Childhood Community acquired Pneumonia in the COVID-19 pandemic

University of Nairobi

An initiative of ETAT+ Trainers in partnership with CPHD and Kenya Paediatric Association

saving children's lives
ETAT+
Emergency Triage Assessement and Treatment plus admission

Outline

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Introduction

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Clinical signs and symptoms

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Assessment of COVID-19 risk and prevention of hospital acquired infection

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Background to guideline change

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(Host) / Current treatment guideline

Edith Gicheha
Oxygen therapy

Dr. Sylvia Mwathi
Treatment failure

Objectives

- To state childhood illnesses that present with respiratory distress.
- To describe etiology of childhood pneumonia.
- To describe clinical signs & symptoms & classification of pneumonia.
- To describe antibiotic treatment of pneumonia.
- To describe use of oxygen therapy in children with pneumonia .

Introduction

Respiratory Distress- Causes

Lung / Airway Disease

- Acute Pneumonia
- Asthma
- PTB
- HIV-PCP
- Croup (LTB)
- Bronchiolitis
- COVID-19

Systemic Disease

- Malaria
- Severe Anaemia
- Severe dehydration
- Heart Disease
- Renal Disease

Pneumonia as a cause of respiratory distress.

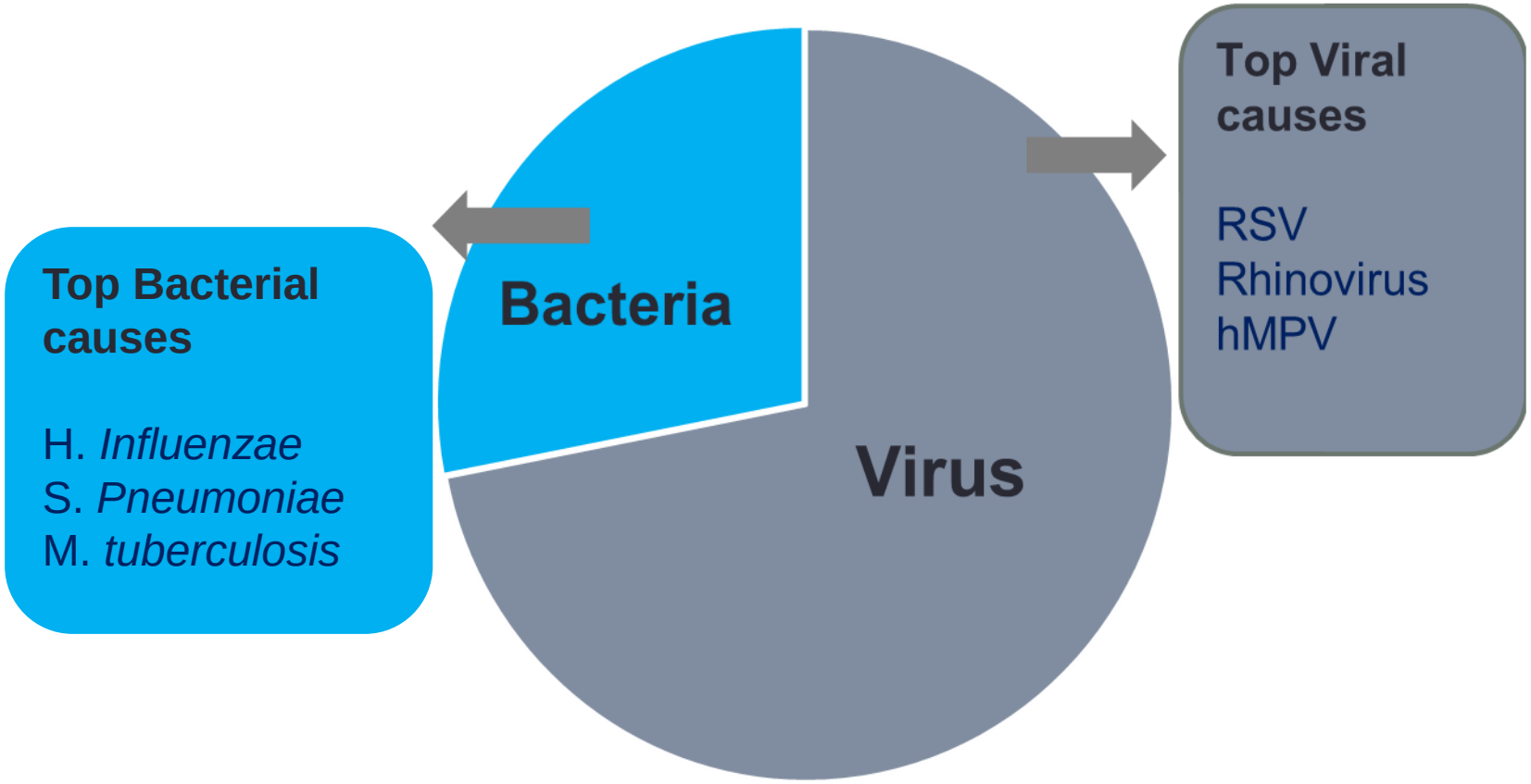
- Pneumonia is the **commonest cause** of severe respiratory distress in children under 5 years.
- A few signs in a child with cough and difficulty breathing classify the severity of pneumonia.
- The **2016 paediatric pneumonia guidelines** should be used for classification of the severity of pneumonia.
- Classify suspected COVID-19 or COVID-19 unlikely for all pneumonia patients.

Etiology of Pneumonia

- Viral pneumonia is the **commonest cause** of all childhood pneumonia with **RSV** as the commonest pathogen.
- **S. *pneumoniae*** is the commonest cause of bacterial pneumonia in children under 5 years.
- **M. *tuberculosis*** should ALWAYS be ruled out in tuberculosis endemic areas.
- **Pneumocystis pneumonia** is commonest cause of fungal pneumonia among HIV infected children.

Childhood Pneumonia etiology in Kenya

- In the **PERCH study**, viral pneumonia was more common than bacterial pneumonia, with **RSV** as the commonest pathogen.

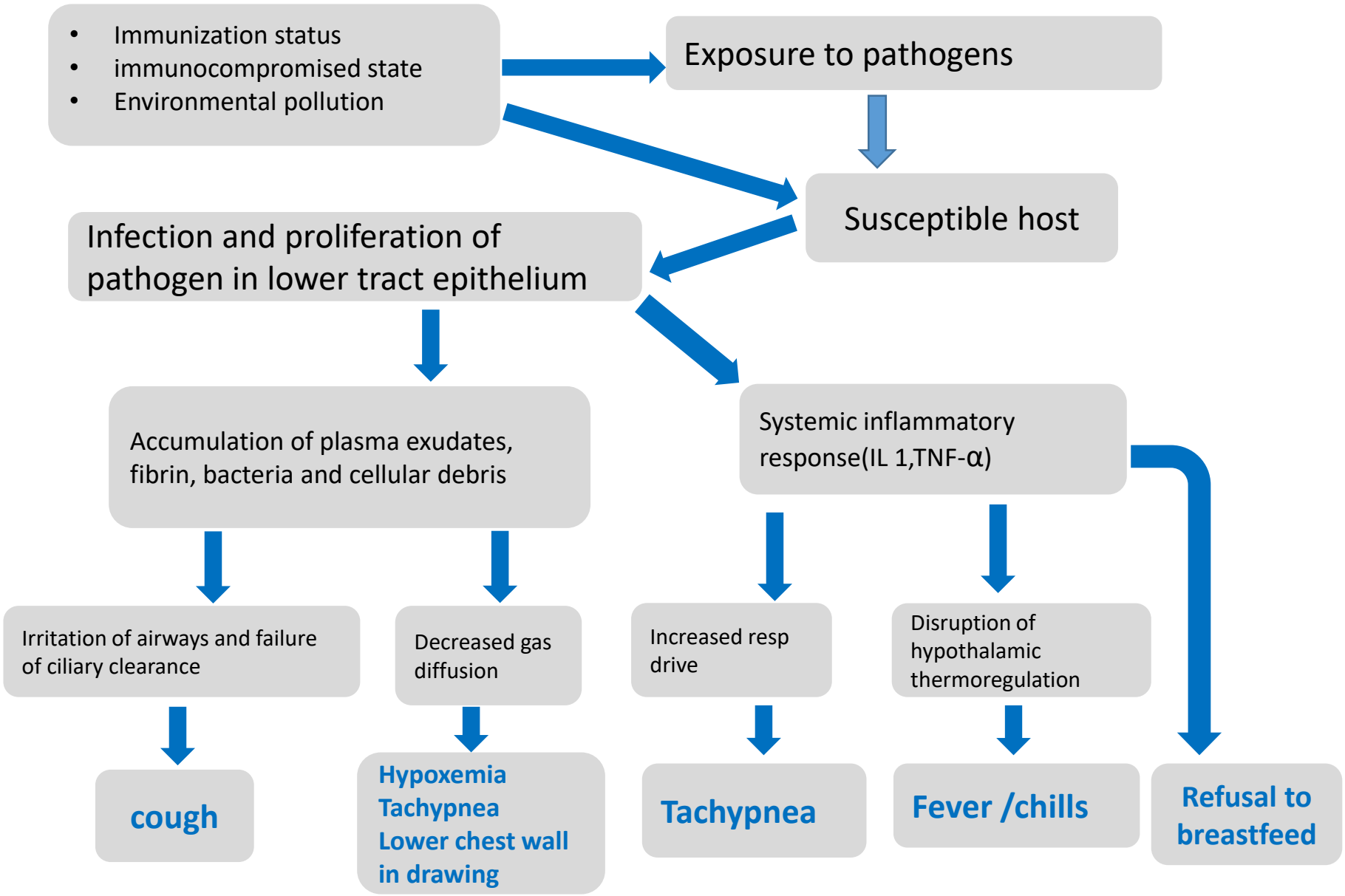


Clinical signs & symptoms

Which symptoms and signs of pneumonia are most useful?

- Best signs to guide in making **syndromic diagnosis** and assessing the **severity** of pneumonia
- Best signs are critical to **assess the risk of mortality** among pneumonia patients
- Best guide to **treatment**s : choice of antibiotics & supportive care and whether inpatient or outpatient care.
- Best signs to **monitor response** to treatment.

Basis of clinical signs of pneumonia



Respiratory Rate

- Counted for 1 minute in a calm child!

