SARI CLINICAL CARE TRAINING

MONITORING PATIENT WITH SARI

World Health Organization

HEALTH EMERGENCIES programme

Learning objectives

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

- Describe the importance of monitoring:
  - for early recognition of deterioration
  - for monitoring response to treatments.
- Describe which clinical parameters to monitor and how often.
- Describe how to record parameters in an easily accessible and accurate patient recording system.
- Describe how to interpret and respond to abnormal or changing clinical parameters.

Monitoring does NOT replace a good history

- Gather timely historical information from patient and family members as this can greatly impact clinical management.
- Does patient have a high risk condition?
- Does patient have exposure risk for emerging respiratory viral infections (i.e. seasonal influenza, zoonotic influenza, MERS-CoV, **2019- nCoV**)?

COVID-19 acute respiratory disease

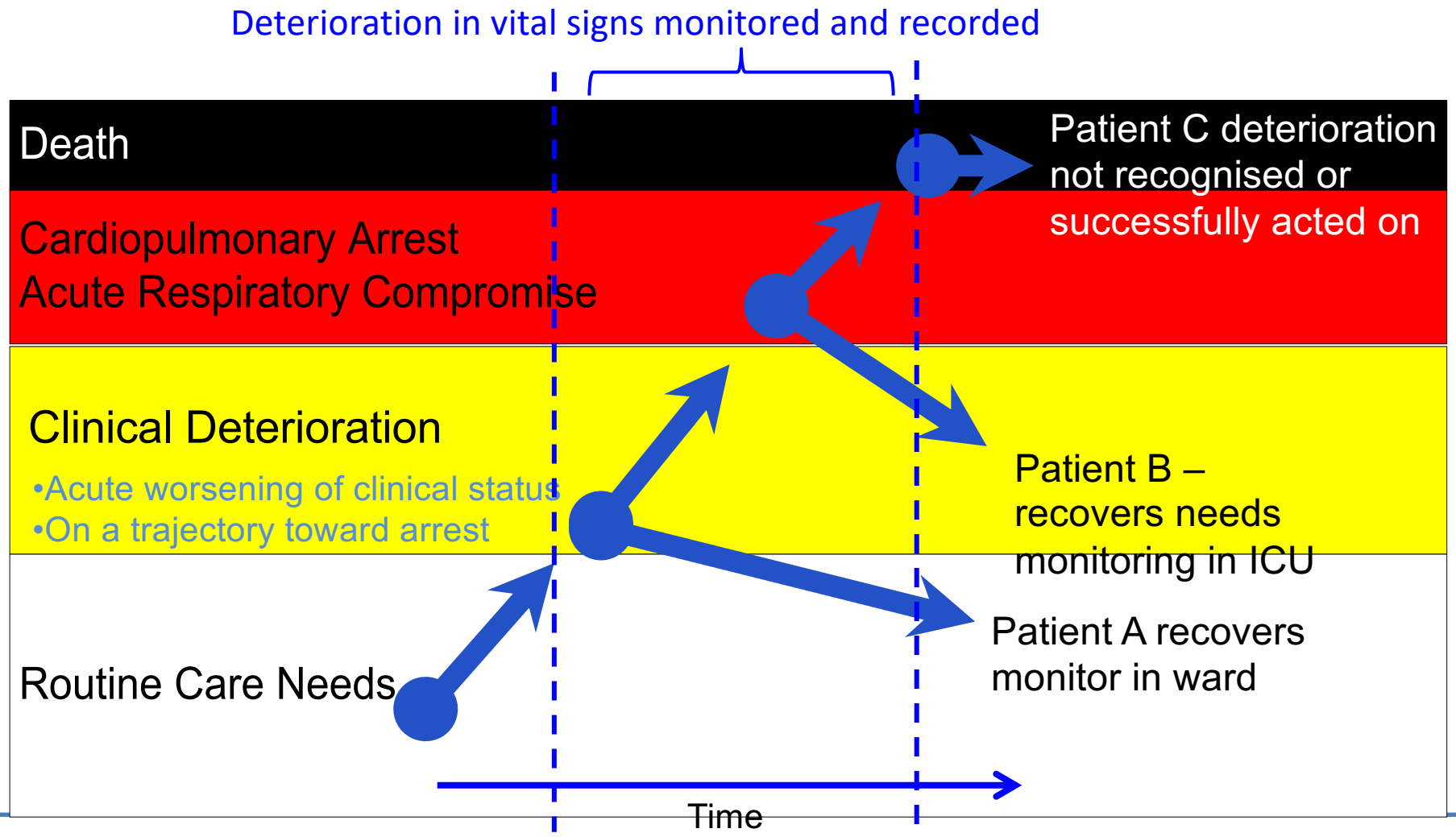
- Most cases have been reported to have mild illness.
- However, progression to severe disease has been reported, including severe pneumonia and respiratory failure.
- Most deaths have been in patients with with co-morbid conditions and advanced age.
- **Monitoring for clinical deterioration is essential when caring for patients with SARI, including those with COVID-19.**

Rationale for monitoring

- Patients with SARI can present with critical illness or become critically ill during the hospitalization.

