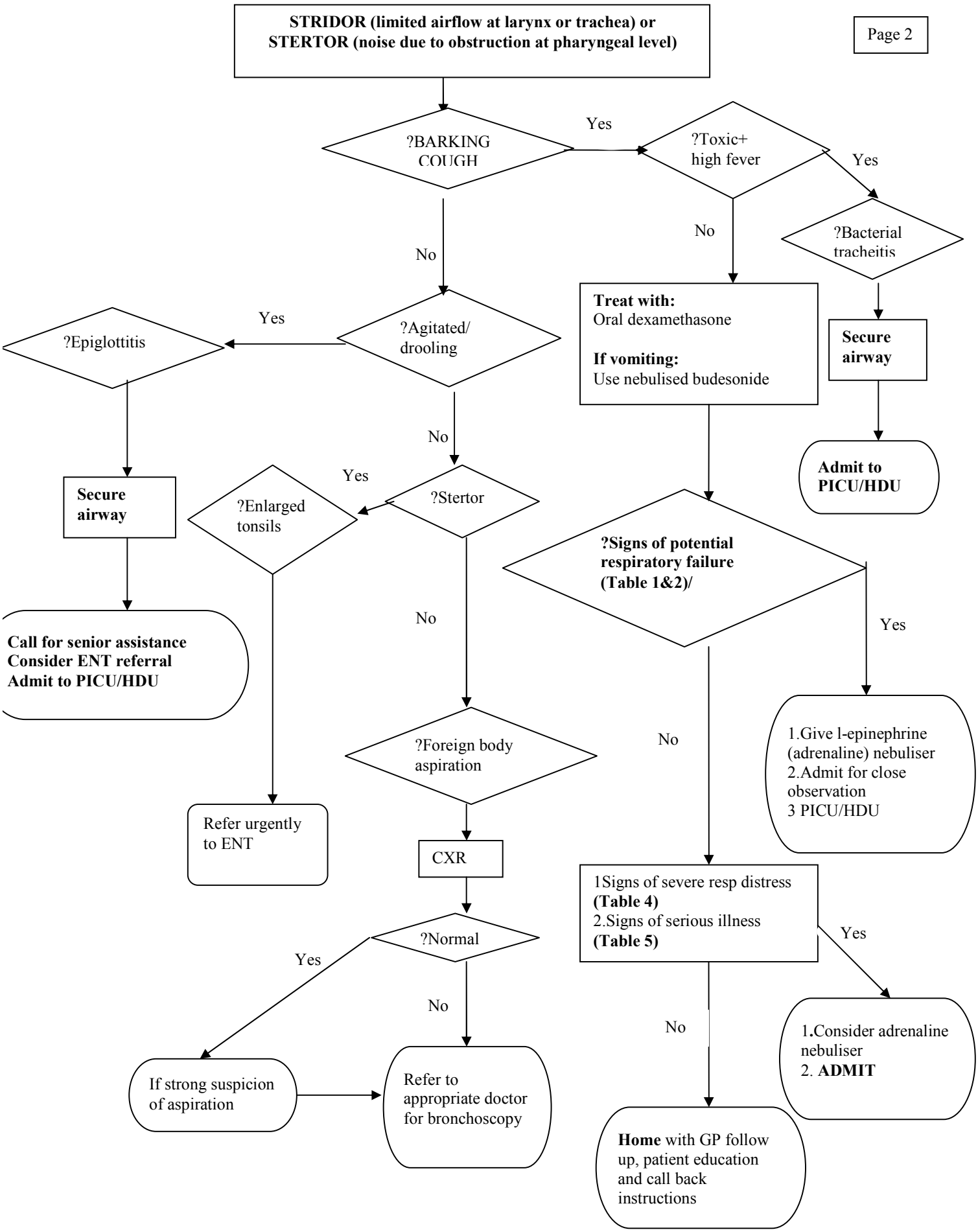
This algorithm must be used in sequence starting with page 1 and finishing with page 5.

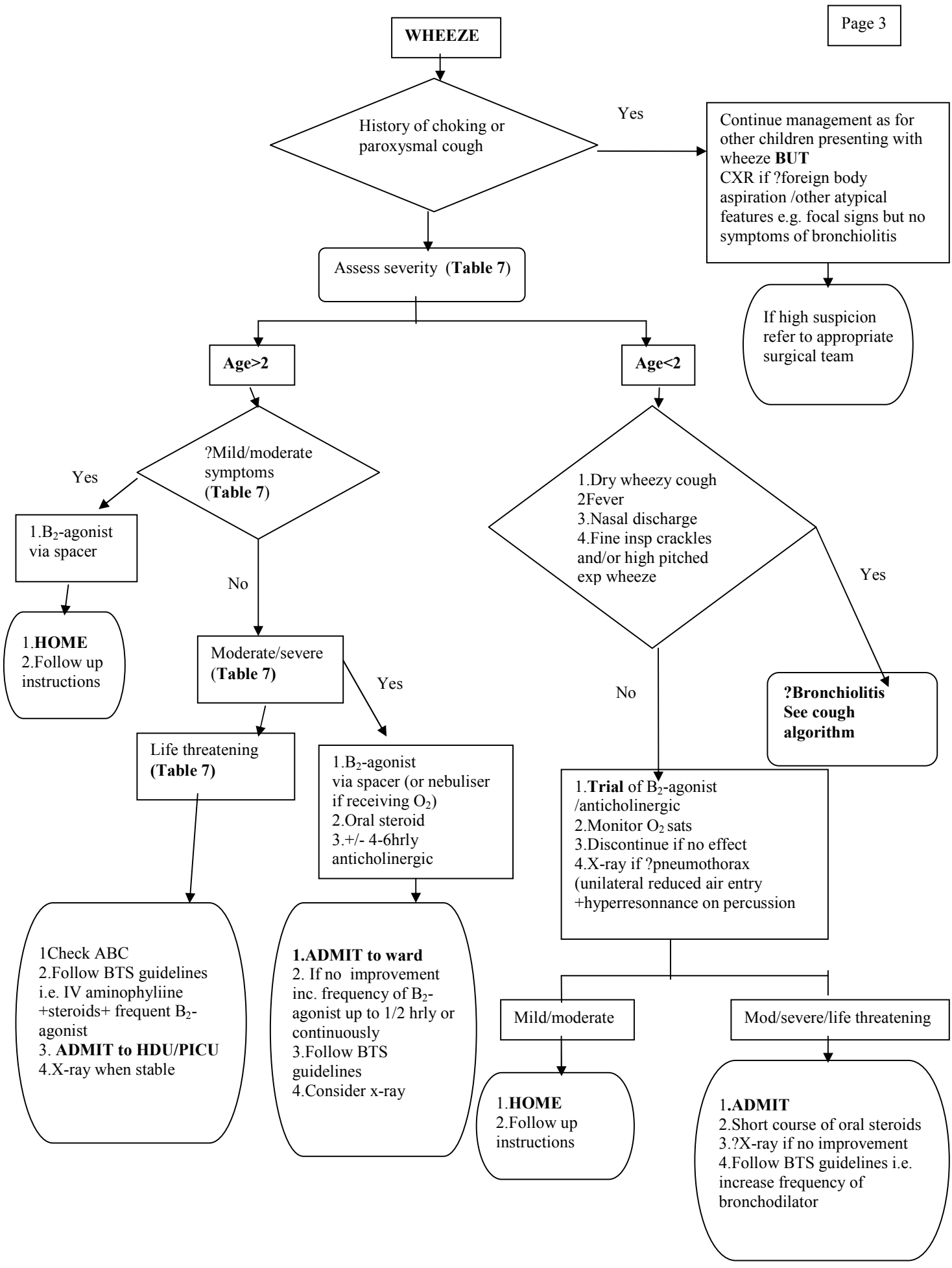
A glossary of terms and abbreviations has been provided.

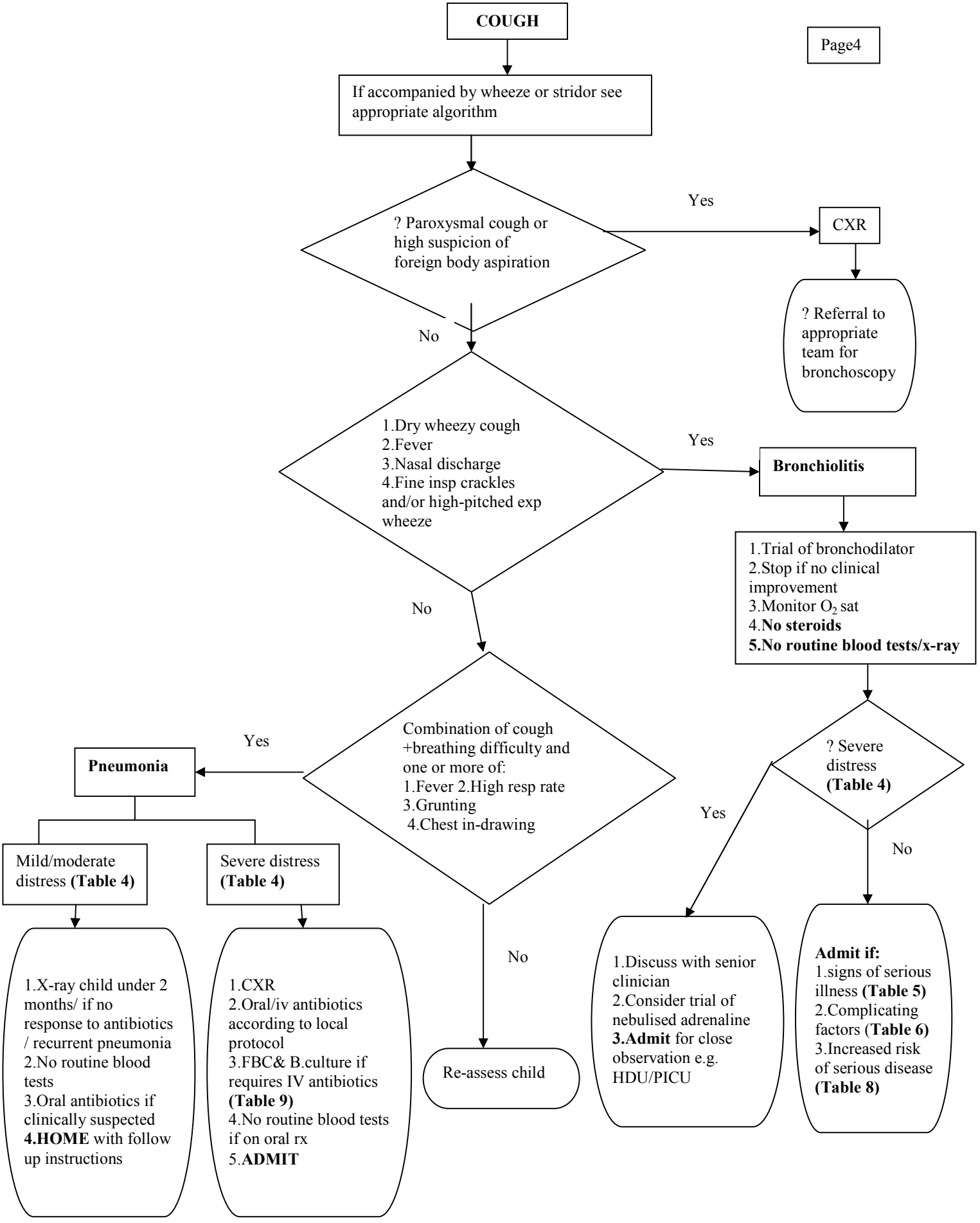
The relevant tables accompany the guideline.

Where drugs are mentioned we have chosen to follow 'medicines for children' until further evidence is available.


ACUTE BREATHING DIFFICULTY(in a previously well child)
Presence of pre-terminal signs or signs requiring urgent attention Table 1&2
Yes
Check: Airway Breathing Circulation
Start basic life support + Call appropriate team for advanced life support
Admit to HDU/PICU
No
Measure respiratory rate for 60 secs & oxygen saturation
If O_2 sat ≤ 92%,give oxygen and admit, continue with algorithm whatever oxygen saturation level is recorded
Admit if severe distress (Table 4)
?Signs of increased work of breathing (Table 3)
Yes
Stridor/stertor wheeze or cough?
Yes
Go to page 2,3 or 4
Mild/moderate distress, (Table 4) Admit if complicating factors/serious illness (Table 5&6)
No
No
?Signs of serious illness (Table 5), /complicating factors (Table 6)
Yes
No
Discuss with senior Dr
Consider alternative diagnoses (Table 10)
Arrange appropriate investigations
Admit
Upper respiratory tract infection
Home with GP follow up, Patient education,
Call back instructions


STRIDOR (limited airflow at larynx or trachea) or
STERTOR (noise due to obstruction at pharyngeal level)
?BARKING COUGH
Yes
?Toxic+ high fever
Yes
?Bacterial tracheitis
No
Treat with:
Oral dexamethasone
If vomiting:
Use nebulised budesonide
Secure airway
Admit to PICU/HDU
No
?Agitated/ drooling
Yes
?Epiglottitis
Secure airway
Call for senior assistance
Consider ENT referral
Admit to PICU/HDU
No
?Stertor
Yes
?Enlarged tonsils
Refer urgently to ENT
No
?Foreign body aspiration
CXR
?Normal
Yes
If strong suspicion of aspiration
No
Refer to appropriate doctor for bronchoscopy
?Signs of potential respiratory failure (Table 1&2)/
Yes
1.Give l-epinephrine (adrenaline) nebuliser
2.Admit for close observation
3 PICU/HDU
No
1Signs of severe resp distress (Table 4)
2.Signs of serious illness (Table 5)
Yes
1.Consider adrenaline nebuliser
2. ADMIT
No
Home with GP follow up, patient education and call back instructions


WHEEZE
History of choking or paroxysmal cough
Yes
Continue management as for other children presenting with wheeze **BUT**
CXR if ?foreign body aspiration /other atypical features e.g. focal signs but no symptoms of bronchiolitis
If high suspicion refer to appropriate surgical team
Assess severity (**Table 7**)
Age>2
Age<2
?Mild/moderate symptoms (**Table 7**)
Yes
No
1.B_2-agonist via spacer
1.**HOME**
2.Follow up instructions
Moderate/severe (**Table 7**)
Yes
No
Life threatening (**Table 7**)
1.B_2-agonist via spacer (or nebuliser if receiving O_2)
2.Oral steroid
3.+/- 4-6hrly anticholinergic
1.Dry wheezy cough
2Fever
3.Nasal discharge
4.Fine insp crackles and/or high pitched exp wheeze
Yes
?Bronchiolitis See cough algorithm
No
1.**Trial** of B_2-agonist /anticholinergic
2.Monitor O_2 sats
3.Discontinue if no effect
4.X-ray if ?pneumothorax (unilateral reduced air entry +hyperresonnance on percussion
1Check ABC
2.Follow BTS guidelines i.e. IV aminophyliine +steroids+ frequent B_2-agonist
3. **ADMIT to HDU/PICU**
4.X-ray when stable
1.ADMIT to ward
2. If no improvement inc. frequency of B_2-agonist up to 1/2 hrly or continuously
3.Follow BTS guidelines
4.Consider x-ray
Mild/moderate
Mod/severe/life threatening
1.**HOME**
2.Follow up instructions
1.**ADMIT**
2.Short course of oral steroids
3.?X-ray if no improvement
4.Follow BTS guidelines i.e. increase frequency of bronchodilator


COUGH
If accompanied by wheeze or stridor see appropriate algorithm
? Paroxysmal cough or high suspicion of foreign body aspiration
Yes
CXR
? Referral to appropriate team for bronchoscopy
No
1.Dry wheezy cough
2.Fever
3.Nasal discharge
4.Fine insp crackles and/or high-pitched exp wheeze
Yes
Bronchiolitis
1.Trial of bronchodilator
2.Stop if no clinical improvement
3.Monitor O_2 sat
4.No steroids
5.No routine blood tests/x-ray
? Severe distress (Table 4)
Yes
No
Admit if:
1.signs of serious illness (Table 5)
2.Complicating factors (Table 6)
3.Increased risk of serious disease (Table 8)
1.Discuss with senior clinician
2.Consider trial of nebulised adrenaline
3.Admit for close observation e.g. HDU/PICU
No
Re-assess child
Combination of cough +breathing difficulty and one or more of:
1.Fever 2.High resp rate
3.Grunting
4.Chest in-drawing
Yes
Pneumonia
Mild/moderate distress (Table 4)
Severe distress (Table 4)
1.X-ray child under 2 months/ if no response to antibiotics / recurrent pneumonia
2.No routine blood tests
3.Oral antibiotics if clinically suspected
4.HOME with follow up instructions
1.CXR
2.Oral/iv antibiotics according to local protocol
3.FBC& B.culture if requires IV antibiotics (Table 9)
4.No routine blood tests if on oral rx
5.ADMIT

Tables included in the algorithm

Table 1 Pre-terminal signs

Exhaustion
Bradycardia
Silent chest
Significant apnoea

Table 2 Signs of severely ill child requiring urgent attention

Inappropriate drowsiness (difficult to rouse)
Agitation
Cyanosis in air

Table 3 Signs of increased work of breathing

Increased respiratory rate
Chest in-drawing (recession)
Nasal flaring
Tracheal tug
Use of accessory muscles
grunting

Table 4 Assessment of severity of breathing difficulty adapted from WHO management of acute respiratory infections in children. World Health Organisation, Geneva, 1995

Assessment of severity(breathing difficulty)			
	Mild	**Moderate**	**Severe**
Oxygen saturation in air	>95%	92-95%	<92%
Chest wall in-drawing	none/mild	moderate	severe
Nasal flaring	absent	may be present	present
grunting	absent	absent	present
Apnoea/pausing	none	absent	present
Feeding history	normal	Approximately half of normal intake	Less than half normal intake
Behavior	normal	irritable	Lethargic Unresponsive Flaccid Decreased level of consciousness Inconsolable

Table 5 Symptoms of Serious Illness (adapted from Viral Upper Respiratory Tract Guideline by Institute for Clinical Systems Improvement and the WHO recommendations on the management of children with cough or breathing difficulty)

