# HRV – Relevant Conditions

Group 31

Imperial College London

# Topics Covered

## COPD

- Introduction and brief summary
- Significant physiological parameters
- Importance of ECG and $PaCO_2$
- Available technologies for remote monitoring

## Sepsis

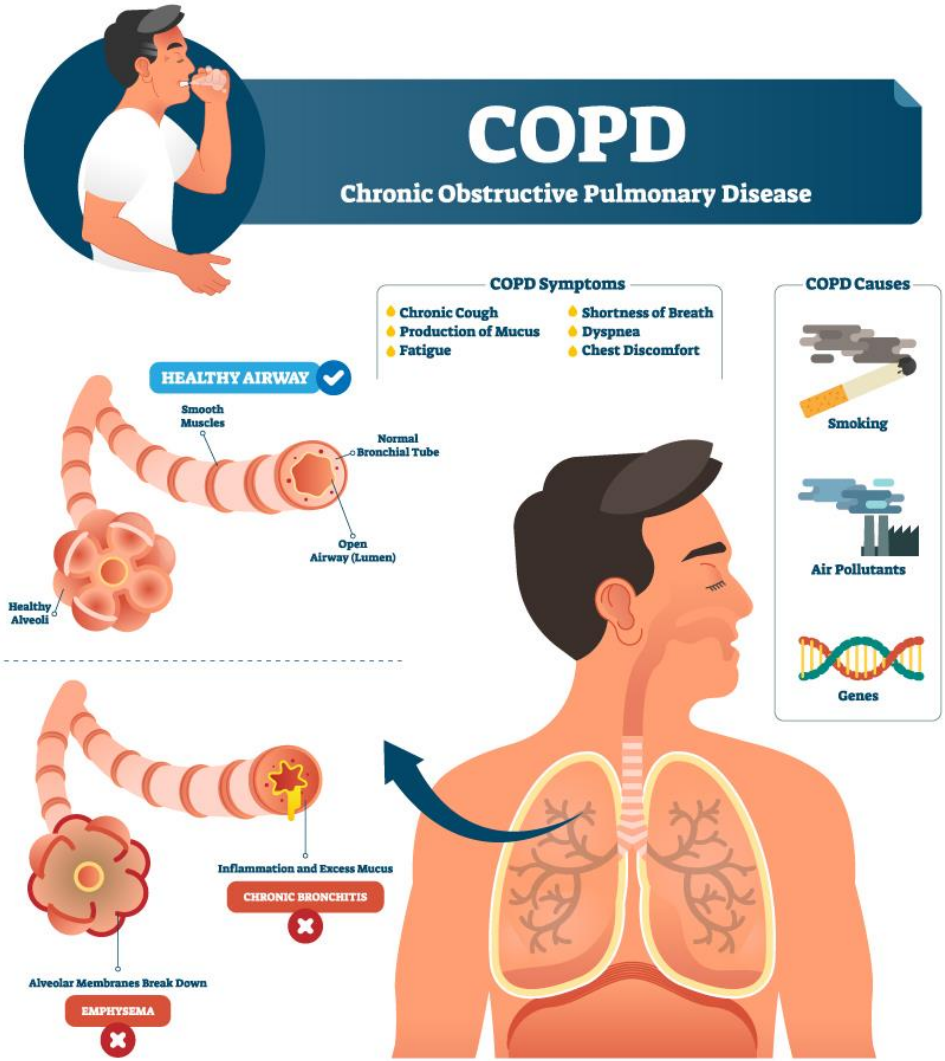
- Introduction and brief summary
- Parameters monitored
- Invasive vs. non-invasive monitoring