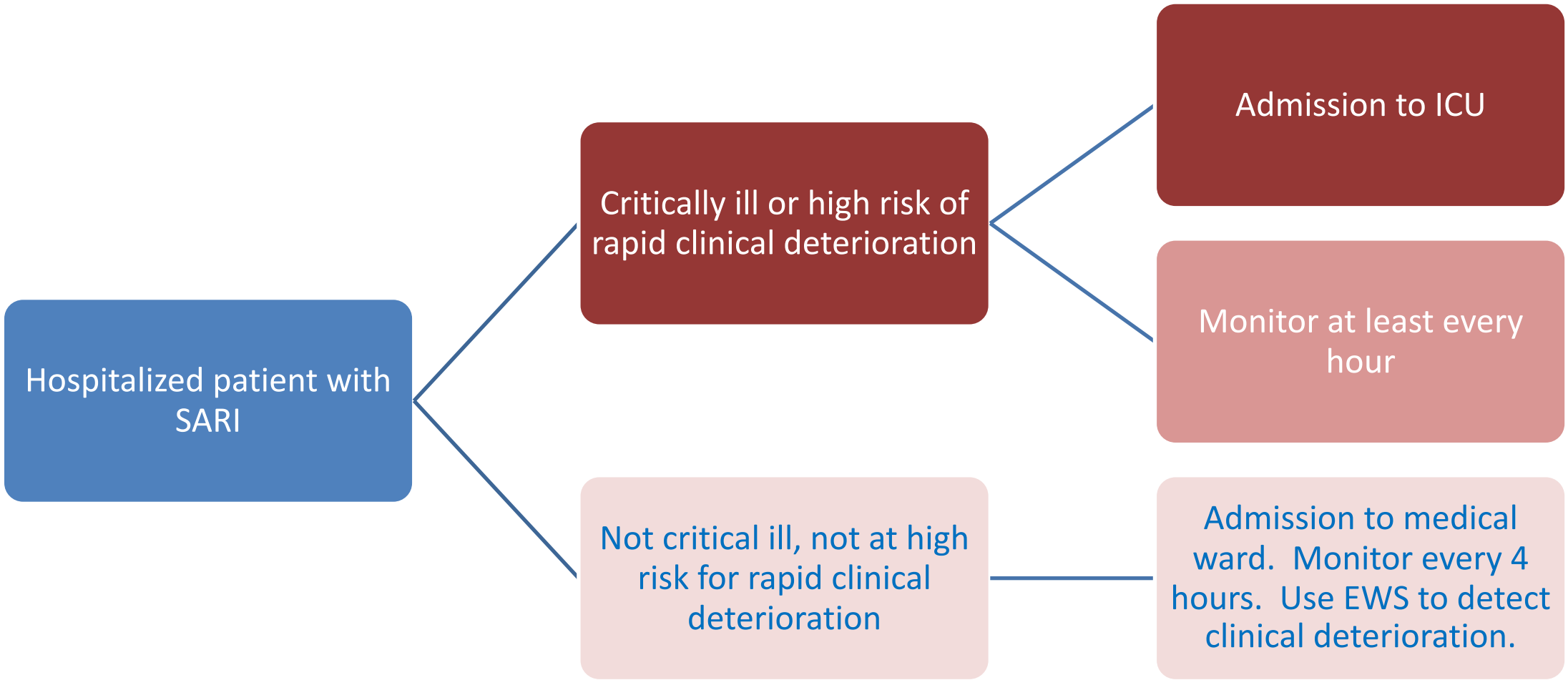
- Monitoring allows early detection of deterioration to trigger a response:
  - early senior clinician to review.
  - more frequent monitoring.
  - timely administration of life saving treatments.
  - titration of ongoing treatments to clinical condition.
  - transfer to higher levels of care (if not already in ICU).

Unrecognized clinical deterioration can lead to death



Adapted from: Duncan H, Hutchison J, Parshuram CS. The Pediatric Early Warning System score: a severity of illness score to predict urgent medical need in hospitalized children. J Crit Care. 2006;21(3):271-278.

Admission: medical ward vs ICU



Caring for the SARI patient on the ward

- If patient with ARI is not critically ill, admission to ward is reasonable:
  - monitor as per clinical status (every 4–6 hours):SBP, temp, RR, SpO_2, HR, consciousness.

- Ward staff should be able to:
  - recognize clinical deterioration
  - be empowered to call for senior help early.

✧ Patient does not need interventions available in the ICU.