< 3 months	3 months -3 years	4 years-adult
Responsiveness and activity • flaccid • cannot awaken or keep awake • weak cry or weak suck • inconsolable • refuse feedings	**Responsiveness and activity** • unresponsive • cannot awaken or keep awake • markedly decreased activity • inconsolable • weak suck or weak cry(if infant) • refuses feeding	**Responsiveness and activity** • decreased level of consciousness • markedly decreased activity • cannot awaken or keep awake
Dehydration and vomiting • reduced wet nappies > 8 hrs	**Dehydration and vomiting** • no urine> 6-8 hrs if < 1yr • no urine> 12 hrs if > 1yr	**Dehydration and vomiting** • no urine> 12 hrs
	Meningeal signs • stiff neck • persistent vomiting	**Meningeal signs** • stiff neck • persistent vomiting • severe headache
Other • petechial and purpuric rash • convulsions • very high fever • hypothermia • capillary refill <3 sec	**Other** • petechial or purpuric rash • convulsions • very high fever unresponsive to treatment • capillary refill < 3sec	**Other** • decreased urination with decreased intake • petechial or purpuric rash • convulsions • very high fever unresponsive to treatment • capillary refill > 3 sec

Table 6 Factors contributing to the clinicians decision regarding admission or discharge

Complicating Factors
Co-morbidity e. g prematurity, congenital heart disease, any chronic lung disease, neurological disorder
Social problems e. g previous non-accidental injury, ill parents, parents having difficulty coping
Infants younger than 2 months of age

Table7 Severity of Asthma, taken from BTS

Table of Severity of Asthma Based on BTS Guidelines		
Age	**Under 5 years**	**Over 5 years**
Mild to Moderate	Wheeze and cough with tightness and mild dyspnoea, no distress, no speech or feeding difficulty Mild respiratory distress Respiratory rate < 50 Pulse < 140 bpm Saturations > 92% in air	Wheeze and cough with tightness Able to talk PEFR > 50% predicted height Pulse < 120 Saturations > 92% in air
Moderate to Severe	Too breathless to talk Too breathless to feed Respiratory rate > 50/min Pulse > 140/min Use of accessory muscles	Too breathless to talk Too breathless to feed Respiratory rate > 40 Pulse > 120/min PEFR < 50% predicted height
Life Threatening	Cyanosis Silent chest Poor respiratory effort Fatigue or exhaustion Agitation or reduced level of consciousness	Cyanosis Silent chest Poor respiratory effort Fatigue or exhaustion PEFR < 33% predicted height Agitation or reduced level of consciousness

Table 8 Infants at risk of developing severe bronchiolitis- (adapted from Management of acute bronchiolitis by Rakshi and Couriel, Archives of Disease in Childhood, 1994; 71:463-469)

Apnoea
Preterm birth
Underlying disorders Lung disease e.g. bronchopulmonary dysplasia,cystic fibrosis Congenital heart disease Immunodeficiency (congenital or acquired) Multiple congenital abnormalities Severe neurological disease

Table 9 Indications for treatment with parenteral antibiotics in a child clinically suspected to have pneumonia

Toxic appearance
Severe respiratory distress
Vomiting
Immunocompromised
Dehydrated and requiring intravenous fluids

Table 10 Differential diagnosis of less obvious causes of respiratory distress (Adapted from Fleischer's Textbook of Emergency Medicine, Chapter 65)

Metabolic Disorders	Central Nervous System Dysfunction	Neuromuscular Disorders	Chest Wall Disorders
Diabetes mellitus	Meningitis	Spinal cord injury	Flail chest
Dehydration	Encephalitis	Infantile botulism	Congenital anomalies
Sepsis	Tumour	Guillain-Barre	
Liver/renal disease	Intoxication	Myopathy	
Intoxication	Status epilepticus		
Inborn errors of metabolism	Trauma		
	Hydrocephalus		

An evidence based guideline for the management of children presenting with acute breathing difficulty

Authors

Dr Monica Lakhanpaul[1], Dr Kate Armon[1], Miss Philipa Eccleston[1], Dr Roderick MacFaul[2], Dr Stephanie Smith[3], Dr Harish Vyas[3], Dr Ursula Werneke[4], Miss Lynn Williams[3], Professor Terence Stephenson[1].

[1]Academic Division of Child Health,
School of Human Development, University of Nottingham,
University Hospital, Nottingham NG7 2UH.

[2]Pinderfields General Hospital
Aberford Road, Wakefield WF1 4DG.

[3]Queen's Medical Centre
University Hospital NHS Trust
Derby Road
Nottingham NG7 2UH.

[4]Maudsley Hospital
London SE5 8AZ.

Correspondance to:
Professor TJ Stephenson at address provided above or
E-mail address Terence.Stephenson@nottingham.ac.uk

Conflict of interest: none

Acknowledgements

Funding: Children Nationwide Medical Research Fund

Additional members of the guideline development group based at University Hospital Nottingham:

Miss L Williams, Accident and Emergency Consultant

Dr S Smith, Paediatric Consultant

Dr H Vyas, Paediatric Intensive Care Consultant

Dr J Norwood, Public Health Consultant

Ms Sue Pearce, Paediatric Accident and Emergency Sister

Ms Paula Lorgelly, Lecturer in the University Department of Health Economics

Mrs Bea Brunton, patient representative

Miss Philippa Eccleston, Nurse researcher

Dr Dermot Ryan, Primary Care representative, member of the General Practice Airways Group.

The guideline development group acknowledges the time and effort of all the Delphi Panel members:

Dr A S Ahuja, Paediatric Consultant, Royal Albert Edward Infirmary, Wigan

Dr J Alexander, Paediatric Intensive Care Consultant, North Staffordshire Hospital

Carolyn Simpson, Paediatric Sister, Queens Medical Centre, Nottingham

Sue Pearce, Sister in Paediatric A&E, Queens Medical Centre, Nottingham

Mr R Bailey, A&E Consultant, Chesterfield and North Derbyshire Royal Hospital

Dr D Barker, Paediatric Consultant, St Mary's Hospital, Portsmouth

Dr H Baumer, Paediatric Consultant, Derriford Hospital, Plymouth

Dr J Bhatt, Paediatric Specialist Registrar, Sheffield

Mr T Beattie, A&E Consultant, Hospital for sick kids, Edinburgh

Dr E Carter, Consultant Paediatrician, Leicester Royal Infirmary

Dr G Collins, Paediatric Consultant, Chesterfield and North Derbyshire Royal Hospital

Dr F Davies, A&E Consultant, Royal London Hospital, London

Dr H Dixon, Paediatric Consultant, Hinchinbrooke Hospital, Huntingdon

Dr R Dinwiddie, Consultant Paediatrician, Great Ormond Street Hospital

Dr T Dorman, Anaesthetic Consultant, Sheffield Children's Hospital

Dr S Edees, Consultant Paediatrician, Royal Berkshire Hospital

Dr M L Everard, Paediatric Consultant, Sheffield Children's Hospital

Mr K Gibbin, ENT Consultant, University Hospital, Nottingham

Dr R Hawkes, Paediatric SHO, University Hospital, Nottingham

Dr M Hewitt, Paediatric Consultant, University Hospital, Nottingham

Dr D Hughes, A&E Consultant, Barnsley Hospital, Barnsley

Dr A Jaffe, Paediatric Research Fellow, Royal Brompton Hospital, London

Dr D Johnston, Paediatric Consultant, University Hospital, Nottingham

Dr H Marcovitch, Paediatric Consultant, Horton General Hospital, Banbury

Mr J McGlashan, Senior Lecturer in ENT, University Hospital, Nottingham

Dr M Mckean, Specialist Paediatric Registrar, Leicester Royal Infirmary

Dr S McKenzie, Paediatric Respiratory Consultant, Royal London Hospital

Dr I Narang, Paediatric Research Fellow, Royal Brompton Hospital, London

Jean Nixon, A&E Nurse, Peterborough

Dr V Nobel, Paediatric Consultant, King's Mill Centre, Mansfield

Dr U Prabhu, Paediatric Consultant, Fairfield General Hospital, Bury

Dr M Quinn, Paediatric Consultant, Royal Devon and Exeter Hospital

Dr F A I Riordan, Paediatric Consultant, Birmingham Heartlands Hospital, Birmingham

Dr N Ruggins, Paediatric Consultant, Derbyshire Children's Hospital, Derby

Professor N Rutter, Paediatric Professor, University Hospital, Nottingham

Dr G A Savill, Paediatric Consultant, Airedale General Hospital, Keighley

Dr D Sharkey, Paediatric SHO, University Hospital, Nottingham

Dr K Shyamanur, Paediatric Consultant, Doncaster

Dr A Smyth, Paediatric Respiratory Consultant, Nottingham City Hospital

Dr J Stroobant, Paediatric Consultant, University Hospital, Lewisham

Dr C L Sullivan, Paediatric Consultant, Singleton Hospital, Swansea

Erica Szondy, Senior Paediatric Nurse, Queens Medical Centre, Nottingham

Dr A Thomson, Paediatric Consultant, John Radcliffe Hospital, Oxford

Dr A P J Thomson, Paediatric Consultant, Mid-Cheshire Hospital NHS Trust

Dr D Thomas, Paediatric Intensive Care Consultant, University Hospital, Nottingham

Dr F Thompson, Paediatric Consultant, Northamptom General Hospital

Dr J R Vyas, Paediatric Respiratory Consultant, Booth Hall Hospital, Manchester

Dr M Webb, Paediatric Consultant, Gloucestershire Royal Hospital

Dr P H Weller, Paediatric Respiratory Consultant City Hospital, Dudley, Birmingham

Dr L Walton, Paediatric SHO, University Hospital, Nottingham

The practical help by Jeanette-Taylor Meek, Gillian Wilson, Sue Waring and Maureen Sisson is also acknowledged.

Contents

Introduction

Clinical guidelines are being developed in increasing number [1]. The impetus for this is rising health care costs and an increasing patient demand for the best available care.

Paediatric attendances to the accident and emergency department (A&E) or an acute admissions ward in England continue to increase yet the length of stay in hospital continues to fall [2, 3, 4, 5]. Admission rates have increased from 40 per 1000 aged 0-4 in 1970 to 100 per 1000 in 1997 [3]. The reasons for this trend are not entirely clear. Children attending with medical conditions to A&E account for at least 15% of all attendances [6]. A recent study [7] found that 50% of children presented acutely with one of three problems: breathing difficulty (25%), seizure (16%) and feverish illness (15%). The mean age of the recorded admissions was 3.5 years with a median of 1.9 years and 25% of the children were less than 6 months in age. A similar distribution was found in Nottingham [8]. In this study, 30% of children presented with a breathing difficulty, 20% with a feverish illness and 5% with a seizure. Armon et al's study [8] identified that senior house officers are the grade of doctor seeing 80% of children. Their knowledge and experience may be variable and guidelines may help them keep up to date with current research thereby reducing variation in practice.

As indicated by the studies mentioned the presentation of children with acute breathing difficulty is a common problem in the acute setting. It is still a major cause of childhood morbidity and mortality not only worldwide but also in the U.K. Breathing difficulty may be due to a number of different diagnoses ranging from a simple upper respiratory tract infection to asthma, croup or pneumonia. When a child presents to the hospital the end diagnosis may not be obvious and therefore, despite the availability of guidelines for

asthma or bronchiolitis, these guidelines are not very helpful for the early management of a child.

Aim of the guideline

- To provide clinicians with recommendations for the management of children presenting with acute breathing difficulty based on the available evidence.
- To promote consistency of care of patients with similar clinical problems.
- To guide the decision-making process of junior doctors seeing the majority of patients in the first instance [9].

The guideline is presented in three sections:

1.Evidence-based recommendations for managing a child with acute breathing difficulty supported by an implementation strategy

2.An algorithm used to translate the recommendations into a format that can be implemented in the department

3.Patient information leaflet

In the first part of the guideline, the key recommendations are intended to direct clinicians to the most appropriate management of the patients based on appraised literature. Recommendations have also been included based on a multidisciplinary consensus opinion to provide guidance in clinically important areas. The guideline is transparent about which recommendations are evidence based and which are based on consensus. The transparency of the methods used to develop the guidelines allows individual clinicians or departments to implement the recommendations appropriately. The guideline development group promotes the application of the recommendations alongside clinical judgement and patient circumstances and preferences. The full technical report and a complete set of appendices are available on request by e-mail from the lead author.

Scope of the guideline

Key areas covered:

- Children presenting to an acute department with an acute breathing difficulty
- The assessment of the child with acute breathing difficulty
- The management of the children from the point of presentation to the hospital to a decision regarding admission or discharge
- The management process includes recommendations regarding identification of the severity of the problem, appropriate investigations and treatment
- Discharge, admission and referral criteria

Guideline limitations

The guideline does not cover:

- Children presenting with chronic respiratory difficulties e.g chronic stridor
- Children with a known underlying respiratory abnormality such as bronchopulmonary dysplasia and cystic fibrosis
- Children presenting with a defined diagnosis rather than a breathing difficulty being their presenting problem
- Children who present with symptoms other than breathing difficulty but ultimately are diagnosed with a respiratory problem.
- Management of children in Primary care either before presentation or after discharge
- Management of children by the ambulance services or paramedics
- Management of children after referral to other specialties e.g. ENT or surgeons
- Management of children admitted to the ward

Definitions

Appendix 1 contains a full glossary of abbreviations and terms

Funding

Development of the guideline was funded by Children Nationwide Charity.

Guideline users

This guideline has primarily been written for use by junior doctors who see children in an acute hospital setting. Senior doctors, nurses or other professionals allied to medicine may wish to refer to its recommendations in order to keep them up to date with current evidence.

Overview of guideline development

Guideline development group

In addition to the authors, the development group was composed of eight doctors and nurses who had expertise in either literature appraisal and guideline development or in the clinical area being addressed by the guideline. Their role was to overview the development process. Input from a primary care physician and a patient representative was sought.

Delphi panel

Sixty-five individuals were approached to be part of the Delphi panel, fifty-nine replied and fifty agreed to participate. The composition of the final panel is provided in table 1a. Members were selected from district general hospitals, tertiary referral centres and included different grades and disciplines of staff. The development group all contributed to the selection process and was not aware of the names forwarded by other members of the group. The panelists were not aware of the identity of other panel members.

Table 1a-Delphi panel

Discipline	Number who replied	Percentage
Paediatric nurse	2	4
Paediatric or emergency nurse	1	2
Paediatric emergency nurse	1	2
A&E consultant	4	8
Paediatric intensive care consultant	2	4
Anaesthetic consultant	1	2
Paediatric respiratory subspecialist	6	12
Paediatric consultant with interest in assessment units and guidelines	2	4
Ear, nose and throat consultant	2	4
Senior house officer	3	6
Registrar with respiratory interest	4	8
Registrar with an interest in guidelines	1	2
General paediatrician	21	42
Total	50	100

Development process

An initial review of the published literature and of existing guidelines was undertaken to determine the amount of evidence currently available and to provide the outline of the decision tree that represents the sequence of events that is involved in the assessment and management of a child with an acute breathing difficulty. The decision tree and statements were all discussed with a respiratory paediatrician in order to check that the key clinical questions had been considered.

The guideline development process was based on the Scottish Intercollegiate Guideline Network [10] and the 'AGREE' criteria used to appraise guidelines provided in the Royal College of Paediatrics Standards for development of clinical guidelines [3]. In addition to searching the computerised databases from 1966 using MesH headings and 'textwords,

limited to 0-16 years of age, further articles were obtained from colleagues and by hand searching the bibliography of articles. A hand search for the last 5 years of the most relevant journals was performed and journals not listed on Medline were searched if thought to be relevant to the subject area. A search for unpublished articles was performed. If high quality evidence was not available, a modified Delphi process was used. The literature was evaluated against standards by SIGN [11].

In summary, after extraction of abstracts and appraising full articles 77 studies were used to provide evidence-based recommendations. Information from reports or existing guidelines was also extracted where appropriate but the guideline is clear about the source of information when providing a grade of recommendation. The articles were assessed for their relevance and quality and then critically appraised. Data were extracted using standardised data extraction forms [11]. The level of evidence was graded 1 to 4 and recommendations were graded A to D based on the level of evidence found. After appraising the literature relevant to the clinical questions, statements were derived which were supported by a discussion of the literature, a grade for the level of evidence and a grade for the strength of the recommendation. Ten percent of the papers were cross checked for their grade of evidence by a public health consultant experienced in literature appraisal.

All the appraised papers along with the summarised data extracted from them, the clinical questions that they address, a summary of the literature discussed and the final recommendation were sent to the Delphi panel. A modified Delphi method was used to provide consensus where evidence was lacking and to help translate the evidence into relevant and unambiguous recommendations. An opportunity was therefore given to the panel to provide additional references, question the appraisal of the papers and to refine the language of the final recommendations.

A patient leaflet was developed in association with the patient representative and provided to the Delphi panel for comments. After completion of the process, the leaflet was again shown to five sets of parents for their final opinion.

The Delphi process for consensus development

The aims of the consensus methods are to identify the extent of agreement within a panel and to identify areas of disagreement. Consensus methods can be used where evidence is lacking and in guideline development as a means by which evidence can be combined with clinical acumen and experience to provide a practical and useable clinical tool.

This guideline was developed using the Delphi method. Its features are anonymity, controlled feedback, iteration (the process occurs in rounds allowing individuals to change their view) and a statistical group response [12].

The first round consisted of a questionnaire based on the systematic review of the scientific evidence, which was sent to the panelists who ranked their level of agreement or disagreement with the recommendations on a 1 to 9 point Likert scale. Clinical questions requiring a consensus opinion where evidence was not available were also sent to the Delphi panel at this time. Consensus of agreement was pre-defined as 83% of panelists answering between 7 and 9 on the Likert scale and therefore agreeing with the recommendations. [13]. Recommendations reaching consensus were included in the guideline. Any recommendations not reaching consensus were either re-written using different language, re-submitted unchanged, or removed from the process altogether. All comments were assessed individually even when a recommendation did not reach consensus.

In the second round, the questionnaire was sent to the respondents again. They received feedback on the rest of the groups' responses allowing them to view their judgement in the light of responses from the other respondents. Both statistical feedback (median and interquartile range) and qualitative feedback of comments were given to the respondents.

It must always be remembered that the consensus process is never used to undermine available evidence but to translate it into a form that can be used by clinicians. The development group had decided in advance that all recommendations based on evidence should be included in the guideline even if the Delphi panel did not agree with them in line with current opinion on evidence-based medicine i.e. that evidence should always be considered as superior to expert opinion alone. The grading was altered from a C to a B for one of the recommendations after this process. For one of the recommendations, two studies provided conflicting evidence and the Delphi process was used to identify which study was supported by consensus opinion. All these details will be made transparent in the guideline.