# COPD

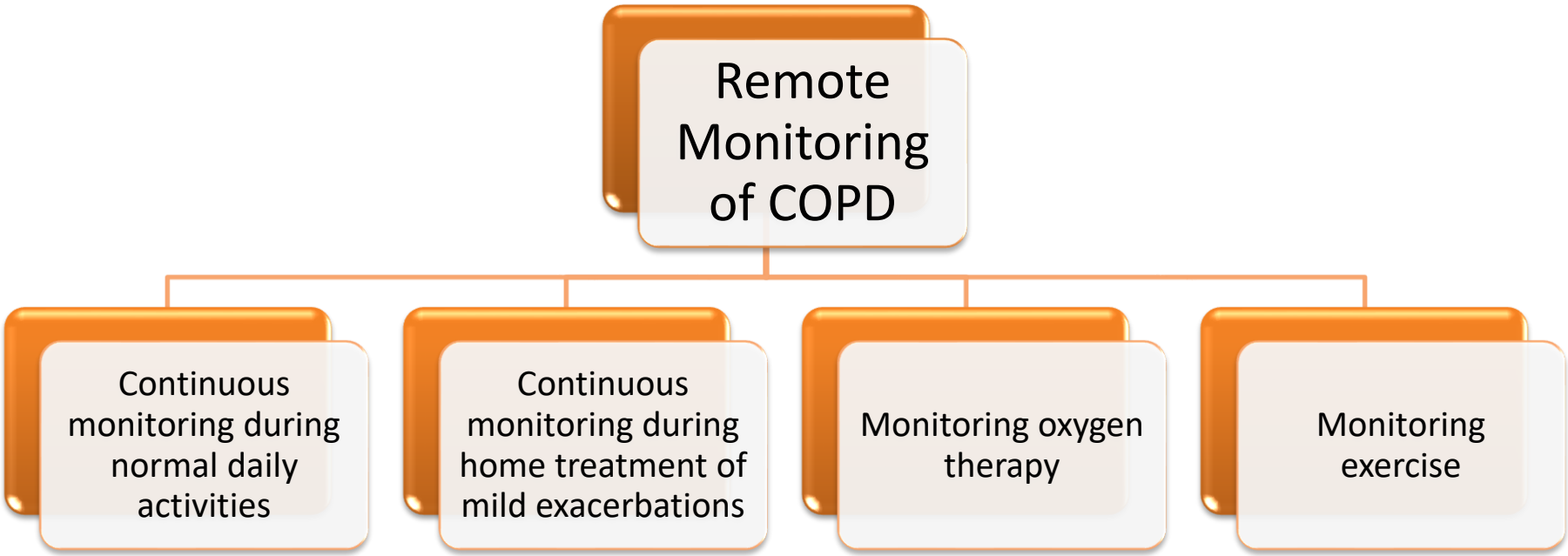
- Chronic Obstructive Pulmonary Disease
- 4th most frequent cause of death worldwide
- No definitive cure
- Characterized by ***V/Q mismatch***

Large airways, bronchioles and lung tissue affected → Increased release of enzyme elastase → Destroyed alveolar walls decrease gas exchange SA → Air trapping in the lung → Impaired regional ventilation causes a V/Q mismatch

# COPD


COPD
Chronic Obstructive Pulmonary Disease
COPD Symptoms
Chronic Cough
Production of Mucus
Fatigue
Shortness of Breath
Dyspnea
Chest Discomfort
COPD Causes
Smoking
Air Pollutants
Genes
HEALTHY AIRWAY
Smooth Muscles
Normal Bronchial Tube
Open Airway (Lumen)
Healthy Alveoli
Inflammation and Excess Mucus
CHRONIC BRONCHITIS
Alveolar Membranes Break Down
EMPHYSEMA