- Fast breathing
  - **RR ≥ 50/min (age 2-11months)**
  - **RR ≥ 40/min (age 12-59months)**

Indrawing

It signifies increased work of breathing but is not a danger sign by itself alone

- AVPU
- Cyanosis
- oxygen saturation,
- Grunting,
- Inability to drink

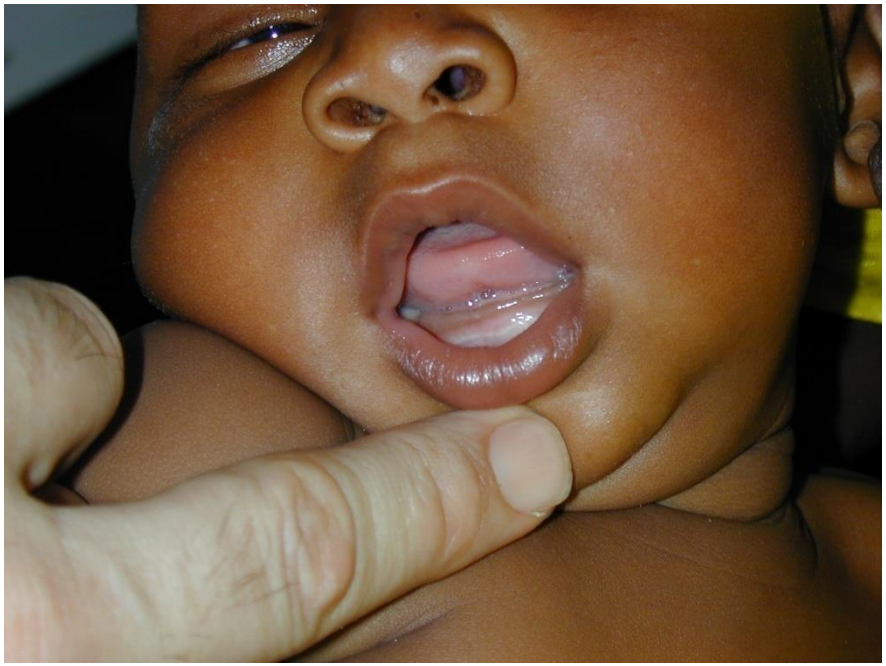
Four Danger signs

Any of the

Danger signs

1. **Hypoxia :**
   - SPO2 <90%
   - Central Cyanosis
2. Altered consciousness
3. if alert assess ability to drink
4. Grunting)

Central Cyanosis



- Gums / Tongue
- **NOT fingers**
- Lips unreliable
- Problem detecting cyanosis if the child has **severe anaemia**
- Cyanosis is a not a sensitive measure of hypoxia so use of pulse oximeter is encouraged all the time

Grunting

Expiratory sound caused by sudden closure of the glottis during expiration in an attempt to maintain forced residual capacity and prevent alveolar collapse.

Pulse oximetry

- Where available, use pulse oximetry to determine oxygen saturation
- Oxygen saturation, when measured appropriately, is a **reliable measure of hypoxia**
- Pulse oximetry can detect hypoxia much **sooner than** the provider can see clinical signs of hypoxia such as cyanosis

Assess level of consciousness : Alert?

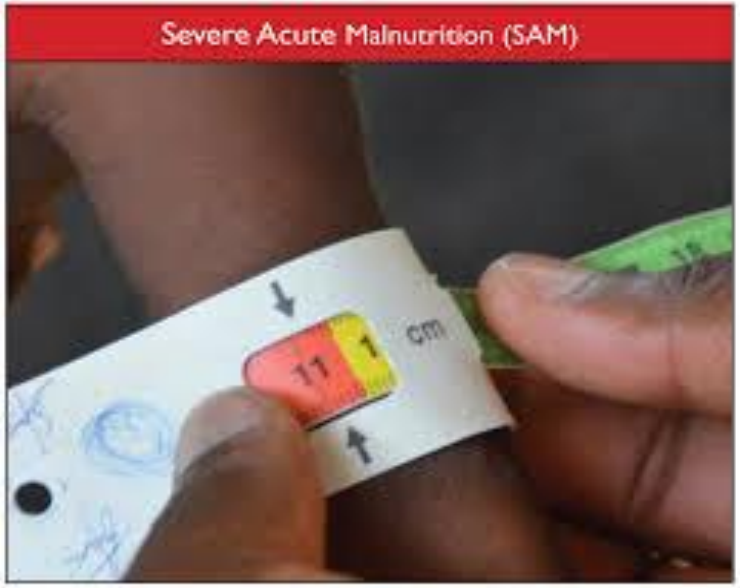
Ability to Drink / Breastfeed in a child who is alert?

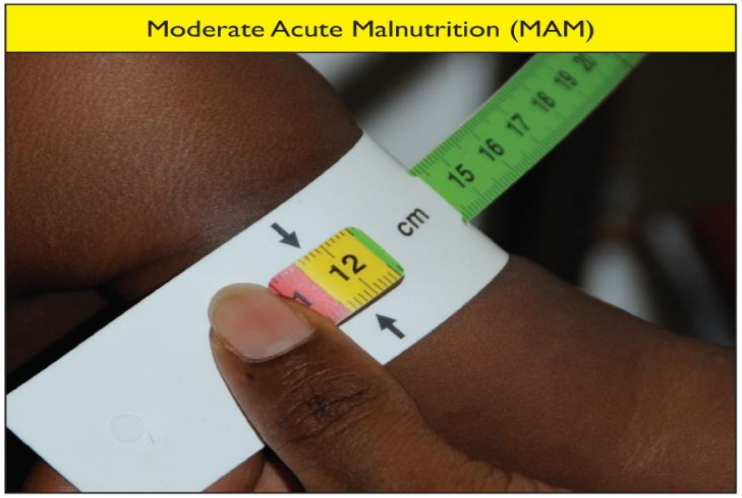
Child with oedema : Should not be included in this guidelines

Oedema	☐None ☐Foot ☐Knee ☐Face

Mid Upper Arm Circumference (MUAC)

- MUAC is the recommended measure for assessing nutritional status in children aged 6 – 59 months
- MUAC is a single linear measurement that does not require arithmetic, table look-up or plotting data on growth charts
- A colour-coded tape is used to determine the level of severity of malnutrition

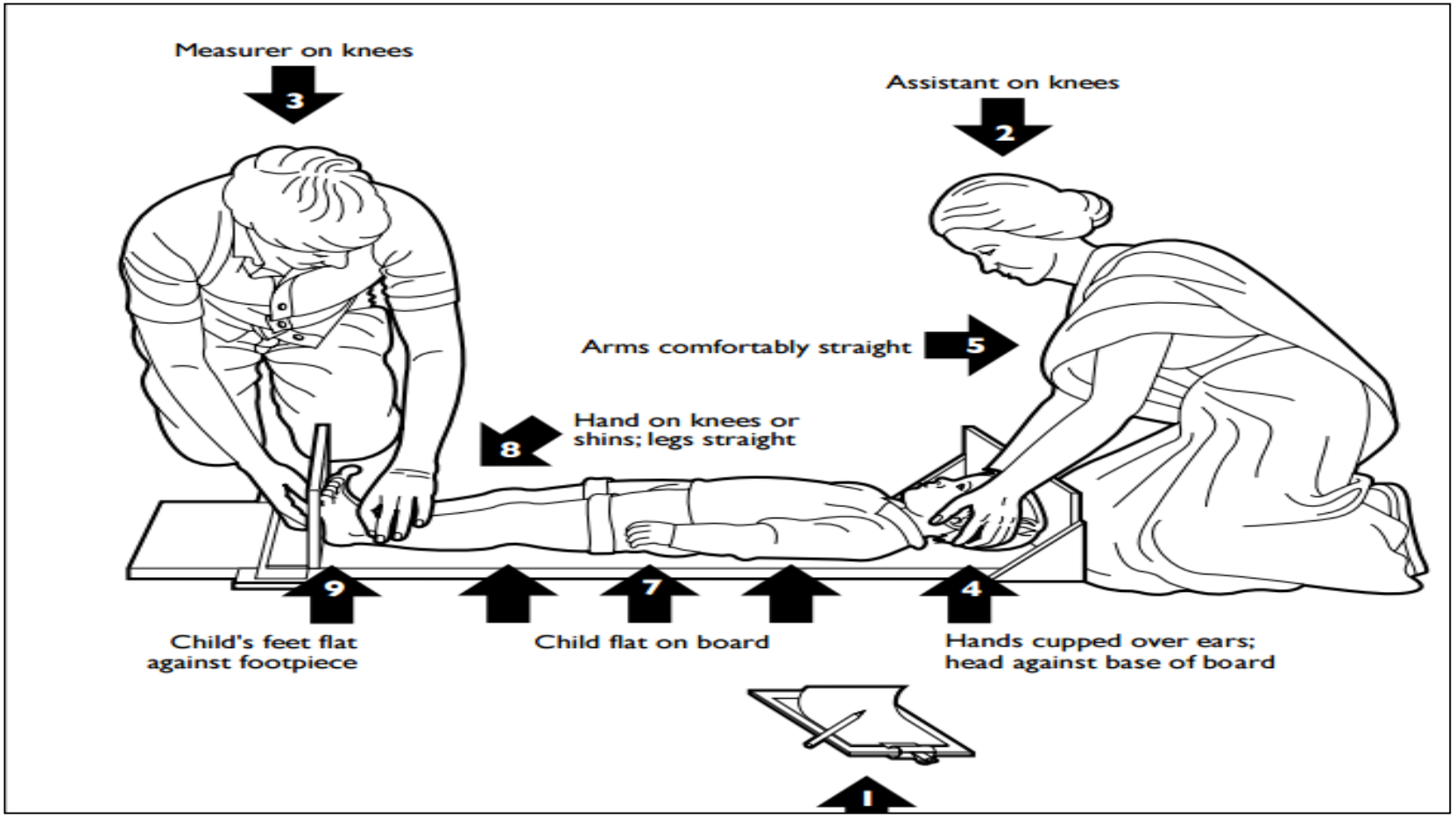




Length measurement

- Classification of nutritional status based on **W/L Z score**

  is used in infants <6 months



Definitions of acute malnutrition

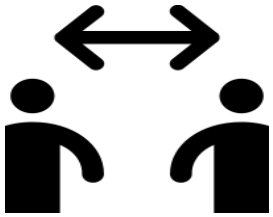
	MUAC cm	WLZ score
None	>13.5	>-1
At Risk	12.5 to 13.4	-2 to -1
Moderate	11.5 to 12.4	-3 to -2
Severe	<11.5	<-3
	Kwashiorkor	

HIV

- Current government policy recommends that **ALL sick children** presenting to facilities with unknown status should be offered HIV testing using PITC

Assessment of COVID-19 risk and prevention of hospital acquired infection

Preventing spread of COVID19 at outpatient department



All patients should be kept 1 m apart

All patients with fever/cough(+ their caregivers) should wear surgical masks

Cough etiquette and hand hygiene for all patients

Healthcare workers should have appropriate PPE

WHO 2020; Global surveillance for COVID-19 caused by human infection with COVID-19 virus: interim guidance;

Case definitions in COVID-19 disease

Suspected case

- Acute respiratory illness and/or fever >38^{0}C **AND** no known cause that fully explains the presentation **AND** a history of travel to a community with COVID-19 transmission at least **14 days** prior to symptom onset; OR
- **Any** acute respiratory illness **AND** having been in contact with a confirmed or probable COVID-19 case in the last 14 days prior to symptom onset; OR
- Severe acute respiratory illness **AND** requiring hospitalization **AND** the absence of an alternative diagnosis fully explaining the clinical presentation

Test for COVID-19

Confirmed case

- A person with **laboratory** confirmation of COVID-19 infection, **irrespective** of clinical signs and symptoms

