SARI CLINICAL CARE TRAINING

CLINICAL SYNDROMES

Learning objectives

At the end of this lecture, you will be able to:

- Describe the importance of early recognition of patients with SARI.
- Recognize patients with severe pneumonia.
- Recognize patients with ARDS.
- Recognize patients with sepsis and septic shock.

SARI

S	SEVERE
A	ACUTE
R	RESPIRATORY
I	INFECTION

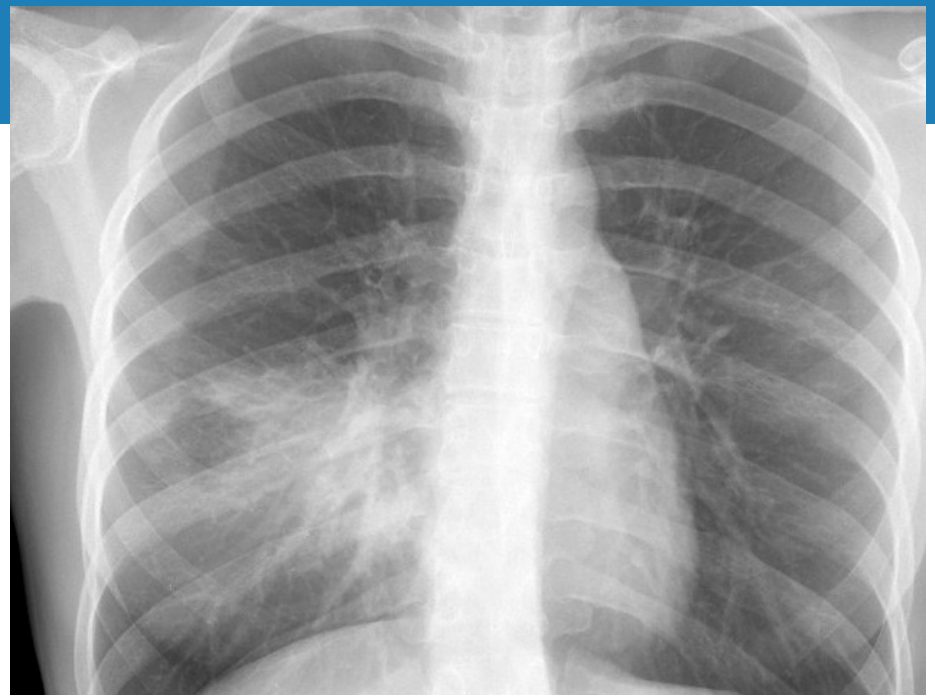
COVID-19 acute respiratory syndrome

- COVID-19 is associated with a broad clinical spectrum of disease.
- Most patients appear to have mild disease: common symptoms include fever, cough, sore throat, fatigue, myalgia.
- It is estimated that 20% have severe disease, which includes severe pneumonia and sepsis.
- Of these, some patients progress to acute respiratory failure requiring mechanical ventilation. Death has occurred in 2% of cases, but CFR estimate still not available.

Importance of early recognition of SARI patients

- Early identification of patients with SARI with sepsis and implementation of of early, evidence-based therapies improves outcomes and reduces mortality.
  - Implementing the Surviving Sepsis Campaign (2016) saves lives:
    - ➔antimicrobial therapy within **1 hour**
    - ➔early, targeted resuscitation for septic shock
    - ➔early application of lung protective ventilation for ARDS
  - Lack of early recognition is a major obstacle!

Pneumonia



Lower respiratory tract infections (pneumonia) and diarrhoea are the second leading cause of death and disability-adjusted life years lost in adults and children globally.

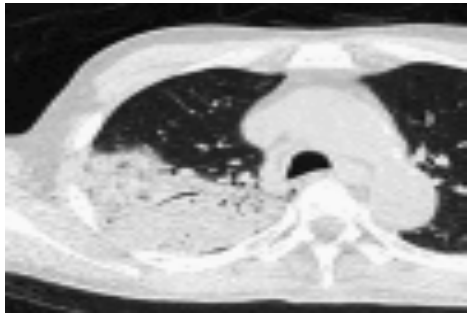
Global Burden of Disease Study (http://vizhub.healthdata.org/gbd-compare/)

Common symptoms of community acquired pneumonia (CAP)

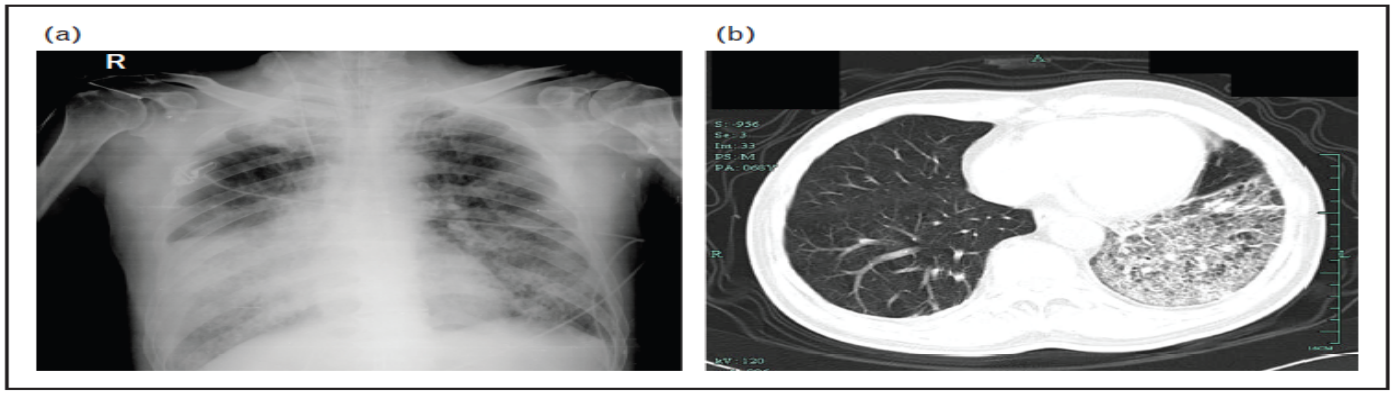
- Fever and cough
- Sputum production
- Haemoptysis
- Difficulty breathing
- Pleuritic chest pain
- Chest radiograph recommended to make diagnosis.