The guideline

The grades of the final recommendations included in the guideline are provided in table 2a.

Table 2a Grades of recommendations included in the final guideline

Grade of recommendation	**Number**
Grade A	**10**
Grade B	**6**
Grade C	**17**

Grade D	**31**

Updating of the guideline

It is anticipated that the guideline should be updated 2 years from its initial dissemination date.

Implementation and Audit

Pre-implementation and post implementation data has been collected from the paediatric emergency department at the Queens Medical Centre where they have been developed and piloted. The information from this will be available in a future paper.

Clinical outcomes to be measured during this process included time to see each health professional, rates of admissions to hospital, length of stay in hospital, rates of investigations such as x-rays and invasive blood tests, and re-attendances to hospital. It would be possible for any institution implementing this guideline to undertake a similar audit process.

An implementation strategy has been included later in the document.

Disclaimer

It is important to remember that guidelines are only one tool used to improve patient care. Clinical acumen and judgement must always be used in conjunction with the guideline. Research is a continuum and it may be necessary to alter practice in light of new evidence before the guideline has been up-dated. It is also important for all clinicians to remember that all guidelines must be used in association with individual patient needs and preferences.

Conflict of interest

The views or interests of the charity funding the development of this guideline have not influenced the final recommendations

Members of the development group have not expressed any conflict of interest with the development of the guideline.

Guidelines Recommendations with Rationale and Strength of Evidence

The aim of this guideline is to guide clinicians through the decision-making process for the management of a child presenting with acute breathing difficulty. The guideline has been presented as a list of recommendations but to encourage utilization and implementation it has been translated into an algorithm.

Initial management

A1 The most important pre-terminal signs of a child with breathing difficulty are:

a) exhaustion

b) bradycardia

c) silent chest

d) significant apnoea

(Listed in table 1)

Strength of evidence 4

Recommendation D

More than 83% consensus achieved

Rationale

When a child presents with a breathing difficulty, it is important to assess the severity of the problem and to identify those children that require basic and advanced life support. The Advanced Paediatric Life Support Manual [14] provides a list of signs indicating

respiratory inadequacy, which have been derived by consensus. It is important to provide clinicians with a list of signs that should alert them that the child needs urgent attention.

A2 The following signs indicate that a child with a breathing difficulty is severely ill and requires immediate and urgent attention:

a) Inappropriate drowsiness (difficult to rouse)

b) Agitation

c) Cyanosis in air

(Listed in table 2)

Strength of evidence 4

Recommendation D

More than 83% consensus achieved

Rationale

These signs may not be independently reliable. They are not specific signs of a child who is severely ill but if these signs are present, they should alert a doctor or nurse that the child requires urgent attention.

A3 The child presenting with breathing difficulty and life threatening or pre-terminal signs will require further investigation and blood tests once stabilized.

Strength of evidence 4

Recommendation D

94% consensus achieved

Rationale

Blood tests must be performed by a clinician on some occasions. It is not possible in such a guideline to cover all scenarios but guidance should be given to clinicians on situations where blood tests should not be omitted.

A4 All children presenting to hospital with an acute breathing difficulty should have their oxygen saturation measured.

Strength of evidence 2

Recommendation C

96% consensus achieved

Rationale

The detection and effective management of hypoxia is an important aspect of the clinical management of acutely ill infants [15]. Pulse oximetry is commonly used to measure hypoxia so that oxygen can be administered if necessary. Poet et al [16] state that noninvasive monitoring of oxygenation has become a standard procedure in paediatrics. The WHO [17] (4D) have produced recommendations based on clinical signs to detect hypoxia and studies from the developing countries have tried to assess the sensitivity and specificity of these signs. In hospitals in the developed world, however, we do not usually need to rely on such methods but the need to identify hypoxia must be recognized.

Onyango et al [18] (2++B) carried out a prospective study on infants and children presenting with symptoms of acute respiratory infection After a clinical assessment, hypoxia was detected using pulse oximetry. Over half of the children studied were hypoxic and the mortality was 4.3 times greater in these children. This study was carried out in a developing country but emphasises the need to detect hypoxia in a child with respiratory symptoms.

Madico et al [19] (2+C) studied children with lower respiratory tract infection with and without pneumonia. The WHO algorithm and radiographic examination was used to identify the children. Pulse oximetry was used to identify hypoxia. The 162 well children had a mean oxygen saturation of 98.7% +-/1.5% compared with the children with acute respiratory tract infection (mean 93.8% +-/3.5%). The combination of saturations measured by pulse oximetry and clinical signs of respiratory illness were found to be a highly sensitive way of detecting acute lower respiratory tract infection and therefore influencing management.

Mullholland et al [20] (2+C) and Shaw et al [21] (2+C) have also shown that pulse oximetry can be a measure of severity of illness in children with bronchiolitis. Mulholland found that, in children less than 15 months of age, the presence of cyanosis correlated with oxygen saturation less than 90%. Shaw et al concluded that in children with bronchiolitis, the oxygen saturation is the best predictor of illness severity and a low oxygen concentration is not always clinically apparent.

A study by Mower et al [22] (2++B) looked at all children presenting to an accident and emergency department who did not require immediate intervention or resuscitation. If physicians only relied on their clinical evaluation they frequently failed to appreciate a reduction in oxygen saturations and alterations in management took place once the oxygen saturation levels were available. For the 305 patients with saturations less than 95%, 81 additional diagnostic tests were ordered after receiving the saturation measurements.

Manekar et al [23] (2++B) studied the oxygen saturation levels in children presenting with respiratory illness to an emergency department. The physician's clinical impression as to whether the child had a low saturation level was compared with pulse oximetry

results. The sensitivity of clinical assessment was 33% and clinical assessment was therefore found to be a sub-optimal method for the detection of hypoxia.

In conclusion, all these studies support the importance of the accurate detection of hypoxia. There was some difficulty in allocating the grade of recommendation. It was finally agreed to recommend Grade C so that the recommendation was relevant to all children despite their underlying diagnosis. However, it was felt important to make clinicians aware of the technical pitfalls when using such a device such as a wrongly sized or poorly positioned probe. An accurate saturation can only be obtained if there is a good pulse signal when the child is still and quiet.

A5 A child's oxygen saturation should be maintained above 92%. If necessary, oxygen therapy should be given to achieve this.

Strength of evidence 4
Recommendation D
88% consensus achieved

Rationale

It was extremely difficult to find evidence to address this issue. Most studies are not comparable because the population in the study and the instruments used differ.

The oxygen-haemoglobin dissociation curve is sigmoidal. At a saturation of 100%, large changes in the partial pressure of oxygen are required before the oxygen saturation will fall. The sigmoid curve is much steeper at a saturation of 90% and below this, only small changes in the partial pressure of oxygen will be required for the oxygen saturation to fall. As mentioned above, Mulholland [20] found that cyanosis was identified in children less than 15 months if their oxygen saturation was less than 90%.

Poets et al [24] (2++B) studied 70 healthy children with a mean age of 8 years and found that the median for the baseline oxygen saturation was 99.5% and the range was 95.8% to 100%.

The American Academy of Respiratory Care (AARC) [25] have recommended an arterial oxygen saturation of less than 90% as representing hypoxia (4D) and have suggested that oxygen therapy be used with the intent of treating or preventing the symptoms and manifestations of hypoxia. It was very difficult to find an actual value at which oxygen should be administered.

Evidence based guidelines addressing respiratory problems such as, the emergency management of acute asthma by the Scottish Intercollegiate Guideline Network [26], the recently developed bronchiolitis guidelines by the Cincinnati Children's Hospital Medical Center [27], the guidelines for cough and wheeze from Southern Auckland [28] and the British Thoracic asthma guidelines [29], all suggest that oxygen saturations should be maintained above 92% (4D).

In summary, 90% saturation or less indicates hypoxia and normal values are above 95.8% saturation. Most guideline groups have chosen 92% as being the level at which oxygen should be administered. Saturation monitors are known for their variable performance and different saturation monitors have different normal ranges. However, when a clinician sees a patient he is not usually aware of the technicalities of the machine and it are therefore important to provide some guide to their use. Unfortunately we do not have better evidence to support this recommendation and the recommendation is based on consensus.

A6 The respiratory rate should ideally be measured for 60 seconds.

Strength of evidence 2

Recommendation B

78% consensus achieved

Rationale

Simoes et al [30] (2++B) compared respiratory rate counts by an observer and by pneumogram of 97 children over two 30 second periods and one 60 second period. The children were under 5 years of age with upper or lower respiratory tract infections or controls. The data suggested that the most accurate way to measure respiratory rate is to count for one minute either at a stretch or in two 30 second blocks, when the child is awake and calm or asleep.

Gadomski [31] et al (2++B) also studied the accuracy of counting respiratory rates in children. Primary care physicians in the study were asked to count and record the respiratory rate of 14 children seen on videotape. Half the group was asked to count for 30 seconds and the other half for 60 seconds. Overall, the median respiratory rate counted over 60 seconds was 63.7 compared with 66.5 when counted for 30 seconds and multiplied by two. Counting over 30 seconds resulted in more false positives than counting over 60 seconds. There was no difference in the false negatives between the groups. Rates counted over 60 seconds were therefore more accurate than 30-second counts.

The Delphi panel did not reach the agreed 83% consensus level for this recommendation. The reason for this was that some of the panel thought that practically it is very difficult in a busy environment to carry through this recommendation. However, the purpose of a

guideline is to present best practice and therefore the recommendation has been included due to the availability of evidence supporting it.

A7 Signs of increased work of breathing include:

a) Increased respiratory rate

b) Chest in-drawing

c) Nasal flaring

d) Tracheal tug

e) Use of accessory muscles

f) Grunting

(Listed in table 3)

Increased respiratory rate, chest in-drawing and nasal flaring:

Strength of evidence 2

Recommendation C

92%, 98%, 88% consensus achieved

Tracheal tug, accessory muscles and grunting:

Strength of evidence 4

Recommendation D

94%, 92%, and 92% consensus achieved

Rationale

Senior clinicians will rely on experience to know the signs indicating that a child is working hard. However, junior doctors and some nurses need to be reminded of these signs.

In order to develop guidelines relevant for the UK we have not included some very good studies from developing countries if the data was not found to be relevant after appraising the papers.

Few studies have tried to address the work of breathing in general terms or to evaluate what is the normal pattern of breathing and then to find evidence for what is abnormal. Most studies have addressed signs of respiratory difficulty in relation to the diagnosis of pneumonia but not in relation to bronchiolitis or wheezing children. In this guideline, we first want to identify children with any breathing difficulty before we decide on a diagnosis. It is for this reason that some studies have not been included at this point despite following a good methodology.

The WHO [17] (4D) in their outpatient management programme of acute respiratory tract infections recognise chest indrawing, fast breathing, stridor or wheeze as representing signs of difficult breathing. They do also acknowledge that nasal flaring, grunting, and cyanosis are additional relevant signs but suggest that if these are present then other more easily recognisable signs will be present. There is an agreement in most textbooks about acceptable signs of the work of breathing. Taussig and Landau [32] (4D) and Forfar and Arneil [33] (4D) in their textbook of paediatrics state that respiratory rate, nasal flaring, use of accessory muscles and retractions are all useful in assessing work of breathing. Various studies have assessed the best sign for predicting a lower respiratory tract infection but there does not seem to be a consensus.

Usha [34] (2+C) studied the reliability of some simple clinical signs. Seventy infants and 148 children attending the outpatient department for cough were studied. Clinical signs were compared with x-ray changes. The best indicators of lower respiratory infection were tachypnoea. Chest in drawing and nasal flaring were also useful but less sensitive

measures of infection. The difficulty with the study was that x-rays were taken as the gold standard for the indication of the presence of a lower respiratory infection and it may be that children who had not yet developed x-ray changes still had an infection.

A8 In children under 6 months of age respiratory rate is not an accurate measurement of respiratory illness.

Strength of evidence 2

Recommendation B

Rationale

Study groups have tried to validate the data provided by the WHO on cut-offs for tachypnoea. Some papers have suggested that although the criteria are useful they should not be relied upon as being the sole predictor of lower respiratory tract infection.

This suggestion has been supported by a study by Campbell et al [35] (2++B) which indicates the variability in respiratory rate for well children under 6 months and many of these well children would have fallen into the criteria of tachypnoea according to the WHO criteria on tachypnoea. Colin Morley et al [36] (2++B) observed 1007 babies under the age of 6 months. 2 assessors carefully examined all babies. An assessment was made on presentation at the hospital with an acute illness but 298 of the babies were also randomly assessed at home. The median respiratory rate for an awake baby without a respiratory illness under the age of 6 months was 58 breaths/minute. The mean respiratory rate for babies with a respiratory illness was 63 breaths /minute. The respiratory rate of babies with a respiratory illness was within the normal range of a healthy baby. The authors conclude that healthy babies breathe fast and that if the WHO

criteria was used half of the babies in the study would have had a respiratory rate above 50/minute.

A9 No recommendation can be provided for respiratory rate indicating tachypnoea. Further research is required.

It has proved very difficult to find an evidence-based definition of tachypnoea. Tachypnoea is used as a measure of work of breathing but only a few studies have defined a normal respiratory rate. It is difficult to compare studies, which try to produce reference values for normal respiratory rates. The studies do not always account for whether the child was asleep, awake, agitated, or calm. In some studies the respiratory rate is counted by observing the child, in others the chest is auscultated and in studies that claim to be more scientific and accurate, equipment such as a pneumogram is attached to the child. In some studies, children were included who presented to the A&E department and in others, children had a cough. Completely well children were therefore not included in the study. All the studies have shown that as a child gets older their breathing rate slows.

The WHO [17] (4D) provides cut-off for fast breathing for 3 different age groups. Members of the WHO agreed upon these values. Their criteria has been used throughout the developing world as a way of determining which children may have a lower respiratory tract infection. Study groups have tried to validate the data provided by the WHO on cut-offs for tachypnoea. Some papers have suggested that although the criteria are useful they should not be relied upon as being the sole predictor of lower respiratory tract infection.

The Delphi panel could not reach the required 83% consensus level for a recommendation to be made. In the light of the available evidence, much of which relates to specific diagnoses, it was decided not to include a recommendation but to suggest that further research is required in this area.

A10 The following are recommendations of definitions to be used for children presenting with acute breathing difficulty:

Stridor indicates limitation of airflow in the upper airway at the larynx or tracheal level. It is a harsh or rasping respiratory noise reflecting upper airway obstruction, usually inspiratory but may be biphasic.

Strength of evidence 4
Recommendation D
94% and 96% consensus achieved

Wheeze indicates limitation of airflow in the lower airway. It is a high pitched whistling noise heard on auscultation which is usually more pronounced in the expiratory phase indicating intrathoracic airway obstruction

Strength of evidence 4
Recommendation D
92% and 100% consensus achieved

Stertor is an airway generated sound caused by obstruction at pharyngeal level e.g. due to large tonsils.

Definition provided by ENT consultant

Grade of evidence 4

Recommendation D

Rationale

The inclusion of panel members from different disciplines such as ENT made it apparent that clinicians caring for children must be able to distinguish stridor from stertor and this should be made apparent in the guideline.

A11 The adapted table (Table 4) can be used to identify the severity of a child presenting with a breathing difficulty

All signs or symptoms do not have to be present for a child to be severe.

Strength of evidence 4

Recommendation D

76% consensus achieved

Rationale

Colin Morley et al [36] (2++B) have concluded from their study that respiratory rate alone is not a reliable indicator of the severity of a babies respiratory illness. Palafox et al [37] (2+C) made the observation that for the first 3 days that a child had symptoms of pneumonia, tachypnoea is not always present and therefore not a reliable sign and cannot be relied upon in the early stages of an illness. Tachypnoea has therefore not been included in the table.

World Health Organisation [17] (4D) has produced a table to help assess the severity of a child with pneumonia. The table combines a number of clinical signs. The table can be adapted by combining it with important clinical signs that detect a serious illness, to cover all breathing difficulties therefore allowing a clinician to easily identify a child with severe illness requiring admission.

The table did not reach the 83% consensus level, but it has still been included so that juniors have some guidance to severity of illness. We have been completely transparent about the level of consensus achieved.

A12 A child with acute breathing difficulty should be admitted to hospital if they fall into any of the following category:

a) **Oxygen saturation less than 92% in air**
b) **Has signs of severe respiratory distress (table 4)**
c) **Has signs indicating that a child with a breathing difficulty is severely ill and requires immediate and urgent attention (table 1 and 2).**
d) **A child with mild to moderate breathing difficulty who has other signs of serious illness (Table 5) [38,17].**

Strength of evidence 4

Recommendation D

98%, 98%, 100%, 96% consensus achieved respectively

Rationale

The recommendations provided suggest some clear guidance on which patients should be admitted to hospital. As we know, any guideline must take into account patient circumstances and there may be a need for judgement in some circumstances.

A13 Blood tests should be considered in a child presenting with acute breathing difficulty and having other signs of serious illness (table 5).

Strength of evidence 4

Recommendation D

92% consensus achieved

Rationale

It is important to highlight to clinicians, situations in which they must consider to perform blood tests.

A14. If a child presents with mild to moderate breathing difficulty but has the following complicating factors, the child may require a short period of observation in hospital:

a) **Co-morbidity e.g. prematurity, congenital heart disease, chronic lung disease, neurological disorder**
b) **Social problems e.g. previous non-accidental injury, ill parents, parents having difficulty coping**
c) **Infants younger than 2 months**

(Listed in table 6)

Strength of evidence 4

Recommendation D

96%, 92%, 86% consensus achieved respectively

Rationale

There is no evidence that analyses the most important features to be taken into account when deciding on admission of a child. Most children with mild to moderate disease do not require admission but it is important to identify those that the clinician needs to be alerted to.

B. Child presenting with stridor/stertor

The first two recommendations are aimed to highlight two rare but life threatening problems i.e. epiglotittis and bacterial tracheitis. They are seen infrequently and may be forgotten when a child is seen. It is therefore important to include them in the guideline so that they are considered in the list of differential diagnoses of a child presenting with stridor.

B1 In a child with stridor, epiglottitis must be considered if the child is agitated, or drooling or there is absence of a cough.

Strength of evidence 2
Recommendation C
88% consensus achieved

Rationale

In England, epiglottitis is now a rare disease due to the Haemophilus type B vaccination. However, the disease still exists. R Mauro et al [40] (2+C) carried out a prospective study identifying children presenting to the accident and emergency department with stridor. The study identified symptoms and signs that helped to predict the diagnosis of epiglottitis. Drooling, agitation and absence of a cough were found useful predictors.

