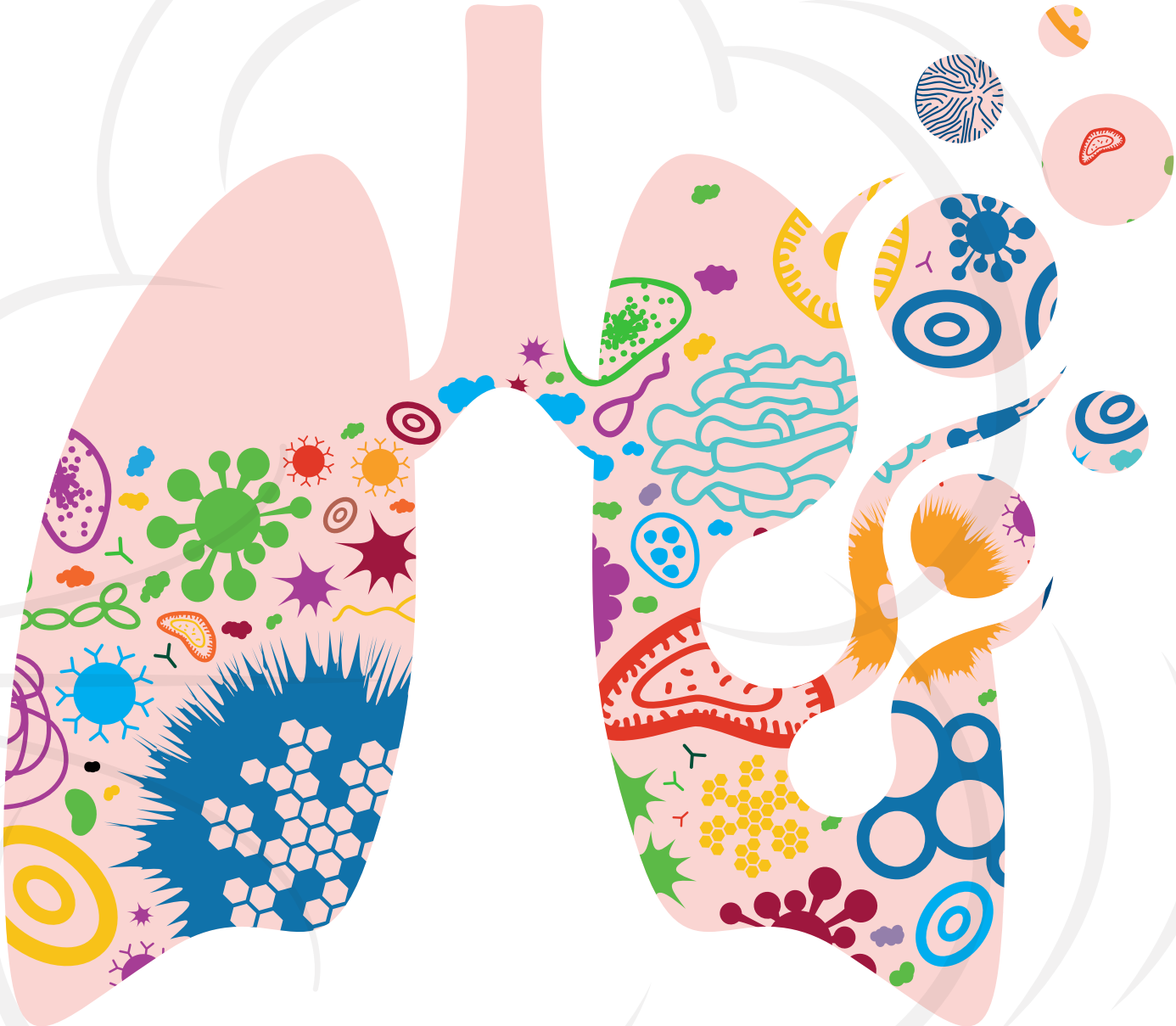
Clinical Care for Severe Acute Respiratory Infection | Toolkit



COVID-19 Adaptation

World Health Organization

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Contents

Foreword

This toolkit is intended for clinicians working in intensive care units in low- and middle-income countries, managing adult and paediatric patients with severe forms of acute respiratory infection, including severe pneumonia, acute respiratory distress syndrome, sepsis and septic shock.

Its main objective is to provide some of the necessary tools that can be used to care for the critically ill patient from hospital entry to hospital discharge. It is a hands-on practical guide to be used by health care professionals involved in critical care management during the COVID-19 pandemic and outbreaks of influenza (seasonal or avian influenza), Middle East respiratory syndrome coronavirus (MERS-CoV) or other emerging respiratory viral epidemics.

The toolkit is structured by topic. Each topic starts with a summary and follows with the list of the available tools and complementary references and resources. The tools provide a framework for users and are to be adapted to local conditions.

The child icon identifies tools to be used and adapted when caring for paediatric patients.

The adult icon identifies tools to be used and adapted when caring for adult patients.

Tools without an icon can be used and adapted when caring for adults and paediatric patients.

Accompanying the toolkit are PowerPoint slide sets – short lectures designed to reinforce the major concepts covered in the toolkit.

Acknowledgements

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In 2020, the toolkit was adapted for the COVID-19 pandemic by Janet Diaz (Unit Head, Clinical Care, World Health Emergency Programme, WHO, Geneva, Switzerland), Pryanka Relan (Technical Officer, Clinical Services and Systems, WHO, Geneva, Switzerland), and Teresa Kortz (Consultant, WHO, Geneva, Switzerland). Special thanks as well go to our copyeditor Vivien Stone (Etchingham, UK) and for the design by L'IV Com Sàrl (Villars-sous-Yens, Switzerland).

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Abbreviations

ABCDE	airway, breathing, circulation, disability, exposure
AHQR	Agency for Healthcare Research and Quality (United States of America)
AMS	altered mental state
ARDS	acute respiratory distress syndrome
ARI	acute respiratory infection
ART	arterial pressure
ASE	attention screening exam
AVPU	alert, verbal, pain, unresponsive (scale for assessing level of consciousness)
bCPAP	bubble continuous positive airway pressure
BEC	basic emergency care
BEE	basal energy expenditure
BPM	beats per minute
BPS	Behavioural Pain Scale
BSI	blood stream infection
CAM-ICU	confusion assessment method for the intensive care unit for adults
CDC	Centers for Disease Control and Prevention (United States of America)
CFR	case fatality ratio
CNS	central nervous system
CO	cardiac output
CO_2	carbon dioxide
COPD	chronic obstructive pulmonary disease
CPAP	continuous positive airway pressure
CPOT	Critical-Care Pain Observation Tool
CR	capillary refill
CVC	central venous catheter
CVP	central venous pressure
DBP	diastolic blood pressure
DVT	deep venous thrombosis
ECG	electrocardiogram
ECMO	extracorporeal membrane oxygenation
EN	enteral nutrition
ESBL	extended spectrum beta-lactamase
ESI	emergency severity index
ETAT	emergency triage assessment and treatment

ETT	endotracheal tube
FiO_2	fraction of inspired oxygen
FLACC	face, legs, activity, cry, consolability
Hb	haemoglobin
HFNC	high-flow nasal cannula
HR	heart rate
ICP	intracranial pressure
ICRC	International Committee of the Red Cross
ICU	intensive care unit
ILI	influenza-like illness
IM	intramuscular
IMAI	integrated management of adolescent and adult illness
IMV	invasive mechanical ventilation
IO	intraosseous
IPC	infection prevention and control
IV	intravenous
JVP	jugular venous pressure
LPV	lung protective ventilation
LR	lactated Ringer's
LRT	lower respiratory tract
MAP	mean arterial pressure
MERS-CoV	Middle East respiratory syndrome coronavirus
MEWS	Modified Early Warning Score
MRSA	methicillin-resistance *Staphylococcus aureus*
NEWS	National Early Warning Score (adults)
NG	nasogastric
NIV	non-invasive ventilation
NMB	neuromuscular blockers
NS	normal saline
NYHA	New York Heart Association
OG	orogastric
PALS	paediatric advanced life support
PaO_2	partial pressure arterial oxygen
pARDS	paediatric acute respiratory distress syndrome
PBW	predicted body weight
pCAM-ICU	confusion assessment method for the intensive care unit for children
PCR	polymerase chain reaction
PEEP	positive end-expiratory pressure
PEWS	Paediatric Early Warning Score

PLR	passive leg raising
po	per os
PPE	personal protective equipment
Pplat	plateau airway pressure
pr	per rectum
PRBC	packed red blood cells
RASS	Richmond Agitation-Sedation Scale
RM	recruitment manoeuvre
ROM	range of motion
RR	respiratory rate
RSI	rapid sequence intubation
RSV	respiratory syncytial virus
RT-PCR	reverse transcription polymerase chain reaction
SARI	severe acute respiratory infection
SAT	spontaneous awakening trial
SBP	systolic blood pressure
SBT	spontaneous breathing trial
$ScvO_2$	saturation of central venous blood
SIRS	systemic inflammatory response syndrome
SOFA	sequential organ failure assessment
SpO_2	oxygen saturation
TV	tidal volume
URT	upper respiratory tract
UTI	urinary tract infection
VAP	ventilator-associated pneumonia
VAS	visual analogue scale
VTE	venous thromboembolism
WHO	World Health Organization

1 Epidemiology

1 Epidemiology

Summary

Coronavirus disease 2019 (COVID-19) is a respiratory tract infection caused by a newly emergent coronavirus, that was first recognized in Wuhan, China, in December 2019. While most people with COVID-19 develop only mild or uncomplicated illness, approximately 14% develop severe disease that requires hospitalization and oxygen support, and 5% require admission to an intensive care unit. In severe cases, COVID-19 can be complicated by acute respiratory distress syndrome (ARDS), sepsis and septic shock, multi-organ failure, including acute kidney injury, and cardiac injury.

Tools

References and resources

Critical preparedness, readiness and response actions for COVID-19: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/critical-preparedness-readiness-and-response-actions-for-covid-19

Country-level coordination, planning and monitoring: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/country-readiness

Surveillance, rapid response teams and case investigation: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/surveillance-and-case-definitions

National laboratories: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-guidance

Clinical care: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/patient-management

Infection protections and control/WASH: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control

Risk communication and community engagement: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/risk-communication-and-community-engagement

Operational support and logistics: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/covid-19-critical-items

Guidance for schools, workplaces and institutions: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/guidance-for-schools-workplaces-institutions

Early investigation protocols: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/early-investigations

Virus origin/reducing animal-human transmission: https://www.who.int/health-topics/coronavirus/who-recommendations-to-reduce-risk-of-transmission-of-emerging-pathogens-from-animals-to-humans-in-live-animal-markets

Points of entry/mass gatherings: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/points-of-entry-and-mass-gatherings

Naming the coronavirus disease (COVID-19): https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it

Humanitarian operations, camps and other fragile settings: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/humanitarian-operations-camps-and-other-fragile-settings

Health workers: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/health-workers

Maintaining essential health services and systems: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/maintaining-essential-health-services-and-systems

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1.1 COVID–19 fact sheet

COVID-19

Zoonotic infection

Coronavirus disease 2019 (COVID-19) is caused by a novel coronavirus (SARS-CoV-2 or the COVID-19 virus), most similar genetically to the SARS coronavirus and is thought to originate bats, with other reservoir hosts unknown.

Cases

- The first cases were reported in December 2019 in China, with SARS-CoV-2 identified in early January.
- Since then cases have been reported in virtually all countries, and a pandemic and Public Health Emergency of International Concern has been declared by WHO on 30 January.
- The latest epidemiology and case counts are available in COVID-19 WHO situation reports (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports).
- The latest technical guidance can be found at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance

Transmission

- The COVID-19 virus is a zoonotic virus, meaning that it can be transmitted between animals and humans. The intermediary animal host has not yet been identified.
- The COVID-19 virus is spread between people mainly via inhalation of respiratory droplets from coughing or sneezing, but can also be passed through fomite/contact.
- Nosocomial transmission can occur where there is inadequate infection prevention and control (IPC) measures including personal protective equipment (PPE) use during close contact with infected individuals.
- The median incubation period is about 5–6 days (range: 1–14 days). The infectious period is unclear but may be 24–48 hours before symptoms appear, with high virus levels being detected in the upper respiratory tract early in the disease course. Virus is still detected in the upper and lower respiratory tract by PCR for several days after symptoms have resolved.
- The role of asymptomatic infection in transmission is unclear, but it has been identified in case reports and is thought to represent a minority of overall human to human transmission events.
- Aerosol-generating procedures present additional risk in health care settings, requiring higher levels of respiratory protection.

Clinical features

- Clinical features range from mild ARI and in some cases, SARI with progressive organ failure, sepsis (10–20%) and ARDS (3–5%). Overall case fatality ratios (CFR) of 1–6% have been reported from some countries.
- According to data from China, approximately 80% of people will have mild (40%) to moderate (40%) disease and recover. Moderate disease will include a mild form of pneumonia.
- More severe disease and higher CFRs have been seen in the elderly (over 60 years old) and those with chronic medical conditions, with clinical deterioration occurring at around day 7 of illness. Children appear to mainly have mild disease.
- The most common clinical features include fever, cough, malaise and shortness of breath.
- Bilateral infiltrates and ground-glass changes are the most commonly reported signs on chest-X-ray and CT imaging, with lymphopenia frequently seen in blood tests.

Prevention

- For all individuals, proper hand washing techniques, respiratory hygiene, social distancing and limiting contact with symptomatic individuals are the main preventative measures.
- In health care settings, enhanced IPC measures are required including appropriate use of PPE (gown, gloves, medical mask eye protection), and addition of airborne precautions (N95/FFP2/3 if AGP) when performing aerosol-generating procedures.

Treatment

- No specific vaccine or treatment is available for COVID-19 but clinical trials are ongoing.
- Optimized supportive care delivery is the mainstay of treatment, with supplemental oxygen therapy required by up to 20% of infections (severe disease).
- Early recognition of those with (or at risk of) severe disease, and access to critical care interventions is key.
- Diagnosis and treatment of co-infections (e.g. respiratory viral and secondary bacterial infections) are important, as is testing for other endemic diseases that can cause undifferentiated febrile illness such as malaria.
- Discharge from hospitals is generally after clinical recovery and two negative PCR swabs > 24 hours apart.

1.2 Other viruses with pandemic potential

Pandemic influenza

- Unpredictable
- Disease and death worldwide
- Pandemic waves
- Little or no immunity
- No vaccine available until months after pandemic begins

Seasonal influenza

- Yearly
- Epidemics
- Some immunity already
- Young children and the elderly are most often at risk
- Vaccine available in some countries

Human infection

Seasonal influenza viruses include A(H1N1), A(H3N2), B, C.

- These circulate worldwide and spread easily from person to person.
- Can cause annual epidemics that peak during winter in temperate climates or cause irregular outbreaks in tropical regions.
- The burden of infection takes a toll on public health through lost workforce productivity and strain on health services.
- Estimated 3–5 million people affected during annual epidemics, resulting in 250 000–500 000 deaths.
- In developed countries, more deaths observed in the elderly while in lesser developed countries there is a higher burden of death from influenza virus infection in children.

Transmission

- Via inhalation of respiratory droplets from coughing or sneezing. Droplets travel ≤ 1 m through the air.
- Close contacts of infected individuals can inhale these droplets and become infected.
- The incubation period is about 2 days. Infectious 1 day before symptoms appear and up to 1 day after symptoms go away.
- Children shed virus longer than adults.
- The estimated attack rate is 5–20% and higher in densely populated communities and schools.

Clinical features

- Uncomplicated acute respiratory infection (ARI) with high fever, cough and viral syndrome that commonly lasts for 1 week and does not require medical attention.
- Can also cause severe illness with pneumonia, sepsis, acute respiratory distress syndrome (ARDS); seen more in patients at high risk (children less than 2 years of age, the elderly, pregnant woman and those with chronic medical conditions).

Experiences from p(H1N1) influenza 2009

- Higher hospitalization rate, especially in young children aged < 5 years (2–3 times that of other age groups). 7–10% hospitalized cases were pregnant women in second/third trimester. Higher proportion of hospitalized patients required intensive care (range 10–39%). Mortality rates were highest in those aged 50–60 years.

Prevention

- Annual vaccination recommended for pregnant women, children aged 6 months to 5 years, elderly (≥ 65 years), individuals with chronic medical conditions and health care workers.

Treatment

- Neuraminidase inhibitors (i.e. oseltamivir) are active against all circulating strains of seasonal influenza and should be given as soon as possible to patients with severe acute respiratory infection (SARI), and those high-risk patients with uncomplicated ARI.

Avian influenza

Zoonotic infection

Avian influenza viruses infect birds, mostly geese and ducks, but also infect poultry and have potential to cause serious disease in humans.

Highly pathogenic avian influenza (H5N1)

- First human outbreak in1997 (Hong Kong SAR, China) and since then there have been 861 cases with 455 deaths (June 2019).
- Since 2010, cases have been reported in: Cambodia, China, Egypt, Indonesia, Thailand, Turkey and Viet Nam; and small numbers in Azerbaijan, Bangladesh, Canada, Djibouti, Iraq, Lao People's Democratic Republic, Myanmar, Nepal, Nigeria and Pakistan.

Low pathogenic avian influenza (H7N9)

- First human outbreak in 2013 (China) and there have been 1562 laboratory-proven cases (September 2017); current number of deaths uncertain but in 2015 there had been 212 deaths out of 571 cases.
- Most cases are in mainland China, and some in Hong Kong SAR and Taipei, Taiwan, China; in addition, travellers returning from China have been detected with the virus in Canada and Malaysia.

Transmission

- Mostly sporadic cases with direct or indirect contact with infected live or dead poultry or contaminated environments.
- Limited human-to-human transmission in blood relatives.

Clinical features

- Asymptomatic infection is rare, based on serological studies.
- SARI and rapid progression to ARDS and multi-organ failure.
- Avian influenza (H7N9) particularly affects people with underlying medical conditions.

Prevention

- Disease control in animals, avoid direct and prolonged exposure to infected animals.

Treatment

- No vaccine is available. Early treatment with neuraminidase inhibitor, as soon as possible.

MERS-CoV

Zoonotic infection

Coronavirus whose primary reservoir is dromedary camels, with origination in bats. Similar strains isolated from camels in Egypt, Oman, Qatar and Saudi Arabia.

Cases

- First case reported in March 2012 (Saudi Arabia). Since, cases have been reported in 27 countries. 83% of cases have been in Saudi Arabia. There was a large outbreak in the Republic of Korea in 2015; and moderate numbers have occurred in Jordan, Oman, Qatar and the United Arab Emirates.
- To date, there are 2449 laboratory-confirmed cases and 845 deaths (August 2019).

Transmission

- Camel-human transmission route is unknown.
- Human-human transmission has been limited to health care settings when inadequate infection prevention and control (IPC) measures during close contact with infected individual.
- No sustained community transmission reported.

Clinical features

- Ranges from asymptomatic to mild ARI and, in some cases, SARI with progressive organ failure, sepsis and ARDS.
- More severe disease seen in the elderly, immunosuppressed and those with chronic medical conditions.

Prevention

- When visiting areas where camels are present, use proper hand washing techniques. Avoid contact with sick camels. Avoid eating raw meat or unpasteurized milk.

Treatment

- No specific vaccine or treatment is available. Experimental protocols are available.

2 Screening, triage and initial approach

2 Screening, triage and initial approach

Summary

Screen and triage at all points of access to the health system, including primary health centres, clinics, hospital emergency units, and ad hoc community settings.

Set up a COVID-19 telephone hotline and referral system to refer patients to the appropriate destination for clinical assessment and/or testing as per local protocol.

Care for all COVID-19 patients in the designated treatment area, according to disease severity and acute care needs. For example, patients with mild or moderate disease (no risk factors) should be instructed to self-isolate and contact the COVID-19 information line for advice on testing and referral. These patients can be isolated (cohorted) at a health facility (if resources allow), community facility with rapid access to health advice or at home according to WHO guidance. Patients with moderate (high-risk group) or severe disease, should be instructed to call the COVID-19 hotline for emergency referral as soon as possible and be isolated and transferred to hospital for inpatient care.

At all first points of access to the health system, apply appropriate infection prevention and control (IPC) precautions at triage to prevent the spread of illness to health care workers or other patients.

For triage use a validated acuity-based triage tool to prioritize patients that need immediate care.

Patients with severe acute respiratory infection (SARI) associated with COVID-19 need acute care in hospital because of complications such as severe pneumonia, sepsis, organ dysfunction, and exacerbation of chronic disease or co-infection.

Patients with SARI associated with COVID-19 can progress to acute organ failure that requires critical care and admission to the intensive care unit (ICU) for intensive monitoring and supportive therapies that cannot be delivered on a general ward. Do not delay ICU admission.

Tools

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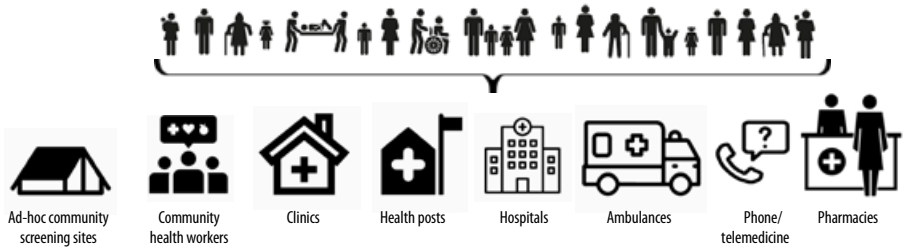
2.1 Screening and triage

Triage refers to the sorting of patients based on specific criteria and can be performed at any point of access to the health care system, including in both pre-hospital and facility-based settings. **Acuity-based triage** is the sorting of patients based on the estimation of their severity. This is used as the basis for identifying those patients who require immediate medical intervention and those who can safely wait, or those who may need to be transported to a specific destination based on their condition. **Acuity-based triage is the standard method of sorting patients in the medical setting.**

The concept of triage has been around for a long time and has led to many different triage tools being created over the years. The **Interagency Integrated Triage Tool** is one that can be utilized for facility-based routine triage, facility-based mass casualty triage (for any situation in which there is a surge of patients coming to a facility) and pre-hospital triage. See www.who.int/emergencycare or contact emergencycare@who.int for more information.

SCREEN FOR COVID-19 AT FIRST POINT OF ACCESS TO THE HEALTH SYSTEM

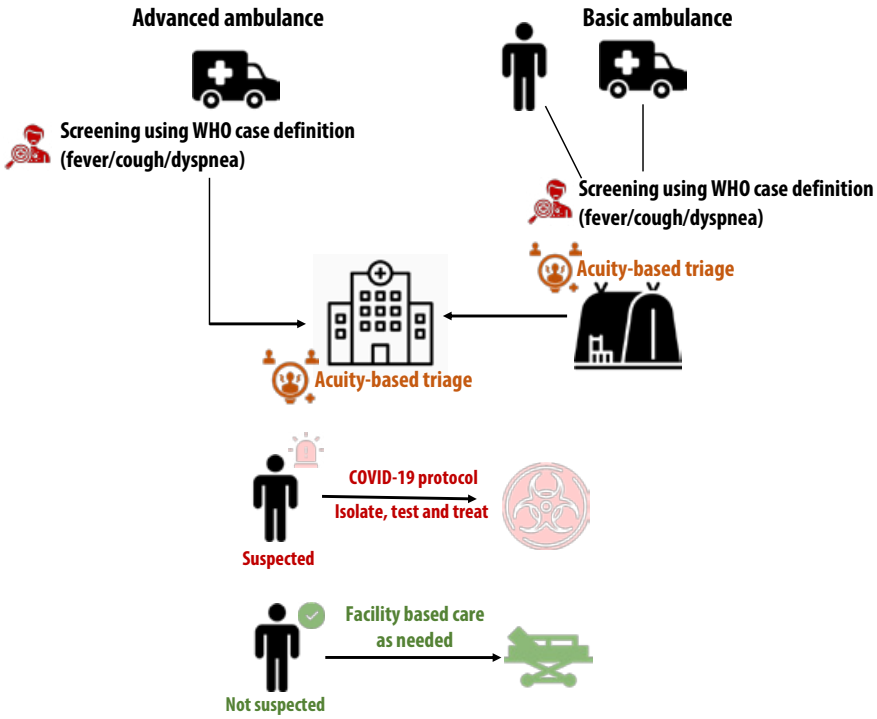


APPLY WHO CASE DEFINITION (fever, cough, dyspnea)

*All patients should be screened for COVID-19 using WHO Case Definitions at the first point they access the health system.

Patients suspected to have COVID-19	Patients NOT suspected to have COVID-19
Refer to appropriate facility or testing site as per local protocol	Management as per local protocol (routine management or referral as per reorganization of service delivery)

TRIAGE AT FACILITY



Source: https://apps.who.int/iris/bitstream/handle/10665/331492/WHO-2019-nCoV-HCF_operations-2020.1-eng.pdf

Interagency Integrated Triage Tool: ≥12 years

1 CHECK FOR RED CRITERIA

- Unresponsive

AIRWAY & BREATHING
- Stridor
- Respiratory distress* or central cyanosis

CIRCULATION
- Capillary refill >3 sec
- Weak and fast pulse
- Heavy bleeding
- HR <50 or >150

DISABILITY
- Active convulsions
- Any two of:
  - Altered mental status
  - Hypothermia or fever
  - Stiff neck
  - Headache
- Hypoglycaemia

OTHER
- High-risk trauma*
- Poisoning/ingestion or dangerous chemical exposure*
- Threatened limb*
- Snake bite
- Acute chest or abdominal pain (>50 years old)
- ECG with acute ischaemia (if done)
- Violent or aggressive

PREGNANT WITH ANY OF:
- Heavy bleeding
- Severe abdominal pain
- Seizures or altered mental status
- Severe headache
- Visual changes
- SBP ≥160 or DBP ≥110
- Active labour
- Trauma

YES

MOVE TO HIGH ACUITY RESUSCITATION AREA IMMEDIATELY

*See Reference Card

NO

2 CHECK FOR YELLOW CRITERIA

AIRWAY & BREATHING
- Any swelling/mass of mouth, throat or neck
- Wheezing (no red criteria)

CIRCULATION
- Vomits everything or ongoing diarrhoea
- Unable to feed or drink
- Severe pallor (no red criteria)
- Ongoing bleeding (no red criteria)
- Recent fainting

DISABILITY
- Altered mental status or agitation (no red criteria)
- Acute general weakness
- Acute focal neurologic complaint
- Acute visual disturbance
- Severe pain (no red criteria)

OTHER
- New rash worsening over hours or peeling (no red criteria)
- Visible acute limb deformity
- Open fracture
- Suspected dislocation
- Other trauma/burns (no red criteria)
- Known diagnosis requiring urgent surgical intervention
- Sexual assault
- Acute testicular/scrotal pain or priapism
- Unable to pass urine
- Exposure requiring time-sensitive prophylaxis (eg. animal bite, needlestick)
- Pregnancy, referred for complications

YES

MOVE TO CLINICAL TREATMENT AREA

NO

Patients with high-risk vital signs or clinical concern need up-triage or immediate review by supervising clinician

YES

3 CHECK FOR HIGH-RISK VITAL SIGNS

HR <60 or >130
RR <10 or >30
Temp <36° or >39°
SpO2 <92%
AVPU other than A

NO

MOVE TO LOW ACUITY OR WAITING AREA

Developed by World Health Organization, The International Committee of the Red Cross, Médecins Sans Frontières

Interagency Integrated Triage Tool: < 12 years

1 CHECK FOR RED CRITERIA

- Unresponsive

AIRWAY & BREATHING
- Stridor
- Respiratory distress* or central cyanosis

CIRCULATION
- Capillary refill >3 sec
- Weak and fast pulse
- Heavy bleeding
- Cold extremities
- Any two of:
  - Lethargy
  - Sunken eyes
  - Very slow skin pinch
  - Drinks poorly

DISABILITY
- Active convulsions
- Altered mental status (confused, restless, continuously irritable or lethargic) with stiff neck, hypothermia or fever
- Hypoglycaemia (if known)

OTHER
- Any infant <8 days old
- Age <2 months and temp <36 or >39°C
- High-risk trauma*
- Threatened limb*
- Acute testicular/scrotal pain or priapism
- Snake bite
- Poisoning/ingestion or dangerous chemical exposure*
- Pregnant with adult red criteria

YES

MOVE TO HIGH ACUITY RESUSCITATION AREA IMMEDIATELY

NO

2 CHECK FOR YELLOW CRITERIA

AIRWAY & BREATHING
- Any swelling/mass of mouth, throat or neck
- Wheezing (no red criteria)

CIRCULATION
- Unable to feed or drink
- Vomits everything
- Ongoing diarrhoea
- Dehydration
- Severe pallor (no red criteria)

DISABILITY
- Restless, continuously irritable or lethargy
- Severe pain

OTHER
- Any infant 8 days to 6 months old
- Malnutrition with visible severe wasting OR oedema of both feet
- Trauma/burn (no red criteria)
- Sexual assault
- Known diagnosis requiring urgent surgical intervention
- New rash worsening over hours or peeling (no red criteria)
- Exposure requiring time-sensitive prophylaxis (e.g. animal bite)
- Pregnancy (no red criteria)
- Headache (no red criteria)

YES

MOVE TO CLINICAL TREATMENT AREA

NO

Patients with high-risk vital signs or clinical concern need up-triage or immediate review by supervising clinician

YES

3 CHECK FOR HIGH-RISK VITAL SIGNS

Temp <36° or >39°

SpO2 < 92%

AVPU other than A

RR	< 1 year	1-4 years	5-12 years
High	50	40	30
Low	25	20	10
HR	**< 1 year**	**1-4 years**	**5-12 years**
High	180	160	140
Low	< 90	< 80	< 70

NO

MOVE TO LOW ACUITY OR WAITING AREA

*See Reference Card

Developed by World Health Organization, International Committee of the Red Cross, Médecins Sans Frontières

High-Risk Trauma Criteria

General Trauma	Road Traffic
Fall from twice person's height	High speed motor vehicle crash
Penetrating trauma excluding distal to knee/ elbow with bleeding controlled	Pedestrian or cyclist hit by vehicle
Crush injury	Other person in same vehicle died at scene
Polytrauma (injuries in multiple body areas)	Motor vehicle crash without a seatbelt
Patient with bleeding disorder or on anticoagulation	Trapped or thrown from vehicle (including motorcycle)
Pregnant	

Major Burns

(the below criteria refer to partial or full thickness burns)	
Greater than 15% body surface area	Inhalation injury
Circumferential or involving face or neck	Any burn in age < 2 or age > 70

Threatened Limb

A patient presenting with a limb that is:

- Pulseless OR
- Painful and one of the following: pale, weak, numb, or with massive swelling after trauma.