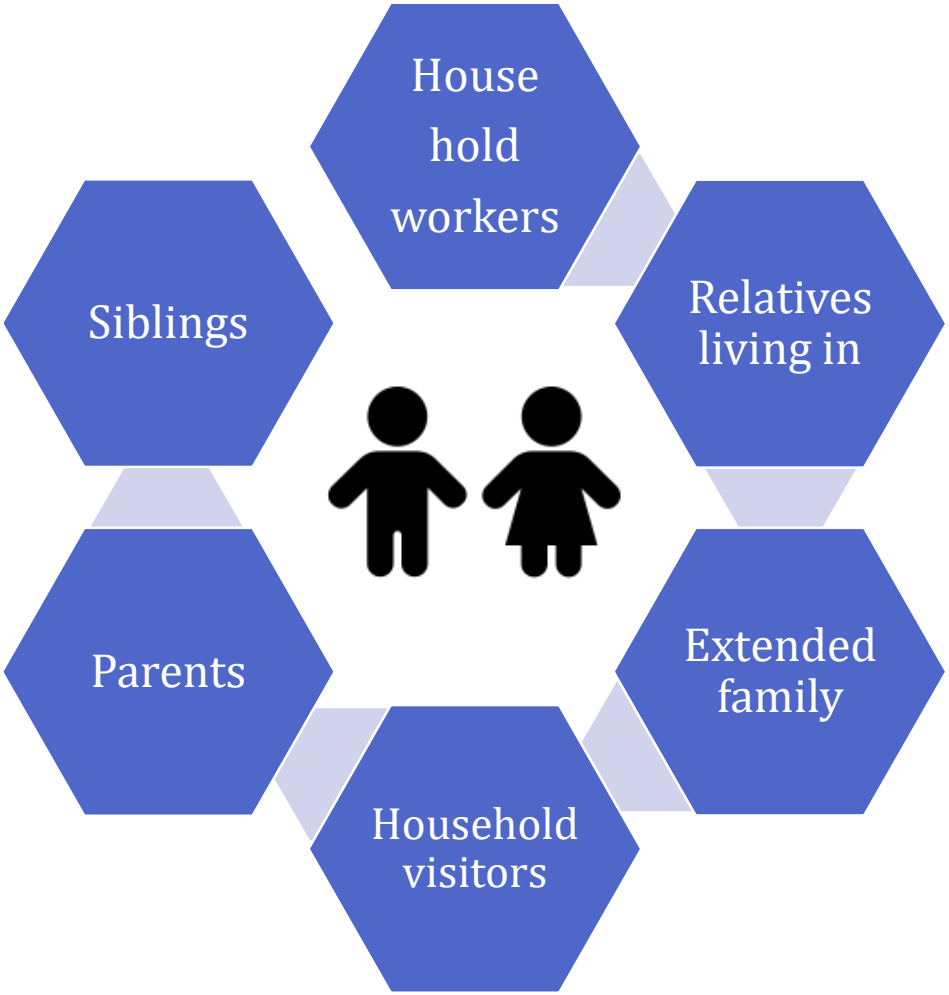
Probable COVID-19 cases when results are pending

(WHO 2020; Global surveillance for COVID-19 caused by human infection with COVID-19 virus: interim guidance;

Identifying a child's household contacts

Experience from China:

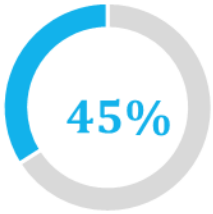
- **>50%** of all patients with COVID-19 had at least one family member with the disease
- **75–80%** of all clustered infections were within families



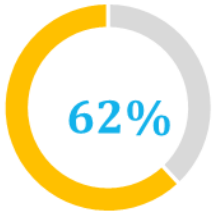
Chen et al: Fangcang shelter hospitals: a novel concept for responding to public health emergencies; Published online April 2, 2020 https://doi.org/10.1016/S0140-6736(20)30744-3

Challenges in using suspected COVID-19 definition as per WHO/MoH criteria

Data from 13 County hospitals in the Clinical Information Network shows prevalence among 2-59 months (N=30042) Pneumonia & fever are common admission diagnosis[1]

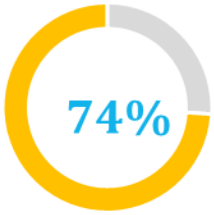


Prevalence of pneumonia

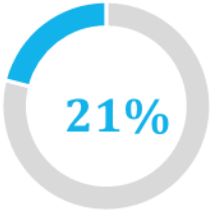


Prevalence of history of fever

Agweyu et al conducted retrospective analysis of severity of pneumonia among 16162 children aged 2-59 months admitted in 14 County hospitals in Kenya[2]



*Had **non-severe** pneumonia*



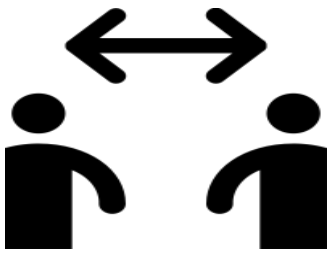
*had **severe** pneumonia*

(1) Ayieko P, et al. Arch Dis Child 2016;101:223–229. doi:10.1136/archdischild-2015-309269; (2) Agweyu et al Lancet Glob Health 2018;6: e74–83 (New WHO classification)

Lay out – screening for suspected COVID 19

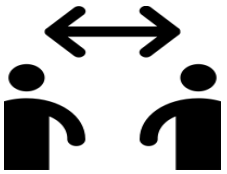
Screening point

All patients to keep 1 meter apart . All patients wash hands & wear masks; those with fever/cough (+ their caregivers) wear surgical masks. Instruct all patients on cough etiquette and hand hygiene



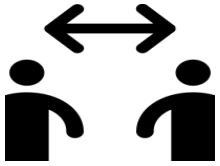
Potentially Contaminated zone

Suspected COVID 19



Clean zone

No fever/no cough/no contact



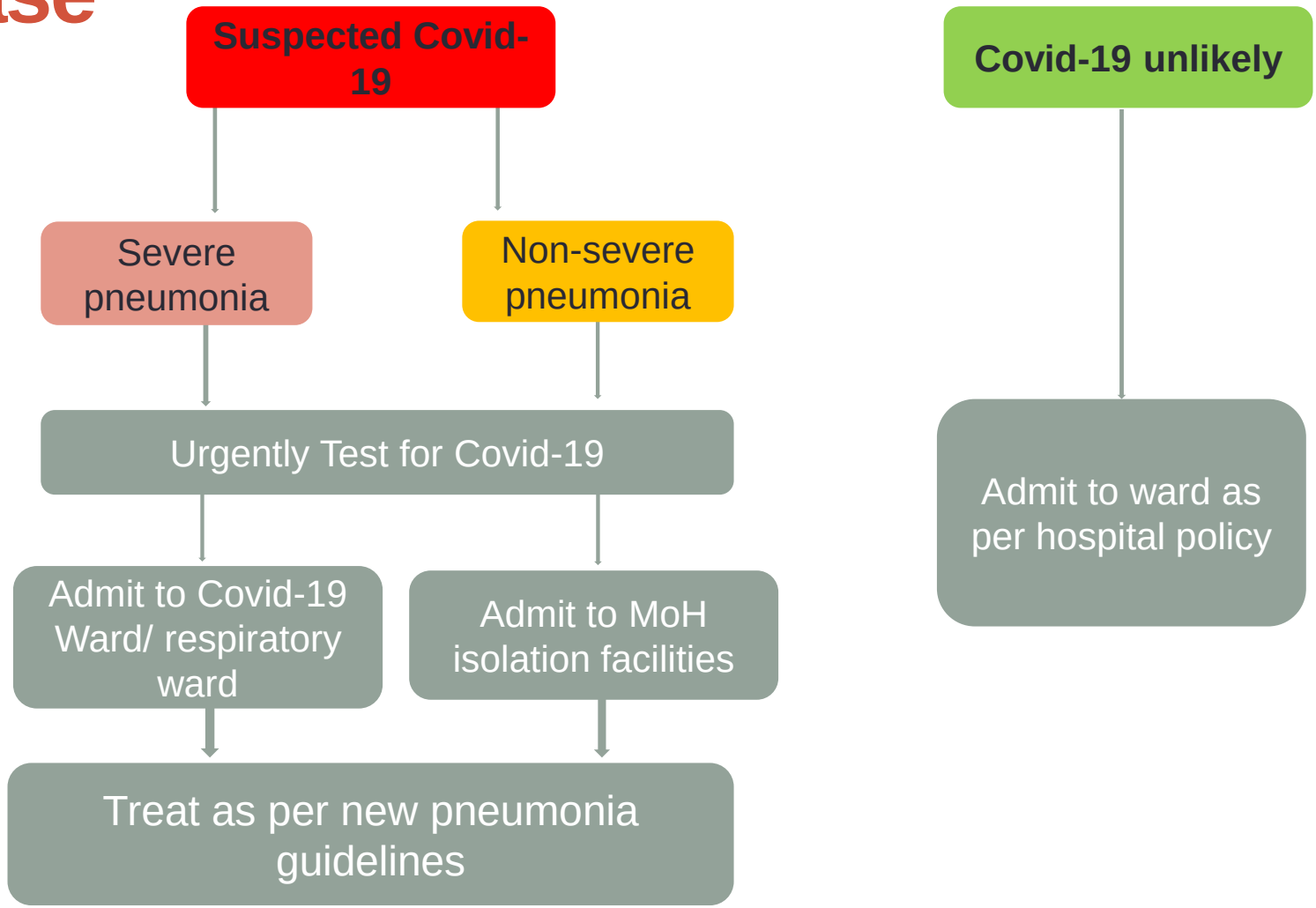
STOP SPREAD OF VIRUS! Protect others! Keep safe!