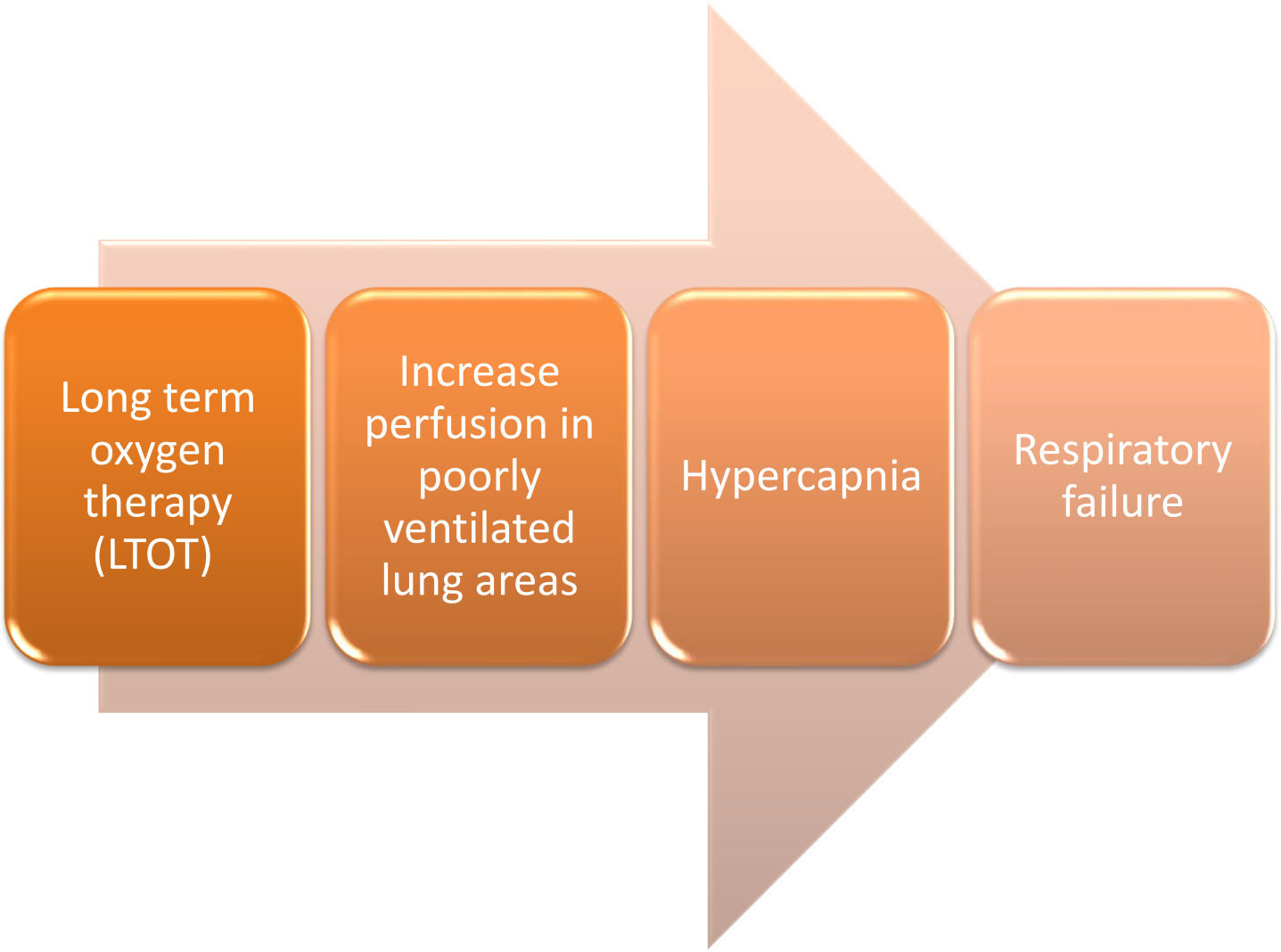
# Remote monitoring COPD



# Significant Physiological Parameters

1. **PaCO2**
2. PaO2
3. **ECG**
4. Spirometry
5. Respiration rate
6. Body temperature
7. Blood pressure
8. Weight

# Why monitor PaCO2?



# How to monitor $PaCO_2$?


**Problem:**

- Gold standard: ABG
  - Invasive, painful, time-consuming and discrete
- $PaO_2$ can be derived from by pulse oximetry
- In contrast, $PaCO_2$ measured from $PetCO_2$
- BUT this is not a reliable estimate for COPD patients!

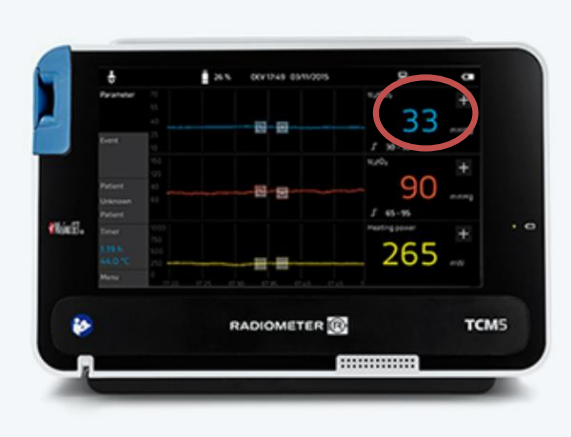
**Solution:**

- Transcutaneous monitoring ($PtcCO_2$)
  - Painless, noninvasive, continuous, minimal disturbance, self-manageable
  - Expensive (device usually shared among patients)
  - 2-min lag for changes in $PaCO_2$ to be seen in $PtcCO_2$