Early recognition of clinical deterioration

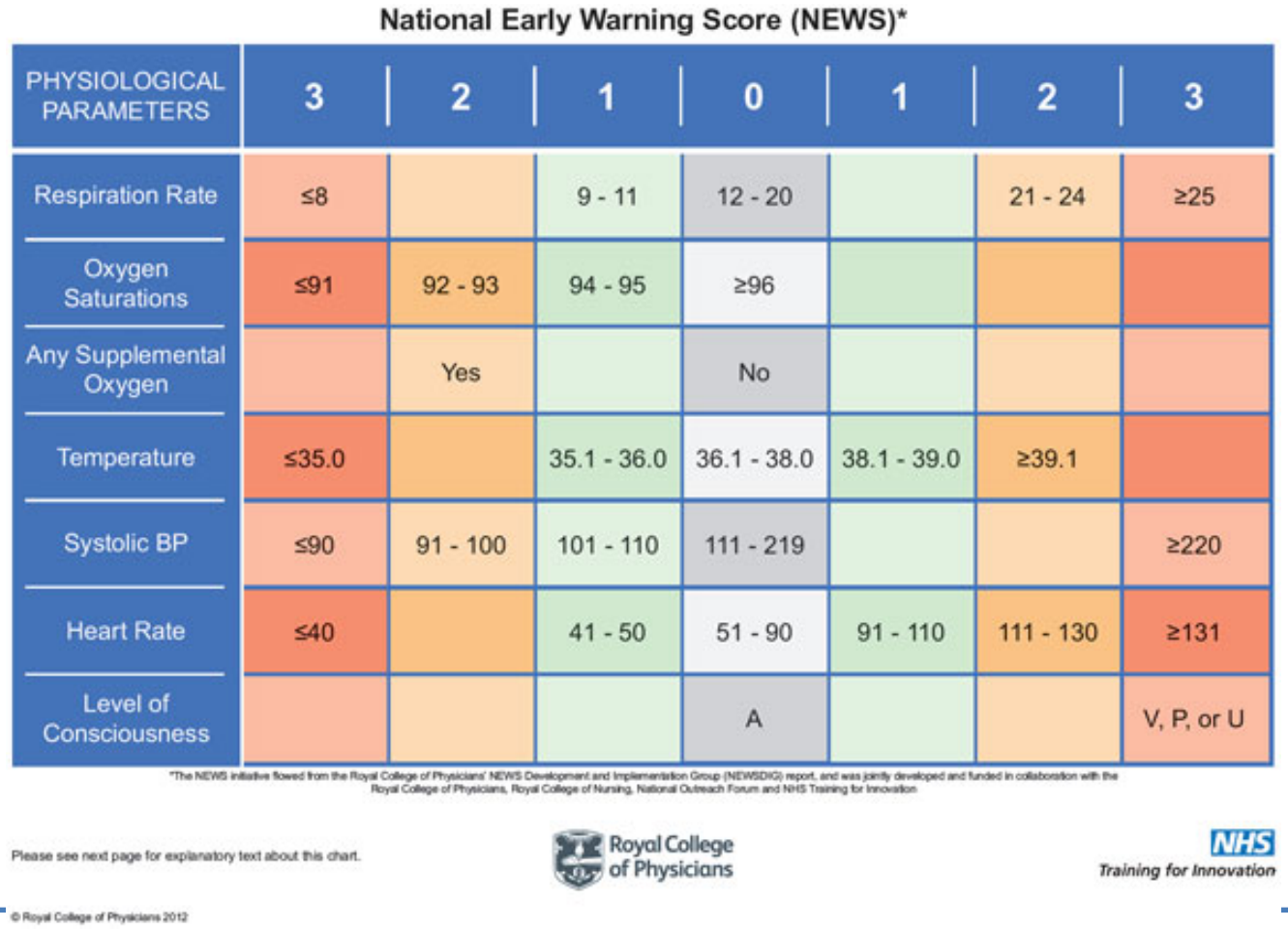
- Allow for prompt initiation of critical treatments and transfer to ICU (if needed) leading to improved outcomes.

- Early warning scoring systems (EWS) may help may facilitate earlier recognition:
  - used as a visual aid and in training
  - should be calibrated for the population (age, case mix)
  - paediatric scores are also available.

- Refer to local policies on ICU admission criteria.

Example: National Early Warning Score(NEWS) (UK)

- Used in the hospital or pre-hospital setting.
- Calculated score based on six physiologic variables and oxygen use.
- Validated in non-pregnant adults only.



National Early Warning Score (NEWS)*

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220
Heart Rate	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Level of Consciousness				A			V, P, or U

*The NEWS initiative flowed from the Royal College of Physicians' NEWS Development and Implementation Group (NEWSDIG) report, and was jointly developed and funded in collaboration with the Royal College of Physicians, Royal College of Nursing, National Outreach Forum and NHS Training for Innovation

Please see next page for explanatory text about this chart.

Royal College of Physicians

NHS Training for Innovation

NEW scores	Clinical risk
0 Aggregate 1 – 4	Low
RED score* (Individual parameter scoring 3) Aggregate 5 – 6	Medium
Aggregate 7 or more	High

- Higher NEWS score predicts mortality when used in the hospital and pre-hospital setting.
- High scores serve to TRIGGER immediate clinical team response.