In regard to the 2 zones in outpatient the following should be observed:

- **Only patients** are allowed to enter waiting area to avoid overcrowding; for children, only one care giver. Patients must keep one meter distance
- **All patients** must wear masks (surgical masks if they have fever)
- **Instruct all patients** to cover nose and mouth during coughing or sneezing with tissue or flexed elbow and perform hand hygiene after contact with respiratory secretions
- **Educate patients and their families** about early identification of symptoms and essential preventative actions
- **Limited** duration in the examination room
- Clean and disinfect equipment (stethoscopes, blood pressure cuffs, pulse oximeters, and thermometers) between each patient use

All the two zones must have each independent examination room, lab, observation room and resuscitation room

Categories of suspected COVID-19 case

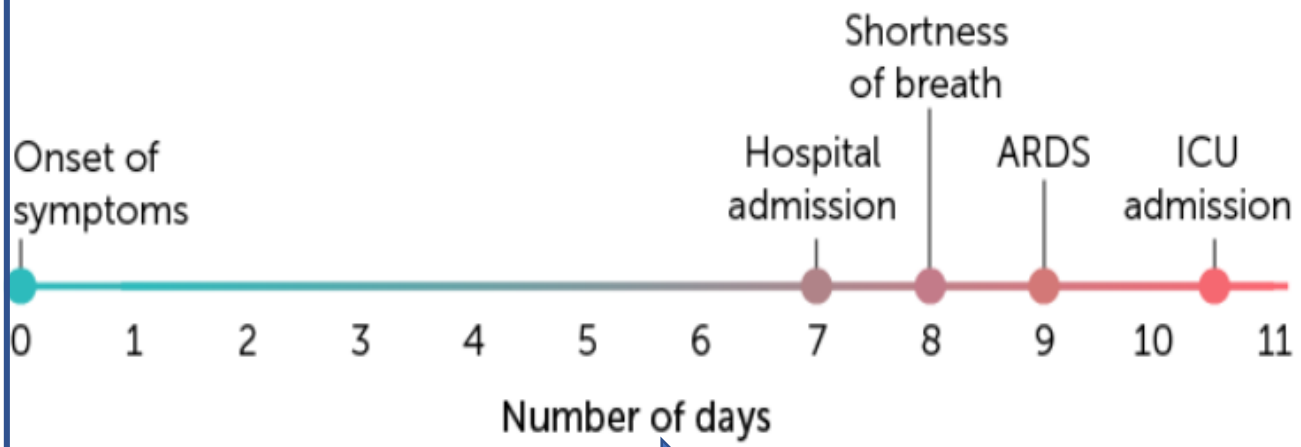


WHO 2020; Global surveillance for COVID-19 caused by human infection with COVID-19 virus: interim guidance;
MoH Kenya 2020: Interim guidelines on management of COVID-19 in Kenya;

How fast the severity of COVID-19 progresses

Well no symptoms after contact with corona virus

Incubation period
1-14 days
(Median 5 days)



80%
Mild & moderate

Require **isolation**

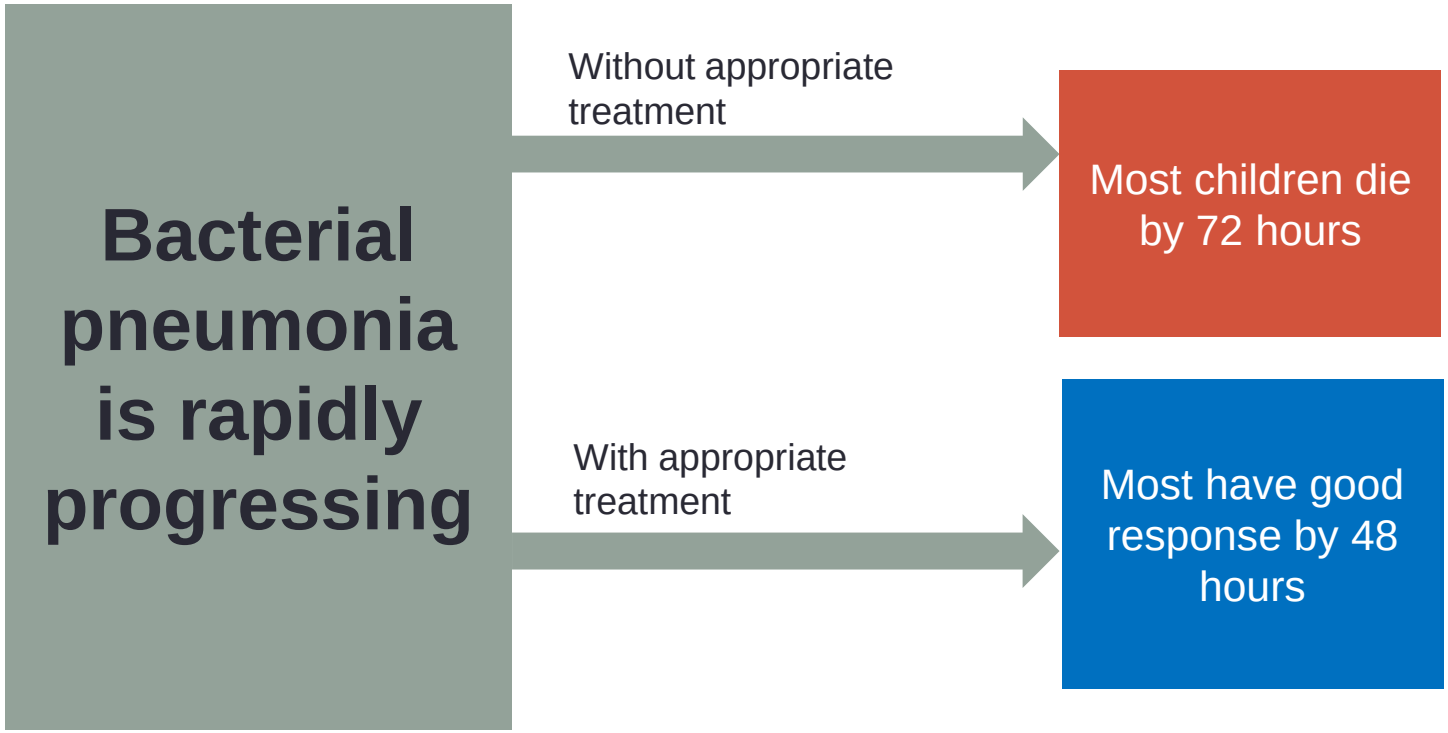
15%
severe

Critical
5%

Require **admission**

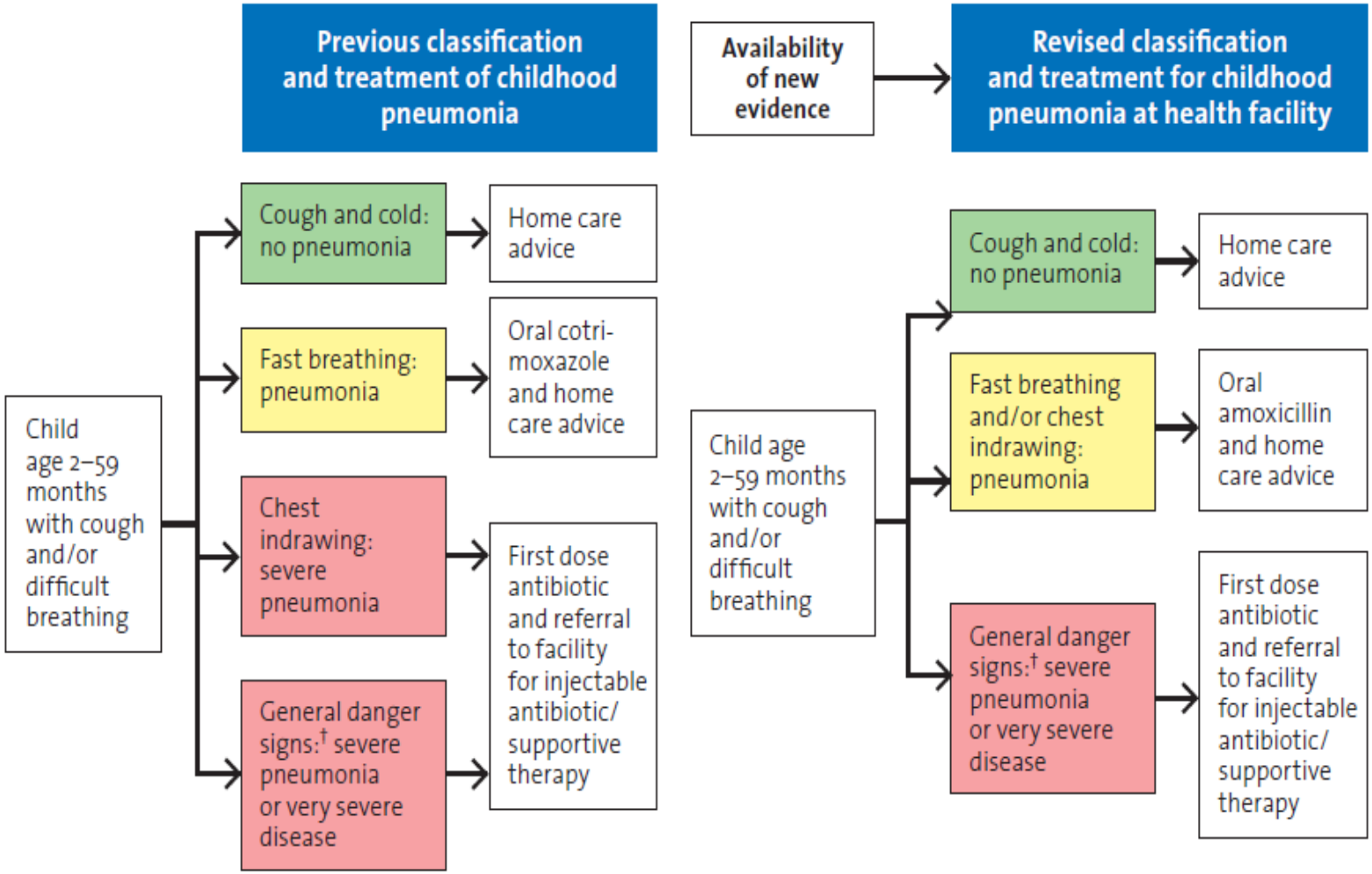
C. Huang et al Lancet 2020

How fast the severity of bacterial pneumonia progresses



Background to guideline change

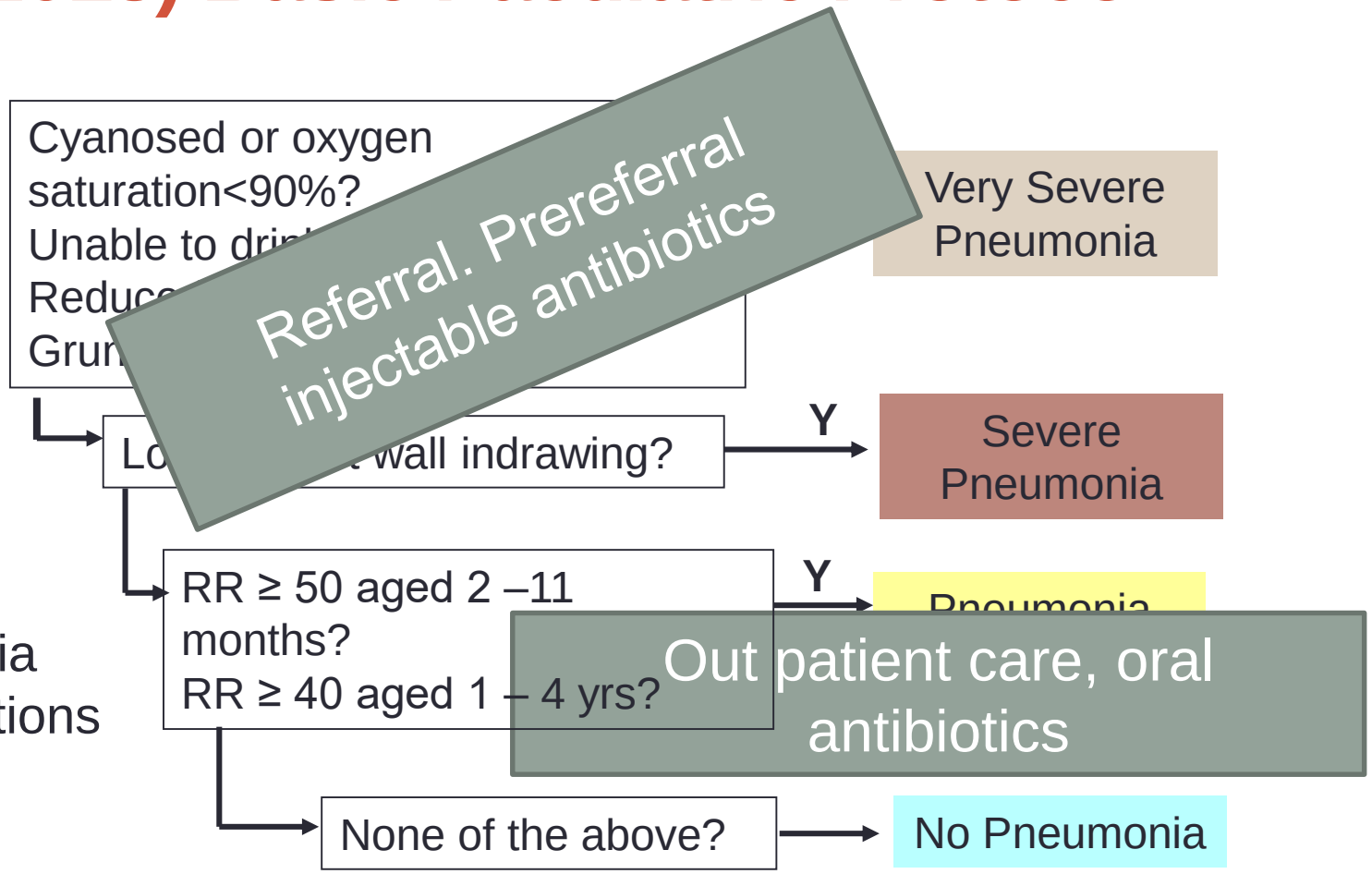
Comparison of previous and revised classification and treatment of childhood pneumonia at health facility