Courtesy of Dr. Harry Shulman at http://chestatlas.com/cover.htm

Radiological findings are non-specific



Bacterial pneumonia



H7N9

Curr Opin Pulm Med 2014, 20:225–232

World Health Organization

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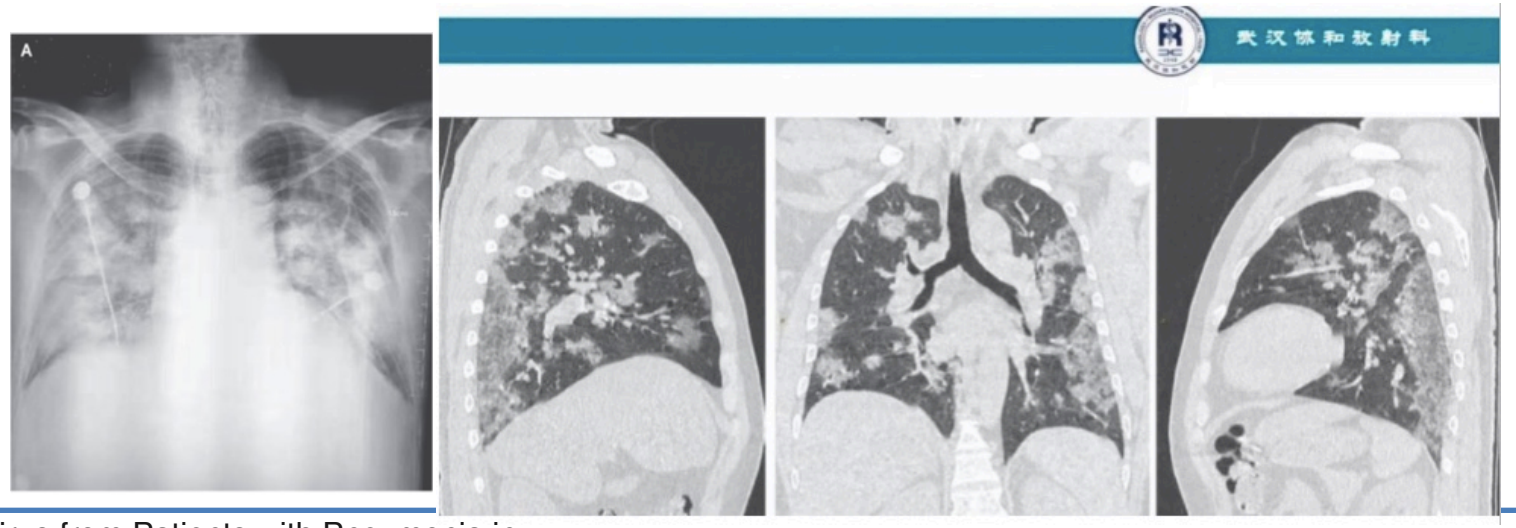
Radiological findings are non-specific

Curr Opin Pulm Med 2014, 20:225–232

MERS



nCoV

Za Nau et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. DOI: 10.1056/NEJMoa2001017

Courtesy Wuhan State Hospital

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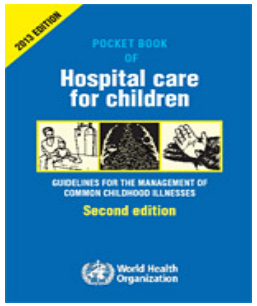
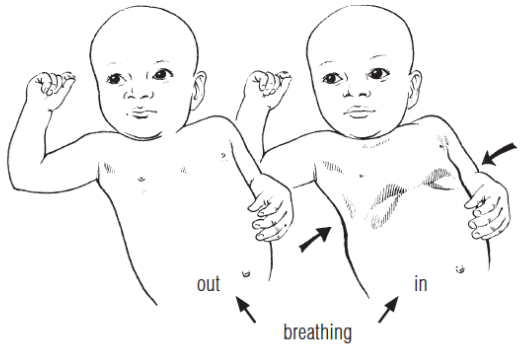
Recognize severe pneumonia



Non-severe pneumonia

- ≥ 50 breaths/min in child aged 2–12 months
- ≥ 40 breaths/min in child aged 1–5 years
- chest indrawing

Fig. 4. Severe lower chest wall indrawing indicates that this child needs oxygen.



Severe pneumonia

- Cough or difficulty breathing and
- ≥ 1 of the following:
  - signs of pneumonia with a general danger sign:
    - lethargy or unconscious
    - convulsions
    - inability to breastfeed or drink.
  - central cyanosis, SpO_2 < 90%
  - severe respiratory distress
    - grunting, very severe chest indrawing.