Outline clinical response to NEWS triggers

NEWS SCORE	FREQUENCY OF MONITORING	CLINICAL RESPONSE
0	Minimum 12 hourly	• Continue routine NEWS monitoring with every set of observations
Total: 1-4	Minimum 4-6 hourly	• Inform registered nurse who must assess the patient; • Registered nurse to decide if increased frequency of monitoring and / or escalation of clinical care is required;
Total: 5 or more or 3 in one parameter	Increased frequency to a minimum of 1 hourly	• Registered nurse to urgently inform the medical team caring for the patient; • Urgent assessment by a clinician with core competencies to assess acutely ill patients; • Clinical care in an environment with monitoring facilities;
Total: 7 or more	Continuous monitoring of vital signs	• Registered nurse to **immediately** inform the medical team caring for the patient – this should be at least at Specialist Registrar level; • Emergency assessment by a clinical team with critical care competencies, which also includes a practitioner/s with advanced airway skills; • Consider transfer of Clinical care to a level 2 or 3 care facility, i.e. higher dependency or ITU;

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Considerations when using EWS in resource-limited settings

- Multiparameter EWS maybe difficult to implement in some settings due to staffing and equipment limitations and may need to be adapted locally:
  - i.e. use fewer parameters that can easily be measured, validate locally.

- EWS may also not be directly generalizable:
  - i.e. scoring/trigger level may need to be adapted

- If ICU beds are limited, a trigger can identify patients that need increased monitoring even if they remain on ward.

Monitoring patients in the ICU

- An ICU can provide the following benefits:
  - frequent monitoring (invasive or non-invasive)
  - timely and safe delivery of treatments
  - interventions and equipment only available in the ICU (i.e. oxygen, ventilation, vasopressors)
  - specialized nursing care and better nurse:patient ratio
  - specialized medical care
  - interdisciplinary team.

Monitor key physiologic parameters

- Respiratory rate (RR)
- SpO_2 (taking into account if oxygen is administered)
- Temperature (T)
- Heart rate (HR)
- Blood pressure (BP, MAP)
- Level of consciousness (AVPU)
- Urine output.

Monitor for clinical signs of instability

- Signs of respiratory distress:
  - accessory muscle use, fatigue
  - nasal flaring, grunting, retractions.
- Signs of cardiovascular instability:
  - change in mental status
  - delayed capillary refill
  - skin mottling
  - cool extremities
  - pulse differential.
- Signs of neurologic instability:
  - impaired level of consciousness, confusion, seizure.

Frequency of monitoring

- Monitor as often as necessary to direct resuscitative and intensive care interventions:
  - i.e. determined by trigger system, organ failure or clinician concern.

- During the early resuscitation phase, monitoring multiple parameters (not just one) is necessary to titrate interventions and guide actions.

- Frequency will depend on local resources, capacity and clinical experience.

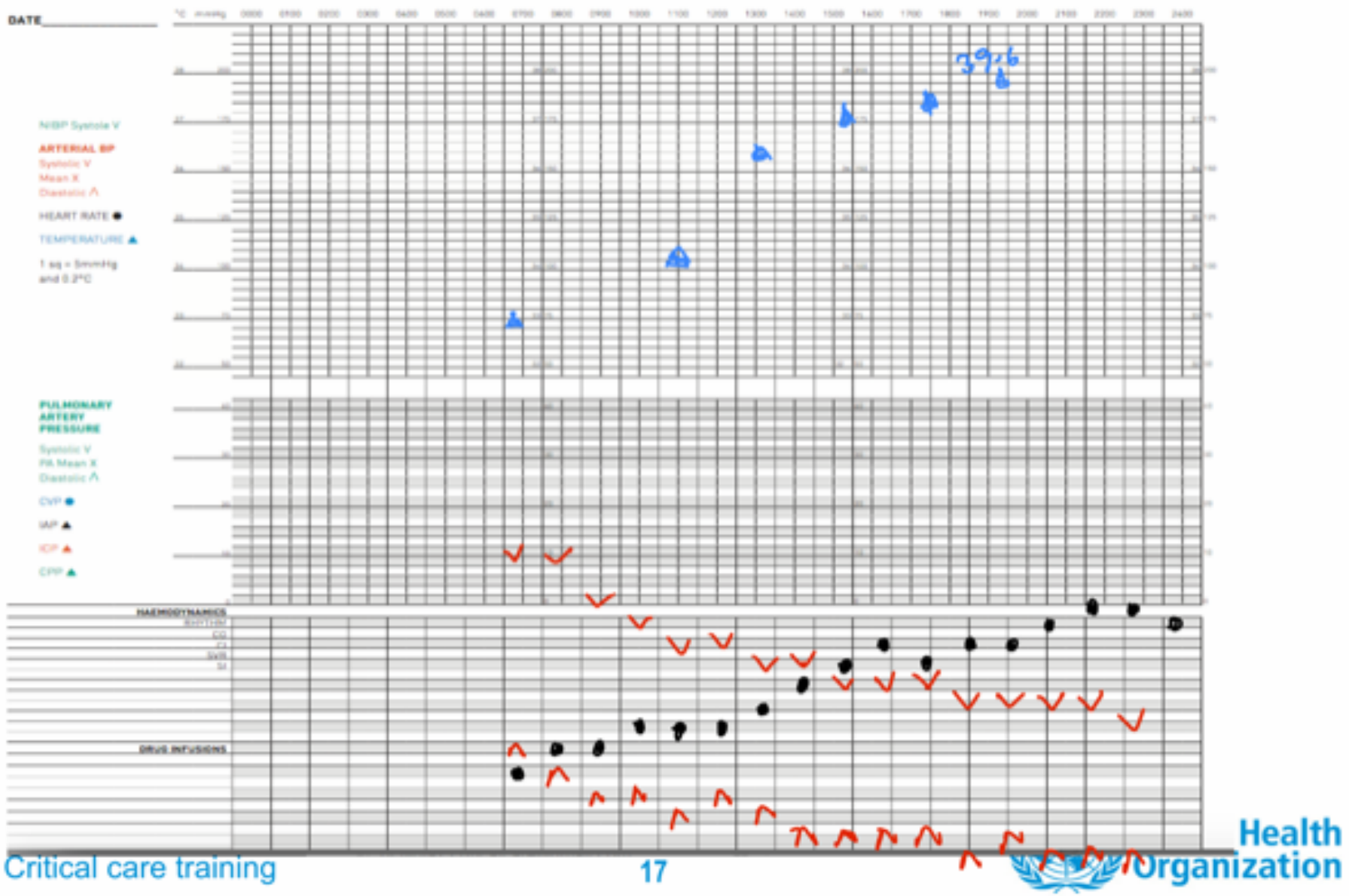
Monitor critically ill patients frequently (1/2)