† Not able to drink, persistent vomiting, convulsions, lethargic or unconscious, stridor in a calm child or severe malnutrition.

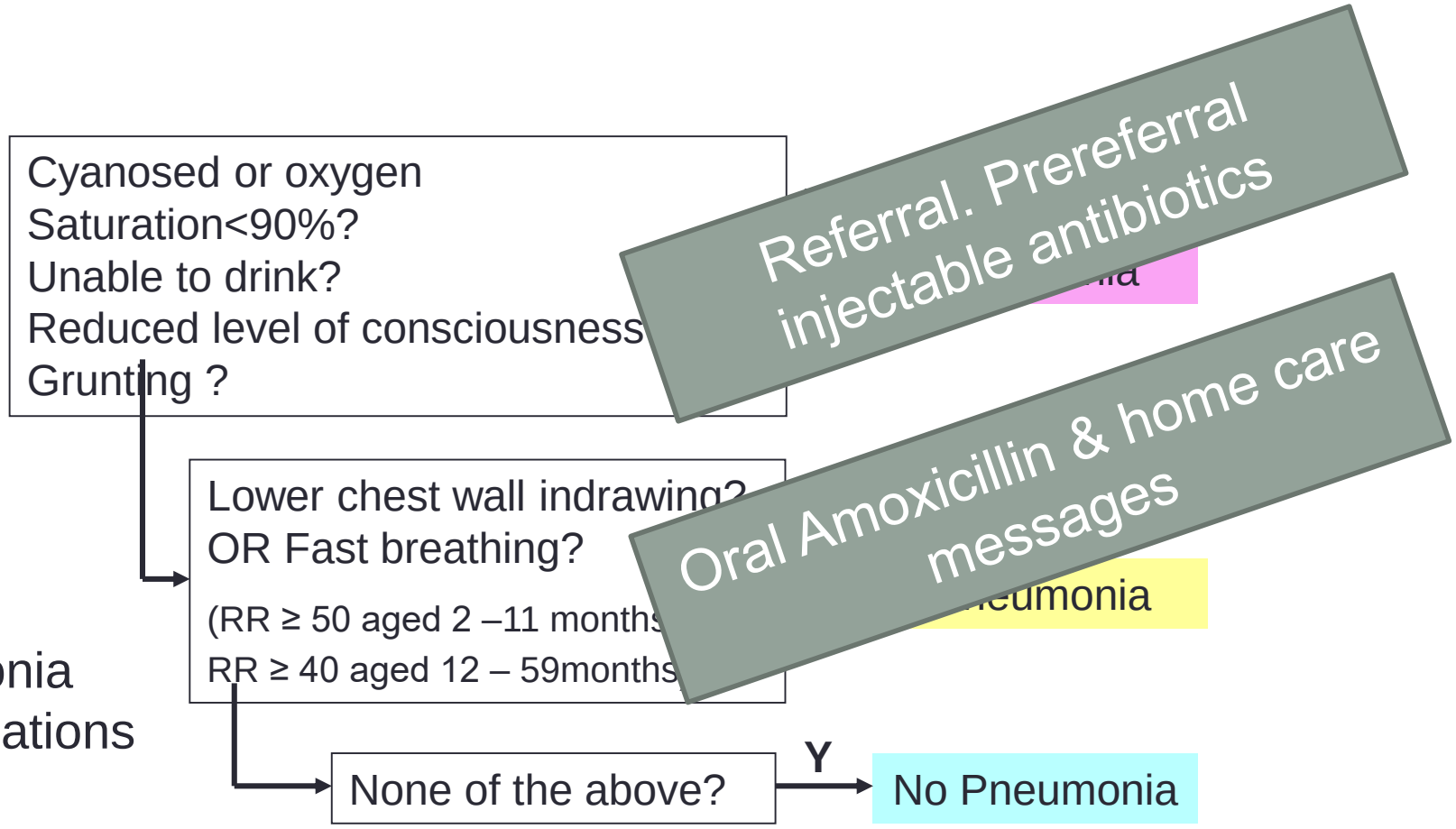
Classification of Pneumonia in 3rd Edition (Nov 2013) Basic Paediatric Protocol

Three pneumonia classifications



Classification & Treatment in the 2016 BPP

Two pneumonia classifications



Reasons for change of classification in this project

- Change tested in Kenya with **good results in clinical trial**
- Consistent with the WHO pneumonia guidelines (2013).
- **Risk of death** for children with lower chest wall indrawing BUT no danger signs is very low **(<1%)**
- **Risk of treatment failure** when using either crystalline penicillin or amoxicillin for pneumonia with lower chest wall in-drawing and no danger signs is low and the same

High dose oral amoxicillin is comparable to crystalline penicillin for treating pneumonia just with indrawing

Revised classification – Cough or difficulty breathing

Danger signs
(hypoxia or cyanosis, AVPU ≠ A, unable to drink, grunting)

→ Severe pneumonia

- P…
- …ment e.g. …eds
- **… REQUIRE INPATIENT CARE**

NO danger signs
but has other features of respiratory distress
(lower chest wall in-drawing OR fast breathing)

→ Pneumonia

- Am…
- …ire supplemental …
- C… feed does NOT require NGT or IVF
- Is alert
- **MAY NOT REQUIRE IN-PATIENT CARE**

Safe to give outpatient treatment for pneumonia with indrawing?

- A child with cough or difficulty breathing with lower chest wall indrawing BUT no danger signs **can safely be managed as an outpatient**
  - **If review at 48 hours can be conducted at a clinic**
  - **If the family can bring the child sooner for any deterioration - careful counseling on danger signs that should prompt early return must be given**
- Is there another illness that makes admission necessary?
- What is the HIV status? Is there severe acute malnutrition?

Special considerations

- Cautious application of the national guideline to the following groups of patients - Applies to 6-59months

Assessment	Possible action/ cause
Cough or fever more than 14 days	Consider TB /look for other causes of fever
Exposure to TB or chronic cough	Possibility of TB
SAM	Use guidelines for severe acute malnutrition
HIV infection	Use guidelines for HIV infected children
Known to have heart or kidney disease	Consider admission/ senior review
Readmission	Hospital acquired infection/TB/missed diagnosis

Current Pneumonia guidelines

How severe is respiratory distress – Cough or Difficult Breathing

Cyanosed/oxygen sat <90%?

Unable to drink?

Reduced level of consciousness?

Grunting ?

Y → Severe Pneumonia

High Risk of Death

High Risk of Hypoxaemia =Give oxygen if saturations <90% or based on clinical S+S

May need fluid / feeding support

Require **crystalline penicillin 50,000IU/kg 6hrly** and **gentamycin 7.5mg/kg 24hrly**

Administer vitamin A

How severe is respiratory distress – Cough or Difficult Breathing (2)

Lower chest wall indrawing?
OR Fast breathing?

(RR ≥ 50 aged 2 –11 months
RR ≥ 40 aged 12 – 59months)

Y →

Non-severe Pneumonia

Not severely ill = Outpatient care **if 48hr review possible**

Can feed orally, is alert & supplemental oxygen not needed

Require high dose **Amoxicillin (4-<10kg 250mg, 10-<14kg 500mg and 14-19kg 750mg) 12 hourly for 5 days)**