# Existing Devices & Technologies

SenTec monitor


TCM5 FLEX

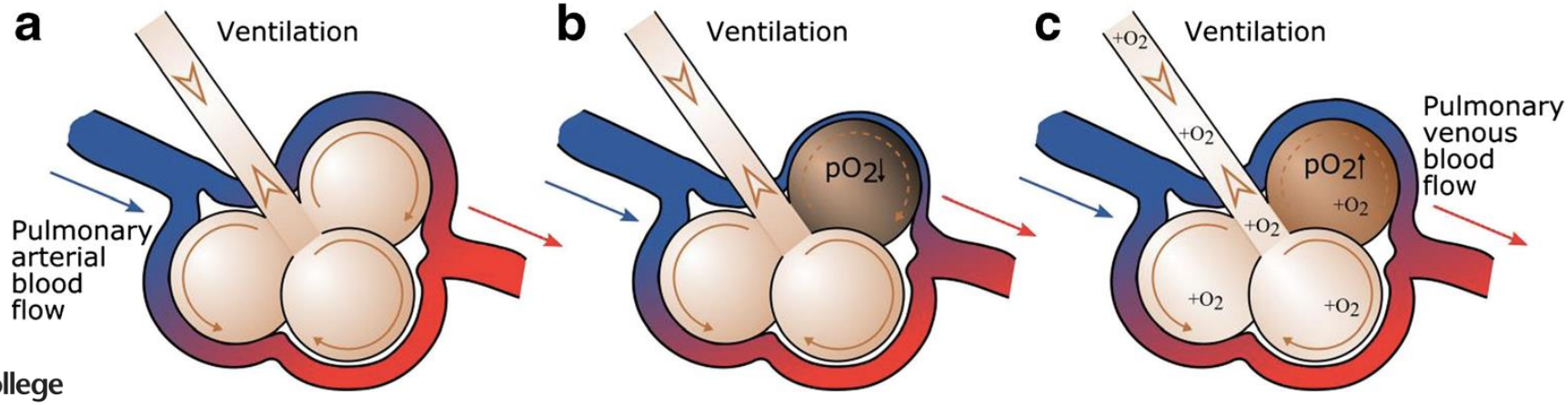



V-Sign™

OxiVenT™

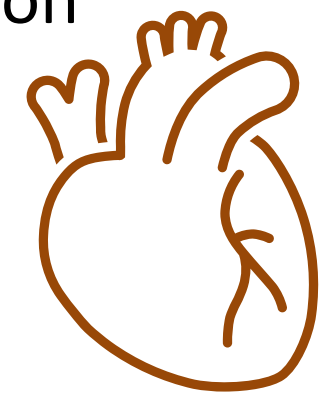
# COPD and Related Cardiac Diseases

- Cardiac failure is the main cause of death for COPD patients
- Arrhythmias and cardiac arrest (observe HR)
- Hypertension, coronary artery disease, breakdown of pulmonary capillaries
- Hypoxemia results in hypoxic pulmonary vasoconstriction



# Why monitor ECG?

- Cardiovascular diseases – *most frequent comorbidity* with COPD
- ECG changes can help identify these various cardiovascular diseases
- Provides HR and RR intervals
- Some medications like corticosteroids cause hypertension



# ECG Changes

- P wave axis farther right than +75 degrees
- Right ventricular hypertrophy
- Late R wave progression in precordial leads
- Low voltage
- Abnormal Q waves in the inferior or anterior leads
- Acute right bundle branch block
- Changes in corrected QT interval
- Due to: Tachycardia, arrhythmias, AF

# Example: Multifocal Atrial Tachycardia

- Rapid irregular rhythm > 100bpm
- At least 3 distinct P wave morphologies
- Associated with *increased mortality in COPD patients*

# Patch ECG (PECG)

**Benefits:**

- Small and wireless
- functions even during sleep and taking a shower
- Sends life-threatening events and alarms to clinicians
- Useful for remote monitoring
- Can obtain HR, heart rate corrected QT interval and estimate RR

**Problems:**

- Only 1 lead
- Approximated RR interval is less accurate for elderly
- High cumulative consumer costs
- Data processing time varies depending on company