RR, HR and SpO_2	**Measure continuously using a non-invasive monitor.**
BP (SBP, DBP, MAP)	Measure every 5–15 minutes during initial resuscitation of patients with shock. Once stabilized, can reduce to every 30–60 minutes. Consider invasive continuous monitor if refractory shock to fluids.
Mental status - AVPU	Monitor hourly. If patient is receiving sedation, analgesia or mechanical ventilation, monitor sedation and pain with standardized scales every hour (RASS, etc.).
Temperature	Measure at least every 3 hours.
Urine output	Measure hourly.
Physical examination	Focused examination of cardiovascular and respiratory system should be assessed every 30–60 minutes during the resuscitation phases of shock. Once patient is stabilized, can reduce to every 2–4 hours.

Monitor critically ill patients frequently (2/2)

Laboratory tests	**As often as needed when managing shock and metabolic abnormalities (i.e. CBC, creatinine, electrolytes, glucose, lactate). Avoid routine laboratory testing.**
Arterial blood gas analysis	On arrival to ICU and then on as needed basis when managing patient on ventilator or concern for hypecapnea or acidosis. If frequent consider arterial catheter.
Ventilator parameters (if patient on mechanical ventilation)	Every 2-4 hours. This includes: mode, expiratory tidal volume, respiratory rate (patient and machine), PEEP, FiO_2, I: E ratio, flow rate, compliance, plateau airway pressure, peak pressure, set inspiratory pressure (if using pressure control mode), or pressure support (if using spontaneous mode).
CVP	Per local training and practice.
Ultrasound	Per local training and practice.

Record clinical parameters in easy to read and interpret form



Interpret and respond (1/2)

- Make sure measurement is correct. Observations may be incomplete or inaccurate even in unwell patients.

- Observations should be interpreted in context of treatment:
  - patient with SpO_2 96% on oxygen at 15 L/min is critically ill (S/F < 100).

- Observations should be interpreted in context of patient reserve:
  - haemodynamic abnormalities coupled with respiratory distress suggest cardiopulmonary collapse is imminent.

Interpret and respond (2/2)

- Interpret and make assessment based on trends:
  - Is patient getting better?
  - Is patient getting worse?
  - Is patient the same?

- If patient is getting worse or the same, be systematic in your response:
  - Is measurement correct?
  - Is there a technical difficulty in delivering treatment?
  - Is the patient getting appropriate therapy?
  - Is there an alternate diagnosis?
  - Is the treatment causing harm?
  -

Monitoring modalities

- Monitoring modalities range in complexity:
  - widely available non-invasive techniques
  - invasive techniques require additional expertise, equipment and training.

- Choose modality that will optimize patient management and minimize risk
  - determined by patient's clinical condition and local resources.

Pulse oximetry (1/2)

- Pulse oximeters should be available in all settings caring for patients with SARI.

- SpO_2 reflects the oxygen saturation of Hb in the arterial blood:
  - most oxygen is bound to Hb in the blood for delivery to tissues
  - normal value is 98–100% (at sea level).

- Clinical signs are not reliable indicators of hypoxaemia.