Other High-Risk Criteria

Signs of Respiratory Distress

Adult	Child
Very fast or very slow breathing	Very fast breathing
Inability to talk or walk unaided	Inability to talk, eat or breastfeed
Confused, sleepy or agitated	Nasal flaring, grunting
Accessory muscle use (neck, intercostal, abdominal)	Accessory muscle use (e.g., head nodding, chest indrawing)

Ingestion/exposure

Use of clinical signs alone may not identify all those who need time-dependent intervention. Patients with high risk ingestion or exposure should initially be up-triaged to Red for early clinical assessment.

2.3 Basic emergency care (BEC): ABCDE approach to the acutely ill

WHO/ICRC/IFEM ***Basic emergency care (BEC): approach to the acutely ill and injured*** is an open-access training course for front-line health care providers who manage acute illness and injury with limited resources, including students, nurses, pre-hospital technicians, clinical officers and doctors who are working in field (pre-hospital) or hospital settings. BEC integrates guidance from WHO *Emergency triage assessment and treatment (ETAT)* and the *Integrated management of adolescent and adult illness (IMAI) district clinician manual* and teaches a systematic approach to the initial assessment and management of four time-sensitive conditions – difficulty in breathing, shock, altered mental status and injury – where early intervention saves lives.

Because emergency care providers must respond to "undifferentiated" patients, those with acute symptoms for which the cause may not be known, BEC teaches a simple, systematic ABCDE approach to managing acute, potentially life-threatening conditions even before a diagnosis is known.

Patients who are acutely ill due to a severe acute respiratory infection may present with any of three life-threatening conditions: difficulty in breathing, shock or altered mental status. The following "quick cards" from BEC summarize the initial approach to assessment and management of key findings from the ABCDE approach. See www.who.int/emergencycare or contact emergencycare@who.int for more information.

ABCDE APPROACH

	ASSESSMENT FINDINGS	IMMEDIATE MANAGEMENT
Airway 	Unconscious with limited or no air movement	If **NO TRAUMA**: head-tilt and chin-lift, use OPA or NPA to keep airway open, place in recovery position or position of comfort. If possible **TRAUMA**: use jaw thrust with c-spine protection and place OPA to keep the airway open (no NPA if facial trauma).
	Foreign body in airway	Remove visible foreign body. Encourage coughing. • If **unable** to cough: chest/abdominal thrusts/back blows as indicated • If patient becomes unconscious: CPR
	Gurgling	Open airway as above, suction (avoid gagging).
	Stridor	Keep patient calm and allow position of comfort. • For signs of anaphylaxis: give IM adrenaline • For hypoxia: give oxygen
Breathing 	Signs of abnormal breathing or hypoxia	Give oxygen. Assist ventilation with BVM if breathing NOT adequate.
	Wheeze	Give salbutamol. For signs of anaphylaxis: give IM adrenaline.
	Signs of tension pneumothorax (absent sounds / hyperresonance on one side WITH hypotension, distended neck veins)	Perform needle decompression, give oxygen and IV fluids. Will need chest tube
	Signs of opiate overdose (AMS and slow breathing with small pupils)	Give naloxone.
Circulation 	Signs of poor perfusion/shock	If **no pulse**, follow relevant CPR protocols. Give oxygen and IV fluids.
	Signs of internal or external bleeding	Control external bleeding. Give IV fluids.
	Signs of pericardial tamponade (poor perfusion with distended neck veins and muffled heart sounds)	Give IV fluids, oxygen. Will need rapid pericardial drainage
Disability 	Altered mental status (AMS)	If NO TRAUMA, place in recovery position.
	Seizure	Give benzodiazepine.
	Seizure in pregnancy (or after recent delivery)	Give magnesium sulphate.
	Hypoglycaemia	Give glucose if <3.5 mmol/L or unknown.
	Signs of opiate overdose (AMS with slow breathing with small pupils)	Give naloxone.
	Signs of life-threatening brain mass or bleed (AMS with unequal pupils)	Raise head of bed, monitor airway. Will need rapid transfer for neurosurgical services
Exposure 	Remove wet clothing and dry skin thoroughly.	
	Remove jewelry, watches and constrictive clothing	
	Prevent hypothermia and protect modesty.	
	Snake bite	Immobilize extremity. Send picture of snake with patient. Call for anti-venom if relevant.

If cause unknown, remember trauma: Examine the entire body and always consider hidden injuries [see also TRAUMA card]

REMEMBER: PATIENTS WITH ABNORMAL ABCDE FINDINGS MAY NEED RAPID HANDOVER/TRANSFER. PLAN EARLY.

NORMAL ADULT VITAL SIGNS

Pulse rate: 60–100 beats per minute
Respiratory rate: 10–20 breaths per minute
Systolic blood pressure >90 mmHg
Oxygen Saturation > 92%

Estimating systolic blood pressure
(not reliable in children and the elderly):
Carotid (neck) pulse → SBP ≥ 60 mmHg
Femoral (groin) pulse → SBP ≥ 70 mmHg
Radial (wrist) pulse → SBP ≥80 mmHg

SAMPLE History

Signs & Symptoms
Allergies
Medications
PMH
Last oral intake
Events

SPECIAL CONSIDERATIONS IN THE ASSESSMENT OF CHILDREN

- Children have bigger heads and tongues, and shorter, softer necks than adults. Position airway as appropriate for age.
- Always consider foreign bodies.

- Look for signs of increased work of breathing (e.g. chest indrawing, retractions, nasal flaring).
- Listen for abnormal breath sounds (e.g. grunting, stridor, or silent chest).

AGE	RESPIRATORY RATE (breaths per minute)
<2 months	40–60
2–12 months	25–50
1–5 years	20–40

- Signs of poor perfusion in children include: slow capillary refill, decreased urine output, lethargy, sunken fontanelle, poor skin pinch
- Look for signs of anaemia and malnourishment (adjust fluids).
- Remember that children may not always report trauma and may have serious internal injury with few external signs.

AGE (in years)	NORMAL HEART RATE (beats per minute)
<1	100–160
1–3	90–150
4–5	80–140

- Always check AVPU
- Hypoglycaemia is common in ill children.
- Check for tone and response to stimulus.
- Look for lethargy or irritability.

INFANTS AND CHILDREN HAVE DIFFICULTY MAINTAINING TEMPERATURE

- Remove wet clothing and dry skin thoroughly. Place infants skin-to-skin when possible.
- For hypothermia, cover the head (but be sure mouth and nose are clear).
- For hyperthermia, unbundle tightly wrapped babies.

DANGER SIGNS IN CHILDREN

- Signs of airway obstruction (unable to swallow saliva/ drooling or stridor)
- Increased breathing effort (fast breathing, nasal flaring , grunting, chest indrawing or retractions)
- Cyanosis (blue colour of the skin, especially at the lips and fingertips)
- Altered mental status (including lethargy or unusual sleepiness, confusion, disorientation)
- Moves only when stimulated or no movement at all (AVPU other than "A")
- Not feeding well, cannot drink or breastfeed or vomiting everything
- Seizures/convulsions
- Low body temperature (hypothermia)

ESTIMATED WEIGHT in KILOGRAMS for CHILDREN 1–10 YEARS OLD:

[age in years + 4] x 2

APPROACH TO THE PATIENT WITH DIFFICULTY IN BREATHING

Key ABCDE Findings (Always perform a complete ABCDE approach first!)

IF YOU FIND...	REMEMBER...
Choking, coughing	Foreign body
Stridor	Partial airway obstruction due to foreign body or inflammation (from infection, chemical exposure or burn)
Facial swelling	Severe allergic reaction, medication effect
Drooling	Indicates a blockage to swallowing
Soot around the mouth or nose, burned facial hair, facial burns	Smoke inhalation and airway burns – rapid swelling can block the airway
Signs of chest wall trauma	Rib fracture, flail chest, pneumothorax, contusion, tamponade
Decreased breath sounds on one side	Pneumothorax (consider tension pneumothorax if with hypotension and hyperresonance to percussion), haemothorax, large pleural effusion/pneumonia
Decreased breath sounds and crackles on both sides	Pulmonary oedema, heart failure
Wheezing	Asthma, allergic reaction, COPD
Fast or deep breathing	DKA
Low blood pressure, tachycardia, muffled heart sounds	Pericardial tamponade
Altered mental status with small pupils and slow breathing	Opioid overdose

Key Findings from the SAMPLE History and Secondary Exam

IF YOU FIND...	REMEMBER...
DIB worse with exertion or activity	Heart failure, heart attack
DIB that began with choking or during eating	Foreign body, allergic reaction
History of fever, cough	Pneumonia, infection
Pesticide exposure	Poisoning
Recent fall or other trauma	Rib fracture, flail chest, pneumothorax, contusion, tamponade
Known allergies, allergen exposure, bite or sting	Allergic reaction
Recent medication or dose change	Allergic reaction or side effect
History of opioid or sedative drug use	Overdose
History of wheezing	Asthma or COPD
History of diabetes	DKA
History of tuberculosis or malignancy	Pericardial tamponade, pleural effusion
History of heart failure	Pulmonary oedema
History of sickle cell disease	Acute chest syndrome

CRITICAL ACTIONS FOR HIGH-RISK CONDITIONS				
CHOKING ***unable to cough, not making sounds***	**STRIDOR** ***high pitched sounds on breathing IN***	**WHEEZING** ***high pitched sounds on breathing OUT***	**SEVERE INFECTION**	**TRAUMA**
Remove any visible foreign body Perform age-appropriate chest/abdominal thrusts or back blows CPR if becomes unconscious	Keep patient calm and allow position of comfort IM adrenaline for suspected allergic reaction Oxygen if concern for hypoxia Early handover/transfer for advanced airway management	Give salbutamol IM adrenaline for suspected allergic reaction Oxygen if concern for hypoxia	Oxygen Antibiotics Oral/IV fluids as appropriate	Oxygen Needle decompression and IV fluids for tension pneumothorax Three-sided dressing for sucking chest wound Rapid transfer to surgical service

SPECIAL CONSIDERATIONS IN CHILDREN	
THE FOLLOWING ARE DANGER SIGNS IN CHILDREN WITH BREATHING COMPLAINTS:	
• Fast breathing • Increased breathing effort (chest indrawing/retractions) • Cyanosis • Altered mental status (including lethargy)	• Poor feeding or drinking, or vomits everything • Seizures/convulsions, current or recent • Drooling or stridor when calm • Hypothermia
Wheezing in children is often caused by an object inhaled into the airway, viral infection or asthma.	
Stridor in children is often caused by an object stuck in the airway or airway swelling from infection.	
Fast or deep breathing can indicate diabetic crisis (DKA), which may be the first sign of diabetes in a child.	
FAST BREATHING MAY BE THE ONLY SIGN OF A SERIOUS BREATHING PROBLEM IN A CHILD.	

DISPOSITION
Salbutamol and IM adrenaline effects last for about 3 hours, and life-threatening symptoms may recur. Monitor closely, always have repeat dose available during transport and caution new providers at handover.
Naloxone lasts approximately 1 hour, and most opioids last longer. Monitor closely, always have repeat dose available during transport and caution new providers.
Following immersion in water (drowning), a person may develop delayed breathing problems after several hours. Monitor closely and caution new providers.
Never leave patients with difficulty in breathing unmonitored during handover/transfer.
Make transfer arrangements as early as possible for any patient who may require intubation or assisted ventilation.

APPROACH TO THE PATIENT WITH SHOCK

Key ABCDE Findings (Always perform a complete ABCDE approach first!)

IF YOU FIND...	REMEMBER...
Difficulty breathing, stridor/wheezing, skin rash, swelling of mouth	Severe allergic reaction
Hypotension with absent breath sounds and hyperresonance on one side, distended neck veins	Tension pneumothorax
Distended neck veins, muffled heart sounds, tachycardia, hypotension	Pericardial tamponade
Sweet smelling breath, deep or rapid breathing	DKA
History of trauma or no known cause	Hidden sources of significant blood loss (stomach, intestines, intra-abdominal, chest, long-bone trauma) or spinal injury

Key Findings from the SAMPLE History and Secondary Exam

IF YOU FIND...	REMEMBER...
Vomiting and diarrhoea	Ask about contacts and report cases per protocol.
Black or bloody vomit or stool	Stomach or intestinal bleeding
Rapid or deep breathing, dehydration, high glucose, sweet-smelling breath, history of frequent urination or known diabetes	Diabetic ketoacidosis
Burns	Severe fluid loss (calculate fluid needs based on burn size)
Fever or HIV	Infection
Recent fall or other trauma	Internal AND external bleeding
Pale conjunctiva or malnutrition	Severe anemia (adjust fluids)
Chest pain	Heart attack (give aspirin if indicated)
Vaginal bleeding	Pregnancy and non-pregnancy related bleeding
Numbness, weakness or shock that does not improve with fluids	Spinal shock (immobilize spine if indicated)

CRITICAL ACTIONS FOR HIGH-RISK CONDITIONS

For all shock:

- **Give oxygen**
- **Give IV fluids**
  - ADULTS: 1 liter RL or NS bolus
  - CHILDREN with NO severe anaemia, NO malnutrition, NO fluid overload: 10–20 ml/kg bolus
  - CHILDREN with malnutrition or severe anaemia: give 10–15 ml/kg dextrose-containing fluid **over 1 hour** and assess for fluid overload every 5 minutes.
  - For suspected heart attack with shock, give smaller boluses, and monitor closely for fluid overload.
- **Monitor vital signs, mental status, breathing and urine output**

AND for specific conditions:

SEVERE ALLERGIC REACTION	TENSION PNEUMOTHORAX	TAMPONADE	FEVER	WATERY DIARRHOEA	POSTPARTUM BLEEDING	DKA	TRAUMA
IM adrenaline Monitor for recurrence, may need repeat doses	Rapid needle decompression Transfer for chest tube	Rapid transfer to advanced provider for drainage	Antibiotics (and anti-malarials if indicated) Assess for source of infection	Full contact precautions Monitor output and continue fluids Assess for cholera and notify public health authorities	Oxytocin and uterine massage Direct pressure for perineal and vaginal tears Rapid transfer to advanced obstetric care	Close monitoring for fluid overload in children Handover/transfer for insulin	Control external haemorrhage with direct pressure, wound packing, tourniquet if indicated Calculate fluid needs based on burn size Rapid transfer for surgery/transfusion as needed

SPECIAL CONSIDERATIONS IN CHILDREN

ASSESSING SHOCK IN CHILDREN

The 2016 WHO guidelines for the care of critically ill children use the presence of three clinical features to define shock:

- Cold extremities
- Weak and fast pulse
- Capillary refill greater than 3 seconds

Additional important considerations include:

- Young children may not be able to drink enough fluid on their own.
- Children have larger surface area to volume ratio and can lose fluids more quickly than adults.
- For a child in shock WITH severe malnutrition or fluid overload, add dextrose and reduce fluids to 10–15 ml/kg over 1 hour.

In children *without* severe malnutrition, severe anaemia or fluid overload, give fluid resuscitation over 30 minutes.

WEIGHT (kg)	FLUID VOLUME (15ml/kg)
4	60
6	90
10	150
14	210
20	300
30	450

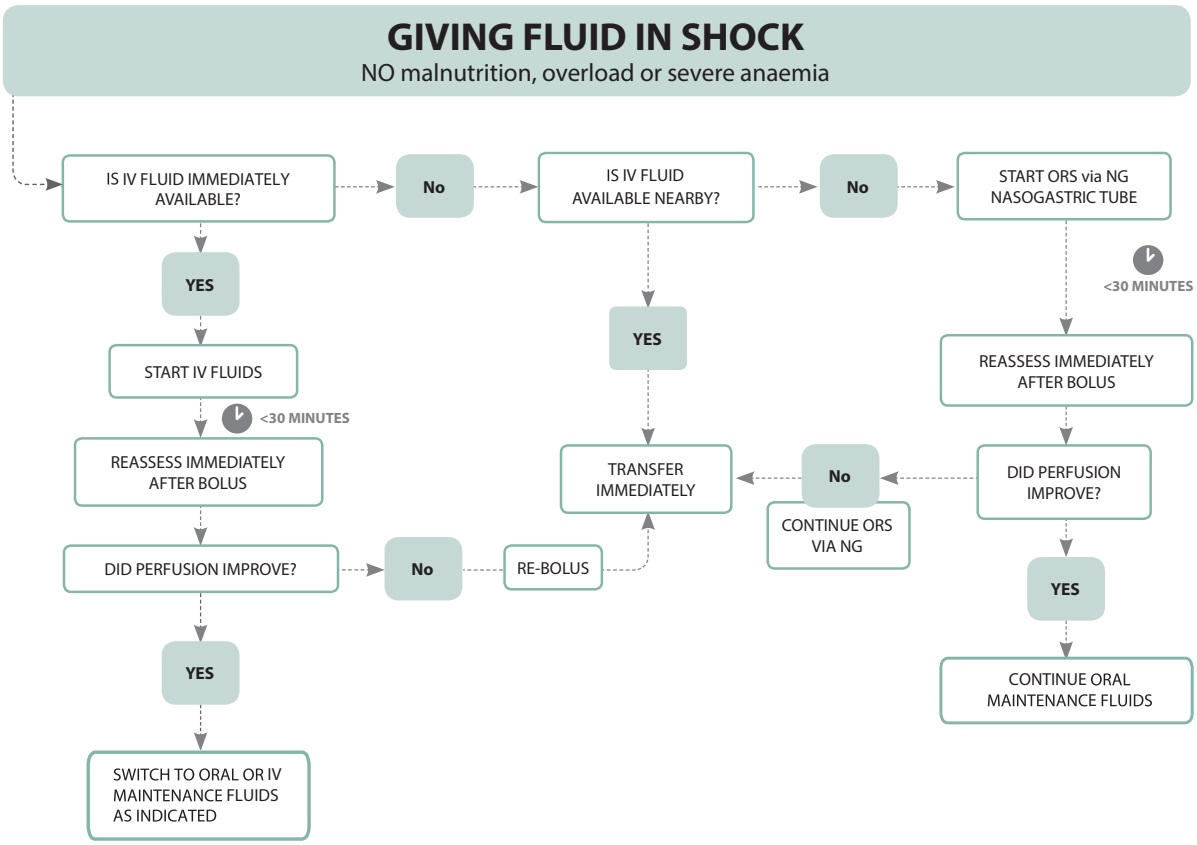
Other important signs of poor perfusion include:

- Sunken eyes; sunken fontanelles in infants
- Abnormal skin pinch test
- Pallor (dehydration with anaemia is more difficult to treat)
- Decreased and dark urine (number of nappies for infants)
- Low blood pressure
- Fast breathing
- Altered mental status
- Very dry mouth and lips
- Lethargy (excessive drowsiness, slow to respond, not interactive)

DISPOSITION

Patients with shock should be at a unit capable of providing IV fluid resuscitation, blood transfusion, and/or surgery, depending on the type of shock.

Maintain fluids during transport. Repeat ABCDE approach and monitor perfusion and breathing closely at all times.



APPROACH TO THE PATIENT WITH ALTERED MENTAL STATUS (AMS)

Key ABCDE Findings (Always perform a complete ABCDE approach first!)

IF YOU FIND...	REMEMBER...
Tachypnoea	Hypoxia, DKA, toxic ingestion
Poor perfusion/shock	Infection, internal bleeding
Tachycardia with normal perfusion	Alcohol withdrawal
Coma	Hypoxia, high or low blood glucose, DKA and toxic ingestion
Hypoglycaemia	Infection, medication side effect (eg, diabetes medications, quinine)
Very small pupils with slow breathing	Opioid overdose
Seizure/convulsion	Abnormal glucose, infection, toxic ingestion (eg, TB meds) or withdrawal (eg, alcohol). Consider eclampsia if current pregnancy or recent delivery.
Weakness on one side or unequal pupil size	Brain mass or bleed
Signs of trauma or unknown cause of AMS	Consider brain injury (with possible spine injury)

Key Findings from SAMPLE History and Secondary Exam

IF YOU FIND...	REMEMBER...
History of wheezing	Severe COPD crisis can cause AMS
History of diabetes	High or low blood sugar, DKA
History of epilepsy	Post-seizure confusion and sleepiness should improve over minutes to hours. Prolonged AMS or multiple convulsions without waking up in between require further workup.
History of agricultural work or known pesticide exposure	Organophosphate poisoning
History of regular alcohol use	Alcohol withdrawal
History of substance use or depression	Acute intoxication, accidental or intentional overdose
History of HIV	Infection, medication side effect
Rash on the lower abdomen or legs or bulging fontanelle in infants	Brain infection (meningitis)
Fever/Hyperthermia	Infectious, toxic, and environmental causes

CRITICAL ACTIONS FOR HIGH-RISK CONDITIONS (Always check blood glucose in AMS, or give glucose if unable to check.)				
HYPOGLYCAEMIA	**OPIOID OVERDOSE**	**LIFE-THREATENING INFECTIONS**	**SEVERE DEHYDRATION**	**TOXIC EXPOSURE OR WITHDRAWAL**
Give glucose Evaluate for infection Monitor for return of hypoglycaemia	Naloxone Monitor need for repeat doses (many opioids last longer than naloxone)	IV fluids Antibiotics For AMS with fever or rash, consider brain infection (meningitis) – isolate patient and wear mask. Cool if indicated for very high fever (avoid shivering).	IV fluids Assess for infection Consider DKA	Gather history and consult advanced provider for locally-appropriate antidotes. Treat alcohol withdrawal with benzodiazepine. Decontaminate for chemical exposures (eg, pesticides).

PAEDIATRIC CONSIDERATIONS	
ALWAYS consider unwitnessed toxic ingestion	Ask about any medications in the household, and any chemicals (eg cleaning products, antifreeze) in or near the house.
Check and regularly re-check blood glucose	Low blood glucose is common in ill young children. High blood glucose can present with AMS and dehydration.
AVOID hypothermia	Keep skin-to-skin with mother, cover child's head. Uncover only the parts you need to see, one at a time, during exam.
Danger signs with ingestions • Stridor • Oral chemical burns	Monitor closely and arrange handover/transfer for advanced airway management.
Monitor fluid status closely	Paediatric patients are more susceptible to both fluid losses and fluid overload.

DISPOSITION CONSIDERATIONS
Patients with AMS who may not be able to protect the airway should never be left alone. Monitor closely and give direct handover to new provider.
Naloxone lasts approximately 1 hour. Most opioids last longer-- always alert new providers that patients may need repeat doses.
Hypoglycaemia often recurs. Alert new providers to monitor blood glucose frequently in any patient who has been treated for hypoglycaemia.

Source: WHO/ICRC/IFEM *Basic emergency care (BEC): approach to the acutely ill and injured,* quick cards (2018).

2.4 Memory aid: key criteria used to assess nutrition and vital signs in children

	Age				
	< 1 month	1 month – 1 year	1–5 years	5–12 years	> 12 years
Normal RR/min	30–40	30–40	20–30	20–25	12–20
RR/min in severe distress	> 60 or < 20	> 50 or < 10	> 40	> 40	> 40
Normal heart rate (HR)/min	120–180	120–180	100–140	90–140	90–140
Normal SBP (mmHg)	60	80	90 + (2 × age)		120
Lower limit SBP (mmHg)	50	70	70 + (2 × age)		90
Normal urine output	1–2 mL/kg/hr		1 mL/kg/hr		0.5–1 mL/kg/hr

Key tips for assessing a sick child

Blood pressure measurement in children
- Cuff should cover ⅔ to ¾ of the upper arm, calf or thigh.
- Cuffs that are too small give falsely high readings.
- Cuffs that are too large give falsely low readings.
- Child should be at rest and not distressed as this will falsely elevate the reading.

To perform capillary refill (CR) assessment
- Press the nail bed of finger or thumb (peripheral CR) or over the sternum (central CR) for 3 seconds.
- Release and count in seconds the time taken for the return of colour (perfusion).

Weight estimates in children
It is always best to weigh children rather than estimate their weight. In an emergency, weight can be estimated in visibly well-nourished children.
- Term infants: 2.5–4.5 kg.
- Estimate at 6 months of age: 5–7 kg.
- Estimate after 1 year of age – (age in years + 4) × 2 kg.

Criteria to define severe malnutrition
- Clinical signs of severe malnutrition: visible ribs and no fat on the buttocks, thighs, arms or shoulders.
- Mid-upper arm circumference < 11.5 cm.
- Bilateral pedal oedema.
- Severe wasting: < 70% weight-for-length or -3SD on charts – *Pocket book of hospital care for children* (WHO, 2013).

Signs of respiratory distress
- Fast RR (normal ranges in table above).
- Nasal flaring, grunting.
- Intercostal recession and tracheal tug.
- Indrawing of the lower chest wall (very severe).
- Central cyanosis of the lips and tongue (very severe).
- Inability to breastfeed, drink (very severe).
- Lethargy (very severe).

2.5 Memory aid for pregnant women: key physiological aspects

Immune system

- May increase susceptibility to intracellular pathogens such as viruses.
- Changes persist following the end of pregnancy.

Cardiovascular

- Blood volume increases by 40–50% causing dilutional anaemia and decreased oncotic pressure.
- Cardiac output increases by 30–50%.
- Heart rate increases by 10–20 beats per minute (bpm).
- Blood pressure decreases by 5–10 mmHg systolic and 10–15 mmHg diastolic. But after 24 weeks' gestation, gradually increases to non-pregnant level by term.
- Systemic vascular resistance decreases by 20%.

Respiratory

- Increased tidal volume (TV) and minute ventilation. Chronic compensated respiratory alkalosis.
- **No change** in RR, tachypnea is **not** a normal variant of pregnancy!
- Vital capacity is unchanged.
- Increased oxygen consumption to 20–40% above non-pregnant levels.
- Decreased oxygen reserve makes pregnant patient more susceptible to effects of respiratory compromise.

Maternal–fetal dyad

- Fetus completely dependent on placenta for oxygen, nutrition and waste removal.
- Placenta is dependent on maternal blood cardiac output (500–800 mL of blood or 17% cardiac output goes to uterus every minute).
- With maternal compromise, blood flow will shunt away from uterus and this can occur before discernible maternal haemodynamic changes.
- If maternal oxygen or blood pressure decreases, the placenta will not be able to maintain adequate perfusion or oxygenation and the fetus will become distressed.

Tips for managing respiratory distress

- Keep SpO_2 > 92–95%.
- Do not delay intubation for worsening respiratory distress. Be prepared for difficult airway!