B2 Bacterial tracheitis can cause severe airway obstruction and should be considered in a child with a croup-like illness (barking cough and stridor) if there is a combination of the following:

a) Toxicity

b) High fever

c) No response to treatment for croup i.e. no improvement in respiratory distress following accepted treatment for croup

Strength of evidence 3

Recommendation D

98%, 86%, 84% consensus achieved respectively

Rationale

There is very little literature on bacterial tracheitis. There is however, agreement that some of the symptoms are similar to those of viral croup and it must therefore be differentiated from this diagnosis.

One paper by Henry et al [41] (3D) and one by Jones et al [42] (3D) have observed children admitted with upper airway obstruction. Jones observed 8 infants and children over 14 months. Children with bacterial tracheitis failed to respond to interventions in the management of croup. The patients had marked subglottic mucosal oedema and mucopus was seen below the subglottic swelling when the trachea was suctioned. The majority of patients grew staphylococcal aureus on culture. Henry observed 7 children over a 2-year period. At endoscopy, there was mucopus and debris. Staphylococcal was the most common pathogen isolated. The children were found to be toxic and had a high fever and were older than the age typical for viral croup.

The next section refers to a child with inspiratory stridor and a barking cough and unlikely to have epiglottitis or bacterial tracheitis and therefore likely to have croup

B3a Nebulised budesonide or dexamethasone are effective in treating croup

Strength of evidence 1

Recommendation A

96% consensus achieved

Rationale

In the medical literature, there is a consensus of opinion that a child presenting with a barking cough, inspiratory stridor, and hoarseness is likely to have viral croup. Several review articles (Macdonald [43], Kaditis [44], Rosekrans [45], Couriel [46]) all agree with the above presenting symptoms.

Glucocorticoids are one treatment that has been used in the management of children with viral croup. Authors from the cochrane acute respiratory group have completed a systematic review [47] (1++A) on the use of glucocorticoids in croup. The authors concluded that:

1.Glucocorticoids are effective in improving symptoms of croup in children as early as 6 hours after treatment.

2.Adrenaline, which can also be used in the treatment of croup, was used less often as an additional intervention and children spent less time in hospital.

3.Nebulised budesonide or dexamethasone, given orally or intramuscularly, are both equally effective in treating croup.

4.The authors were not able to compare the route of administration in a meaningful way.

There is extremely good evidence that glucocorticoids are effective treatments.

B3b In a child with suspected croup, oral dexamethasone is cheaper and as efficacious as budesonide. Until more evidence becomes available, oral dexamethasone should therefore be used in preference to nebulised budesonide except in those children who are vomiting or unable to tolerate oral.

Strength of evidence 4

Recommendation D

90% consensus achieved

Rationale

There is not clear evidence about the dose to be used or method of administration.

Nebulised budesonide has not been shown to be more effective than oral steroids. The authors of the cochrane review have suggested that oral dexamethasone be the preferred steroid to be used because of its safety and efficacy. Nebulised budesonide can be reserved for a child who is vomiting. Intramuscular dexamethasone is also effective but is a more painful route of administration. Further research is needed into the most effective dose and route of administration required.

B4a L-epinephrine (adrenaline) can be used in children with severe croup in addition to oral or nebulised steroids

Strength of evidence 1

Recommendation B

96% consensus achieved

Rationale

Studies in North America have shown a positive outcome when racemic epinephrine has been used. Westley et al [48] (1-B) has shown that nebulised racemic epinephrine is effective in the treatment of acute signs of croup. However, racemic epinephrine is not available in the U.K. Studies that are more recent have looked at using L-epinephrine, which is available in the U.K.

Waisman et al [49] (1+A) studied children aged 6 months to 6 years and compared treatment with racemic epinephrine and l-epinephrine in a randomised double blind fashion. He was able to show that l-epinephrine can be used safely and effectively instead of racemic epinephrine for the treatment of acute croup. The effect was only short term and only lasted for 60 to 90 minutes after the treatment. The study emphasised the risk of a rebound effect and therefore suggests hospitalization for children treated with l-epinephrine.

Fitzgerald et al [50] (1+B) studied children aged 0.5 years to 6 years. In a randomized, double blind study he was able to show that nebulised adrenaline is as effective as nebulised budesonide in the treatment of children with moderately severe croup. All patients had significant improvement from baseline observations and there was no significant difference between the two groups. Other studies mentioned above have shown that oral medication is as efficacious as nebulised budesonide. From this we can extrapolate, that nebulised adrenaline is as efficacious as oral dexamethasone. Fitzgerald et al [50] (1+B) have speculated that if used sequentially nebulised budesonide and adrenaline may have an additive effect. However, further studies are needed in this area.

B4b If treated with l-epinephrine (adrenaline) a child with severe disease requires close observation. Admission to intensive care or high dependency for observation should be considered.

Strength of evidence 4

Recommendation D

92% and 98% consensus achieved

The next section refers to a child presenting with stridor or stirtor but has no barking cough and no evidence of epiglotittis.

Rationale

North American studies [51-53] have recently shown that children could be discharged safely after 2 -3 hours of being given racemic epinephrine. These studies are not relevant to the British population who use l-epinephrine (adrenaline) and no studies have been carried out to look at early discharge after this treatment. We need to decide whether in relation to the British population treated with nebulised l-epinephrine, all children requiring this treatment need to be admitted to a high dependency or intensive care unit.

B5 Enlarged tonsils should be considered in a child presenting with breathing difficulty and stirtor. The child should be referred to the ENT surgeons.

Strength of evidence 4

Recommendation D

Highlighted by ENT surgeon participating in the Delphi process

Rationale

During the Delphi process, it was apparent that it was important to highlight a child with stirtor separately from stridor. By doing this, it is possible to identify children with pharyngeal problems. These children should be referred to the ENT surgeons if they are

causing severe respiratory distress. Enlarged tonsils should be considered and a child urgently referred if found.

B6 Aspiration of a foreign body should be considered in a child presenting with stridor. The child could also present with cough, wheeze, or breathlessness.

Strength of evidence 2

Recommendation C

84%, 90%, 92%, and 94% consensus achieved

Rationale

Barharloo [54] (2+C) carried out a retrospective study of a 20-year experience. The peak incidence of foreign body aspiration occurred in the second year of life. The study included 84 children up to 8 years old and 28 adults. Forty-nine percent of patients presented with a sudden onset of choking and intractable cough. Other presenting symptoms included, fever, breathlessness and wheezing.

B7 A child presenting with a history of choking, paroxysmal cough or any suspicion of foreign body should have a chest x-ray.

Strength of evidence 4

Grade of recommendation D

96% consensus achieved

Rationale

If aspiration of a foreign body is considered, guidance on the appropriate investigations also needs to be provided.

B8 A normal chest x-ray cannot rule out the diagnosis of foreign body aspiration.

Strength of evidence 2

Recommendation C

100% consensus achieved

Rationale

Chest x-rays are performed in children with a history of foreign body aspiration. Svedstrom [55] (2+C) found that plain film radiology alone was neither sensitive nor specific enough to diagnose foreign body aspiration. Twenty-four per cent of patients who had a foreign body found on endoscopic examination showed no abnormalities on radiology. The sensitivity of the test in this study was 68% and specificity was 67%.

Mu [56] (3D) in their retrospective review of 400 children found that in two thirds of the children a normal x-ray was reported. It is important to perform a chest x-ray on children with suspicion of aspirated foreign body, but it is important to realize that a normal x-ray does not exclude the diagnosis.

C. Child presenting with wheeze.

This section is concerned with the management of children presenting with wheeze

C1 The presence of a foreign body should be considered in a child presenting with acute breathing difficulty and wheeze.

Strength of evidence 2

Recommendation C

66% consensus achieved when the word 'excluded was used'. More than 93% consensus would have been achieved if we had originally used the word 'considered'.

Refer to recommendation B6

Rationale

This statement has been included so that clinicians do not automatically treat children with bronchodilators without considering a diagnosis of a foreign body aspiration [57].

C2 During the acute management of a child with wheeze it is not possible to differentiate between those who will have transient symptoms and those who will later develop asthma. After consideration of diagnosis of a foreign body the acute management should focus on the relief of symptoms rather than the ultimate diagnosis

Strength of evidence 2

Recommendation B

84% consensus achieved

Rationale

The British Thoracic Society [29] (4D) now state that there are difficulties when using terms such as asthma in young children. They suggest that to avoid disagreement we should not try to define asthma in the young but to use terms such as wheezing illness or infantile asthma.

Some studies have tried to differentiate between different children with wheezing illness at a young age. A large birth cohort study has been carried out by Martinez et al [58] (2++B) and found that the majority of infants who wheeze have transient conditions and

do not have a risk of asthma or allergies later in life. These children do not have an increased risk of asthma or allergies in later life. The study did find that maternal asthma, maternal smoking, rhinitis apart from colds, eczema during the first year of life and male sex were all independently associated with persistent wheezing. A minority of infants with early wheezing probably has a predisposition to asthma. This study did not go on to assess whether the two groups should be treated differently.

C3 The criteria suggested by the British Thoracic Society (Table 7)[29] regarding the differentiation between mild, moderate, severe and life threatening asthma or wheeze should be accepted

Strength of evidence 4
Recommendation D
88% consensus achieved

C4 In children under the age of 2, the limited evidence does not support the widespread indiscriminate use of anticholinergic agent i.e. anticholinergic agents should only be used on a trial basis on children under the age of 2 until further research is available

Strength of evidence 1
Recommendation A
80% consensus achieved

Rationale

Everard [59] (1++A) has recently published a Cochrane systematic review addressing this problem. Studies were included if they studied children under the age of 2 years, which

therefore included those less than 12 months in whom anticholinergics are frequently used. The results of the review indicated that:

1. The only hospital based study of ipratropium bromide and placebo did not demonstrate any statistical significant benefit.
2. The addition of ipratropium bromide to beta- agonists was not associated with any consistent evidence of benefit over beta-agonists alone.
3. Further studies would be required before ibratropium bromide could be dismissed as ineffective.

This well conducted systematic review has identified the poor evidence base for its use and further research is required. The review was not able to conclude as to whether in this age group of children a combination of the 2 treatments is beneficial.

C5 In a child under the age of 2 with wheeze, a trial of either an anticholinergic agent, beta-2 agonist or both can be used to relieve symptoms. Oxygen saturation and response to treatment must be monitored.

Strength of evidence 4

Recommendation D

92% consensus achieved

C6 In children over the age of 2 with moderate to severe asthma, the addition of 4-6 hrly anticholinergics to the beta 2-agonists inhalation regimen is indicated if there has been poor response to beta 2 agonist alone.

Strength of evidence 1

Recommendation A

92% consensus achieved

Rationale

Plotnick and Ducharme [60] have recently completed a Cochrane systematic review addressing this issue (1++A). The review only included studies that involved children aged 18 months to 17 years. Children under the age of 18 months were not included. The review concluded that in children with acute asthma the addition of multiple doses of anti-cholinergics to inhaled beta 2-agonists appears to improve lung function and may decrease hospital admission. The systematic review includes studies of children between 18 months and 2 years, however, the evidence is not clear for this age group and has therefore not been included in the final statement.

C7 In children over the age of 2, without life-threatening asthma (Table 7) and not requiring oxygen, holding chambers (spacers) could be used instead of nebulisers in most situations.

Strength of evidence 1

Recommendation A

90% consensus achieved

A large variety of inhaler devices exist for the treatment of asthma. The National Institute of Clinical Excellence [61] has recently produced guidance for clinicians for the treatment of chronic asthma. Cates and Rowe [62] (1++A) have carried out a systematic review addressing inhaler devices for the treatment of acute asthma. Studies involving children presenting to emergency department or presenting to a community setting over the age of 2 were included in the review. The review concluded that none of the outcome measures were significantly worse with holding chambers and therefore they could be

substituted for nebulisers in the treatment of acute asthma in emergency departments. The review suggests that paediatric patients using holding chambers may have shorter stays in the emergency department, less hypoxia, and lower pulse rates, compared to patients receiving the same treatment via a nebuliser. It did not address children with life threatening symptoms and this group of children should not be included in this discussion. The review did not comment that the cost of the different modes of treatment might be the deciding factor in different hospitals.

C8 All children, regardless of their age, with moderate-severe or life threatening wheeze should be prescribed a short course of oral steroids.

Strength of evidence 4

Recommendation D

84% consensus achieved

Rationale

It is important to give guidance on which children should be receiving oral steroid treatment if they present with wheeze. The British Thoracic Society [29] have suggested that all children including those under the age of 12 months should be treated with oral steroids if they have moderate to severe or life threatening wheeze. However, they acknowledge that there is no good research that can provide us with the information to decide whether children under the age of 12 months benefit from oral steroids. A consensus opinion needed to be achieved to address this issue.

C9 Aminophylline should continue to be used for the treatment of acute severe life threatening asthma when other treatments including salbutamol and corticosteroids have been unsuccessful

Strength of evidence 1

Recommendation A

88% consensus achieved

Rationale

Children presenting with acute severe or life threatening asthma will be admitted to hospital but their treatment will start immediately on presentation to hospital. It is for this reason that treatment with aminophylline is being discussed here. Aminophylline may be considered in the A&E department before admission actually takes place.

Mitra et al [63] concluded from their recent Cochrane systematic review that in children over the age of 2 aminophylline should still be used as a bronchodilator in addition to inhaled bronchodilators.

The next section will consider investigations for a child presenting with wheeze or asthma

C10 Chest x-rays do not routinely need to be performed on every child presenting with their first acute attack of wheeze. Consider if there are atypical clinical features (e.g. focal signs, suspicion of foreign body).

Strength of evidence 2

Recommendation C

76% consensus achieved

Rationale

Gershel et al [64] (2+C) assessed the value of routine x-rays during acute first attacks of wheeze. The study population consisted only of children over the age of 1 but who presented with an initial episode of wheezing. The study found that in most instance children with a combination of abnormalities on auscultation and of vital signs such as tachypnoea, tachycardia, fever, localised rales, and localized breath sounds could identify children who were likely to have abnormal findings on x-ray. The results of the study did not support routine x-ray in children with first presentation of wheeze. The authors suggest careful clinical examination to identify a sub-group who will benefit from the investigation.

Mahabee-Gittens et al [65] (2-D) recently carried out a retrospective review of children under 18 months visiting the emergency department with wheezing. They made similar conclusions to Gershel's[52] study. They concluded that patients who were found to have focal infiltrates on chest x-ray were more likely to have a history of fever, temperature, or crackles on examination. They also found that on less than 1 % of x-rays were there finding other than those representing bronchiolitis, asthma, or focal infiltrates. The authors therefore recommend selective use of x-rays. They suggest that children with wheeze should be x-rayed if they have a history of fever, temperature more than 38.4, or crackles on examination.

A more recent study by Walsh-Kelly et al [66] (2+C) studied children of all ages with an initial episode of wheezing presenting to the children's hospital. Only 6.2% of children in this study had pathological radiological findings. 25.4% had normal findings and in the majority i.e. 68% reactive airways disease was identified. However, no combination of variables was able to identify patients with pathological chest disease. The authors therefore, suggest that in order to be able to identify the children who present with first

time wheeze and have underlying pathology the practice to x-ray all children presenting in this way should be continued.

Due to the variation in advice, a consensus needed to be achieved. The majority of the panel agreed with the recommendation provided.

C11 A child presenting with acute asthma/wheeze do not routinely require a chest x-ray

Strength of evidence 2

Recommendation C

98% consensus achieved

Rationale

At present, there is not strong evidence to give firm guidance on this issue. Both the SIGN asthma guideline [26] (4D) and the British Thoracic asthma guideline [29] (4D) do not suggest that routine x-rays be performed in acute asthma.

Brooks [67] (2+C) studied all children who were admitted to the Buffalo Children's Hospital between January 1980 through May 1980 admitted with acute asthma unresponsive to emergency treatment. The study showed that in this particular group of children there was a low incidence of x-ray abnormalities. The abnormalities rarely altered management and the authors therefore conclude that routine x-rays may not need to be performed but acknowledge that x-rays may still be required in children who are particularly ill or unresponsive to treatment.

C12 A child presenting with acute wheeze/asthma with the following unusual signs should have a chest x-ray when stable:

a) unilateral reduced air entry and hyperresonance on percussion (signs of pneumothorax)
b) no improvement after treatment of severe symptoms

Strength of evidence 4

Recommendation D

96% and 98% consensus achieved respectively

Rationale

Although routine x-rays are not required, clinicians do require some guidance on situations where x-rays should be performed.

C 13 A child presenting or admitted with acute wheeze does not routinely require blood tests.

Strength of evidence 4

Recommendation D

92% and 94% consensus achieved

Rationale

Invasive tests should not be unnecessarily carried out on children. It is therefore important for clinicians to be clear when they do not need to be performed routinely.

D In this section we will discuss a child under the age of 2 who presents with wheeze.

In this age group, it is important to identify a child who has bronchiolitis. A child may present with a wheeze and then using clinical signs and symptoms, a working diagnosis of bronchiolitis may be made. Children not thought to have bronchiolitis have been discussed in the section above. We will now discuss the management of children who are thought to have bronchiolitis. Many of the decisions for a child with bronchiolitis have already been addressed in earlier sections. The child with complications, with signs of a serious illness and low oxygen saturations has already been covered. We will only discuss questions in this section that have not been covered already.

D1. Bronchiolitis is a seasonal viral illness characterised by fever, nasal discharge, and dry wheezy cough. On examination there are fine inspiratory crackles and/or high pitched expiratory wheeze.

Strength of evidence 4
Recommendation D
90% consensus achieved

Rationale

According to Rakshi and Couriel [68] (4D), a child with bronchiolitis usually has a fever and nasal discharge, which then develops into a dry cough with distressed breathing. On examination the child has fine inspiratory crackles and may have a high pitched expiratory wheeze. This definition is accepted in the U.K but is different from that in the United States and therefore one must interpret some of the studies carried out in the U.S.A with caution. In the U.S.A there is much more emphasis on the inclusion of wheeze in the diagnosis.

D2 In a child clinically diagnosed with bronchiolitis, bronchodilators should not be routine practice. A trial may be considered but stopped if found to be of no help.