Administer **vitamin A**

Review in 2 days for improvement /deterioration/unable to feed

How severe is respiratory distress – Cough or Difficult Breathing

History of cough / difficult breathing ONLY

Y →

Cough, No Pneumonia

Outpatient care

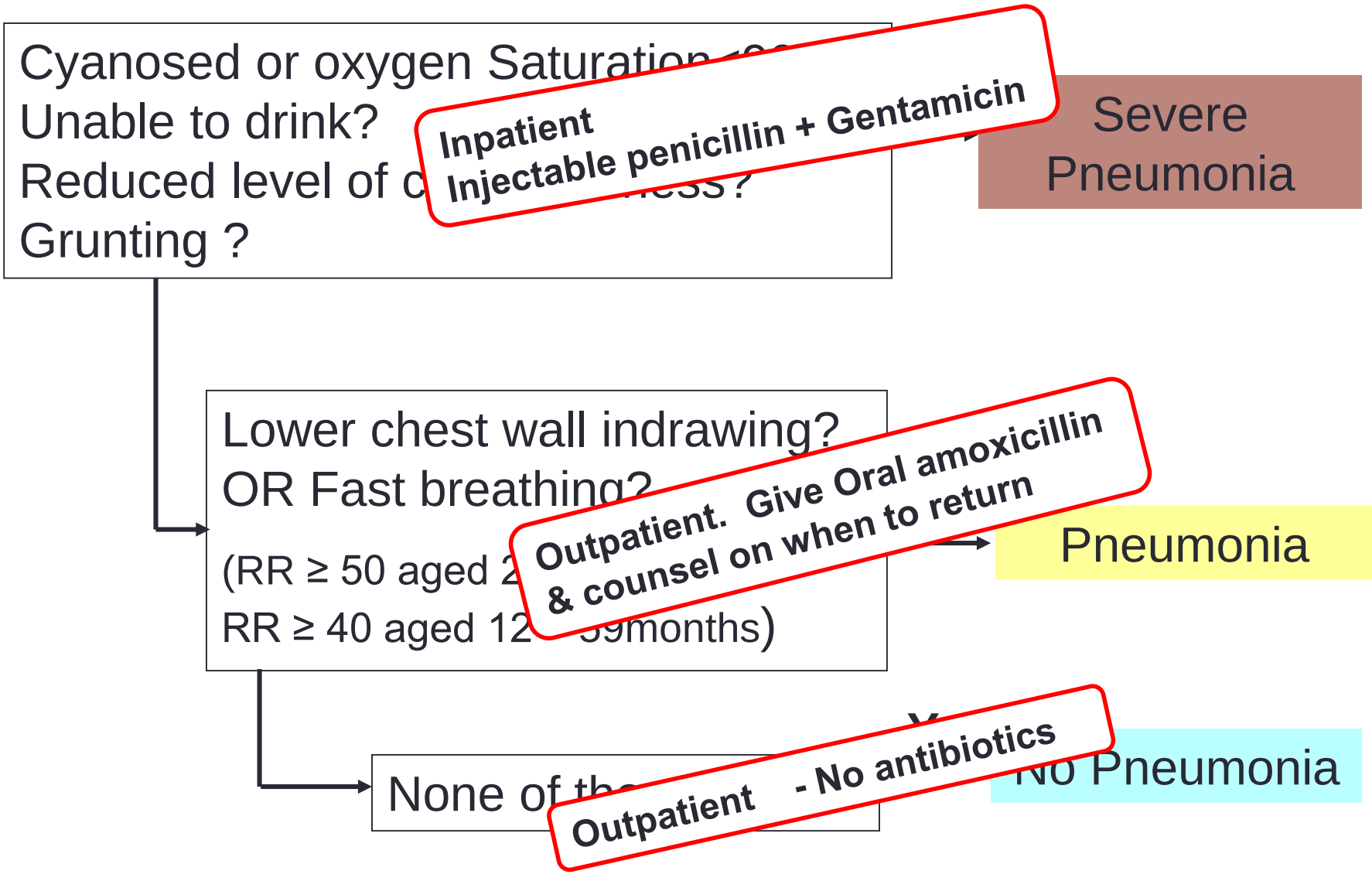
Antibiotics not indicated

Counsel on signs of deterioration

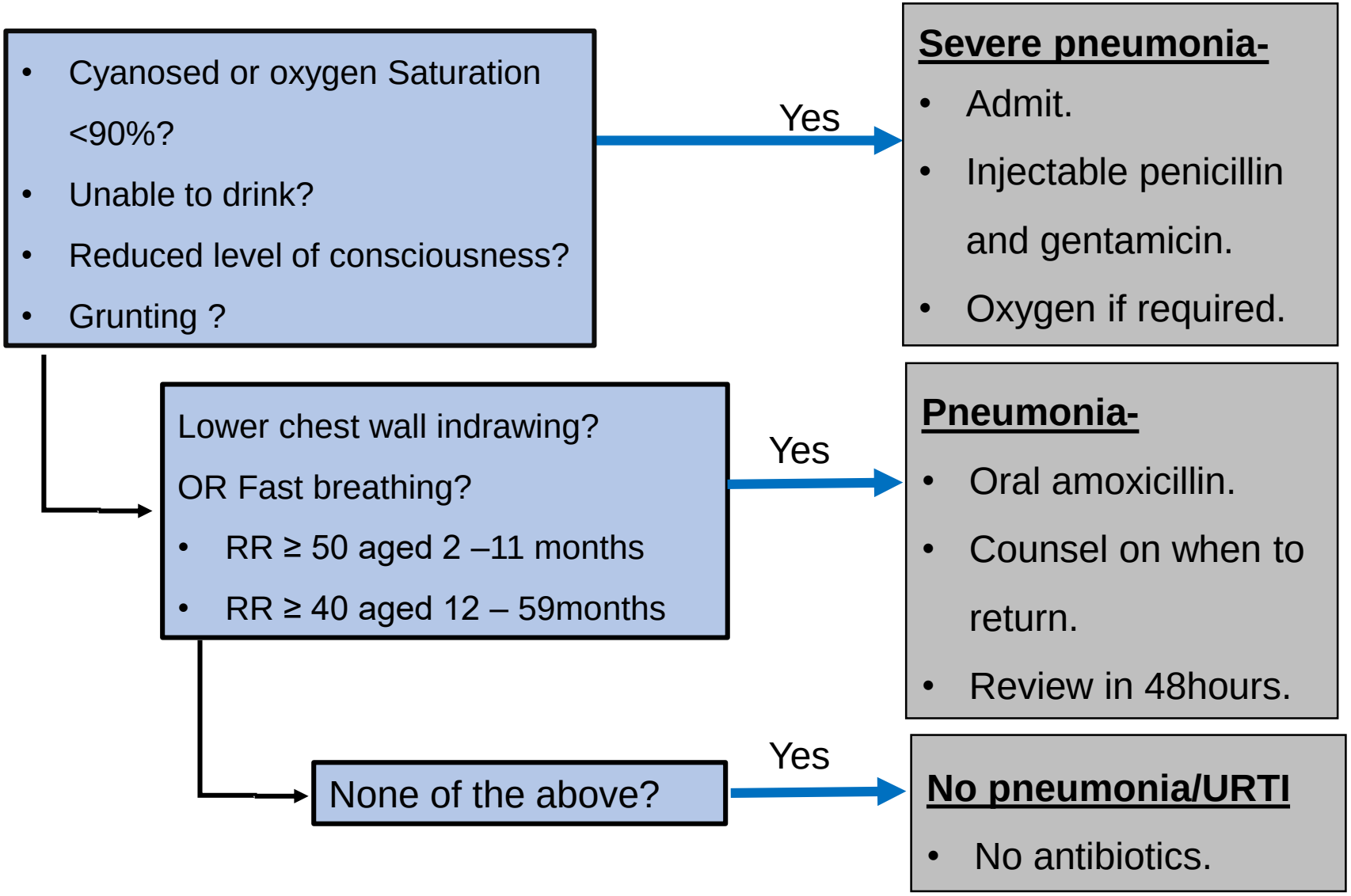
Check immunization status, deworm if need, administer Vitamin A

Cough syrups SHOULD NOT be prescribed.

4th Edition (Feb 2016) Pneumonia Guidelines



2016 Pediatric Pneumonia Guidelines



REVISED WHO CLASSIFICATION AND TREATMENT OF CHILDHOOD PNEUMONIA AT HEALTH FACILITIES: EVIDENCE SUMMARIES 2014

Admission or discharge for pneumonia with in - drawing?

- A child with cough or difficulty breathing with lower chest wall indrawing BUT no danger signs **can safely be managed as an outpatient**
  - **If review at 48 hours can be conducted at a clinic**
  - **If the family can bring the child sooner for any deterioration - careful counseling on danger signs that should prompt early return must be given**
- Is there another illness that makes admission necessary?
- What is the HIV status?
- Is there severe acute malnutrition?

HIV infected/exposed

HIV infected or exposed with either

- Severe pneumonia or
- Pneumonia with in-drawing

- Admit
- Treat with crystalline Penicillin & Gentamicin
- Oxygen if required

+

< 12months of age give empiric treatment for PCP – high dose cotrimoxazole

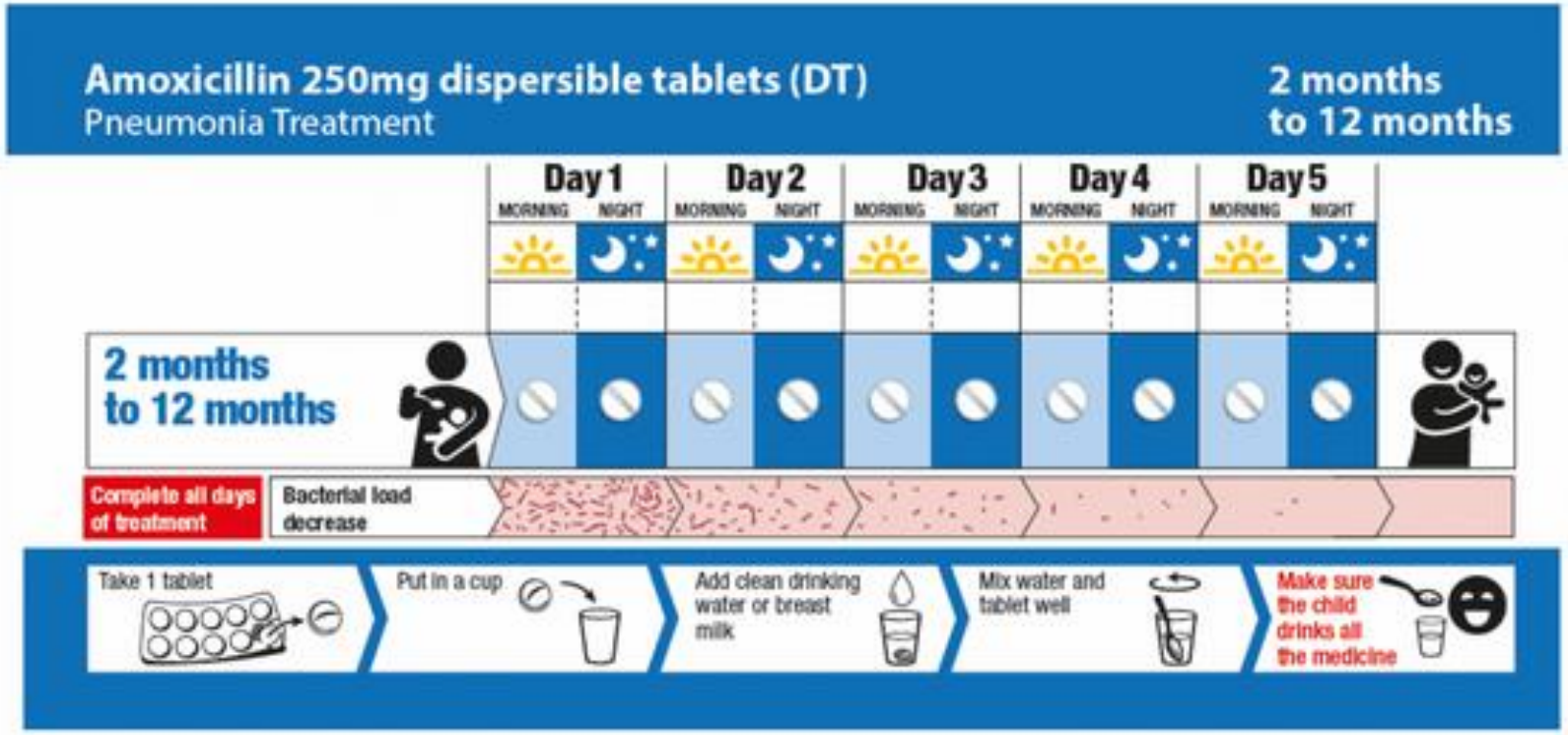
Empiric treatment- not recommended for children above one year