Tips for managing hypotension

- Ensure adequate resuscitation but avoid fluid overload.
- Do not lay flat. Position with lateral tilt (elevate either hip 10–12 cm) to augment venous return to heart.
- Cautious vasopressor use as risk of reducing uterine perfusion, must monitor fetus.

Tips regarding antimicrobial therapy

- For suspected influenza virus infection, it is **safe** to treat with oseltamivir and give as soon as possible.
- Also give antibiotics – penicillins, cephalosporins and macrolides are appropriate in pregnancy.
- Avoid flouroquinolones and doxycycline if possible.

Tips regarding preterm labour

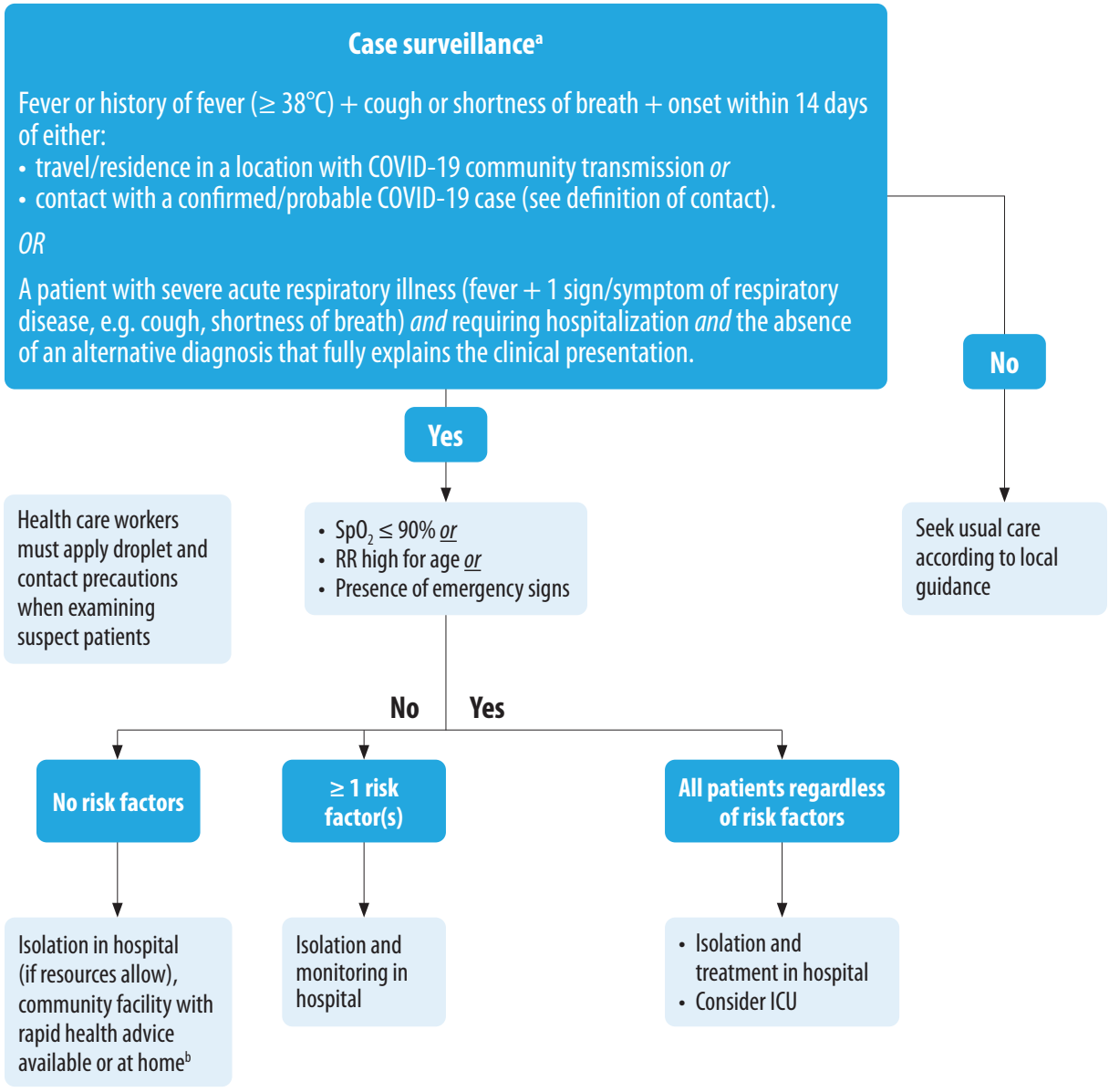
- Tocolytics may worsen maternal status by decreasing blood pressure, tachycardia, arrhythmias or causing pulmonary oedema.
- Antenatal corticosteroids promote fetal lung maturation if there is need to deliver fetus preterm (weeks 24–34). Can use betamethasone 12 mg IM every 24 hours for two doses or dexamethasone 6 mg IM every 12 hours for four doses.

Haemodynamic changes in pregnancy

	Change with pregnancy	
Measurement	% change	(absolute change)
Cardiac output	30–50% ↑	(2 L/min)
Heart rate	15–20% ↑	(12 bpm)
Stroke volume	20–30% ↑	(18 mL)
Mean arterial pressure	0–5% ↓	
Central venous pressure	No change	
Systemic vascular resistance	20–30% ↓	(320 dynes/cm^5)
Left ventricular stroke work index	No change	
Mean pulmonary artery pressure	No change	
Pulmonary capillary wedge pressure	No change	
Pulmonary vascular resistance	30% ↓	(40 dynes/cm^5)

Source: Adapted from Hegewald and Crapo (2011).

2.6 Decision-making algorithm for patient presenting with acute respiratory infection (influenza or COVID-19 suspected or known to be circulating)



Notes:
[a] *Global surveillance for COVID-19 caused by human infection with COVID-19 virus: interim guidance* (https://apps.who.int/iris/handle/10665/331506).
[b] For guidance see: https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts

Uncomplicated influenza-like illness (ILI) symptoms

- Fever
- Cough
- Sore throat
- Rhinorrhoea or nasal congestion
- Headache
- Muscle pain or malaise
- Gastrointestinal illness such as diarrhoea or vomiting, but **no** evidence of dehydration
- **No** shortness of breath
- *Note:* The elderly and immunosuppressed may present with atypical symptoms. Symptoms due to physiologic adaptations of pregnancy and adverse pregnancy events, such as dyspnea, fever, gastrointestinal symptoms or fatigue, may overlap with COVID-19 symptoms.

Signs and symptoms of complications of ARI (SARI)

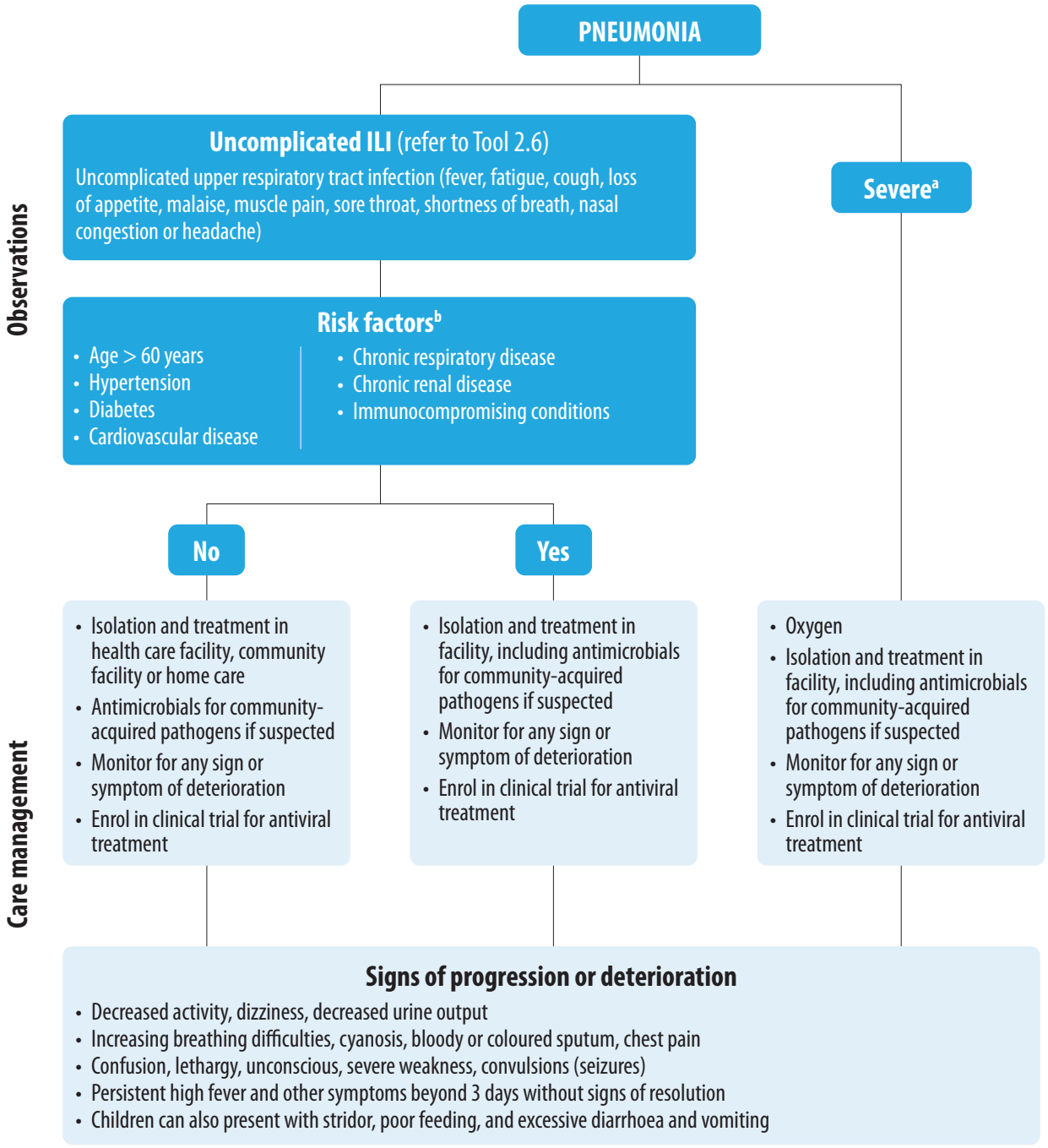
- Respiratory distress: fast breathing, shortness of breath, accessory muscle use, cyanosis. In children – central cyanosis, severe distress, grunting, severe chest indrawing or danger signs of lethargy, convulsions or inability to breastfeed or drink.
- Cardiovascular distress:
  - **Adult:** low blood pressure (SBP < 100); delayed capillary refill (> 3 seconds < 65 years or > 4.5 seconds in the elderly); fast and weak pulse.
  - **Child:** delayed capillary refill (> 3 seconds); fast and weak pulse; or cool extremities or hypotension.
- Neurologic distress: alteration in mental status such as coma, lethargy, confusion, seizures, agitation.
- Dehydration: in children – diarrhoea plus any two of the following signs: lethargy, sunken eyes, very slow skin pinch, unable to drink or drinks poorly.
- Persistent fever that is not responding after 3 days.

Emergency signs

- Obstructed or absent breathing
- Severe respiratory distress
- Central cyanosis
- Shock
- Coma
- Convulsions.

2.7 Decision-making algorithm for hospitalization of patient with pneumonia (influenza or COVID-19 known to be circulating)

This is an algorithm to assist in the decision-making for hospitalization of the patient presenting with suspected COVID-19 pneumonia. It takes into account the severity of the pneumonia and the presence or absence of risk factors for severe disease and the progression of disease. Clinical judgement is essential in disease severity assessment.



[a] Severe pneumonia

Pocket book of hospital care for children (WHO, 2013).

- Cough or difficulty breathing with at least one of the following:
  - central cyanosis or oxygen saturation (SpO_2) < 90%
  - severe respiratory distress (e.g. grunting, very severe chest indrawing)
  - general danger sign (e.g. inability to breastfeed or drink, lethargy or unconscious, convulsions)
- Any or all of the following may also be present:
  - fast breathing (e.g. 2–11 months ≥ 50/min; 1–5 years ≥ 40/min.
  - chest indrawing

IMAI district clinician manual: hospital care for adults and adolescents (WHO, 2011).

- RR > 30/min
- SpO_2 < 90%
- Signs of severe respiratory distress (e.g. inability to speak, use of accessory muscles)

[b] Defining risk factors for poor outcomes associated with COVID-19 infection is an evolving field of research. As more studies are conducted and published, our collective understanding of what places individuals at increased risk may evolve.

2.8 Decision-making support tool for hospitalization and ICU admission for patient with severe acute respiratory infection and severe pneumonia

Patients should be admitted to ICU based on severity of clinical condition and resource availability. In hospitals where oxygen therapy is only available in the ICU, admit all SARI patients to the ICU. In hospitals where oxygen therapy can also be delivered on ward, admit less severe SARI patients to the ward but with increased monitoring. During outbreaks, a surge of patients may exhaust resources; less severe cases may need to be managed outside the ICU.

In adults, the CURB-65 score is a validated tool that, when combined with clinical judgement, can be used to predict mortality and aid in determining admission for adult patients with pneumonia. This is adapted from the *British Thoracic Society guidelines for the management of community acquired pneumonia in adults* (BTS, 2009).

CURB-65 score One point for each feature present:
Confusion
Urea > 7 mmol/L
RR ≥ 30/min
Blood pressure (SPB < 90 or DPB ≤ 60 mmHg)
age ≥ **65** years

Score 0–1: low severity (risk of death is < 3%)
Score 2–3: moderate severity (risk of death 3–15%)
Score 3–5: high severity (risk of death > 15%)

If score is 0–1, consider home-based care
If score is 2 or more, consider hospitalization
If score is 3 or more, consider ICU

2.9 Checklist for admission

☑ Once you have decided to admit a patient with severe influenza virus infection to the hospital, consider using this checklist to ensure the following have been done in preparation for admission. This is adapted from the *IMAI district clinician manual: hospital care for adults and adolescents* (WHO, 2011).

☐ Essential diagnostic tests obtained:
e.g. complete blood cell count, chemistry panel, glucose, chest radiograph, upper respiratory tract specimens for viral testing (during influenza season), blood sample for culture (when possible, before first dose of antimicrobials), but do not delay antimicrobials.

☐ Emergency treatments given, patient's response checked:
e.g. oxygen therapy, insertion of peripheral IV (use appropriate antisepsis for the skin to prevent catheter-related infections), initial fluid therapy (and vasopressors if in shock).

☐ First dose of antibiotics and oseltamivir (during influenza season).

☐ Documentation completed.

☐ Determined the level of care the patient needs:
e.g. ICU, high dependency unit, ward.

☐ Determined infection prevention and control measures the patient needs.

☐ Verbal communication with ward staff completed to ensure continuity of care.

☐ Patient prepared for safe transfer.

2.10 Checklist for transfer

Transport of the critically ill patient can be risky as complications during this process can be life threatening and may be related to clinical, organizational, or equipment issues.

☑ Consider using this checklist to ensure the safe transport of the patient to the designated unit. This is adapted from the *IMAI district clinician manual: hospital care for adults and adolescents* (WHO, 2011).

☐ Patient stabilized.

☐ Appropriate infection prevention and control measures in place:
e.g. medical mask for patients with ARI.

☐ Everything secured: airway, NG tube, IV, monitors, endotracheal tubes, ventilator.

☐ Enough drugs: vasopressors, sedatives.

☐ Enough oxygen: adequate oxygen saturation (SpO_2).

☐ Enough IV fluids: blood pressure adequate.

☐ Health care workers (e.g. transporters, receiving staff) and receiving unit/ward prepared.

3 Infection prevention and control for patients with SARI

3 Infection prevention and control for patients with SARI

Summary

Administrative and engineering measures and personal protective equipment (PPE) work in harmony to prevent the spread of infection and keep health care workers and patients safe.

When caring for **all** patients in the hospital, implement standard precautions, which include **hand hygiene!**

When caring for patients with ARI also use droplet precautions.

When caring for patients with SARI that may have avian influenza, MERS-CoV, COVID-19 or novel viral infection, also add contact precautions.

When carrying out certain high-risk procedures such as intubation, use airborne precautions.

Tools

References and resources

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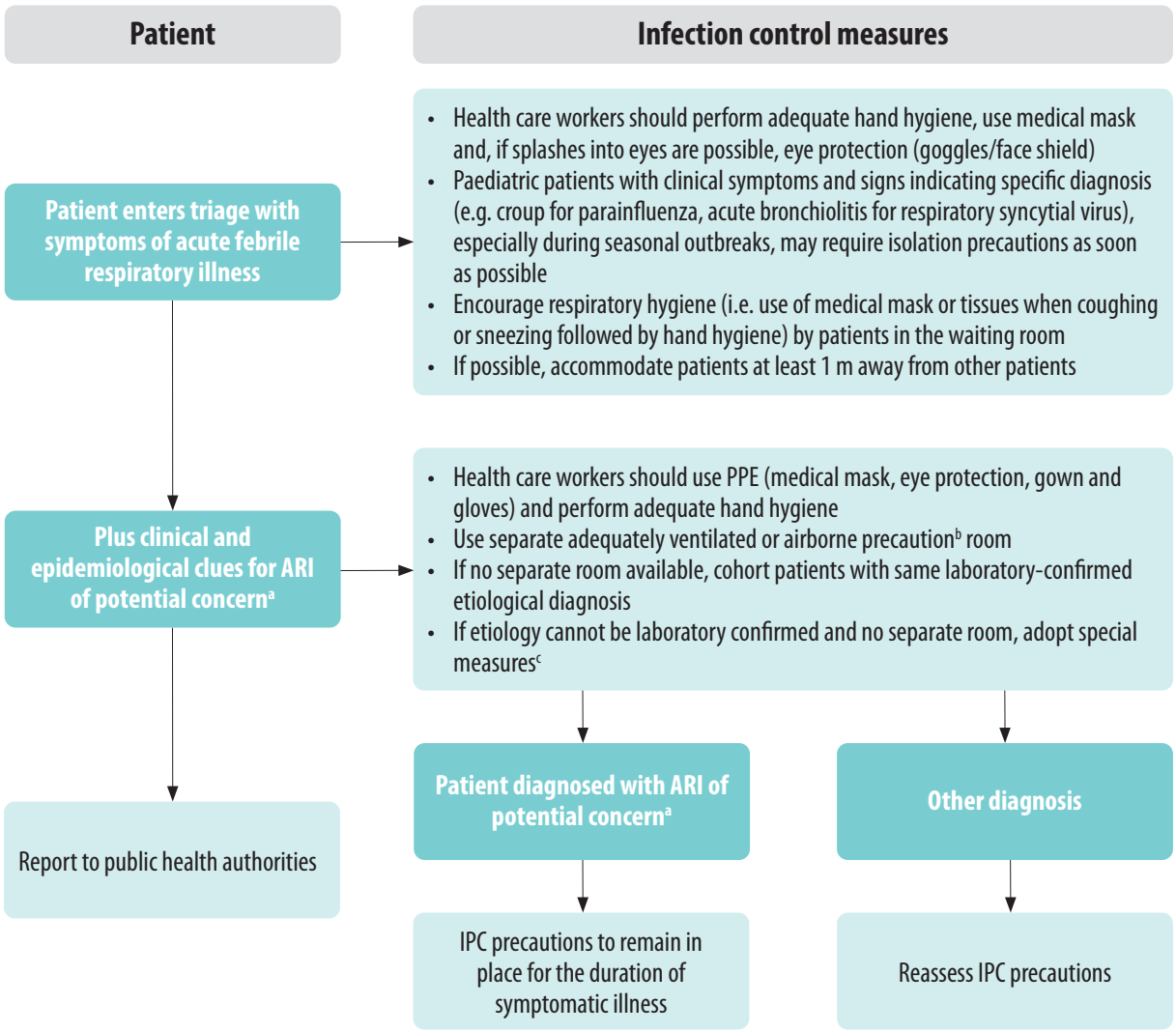
3.1 How to implement infection control measures for COVID-19

Instructions for patients	Give suspect patient a medical mask and direct patient to separate area; an isolation room if available. Keep at least 1 m distance between suspected patients and other patients. 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.
Apply droplet precautions	Droplet precautions prevent large droplet transmission of respiratory viruses. Use a medical mask if working within 1 m of the patient. Place patients in single rooms, or group together those with the same etiological diagnosis. If an etiological diagnosis is not possible, group patients with similar clinical diagnosis and based on epidemiological risk factors, with a spatial separation. When providing care in close contact with a patient with respiratory symptoms (e.g. coughing or sneezing), use eye protection (face mask or goggles), because sprays of secretions may occur. Limit patient movement within the institution and ensure that patients wear medical masks when outside their rooms.
Apply contact precautions	Contact precautions prevent direct or indirect transmission from contact with contaminated surfaces or equipment (i.e. contact with contaminated oxygen tubing/interfaces). Use PPE (medical mask, eye protection, gloves and gown) when entering room and remove PPE when leaving and practise hand hygiene following PPE removal. If possible, use either disposable or dedicated equipment (e.g. stethoscopes, blood pressure cuffs, pulse oximeters and thermometers). If equipment needs to be shared among patients, clean and disinfect between each patient use. Ensure that health care workers refrain from touching their eyes, nose and mouth with potentially contaminated gloved or ungloved hands. Avoid contaminating environmental surfaces that are not directly related to patient care (e.g. door handles and light switches). Avoid medically unnecessary movement of patients or transport. Perform hand hygiene.
Apply airborne precautions when performing an aerosol-generating procedure	Ensure that health care workers performing aerosol-generating procedures (e.g. open suctioning of respiratory tract, intubation, bronchoscopy, cardiopulmonary resuscitation) use the appropriate PPE, including gloves, long-sleeved gowns, eye protection, and fit-tested particulate respirators (N95 or equivalent, or higher level of protection). A scheduled fit test should not be confused with a user's seal check before each use. Whenever possible, use adequately ventilated single rooms when performing aerosol-generating procedures, meaning negative pressure rooms with a minimum of 12 air changes per hour or at least 160 L/second/patient in facilities with natural ventilation. Avoid the presence of unnecessary individuals in the room. Care for the patient in the same type of room after mechanical ventilation begins.

3.2 How to implement infection control measures for SARI

These algorithms are adapted from the WHO guidelines, *Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care* (WHO, 2014).

Decision-tree for infection prevention and control measures for patients known or suspected to have an acute respiratory infection



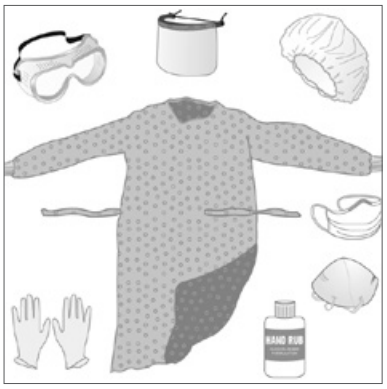
[a] ARIs of potential concern include SARS, COVID-19, new influenza virus causing human infection (e.g. human cases of avian influenza) and novel organism-causing ARIs that can cause outbreaks with high morbidity and mortality. Clinical and epidemiological clues include severe disease in a previously healthy host, exposure to household member or close contact with severe ARI, cluster of cases, travel, exposure to ill animals or laboratory.
[b] Airborne precaution rooms include both mechanically and naturally ventilated rooms with ≥ 12 air changes per hour and controlled direction of airflow.
[c] The term "special measures" means allowing patients with epidemiological and clinical information suggestive of a similar diagnosis to share a room, but with a spatial separation of at least 1 m.

3.3 Personal protective equipment (PPE)

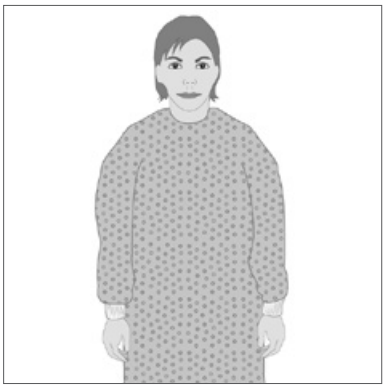
Remember, PPE use should be guided by risk assessment concerning anticipated contact with blood and other bodily fluids, including respiratory droplets and secretions, during patient care and presence of non-intact skin. For example, if there is a risk of splash to the body and face then use hand hygiene, gloves, gown, medical mask and eyewear. How to put and remove PPE appropriately is shown below.

Putting on and removing PPE

A. Putting on PPE (when all PPE items are needed)



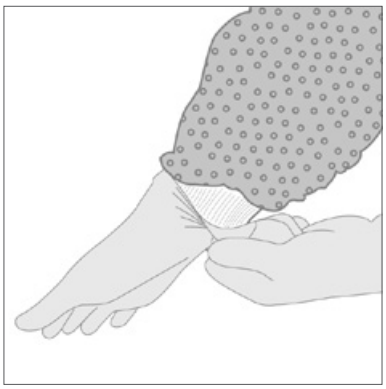
1 Identify hazards and manage risk.
- Gather the necessary PPE.
- Plan where to put on and take off PPE.
- Do you have a buddy? Mirror?
- Do you know how you will deal with waste?



2 Put on a gown.

3 Put on particulate respirator or medical mask; perform user seal check if using a respirator.

4 Put on eye protection, e.g. face shield/ goggles (consider anti-fog drops or fog-resistent goggles). Caps are optional; if worn, put on after eye protection.



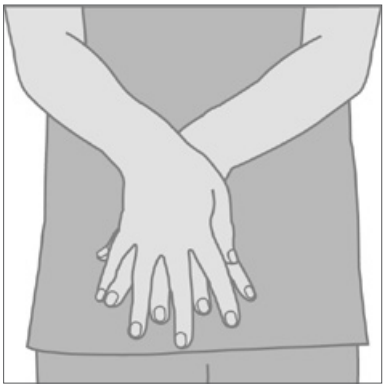
5 Put on gloves (over cuff).

B. Taking off PPE

1 Avoid contamination of self, others and the environment. Remove the most heavily contaminated items first.

Remove gloves and gown:

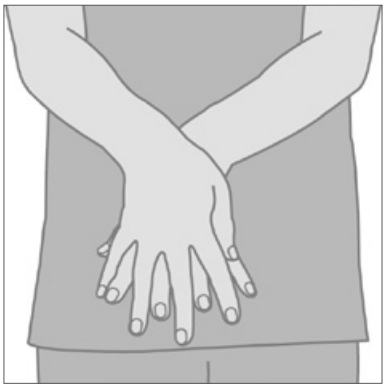
- Peel off gown and gloves and roll inside out.
- Dispose gloves and gown safely.



2 Perform hand hygiene.

3 Remove cap (if worn). Remove goggles from behind. Put goggles in a separate container for reprocessing.

4 Remove respirator from behind.



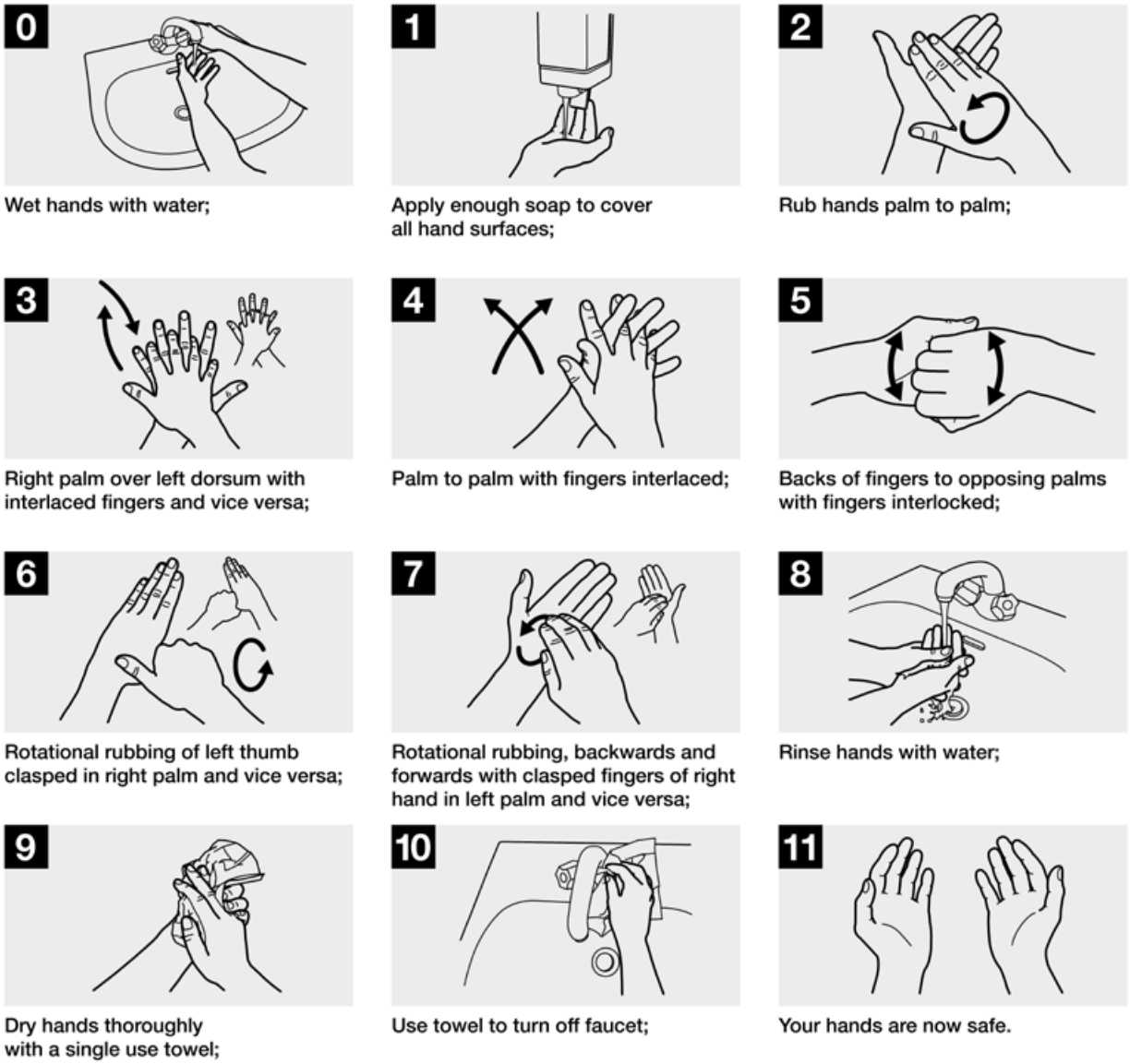
5 Perform hand hygiene.