Strength of evidence 1

Recommendation A

86% consensus achieved

Rationale

Kellner et al [69] (1++A) from the Cochrane acute respiratory infections group have completed a systematic review to address whether bronchodilators are beneficial in the management if bronchiolitis. The review concluded that bronchodilators produce modest short-term improvement in clinical features of mild or moderately severe bronchiolitis. The review does not recommend routine use of bronchodilators. However some of the studies did show an improvement in clinical score and the reviewers acknowledge that the outcome measures assessed may not be adequate to measure the improvement that may occur from treatment.

D3 During a trial of bronchodilator therapy the child should be closely monitored for clinical deterioration and hypoxaemia and treatment stopped if there is no clinical improvement.

Strength of evidence 1

Recommendation A

86% consensus achieved

Rationale

A double blind placebo controlled trial by Ling Ho [70] (1+A) and an observational study by C.O' Callaghan [71] (2+C) found that some infants have a deterioration in lung function and may become hypoxic after administration of salbutamol.

D4 Budesonide is not recommended in the management of a child with bronchiolitis.

Strength of evidence 1

Recommendation A

100% consensus achieved

Rationale

A multi-center randomised double blind placebo controlled trial by A.Cade et al [72] (1++A) and a smaller trial by Richter [73] (1+A) found no clinical benefit from the administration of nebulised corticosteroid.

D5 Oral or intramuscular steroids are not recommended in the routine treatment of a child with bronchiolitis.

Strength of evidence 1

Recommendation A

98% consensus achieved

Rationale

Double blind randomized controlled trials by De Boek [74] (1+A) and by Roosevelt [75] (1++A) studying the efficacy of dexamethasone therapy for children with bronchilitis found no advantage in the use of this treatment. We could find no randomised control trial that recommended the use of dexamethasone. A randomised double-blind placebo

controlled trial by Klassen et al [76] (1++A) set out to determine the clinical benefit of oral dexamethasone in children treated with nebulised salbutamol. No affect on the clinical course of the disease was found. The difficulty with Roosevelt's study and with Klassen's study are that they were carried out in countries where the definition of bronchiolitis is different from that in the U.K., therefore further research in British infants is required.

D6 In a child with bronchiolitis and severe respiratory distress, a trial therapy of nebulised adrenaline (l-epinephrine) may be considered after discussion with a senior clinician

Strength of evidence 1

Recommendation B

60% consensus achieved

Rationale

Most studies addressing this issue have been carried using racemic epinephrine, which is not available in the United Kingdom. A double blind randomized control trial by Menon [77] (1+A) is the only study we could find using adrenaline (l-epinephrine). In this study at 60 minutes after the therapy there was a statistically significant improvement in oxygen saturations and Menon concluded that nebulised epinephrine was more efficacious than salbutamol for infants with acute bronchiolitis. However, only 42 patients were included in the study and therefore further larger research studies are required before adrenaline can routinely be recommended in the treatment of a child with bronchiolitis. A majority consensus was achieved with this recommendation but only 60%. Clinicians are concerned in the U.K about the use of adrenaline in children. Currently there is only one study that has been performed using adrenaline. It is for this

reason that despite the study being a randomised controlled trial a grade B has been attributed to this recommendation.

D7 If treated with adrenaline (l-epinephrine) the child requires close observation. Admission to intensive care or high dependency for observation should be considered.

Strength of evidence 4

Recommendation D

98% and 92% consensus achieved respectively

Rationale

If we are to accept the recommendation, it is important to consider where the ongoing care will be provided.

D7 Blood tests are not routinely recommended in the management of a child with bronchiolitis.

Strength of evidence 4

Recommendation D

96% consensus achieved

Rationale

One of the aims of the guideline is to reduce unnecessary investigations. Bronchiolitis is a viral illness and the only reason to carry out blood tests would be if there were concerns about the presence of a bacterial infection. Studies mentioned in previous statements have

shown the difficulty in differentiating viral from bacterial pneumonia and therefore routine blood testing is not recommended routinely.

D8 Routine x-ray of a child with clinically diagnosed bronchiolitis is not recommended.

Strength of evidence 2

Recommendation C

92% consensus achieved

Rationale

Numerous review articles have been written in this area and have discussed whether x-rays or other clinical features can help predict the severity of a child's illness. Prematurity, age less than 2 months and apnoea at presentation have been suggested to be important in predicting the severity of illness. The articles addressing this issue have produced conflicting results and it is for this reason that it is very difficult to provide a definitive evidence based recommendation. The Cincinnati evidence-based guideline for infants with bronchiolitis [27] (4D) does not recommend routine chest x-rays but does not clarify whom the exceptions would be. Clinicians are left to make their own judgements for specific cases.

Bronchiolitis is a viral infection and the only reason for doing an x-ray is to diagnose whether a child has a bacterial pneumonia. Swingler [78], as mentioned previously, has suggested that children over the age of 2 months who are not admitted to hospital should not have a chest x-ray and an observational study by Friis [79] et al (2+C) did not show correlation between a viral or bacterial diagnosis and the chest x-ray. Friis studied 128 infants and children under the age of 7 years. The children under the age of 6 months were more likely to have x-ray changes localized to one lobe or segment but this did not

correlate with positive bacterial findings. The study does not support routine x-ray of a child with bronchiolitis but the authors do suggest caution in children under the age of 6 Months. There is also concern about children under the age of 2 months. Children of this young age are thought to be at risk of severe illness. A consensus opinion needs to be achieved as to whether all children presenting with symptoms of bronchiolitis at this age should have a chest x-ray.

D9 A child aged less than 2 months with clinical signs of bronchiolitis should be admitted if they are at risk of developing serious disease (see table 8) [20]

Strength of evidence 4

Recommendation D

98% consensus achieved

Rationale

Guidelines for admission for children have been provided earlier. This recommendation refers specifically to children with clinical bronchiolitis.

E Child presenting with a cough

Previous sections should be referred to if a child has wheeze or stridor.

E1 A child who has aspirated a foreign body can present with a cough

Strength of evidence 2

Recommendation C

90% consensus achieved

Refer to B6

Rationale

Addressed in an earlier section

E2 A child presenting with a breathing difficulty and a history, paroxysmal cough or any suspicion of foreign body aspiration should have a chest x-ray.

Strength of evidence 4

Recommendation D

96% consensus achieved

Rationale

Addressed in earlier section

E3 In a child with cough and breathing difficulty the probability of pneumonia is increased in the presence of any of the following:

a) tachypnoea

b) grunting

c) chest in-drawing

d) fever

e) nasal flaring

f) crepitations

Strength of evidence 2

Recommendation C

88% and 93% consensus achieved respectively for a) and b)

Consensus not achieved for c), d)(66% consensus), e)(68% consensus), f)(82% consensus) but based on level 2 evidence

Rationale

Most of the studies encountered when reading the literature were not appropriate for our population. They were carried out in the developing world or on malnourished children or were not comparable with each other due to them using different cut-off points or using different methodology or the age groups studied varying from study to study. It is therefore difficult to produce any precise guidelines based directly on the current evidence. However, we can use the evidence to develop guidelines based on a combination of evidence and consensus opinion.

The World Health Organisation [17] (4D) has produced an algorithm for the developing world to help with making the diagnosis of a lower respiratory tract infection. To some extent we can base our guidelines on these but we must adapt them for our population who will not be exposed to the same infections, will have access to different health care, may present at an earlier stage in the disease and will probably not be malnourished.

The WHO algorithm stresses the importance of tachypnoea as indicating pneumonia. Other signs that relate to the severity of the pneumonia are chest in drawing, nasal flaring, grunting, and cyanosis. The algorithm suggests that any child with chest in drawing have severe pneumonia.

Various different studies have tried to assess the sensitivity and specificity of these signs but we could not find any grade 1 trials that studied this issue. In most studies, the gold standard used for the diagnosis of pneumonia was a positive chest x-ray. This incorporates bias into these studies because children who were more likely to have pneumonia from their clinical signs were more likely to have a chest x-ray. The other

problem is that according to Palafox et al [37] (2+C) children in the early stages of pneumonia may not have a positive x-ray despite having clinical signs.

In most studies, tachypnoea is recognized as being important for predicting pneumonia. The predictive value of this sign differs between different studies. Only a few studies have been carried out in the developed world and these are all biased to some degree.
Leventhal [80] (2+C) studied 136 children attending the emergency department. They recorded important clinical signs and symptoms as per the study questionnaire. A chest x-ray was taken and the predictive value of signs and symptoms for the diagnosis of pneumonia was calculated. The absence of tachypnoea was useful for ruling out pneumonia and one third of children with tachypnoea had pneumonia on x-ray. Grunting and nasal flaring increased the chance of pneumonia but their absence could not be relied upon to rule out pneumonia. The predictive value of a cluster of symptoms was then studied. The study found that the classical cluster of symptoms associated with pneumonia (fever, cough, and rales) did not improve the ability to predict a diagnosis of pneumonia. Of the children with at least one pulmonary finding (respiratory distress, tachypnea, rales, or decreased breath sounds) 27% had an x-ray finding of pneumonia and all children without pulmonary findings had a normal x-ray. The height of fever in children with a sign of pneumonia was not found a predictor of pneumonia. The difficulty with this study is that the authors do not give a definition of tachypnoea and the ability of the clinicians to observe signs in the child.

A study by Taylor et al [81] (2+C) studied 576 patients under the age of 2 with a temperature of 38 degrees or more. A positive chest x-ray was used to diagnose pneumonia. Children with pneumonia were found to have a significantly higher respiratory rate than those without pneumonia. The positive predictive value of tachypnoea as a sign of pneumonia was 20.1% and the negative predictive value was

97.4%. The authors concluded that if tachypnoea were not present it would exclude the diagnosis of pneumonia in most children. The predictive value of other signs or symptoms such as cough was not discussed in this study. The problem with study was that it was carried out on a very select group of patients and therefore would not include all the children presenting without a temperature but with clinical signs. The other problem was that chest x-rays were not obtained for every patient and therefore some children with pneumonia may have been missed.

Two studies from the developing countries have observed children presenting with a breathing difficulty and a cough. Harari et al [82] (2+C) and another by Mulholland et al [83] (2+C) overcame the problem of bias of x-ray by carrying out x-rays on all children with abnormal clinical findings. Both studies found that the presence of tachypnoea or chest in drawing or both was a good indication of pneumonia. Harari's study found that chest in drawing and/or respiratory rate over 50 per minute had a positive predictive factor of 45% of x-ray evidence of pneumonia and 83% negative predictive factor. Harari's study found that the presence of fever or crepitations was not helpful in the diagnosis of pneumonia. The study concluded that antibiotics should be given to children with a cough and tachypnoea or chest in drawing. The study was well conducted but we must remember that the study groups are children from a developing country who may have more severe pneumonia than children in England or a higher incidence of bacterial pneumonia.

In Palafox et al's [37] (2+C) study, tachypnoea showed the highest sensitivity (74%) and specificity (67%) for diagnosing pneumonia. In children who had the disease for less than 3 days, tachypnoea had a lower sensitivity and specificity. The authors conclude that in the first 3 days of an illness, clinicians should rely on this sign cautiously and therefore the absence of tachypnoea does not necessarily mean the absence of pneumonia.

MacFaul et al carried out a prospective study (unpublished) [84] on 2300 paediatric admissions. The table included is a summary of the symptoms and signs found to help to predict pneumonia.

Age	**Presenting problem category: 'Breathing difficulty'**	**Symptom combination: cough, fever without breathing difficulty**	**Symptom combination: cough, fever with breathing difficulty**
All ages	9%	14%	19%
< 1 year	11%	6%	25%
1-3 years	6%	10%	6%
> 3 years	8%	23%	36%

From this study it appears that a combination of cough, breathing difficulty and fever increase the likelihood that a child has pneumonia. High fever was also found to an important sign by Campbell et al [35] (2+C).

The next section will discuss the role of chest x-rays, other investigations and management of children with a clinical suspicion of pneumonia.

E4

a) All children under the age of 2 months with clinically suspected pneumonia should have a chest x-ray

Strength of evidence 4

Recommendation D

94% consensus achieved

b) Children over the age of 2 months with signs suggesting pneumonia but who do not require admission to hospital do not routinely require a chest x-ray. An x-ray may be indicated if there has been no response to oral antibiotics or the patient is not presenting with the first episode of pneumonia

Strength of evidence 1

Recommendation A

80% consensus achieved

c) A child admitted to hospital with clinically suspected pneumonia i.e. with cough and severe respiratory distress should have a chest x-ray

Strength of evidence 4

Recommendation D

89% consensus

Rationale

The gold standard for diagnosing pneumonia is a positive chest x-ray. However, a child in the early stages of the disease may not have a positive chest x-ray. If a child has positive clinical signs but a negative x-ray it is questionable whether the child should be treated with antibiotics, therefore, it is questionable whether there is any advantage in performing the x-ray if it does not alter management?

Swingler [78] (1++A) has concluded from his Cochrane systematic review that there is no evidence to show that performing a chest x-ray in ambulatory children aged over 2 months with an acute lower respiratory infection improves outcome. This evidence only applies to ambulatory children and not to children admitted to hospital. The studies included did not assess children under the age of 2 months.

A consensus opinion needed to be achieved about whether children under the age of 2 months who are clinically suspected to have pneumonia or any other respiratory infection should have a chest x-ray regardless whether they are ambulatory or not. A consensus was also needed for whether all children admitted to hospital with suspected pneumonia should have a chest x-ray.

E5 Even when a chest x-ray is taken, it is not accurate enough to be able to differentiate between viral and bacterial pneumonia.

Strength of evidence 2

Recommendation C

96% consensus achieved

Rationale

No randomized-controlled trials have been carried out to address either of these issues. The studies that have tried to assess the accuracy of a chest x-ray for differentiating between viral and bacterial pneumonia are not comparable. Their methodology can be questioned and many have been carried out on small groups of children. Some studies have been carried out on outpatients and others on in-patients, the ages of the children involved also varies; therefore, the study groups are not comparable. Bacterial and viral pneumonia are diagnosed by methods that are not 100% sensitive or specific and therefore relying on these methods for accurately diagnosing bacterial or viral pneumonia

is not in itself accurate and therefore biases the results. A study by Korppi et al [85] (2+C) has also shown that lobar consolidation is not the only type of radiological picture associated with pneumonia but bacterial infection alone or mixed with viral infection can be associated with interstitial and alveolar infiltrates.

It was possible to find studies that attempted to assess the accuracy of a chest x-ray for the detection of viral or bacterial pneumonia. However, there is no agreement between the results of the studies. A study by Swischuk [86] (2+C) found an overall 90% accuracy when trying to identify the type of pneumonia. This is not supported by results from Bettenay's [87] study (2+C) which found that when an x-ray suggested a bacterial infection only there was actually only a 30% chance of isolating a bacteria.

The flaws from these studies have been mentioned above and therefore no strong conclusion can be made from them. Despite all these difficulties, it is apparent from the studies that it is difficult to diagnose pneumonia radiologically and to differentiate between viral and bacterial pneumonia.

E6 In children with clinically suspected pneumonia a normal chest x-ray cannot exclude pneumonia

Strength of evidence 2
Recommendation C
88% consensus achieved

Rationale

In many studies, the chest x-ray has been used as a gold standard for diagnosing pneumonia. However, inter-observer variability in the interpretation of x-rays ultimately

affects the results of the studies. As mentioned earlier in Pafalox's [37] study the x-ray is not always positive in the first few days of the illness. This in itself introduces a variable into the studies.

Davies et al [88] (2+C) studied the chest x-rays of 40 infants under the age of 6 months admitted with lower respiratory tract infection and showed that there is variation in intraobserver and inter-observer agreement among radiologists. The authors suggest that clinicians should be aware of this problem when treating children. However, the gold standard of pneumonia, lobar consolidation, appeared to be reliable.

Another study by Kiekara et al [89] (2+C) was carried out on a much larger group of children. Chest x-rays of 201 hospitalized with suspected or confirmed pneumonia were evaluated 3 years apart.127 cases were diagnosed with definite pneumonia on both occasions. In 46 of the cases (24 %) variation between the two evaluations occurred. The study found that radiological diagnosis of pneumonia was difficult in children and not all children had lobar consolidation but some children had interstitial or alveolar pneumonia.

E7

a) No laboratory tests should be routinely performed on children with clinically suspected pneumonia who are not admitted to hospital

Strength of evidence 2

Recommendation C

94% consensus achieved

b) It is not necessary to carry out blood tests in a child admitted to hospital with clinically suspected pneumonia but who is treated with oral antibiotics

Strength of evidence 2

Recommendation C

82% consensus achieved

c) All children admitted to hospital with clinically suspected pneumonia and who will be treated with intravenous antibiotics should have a full blood count and blood culture. Acute phase reactants, urea, and electrolytes are not required routinely.

Strength of evidence 2

Recommendation C

76% consensus achieved originally but recommendation was reworded after re-appraising the evidence

d) Acute phase reactants such as ESR and CRP do not help distinguish between viral and bacterial infection.

Strength of evidence 2

Recommendation C

Rationale

Laboratory tests are usually performed to help with the diagnosis or to identify the causal agent of the pneumonia. Therefore, they should only be carried out if they can actually help with either of these. The investigations carried out vary according to the doctor's experience and the tests available in the hospital. The decision regarding the laboratory investigation of a child is based on expert opinion and textbook advice. Few studies have addressed this issue in the context of patient management. Some studies have looked at

the prevalence of bacteraemia but these studies cannot be compared because some involve children from the developing country, others involve children seen in outpatients departments, and therefore these studies are not comparable.

Hickey [90] (2+C) carried out a retrospective review of x-rays of 939 patients in a tertiary children's hospital who had radiographic evidence of pneumonia. Four hundred and nine (44%) of these patients had blood cultures taken. Only 11 (2.7%) grew pathogenic bacteria. This study probably over-estimated the rate of bacteraemia because in 56% of cases, a blood culture was not taken and this was more likely to occur in children with mild pneumonia who may not have shown any evidence of bacteraemia. The study also found that clinical management was not altered because the antibiotic regime was started prior to the culture results being available and antibiotic regimes were not altered on the basis of the laboratory reports. The study has many flaws because it is retrospective and relies firstly on the radiographic diagnosis of pneumonia and then on the technique of the clinician doing the blood culture. Despite the results of this study, other papers based on consensus opinion provide a range of positive blood cultures between 10 and 40% and a review by Heath [91] states that a pathogen is not found in 20-60% of cases.