Pulse oximetry (2/2)

Finger clip probes

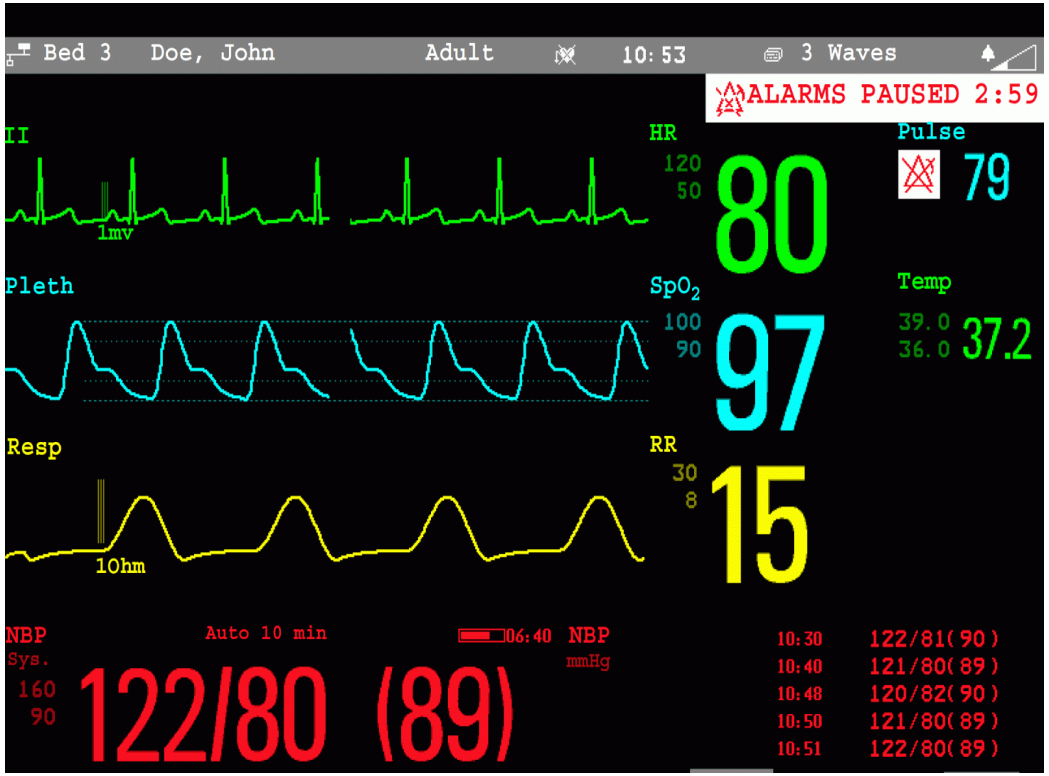
Ear probes

All pictures © WHO/S Mardel

Benefits	Limits
Accurate	Requires a pulsatile signal – challenging with motion or poor perfusion
Fast	Does not measure ventilation (pCO_2)
Easy to use	False readings can be seen with abnormal Hb or CO poisoning
	Remember to remove nail polish if present!

Continuous cardiac monitoring

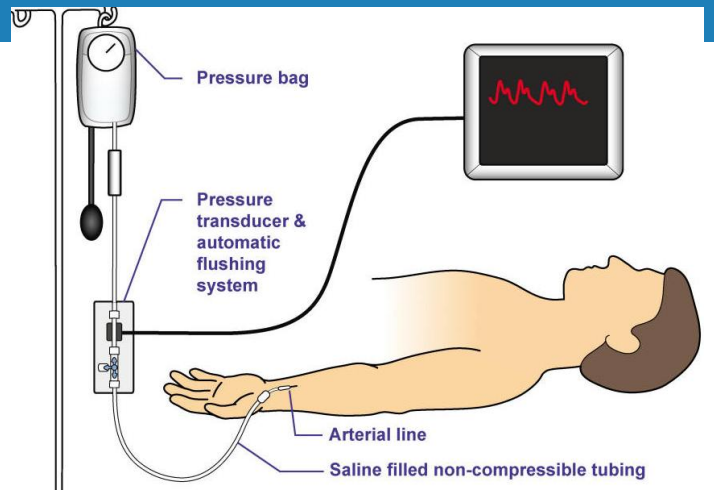
- Continuous monitoring preferred for critically ill patients:
  - especially when vasopressors are administered.
- Benefits: can interface with both non-invasive and invasive devices.
- Limits: need special equipment and materials.