3.4 Hand hygiene

Hand hygiene must be performed before and after any contact with patients and after contact with contaminated items or surfaces. Use an alcohol-based product if hands are not visibly soiled. Wash hands with soap and water when they are visibly soiled or contaminated with proteinaceous material. Below is an example of hand washing with soap and water. The same rubbing technique can be used with alcohol-based product. This entire procedure can take should take 40–60 seconds (20–30 seconds for alcohol-based hygiene).

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40–60 seconds



3.5 Checklist for aerosol-generating procedures

☑ Consider using this checklist when performing aerosol-generating procedures, such as intubation, cardiopulmonary resuscitation, bronchoscopy, aspiration, or open suctioning of respiratory tract secretions.

Note: There is limited research available regarding the risk of non-invasive ventilation and high-flow oxygen therapy, but experts suggest using airborne precautions in these procedures also.

☐ Perform hand hygiene before and after patient contact **and** after PPE removal.

☐ Use a facial particulate respirator (e.g. European Union FFP2 or United States of America National Institute for Occupational Safety and Health-certified N95). Perform a seal check.

☐ Use eye protection (e.g. goggles or a face shield).

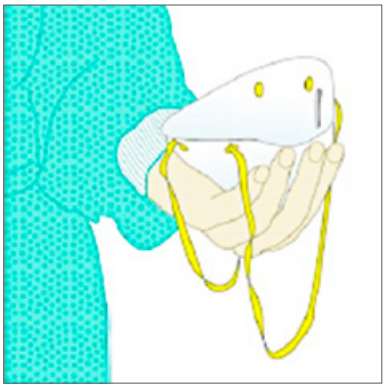
☐ Use a clean, non-sterile, long-sleeved gown.

☐ Use gloves (some of these procedures require sterile gloves).

☐ Make sure adequately ventilated room (e.g. ≥ 12 air changes per hour plus control of airflow direction).

☐ Avoid unnecessary individuals in the room.

Sequence of steps in a particulate respirator seal check



1 Cup the respirator in your hand with the nosepiece at your fingertips allowing the headbands to hang freely below your hand.

2 Position the respirator under your chin with the nosepiece up.

3 Pull the top strap over your head resting it high at the back of your head. Pull the bottom strap over your head and position it around the neck below the ears.

4 Place fingertips of both hands at the top of the metal nosepiece. Mould the nosepiece (USING TWO FINGERS OF EACH HAND) to the shape of your nose. Pinching the nosepiece using one hand may result in less effective respirator performance.

5 Cover the front of the respirator with both hands, being careful not to disturb the position of the respirator.

5A Positive seal check
Exhale sharply. A positive pressure inside the respirator = no leakage. If leakage, adjust position and/or tension straps. Reset the seal.

Repeat the steps until respirator is sealed properly.

5B Negative seal check
Inhale deeply. If no leakage, negative pressure will make respirator cling to your face.

Leakage will result in loss of negative pressure in the respirator due to air entering through gaps in the seal.

4 Monitoring the patient

4 Monitoring the patient

Summary

Patients with severe or critical illness are frequently monitored because of their dynamic clinical condition and need for timely (and titrated) interventions.

The National Early Warning Score (NEWS) is a standardized tool that can be used in hospital and pre-hospital settings to trigger early and appropriate clinical response to deteriorating patients. The Paediatric Early Warning Score (PEWS) is a standardized tool used to identify hospitalized children at risk of clinical decompensation.

In the ICU, haemodynamic and respiratory physiological parameters are monitored frequently (sometimes continuously); along with frequent physical exams and laboratory tests, as needed. Don't forget to take a history.

Pulse oximetry is essential at all health facilities to assess patients at first point of contact, to conduct triage and inform referral.

When patients fail to respond to treatments or deteriorate, use a systematic approach to interpret data and modify the treatment plan, then continue monitoring.

Tools

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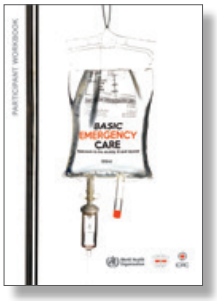
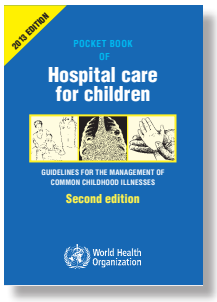
Key resources for supporting management of severe acute respiratory infections in children



Basic emergency care (BEC): approach to the acutely ill and injured (2018)

Developed by WHO and ICRC, in collaboration with the International Federation for Emergency Medicine, *Basic emergency care (BEC): approach to the acutely ill and injured* is an open-access training course for front-line health care providers who manage acute illness and injury with limited resources. Produced in response to requests from multiple countries and international partners, the BEC package includes a Participant Workbook and electronic slide decks for each module. Integrating the guidance from WHO *Emergency triage, assessment and treatment (ETAT)* for children and the *Integrated management of adult/adolescent illness (IMAI)*, BEC teaches a systematic approach to the initial assessment and management of time-sensitive conditions where early intervention saves lives.

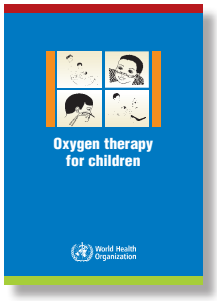
https://www.who.int/publications-detail/basic-emergency-care-approach-to-the-acutely-ill-and-injured



Pocket book of hospital care for children: guidelines for the management of common illnesses with limited resources (second edition) (2013)

This is for use by doctors, nurses and other health workers caring for children at first level referral hospitals with basic laboratory facilities and essential medicines. These guidelines focus on the management of the major causes of childhood mortality in most developing countries including pneumonia, and also cover common procedures, patient monitoring and supportive care on the wards.

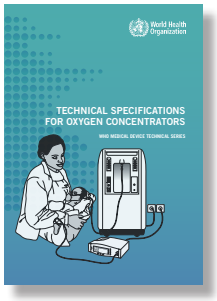
https://www.who.int/maternal_child_adolescent/documents/child_hospital_care/en/



Oxygen therapy for children (2016)

This is a bedside manual for health workers to guide the provision of oxygen therapy for children. The manual focuses on the availability and clinical use of oxygen therapy in children in health facilities to guide health workers, biomedical engineers and administrators. It addresses detection of hypoxaemia, use of pulse oximetry, clinical use of oxygen, delivery systems and monitoring of patients on oxygen therapy. The manual also addresses the practical use of pulse oximetry, and oxygen concentrators and cylinders.

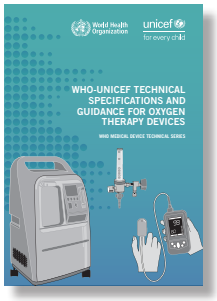
http://www.who.int/maternal_child_adolescent/documents/child-oxygen-therapy/en/



Technical specifications for oxygen concentrators (2015)

This provides an overview of oxygen concentrators and technical specifications to aid in selection, procurement and quality assurance. It highlights the minimum performance requirements and technical characteristics for oxygen concentrators and related equipment that are suitable for the use in health facilities.

https://www.who.int/medical_devices/publications/tech_specs_oxygen-concentrators/en/



WHO-UNICEF technical specifications and guidance for oxygen therapy devices (2019)

The purpose of this document is to increase access to quality products to ensure the supply of oxygen, especially in low- and middle-income countries and low-resource settings within countries from all income groupings. This project is one of many related to improving oxygen supply that other stakeholders are working on. These efforts aim to support ministries of health to ensure oxygen supply is available, as well as raise awareness of the importance of appropriate selection, procurement, maintenance and use of medical devices, both capital equipment and single-use devices.

https://www.who.int/medical_devices/publications/tech_specs_oxygen_therapy_devices/en/

4.1 AVPU scale: a simple tool for assessing level of consciousness

This scale is a simple way to assess a patient's mental status. Each letter corresponds to the patient's level of consciousness.

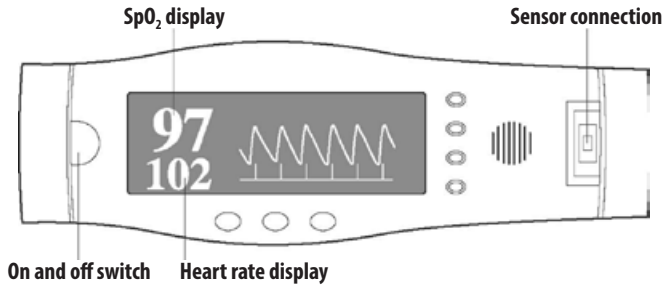
Score	Description
A	Alert
V	Responds to verbal stimuli
P	Responds to painful stimuli
U	Unresponsive or coma

4.2 Pulse oximetry monitoring

A pulse oximeter measures oxygen saturation of haemoglobin in the blood by comparing the absorbance of light of different wavelengths across a translucent part of the body. Pulse oximetry is the best method available for detecting and monitoring hypoxaemia. Even the best combinations of clinical signs commonly lead to misdiagnosis of hypoxaemia in some patients with normal oxygen saturation or fail to detect some hypoxaemic patients. Pulse oximetry should be performed on all patients with SARI.

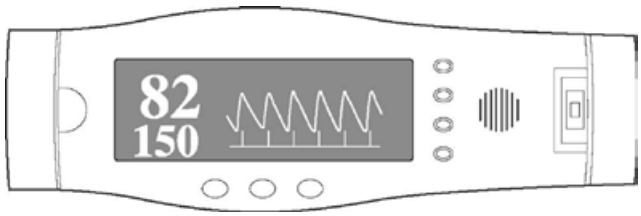
Examples of pulse oximeter displays showing normal and abnormal readings are given below.

Pulse oximeter displaying normal reading



This image shows a pulse oximeter with a normal reading (pulse rate = 102 BPM; SpO_2 = 97%) and a plethysmographic (pulse) wave indicating a good arterial trace and a valid reading.

Pulse oximeter displaying abnormal reading



In this image (pulse rate = 150 BPM; SpO_2 = 82%), the pulse oximeter has a good plethysmographic wave, indicating a valid arterial trace. Therefore, the SpO_2 reading, which is abnormally low (82%), is accurate and indicates that the patient is hypoxaemic. Oxygen should be given. Note the increased heart rate, which is common in seriously ill patients.

Source: Oxygen therapy for children (WHO, 2016).

4.3 Blood gas analysis monitoring

Blood gas analysis can be used to measure the PaO_2 and carbon dioxide in arterial (or venous or capillary) blood. It also indicates the blood pH, which is often abnormal in seriously ill patients with SARI. Metabolic acidosis (low blood pH) is commonly seen when there is major disturbance of the circulation or oxygen delivery, as in severe hypoxaemia due to SARI, ARDS, sepsis and septic shock. Thus, blood gas analysis provides information on oxygenation, ventilation and circulation, and electrolyte concentrations (particularly sodium and potassium) which are measured in the same blood sample and analyser.

Electrolyte abnormalities are common in seriously ill patients with SARI. With an arterial cannula for repeated blood sampling, arterial blood gas analysis is a means for monitoring changes in response to therapy. Venous and capillary blood are easier to monitor than arterial blood but are of no use for determining oxygenation. The carbon dioxide level in arterial, capillary or venous blood helps in assessing alveolar ventilation and monitoring trends in the efficiency of ventilation. The pH is a direct indicator of overall acid–base status in arterial, capillary and venous blood. The probable cause of pH disturbances can be inferred only from the partial pressure of carbon dioxide and the blood bicarbonate concentration (or the base excess or deficit).

Source: Oxygen therapy for children (WHO, 2016).

4.4 National Early Warning Score (NEWS) for adults

The NEWS score was developed by the Royal College of Physicians (United Kingdom of Great Britain and Northern Ireland) to improve the assessment of acute-illness severity of patients in hospital and pre-hospital settings. Please refer to all materials, including posters and training materials, on their website (https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2).

Chart 1: NEWS scoring system

Physiological parameter	Score 3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Source: Royal College of Physicians (2017).

Chart 2: NEWS thresholds and triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

**The response team must also include staff with critical care skills, including airway management.

Source: Royal College of Physicians (2017).

Chart 3: Clinical response to NEWS trigger thresholds

NEW score	Frequency of monitoring	Clinical response
0	Minimum 12 hourly	• Continue routine NEWS monitoring
Total 1–4	Minimum 4–6 hourly	• Inform registered nurse, who must assess the patient • Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required
3 in single parameter	Minimum 1 hourly	• Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary
Total 5 or more Urgent response threshold	Minimum 1 hourly	• Registered nurse to immediately inform the medical team caring for the patient • Registered nurse to request urgent assessment by a clinician or team with core competencies in the care of acutely ill patients • Provide clinical care in an environment with monitoring facilities
Total 7 or more Emergency response threshold	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 team with critical care competencies, including practitioner(s) with advanced airway management skills • Consider transfer of care to a level 2 or 3 clinical care facility, ie higher-dependency unit or ICU • Clinical care in an environment with monitoring facilities

Source: Royal College of Physicians (2017).

4.5 Paediatric Early Warning Score (PEWS)

This score was published in *Critical Care* in 2011 (see Parshuram et al, 2011), has been used in Canada and the United Kingdom of Great Britain and Northern Ireland and has been shown to be clinically effective in low-resource settings (see Brown et al, 2019).

As in the adult scoring system, it is used to alert staff on general paediatric wards that a child is becoming critically unwell. The scoring system may need calibration or adjustment if used in a different environment to that for which it was developed. A score of 8 or more has a sensitivity of 83% for an impending emergency, including a possible cardiopulmonary arrest, and indicates that the child is critically ill and should be evaluated immediately by a physician and that a higher level of care should be considered.

The seven items in the lefthand column should be scored and added together.

		Item sub-score			
Item	**Age group**	**0**	**1**	**2**	**4**
HR (bpm)	0 to < 3 months	> 110 and < 150	≥ 150 or ≤ 110	≥ 180 or ≤ 90	≥ 190 or ≤ 80
	3 to < 12 months	> 100 and < 150	≥ 150 or ≤ 100	≥ 170 or ≤ 80	≥ 180 or ≤ 70
	1–4 years	> 90 and < 120	≥ 120 or ≤ 90	≥ 150 or ≤ 70	≥ 170 or ≤ 60
	> 4–12 years	> 70 and < 110	≥ 110 or ≤ 70	≥ 130 or ≤ 60	≥ 150 or ≤ 50
	> 12 years	> 60 and < 100	≥ 100 or ≤ 60	≥ 120 or ≤ 50	≥ 140 or ≤ 40
SBP (mmHg)	0 to < 3 months	> 60 and < 80	≥ 80 or ≤ 60	≥ 100 or ≤ 50	≥ 130 or ≤ 45
	3 to < 12 months	> 80 and < 100	≥ 100 or ≤ 80	≥ 120 or ≤ 70	≥ 150 or ≤ 60
	1–4 years	> 90 and < 110	≥ 110 or ≤ 90	≥ 125 or ≤ 75	≥ 160 or ≤ 65
	> 4–12 years	> 90 and < 120	≥ 120 or ≤ 90	≥ 140 or ≤ 80	≥ 170 or ≤ 70
	> 12 years	> 100 and < 130	≥ 130 or ≤ 100	≥ 150 or ≤ 85	≥ 190 or ≤ 75
CR time		< 3 seconds			≥ 3 seconds
RR (breaths/min)	0 to < 3 months	> 29 and < 61	≥ 61 or ≤ 29	≥ 81 or ≤ 19	≥ 91 or ≤ 15
	3 to < 12 months	> 24 or < 51	≥ 51 or ≤ 24	≥ 71 or ≤ 19	≥ 81 or ≤ 15
	1–4 years	> 19 or < 41	≥ 41 or ≤ 19	≥ 61 or ≤ 15	≥ 71 or ≤ 12
	> 4–12 years	> 19 or < 31	≥ 31 or ≤ 19	≥ 41 or ≤ 14	≥ 51 or ≤ 10
	> 12 years	> 11 or < 17	≥ 17 or ≤ 11	≥ 23 or ≤ 10	≥ 30 or ≤ 9
Respiratory effort		Normal	Mild increase	Moderate increase	Severe increase/ any apnoea
SpO_2 (%)		> 94	91 to 94	≤ 90	
Oxygen therapy		Room air		Any to < 4 L/min or < 50%	≥ 4 L/min or ≥ 50%

Source: Parshuram et al (2011).

Notes: CR time – capillary refill time; HR – heart rate; RR – respiratory rate; SBP – systolic blood pressure; SpO_2 – peripheral oxygen saturation.

5 Respiratory specimen collection and processing

5 Respiratory specimen collection and processing

Summary

In patients with SARI, the differential diagnosis should include community-acquired pathogens, including influenza virus infection if influenza activity is known or suspected in the community, or novel virus infection, such as COVID-19, if epidemiological risk factors are present. Differential diagnosis should also be informed by local epidemiology, including viral infections such as malaria, dengue or tuberculosis.

In malaria-endemic areas, patients with fever should be tested for the presence of malaria or other co-infections and treated as appropriate. In endemic settings, arbovirus infection (dengue/chikungunya) should also be considered in the differential diagnosis of undifferentiated febrile illness, particularly when thrombocytopenia is present. Co-infection with COVID-19 virus may also occur and a positive diagnostic test for dengue does not exclude the testing for COVID-19.

If patient meets criteria for SARI treatment, collect blood and sputum cultures for bacteria that cause pneumonia and sepsis, ideally before antimicrobial therapy. However, **do not delay** empiric antimicrobial treatment with antibiotics or antivirals if influenza virus infection is suspected.

Collect specimens from the upper respiratory tract (URT: nasopharyngeal and oropharyngeal) AND, where clinical suspicion remains and URT specimens are negative, collect specimens from the lower respiratory tract when readily available (LRT: expectorated sputum, endotracheal aspirate or bronchoalveolar lavage in ventilated patient) for COVID-19 virus testing by RT-PCR and bacterial stains/cultures.

In hospitalized patients with confirmed COVID-19, repeat URT and LRT samples can be collected to demonstrate viral clearance. The frequency of specimen collection will depend on local epidemic characteristics and resources. For hospital discharge, in a clinically recovered patient, two negative tests, at least 24 hours apart, are recommended.

Tools

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5.1 Differential diagnosis of SARI

It is important to develop a differential diagnosis rapidly for all patients presenting with SARI. This will allow you to guide the initial IPC, diagnostic and treatment measures.

The rate of co-infection (COVID-19 infection complicated by another infection) is unknown. Therefore, a positive diagnostic test for another infection does not exclude the need for COVID-19 testing.

Viral pathogens

Common viral pathogens
Respiratory syncytial virus (RSV), parainfluenza virus, rhinoviruses, adenovirus, enterovirus (EVD68), human metapneumovirus, bocavirus, influenza virus.
Less common, unless at risk or increased risk due to an epidemic
Varicella zoster, measles, human coronavirus including COVID-19, MERS and SARS, hantavirus.
If immunosuppressed (i.e. PL-HIV)
Cytomegalovirus, herpes simplex viruses in addition to above.

Bacterial pathogens

Most common bacterial pathogens
Streptococcus pneumoniae, Hemophilus influenzae, Moraxella catarrhalis, Legionella pneumophila, non-pneumophila Legionella, Chlamydia pneumonia, Mycoplasma pneumoniae, Klebsiella pneumonia, Staphylococcus aureus.
Less common, unless at risk or in high-prevalence country
Mycobacterium tuberculosis, Burkholderia pseudomallei, Rickettsial infections, Coxiella burnetti (Q fever), Leptospira spp, Chlamydia psittaci, Bortedella pertussis, Salmonella sp.
Resistant pathogens
Risk factors for multidrug-resistant pathogens
Intravenous antimicrobial therapy within < 90 days.
Resistant pathogens include
• Methicillin-resistant *S. aureus* (MRSA). • Non-fermenters such as *Pseudomonas aeruginosa, Acinetobacter baumannii.* • Extended spectrum beta-lactamase (ESBL) producers such as *E. coli, Klebsiella, Enterobacter*.

Other endemic infections

Potential endemic infections
Malaria, dengue, chikungunya, tuberculosis, HIV.

5.2 Specimen collection kit for upper respiratory tract specimens

It is best to compile a specimen collection kit before starting to take specimens. Here is an inventory of all items that should be in the specimen collection kit for upper respiratory tract specimens.

Required items

© WHO/Tim Healing

- PPE (gloves, medical mask, gown)
- ice packs/cooler box
- field collection forms
- an alcohol-resistant pen or marker for labelling samples
- sterile Dacron or rayon swabs
- 1–2 mL viral transport medium
- specimen collection containers.

Technique

1. Disinfect bottles.
2. Swab with rigid (plastic) shaft for throat and nasal specimens.
3. Use tongue depressors for throat swabs.
4. Use sterile saline (0.9% NS) for nasopharyngeal aspiration.
5. Use sputum or mucus trap for nasopharyngeal aspiration (also require negative pressure).

Swabs

The type of swab used is very important. Only **sterile Dacron or rayon swabs** with **aluminum or plastic shafts** should be used. This is because calcium alginate or cotton swabs, or swabs with wooden sticks, may contain substances that inactivate some viruses and inhibit PCR testing.

5.3 Nasopharyngeal swab technique

Required materials

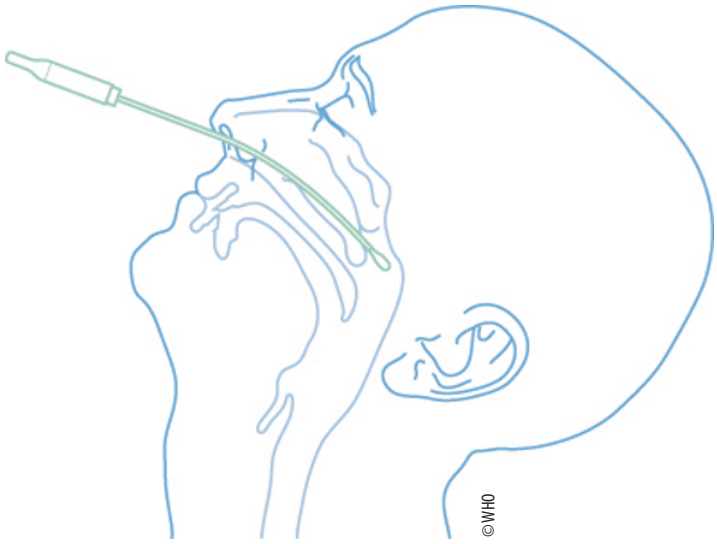
- swab with **flexible** (aluminium) shaft.

Technique

1. Apply standard, contact and droplet precautions.
2. Insert swab into one nostril and back into the nasopharynx.
3. Leave swab in place for a few seconds.
4. Then slowly remove swab while rotating it over surface of posterior nasopharynx.
5. Withdraw swab from collection site; insert into transport tube or container with viral transport medium.
6. Repeat procedure with another swab for the second nostril to deliver optimal combined sample.
7. Label specimen container.
8. After collection, immediately transport specimen to the laboratory for viral PCR testing and viral antigen detection. If transport to the laboratory is delayed, place specimen on ice or in refrigeration.

In case of nasopharyngeal swab in **infants** and **young children**:

- Use a swab of appropriate size: measure the distance from the nose to the ear (philtrum to the tragus).
- Insert the swab half to full amount of that distance, stopping if you encounter resistance.
- Insert the swab horizontally, below the inferior turbinate, not diagonally up the nose.



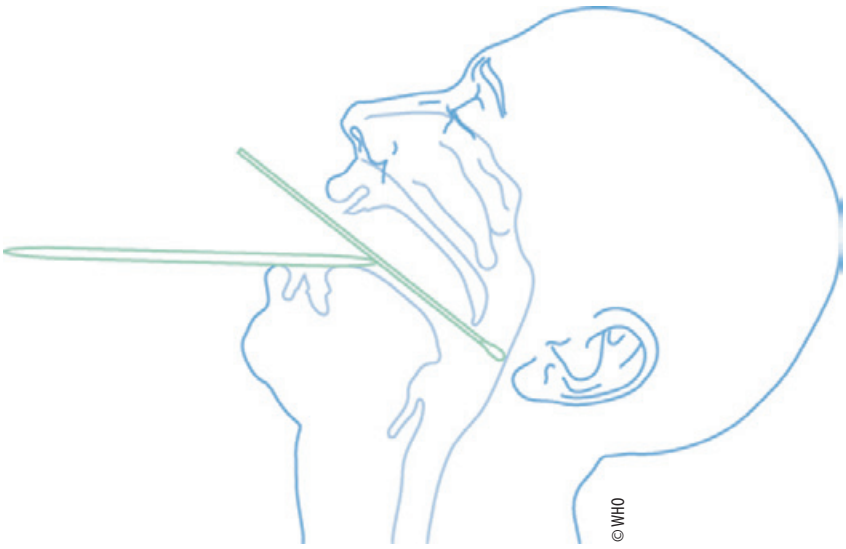
5.4 Posterior pharyngeal swab or throat swab technique

Required materials

- swab with rigid (plastic) shaft
- tongue depressor.

Technique

1. Apply standard, contact and droplet precautions.
2. Ask the subject to open his or her mouth and say "ah" to elevate the uvula.
3. Depress the tongue to hold out of way with tongue depressor.
4. Swab the posterior pharynx and avoid tonsils and do not touch tongue with swab.
5. Insert into transport tube or container with viral transport medium. Break applicator tip to ensure closure of vial.
6. Label specimen container.
7. Immediately transport specimen to the laboratory for viral PCR testing and viral antigen detection. If transport to the laboratory is delayed, place specimen on ice or in refrigeration.



5.5 Tracheal aspirate technique

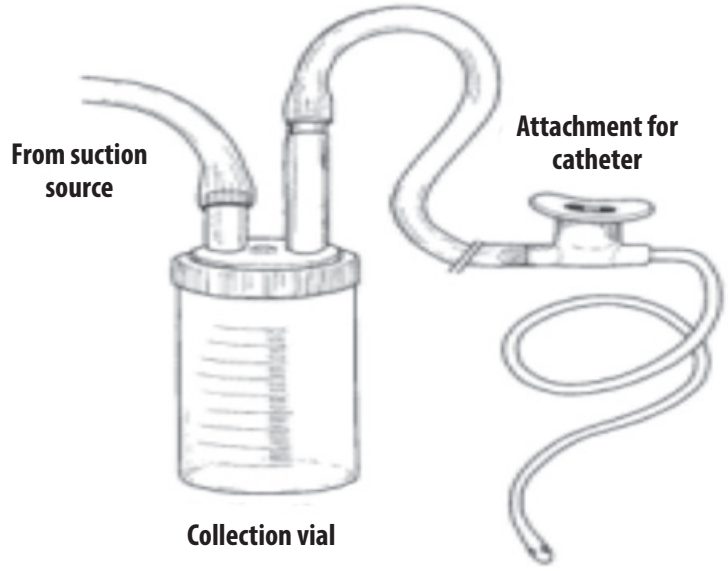
Intended for patients intubated and receiving invasive mechanical ventilation (IMV).