We could find no evidence relating the results of white blood counts with the management of patients. A raised white blood count with a predominance of polymorphonuclear cells usually indicates bacterial disease but we were not able to find any studies that addressed whether doctors waited for these results before treating a patient and whether their management altered once these results were available.

Turner et al [92] (2+C) however, carried out a study on 98 patients with radiologically diagnosed pneumonia. They found that both children with proven viral and bacterial pneumonia had an equally raised white count but the total neutrophils were greater in

children with bacterial infection indicating that full blood counts are useful in differentiating between viral and bacterial infection if interpreted correctly.

Similarly a raised CRP and ESR are thought to be associated with bacterial infection but this test is not always available and again no studies have looked at the influence of the result on the management of the patient. Turner et al found no statistical difference between the CRP's of children with viral or bacterial infection. Turner's study may be biased because only 98 patients were studied and also because all patients seen in the out-patients clinic and the emergency room were included and therefore did not represent the more severely ill children. However, by conducting the study in this way the results reflect the mix of patients who usually present. Nohynek et al [93] (2+C) also found that neither full blood count, CRP nor ESR helped in the diagnosis of pneumonia because an abnormal value could neither prove nor disprove a bacterial infection.

The results of viral studies on the patient's blood are not rapidly available and therefore have little influence on the immediate management of a patient. Viral immunofluorescence may be useful in identifying a virus but has little effect on the immediate management of a patient.

A recent study by Clements et al [95] (2+C) has shown that that polymerase chain reaction provides a rapid method for diagnosing bacterial pneumonia and increased the diagnostic from 13% to 31 %. However, this is an expensive and therefore not readily available test.

Children who have mild to moderate pneumonia and the intention is that they will be sent home will probably not wait for their blood results and their management will not be altered on the basis of the laboratory test results.

A difficulty arises in children who are admitted to hospital but are able to tolerate oral antibiotics. It is in these children that a consensus opinion needs to be achieved to decide whether invasive investigations are necessary. It is not clear from the evidence, which children should have investigations taken and I have therefore provided a number of alternative questions to assess the degree of agreement with each question.

E8 A child admitted to hospital with clinically suspected pneumonia should be prescribed parenteral antibiotics if they have either of the following:

a) toxic appearance
b) severe respiratory distress
c) vomiting
d) immunocompromised
e) dehydrated and requiring intravenous fluids
(See Table 9)

Strength of evidence 4
Recommendation D
90%, 94%, 94%, 92%, and 94% consensus achieved

Rationale

We were unable to find any evidence that could provide the answer to this question. No randomized control trials exist to address whether intravenous antibiotics are more efficacious than oral antibiotics in children with pneumonia. The question is difficult to answer due to the variation in antibiotics used in different hospitals and the variation in severity of the illness. Different antibiotics achieve different therapeutic levels in the blood. Some drugs are well absorbed orally others are not. The other difficulty is that

often by the time a child is admitted to hospital they are vomiting and not tolerating oral medication or the parents have already treated their child with a course of antibiotics at home. It is therefore difficult to provide evidence-based guidelines on how to prescribe antibiotics. A consensus must be achieved to help with this part of the guideline.

Children with mild to moderate symptoms and who are going to go home should do so on oral antibiotics. Jadavi et al [97](4D) have developed a list of recommendations for children admitted to hospital who may require parenteral antibiotics. These recommendations were used in the Delphi process for the development of this guideline.

E9 The antibiotic used for the treatment of a child with community acquired pneumonia should be chosen according to the local protocol

Strength of evidence 4

Recommendation D

90% consensus achieved

Rationale

Pneumonia can be caused by different organisms depending on the country and the area. Different hospitals have their own protocols for the antibiotics that should be used in the treatment of pneumonia depending on the local antibiotic resistance and the drugs on the hospital formulary. It is difficult therefore to provide a recommendation to answer this question

Implementation strategy

During the development of the guideline, it was important to consider the process of implementation. Unless guidelines are disseminated and implemented, they are unable to bring about the change in behavior intended.

Dissemination

It is the aim of the guideline development group to raise the awareness of the existence of the guideline so that clinicians in other hospitals can take advantage of the work that has already been completed and not spend time producing similar guidelines. We hope to publish the guideline in peer reviewed journals, to present it at national and international meetings and to disseminate it via an authoritative body such as the Medical Colleges.

Steps involved in implementation of the guideline

Identify target users

Target users were identified so that the guideline could be presented in a format that could be easily implemented. The guideline development group decided that junior doctors should be the main users of the guideline.

The guideline has been presented in two forms. The complete guideline including a full technical report and appendices can be referred to by clinicians that wish to understand the source of information they are instructed to follow. In addition, the algorithm can be used by clinicians who feel they have little time to read and wish to follow a guideline in a quick and easy to follow form. The algorithm has been designed in such a way that it could easily be presented in electronic format on the Internet or Intranet promoting easy access to the guideline and therefore dissemination and distribution.

Identifying stakeholders

Junior doctors do not work independently. They will work together will nurses, senior clinicians, members of other disciplines, primary care doctors and patients themselves. It is important that as many stakeholders as possible are involved in the development of the guideline at the outset. The Delphi process has the advantage that it allows easy access and involvement of the stakeholders. Senior clinicians in the hospital where the guideline was piloted were included in the Delphi process to reduce potential barriers to implementation at a later stage. Guidelines presented in electronic format are becoming increasingly popular and it would therefore be important to include individuals involved with this process such as clinical audit co-ordinators, clinical effectiveness co-ordinators, and the hospital information and technology department. Close links were therefore developed with our audit department who have a particular interest in clinical guidelines.

Quality

The guideline has been developed using rigorous and transparent methods. This allows the guideline to be flexible so that it can be adapted for local use, especially where t has been based on consensus opinion.

Education and communication

It is important that guidelines are not just disseminated to their users but also implemented. Within the hospital, it is necessary to hold training sessions so that clinicians are not only aware of the presence of the guideline but also how to use it. Training sessions may be held individually, as small workshops or as much larger conferences.

Local opinion leaders and members of groups carrying authority such as the clinical governance teams are important for the promotion of the guideline. They are able to

emphasis the benefits of using guidelines and encourage audit and feedback to inform professionals about the implementation process.

Audit and feedback

It is important for all organisations using guidelines to audit their effect on the management of patients. This not only provides valuable information on any modifications that may be required to be made to the guideline on a local level but also to help encourage clinicians to use the guideline. This guideline is currently being audited in Nottingham.

Care pathways

We decided not develop a care pathway for this guideline because we thought that it would be more appropriate for this to be developed at a local level so that the guideline can be incorporated in the current documentation used by individual organisations.

In summary

Implementation is an extremely important part of the development process. Strategies have been used to implement the guideline at the hospital in which the guideline was developed. However, we have tried to provide here an outline of essential components to the implementation of the guideline that can be used at other institutions.

Discussion

Clinical guidelines are now an integral part of clinical governance and are a tool for promoting best practice. In order to do this, paediatricians need to integrate the highest quality scientific evidence with clinical expertise and the opinions of the family[98].

Junior doctors have varied experience in managing acute paediatric patients and value some guidance. Traditionally, they turn to textbooks for advice, many of which are out of date, and their source of evidence is unknown. Very few textbooks include literature that has been critically appraised. Yet even today, textbooks are a widely used and readily available source of knowledge. With increasing interest in evidence-based medicine, clinicians are searching for answers from randomised-controlled trials or systematic reviews and meta-analyses. Unfortunately in paediatrics, all too often the clinical questions that are at the forefront of a clinician's mind are not currently answered by high quality research. A guideline based on the most up to date evidence, and on a large consensus opinion when evidence is not available, is useful to junior staff when faced with a patient requiring immediate treatment.

Before guidelines are used, they should be appraised for the rigour of the methods used to develop them and evidence of this process should be available [99]. We made a rigorous attempt to search for the highest quality evidence available and recommendations were graded according to the evidence available. A number of cross checks were employed to retain the rigour of the development of the guideline. Another member of the steering group checked the grades of the research papers. The guideline development group oversaw the development itself and the evidence was provided to the panel of 50. This in itself acts as an internal peer review of the search and appraisal system used.

Criticisms regarding the Delphi process for guideline development include concerns that guidelines based on consensus promotes practice which is not based on the highest level of evidence and may in fact not be best practice. Other concerns include consensus guidelines hindering innovation and research in medicine, and of consensus opinion overriding evidence. In our view, the development of guidelines by formal consensus ensures that where evidence is available it is incorporated into the guideline but allows evidence- based recommendations to be linked so that they can be applied in the clinical situation. The consensus process itself was formal and transparent. It was never used to undermine available evidence but to translate it into a form that could be used by clinicians. In addition, guidelines help to promote, not hinder research. Areas of medicine where only consensus is available will be highlighted and resources should be made available to provide the evidence in the future.

Very few guidelines can be solely based on evidence and most include consensus to some degree [13]. However, this is not always made apparent or rigorous manner. The consensus is often informal and results from the opinion of a small steering group. It is unusual to be able to track the origins and the development of the final consensus achieved. In addition, many guidelines are developed by small groups of experts and when these guidelines are disseminated, they are not implemented because they are not relevant to the population using the guideline or the patients they addresses. By involving a multidisciplinary panel at all levels of experience and a primary care representative, it was possible to present the final guideline in a form that was relevant and usable. The guideline has now been implemented in the emergency department at the Queens Medical Centre, Nottingham and the results of the implementation process will be published in a future paper.

When considering the relevance of the guideline it was decided to make it problem based [9] rather than diagnosis based, unlike many other existing guidelines. Junior doctors with little paediatric experience often need advice on managing a patient at presentation to the hospital and the sequential approach to arriving at a diagnosis. They will only be able to refer to the guidelines relating to specific diagnosis once they are confident that the correct diagnosis has been made. Our guideline is one of a very few problem- based guidelines relating to the initial management of a child presenting to hospital.

Conclusion

This guideline is an evidence-based guideline not a consensus guideline. It uses formal consensus opinion to make it clinically relevant by linking evidence-based recommendations together when there are intervening steps where evidence is not available. Without this interim process, the development of an algorithm would not be possible. A combination of evidence based medicine and consensus is an extremely rigorous method if used correctly. Our problem based guideline was specifically developed for use by junior doctors who are often the first to see patients, who wish to apply basic safe management to their patients and often do not have immediate access to senior support. This guideline provides them with this help in a logical easily implemented manner but also keeps them up to date with current evidence and opinions.

Breathing Difficulties in Children-Information for parents

Your child is well enough to be looked after at home at present but if he/she becomes ill, they may need to be seen again. This leaflet is about the first day or two after your child leaves hospital. We are giving you this to help you when you are at home.

Your child has been in hospital with:

When you take your child home:
It is important that you:
1. encourage your child to drink plenty little and often
2. check their breathing and colour (see below)
3. give your child the medication prescribed by the doctor

You must call a doctor or go back to the hospital if:
1. your child is struggling to breathe and getting very tired
2. your child is too breathless to talk or your baby is grunting
3. your child changes colour and becomes pale grey, white or blue around the lips
4. **you are worried that your child has got worse**

If you require further advice, you can contact:

1. Your own GP
2. NHS direct - 0845 4647
3. Other

REMEMBER IF YOU ARE WORRIED ASK FOR HELP

Algorithm for the management of children with acute breathing difficulty

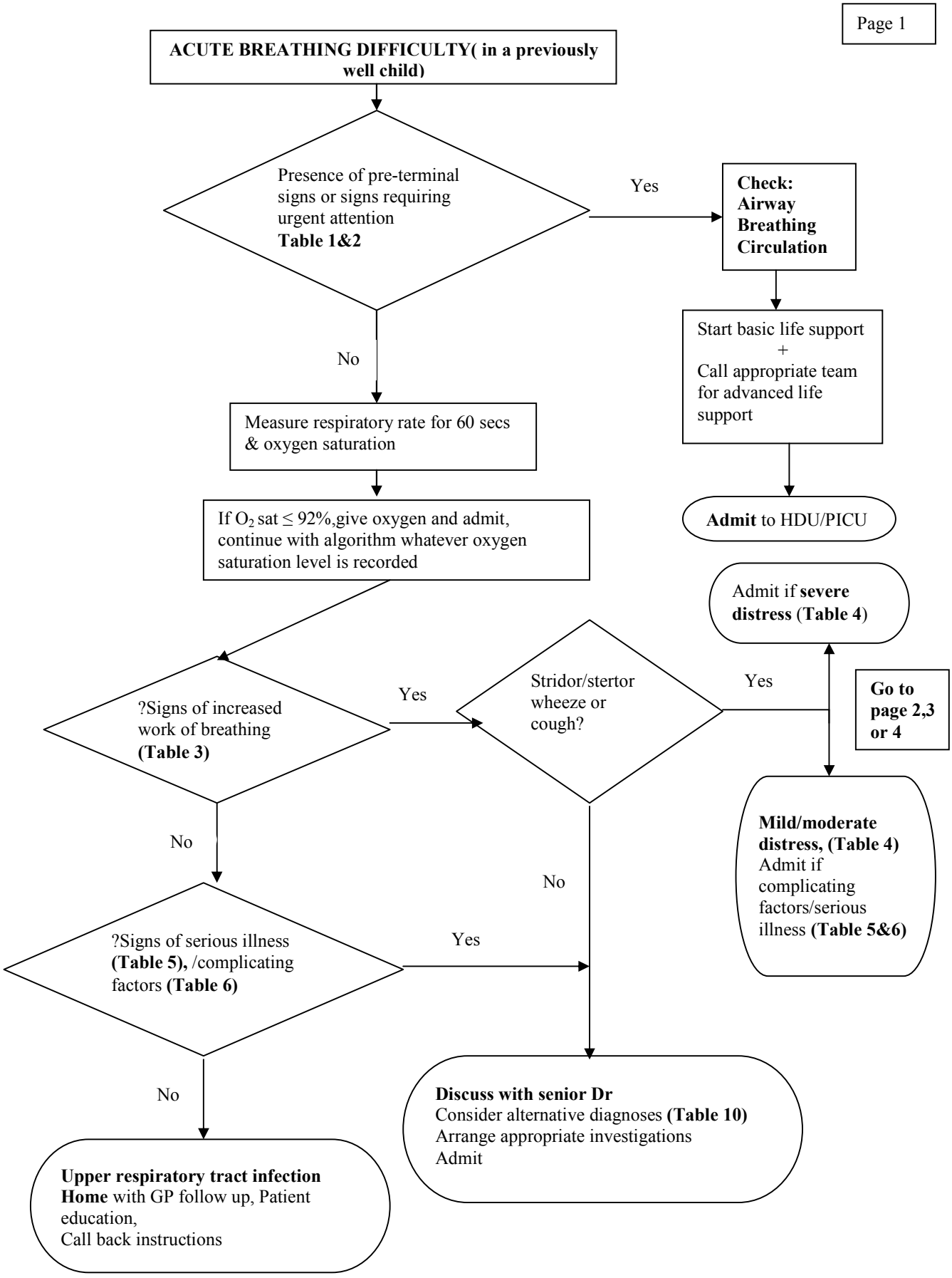
This algorithm must be used in sequence starting with page 1 and finishing with page 5.

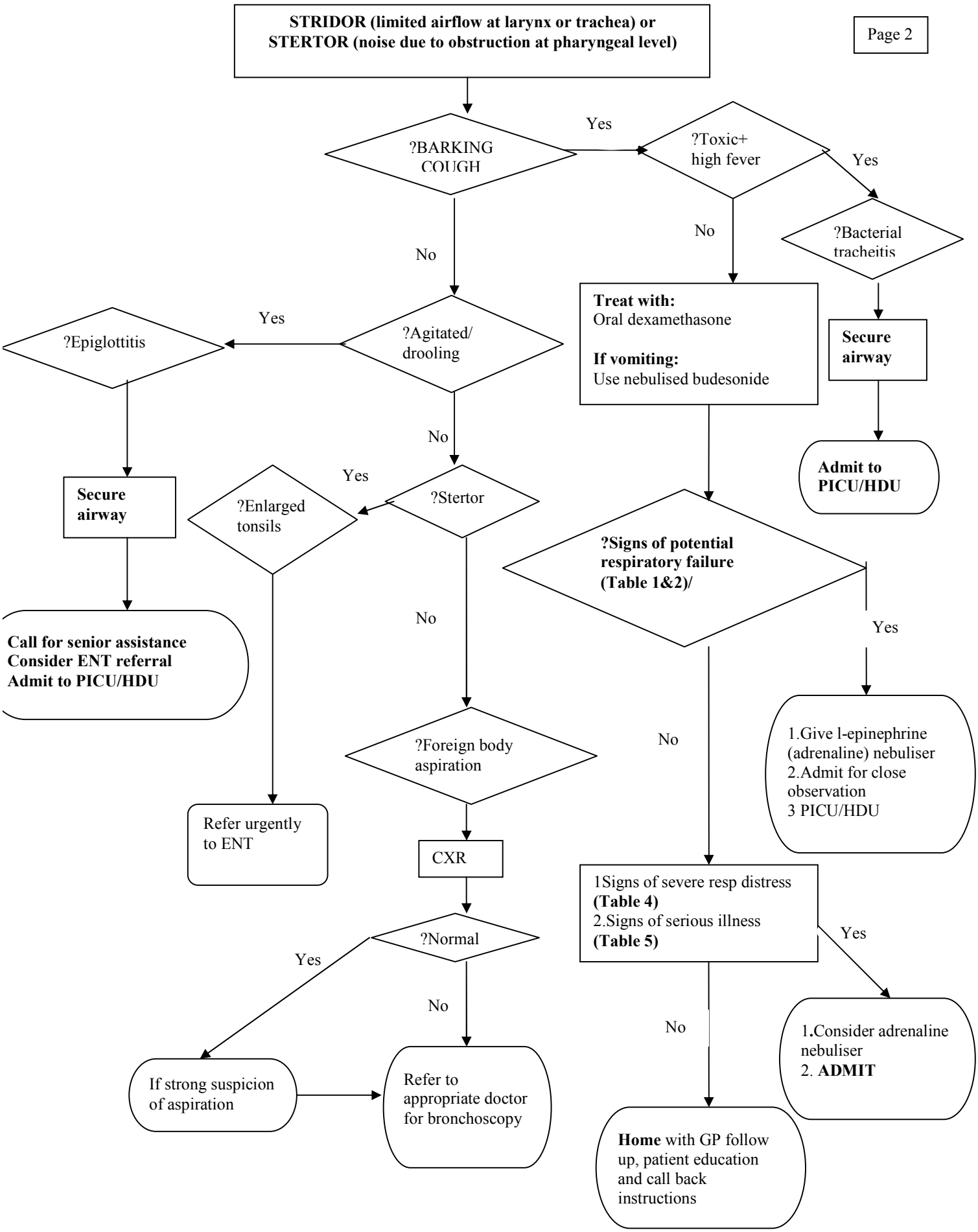
A glossary of terms and abbreviations has been provided.