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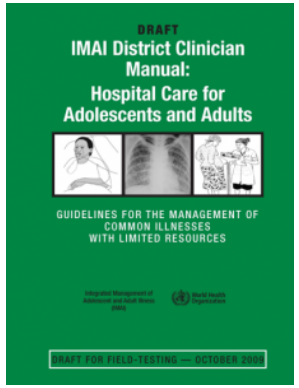
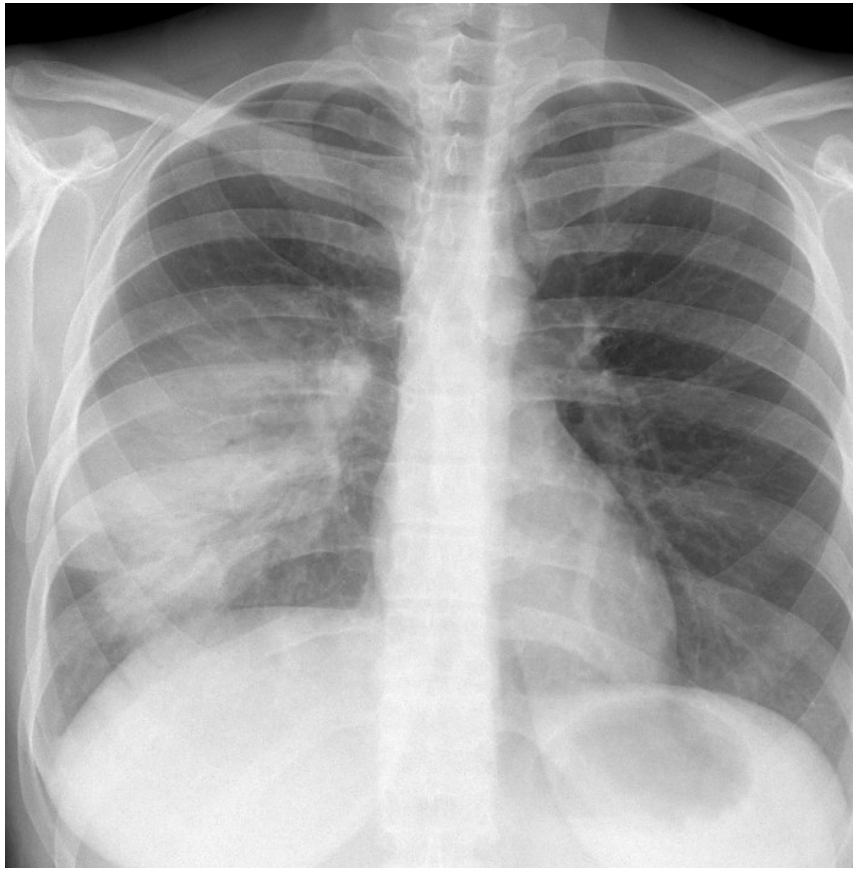
Recognize severe pneumonia



- Fever and cough
- RR > 30/min
- SpO_2 < 90% on room air
- Severe respiratory distress:
  - inability to speak
  - use of accessory muscles.



Courtesy of Dr. Harry Shulman at http://chestatlas.com/cover.htm

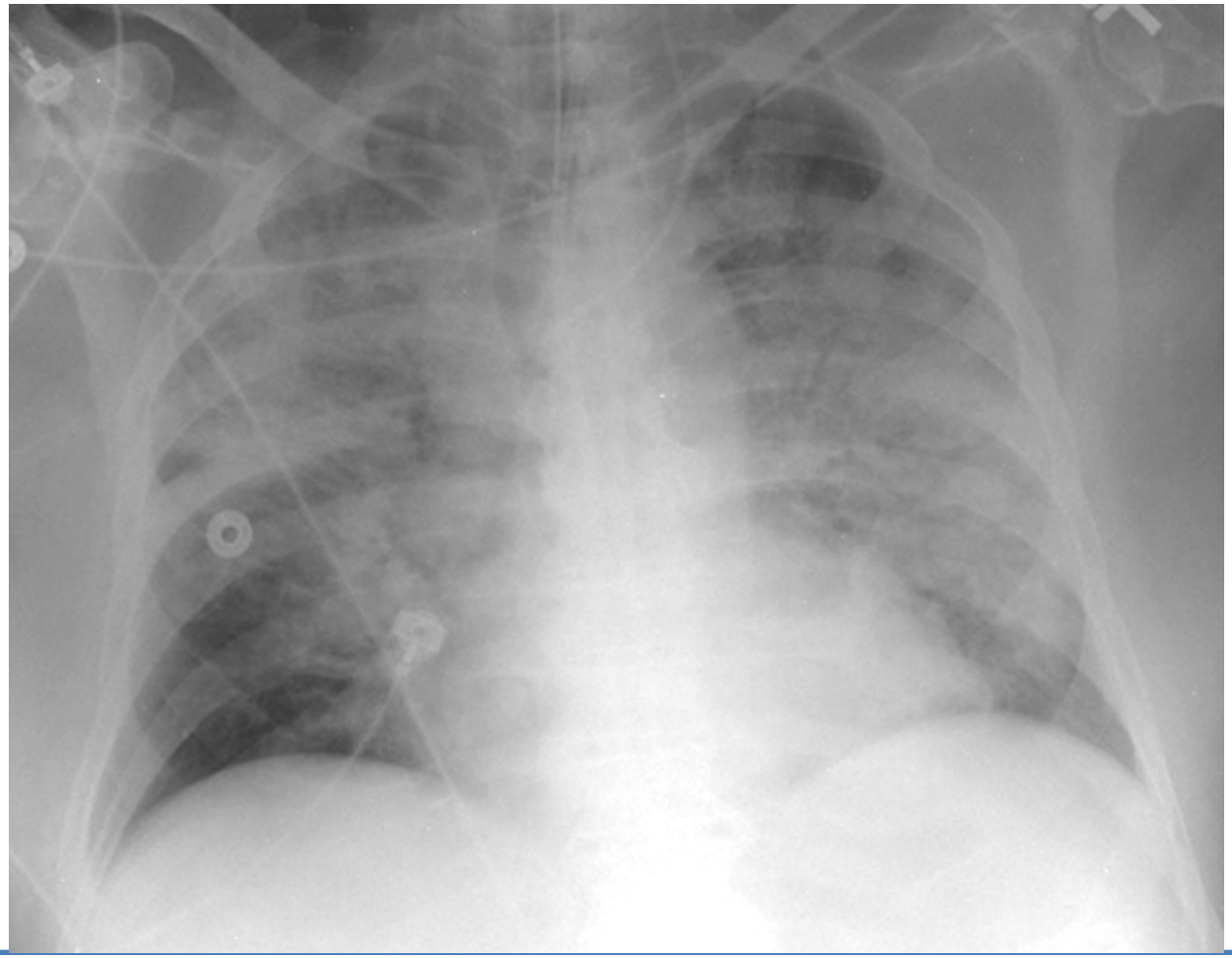
Pneumonia severity scores (1/2)