Required materials

- suction outlet (portable or wall)
- sterile suction catheter
- specimen mucus trap (i.e. Lucken's tube)
- sterile saline (0.9% NS)
- IPC for airborne precautions (N-95 particulate mask)
- a sterile suction catheter (not a closed, inline system)
- suction tubing
- airway emergency equipment.

Technique

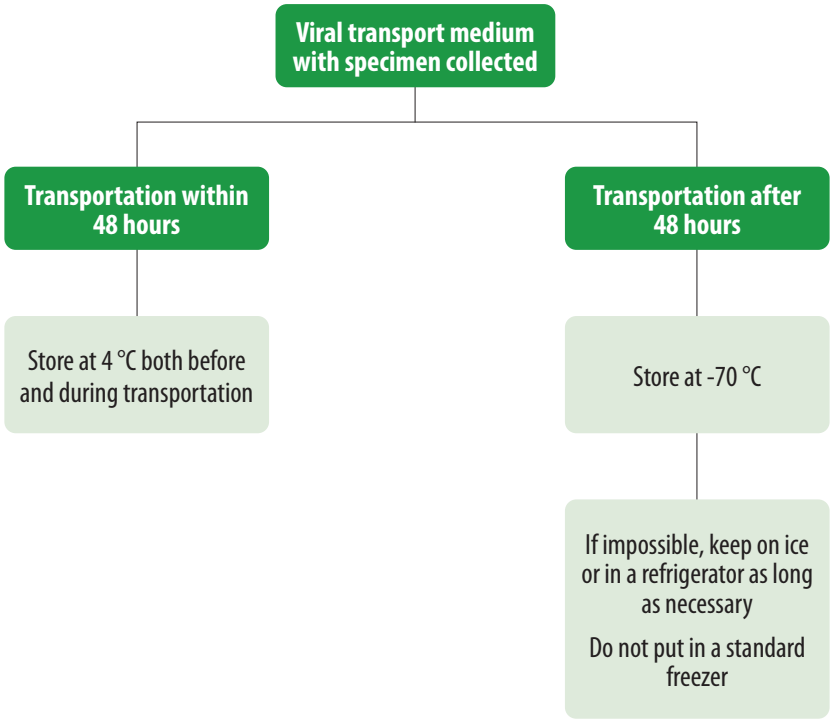
1. Apply standard, contact, droplet and airborne precautions.
2. Prepare patient: pre-oxygenate with 100% fraction of inspired oxygen (FiO_2). Give adequate sedation.
3. Attach mucous trap to catheter and suction outlet. Turn on suction to make sure functioning. Then turn it off.
4. When you are ready, disconnect ventilator tubing from endotracheal tube.
5. Without applying suction, insert sterile suction catheter apparatus into endotracheal tube, about 2–3 cm beyond tip.
6. Apply suction and collect sample into the mucous trap. Hold trap upright to prevent secretions from going into the pump. Slowly withdraw catheter. Replace ventilator tubing.
7. If inadequate sample, instill 3–5 mL of sterile saline, give two sigh breaths and apply suction.
8. After collection, immediately transport specimen to laboratory for viral testing and bacteriology.
9. Store in refrigerator (2–8 °C) for maximum 24 hours.
10. If delay, store in freezer < -20 °C.



5.6 Guideline for specimen storage

Viral transport medium is used immediately after the collection of samples for viral isolation and testing. It prevents the specimen from drying out and prevents bacterial and fungal growth.

Although you should send specimens in viral transport medium to the laboratory as soon as possible, it is important to properly store them before you send them to a laboratory if there is a delay.



Do not freeze samples in the standard freezer. It is very important to avoid freeze-thaw cycles because this will destroy the virus. It is better to keep a sample on ice even for a week, than to allow the sample to freeze and thaw multiple times.

Viral transport medium information

Possible suppliers
Local laboratory and commercial supplier.

Description
It is usually supplied in the form of 1–3 mL of viral transport medium in sterile container.

Stock management
It is important that clinicians liaise with the laboratory to make sure that there is sufficient stock of viral transport medium available at facility, and that the viral transport medium is stored in an area which is accessible to clinicians when needed.

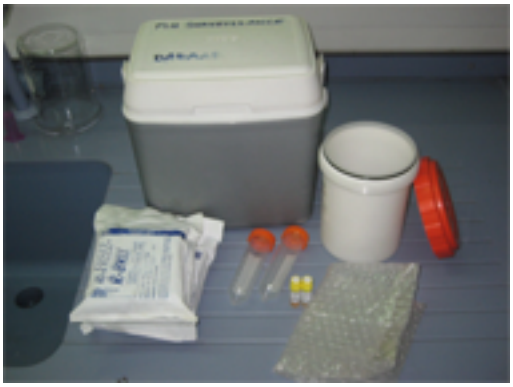
Conservation
If viral transport medium must be stored for long periods this should be done in a freezer at -20 ºC. For short periods of time viral transport medium may be stored in a fridge at 4–6 ºC.

5.7 Material for specimen transportation

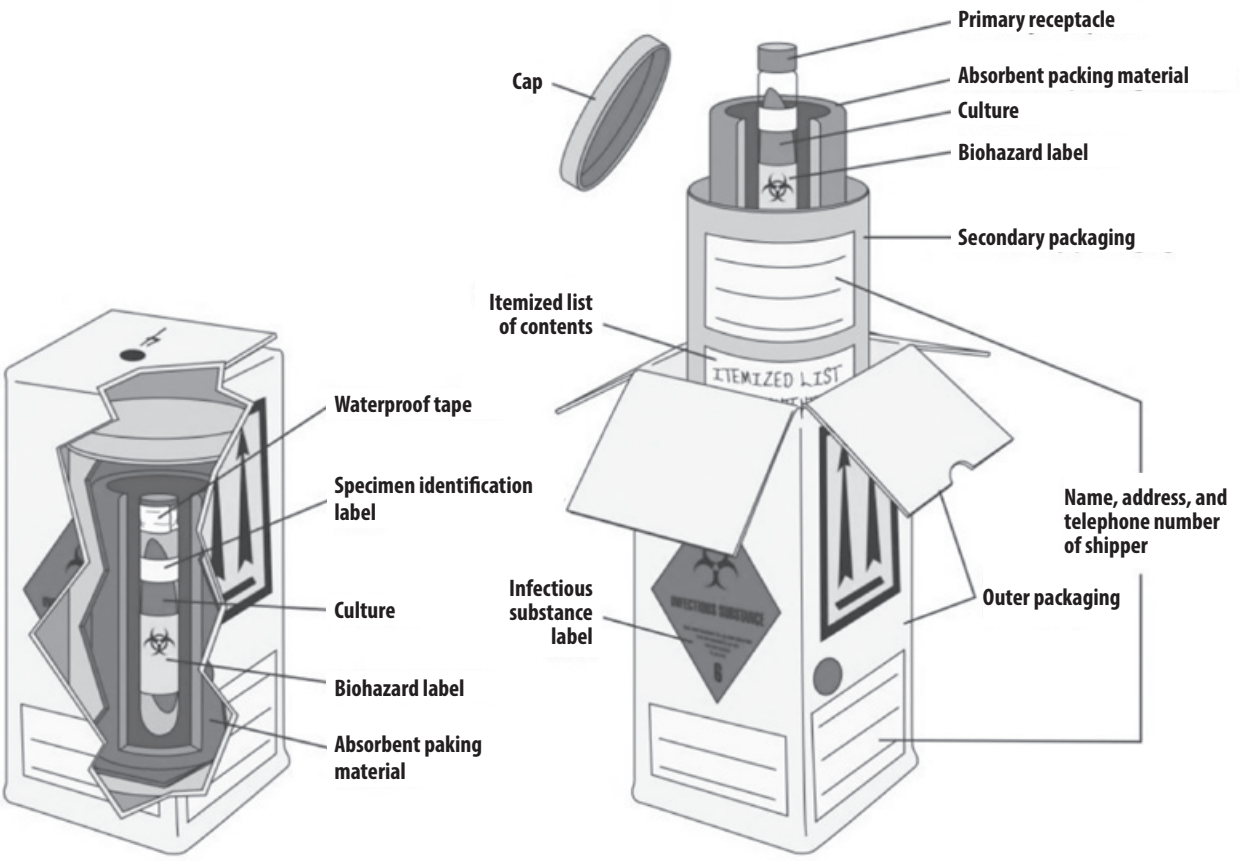
When you are ready to pack specimens, no more than 500 mL should be in the specimen container. For transportation from the field to the laboratory, you must use three packaging layers. This is done to protect specimens from damage during transportation.

Required materials

- primary waterproof container (e.g. Falcon tube)
- absorbent material:
  - bubble wrap
  - secondary recipient
  - cooler box
  - ice packs
  - sample identification form.



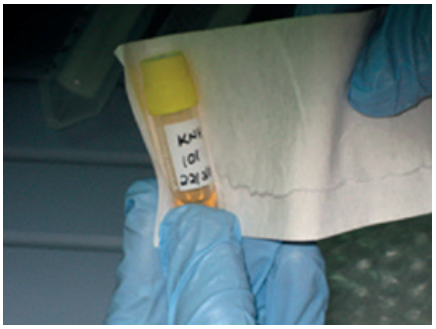
Packing and labelling of infectious substances not refrigerated



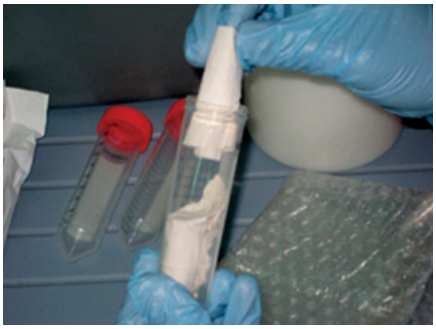
5.8 Guideline for specimen transportation

Viral transport medium is used immediately after the collection of samples for viral isolation and testing. It prevents the specimen from drying out and prevents bacterial and fungal growth.

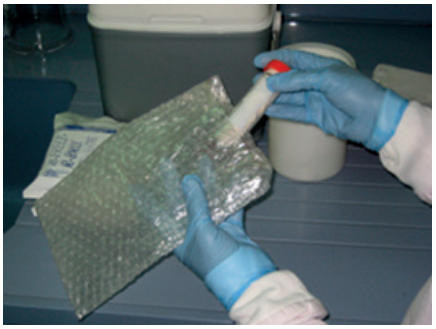
Although you should send specimens in viral transport medium to the laboratory as soon as possible, it is important to properly store them before you send them to a laboratory if there is a delay.



1 Envelop the cryo-tube with blotting paper.



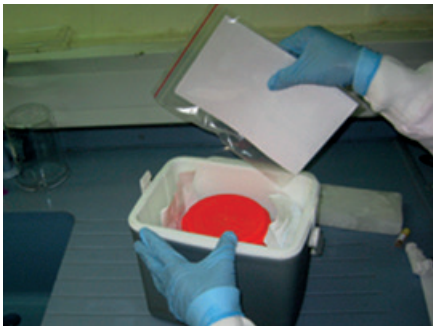
2 Place the enveloped cryo-tube in the primary waterproof container and close in order to be watertight.



3 Place the primary waterproof container in bubble wrap or a shock-absorbing material.

4 Place all components in a waterproof secondary recipient container and close in order to be watertight.

5 Place ice packs in the cooler box. Put the filled secondary container in the cooler box. The recipient container should be in a vertically position.



6 Insert the sample identification form in a zip bag and place the zip bag in the cooler box, next to the secondary recipient container.

7 Close the cooler box in order to be watertight. Write expeditor and addressee on the external part of the cooler box. Put infectious substance label if necessary.

Source: Adapted from influenza sentinel surveillance training, Institute Pasteur of Madagascar, CDC and WHO.

5.9 Guide for blood culture collection

Blood cultures should be obtained before starting antimicrobial therapy in all patients with sepsis in the hospital. The Surviving Sepsis Campaign guidelines caution that this should not delay antimicrobial treatment by more than 45 minutes. This technique is adapted from the United States Centers for Disease Control and Prevention (CDC) website (http://www.cdc.gov/getsmart/healthcare/implementation/clinicianguide.html).

Required materials

- PPE (gloves and mask)
- alcohol swabs
- chlorhexidine swabs (associated with less contamination than standard povidone-iodine)
- blood culture bottles (two bottles per set, one anaerobe and one aerobe)
- two sterile needles (adult: 22 gauge; paediatric: 25 gauge)
- two syringes (adult 20 mL; paediatric 5 mL)
- tourniquet
- sterile gauze pad
- adhesive tape
- patient labels
- plastic zip lock bag for transport.

Technique

1. Check patient ID, explain procedure.
2. Hand washing.
3. Disinfect bottle tops with 70% isopropyl alcohol (alcohol pad) in a circular motion, allow to dry.
4. Clean the puncture site with chlorhexidine swab. Using aseptic technique, remove applicator from package. Holding applicator downward, squeeze wings and release solution. Scrub back and forth over the site for 30 seconds on dry skin. Allow to dry.
5. Puncture the vein with clean needle. Use sterile gloves if you plan to palpate vein after cleaning site.
6. For adults, collect 10–20 mL and 3–5 mL for a child for each blood culture set.
7. Remove needle from vein, divide blood into two blood culture bottles, by placing same needle perpendicularly into the bottle. Do not overfill bottles. If not enough for both bottles, preferably fill the aerobic bottle.
8. Gently rotate bottle to mix blood and broth.
9. Two blood cultures (by separate stick) per septic episode is sufficient.
10. Place label and put into plastic bag and send to the laboratory.

Contaminated blood culture

If skin is not adequately cleansed before obtaining culture, bacteria from the skin may be injected into the bottle, producing contamination and a false positive blood culture. This may lead to misdiagnosis and prolonged antimicrobial use.

6 Oxygen therapy

6 Oxygen therapy

Summary

Give supplemental oxygen therapy immediately to patients with SARI and respiratory distress, hypoxaemia or shock and target SpO_2 > 94%.

In adults, start at 5 L/min and in children at 1–2 L/min using nasal cannula. Monitor SpO_2 immediately because clinical signs of hypoxaemia are unreliable.

Pulse oximeters should be available in all areas where emergency oxygen is delivered. Blood gas analyser should be available in the ICU to also measure ventilatory parameters (pH, $PaCo_2$).

Titrate oxygen to target SpO_2 ≥ 90% (or > 92–95% in pregnant females) using the appropriate dose (flow rate) and delivery device.

Newer high-flow oxygen systems can be used in select cases of non-hypercapnic, hypoxaemia respiratory failure.

Tools

6.1 Algorithm to deliver increasing oxygen in adults
6.2 Algorithm to deliver increasing oxygen in children
6.3 Checklist to troubleshoot warning signs during oxygen therapy delivery
6.4 Algorithm to escalate supportive respiratory therapy

References and resources

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6.1 Algorithm to deliver increasing oxygen in adults

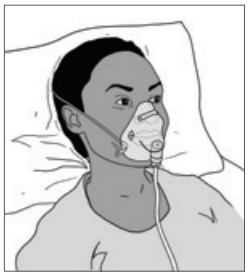
This is reproduced from the WHO *IMAI district clinician manual: hospital care for adolescents and adults: guidelines for the management of illnesses with limited resources* (Volume 1) (WHO, 2011).

How to deliver increasing oxygen

Place prongs inside the nostril. Hook tubing behind ears. Flow rates higher than 5 L will dry mucous membranes.

- ➜ **Start oxygen at 5 L/min**
- ➜ Use nasal prongs
- ➜ Assess response

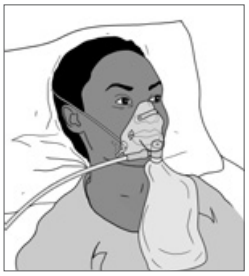
If increasing respiratory distress or SpO_2 < 90%[a]



Secure mask firmly on face over nose and mouth. Pull strap over head.

- ➜ Use face mask
- ➜ **Increase oxygen to 6–10 L/min**
- ➜ Assess response

If increasing respiratory distress or SpO_2 < 90%[a]



Make sure bag is full to deliver highest oxygen concentration. An empty bag is dangerous.

- ➜ Use face mask with reservoir
- ➜ **Increase oxygen to 10–15 L/min**
- ➜ Make sure bag inflates
- ➜ Call for help from district clinician
- ➜ Assess response

If increasing respiratory distress or SpO_2 < 90%[a], transfer to a hospital with available invasive mechanical ventilator possible

- ➜ Call for help from district clinician for possible tracheal intubation
- ➜ **Start manual ventilation (bagging) with high-oxygen flow**

Estimating FiO_2 when delivering oxygen

Adults

- 2–4 L/min ~ FiO_2 0.28–0.36
- 5 L/min ~ FiO_2 0.40
- 6–10 L/min ~ FiO_2 0.44–0.60
- 10–15 L/min ~ FiO_2 0.60–0.95

Note:

[a] Patients presenting with emergency signs should receive oxygen therapy if SpO_2 is < 94%.
Emergency signs:

- Obstructed or absent breathing
- Severe respiratory distress
- Central cyanosis
- Signs of shock, defined as cold extremities with capillary refill time > 3 sec and weak and fast pulse
- Coma (or seriously reduced level of consciousness)
- Seizures
- Signs of severe dehydration: lethargy or unconscious, sunken eyes, very slow return after pinching the skin.

6.2 Algorithm to deliver increasing oxygen in children

Nasal prongs are the preferred method of delivering oxygen to infants and children < 5 years of age with hypoxaemia who require oxygen therapy.

Practical considerations

The distal prong should fit well into the nostril (premature infants: 1 mm; infants weighing up to 10 kg: 2 mm). The prongs should be secured with a piece of tape on the cheeks near the nose as shown above. Care should be taken to keep the nostrils clear of mucus to avoid blockage.

Starting flow and titration parameters

When the child has only respiratory distress, oxygen supplementation is recommended at SpO_2 < 90%. Children presenting with emergency signs (obstructed or absent breathing, severe respiratory distress, central cyanosis, signs of shock, coma or seriously reduced level of consciousness, seizures, signs of severe dehydration) with or without respiratory distress should receive oxygen therapy if their SpO_2 is < 94%. These children should receive oxygen initially by nasal prongs at a standard flow rate (0.5–1 L/min for neonates; 1–2 L/min for infants; and 2–4 L/min for older children) or through an appropriately sized face mask (> 4 L/min) to reach an SpO_2 of ≥ 94%.

If severe hypoxaemia persists despite maximal flow rates:

- start CPAP (if available);
- start secondary source of oxygen with face mask with reservoir bag.

Oxygen delivery methods in children and infants

Method	Maximum O_2 flow (L/min)[a]	Actual inspired O_2 fraction (%) from 1 L/min by a 5-kg infant	PEEP	Humidification	Risk for hypercapnia	Risk for airway obstruction	Equipment required	Nursing demand
Nasal prongs	Neonates: 0.5–1							
	Infants: 2							
	Preschool: 4							
	School: 6	45	Minimal	Not required	No	Minimal	Nasal prongs	+
Nasal catheter	Neonates: 0.5							
	Infants: 1	50	+	Not required	No	+	8-F catheter	++
Nasopharyngeal catheter	Neonates: 0.5							
	Infants: 1	55	++	Required	No	++	8-F catheter, humidifier	+++
Head box, face mask, incubator tent *Not recommended as oxygen is used inefficiently*	Head box: 2–3 L/kg per min		Nil	Not required	Yes	No	Head box, face mask	+++

Source: Oxygen therapy for children (WHO, 2016).

Notes:
[a] Higher flow rates without effective humidification may cause drying of nasal mucosa, with associated bleeding and airway obstruction.
F – French; PEEP – positive end-expiratory pressure.

6.3 Checklist to troubleshoot warning signs during oxygen delivery

☑ If **respiratory distress and hypoxaemia fail to improve** despite increasing oxygen, use a systematic approach to manage your patient. Consider using this checklist.

Repeat the quick check BEC ABCDE approach (Tool 2.3).

Equipment

- Is the measurement correct?
  - ☐ Repeat measurement (e.g. place pulse oximeter correctly; use another pulse oximeter, get an arterial blood gas if appropriate).
- Is there technical difficulty in delivering treatments?
  - ☐ Check that the oxygen source is working:
    - ☐ Is the gas oxygen?
    - ☐ Is the cylinder full?
    - ☐ Is the concentrator on?
  - ☐ Check equipment (e.g. tubing and masks) are appropriate and functioning:
    - ☐ Are the flows correct for type of mask being used?
    - ☐ If using a face mask with reservoir bag, is reservoir bag full?
    - ☐ Is the tubing kinked?
- Is there an alternate diagnosis?
  - ☐ Does the patient have acute respiratory distress syndrome (ARDS)?
  - ☐ Does the patient have acute heart failure?
- Is the patient getting appropriate therapy for the correct diagnosis?
  - ☐ Ensure underlying etiology is being appropriately managed (e.g. antimicrobials given for pneumonia).
- Is our treatment causing harm?
  - ☐ Consider complications and modify management accordingly (e.g. too much fluid leading to pulmonary oedema? Allergic reaction to medication?).
- Does the patient have hypoxemia that is refractory to high-flow oxygen (e.g. significant shunt from ARDS)?
  - ☐ Consider initiation of mechanical ventilator support for management of respiratory failure.

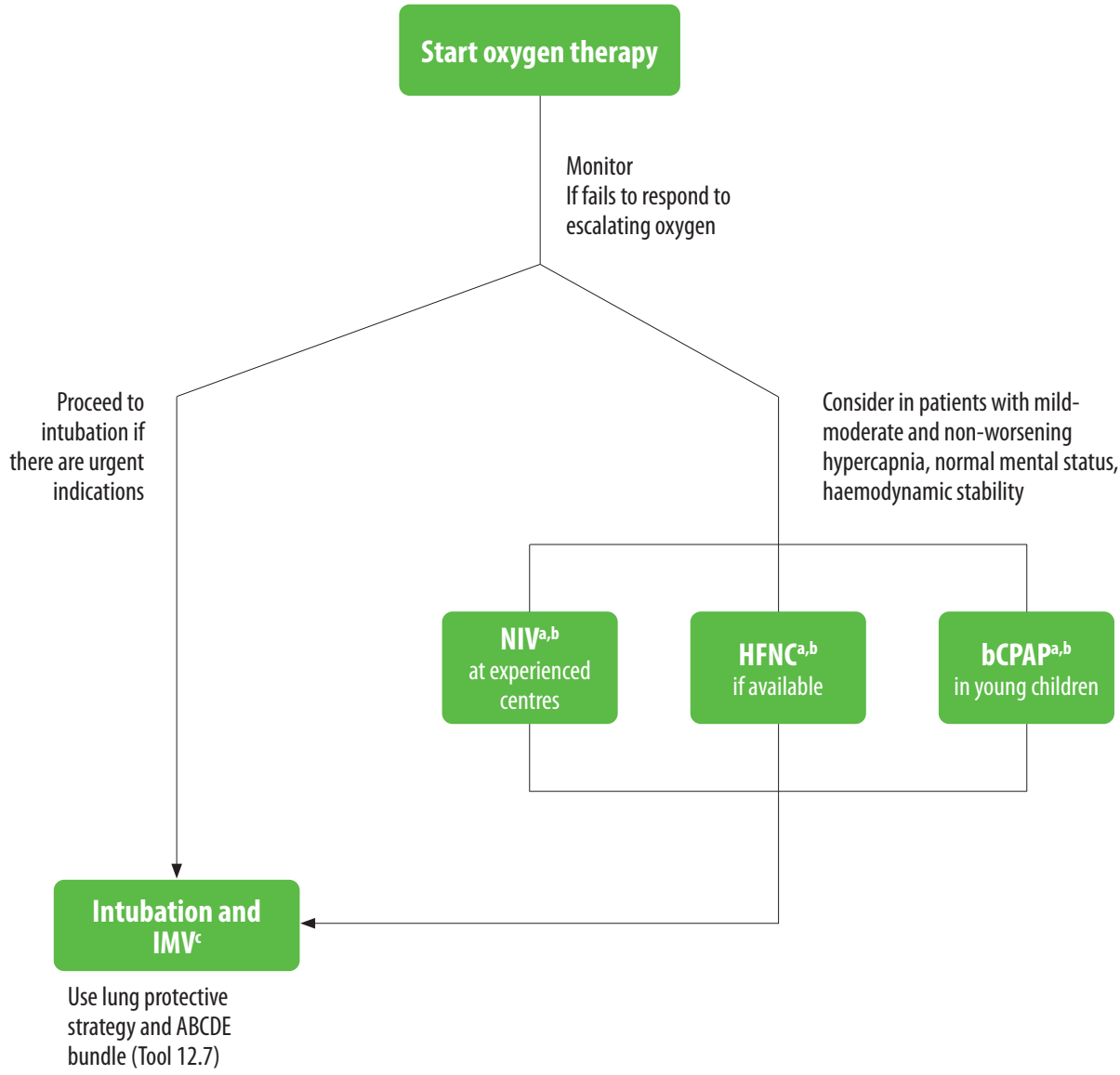
☑ If the **patient's mental status deteriorates** despite SpO_2 > 90%, consider the following:

☐ Manage airway, assist ventilation if needed – do not wait for arterial blood gas results if the patient requires assisted ventilation on clinical grounds.

☐ Check arterial blood gas, if available, to evaluate ventilation. Patients with acute respiratory acidosis from carbon dioxide (CO_2) retention will not be detected with SpO_2 alone.

☐ Consider alternate causes of altered mental status and treat appropriately (e.g. acute central nervous system [CNS] event, electrolyte abnormalities, low glucose).

6.4 Algorithm to escalate supportive respiratory therapy



Notes:
[a] Health care worker must apply airborne precautions.
[b] Patients receiving NIV, HFNC or bCPAP should be in a monitored setting and cared for by experienced personnel capable of performing endotracheal intubation in case the patient acutely deteriorates or does not improve after a short trial (about 1 hour). Do not delay intubation if there is an indication.
[c] Intubation and IMV only in experienced centres; and the most experienced clinicians should intubate given the risk of decompensation and aerosolization during the procedure.

bCPAP – bubble continuous positive airway pressure; HCW – health care worker; HFNC – high-flow nasal cannula; IMV – invasive mechanical ventilation; NIV – non-invasive ventilation; SARI – severe acute respiratory illness.

7 Antimicrobial therapy

7 Antimicrobial therapy

Summary

Give empiric antimicrobials to treat all likely pathogens causing SARI and sepsis as soon as possible, within 1 hour of initial assessment for patients with sepsis.

For COVID-19 with severe pneumonia, treat with IV antibiotics. For COVID-19 uncomplicated pneumonia, treat with oral antibiotics.

If suspect other etiologies, such as influenza, empiric therapy with a neuraminidase inhibitor should be considered. In malaria-endemic areas, patients with fever should be tested for the presence of malaria or other co-infections and treated as appropriate.

When seasonal influenza A or B viruses are known or suspected to be circulating among persons in the community, or there is suspected avian influenza A virus infection, treat SARI patients with empiric antiviral **and** antimicrobials for all likely pathogens as soon as possible (within 1 hour).

Oseltamivir is a neuraminidase inhibitor antiviral drug and is active against all currently circulating influenza viruses that infect humans. It can be delivered enterically to a ventilated patient via nasogastric (NG) or orogastric (OG) tube.

If the clinical course remains severe or progressive, despite ≥ 5 days of treatment, continue on with treatment but also consider alternate diagnosis and oseltamivir resistance.

Tools

7.1 Anti-COVID-19 therapeutics
7.2 Pneumonia severity and empiric antimicrobial therapy
7.3 Oseltamivir notice

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7.1 Anti-COVID-19 therapeutics

There is no current evidence to recommend any specific anti-COVID-19 treatment for patients with confirmed COVID-19.

There are many ongoing clinical trials testing various potential antivirals; these are registered on https://clinicaltrials.gov/ or on the Chinese Clinical Trial Registry (http://www.chictr.org.cn/abouten.aspx).

Investigational anti-COVID-19 therapeutics should be used only in approved, randomized controlled trials.