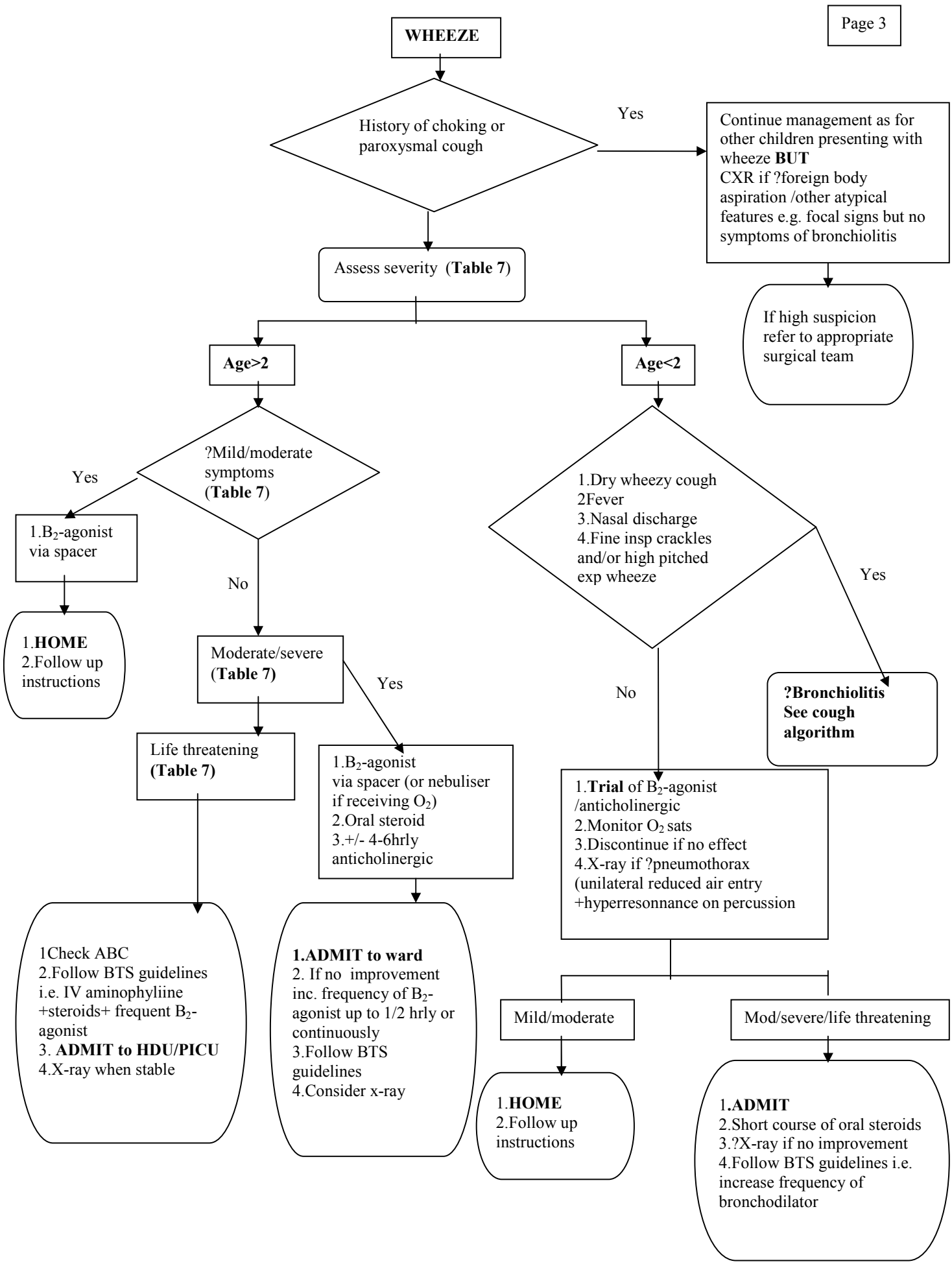
The relevant tables accompany the guideline.

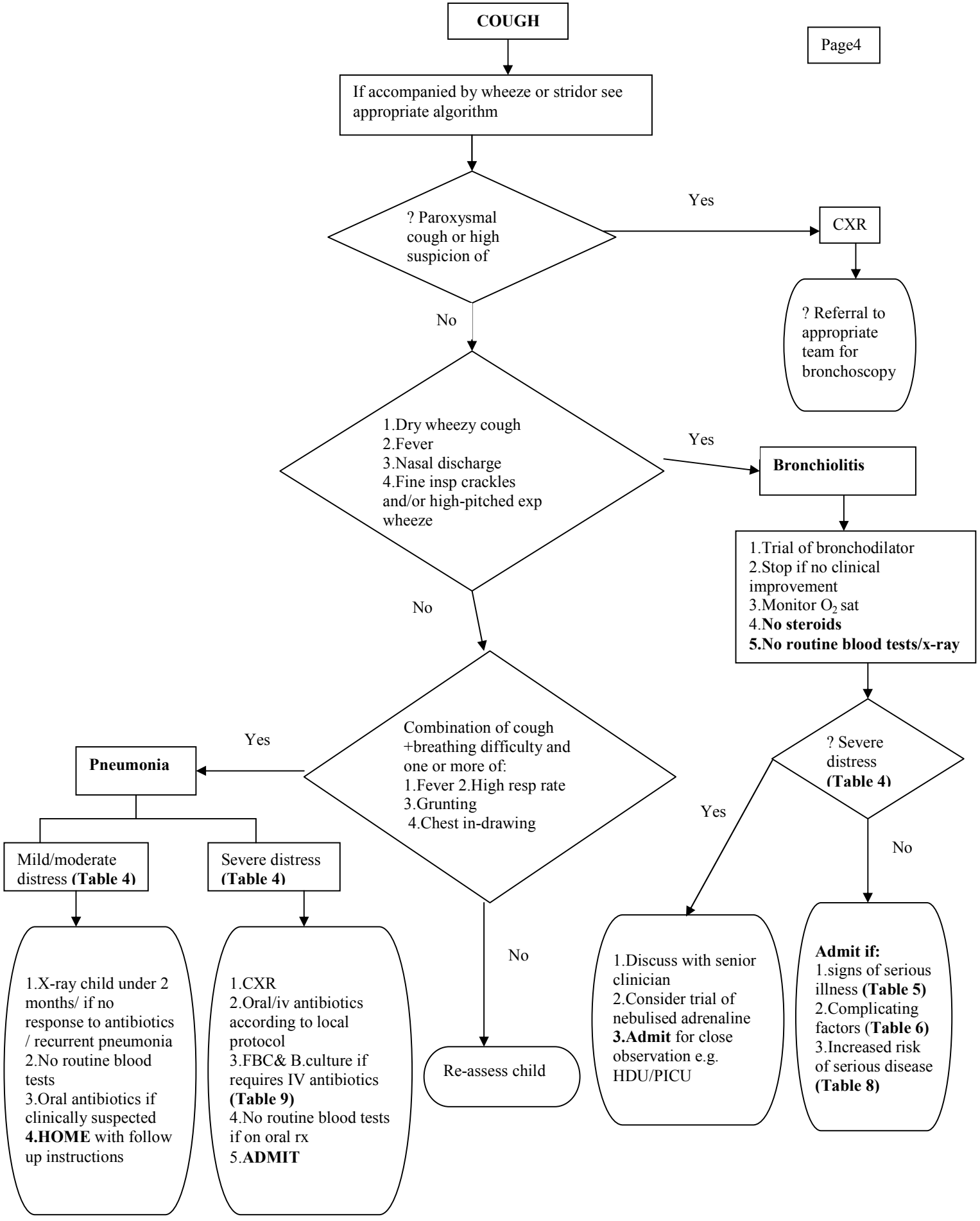
Where drugs are mentioned we have chosen to follow 'medicines for children' until further evidence is available.

The full technical report is available by e-mailing monica.lakhanpaul@nottingham.ac.uk


ACUTE BREATHING DIFFICULTY(in a previously well child)
Presence of pre-terminal signs or signs requiring urgent attention
Table 1&2
Yes
Check:
Airway
Breathing
Circulation
Start basic life support
+
Call appropriate team for advanced life support
Admit to HDU/PICU
No
Measure respiratory rate for 60 secs & oxygen saturation
If O2 sat ≤ 92%,give oxygen and admit, continue with algorithm whatever oxygen saturation level is recorded
Admit if severe distress (Table 4)
?Signs of increased work of breathing (Table 3)
Yes
Stridor/stertor wheeze or cough?
Yes
Go to page 2,3 or 4
Mild/moderate distress, (Table 4)
Admit if complicating factors/serious illness (Table 5&6)
No
No
?Signs of serious illness (Table 5), /complicating factors (Table 6)
Yes
Discuss with senior Dr
Consider alternative diagnoses (Table 10)
Arrange appropriate investigations
Admit
No
Upper respiratory tract infection
Home with GP follow up, Patient education,
Call back instructions


STRIDOR (limited airflow at larynx or trachea) or
STERTOR (noise due to obstruction at pharyngeal level)
?BARKING COUGH
Yes
?Toxic+ high fever
Yes
?Bacterial tracheitis
No
Treat with:
Oral dexamethasone
If vomiting:
Use nebulised budesonide
Secure airway
Admit to PICU/HDU
No
?Agitated/ drooling
Yes
?Epiglottitis
Secure airway
Call for senior assistance
Consider ENT referral
Admit to PICU/HDU
No
?Stertor
Yes
?Enlarged tonsils
Refer urgently to ENT
No
?Foreign body aspiration
CXR
?Normal
Yes
If strong suspicion of aspiration
No
Refer to appropriate doctor for bronchoscopy
?Signs of potential respiratory failure (Table 1&2)/
Yes
1.Give l-epinephrine (adrenaline) nebuliser
2.Admit for close observation
3 PICU/HDU
No
1Signs of severe resp distress (Table 4)
2.Signs of serious illness (Table 5)
Yes
1.Consider adrenaline nebuliser
2. ADMIT
No
Home with GP follow up, patient education and call back instructions


WHEEZE
History of choking or paroxysmal cough
Yes
Continue management as for other children presenting with wheeze **BUT**
CXR if ?foreign body aspiration /other atypical features e.g. focal signs but no symptoms of bronchiolitis
If high suspicion refer to appropriate surgical team
Assess severity (**Table 7**)
Age>2
Age<2
?Mild/moderate symptoms (**Table 7**)
Yes
No
1.B_2-agonist via spacer
1.**HOME**
2.Follow up instructions
Moderate/severe (**Table 7**)
Yes
Life threatening (**Table 7**)
1.B_2-agonist via spacer (or nebuliser if receiving O_2)
2.Oral steroid
3.+/- 4-6hrly anticholinergic
1Check ABC
2.Follow BTS guidelines i.e. IV aminophyliine +steroids+ frequent B_2-agonist
3. **ADMIT to HDU/PICU**
4.X-ray when stable
1.ADMIT to ward
2. If no improvement inc. frequency of B_2-agonist up to 1/2 hrly or continuously
3.Follow BTS guidelines
4.Consider x-ray
1.Dry wheezy cough
2Fever
3.Nasal discharge
4.Fine insp crackles and/or high pitched exp wheeze
Yes
No
?Bronchiolitis See cough algorithm
1.**Trial** of B_2-agonist /anticholinergic
2.Monitor O_2 sats
3.Discontinue if no effect
4.X-ray if ?pneumothorax (unilateral reduced air entry +hyperresonnance on percussion
Mild/moderate
Mod/severe/life threatening
1.**HOME**
2.Follow up instructions
1.**ADMIT**
2.Short course of oral steroids
3.?X-ray if no improvement
4.Follow BTS guidelines i.e. increase frequency of bronchodilator


COUGH
If accompanied by wheeze or stridor see appropriate algorithm
? Paroxysmal cough or high suspicion of
Yes
CXR
? Referral to appropriate team for bronchoscopy
No
1.Dry wheezy cough
2.Fever
3.Nasal discharge
4.Fine insp crackles and/or high-pitched exp wheeze
Yes
Bronchiolitis
1.Trial of bronchodilator
2.Stop if no clinical improvement
3.Monitor O_2 sat
4.No steroids
5.No routine blood tests/x-ray
? Severe distress (Table 4)
Yes
No
Admit if:
1.signs of serious illness (Table 5)
2.Complicating factors (Table 6)
3.Increased risk of serious disease (Table 8)
1.Discuss with senior clinician
2.Consider trial of nebulised adrenaline
3.Admit for close observation e.g. HDU/PICU
No
Combination of cough +breathing difficulty and one or more of:
1.Fever 2.High resp rate
3.Grunting
4.Chest in-drawing
Yes
Pneumonia
Mild/moderate distress (Table 4)
Severe distress (Table 4)
1.X-ray child under 2 months/ if no response to antibiotics / recurrent pneumonia
2.No routine blood tests
3.Oral antibiotics if clinically suspected
4.HOME with follow up instructions
1.CXR
2.Oral/iv antibiotics according to local protocol
3.FBC& B.culture if requires IV antibiotics (Table 9)
4.No routine blood tests if on oral rx
5.ADMIT
No
Re-assess child

Tables included in the algorithm

Table 1 Pre-terminal signs

Exhaustion
Bradycardia
Silent chest
Significant apnoea

Table 2 Signs of severely ill child requiring urgent attention

Inappropriate drowsiness (difficult to rouse)
Agitation
Cyanosis in air

Table 3 Signs of increased work of breathing

Increased respiratory rate
Chest in-drawing (recession)
Nasal flaring
Tracheal tug
Use of accessory muscles
grunting

Table 4 Assessment of severity of breathing difficulty adapted from WHO management of acute respiratory infections in children. World Health Organisation, Geneva, 1995 [17]

Assessment of severity(breathing difficulty)			
	Mild	**Moderate**	**Severe**
Oxygen saturation in air	>95%	92-95%	<92%
Chest wall in-drawing	none/mild	moderate	severe
Nasal flaring	absent	may be present	present
grunting	absent	absent	present
Apnoea/pausing	none	absent	present
Feeding history	normal	Approximately half of normal intake	Less than half normal intake
Behavior	normal	irritable	Lethargic Unresponsive Flaccid Decreased level of consciousness Inconsolable

Table 5 Symptoms of Serious Illness (adapted from Viral Upper Respiratory Tract Guideline by Institute for Clinical Systems Improvement [38]and the WHO recommendations on the management of children with cough or breathing difficulty [17])

< 3 months	3 months -3 years	4 years-adult
Responsiveness and activity • flaccid • cannot awaken or keep awake • weak cry or weak suck • inconsolable • refuse feedings	**Responsiveness and activity** • unresponsive • cannot awaken or keep awake • markedly decreased activity • inconsolable • weak suck or weak cry(if infant) • refuses feeding	**Responsiveness and activity** • decreased level of consciousness • markedly decreased activity • cannot awaken or keep awake
Dehydration and vomiting • reduced wet nappies > 8 hrs	**Dehydration and vomiting** • no urine> 6-8 hrs if < 1yr • no urine> 12 hrs if > 1yr	**Dehydration and vomiting** • no urine> 12 hrs
	Meningeal signs • stiff neck • persistent vomiting	**Meningeal signs** • stiff neck • persistent vomiting • severe headache
Other • petechial and purpuric rash • convulsions • very high fever • hypothermia • capillary refill <3 sec	**Other** • petechial or purpuric rash • convulsions • very high fever unresponsive to treatment • capillary refill < 3sec	**Other** • decreased urination with decreased intake • petechial or purpuric rash • convulsions • very high fever unresponsive to treatment • capillary refill > 3 sec

Table 6 Factors contributing to the clinicians decision regarding admission or discharge [39]

Complicating Factors
Co-morbidity e. g prematurity, congenital heart disease, any chronic lung disease, neurological disorder
Social problems e. g previous non-accidental injury, ill parents, parents having difficulty coping
Infants younger than 2 months of age

Table7 Severity of Asthma, taken from BTS [29]

Table of Severity of Asthma Based on BTS Guidelines		
Age	**Under 5 years**	**Over 5 years**
Mild to Moderate	Wheeze and cough with tightness and mild dyspnoea, no distress, no speech or feeding difficulty Mild respiratory distress Respiratory rate < 50 Pulse < 140 bpm Saturations > 92% in air	Wheeze and cough with tightness Able to talk PEFR > 50% predicted height Pulse < 120 Saturations > 92% in air
Moderate to Severe	Too breathless to talk Too breathless to feed Respiratory rate > 50/min Pulse > 140/min Use of accessory muscles	Too breathless to talk Too breathless to feed Respiratory rate > 40 Pulse > 120/min PEFR < 50% predicted height
Life Threatening	Cyanosis Silent chest Poor respiratory effort Fatigue or exhaustion Agitation or reduced level of consciousness	Cyanosis Silent chest Poor respiratory effort Fatigue or exhaustion PEFR < 33% predicted height Agitation or reduced level of consciousness

Table 8 Infants at risk of developing severe bronchiolitis- (adapted from Management of acute bronchiolitis by Rakshi and Couriel, Archives of Disease in Childhood, 1994; 71:463-469) [69]

Apnoea
Preterm birth
Underlying disorders Lung disease e.g. bronchopulmonary dysplasia,cystic fibrosis Congenital heart disease Immunodeficiency (congenital or acquired) Multiple congenital abnormalities Severe neurological disease

Table 9 Indications for treatment with parenteral antibiotics in a child clinically suspected to have pneumonia

Toxic appearance
Severe respiratory distress
Vomiting
Immunocompromised
Dehydrated and requiring intravenous fluids

Table 10 Differential diagnosis of less obvious causes of respiratory distress (Adapted from Fleischer's Textbook of Emergency Medicine, Chapter 65) [39]

Metabolic Disorders	Central Nervous System Dysfunction	Neuromuscular Disorders	Chest Wall Disorders
Diabetes mellitus	Meningitis	Spinal cord injury	Flail chest
Dehydration	Encephalitis	Infantile botulism	Congenital anomalies
Sepsis	Tumour	Guillain-Barre	
Liver/renal disease	Intoxication	Myopathy	
Intoxication	Status epilepticus		
Inborn errors of metabolism	Trauma		
	Hydrocephalus		

Appendix 1
Glossary of definitions and abbreviations

Definitions

Child

Every human being below the age of 18 years unless the law applicable to the child is attained earlier [United Nations 1991]

Clinical practice guideline

Systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances [Institute of Medicine 1992].