# Existing Devices & Technologies

Savvy ECG senzor

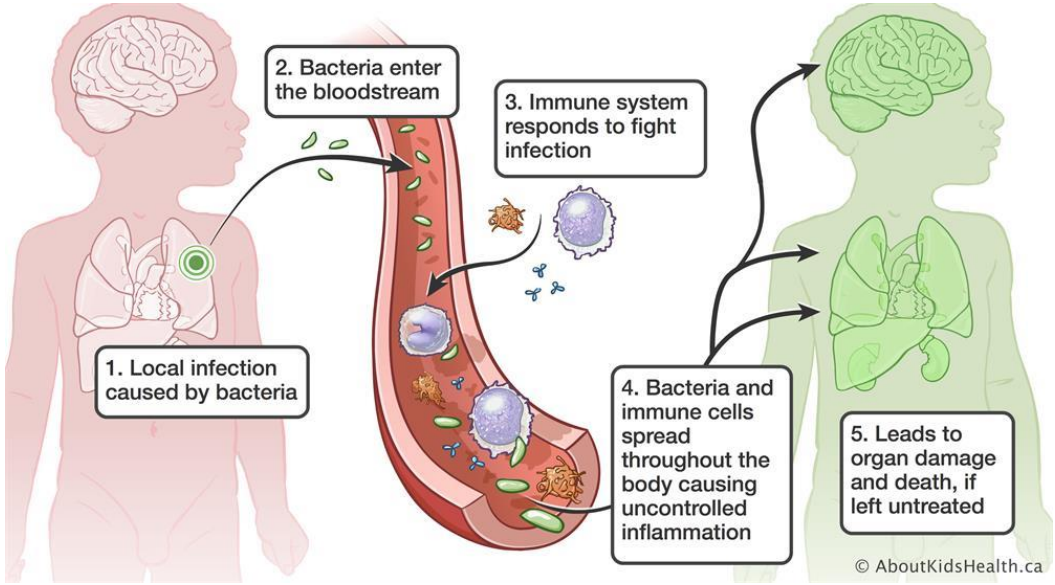

ZIO® XT Patch


SEEQ™ MCT patch device
by Medtronic, Inc.

# Sepsis

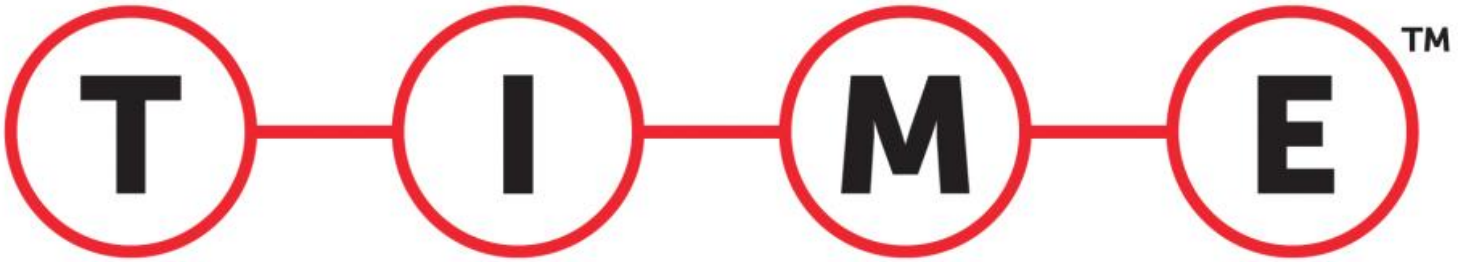
# Sepsis

- Chemical imbalance during immune response
- Infection of internal organ(s)
- More common in:
  - Pregnant women
  - Children and elderly
- Sepsis → severe sepsis → septic shock



# Recognising Sepsis

When it comes to sepsis, remember ***IT'S ABOUT TIME***™. Watch for:




**TEMPERATURE**
higher or lower than normal

**INFECTION**
may have signs and symptoms of an infection

**MENTAL DECLINE**
confused, sleepy, difficult to rouse

**EXTREMELY ILL**
severe pain, discomfort, shortness of breath

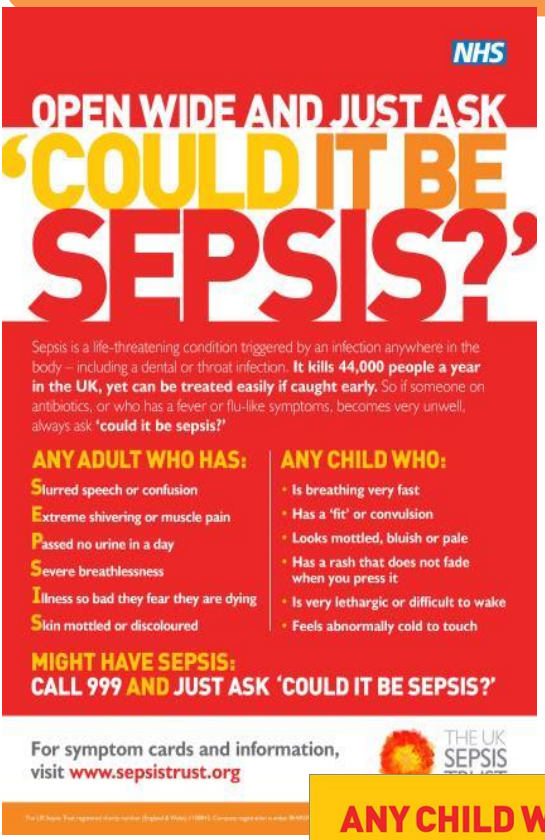
If you experience a combination of these symptoms: seek urgent medical care, call 911, or go to the hospital with an advocate. Ask: **"Could it be sepsis?"**