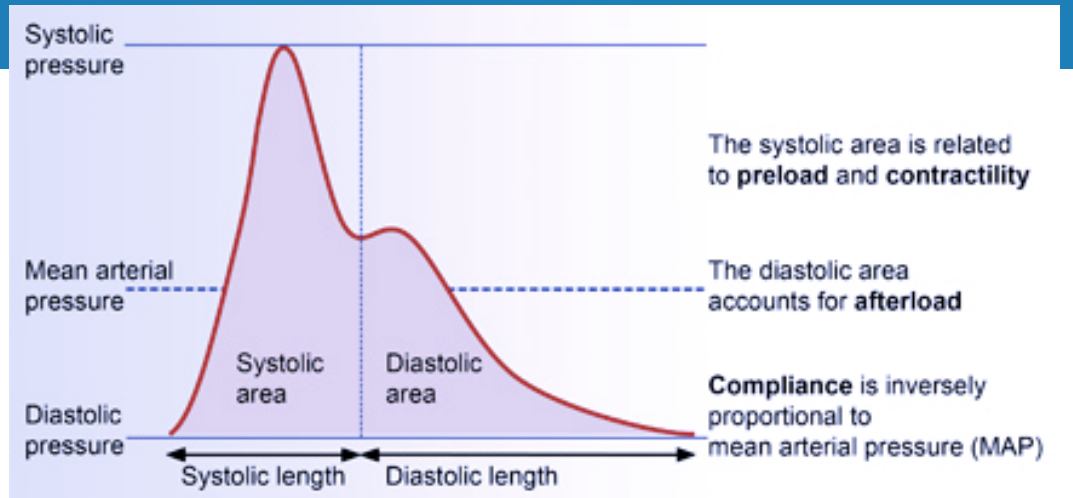


Non-invasive blood pressure monitoring

Benefits	Limitations and risks
Widely available	Inaccurate readings with inappropriate cuff size
Simple, little training needed	Technically difficult to obtain in shock states
Calculates MAP	Use appropriate cuff size for patient

Invasive blood pressure monitoring





MAP = 1/3 *SBP + 2/3*DBP

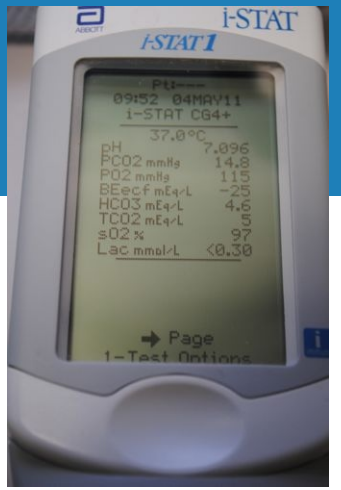
Benefits	Limitations and risks
Directly measures arterial pressure	Requires skilled clinician to insert
More accurate	Equipment (PPE, catheter, non-compressible tubing, pressure monitor)
More reproducible	Nursing care to prevent dislodgement
Continuous	Risks: infection, arterial thrombosis, bleeding

Arterial blood gas analysis (1/2)

- Arterial blood gas analysis (ABG) should be available in the ICU.

- Measure ABG in patients with:
  - severe hypoxaemia
  - risk of hypercapnea (e.g. COPD, depressed mental status)
  - risk of metabolic abnormalities (e.g. acidosis)
  - poor perfusion states making SpO_2 unreliable (e.g. shock)
  - deteriorating conditions
  - respiratory failure on invasive mechanical ventilation.

Arterial blood gas analysis, 2/2

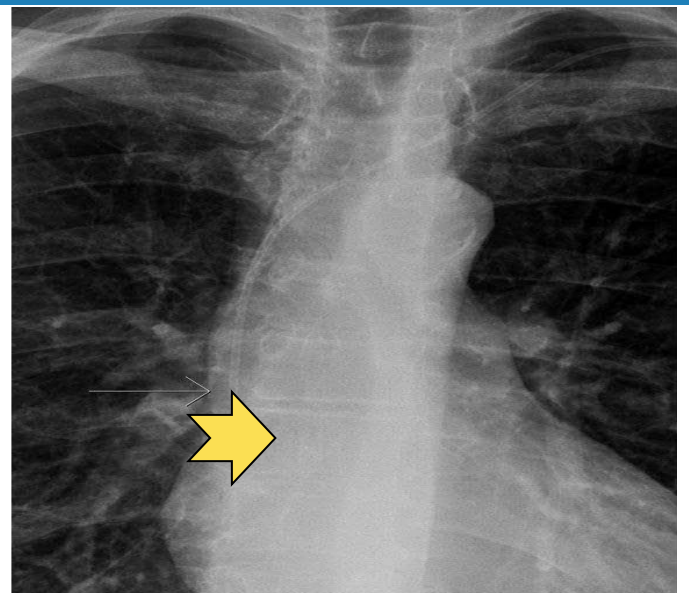


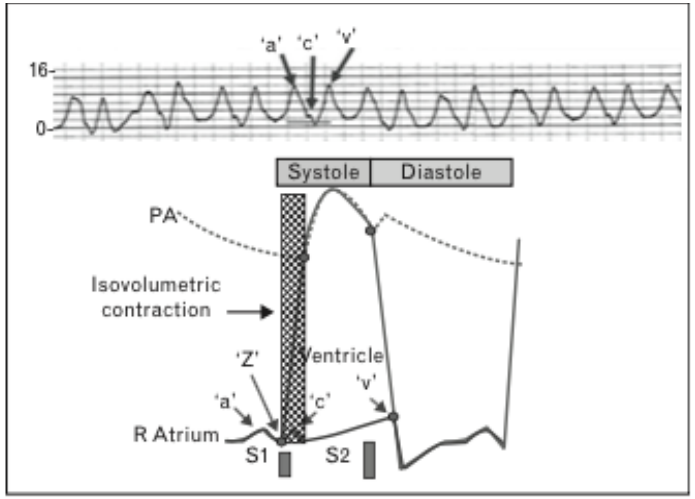
Benefits	Limits
Measures pH, $PaCO_2$, PaO_2 Informs about ventilation and acidosis May also be used to measure lactate, haemoglobin, potassium	Invasive arterial puncture Heparinized syringe Rapid transfer (on ice if > 20 minutes to lab) Blood gas analyser machine Carbon monoxide level not detected on all machines.