COVID-19 research needs

Research need	Additional information
Standardized clinical data to improve understanding of the natural history of disease	• Contact COVID_ClinPlaftorm@who.int for log-in credentials • Clinical characterization research protocols available at: https://isaric.tghn.org/protocols/severe-acute-respiratory-infection-data-tools/
If RCT not possible, use the Monitored Emergency Use of Unregistered Interventions Framework	https://www.who.int/ethics/publications/infectious-disease-outbreaks/en/
Prioritization of therapeutics	WHO R&D Blueprint website: https://www.who.int/blueprint/priority-diseases/key-action/novel-coronavirus/en/

7.2 Pneumonia severity and empiric antimicrobial therapy

Pneumonia severity and treatment recommendations

Classification	Sign or symptom	Treatment
Mild illness	Patients with uncomplicated upper respiratory tract viral infection may have non-specific symptoms such as fever, fatigue, cough (with or without sputum production), anorexia, malaise, muscle pain, sore throat, dyspnea, nasal congestion or headache. Rarely, patients may also present with diarrhoea, nausea and vomiting. The elderly and immunosuppressed may present with atypical symptoms. Symptoms due to physiologic adaptations of pregnancy or adverse pregnancy events, such as dyspnea, fever, GI symptoms or fatigue, may overlap with COVID-19 symptoms.	• Isolation in hospital, community facility or home care • Soothe the throat and relieve cough with safe remedy • Give antipyretics for fever • Monitor and return immediately if signs of decompensation
Pneumonia	**Adult** with pneumonia but no signs of severe pneumonia and no need for supplemental oxygen. **Child** with non-severe pneumonia who has a cough or difficulty breathing + fast breathing: fast breathing (in breaths/min): < 2 months ≥ 60; 2–11 months: ≥ 50; 1–5 years: ≥ 40, and no signs of severe pneumonia.	• Isolation in hospital, community facility or home care depending on risk factors • Give appropriate antibiotic • Monitor and return immediately if signs of decompensation
Severe pneumonia	**Adolescent or adult:** fever or suspected respiratory infection, plus one of: respiratory rate > 30 breaths/min; severe respiratory distress; or SpO_2 ≤ 90% on room air. **Child** with cough or difficulty in breathing, plus at least one of the following: central cyanosis or SpO_2 < 90%; severe respiratory distress (e.g. grunting, very severe chest indrawing); signs of pneumonia with a general danger sign: inability to breastfeed or drink, lethargy or unconsciousness, or convulsions. Other signs of pneumonia may be present: chest indrawing, fast breathing (in breaths/min): < 2 months: ≥ 60; 2–11 months: ≥ 50; 1–5 years: ≥ 40. While the diagnosis is made on clinical grounds; chest imaging may identify or exclude some pulmonary complications.	• Isolation and treatment in a hospital, consider intensive care • Manage airway as appropriate • Give oxygen if saturation < 90% and haemodynamically stable; give oxygen if saturation < 94% and patient has emergency signs (obstructed or absent breathing, severe respiratory distress, central cyanosis, shock, coma or convulsions) • Give antipyretics for fever • Give recommended antibiotic • Monitor for signs of decompensation

Sources:
Pocket book of hospital care for children (WHO, 2013); Clinical management of severe acute respiratory infection (SARI) when COVID-19 disease is suspected (WHO, 2020; https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected); *Paediatric emergency triage, assessment and treatment: care of critically ill children* (WHO 2016; https://apps.who.int/iris/bitstream/handle/10665/204463/9789241510219_eng.pdf;jsessionid=165EAA36C70BD5B3ACE05675A9BE9925?sequence=1).

Empiric antibiotics for adults with SARI and severe pneumonia

For severe pneumonia in adults, give empirical broad-spectrum IV antimicrobials within the first hour. This is crucially important. Refer to national or institutional recommendations. Common choices include:

- ceftriaxone 1–2 g once daily PLUS a macrolide (preferred); OR
- ampicillin 2 g IV 4 times a day PLUS a macrolide.

Macrolides include erythromycin 500 mg 4 times a day, azithromycin 500 mg once a day, clarithromycin 500 mg twice a day. Alternatives to a macrolide include doxycycline 100 mg twice a day (avoid in pregnancy) or an oral respiratory quinolone (e.g. levofloxacin).

Empiric antibiotics for children with SARI and severe pneumonia

Give intravenous ampicillin (or benzylpenicillin) and gentamicin.

- ampicillin 50 mg/kg or benzylpenicillin 50 000 U/kg IM or IV every 6 hours for at least 5 days
- gentamicin 7.5 mg/kg IM or IV once a day for at least 5 days.

If the child does not show signs of improvement within 48 hours and staphylococcal pneumonia is suspected, switch to gentamicin 7.5 mg/kg IM or IV once a day and cloxacillin 50 mg/kg IM or IV every 6 hours. Use ceftriaxone (80 mg/kg IM or IV once daily) in cases of failure of first-line treatment.

7.3 Oseltamivir notice

WHO recommendations

- Oseltamivir can be used when influenza is suspected or known to be circulating. If testing for influenza is not possible, empiric treatment is indicated.
- Oseltamivir is not proven to be effective for COVID-19.

Treatment dosing

	Dosing[a]
Adults	
Mild illness	75 mg orally, twice daily for 5 days
With severe illness or severe immunocompromising conditions	75 mg orally, twice daily for 5 days Consider higher dose[b] –150 mg orally, twice daily
Children ≥ 1 year old	
< 15 kg	30 mg orally twice daily for 5 days
15 to < 23 kg	45 mg orally twice daily for 5 days
23 to < 40 kg	60 mg orally twice daily for 5 days
≥ 40 kg	75 mg orally twice daily for 5 days
Children < 1 year old	
14 days to 1 year	3 mg/kg orally twice daily for 5 days

Notes:
[a] The route of administration can be either via NG or OG tube if the patient cannot take medication orally (see safety profile). Where the clinical course remains severe or progressive, despite ≥ 5 days of antiviral treatment, treatment should be continued without a break until virus infection is resolved or there is satisfactory clinical improvement.
[b] The rationale for higher dosing is that there is decreased enteral absorption along with high and prolonged viral replication during severe illness. In children, consider double the daily dose.

Safety considerations and side-effects

Safety profile: Oseltamivir has not been associated with increased adverse effects in adult outpatients. However, oseltamivir has not been evaluated in severely ill patients, pregnancy, or paediatric populations. Oseltamivir should be used with caution:

- In patients with **kidney disease**: reduce dose to 75 mg daily if creatinine clearance is 10–30 mL/min.
- In patients with **liver disease** the safety and efficacy has not been evaluated, so dose reduction is not recommended at this time.
- For **pregnant** or **nursing mothers**, oseltamivir is recommended as therapy in pandemic influenza (H1N1) 2009 virus as there is a high risk of severe illness in pregnant women and there is no evidence of adverse effects or birth defects.

Side-effects: Side-effects are generally minor and involve the gastrointestinal tract, although rare neuropsychiatric complications have also been described:

- Nausea (mitigated by taking with food), vomiting.
- Rare neuropsychiatric adverse events – association seen primarily in one country, causality has not been established.

Oral formulations

Formulations	Description
Capsules	30 mg, 45 mg, 75 mg each Brand names: Antiflu®, Tamiflu®, etc. Store at room temperature (15–30 °C)
Liquid suspension	White powder mixed with 23 mL of drinking water Fruit flavoured Refrigeration required Use within 10 days Oral dispenser included (must confirm dosage and volume when administering)
Oral suspension	If commercial suspension unavailable a suspension may be prepared from oseltamivir capsules

Preparation of oral oseltamivir suspension

If a commercial oseltamivir powder for oral suspension is unavailable, a suspension may be compounded in a pharmacy:

- The inhouse suspension should be made at 15 mg/mL for persons > 1 year; and 10 mg/mL for those ≤ 1 year.
- The suspension can be made from oseltamivir phosphate capsules using sterile water at the bedside.

8 Sepsis and septic shock

8 Sepsis and septic shock

Summary

Deliver early targeted resuscitation to treat patients with sepsis-induced shock using crystalloids, vasopressors and, in some cases, inotropes and blood transfusion.

Resuscitation targets for adults and children include improved blood pressure and other markers of tissue perfusion (mental status, urine output, skin, lactate, and in children specifically, improved heart rate). In children, tachycardia is an early sign of sepsis-induced shock and low blood pressure is a late finding.

Resuscitation with crystalloid fluid remains the most common intervention for septic shock and should be given as a challenge to improve targets of perfusion; and promptly stopped when no longer responsive, to avoid harms of excess fluid.

Resuscitation strategies for children with septic shock should be modified if the child has severe malaria with anaemia or severe malnutrition; or is being cared for in settings without ICU capacity.

Refer to the shock quick cards from the WHO/ICRC *Basic emergency care (BEC): approach to the acutely ill and injured* (https://www.who.int/publications-detail/basic-emergency-care-approach-to-the-acutely-ill-and-injured) (Tool 2.3) for initial approach and management of patients with septic shock.

Tools

8.1 Sepsis definitions
8.2 Targeted resuscitation in adults in an ICU setting
8.3 Initial resuscitation, fluid and vasoactive-inotrope management algorithm for children with septic shock
8.4 Guide to to the use of vasopressors in septic shock for adults and children
8.5 Passive leg raise

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8.1 Sepsis definitions

Sepsis

Adults: life-threatening organ dysfunction caused by a dysregulated host response to suspected or proven infection.[a] Signs of organ dysfunction include: altered mental status, difficult or fast breathing, low oxygen saturation, reduced urine output, fast heart rate, weak pulse, cold extremities or low blood pressure, skin mottling, or laboratory evidence of coagulopathy, thrombocytopenia, acidosis, high lactate, or hyperbilirubinemia.

Children: suspected or proven infection and ≥ 2 age-based systemic inflammatory response syndrome (SIRS) criteria, of which one must be abnormal temperature or white blood cell count. SIRS criteria include: abnormal temperature < 36 °C or > 38.5 °C, heart rate > 2 SD above normal for age or bradycardia if < 1 year of age, respiratory rate > 2 SD above normal for age, and abnormal white blood cell count or > 10% immature neutrophils.

Septic shock

Adults: persisting hypotension despite volume resuscitation, requiring vasopressors to maintain MAP MAP ≥ 65 mmHg and serum lactate level > 2 mmol/L.

Children: any hypotension (SBP < 5th centile or > 2 SD below normal for age) or two or three of the following: altered mental state; tachycardia or bradycardia (HR < 90 bpm or > 160 bpm in infants and HR < 70 bpm or > 150 bpm in children); prolonged capillary refill (> 2 sec) or feeble pulse; tachypnoea; mottled or cool skin or petechial or purpuric rash; increased lactate; oliguria; hyperthermia or hypothermia.

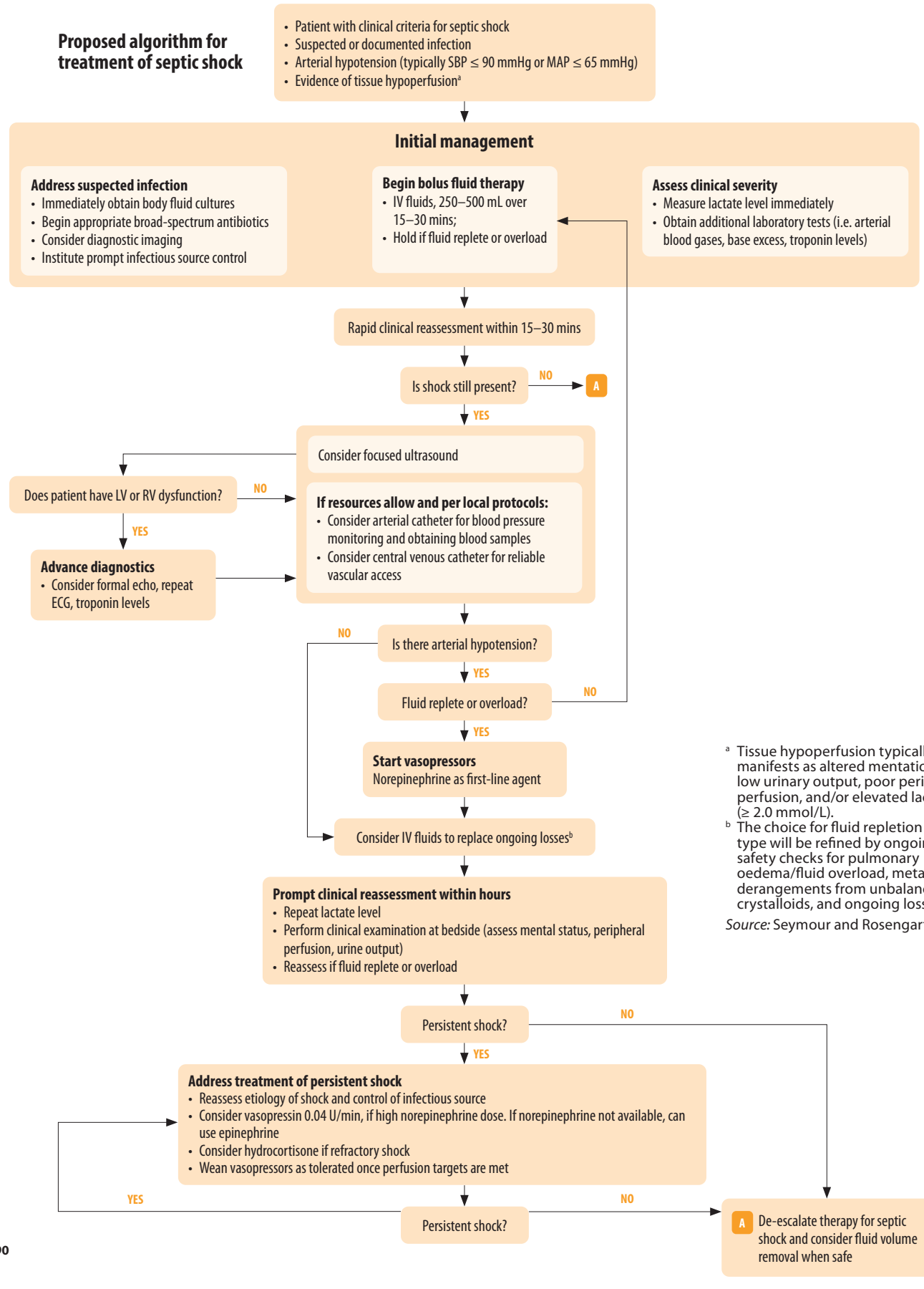
Sources: Rhodes et al (2020); Weiss et al (2020).

[a] The SOFA score ranges from 0 to 24 and includes points related to six organ systems: respiratory (hypoxemia defined by low PaO_2/FiO_2); coagulation (low platelets); liver (high bilirubin); cardiovascular (hypotension); central nervous system (low level of consciousness defined by Glasgow Coma Scale); and renal (low urine output or high creatinine). Sepsis is defined by an increase in the sepsis-related SOFA score of ≥ 2 points. Assume the baseline score is 0 if data are not available.

Notes: bpm beats/minute; FiO_2 fraction of inspired oxygen; MAP mean arterial pressure; PaO_2 partial pressure of oxygen; SBP systolic blood pressure; SOFA sequential organ failure assessment.

8.2 Targeted resuscitation in adults in an ICU setting

This algorithm is adapted from Seymour and Rosengart (2015) (see References and resources). It can be adapted to your settings.



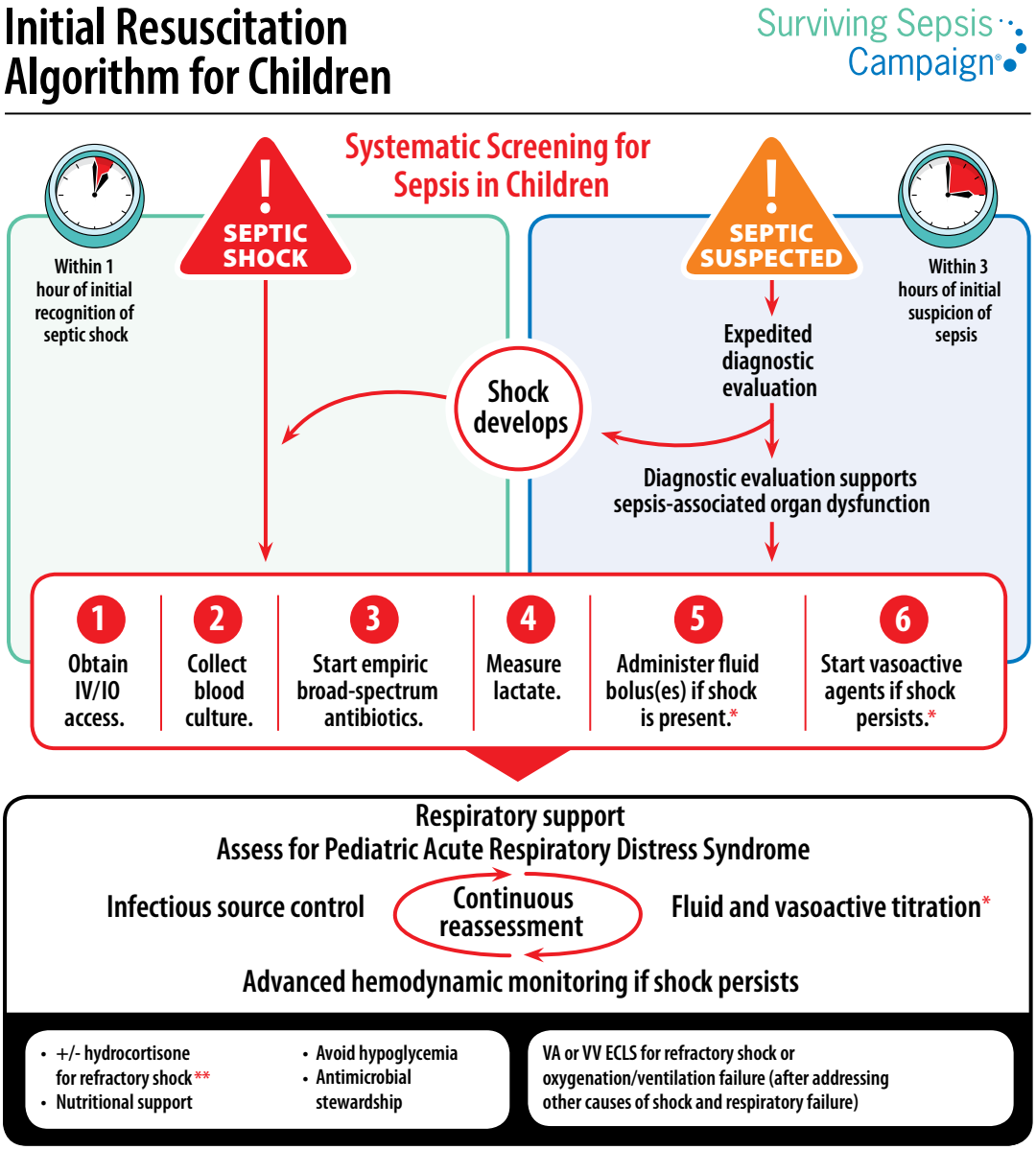
[a] Tissue hypoperfusion typically manifests as altered mentation, low urinary output, poor peripheral perfusion, and/or elevated lactate (≥ 2.0 mmol/L).

[b] The choice for fluid repletion and type will be refined by ongoing safety checks for pulmonary oedema/fluid overload, metabolic derangements from unbalanced crystalloids, and ongoing losses.

Source: Seymour and Rosengart (2015).

8.3 Initial resuscitation, fluid and vasoactive–inotrope management algorithm for children with septic shock

This algorithm, from the Surviving Sepsis Campaign, is based on recently published paediatric sepsis and septic shock guidelines and has been adapted for use in health care systems with and without intensive care (see References and resources).



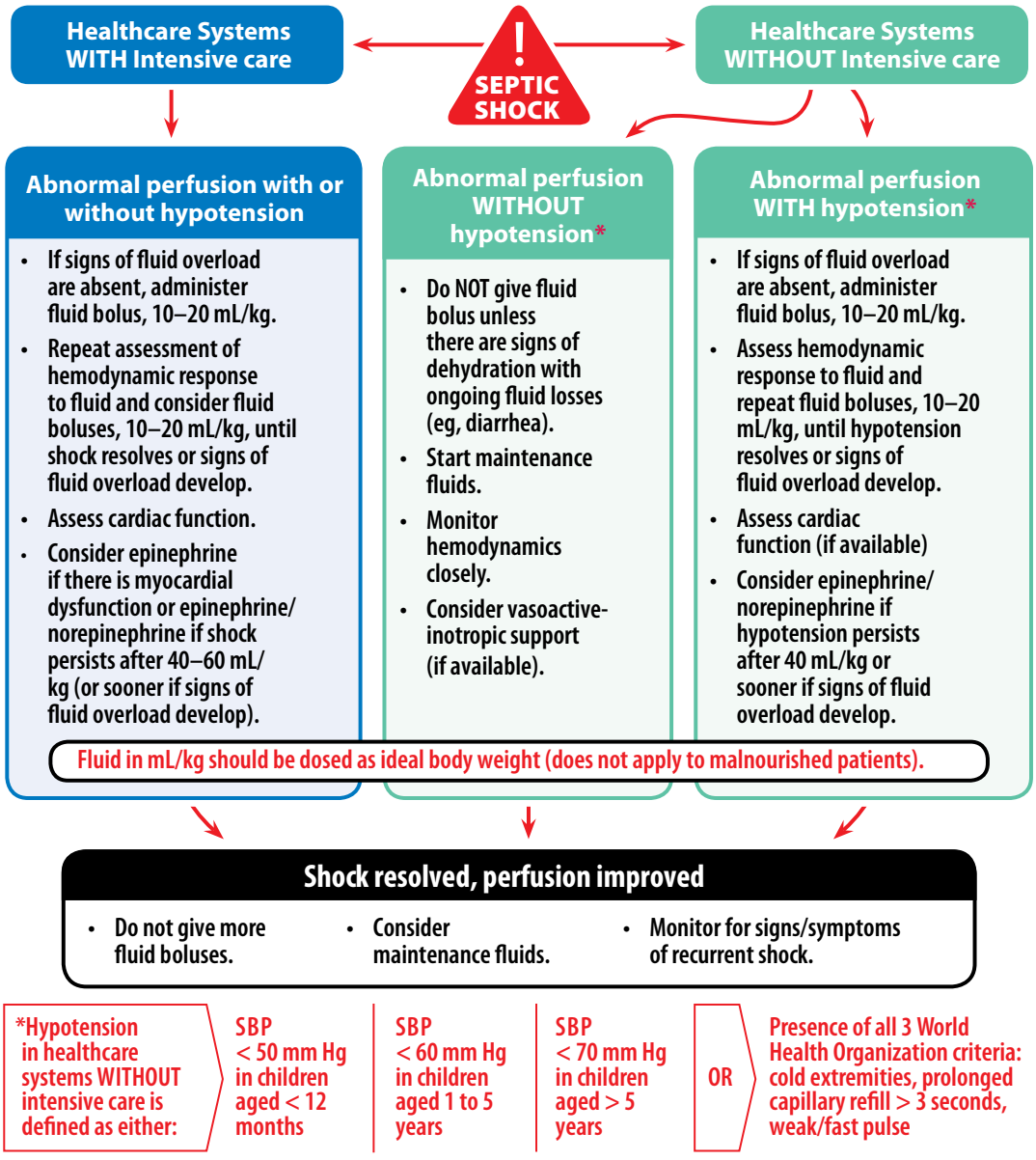
*See fluid and vasoactive algorithm. Note: Fluid bolus should be omitted from bundle if a) fluid overload is present or b) it is a low-resource setting without hypotension. Fluid in mL/kg should be dosed as ideal body weight.

**Hydrocortisone may produce benefit or harm.

www.sccm.org/SurvivingSepsisCampaign/Guidelines/Pediatric-Patients

Fluid and Vasoactive-Inotrope Management Algorithm For Children

Surviving Sepsis Campaign



www.sccm.org/SurvivingSepsisCampaign/Guidelines/Pediatric-Patients

Sources: Rhodes et al (2020); Weiss et al (2020).

8.4 Guide to the use of vasopressors in septic shock for adults and children

In adults, the Surviving Sepsis Campaign guidelines recommend vasopressors to be started if MAP < 65 mmHg. Norepinephrine is recommended as the first-line agent; however, epinephrine can be used as an alternative. Administer vasopressors at a strictly controlled rate, titrate to maintain MAP 65 mmHg, reduce as the MAP improves and discontinue promptly when no longer needed. Dopamine is not recommended because of the risk of tachyarrythmias and concern of poorer outcome. Administer dobutamine, an inotrope, when there are persistent signs of hypoperfusion and clinical evidence of myocardial dysfunction (i.e. echo, $ScvO_2$ < 70%) after adequate MAP and fluid status achieved.

In children, the Surviving Sepsis Campaign guidelines recommend vasopressors if clinical signs of shock persist after fluid resuscitation and should not be delayed. The recommended first-line agent is epinephrine in children with septic shock. If shock persists, add a second agent, and vasopressin can be added in children requiring high-dose vasopressors. These agents should be administered at a strictly controlled rate and titrated to achieve targets of adequate tissue perfusion.

Route of administration	Norepinephrine	Dobutamine	Epinephrine	Vasopressin
Central vein preferred	Initial: 0.1–0.2 µg/kg/min Range: increase by 0.1 µg/kg/min increments; consider refractory if > 1 µg/kg/min	Initial: 2–5 µg/kg/min Range: increase by 2.5 µg/kg/min increments; maximum 20 µg/kg/min	Initial: 0.1–0.2 µg/kg/min Range: increase by 0.1 µg/kg/min increments; consider refractory if > 1 µg/kg/min	Initial: 0.01–0.08 units/min Fixed dose No titration necessary
Peripheral vein if necessary	Same dosing	Same dosing	Same dosing	Same dosing

Dose initiation and titration should be individualized. The MAP goal can be individualized based on other clinical history (i.e. consider higher MAP target > 80 mmHg in patients with chronic hypertension). Also target other markers of perfusion, such as capillary refill, absence of skin mottling, strong peripheral pulses, warm and dry extremities, urine output and normal mental status.

Note: Children can move between various shock states and vasopressors should be adjusted accordingly.

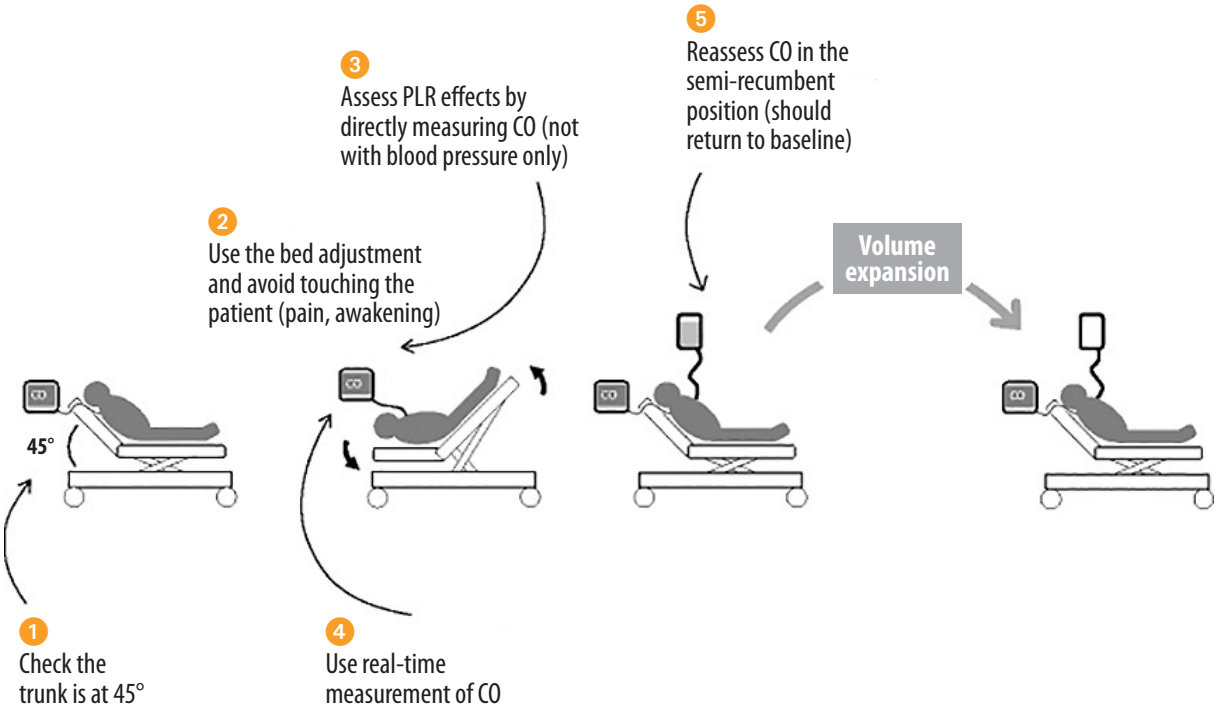
Side-effects of vasopressors include tachyarrhythmias, ischaemia to organs and cool or cyanotic extremities. Peripheral administration may be complicated by soft tissue necrosis if the vasopressor is extravasated.