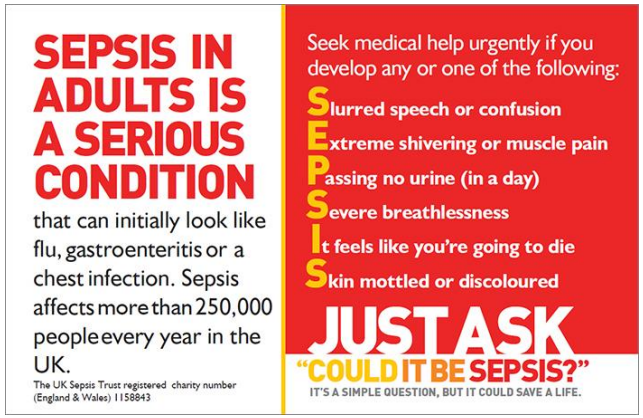
sepsis.org

SEPSIS ALLIANCE

# Recognising Sepsis











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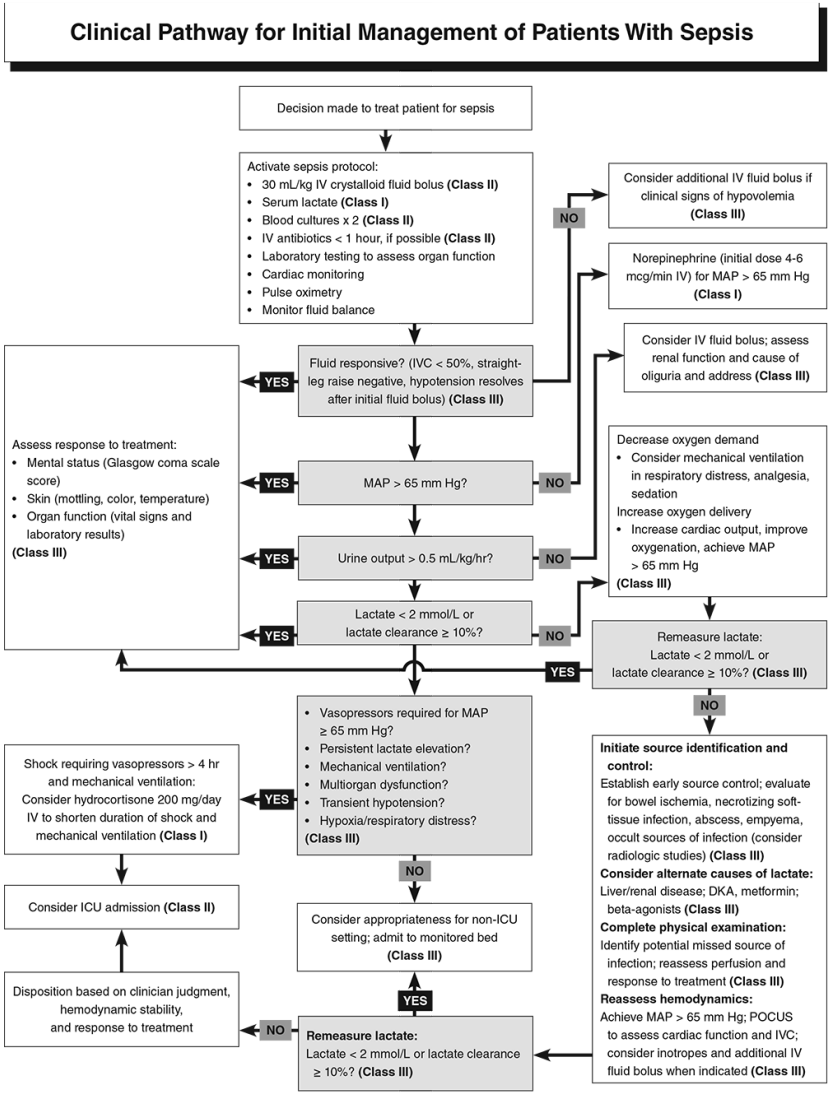
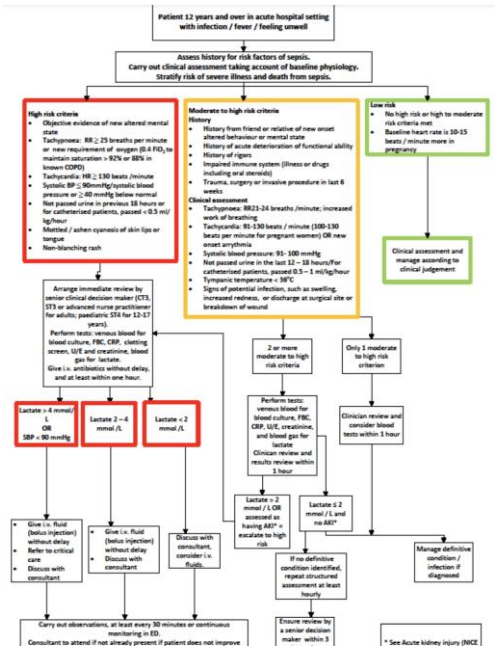
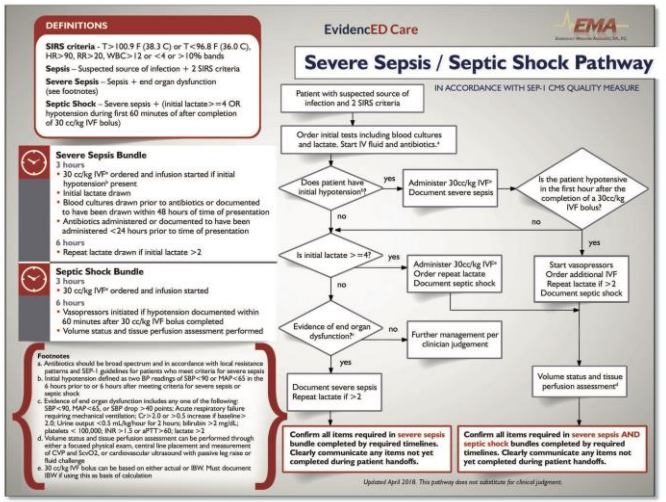
# Management of Sepsis




Abbreviations: DKA, diabetic ketoacidosis; ICU, intensive care unit; IV, intravenous; IVC, inferior vena cava; MAP, mean arterial pressure; POCUS, point-

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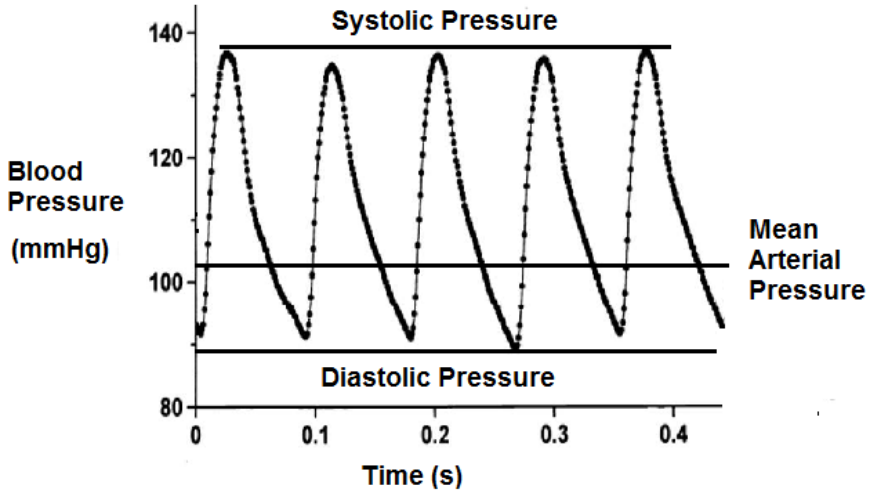
# Significant Physiological Parameters