- **Severity scores can guide decision-making process regarding hospitalization and ICU admission:**
  - must be used alongside clinical judgement
  - validate scoring system in your setting.
- **For example, the CURB-65 score includes:**
  - Confusion
  - Urea > 7 mmol/L
  - RR ≥ 30 breaths/min
  - Blood pressure (SBP < 90 mmHg or DBP ≤ 60 mmHg)
  - Age > 65.

Pneumonia severity scores (2/2)

- **Higher score is associated with higher risk of death:**
  - score 0–1, low risk of death
    - may be suitable for treatment at home, always take into account the patient's social circumstances and wishes
  - score 2, moderate risk of death,
    - consider for short stay hospitalization or close outpatient treatment
  - score ≥ 3, high risk of death
    - 4–5 consider for ICU hospitalization.

Acute respiratory distress syndrome (ARDS)



Courtesy Dr. WR Webb/UCSF

ARDS

A	ACUTE
R	RESPIRATORY
D	DISTRESS
S	SYNDROME

Acute respiratory distress syndrome (ARDS)

- In adults, ARDS accounts for 10.4 % ICU admissions; 23% of patients on mechanical ventilation. Mortality ranges between 35–46% (Lung Safe, JAMA, 2016). **O**lder age, active neoplasm, haematologic neoplasm, chronic liver failure, and more severe disease associated with higher mortality.

- ARDS is less common in children, but incidence increases with age. Mortality ranges between18–35%. Concern for under-recognition may lead to underestimation of prevalence (Rota et al. Rev Bras Ter Intensiva. 2015;27(3):266–273).

Recognize patients with ARDS (1/2)

- Rapid progression of severe respiratory distress:
  - severe shortness of breath
  - inability to complete full sentences
  - tachypnoea
  - use of accessory muscles of respiration
  - cyanosis (very severe).

Recognize patients with ARDS (2/2)

- Severe hypoxaemia requiring high-flow oxygen therapy:

 - **SpO_2/FiO_2 ≤ 315 or**  **SpO_2/FiO_2 ≤ 264.**

- Early recognition and implementation of lung protective ventilation saves lives.

ARDS: four clinical criteria (1/3)

Berlin definition, JAMA 2012

1. Acute onset
   - ≤1 week of **known insult** or new or worsening respiratory status.

2. Origin of oedema:
   - Respiratory failure not fully explained by cardiac failure or fluid overload.
   - Need objective assessment (e.g. echocardiography) to exclude hydrostatic cause of oedema if no risk factor present.

ARDS: four clinical criteria (2/3)

Berlin definition, JAMA 2012

3. Severity of oxygenation impairment (if ABG available)

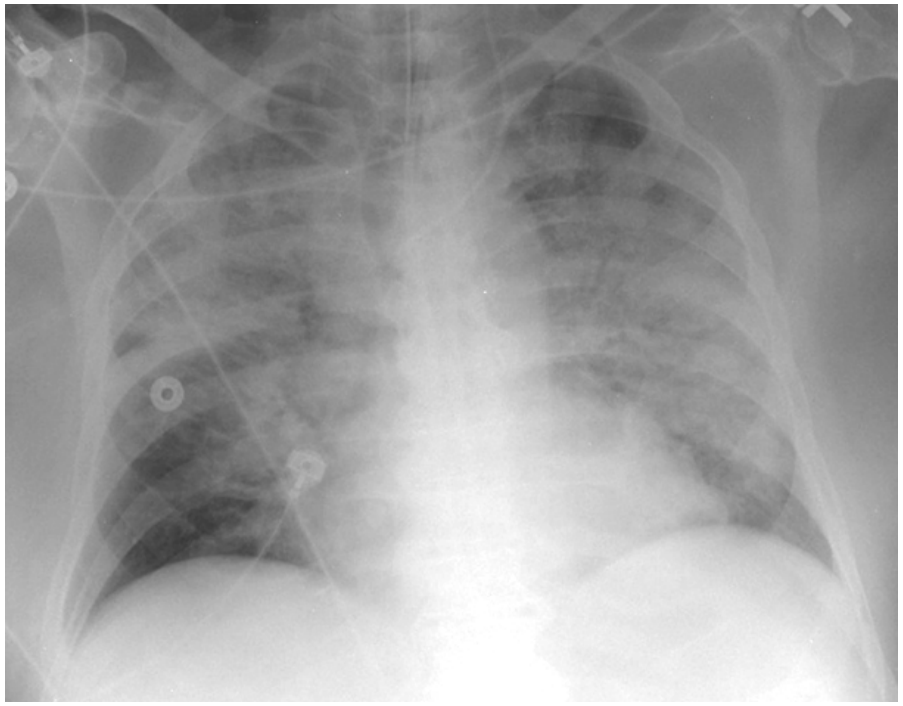
Disease severity	PaO_2/FiO_2	PEEP
Mild ARDS	200 < x ≤ **300**	≥ 5 cm H_2O (or CPAP)
Moderate ARDS	100 < x ≤ 200	≥ 5 cm H_2O
Severe ARDS	x ≤ 100	≥ 5 cm H_2O

*If altitude is higher than 1000 m, then correction factor should be calculated as follows: PaO_2/FiO_2 x barometric pressure/760 mmHg.