Side-effects of inotropes, such as dobutamine, include tachyarrythmias and hypotension due to peripheral vasodilation. Thus, in septic shock, inotropes should be used in combination with vasopressors to maintain MAP at goal in adults, and children with low systemic vascular resistance.

8.5 Passive leg raise

In acute circulatory failure, passive leg raising (PLR) is a test that predicts whether cardiac output (CO) will increase with volume expansion. By transferring a volume of around 300 mL of venous blood from the lower body towards the right heart, PLR mimics a fluid challenge. However, no fluid is infused and the haemodynamic effects are rapidly reversible.

Best method for passive leg raising – the five rules to be followed



Source: Monnet and Teboul (2015).

9 Acute respiratory distress syndrome (ARDS)

9 Acute respiratory distress syndrome (ARDS)

Summary

Intubation and invasive mechanical ventilation are indicated in most patients with ARDS and hypoxaemic respiratory failure. Lung protective ventilation (LPV) reduces mortality in patients with ARDS. LPV means:

- delivering low tidal volumes (TV) (target 6 mL/kg ideal body weight or less);
- achieving low plateau airway pressure (Pplat) (target Pplat ≤ 30 cm H_2O); and
- use of moderate positive end-expiratory pressure (PEEP) to recruit lung.

In adults and paediatric patients with moderate-severe ARDS (P/F < 150) use prone position. Extracorporeal membrane oxygenation (ECMO) has been used for COVID-19 patients and should only be done at expert centres under strict protocols in patients that are not responding to lung protective ventilation and prone position strategy. More information about outcomes is needed.

High-flow nasal cannula (HFNC) may be safe in patients with mild-moderate and non-worsening hypercapnia (mild ARDS), normal mental status, haemodynamic stability, and no need for emergent intubation. Patients receiving HFNC should be in a monitored setting and cared for by experienced personnel capable of performing endotracheal intubation in case the patient acutely deteriorates or does not improve after a short trial (about 1 hour). Do not delay intubation if there is an indication.

Use airborne precautions when conducting aerosol-generating procedures.

Tools

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9.1 Memory aid: diagnosis and classification of ARDS

Berlin definition of acute respiratory distress syndrome (ARDS)

Timing	Within 1 week of a known clinical insult or new or worsening respiratory symptoms
Chest imaging[a]	Bilateral opacities – not fully explained by effusions, lobar/lung collapse or nodules
Origin of oedema	Respiratory failure not fully explained by cardiac failure or fluid overload Need objective assessment (e.g. echocardiography) to exclude hydrostatic oedema if no risk factor present
Oxygenation[b]	
Mild	$200 < PaO_2/FiO_2 \leq 300$ with PEEP or CPAP ≥ 5 cm H_2O[c]
Moderate	$100 < PaO_2/FiO_2 \leq 200$ with PEEP ≥ 5 cm H_2O
Severe	$PaO_2/FiO_2 \leq 100$ with PEEP ≥ 5 cm H_2O

Notes:
[a] Chest radiograph or computed tomography scan;
[b] If altitude is higher than 1000 m, the correction factor should be calculated as follows: [$PaO_2/FiO_2 \times$ (barometric pressure/760)];
[c] This may be delivered non-invasively in the mild ARDS group;
CPAP – continuous positive airway pressure; FiO_2 – fraction of inspired oxygen; PaO_2 – partial pressure arterial oxygen; PEEP – positive end-expiratory pressure.

A recent publication suggests a modified definition for resource-constrained environments, that excludes the need for CPAP or PEEP, arterial blood analysis and chest radiograph.

Note: This definition requires validation before widespread use.

Kigali modifications of Berlin definition

Chest imaging	Bilateral opacities – not fully explained by effusions, lobar/lung collapse or nodules by chest radiograph or ultrasound. Ultrasound findings defined as presence of B-lines or consolidations without associated effusions found in at least one area on each side of the chest. The protocol requires six areas of each side of chest (two anterior, two lateral, two posterolateral) to be examined.
Oxygenation	$SpO_2/FiO_2 \leq 315$, no PEEP or CPAP requirement

9.2 Memory aid: diagnosis and classification of pARDS

Paediatric acute respiratory distress syndrome (pARDS) definition

Age	Exclude patients with perinatal related lung disease			
Timing	Within 7 days of known clinical insult			
Origin of oedema	Respiratory failure not fully explained by cardiac failure or fluid overload			
Chest imaging	Chest imaging findings of new infiltrates(s) consistent with acute pulmonary parenchymal disease			
Oxygenation	**Non-invasive mechanical ventilation**	**Invasive mechanical ventilation**		
	pARDS (no severity stratification)	**Mild**	**Moderate**	**Severe**
	Full face mask bilevel ventilation of CPAP ≥ 5 cm H_2O PF ratio ≤ 300 SF ratio ≤ 264	4 ≤ OI < 8 5 ≤ OSI < 7.5	8 ≤ OI < 16 7.5 ≤ OSI < 12.3	OI ≥ 16 OSI ≥ 12.3

CPAP – continuous positive airway pressure; OI – Oxygenation Index ([FiO_2 × mean airway pressure × 100]/PaO_2); OSI – oxygen saturation index ([FiO_2 × mean airway pressure × 100]/SpO_2); PF ratio – PaO_2:FiO_2 ratio; SF ratio – SpO_2:FiO_2 ratio.

Source: Khemani RG, Smith LS, Zimmerman JJ, Ericson S, for the Pediatric Acute Lung Injury Consensus Conference Group. Pediatric acute respiratory distress syndrome: definition, incidence, and epidemiology: proceedings from the Pediatric Acute Lung Injury Conference. PCCM. 2015;16(5):S23-S40.

9.3 Checklist for rapid sequence intubation procedure

☑ This tool can be used before performing endotracheal intubation. This is adapted with permission from the ICU and Emergency Medical Retrieval Service at the Royal Alexandria Hospital, Paisley, Scotland.

Equipment

- ☐ suction: working Yankauer sucker under right side of pillow
- ☐ ambu-bag, 15 L/min oxygen, PEEP valve (pre-oxygenation and post-intubation)
- ☐ endotracheal tube (ETT): correct size, cuff checked and lubricated +/- stylet
- ☐ two working laryngoscopes with blades
- ☐ 20 mL syringe
- ☐ tube tie
- ☐ gum elastic bougie on trolley top
- ☐ oropharyngeal airway on trolley top
- ☐ confirm laryngeal mask airway and surgical airway kit
- ☐ capnograph set up
- ☐ stethoscope
- ☐ ventilator checks complete
- ☐ alternate oxygen source (cylinder/flowmeter)

Drug

- ☐ IV access patent and accessible
- ☐ induction agents: hypnotic/opiate/neuromuscular blockers
- ☐ maintenance infusions prepared
- ☐ vasopressor and atropine drawn up

Team role

- ☐ doctor 1: airway management and drug administration order
- ☐ nurse 1: assistant and drug administration
- ☐ nurse 2: cricoid pressure (controversial)
- ☐ team role respiratory therapist: airway management and ventilation assistance

Appropriate infection prevention precautions

- ☐ if suspect COVID-19, use airborne precautions

Rapid sequence intubation (RSI)

Definition: RSI is an advanced medical protocol of advanced airway support designed for the expeditious intubation of the trachea of a patient.

Target: Patients suspected of having an increased risk of aspirating stomach contents into the lungs.

Technique: Quicker form of the process normally used to "induce" a state of general anaesthesia. It uses drugs to rapidly allow an ETT to be placed between the vocal cords, by blocking the patient's involuntary reflexes and muscle tone in the oropharynx and larynx. Once the ETT has been passed between the vocal cords, a cuff is inflated around the tube in the trachea and the patient can then be artificially ventilated. Correct ETT position can be verified by direct visualization through the vocal cords; capnography (persistent CO_2 return; may show CO_2 transiently if in oesophagus); high SpO_2, bilateral breath sounds on chest auscultation; and correct position on X-ray.

9.4 Checklist for preparing for intubation and mechanical ventilation in children

☑ This tool can be used before performing endotracheal intubation. Intubation and IMV can be indicated, as in adults, in case of hypoxaemia refractory to supplemental oxygen, depressed level of consciousness (AVPU) and severe shock.

☐ Pre-oxygenate for 5 minutes with 100% FiO_2.
Children and infants have reduced functional residual capacity; they can desaturate quickly on induction.

☐ Decompress the stomach to prevent diaphragmatic splinting:
- ☐ use airway adjuncts to reduce stomach inflation;
- ☐ in bag-mask ventilation place NG tube early and regularly aspirate with large bore syringe to decompress stomach.

☐ Anticipate shock.
Benzodiazepines, thiopental, inhalational agents and propofol cause myocardial depression and vasodilation; this can unmask or worsen shock:
- ☐ anticipate and use ketamine for induction if available (with atropine);
- ☐ anticipate by pre-loading with volume (10–20 mL/kg 0.9% saline) and/or starting/increasing inotropic support.

☐ Consider atropine in all neonates and children to prevent bradycardia caused by vagal stimulation during laryngoscopy.

☐ Use induction agent ± opiate and neuromuscular relaxant in all patients including neonates; it will optimize the view and make intubation easier.

☐ Confirm correct ETT placement. As in adults, an adequate end-tidal CO_2 reading remains the gold standard. But correct placement can be inferred from:
- ☐ improving SpO_2;
- ☐ bilateral equal air on auscultation;
- ☐ chest X-ray position of ETT tip 1–2 cm above the carina, or T3 posteriorly.

Choice of an induction agent

		Intravenous dose	Notes
Opiates	Atropine	20 mcg/kg (min dose 100 mcg); > 12 years 300–600 mcg	
	Fentanyl	2–5 mcg/kg	Can cause ↓ blood pressure
	Morphine	0.1–0.2 mg/kg	Takes long time to be effective ~10 mins
Induction agent	Ketamine	1–2 mg/kg	Can cause ↑ intracranial pressure
	Etomidate	0.3 mg/kg	Can cause adrenal suppression, do not use in sepsis
	Propofol 1% (induction only)	2.5–3.5 mg/kg (> 3 years)	Can cause ↓ blood pressure
Neuromuscular blockers	Suxamethonium	3 mg/kg/dose (neonate); 1–2 mg/kg all other ages	Avoid if K+ high, neuromuscular patients, acute burn or renal failure
	Rocuronium	1 mg/kg	First-line RSI paralytic
	Vecuronium	0.1 mg/kg	
	Atracurium	0.5 mg/kg	
	Pancuronium	0.1 mg/kg	

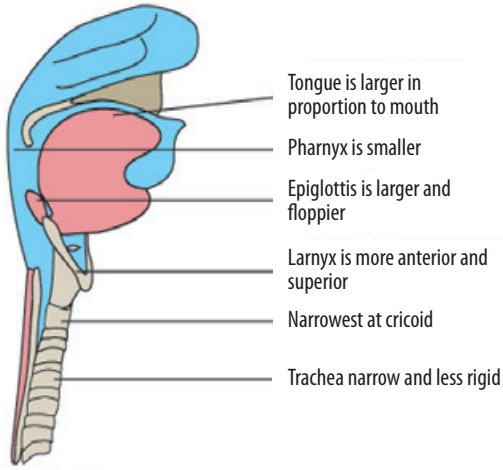
Choice of size of endotracheal tubes

	Term infant	Estimate at 6 months	Children ≥ 1 year (kg)
Diameter (size) of ETT (cuffed preferred)	3–3.5	3.5–4	(Age/4) + 4 (uncuffed); (Age/4) + 3.5 (cuffed)
Length oral ETT at lips (confirm on X-ray)	8–9	10	(Age/2) + 12 cm
Length nasal ETT at nose (confirm on X-ray)	10–11	12	(Age/2) +15 cm
Suction catheter size	2 x ETT = 6	2 x ETT = 8	2 x ETT

Anatomical differences between children and adults

Anatomical differences between children and adults can make ventilation more difficult.

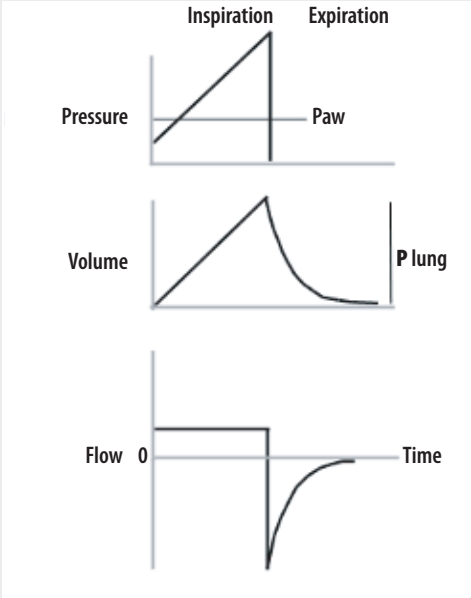
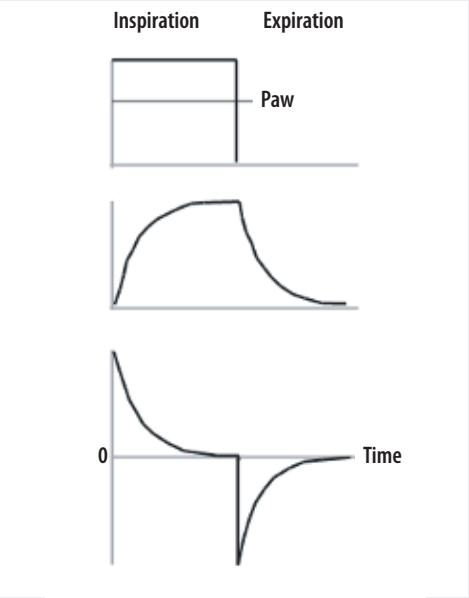
- **Lower chest wall rigidity** of children implies an earlier respiratory failure in infants in any pathology that causes ↓ compliance of lung, e.g. viral pneumonitis.
- **Smaller airway diameter** of children implies an upper airway resistance.
- **Larger abdomen** of children implies a ↓ functional residual capacity → ↑ atelectasis at end expiration and atelectrauma.
- **Larger tongue**, anterior **larynx, narrow cricoid ring, larger occiput** require positioning of the airway (e.g. use of neck rolls) to optimize visualization on laryngoscopy:
  - neonates and infants in neutral position
  - older children in "sniffing morning air" position.



Child's upper airway

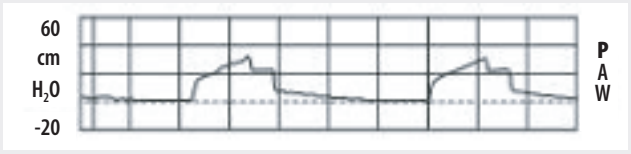
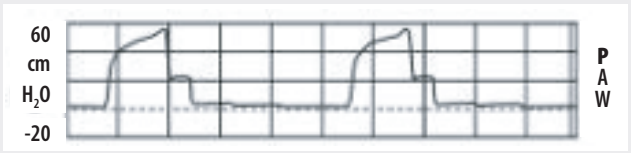
Tips: Anticipate a difficult airway, particularly if stridor or a small posteriorly placed jaw are present. Pre-oxygenate, have a range of ETT and blades and the most experienced operator available.

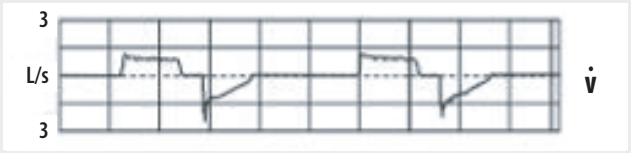
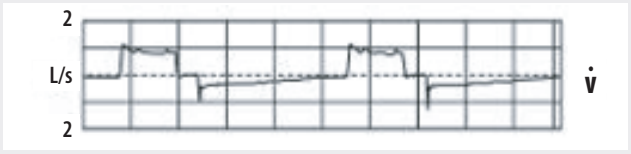
9.5 Memory aid: comparison of normal waveforms during volume and pressure-limited ventilation

Volume control	Pressure control
	
• Volume limited ventilation • Flow is fixed (shown) or descending • Volume is set and the airway pressures are variable • Inspiration cycles to expiration after fixed time or volume delivered • To measure Pplat you need to perform an inspiratory pause, which means briefly stopping gas flow at the end of inspiration • Patient can trigger a breath	• Pressure limited ventilation • Flow is variable • Pressure is set (see square wave form) and the volumes are variable • Inspiration cycles to expiration after fixed time • Pplat is the set inspiratory pressure (Pinsp), equal to driving pressure + PEEP • Patient can trigger a breath

Notes: Paw – airway pressure; PEEP – positive end-expiratory pressure; Pplat – plateau airway pressure.

9.6 Memory aid: recognizing and interpreting abnormal pressure and flow waveforms during volume control ventilation

Pressure curves	Characteristics	Interpretation
	Normal pressure curve	Normal
	Increased peak airway pressure Increased Pplat	Reduced compliance
	Increased peak airway pressure Normal Pplat Intrinsic PEEP	Increased resistance

Flow curves	Characteristics	Interpretation
	Normal flow pattern	Normal
	High expiratory peak flow rate expiratory flow is shorter	Reduced compliance
	Prolonged expiratory flow Intrinsic PEEP	Increased resistance

Source: Adapted from *Using the ventilator to probe physiology: monitoring graphics and lung mechanics during mechanical ventilation* (course), Hess DR (2005).

9.7 Guide to distinguishing between the causes of high peak airway pressures: resistance versus compliance

Abnormal airway pressure(s)	High peak with high plateau airway pressure	High peak with normal plateau airway pressure
Main physiologic problem	Reduced respiratory system compliance (Crs)	High resistance (R)
Formula	$C_{rs} = \frac{\text{Tidal volume}}{P_{plat} - PEEP}$	$R = \frac{P_{peak} - P_{plat}}{\text{Flow}}$
Normal	60–100 mL/cm H_2O	5–10 cm H_2O/L/sec for intubated adult
Problems that can be treated quickly	• mainstem bronchus intubation • tension pneumothorax • pleural effusion • abdominal distension • congestive heart failure • atelectasis • hyperinflation	**Patient problems:** • patient biting, coughing, fighting ventilator • secretions • bronchospasm **Ventilator problems:** • tube kinked • circuit filled with water • small endotracheal tube
Other problems that may improve over the time	• ARDS • consolidation • fibrosis • chest wall oedema • thoracic deformity	• Asthma • Chronic obstructive pulmonary disease (COPD)

Factors influencing peak airway pressure

P airway = **P** resistance + **P** compliance

Airflow resistance	Respiratory system compliance	Chest wall compliance
• size of airway • lower airway obstruction • mechanical obstruction	• chest wall • tidal volume • lung elasticity	• chest wall • patient position • external compression of chest from abdomen

9.8 Troubleshooting high peak airway pressures, low tidal volumes, desaturation or haemodynamic instability in ventilated patient

☑

☐ **Is the endotracheal tube in the trachea?**
- Large cuff leak or no chest rise with inspiration suggest that ETT is dislodged: assess with direct laryngoscopy and re-intubate.

☐ **Is there a problem with the ventilator circuit or oxygen supply?**
- Take the patient off the ventilator and hand ventilate with 100% oxygen while checking equipment.

☐ **Can you pass a suction catheter through the endotracheal tube?**
- If no, ETT may be kinked: straighten or insert bite block to prevent patient from biting.
- If no, ETT may be blocked with secretions: reintubate with new ETT.
- If yes, suction ETT to remove sputum/mucus plugs.

☐ **Are there breath sounds bilaterally?**
- Unilaterally absent breath sounds: evaluate for mainstem intubation/lobar collapse versus pneumothorax by assessing mediastinal shift and by chest X-ray if patient not in extremis:
  - Suspicion of tension pneumothorax mandates immediate needle decompression followed by chest tube placement, without a chest X-ray.
  - Mainstem intubation may be suspected clinically if ETT further in patient than previously. Withdraw to previous position; can confirm with bronchoscopy if available.
  - Lobar collapse or atelectasis may respond to aggressive suctioning and can be confirmed with chest X-ray.
- Bilateral wheezing: consider bronchospasm; give bronchodilators.
- Bilateral crackles: consider pulmonary oedema; give diuretic or more PEEP depending on full clinical evaluation of volume status.

☐ **Are there other problems causing low compliance?**
- Abdominal distension: drain stomach with NG tube.
- Auto-PEEP: diagnose by examining ventilator waveforms. Treat with bronchodilators, sedation; may require temporary disconnection from positive pressure.

☐ **Is there haemodyamic instability?**
- Restore haemodyamic stability with fluid or vasopressors while determining and treating primary cause.
- If severe hypotension, evaluate for tension pneumothorax or severe auto-PEEP (often in patients with asthma or COPD).
- Other causes include high airway pressures reducing venous return, vasodilation due to sedative and analgesic medications or a new problem (sepsis, bleeding, pulmonary embolism, myocardial infarction).

☐ **Is the patient agitated and asynchronous with the ventilator?**
- May be secondary to any other problem or may be primary problem and causing asynchrony: treat cautiously with sedation.

9.9 ARDS Network protocol to deliver lung protective ventilation

This protocol to deliver lung protective ventilation (LPV) was used in the low tidal volume (TV) trial published in 2000 (ARDS Network et al, 2000) (see References and resources). There are two PEEP/FiO_2 grids; the second one can be used for more severe hypoxaemia.

Principles are the same for children except that children younger than 8 years require a lower maximum PEEP – 15 cm H_2O and the peak Pplat should be < 28 cm H_2O.

Ventilator set up and adjustment

1. Calculate predicted body weight (PBW):
   Males = 50 + 1.1 [height (cm) – 152]
   Females = 45.5 + 1.1 [height (cm) – 152].
2. Select any ventilator mode.
3. Set ventilator settings to achieve initial TV = 8 mL/kg PBW.
4. Reduce TV by 1 mL/kg at intervals ≤ 2 hrs until TV = 6mL/kg PBW.
5. Set initial rate to approximate baseline minute ventilation (not > 35 breaths/min).
6. Adjust TV and RR to achieve pH and Pplat goals below.

Oxygenation goal: PaO_2 55–80 mmHg or SpO_2 88–95%

Use a minimum PEEP of 5 cm H_2O. Consider incremental PEEP/FiO_2 combinations such as shown below to achieve goal. PEEP levels > 15 should not be used in children < 8 years.

Lower PEEP/higher FiO_2														
FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18–24
Higher PEEP/lower FiO_2 for more severe hypoxaemia														
FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5–0.8	0.8	0.9	1.0	1.0
PEEP	5	8	10	12	14	14	16	16	18	20	22	22	22	18–24

- **Pplat goal: ≤ 30 cm H_2O**
  Check Pplat using 0.5 second inspiratory pause, at least every 4 hours and after each change in PEEP or TV.
  – If Pplat > 30 cm H_2O or > 28 cm H_2O in children: decrease TV by 1mL/kg steps (minimum = 4 mL/kg).
  – If Pplat < 25 cm H_2O and TV < 6 mL/kg: increase TV by 1 mL/kg until Pplat > 25 cm H_2O or TV = 6 mL/kg.
  – If Pplat < 30 cm H_2O and breath stacking or asynchrony occurs: may increase TV in 1 mL/kg increments to 7–8 mL/kg if Pplat remains ≤ 30 cm H_2O.

- **pH goal: 7.30–7.45**
  Acidosis management: (pH < 7.30).
  – If pH 7.15–7.30: increase RR until pH > 7.30 or $PaCO_2$ < 25 (maximum set RR = 35).
  – If pH < 7.15: increase RR to 35.
  – If pH remains < 7.15, TV may be increased in 1 mL/kg steps until pH > 7.15 (Pplat target of 30 may be exceeded). May give $NaHCO_3$ to act as a transient buffer.

- **Alkalosis management: pH > 7.45**
  – Decrease ventilator rate if possible.

- **Inspiration to expiration ratio goal**
  – Recommend that duration of inspiration be ≤ duration of expiration.

9.10 Checklist for proning a patient with severe ARDS

This checklist is adapted from Messerole et al (2002) and the most recent randomized control trial by Guérin et al (2013) (see References and resources). These studies found an improved mortality in patients treated with LPV plus prone position.

Prone ventilation should be carried out by four to five team members using a protocol rehearsed in advance. It is easier to perform in children. See the following article and video (https://www.nejm.org/doi/full/10.1056/).

Timing and duration of prone position

The most recent clinical trial (Guérin et al, 2013) observed mortality benefit in patients with severe ARDS. Patients were turned prone within 24 hours of recognition and kept prone for at least 12–16 consecutive hours a day.

Contraindications (from Guérin et al, 2013)

- elevated intracranial pressure > 30 mmHg or cerebral perfusion pressure < 60 mmHg
- massive haemoptysis
- recent tracheal surgery or sternotomy
- serious facial trauma or facial surgery
- deep venous thrombosis treated for less than 2 days
- cardiac pacemaker inserted in the last 2 days
- unstable spine, femur or pelvic fractures
- MAP < 65 mmHg
- pregnancy
- single anterior chest tube with air leaks.

Preparation

1. Check for contraindications:
   - facial or pelvic fractures
   - burns or open wounds on the ventral body surface
   - conditions associated with spinal instability (e.g. rheumatoid arthritis, trauma)
   - conditions associated with increased intracranial pressure
   - life-threatening arrhythmias.

2. Consider possible adverse effects of prone positioning on chest tube drainage.

3. Whenever possible, explain the manoeuvre to the patient or their family.

4. Confirm from a recent chest X-ray that the tip of the endotracheal tube is located 2–4 cm above the main carina.

5. Inspect and confirm that the endotracheal tube and all central and large bore peripheral catheters are firmly secured.

6. Consider exactly how the patient's head, neck and shoulder girdle will be supported after they are turned prone. Assemble all needed pillows, foam pads or other supports that might be needed.

7. Stop tube feeding, check for residual, fully evacuate the stomach, and cap or clamp the feeding and gastric tubes.

8. Prepare endotracheal suctioning equipment, and review what the process will be if copious airway secretions abruptly interfere with ventilation.

9. Decide whether the turn will be rightward or leftward.

10. Prepare all IV tubing and other catheters and tubing for connection when the patient is prone:
- assure sufficient tubing length
- relocate all drainage bags on the opposite side of the bed
- move chest tube drains between the legs
- reposition IV tubing toward the patient's head, on the opposite side of the bed.

Turning procedure

1. Place one (or more) people on both sides of the bed (to be responsible for the turning processes) and another at the head of the bed (to assure the central lines and the endotracheal tube do not become dislodged or kinked).

2. Increase the FiO_2 to 1.0 and note the mode of ventilation, the tidal volume, the minute ventilation, and the peak and plateau airway pressures.

3. Pull the patient to the edge of the bed furthest from whichever lateral decubitus position will be used while turning.

4. Place a new draw sheet on the side of the bed that the patient will face when in this lateral decubitus position. Leave most of the sheet hanging.

5. Turn the patient to the lateral decubitus position with the dependent arm tucked slightly under the thorax. As the turning progresses the nondependent arm can be raised in a cocked position over the patient's head. Alternatively, the turn can progress using a log-rolling procedure.

6. Remove ECG leads and patches. Suction the airway, mouth and nasal passages if necessary.

7. Continue turning to the prone position.

8. Reposition in the centre of the bed using the new draw sheet.

9. If the patient is on a standard hospital bed, turn their face toward the ventilator. Assure that the airway is not kinked and has not migrated during the turning process. Suction the airway if necessary.

10. Support the face and shoulders appropriately avoiding any contact of the supporting padding with the orbits or the eyes.

11. Position the arms for patient comfort. If the patient cannot communicate avoid any type of arm extension that might result in a brachial plexus injury.

12. Auscultate the chest to check for right mainstem intubation. Reassess the tidal volume and minute ventilation.

13. Adjust all tubing and reassess connections and functions.

14. Reattach ECG patches and leads to the back.

15. Tilt the patient into reverse Trendelenburg. Slight, intermittent lateral repositioning (20–30°) should also be used, changing sides at least every 2 hours.

16. Document a thorough skin assessment every shift, specifically inspecting weight bearing, ventral surfaces.

The criteria for stopping prone treatment were:

- Oxygenation improvement defined as $PaO_2/FiO_2 \geq 150$ mmHg with PEEP ≤ 10 cm H_2O and $FiO_2 \leq 0.6$; in the prone group, these criteria had to be met in supine at least 4 hours after the end of the last prone session.
- PaO_2/FiO_2 ratio deterioration by more than 20% relative to supine before two consecutive prone sessions; and
- Complications occurring during a prone session and leading to its immediate interruption, such as non-scheduled extubation, mainstem bronchus intubation, endotracheal tube obstruction, haemoptysis, $SpO_2 < 85\%$ or $Pa_2 < 55$ mmHg for more than 5 minutes under FiO2 1.0, cardiac arrest, HR < 30 BPM for more than 1 minute, SBP < 60 mmHg for more than 5 minutes, or any other life-threatening reason for which the clinician decided to stop.