- Lactate: >2mmol/L
- ECG: HR, BP
- SpO2, RR: >25 breaths/min
- **MAP:** >65 mmHg
- Urine output: none in >18h



# MAP Monitoring: Invasive

- Arterial cannula and saline tubing: conduction to transducer

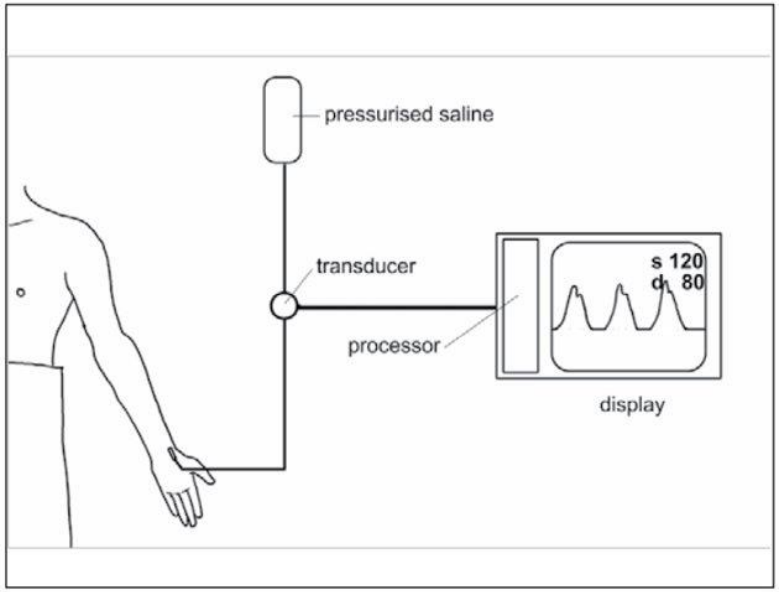



**Figure 1.** *Components of an arterial monitoring system.*

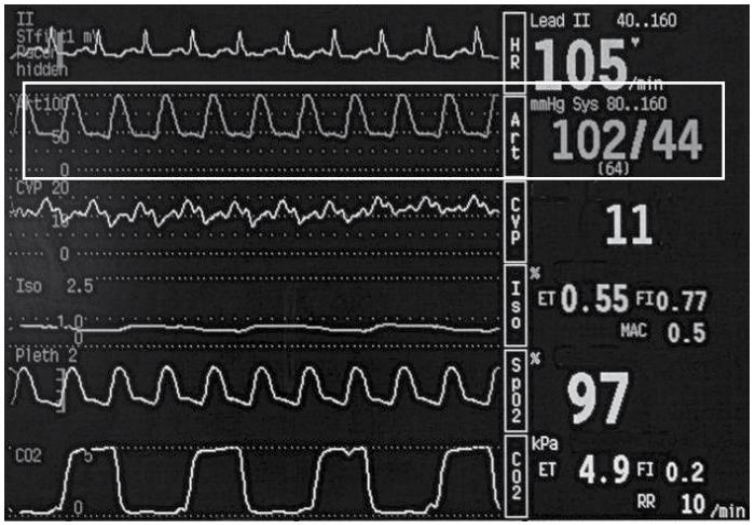



**Figure 2.** *Invasive blood pressure monitoring (boxed). The waveforms are usually colour coded (red for the arterial trace) and the monitor displays the systolic/diastolic BP, with the mean arterial BP in brackets below.*

# MAP Monitoring: Non-Invasive




- Comfort vs efficiency/accuracy – trade-off
- MAP= DP + 1/3(SP – DP) = DP + 1/3(PP)

# Questions