ARDS: four clinical criteria

Berlin definition, JAMA 2012

4. Bilateral opacities, not fully explained by effusions, lobar/lung collapse or nodules on chest x-ray or CT.



Courtesy Dr. WR Webb/UCSF

Figure 1 – X-ray computed tomography of the thorax showing diffuse, patchy bilateral ground glass opacities and consolidation at ICU admission.

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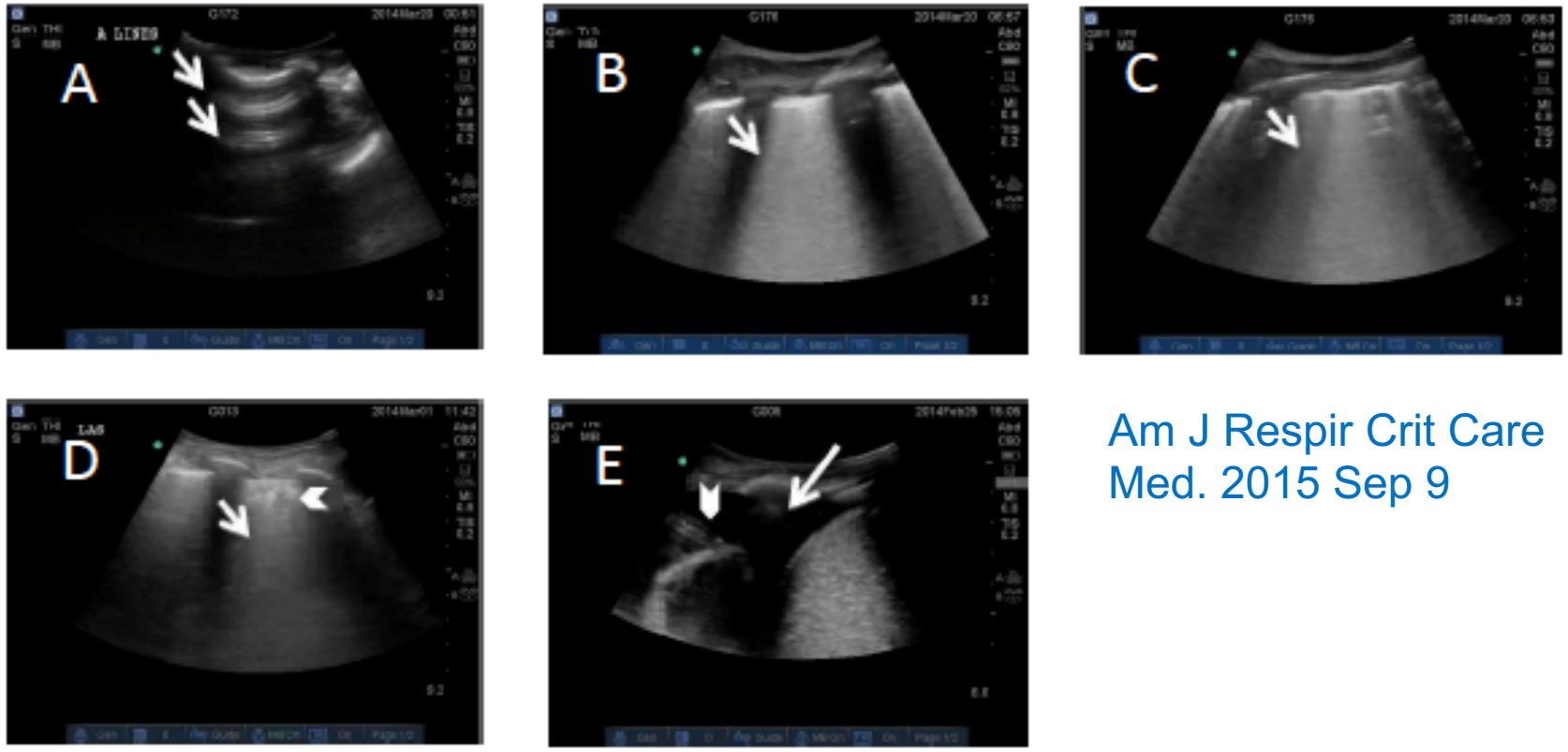
ARDS in resource-limited settings

- **Kigali-modification of Berlin criteria clinical**

Challenge	Adaptation
No arterial blood gas analyser to assess degree of hypoxaemia	$SpO_2/FiO_2 \leq 315$ is ARDS
No mechanical ventilation	Remove PEEP and CPAP from definition
No chest radiograph or CT scan	Use ultrasound to document bilateral chest opacities



Am J Respir Crit Care Med. 2015 Sep 9

Figure E1. Example ultrasound findings from our study patients. A) demonstrates repeating horizontal "A lines" (arrows), an artifact of normal lung parenchyma. B) and C) are examples of "B lines" indicating alveolar-interstitial filling (arrows). D) shows a consolidation, with tissue density (arrow) and punctiform lesions indicating air bronchograms (arrow head). E) demonstrates a pleural effusion (arrow) with floating consolidated lung (arrow head). We did not include these latter cases as consolidations since the lung compression could be due solely to effusion.