Blood gas analysis (i.e. ABG)

- In resource limited settings, ABG analysis may not be available or frequent measurements not possible.
  - Can consider use of end-tidal CO_2 in conjuction with SpO_2 and RR to make assessment, understanding the limitations.

Central venous pressure





- Central venous pressure (CVP) is commonly used to estimate pre-load of the right heart:
  - measure at the end of expiration to reflect transmural pressure (not volume)
  - normally is very low (2–4 cm H_2O).
- High and low values may be helpful to understand right ventricular function.
- Debate regarding CVP use in resuscitation exists.

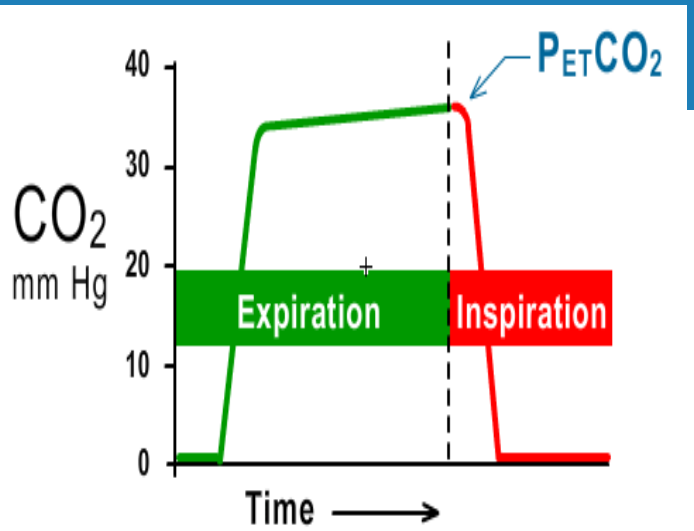
CVC and CVP

Benefits	Limitations and risks
Central venous catheter (CVC) allows safer delivery of vasopressors: •preferred over peripheral veins •recent clinical trials in septic shock found that nearly 50% of patients require CVC for vasopressor management. CVC when placed in the internal jugular or SCV allows monitoring of: $ScvO_2$, CVP.	CVC placement is invasive and carries risk •requires training, equipment (catheter kit), materials for sterile insertion and ultrasound (recommended when available) •**risks:** pneumothorax, arterial puncture, blood stream infection, thrombosis. CVP measurement is challenging: •measuring requires zeroing, levelling and standard procedures •varies with body position, intrathoracic pressure and structural heart disease. CVP interpretation is challenging •what does it mean?

Point of care ultrasound

Benefits	Limits
Ultrasound is becoming widely available in ICU around the world.	Requires financial investment to procure and maintain equipment.
Portable, easy to use devices that can give valuable information rapidly.	Requires training for intensivists to ensure accurate and reliable measurements.
Diagnostic and therapeutic uses: •cardiac-IVC, function, tamponade •pulmonary-effusion, pneumothorax, ARDS, oedema •procedures: central venous catheterization, paracentesis, thoracentesis.	Impact on clinical care will be determined if information gathered from ultrasound is used to make clinical decisions. Protocols and guidelines needed.

Capnography



- **Benefits:**

  measures end-tidal CO_2 tension in expired air from sampling gas in respiratory circuit:

  in normal lungs, $P_{ET}CO_2$ is about 3–5 mmHg less than $PaCO_2$

  confirms endotracheal intubation

  assess perfusion (during CPR).

- **Limits:**
  - inaccurate if there is no discernable plateau:
    - e.g. airflow obstruction.
  - underestimates $PaCO_2$ when there is decreased lung perfusion:
    - pulmonary emboli
    - hypotension
    - high PEEP
    - severe ARDS
    - emphysema.

Limitations of monitoring

- Failure to accurately assess, record, interpret and respond the clinical parameters at suitable intervals is frequent cause of harm:
  - Junior staff should be trained in recognizing patterns of clinical deterioration.
  - Staff must be empowered to call for help from senior clinicians.
  - Clinician must recognize and interpret trends and then use this information to optimize patient management.
- Failure to gather history:
  - Don’t forget to gather this information from patient and family members as this can greatly impact clinical management.

Summary

- Monitoring does not replace a good history. Ask about possible exposure to COVID-19.
- An early warning scoring system is a standardized tool that can be used in the hospital and pre-hospital settings to trigger early and appropriate clinical response to deteriorating patients.
- Critically ill patients are monitored frequently (sometimes continuously) because of their dynamic clinical condition and need for timely (and titrated) resuscitation and intensive interventions.
- Use of non-invasive versus invasive monitoring modalities should be based on clinical experience, local resources and risk-beneft analysis.
- When patients fail to respond to treatments or deteriorate, use a systematic approach to interpret data and modify the treatment plan in a timely manner.

Acknowledgements

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