Why use Amoxicillin DT

- More stable than liquids; longer shelf life
- Does not need refrigeration- ideal for low income settings
- Less bulky- easy transport and storage.
- Breast-milk/ water
- Ideal for 0-6months.
- Cheaper
- Scored tablets- ease of use

https://www.unicef.org/innovation/stories/rethinking-amoxicillin-packaging

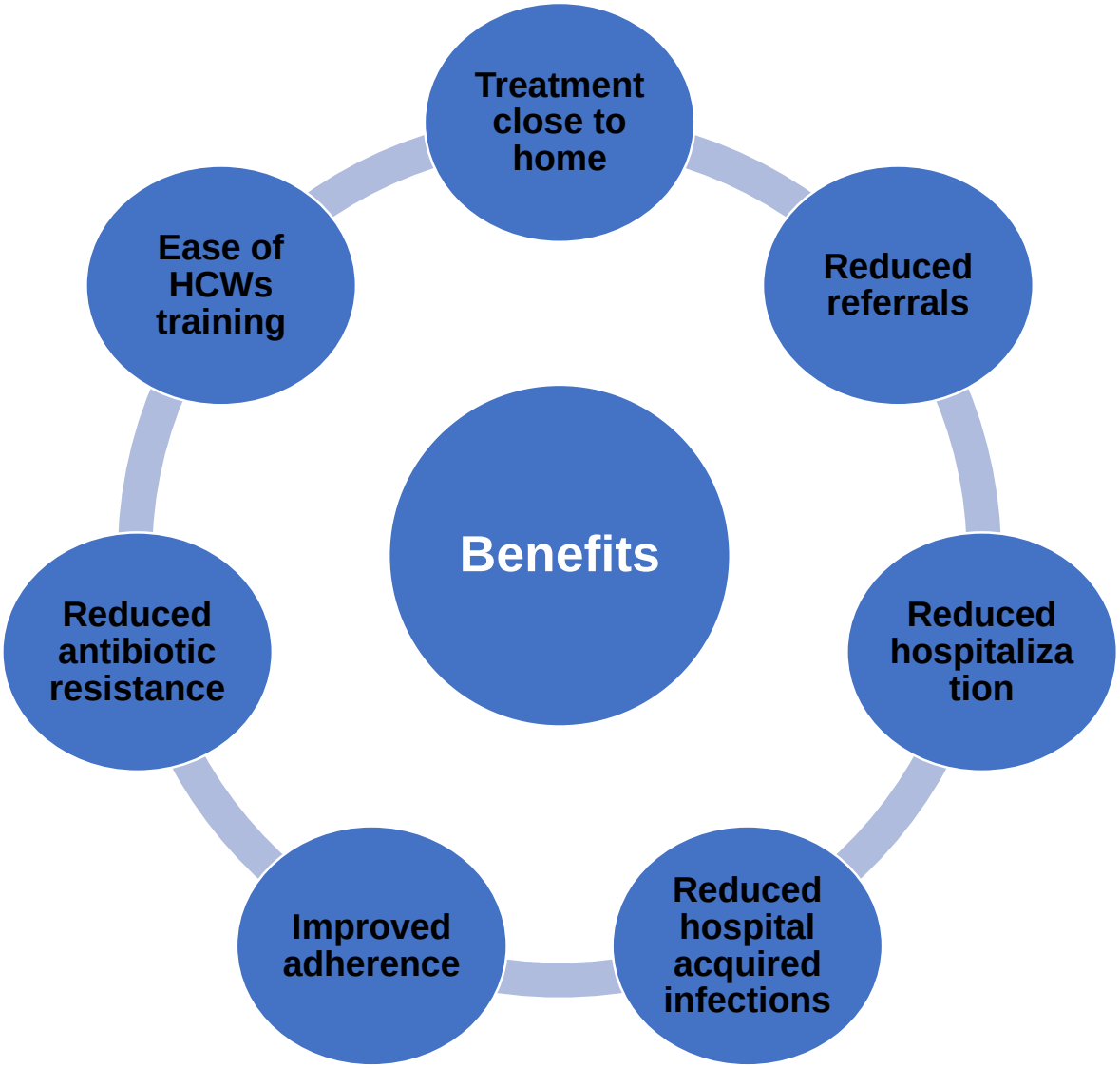
How to give Amoxicillin DT



A dispensing envelope containing a pack of 1×10 tablets of 250mg amoxicillin DT and depictive instructions on the cover (for children under one year).

https://www.unicef.org/innovation/stories/rethinking-amoxicillin-packaging

Benefits of the new recommendation



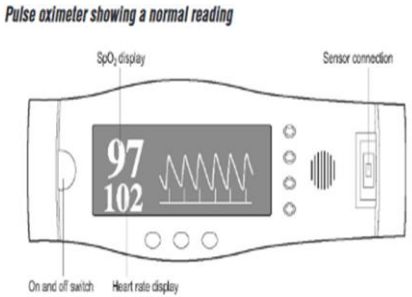
Revised WHO classification and treatment of childhood pneumonia at health facilities

Supportive treatment

Detection of hypoxemia-Pulse oximeter

Non invasive method for measuring arterial oxygen saturation across a translucent part of the body

Normal range- above 90%

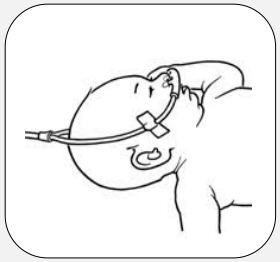


Measures O_2 saturation of hemoglobin by comparing the absorbance of light of different wavelengths and the readings shown on a display

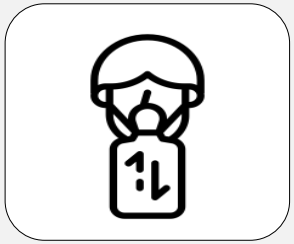
- Do not reflect on CO_2 - cannot be used to detect hypercarbia
- Cannot indicate the adequacy of ventilation in children receiving oxygen, clinical monitoring of work of breathing is a guide to adequacy of ventilation.

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

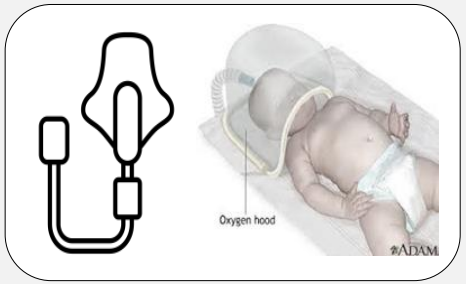
Oxygen delivery administration



- Preferred method for spontaneously breathing patients.
- Safe, simple, easily tolerable
- Humidification for high flow
- Titrate the flow against the $SP0_2$



- Titrated every 15mins depending on need
- Used to deliver high dose oxygen to spontaneously breathing patients.
- Post resuscitation care.



- Face masks and headboxes not recommended.
- Oxygen wastage
- Potential risk of carbon dioxide toxicity.

WHO Oxygen therapy for children 2016

Oxygen therapy

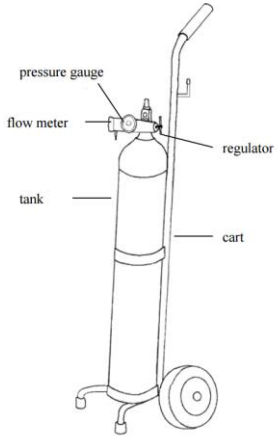
Oxygen Sources

Oxygen Concentrators

PS:

- Clean outer filter every week
- Change inner filter with color changes
- Analyze oxygen concentration every 3 months or if it breaks down

Oxygen Cylinders



PS:

- Have 2 at all times
- Secure on a trolley
- Keep away from flames

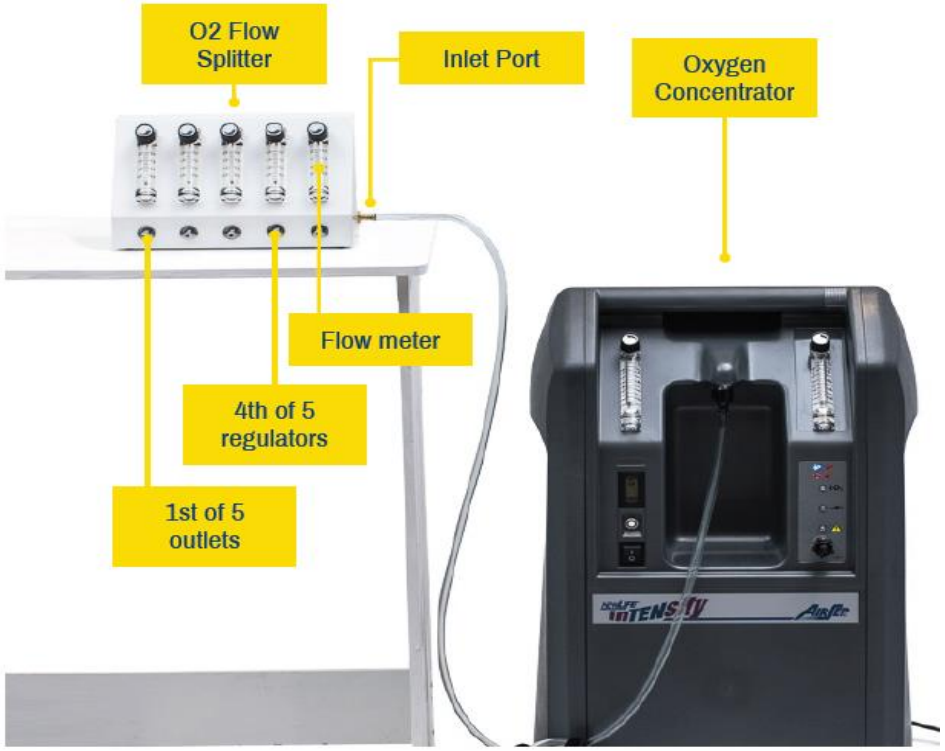
Central Piped Oxygen

PS:

- Differentiate piped oxygen and medical air
- Clean the attachment valves daily

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Sources – Flow Splitter



PS:

- Used to deliver independently controlled oxygen to multiple patients
- When you alter one valve flow, check that you adjusted the right valve for the intended child and ensure other valves remain as set.
- Read the flowmeter at eye level either above, middle or bottom of the ball based on manufacturer's recommendations

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Delivery Methods

Nasal Prongs

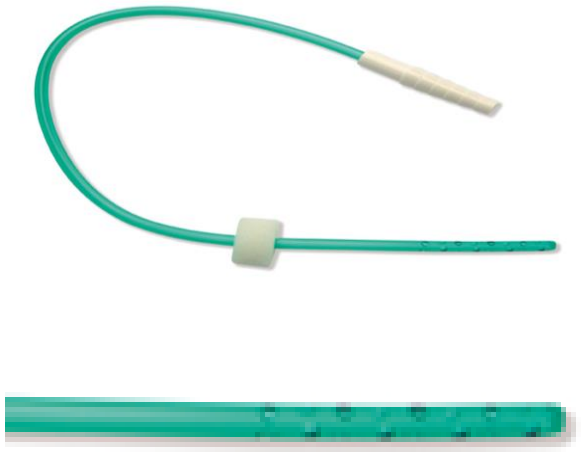
Proper Use

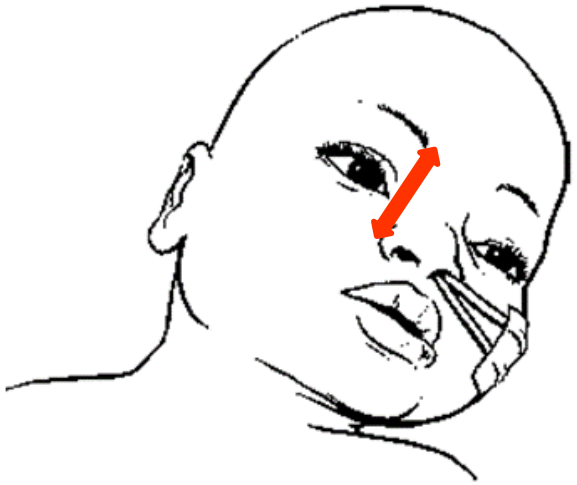
- Ensure airway is clear – suction if necessary (use N95 mask), position
- Instill 2 drops of normal saline into nostrils before inserting the prongs
- Place prongs 2mm from nasal septum
- Secure on both cheeks with transpore adhesive, run the tubing to the back
- Adjust flow rate:
    1. **Standard Flow rate – Neonates 0.5-1L/min, Infant/child 1-2L/min (FIO2 -30-35%)**
    2. **High Flow rate – Neonates 2L/min, Infant/child 4-8L/min (FIO2 45-55%)**

Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Oxygen Delivery Methods

Nasal Catheter





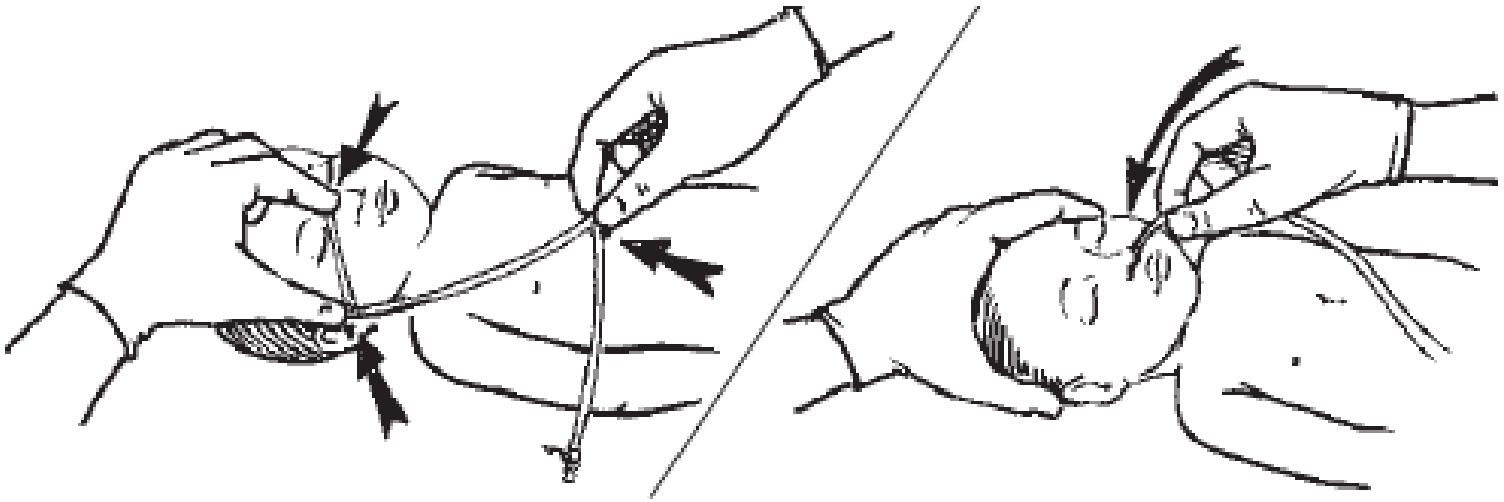
Proper Use

- Ensure airway is clear – suction if necessary (use N95 mask), position
- Correct placement sizing – side of the nose to the inner margin of the eyebrow
- Adjust flow rate as for nasal prongs
- Insert appropriately sized nasal gastric (NG) tube if giving high flow rates;
    1. **Confirm gastric placement using a blue litmus paper**
    2. **Insert in same nostril as oxygen catheter**

Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Inserting a nasogastric tube(NGT)

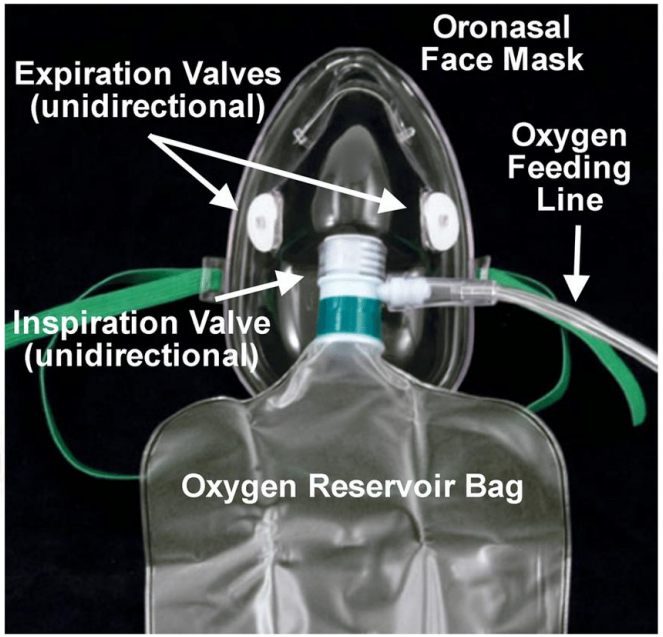
Sizing the NGT – measure the distance from the nose to the ear lobe, then to the xiphisternum (epigastrium). Mark the tube at this point
Inserting - Lubricate the tip of the catheter with water, and insert until the measured distance is reached, fix the tube with tape at the nose



Confirming position : Check that aspirate turns blue litmus paper pink. If no aspirate is obtained, inject air down the tube and listen over the abdomen with a stethoscope

Oxygen Delivery Methods

Oxygen Face Mask with a reservoir (Non Rebreather Mask)



Proper Use

- Mostly used post resuscitation
- Ensure airway is clear – suction if necessary (use N95 mask), position
- Ensure the reservoir is filled with oxygen before placing mask on the child
- Ensure it covers nose and mouth
- Adjust flow rate to 10 -15L/min for all age groups to deliver FIO2 80-90%

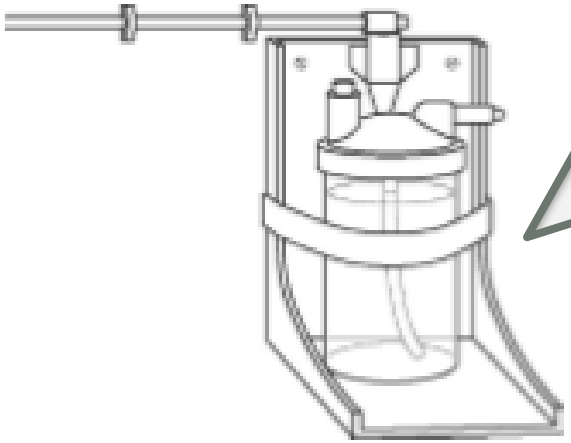
Kenyan Pediatric protocol 2016; WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Humidification

- Reduce dryness of O_2 from a source by bubbling it through water.

Indications

- High flow rates above 4L/min with nasal catheters/nasal prongs
- Use of Non Rebreather Mask (10 – 15L/min)



- **Use distilled clear water ONLY**
- **Change the water daily- Reduces risk of bacterial contamination**

- O_2 delivery at standard flow rate through a nasal catheter or nasal prongs does not require humidification

WHO oxygen therapy for children 2016 : https://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/

Titrating & Stopping Oxygen

- When Oxygen is started, titrate every **10 - 15mins** by **0.5L/min** until **SpO2 is 90-96%**
- Change the oxygen delivery methods (nasal prongs, catheter or NRM) and flow rates based on need
- Stop titrating and begin close monitoring if clinically stable (no emergency signs, SpO2 > 90% and no increase WoB)
- Wean off oxygen every **10 –15 min** and carefully examine for changes in WoB and SpO_2 to assess whether supplemental oxygen is still required.
- Once oxygen is stopped, recheck SpO_2 after 1h, as late desaturation can sometimes occur
- Discharge only if child has been stable with **SpO2 ≥ 90% and no increased WoB** on room air for at **least 24hrs**

WHO oxygen therapy for children 2016 : Sources and delivery of oxygen; page 32-33

Complications of oxygen therapy

a) O_2 toxicity (overdose >96%)

Peripheral vessels

Induces vasoconstriction- impaired organ perfusion- esp cerebral and coronary region

CNS

- ROS-neuronal damage – convulsions,
- Retinal damage, neonates- ROP

Respiratory system

- Absorptive atelectasis,
- Reactive oxygen species-
  - Tracheobronchitis,
  - Pleuritic pain,
  - Bronchial irritation,
  - Diffuse alveolar damage - eventual pulmonary fibrosis

*Helmerhorst, H.J.F., Schultz, M.J., van der Voort, P.H.J. et al. Bench-to-bedside review: the effects of hyperoxia during critical illness. Crit Care **19,** 284 (2015). https://doi.org/10.1186/s13054-015-0996-4*

Complications of oxygen therapy

b) Hypoxia (underdose- <90%)

All body organs

Failure of oxygen dependent Na/K ATPase pumps-energy failure- membrane depolarization- uncontrolled Ca^{2+} influx- activation of calcium dependent caspases, proteases- cell death esp in the CNS.

Respiratory system

- Pulmonary arteries- vasoconstriction.
- Sustained hypoxic constriction- pulmonary hypertension

Michiels C. (2004). Physiological and pathological responses to hypoxia. The American journal of pathology, 164(6), 1875–1882. https://doi.org/10.1016/S0002-9440(10)63747-9

Treatment failure

Within 48 hours of illness

Treatment failure definition	Action plan
Severe pneumonia child getting worse, re-assess thoroughly, get chest X ray if not already done *(looking for empyema /effusion, cavitation etc).*	Switch to ceftriaxone unless Staphylococcal *pneumonia* is suspected; then use flucloxacillin and gentamicin.
Pneumonia *without* improvement in at least **one** of: ❖ *Respiratory rate,* ❖ *Severity of indrawing,* ❖ *Fever,* ❖ *Ability to drink or feed.*	Admit the child *Suspect PCP especially if <12m, an HIV test **must** be done - treat for Pneumocystis if HIV positive.* Change treatment from amoxicillin to penicillin and gentamicin

Ceftriaxone is a third generation cephalosporin with activity against penicillinase resistant pneumococci strains and increased activity against gram –ve organisms.

On day 5 of illness

Treatment failure definition	Action plan
At least **three** of: ✓ Fever >38◦C ✓ Respiratory rate >60 bpm ✓ Still cyanosed and saturation<90% no better than on admission ✓ Chest indrawing persistent ✓ Worsening CXR	• If on amoxicillin then change to penicillin and gentamicin. • If on penicillin and gentamicin switch to ceftriaxone unless. • Staphylococcal *pneumonia* is suspected; then use flucloxacillin and gentamicin.

Summary

1. Correct assessment is key- (also assess for COVID19 risk).
2. Correct classification- Severity and COVID likely or unlikely.
3. Correct treatment- including specific and supportive