ARDS defined as B-lines and/or consolidations present without effusions on both sides.

ARDS in infants and children (1/2)

- International consensus statement suggests alternate definition for infants and children.

Challenge	Adaptation
Arterial blood gas analysis less commonly used in children	SpO_2 is acceptable alternative to PaO_2 $PaO_2/FiO_2 \leq 300$ or $SpO_2/FiO_2 \leq 264$

ARDS in infants and children (2/2)

Disease severity	OSI (oxygen saturation index)	Oxygen index (OI)
Mild ARDS	$5 \leq x < 7.5$	$4 \leq x < 8$
Moderate ARDS	$7.5 \leq x < 12.3$	$8 \leq x < 16$
Severe ARDS	≥ 12.3	≥ 16

OSI = FiO_2 X (mean airway pressure X 100)/SpO_2

OI = FiO_2 X (mean airway pressure X 100)/PaO_2

Mean airway pressure = $\frac{(Ti \times PIP) + (Te \times PEEP)}{Tt}$

Reminder: always consider other causes of diffuse alveolar infiltrates

- Acute heart failure.
- Other acute pneumonias (not primary infection):
  - e.g. acute interstitial pneumonia, hypersensitivity pneumonitis, cryptogenic organizing pneumonia, eosinophilic pneumonia.
- Diffuse alveolar haemorrhage:
  - e.g. associated with autoimmune diseases.
- Malignancy:
  - e.g. bronchoalveolar cell carcinoma.

SEPSIS

Suspected or documented infection

And acute, life-threatening organ dysfunction

Caused by dysregulated host response to infection.

Sepsis

- Sepsis and septic shock are medical emergencies. Treatment and resuscitation should begin immediately (Surviving Sepsis Campaign, 2016).
- Global estimate: 20 million cases of hospital-treated sepsis leading to 20 million deaths annually (Lancet 2020)*.

World Health Organization

*Kempker J, Martin S. A global accounting of sepsis
Lancet 2020:295(10219);168-170

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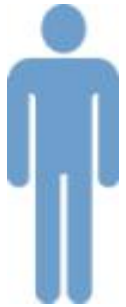
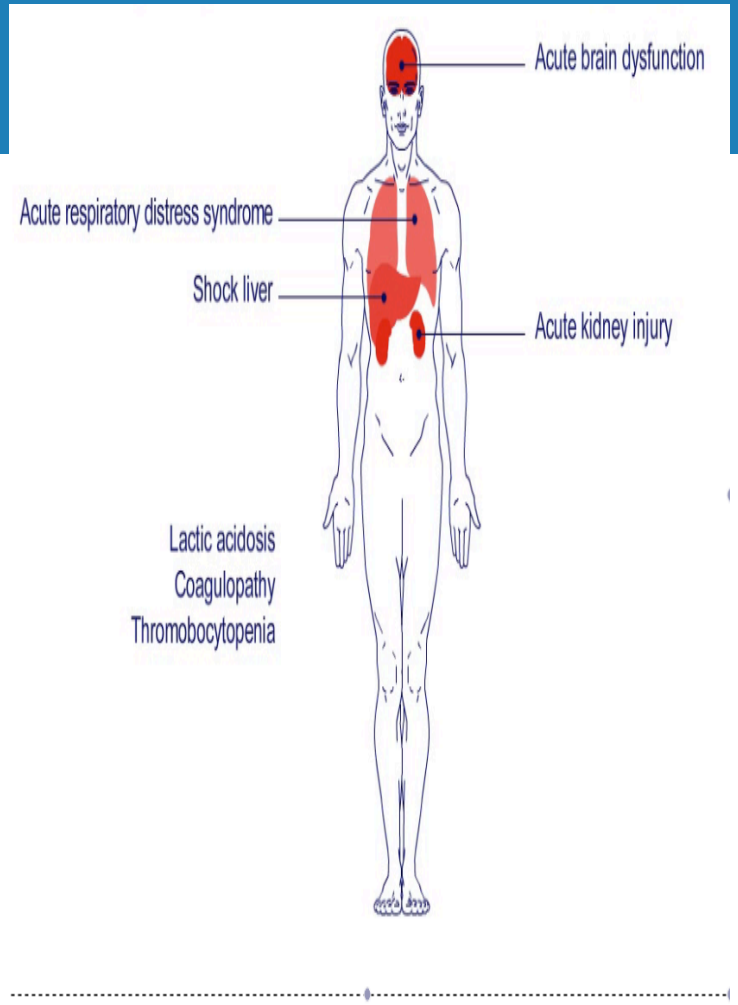
SEPSIS-3: consensus (JAMA, 2016)

- **Current definition of sepsis:**
  - suspected or documented infection
  - And acute, life-threatening organ dysfunction
  - caused by dysregulated host response to infection.