Evidence-based guidelines

Clinical practice guidelines based on a systematic review of scientific data [NHMRC: Quality of Care and Health Outcomes Committee 1995]

Consensus-based methods

Clinical practice guidelines based on a consensus of expert opinion [NHMRC: Quality of Care and Health Outcomes Committee 1995]

Evidence based medicine

The integration of best clinical evidence from systematic research with clinical experience and patient values to make decisions about the individual patient 's care [Sackett et al 2000].

Consensus methods

Methods used to determine the extent to which experts or lay people agree about a given issue [Mays and Pope 1996]

Acute breathing difficulty

Any unusual pattern of breathing. Mothers may describe it in different ways. For example, they may use the terms 'noisy', 'fast', or 'interrupted' [World Health Organisation, outpatient management of acute respiratory infections in children 1995].

Stridor

Limitation of airflow in the upper airway at the larynx or tracheal level. It is a harsh or rasping respiratory noise reflecting upper airway obstruction, usually inspiratory but may be biphasic (consensus).

Wheeze

Limitation of airflow in the lower airway. It is a high pitched whistling noise heard on auscultation which is usually more pronounced in the expiratory phase indicating intrathoracic airway obstruction (consensus).

Stirtor

Airway generated sound caused by obstruction at pharyngeal level e.g due to large tonsils.

Bronchiolitis

A seasonal viral illness characterised by fever, nasal discharge, and dry wheezy cough. On examination there are fine inspiratory crackles and/or high pitched expiratory wheeze (consensus).

Abbreviations

A&E	Accident and emergency
ENT	Ear, nose and throat
AGREE	Appraisal of guidelines for research and evaluation instrument
SIGN	Scottish Intercollegiate Guideline Network
RCPCH	Royal College of Paediatrics and Child Health
Scharr	School of Health and Related Research
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation
BTS	British Thoracic Society
NICE	National Institute of Clinical Excellence
ESR	Erythrocyte sedimentation rate
CRP	C-reactive protein
CXR	Chest x-ray
URTI	Upper respiratory tract infection
PICU	Paediatric intensive care unit
HDU	High dependancy unit
ABC	Airway, breathing circulation
IV	Intravenous
PEFR	Peak expiratory flow rate
NHMRC	National Health and Medical Research Council
EBM	Evidence based medicine
BPA	British Paediatric Association
AHCPR	US Agency for Health Care Policy and Research

Appendix 2
References

References

1. Woolf SH., Grol R et al. (1999). "Clinical Guidelines: Potential benefits, limitations, and harms of clinical guidelines." British Medical Journal **318**: 527-530.

2. Audit Commission (1993). Children First: A study of Hospital Services. London, HMSO.

3. Royal College of Paediatrics and Child Health; Quality of Practice Committee (1998). Standards for Development of Clinical Guidelines in Paediatrics and Child Health: Role of the Royal College of Paediatrics and Child Health. London.

4. Macfaul R., Glass EJ et al. (1994). "Appropriateness of Paediatric Admissions." Archives of Disease in Childhood **71**: 51-58.

5. Hill AM. (1989). "Trends in Paediatric Admissions." BMJ **268**: 1479-1483

6. British Paediatric Association, British Association of Paediatric Surgeons and Casualty Surgeons Association (1988). Joint Statement on Children's Attendances at Accident and Emergency Departments.

7. Stewart M, Werneke U et al. (1998). "Medical and Social factors associated with the admission and discharge of acutely ill children." Archives of Disease in Childhood **79**(3): 219-224.

8. Armon K., Stephenson T et al. (2001a). "Determining the common presenting problems to paediatric accident and emergency." Archives of Disease in Childhood **84**:

9. Armon K., Stephenson T et al. (2001b). "An evidence and consensus based guideline for acute diarrhoea management." Archives of Disease in Childhood **85**: 132-142

10. Scottish Intercollegiate Guideline Network (1999). SIGN Guidelines, An introduction to SIGN methodology for the development of evidence-based guidelines. Edingburgh.

11. Scottish Intercollegiate Guideline Network (2000). Grading System for Recommendations in Evidence-Based Clinical Guidelines: Report of a review of the system for grading recommendations in SIGN guidelines.

12. Pill J. (1971). "The Delphi Method: Substance, Context, A Critique and An Annotated Bibliography." Socio-Economic Planning Science **5**: 51-71.

13. Murphy M., Black N, et al. (1998). "Consensus development methods, and their use in clinical guideline development." Health Technology Assessment. NHS R&D HTA Programme **2**(3).

14. ALSG (1997). Advanced Paediatric Life Support; The practical approach. London, BMJ Publishing Group.

15. Rajesh VT, Singhi S et al (2000). "Tachypnoea is a good predictor of hypoxia in acutely ill infants under 2 months." Archives Disease in Childhood **82**: 46-49.

16. Poets CF, Southall D (1994). "Non-Invasive Monitoring of Oxygenation in Infants and Children. Practical Considerations and Areas of Concern." Pediatrics **93**(5): 737-746.

17. World Health Organisation (1995). The management of acute respiratory infections in children. Practical guidelines for outpatient care, World Health Organisation, Geneva.

18. Onyango FE, Steinhoff MC et al (1993). "Hypoxaemia in young children with acute lower respiratory infection." BMJ **306**: 612-615.

19. Madico G, Gilman RH et al (1995). "The role of pulse oximetry. Its uses as an indicator of severe respiratory disease in Peruvian children living at sea level. Respiratory group in Peru." Archives of Pediatrics and Adolescent Medicine **149** (11): 1259-63.

20. Mullholland EK, Olinsky A et al (1990). "Clinical findings and severity of acute bronchiolitis." Lancet **335**: 1259-1261.

21. Shaw K, Bell L et al. (1991). "Outpatient assessment of infants with bronchiolitis." American Journal Disease in Childhood **145**: 151-155.

22. Mower WR, Sachs C et al. (1997). "Pulse oximetry as a fifth pediatric vital sign." Pediatrics **99**(5): 681-686.

23. Manekar AM, Petrack EM et al (1995). “Contribution of routine pulse oximetry to evaluation and management of patients with respiratory illness in a pediatric emergency department.” Annals of Emergency Medicine **25**: 36-40.

24. Poets CF, Stebbens VA et al (1993). “Oxygen saturation and breathing patterns in children.” Pediatrics **92**: 686-690.

25. American Academy of Respiratory Care (1991). “AARC Clinical Practice Guideline Oxygen Therapy in the Acute Care Hospital.” Respiratory Care Journal **36**: 1410-1413.

26. Scottish Inter Collegiate Guideline Network (1999). “Emergency management of Acute Asthma.” Sign.

27. Cincinnati Medical Center Children's Hospital (1998). “Evidence based guidelines for the management of infants one year of age or less with a first time episode of bronchiolitis.” National Clearing House.

28. South Auckland Integrated Health Board (2000). “Guidelines for the management of cough and wheeze in the first year of life.

29. British Thoracic Society (1997). “Guidelines on asthma management.” Thorax **52** (supp 1).

30. Simoes EA, Roark FR et al (1991). “Respiratory rate: measurement of variability over time and accuracy at different counting periods.” Archives of Disease in Childhood **66**: 1199-1203.

31. Gadomski AM, Khallaf N et al (1993). "Assessment of respiratory rate and chest indrawing in children with ARI by primary care physician in Egypt." WHO Bulletin **71**: 523-527.

32. Taussig L, Landau L (1999). Paediatric respiratory Medicine, Moby.

33. Forfar and Arneil's Textbook of paediatrics (1992), Churchill Livingstone.

34. Usha N, Katariya S et al (1990). "Simple clinical signs of lower respiratory tract infection." Tropical Doctor **20**: 158-160.

35. Cambell H, Lamont AC et al (1989). "Assessment of clinical criteria for identification of severe acute lower respiratory tract infections in children." Lancet **1**: 297-299.

36. Morley CJ, Thornton AJ, et al (1990). "Respiratory rate and severity of illness in babies under 6 months." Archives of Disease in Childhood **65**: 834-837.

37. Palafox M, Guiscafre H, et al (2000). "Diagnostic value of tachypnoea in pneumonia defined radiologically." Archives of Disease in Childhood **82**: 41-45.

38. Institute for clinical systems improvement (1999) Health Care Guideline: Viral upper respiratory Infection (VURI) in children and adults

39. Fleischer GR and Ludwig S (1993). Textbook of Pediatric Emergency Medicine, Baltimore: Williams & Wilkins.

40. Mauro RD, Poole SR et al (1988). "Differentiation of epiglottitis from laryngotracheitis." American Journal of Disease of Children **142**(6): 679-682.

41. Henry RL, Mellis CM et al (1983). "Pseudomembranous croup." Archives of Disease in Childhood **58**: 180-183.

42. Jones R, Santos JI et al (1979). "Bacterial tracheitis." JAMA **242**(8): 721-726.

43. .Macdonald, W., G. C. Geelhoed, et al (1997). "Management of childhood croup." Thorax **52** (9): 757-759.

44. Kaditis AT and Wald ER (1998). "Viral croup: current diagnosis and treatment." Pediatric Infectious Disease Journal **17**: 827-834.

45. Rosekrans JA. (1998). "Viral croup: current diagnosis and treatment." .

46. Couriel JM. (1988). "Management of croup." Archives of Disease in Childhood **63**(11): 1305-1308.

47. Ausejo M, Saenz A et al (2000). "Glucocorticoids for croup." The Cochrane Database of Systematic Reviews (1).

48. Westley CR (1978). "Nebulized racemic epinephrine by IPPB for the treatment of croup." American Journal of Disease in Childhood **132**: 484-487.

49. Waisman Y, Klein BL et al. (1992). "Prospective randomized double-blind study comparing L-epinephrine and racemic epinephrine aerosols in the treatment of laryngotracheitis." Pediatrics **89**(2): 302-306.

50. Fitzgerald D, Mellis C et al. (1996). "Nebulized budesonide is as effective as nebulized adrenaline in moderately severe croup." Pediatrics **97**(5): 722-725.

51. Kelley P and Simon JE (1992). "Racemic epinephrine use in croup and disposition." American Journal of Emergency Medicine **10**: 181-183.

52. Prendergast M, Jones J et al (1994). "Racemic epinephrine in the treatment of laryngotracheititis: can we identify children for outpatient therapy?" American Journal of Emergency Medicine **12**: 613-616.

53. Ledwith CA, Shea LM et al. (1995). "Safety and efficacy of nebulized racemic epinephrine in conjunction with oral dexamethasone and mist in the outpatient treatment of croup." Annals of Emergency Medicine **25**: 331-337.

54. Baharloo F, Veyckemans F et al (1999). "Tracheobronchial foreign bodies: Presentation and management in children and adults." Chest **115** (5): 1357-1362.

55. Svedstrom E, Puhakka H et al (1989). "How accurate is chest radiography in the diagnosis of tracheobronchial foreign bodies in children?" Pediatric radiology **19** (8): 520-522.

56. Mu L, Ping H et al (1991). "Inhalation of foreign bodies in Chinese children: A review of 400 cases." Laryngoscope **101**: 657-660.

57. Selvadurai H and Mellis C (1998). "Practical management of wheezy infants and toddlers." Modern medicine of Australia **41**(6): 18-32.

58. Martinez F. D, Wright AL et al (1995). "Asthma and wheezing in the first six years of life." The New England Journal of Medicine **332**(3): 133-138.

59. Everard ML, Bara A, et al (2000). "Anti-cholinergic drugs for wheeze in children under the age of two years." The Cochrane Library(1).

60. Plotnick LH, Ducharme FM et al (2000). "Combined inhaled anticholinergic agents and beta-2-agonists for the initial treatment of acute asthma in children." The Cochrane Database of Systematic Reviews.

61. Payne N, Beard S et al (2000). Clinical and cost effectiveness of inhaler devices for children with chronic asthma, National Institute of Clinical Excellence.

62. Cates CJ and Rowe BH (2000). "Holding chambers versus nebulisers for beta-agonist treatment of acute asthma." The Cochrane Database of Systematic Reviews.

63. Mitra A, Bassle D, Dumarche FM (2001). "Intravenous aminophylline for acute asthma in children over 2 years using inhaled bronchodilators." The Cochrane Database of Systematic Reviews

64. Gershel JC, Goldman HS et al (1983). “The usefulness of chest radiographs in first asthma attacks.” New England Journal of Medicine **309**: 336-339.

65. Mahabee-Gittens EM, Bachman DT et al (1999). “Chest radiographs in the pediatric emergency department for children less than or equal to 18 months of age with wheezing.” Clinical pediatrics **38**(7): 395-399.

66. Walsh-Kelly CM, Kim MK et al. (1996). “Chest radiography in the initial episode of bronchospasm in children: Can clinical variables predict pathological findings.” Annals of emergency medicine **28**: 391-395.

67. Brooks LJ, Cloetier MM et al. (1982). “Significance of roentgenographic abnormalities in children hospitalized for asthma.” Chest **82** (3): 315-319.

68. Rakshi K. and Couriel J (1994). “Management of acute bronchiolitis.” Archives of Disease in Childhood **71**: 463-469.

69. Kellner JD, Ohlssan A et al (2000). “Bronchodilators for bronchiolitis.” Cochrane database of systematic reviews(1).

70. Ho L, Collis G et al. (1991). “Effect of Salbutamol on Oxygen saturation in bronchiolitis.” Archives of Disease in Childhood **66**: 1061-1064.

71. O'Callaghan C, Milner AD et al. (1986). “Paradoxical deterioration in lung function after nebulised salbutamol in wheezy infants.” The Lancet **20/27**: 1424-1425.

72. Cade A, Brownlee KG et al. (2000). "Randomised placebo controlled trial of nebulised corticosteroids in acute respiratory synctial viral bronchiolitis." Archives of Disease in Childhood **82**: 126-130.

73. Richter H and Seddon P (1998). "Early nebulized budesonide in the treatment of bronchiolitis and the prevention of postbronchiolitic wheezing." The Journal of Pediatrics **132**: 849-853.

74. Boeck KD, Nathalie Van der Aa et al (1997). "Respiratory synctial virus bronchiolitis: A double -blind dexamethasone efficacy study." The Journal of Pediatrics **131**: 919- 921.

75. Roosevelt GK, Sheehan K et al. (1996). "Dexamethasone in bronchiolitis: a randomised controlled trial." The Lancet **348**: 292-295.

76. Klassen TP, Sutcliffe T et al (1997). "Dexamethasone in salbutamol-treated inpatients with acute bronchiolitis: A randomized, controlled trial." The Journal of Pediatrics **130**: 191-196.

77. Menon K, Sutcliffe T et al. (1995). "Clinical and laboratory observations: A randomized trial comparing the efficacy of epinephrine with salbutamol in the treatment of acute bronchiolitis." Journal Pediatrics **126**(6): 1004-1007.

78. Swingler GH and Zwarenstein M (2000). "Chest Radiograph in acute respiratory infections in children." The Cochrane Database of Systematic Reviews.

79. Friis B, Eiken M et al. (1990). "Chest X-ray Appearances in Pneumonia and Bronchiolitis." Acta Paediatrica Scandinavia **79**: 219-225.

80. Leventhal JM. (1982). "Clinical Predictors of pneumonia as a guide to ordering chest roentgenograms." Clinical Pediatrics **21**: 730-740.

81. Taylor JA, DelBeccaro M et al (1995). "Establishing Clinically Relevant Standards for Tachypnoea in Febrile Children Younger Than 2 Years." Archives of Pediatrics and Adolescent Medicine **149** (3): 283-287.

82. Harari M, Shann F et al (1991). "Clinical Signs of pneumonia in children." The Lancet **338**: 928-930.

83. Mullholland EK, Simoes EAF et al (1992). "Standardized diagnosis of pneumonia in developing countries." The Pediatric Infectious Disease Journal **11**: 77-81.

84. MacFaul R and Werneke U. Risk of presenting problems for illness in district general hospitals (unpublished)

85. Korppi M, Kiekara O et al (1993). "Comparison of radiological findings and microbial aetiology of childhood pmeumonia." Acta Paediatrica **82**(4): 360-363.

86. Swischuk LE and Hayden CK (1986). "Viral vs bacterial pulmonary infections in children (is roentgenographic differentiation possible?)." Pediatric Radiology **16**(4): 278-284.

87. Bettenay FA, de Campo JF, et al (1988). "Differentiating bacterial from viral pneumonias in children." Pediatric Radiology **18**(6): 453-454.

88. Davies HD, Wang EE et al (1996). "Reliability of the chest radiograph in the diagnosis of lower respiratory infections in young children." Pediatric Infectious Disease Journal **16** (1): 85-86.

89. Kiekara O, Korppi M et al (1996). "Radiological diagnosis of pneumonia in children." Annals of Medicine **28**(1): 69-72.

90. Hickey R, Bowman M et al (1996). "Utility of Blood Cultures in Pediatric Patients Found to Have Pneumonia in the Emergency Department." Annals of Emergency Medicine **27**(6): 721-725.

91. Heath PT (2000). "Epidemiology and bacteriology of bacterial pneumonias." Paediatric respiratory reviews **1**: 4-7.

92. Turner RB, Lande AE et al (1987). "Pneumonia in pediatric outpatients: Cause and clinical manifestations." J Pediatrics **111**: 194-200.

93. Nohyneck H, Valkeila E et al (1995). "Erythrocyte sedimentation rate, white blood cell count and serum C-reactive protein in assessing etiologic diagnosis of acute lower respiratory infections in children." Pediatric Infectious Disease Journal **14**: 484-490

94. Clements H, Stephenson TJS et al (2000). "Rationalised prescribing for community acquired pneumonia: a closed loop audit." Archives of Disease in Childhood **83**.

95. Jadavi T, Law B et al (1997). "A practical guide for the diagnosis and treatment of pediatric pneumonia." Can Med Assoc J **156:** s703-711

96. .Moyer VA, Elliot EJ. Preface. In Moyer VA, Elliot EJ, Davis RL, et al, eds Evidence based paediatrics and child health. London: BMJ Books 2000.

97. Eccles M North of England evidence based guidelines project: methods of guideline development. *BMJ* 1996 **312**: 760-762