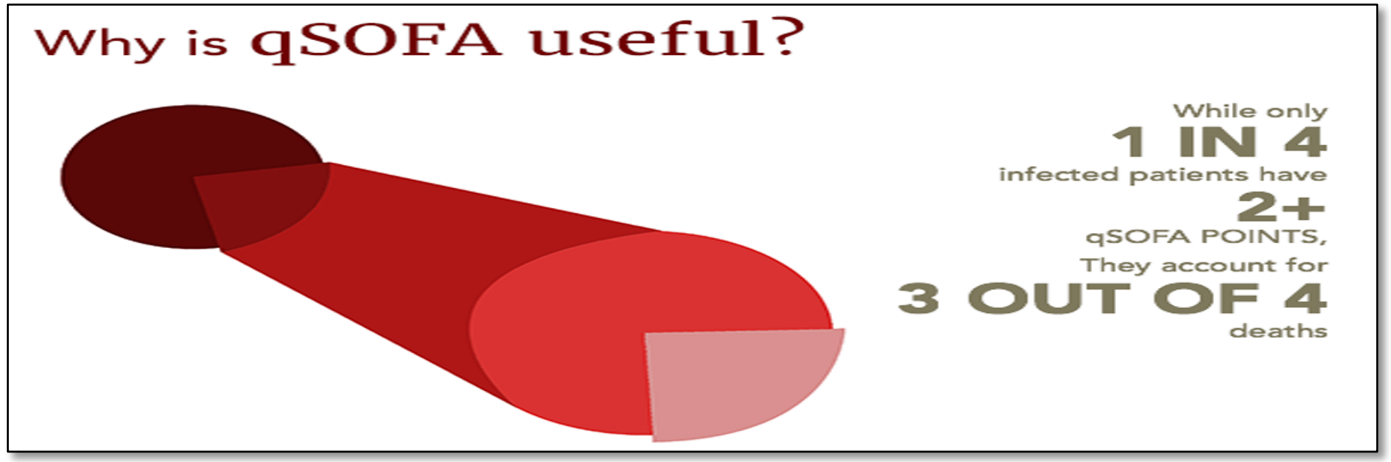
- Brain
  - confusion, lethargy, coma
- Lungs
  - hypoxemia, acute respiratory distress syndrome
- Cardiovascular
  - hypotension, hypoperfusion, shock
- Kidney
  - oliguria, elevated creatinine, acute kidney injury
- Liver
  - transaminitis, elevated bilirubin
- Gastrointestinal
  - ileus
- Hematologic
  - coagulopathy, thrombocytopenia
- Lactic acidosis

Sepsis-3 and SOFA score calculation

	SOFA Score				
Variables	0	1	2	3	4
Respiratory PaO_2/FIO_2, mmHg	> 400	≤ 400	≤ 300	≤ 200†	≤ 100†
Coagulation Platelets X $10^3/\mu L$‡	>150	≤ 150	≤ 100	≤ 50	≤ 20
Liver Bilirubin, mg/dL‡	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	> 12.0
Cardiovascular Hypotension	No hypotension	Mean arterial pressure < 70 mm Hg	Dop ≤ 5 or dob (any dose)	Dop >5, epi ≤ 0.1, or norepi ≤ 0.1§	Dop >15, epi >0.1, or norepi > 0.1§
Central nervous system Glasgow Coma Score Scale	15	13-14	10-12	6-9	< 6
Renal Creatinine, mg/dL Or urine output, mL/day	<1.2	1.2-1.9	2.0-3.4	3.5-4.9 or < 500	> 5.0 or < 200

Sepsis = acute change of ≥ 2 points in the SOFA from baseline (if available).

Sepsis-3 and qSOFA



www.jamasepsis.com
www.qsofa.org

In patient with suspected infection, the presence of ≥ 2 of the following associated with increase risk of death:

- **alteration in sensorium**
- **RR ≥ 22 breaths/min**
- **SBP ≤ 100 mmHg.**

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SEPSIS-3: consensus (JAMA, 2016)

- **Current definition of septic shock (subset of sepsis):**
  - circulatory, cellular and metabolic dysfunction associated with higher mortality
  - hypotension unresponsive to fluid challenge
  - requires vasopressors to maintain mean arterial pressure of 65 mmHg or greater
  - serum lactate > 2 mmol/L (when available).

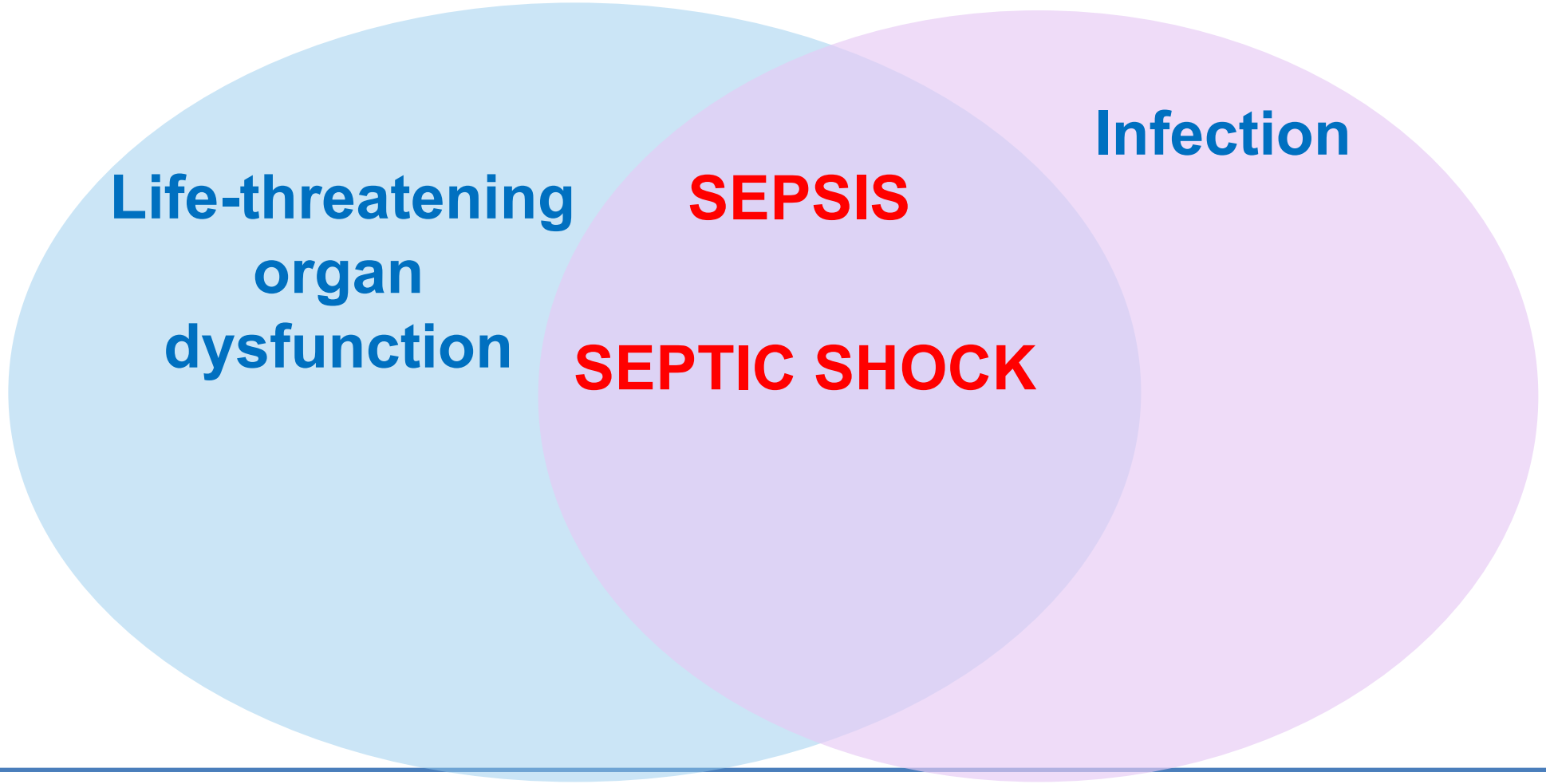
Clinical features of shock

- Hypotension:
  - SBP < 100 mmHg or MAP < 65 mmHg, or
  - SBP decrease of > 40 mmHg of baseline.

- Clinical signs of hypoperfusion:
  - altered sensorium
  - prolonged capillary refill
  - mottling of the skin
  - reduced urine output.

- Elevate serum lactate > 2 mmol/L.

A spectrum of disease
Sepsis → septic shock



Sepsis in children

- Many similarities with adults.
- Children with SARI also have sepsis.
- New consensus definitions more similar to adults coming in the near future.

Clinical features of shock in child

- Mental status alteration:
  - irritability, inappropriate crying, confusion, poor interactions
  - drowsiness, poor interaction, lethargy, or unarousable.
- Capillary refill abnormalities:
  - prolonged capillary refill
  - flash capillary refill.
- Abnormal peripheral pulses:
  - weak distal pulses
  - widened pulse pressure (bounding pulses).
- Cool or mottled extremities
- Hypotension (late finding in children)

Shock definition WHO ETAT 2016

- The presence of all three clinical criteria required to diagnose shock:
  - delayed capillary refill > 3 sec, **and**
  - cold extremities, **and**
  - weak and fast pulse.
  - or, frank hypotension (age-related SBP or MAP).

Age	< 1 month	1–12 months	1–12 years	> 12 years
SBP	< 50	< 70	70 + (2 × age)	< 90

Shock definition PALS 2015 (1/2)

- Fluid-unresponsive hypotension (age-related SBP or MAP)

Age	< 1 month	1–12 months	1–12 years	> 12 years
SBP	< 50	< 70	70 + (2 × age)	< 90

- Need for vasopressor
- Delayed capillary refill
- Core to peripheral temperature gap > 3 ^{o}C.

Shock definition PALS 2015 (2/2)

- Oliguria (< 1 mL/kg/hr).

- High lactate (uncommon finding in children and can also be seen in other causes of shock).

Not all criteria need to be present to diagnose shock when using the PALS criteria.

Sepsis and mortality

- Higher mortality associated with increased severity.
- Higher mortality in settings with resource limitations.
- In children, recent study in PICUs suggest an 8% prevalence and mortality of 25%, similar to adults.

Reminder: always consider simultaneous cause of shock

- Cardiogenic
  - impaired cardiac contractility (e.g. myocardial ischemia).
- Haemorrhagic
  - massive blood loss (e.g. gastrointestinal bleed, trauma).
- Hypovolaemic
  - severe diarrheal illness (e.g. cholera).
- Neurogenic
  - acute spinal cord injury (e.g. trauma).
- Obstructive
  - cardiac tamponade, massive pulmonary embolism.
- Endocrine
  - adrenal insufficiency (e.g. disseminated TB).

If clinical examination is unclear about cause of shock, then obtain further hemodynamic assessment (i.e. cardiac ultrasound) to guide therapy.

Summary

- Early identification of patients with SARI with sepsis allows implementation of early evidence-based therapies and saves lives.
- Suspect severe pneumonia when patient has clinical pneumonia **and** a rapid RR, signs of respiratory distress, or low SpO_2 < 90%.
- Suspect ARDS when patient has rapid progression of severe respiratory distress, severe hypoxaemia and bilateral chest opacities.
- Suspect sepsis when patient has infection **and** life-threatening organ dysfunction.
- Suspect septic shock when patient has signs of tissue hypoperfusion or shock refractory to fluid challenge.

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Contributors

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Dr Neill Adhikari, Sunnybrook Health Sciences Centre, Toronto, Canada

Dr Janet V Diaz, WHO Consultant, San Francisco, USA

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