10 Manage pain, sedation and delirium

10 Manage pain, sedation and delirium

Summary

Implement a protocolized management approach to pain, agitation and delirium to improve patient outcomes.

Regularly assess patients using standardized, reproducible scales (i.e. VAS, RASS, CAM-ICU).

First, treat pain (with opioids and non-opioids) to minimize the harmful effects of sedatives.

Then treat anxiety using non-benzodiazepines sedatives (when possible) and target **light** sedation in most patients.

Delirium should be prevented using non-pharmacologic interventions first.

Tools

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10.1 Numerical pain assessment scales

Visual analogue scale

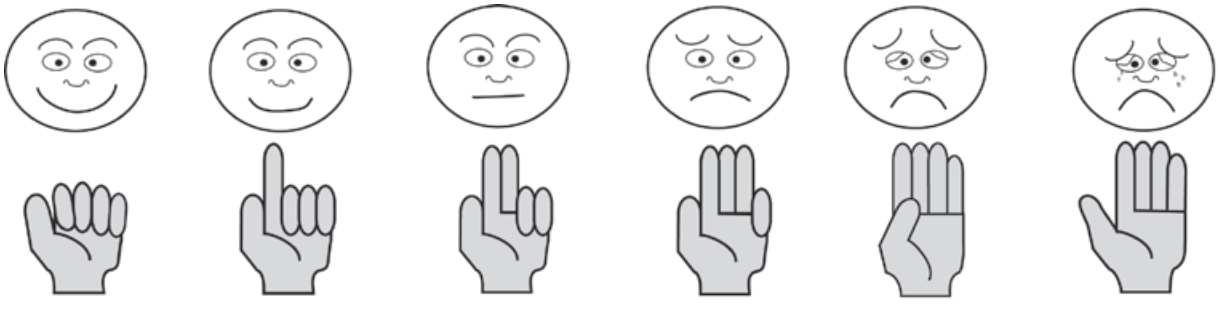
The visual analogue scale (VAS) for pain assessment in adults and adolescents is a validated and widely used method of monitoring the subjective level of pain experienced by patients. It is a 10 cm long scale, which ranges from 0 (no pain) to 10 (the worst pain that one can imagine). It is flexible, in that patients can make verbal or visual responses (i.e. if verbal communication is not possible, the patient can be shown a 10 cm scale and can point to the region which corresponds to their pain).

A major limitation of the VAS is that it requires an awake patient who grasps the concept of a scale. These conditions are frequently not satisfied in ICU patients.

The lower the VAS score, the higher the quality of the analgesia. However, a low VAS score with excessive sedation must be avoided, if possible. The level of sedation must be also closely monitored (see the Richmond Agitation-Sedation Scale tool).

Wong–Baker Faces Scale

The Wong-Baker Faces Scale can be used in younger children – they are asked to point to the face that reflects their pain level.



Source: Wong and Hockenberry (2001).

10.2 Behavioural pain assessment scales

There are two validated behavioural pain assessment scales that can be used to assess pain in adult patients on mechanical ventilation. In the noncommunicative patient these are recommended to use instead of physiological indicators alone.

Behavioural Pain Scale (BPS)

BPS score ranges from 3 (no pain) to 12 (maximum pain).

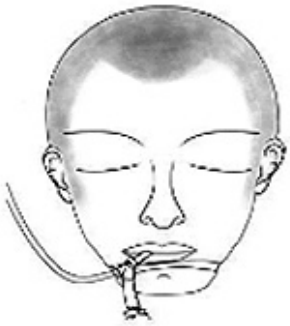
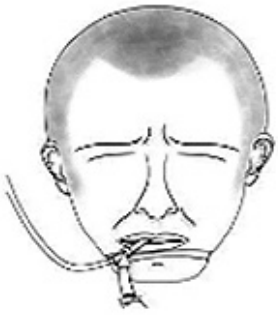
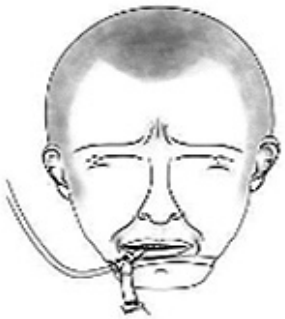
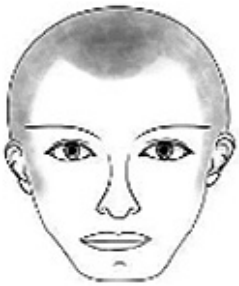
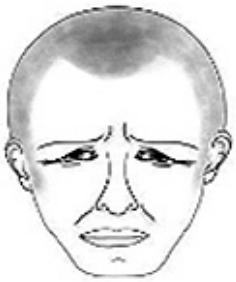
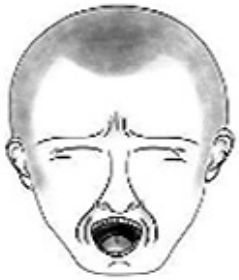
Item	Description	Score
Facial expression	Relaxed	1
	Partially tightened (e.g. brow lowering)	2
	Fully tightened (e.g. eyelid closing)	3
	Grimacing	4
Upper limb movements	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Compliance with mechanical ventilation	Tolerating movement	1
	Coughing but tolerating ventilation most of the time	2
	Fighting ventilator	3
	Unable to control ventilation	4

Critical-Care Pain Observation Tool (CPOT)

Indicator	Score		Description
Facial expressions	Relaxed, neutral	0	No muscle tension
	Tense	1	Presence of frowning, brow lowering, orbit tightening and levator contraction or any other change (e.g. opening eyes or tearing during nociceptive procedures)
	Grimacing	2	All previous facial movements plus eyelid tightly closed (the patient may present with mouth open or biting endotracheal tube)
Body movements	Absence of movements or normal position	0	Does not move at all (doesn't necessarily mean absence of pain) or normal position (movements not aimed toward the pain site or not made for the purpose of protection)
	Protection	1	Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements
	Restlessness/agitation	2	Pulling tube, attempting to sit up, moving limbs/thrashing, not following commands, striking at staff, trying to climb out of bed
Compliance with the ventilator (intubated patients)	Tolerating ventilator or movement	0	Alarms not activated, easy ventilation
	Coughing but tolerating	1	Coughing, alarms may be activated but stop spontaneously
or	Fighting ventilator	2	Asynchrony; blocking ventilation, alarms frequently activated
Vocalization (extubated patient)	Talking in normal tone or no sound	0	Talking in normal tone or no sound
	Sighing, moaning	1	Sighing, moaning
	Crying out, sobbing	2	Crying out, sobbing
Muscle tension Evaluation by passive flexion and extension of upper limbs when patient is at rest or evaluation when patient is being turned	Relaxed	0	No resistance to passive movements
	Tense, rigid	1	Resistance to passive movements
	Very tense or rigid	2	Strong resistance to passive movements or incapacity to complete them
	Total	(_ /8)	

Source: Adapted from Gélinas et al (2006).

Facial expressions

	0	1	2
	Relaxed, neutral (no muscle tension)	**Tense** (frowning, brow lowering, orbit tightening, little levator contraction)	**Grimacing** (contraction of the whole face: frowning, brow lowering, eyes tightly closed, levator contraction – mouth may be opened or the patient may be biting the endotracheal tube)
Intubated patient			
Non-intubated patient			

Source: Adapted from Payen et al (2001).

Note: A score of 1 may be attributed when a change in the patient's facial expression is observed compared with rest (e.g. opening or weeping).

How to use the Critical-Care Pain Observation Tool

1. The patient must be observed at rest for 1 minute to obtain a baseline vaue of the CPOT.
2. Then, the patient should be observed during nociceptive procedures known to be painful (e.g. turning, wound care) to detect any changes in the patient's behaviours to pain.
3. The patient should be evaluated before and at the peak effect of an analgesic agent to assess whether the treatment was effective or not in relieving pain.
4. For the rating of the CPOT, the patient should be attributed the highest score observed for each item during the observation period.
5. The patient should be attributed a score for each behaviour included in the CPOT and muscle tension should be evaluated last, especially when the patient is at rest because the stimulation of touch alone (when performing passive flexion and extension of the arm) may lead to behavioural reactions.

Free teaching CPOT video available from the Society of Critical Care Medicine:
https://www.sccm.org/ICULiberation/Resources/Critical-Care-Pain-Observation-Tool-How-to-Use-it

Observation of patient at rest (baseline)
The nurse looks at the patient's face and body to note any visible reaction for an observation period of 1 minute. She/he gives a score for all items except for muscle tension. At the end of the 1-minute period, the nurse holds the patient's arm in both hands – one at the elbow, and uses the other one to hold the patient's hand. Then she/he performs and passive flexion and extension of the upper limb, and feels any resistance the patient may exhibit. If the movements are performed easily, the patient is found to be relaxed with no resistance (score 0). If the movements can still be performed but with more strength, then it is concluded that the patient is showing resistance to movement (score 1). Finally, if the nurse cannot perform the movement, strong resistance is felt (score 2). This can be observed in patients who are spastic.

Observation of patient during turning
Even during the turning procedure, the nurse can still assess the patient's pain. While she/he is turning the patient on one side, she/he looks at the patient's face to note any reactions such as frowning or grimacing. These reactions may be brief or can last longer. The nurse also looks out for body movements. For instance, she/he looks for protective movements like the patient trying to reach or touching the pain site (e.g. surgical incision, injury site). In the mechanically ventilated patient the nurse pays attention to alarms and if they stop spontaneously or require that she/he intervenes (reassurance, administering medication). According to muscle tension, the nurse can feel if the patient is resisting to the movement or not. A score of 2 is given when the patient is resisting against the movement and attempts to get on his/her back.

10.3 COMFORT–B Scale to assess sedation in children

The sedation and pain levels of children in intensive care should be assessed at least 4 hourly in intensive care. A number of tools are available to assess pain and sedation. Here we describe the use of COMFORT- B scale for sedation and the Face, Legs, Activity, Cry, Consolability (FLACC) scale for pain.

COMFORT–B Scale

The COMFORT-B cannot be used in children who are receiving muscle relaxant drugs or children with severe neurological impairment. The child should be observed for 2 minutes and six behaviours are scored as below (score either respiratory response or crying, depending on the child's intubation status).

Children scoring 11–22 are in the optimal range of sedation; children scoring < 10 may be oversedated (consider weaning); and children > 23 are undersedated.

COMFORT-B Scale

Item	Description	Score
Alertness	1. Deeply asleep	
	2. Lightly asleep	
	3. Drowsy	
	4. Fully awake and alert	
	5. Hyperalert	
Calmness/agitation	1. Calm	
	2. Slightly anxious	
	3. Anxious	
	4. Very anxious	
	5. Panicky	
Respiratory response (ventilated children)	1. No coughing and no spontaneous respiration	
	2. Spontaneous respiration with little or no response to ventilation	
	3. Occasional cough or resistance to ventilator	
	4. Actively breathes against ventilator or coughs regularly	
	5. Fights ventilator, cough or choking	
Cry (non-ventilated children)	1. Quiet breathing, no crying	
	2. Sobbing or gasping	
	3. Moaning	
	4. Crying	
	5. Screaming	

COMFORT-B Scale

Item	Description	Score
Physical movement	1. No movement	
	2. Occasional, slight movements	
	3. Frequent, slight movements	
	4. Vigorous movement limited to extremities	
	5. Vigorous movements including torso and head	
Muscle tone	1. Muscles totally relaxed, no muscle tone	
	2. Reduced muscle tone	
	3. Normal muscle tone	
	4. Increased muscle tone and flexion of fingers and toes	
	5. Extreme muscle rigidity and flexion of fingers and toes	
Facial tension	1. Facial muscle totally relaxed	
	2. Facial muscle tone normal; no facial muscle tension evident	
	3. Tension evident in some facial muscles	
	4. Tension evident throughout facial muscles	
	5. Facial muscles contorted and grimacing	
	Total score	

Source: Adapted from Ambuel et al (1992).

FLACC Behavioural Pain Assessment Scale

The FLACC scale is a measurement used to assess pain for children between 2 months and 7 years or for individuals who are unable to communicate their pain. The scale has five criteria, each of which is assigned a scale of 0, 1 or 2.

FLACC Behavioural Pain Assessment Scale

	Scoring		
Categories	**0**	**1**	**2**
Face	No particular expression or smile	Occasional grimace or frown; withdrawn, disinterested	Frequent to constant frown, clenched jaw, quivering chin
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arches, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractible	Difficult to console or comfort

How to use the FLACC

In patients who are awake: observe for 1 to 5 minutes or longer. Observe legs and body uncovered. Reposition patient or observe activity. Observe body for tenseness and tone. Initiate consoling interventions if needed.

In patients who are asleep: observe for 5 minutes or longer. Observe legs and body uncovered. If possible, reposition the patient. Touch the body and observe for tenseness and tone.

Face

- Score 0 if the patient has a relaxed face, makes eye contact, shows interest in surroundings.
- Score 1 if the patient has a worried facial expression, with eyebrows lowered, eyes partially closed, cheeks raised, mouth pursed.
- Score 2 if the patient has deep furrows in the forehead, closed eyes, an open mouth, deep lines around nose and lips.

Legs

- Score 0 if the muscle tone and motion in the limbs are normal.
- Score 1 if the patient has increased tone, rigidity, or tension; if there is intermittent flexion or extension of the limbs.
- Score 2 if the patient has hypertonicity, the legs are pulled tight, there is exaggerated flexion or extension of the limbs, tremors.

Activity

- Score 0 if the patient moves easily and freely, normal activity or restrictions.
- Score 1 if the patient shifts positions, appears hesitant to move, demonstrates guarding, a tense torso, pressure on a body part.
- Score 2 if the patient is in a fixed position, rocking; demonstrates side-to-side head movement or rubbing of body part.

Cry

- Score 0 if the patient has no cry or moan, awake or asleep.
- Score 1 if the patient has occasional moans, awake or asleep.
- Score 2 if the patient has frequent or continuous moans, cries, grunts.

Consolability

- Score 0 if the patient is clam and does not require consoling.
- Score 1 if the patient responds to comfort by touching or talking in 30 seconds to 1 minute.
- Score 0 if the patient requires constant comforting or is inconsolable.

When feasible, behavioural measurement of pain should be used in conjunction with self-report. When self-report is not possible, interpretation of pain behaviours and decisions regarding treatment of pain require careful consideration of the context in which pain behaviours are observed.

Interpreting the **Behavioural Score**
Each category is scored on the 0–2 scale, which results in a total score of 0–10; 0 = Relaxed and comfortable; 1–3 = Mild discomfort; 4–6 = Moderate pain; 7–10 = Severe discomfort or pain or both.

Source: Merkel et al (1997).

10.4 Richmond Agitation–Sedation Scale (RASS)

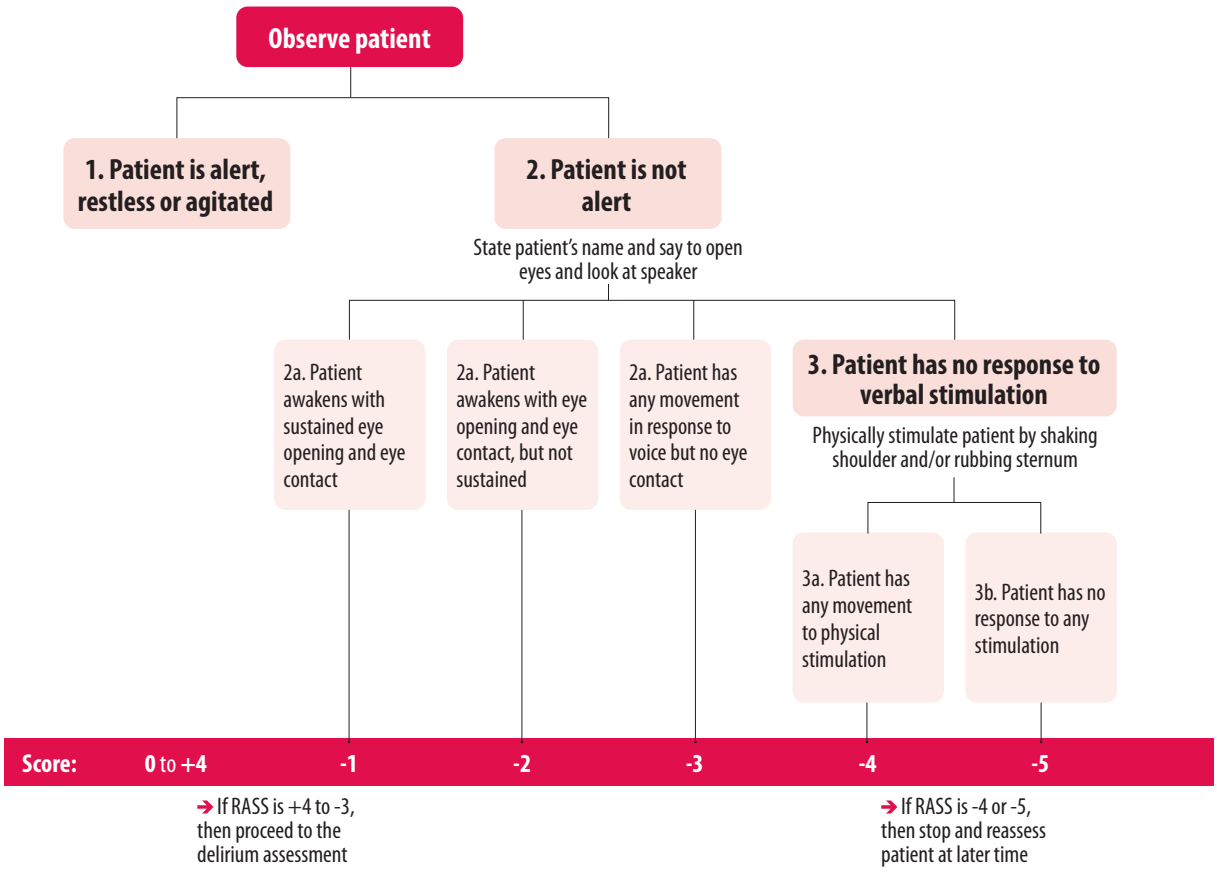
Assess agitation, anxiety and sedation levels on a regular basis using a standardized scale and set a daily sedation target based on clinical condition and management plans for the day. Consider the use of the Richmond Agitation-Sedation Scale (RASS). This has been validated in many clinical trials and can be easily taught to staff.

Score	Term	Description	
+4	Combative	Overtly combative, violent, immediate danger to staff	
+3	Very agitated	Pulls or removes tube(s) or catheter(s); aggressive	
+2	Agitated	Frequent non-purposeful movement, fights ventilator	
+1	Restless	Anxious but movements not aggressive vigorous	
0	Alert and calm		
-1	Drowsy	Not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (> 10 seconds)	Verbal stimulation
-2	Light sedation	Briefly awakens with eye contact to voice (< 10 seconds)	
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)	
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	Physical stimulation
-5	Unarousable	No response to voice or physical stimulation	

Source: Adapted from Sessler et al (2002).

Algorithm for RASS assessment

In most patients, this assessment is very quick and takes only 30 seconds (only 10% take a few minutes).



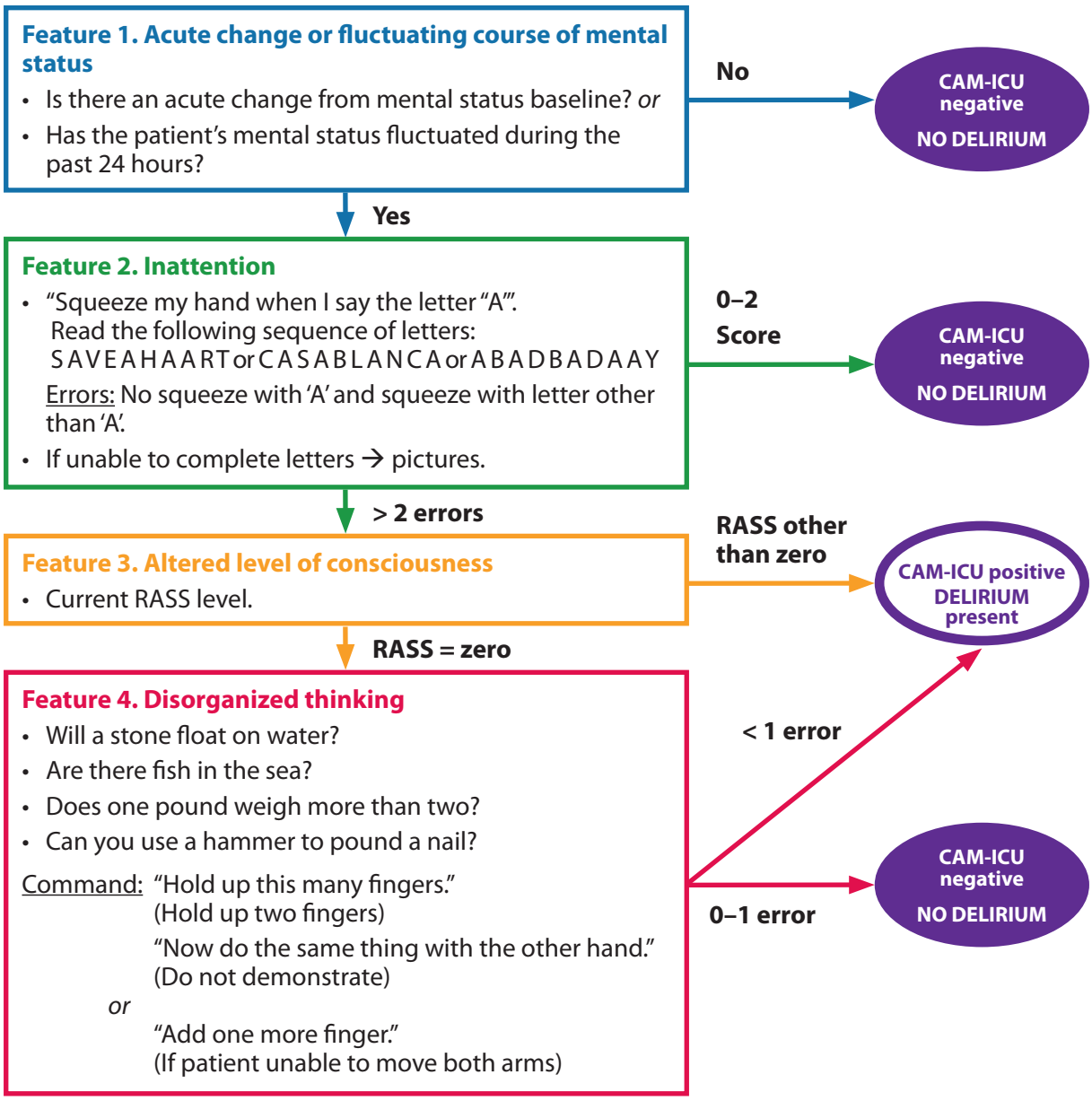
Source: Adapted from Sessler et al (2002).

10.5 Flowchart and worksheet for the Confusion Assessment Method of the ICU for adults (CAM-ICU)

Use the CAM-ICU flowsheets and worksheet (http://icudelirium.org/docs/CAM_ICU_training.pdf), reproduced below, to assess delirium in conjunction with the RASS scale. For additional training materials on how to do the CAM-ICU and train staff, visit https://www.icudelirium.org/medical-professionals/downloads/resources-by-category

CAM-ICU flowchart

The flowchart can be used as a pocket card or wall poster to easily reference the procedure to assess for the presence of delirium.



Source: Ely et al (2001).

CAM-ICU worksheet

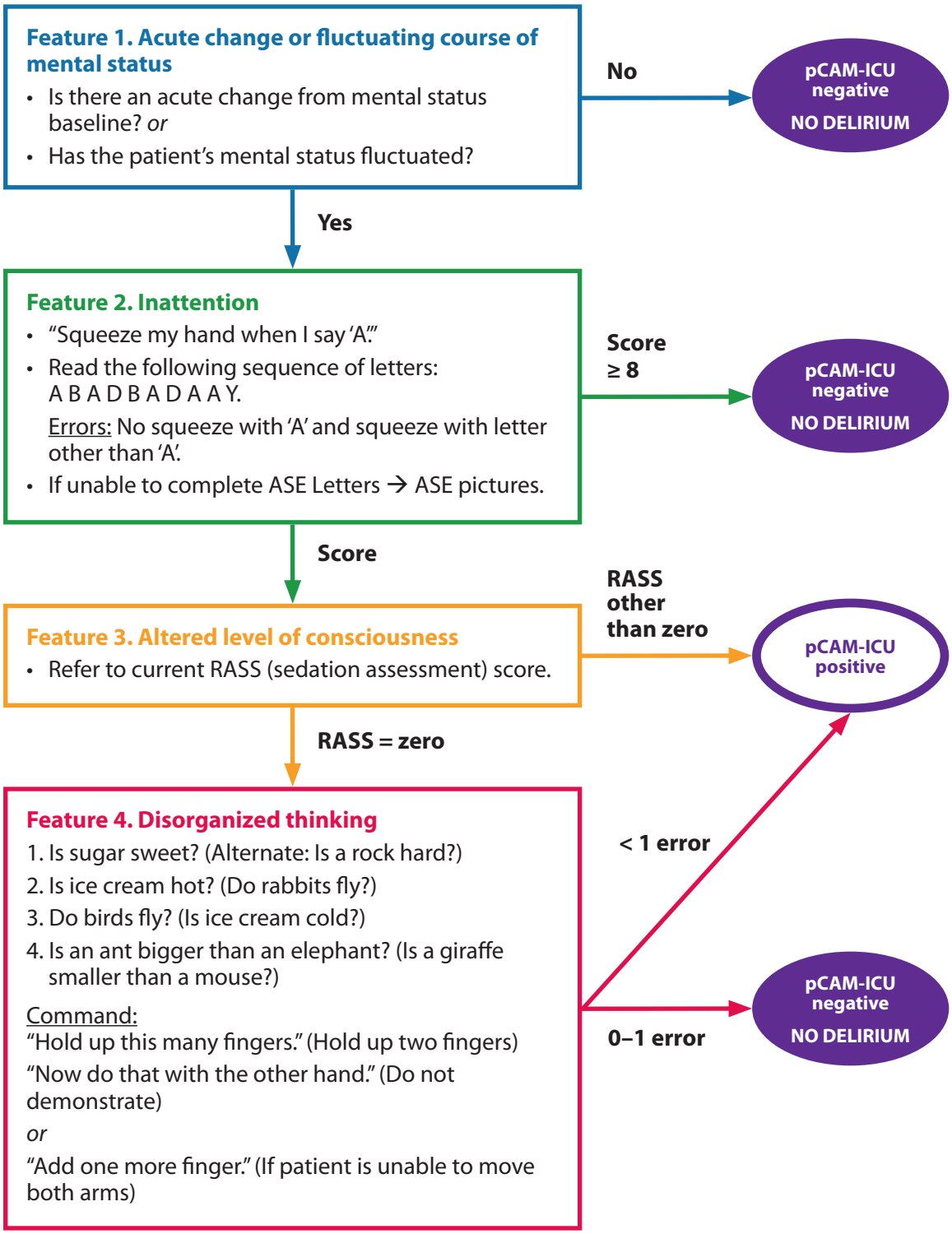
	Score	Check here if present
Feature 1: Acute onset or fluctuating course		
Is the patient different than his/her baseline mental status? *or* Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e. RASS/SAS, GCS or previous delirium assessment)?	Either question Yes →	☐
Feature 2: Inattention		
Letters attention test: Directions: Say to the patient, "I am going to read you a series of 10 letters. Whenever you hear the letter 'A', indicate by squeezing my hand." Read the letters from the following list in a normal tone 3 seconds apart. S A V E A H A A R T *or* C A S A B L A N C A *or* A B A D B A D A A Y Errors are counted when patient fails to squeeze on the letter "A" and when the patient squeezes on any letter other than "A". If unable to complete letters attention test → use pictures (see Tool 10.7)	Number of errors > 2 →	☐
Feature 3: Altered level of consciousness		
Present if actual RASS score is anything other than alert and calm (zero)	RASS anything other than zero →	☐
Feature 4: Disorganized thinking		
Yes/No questions: Will a stone float on water? Are there fish in the sea? Does one pound weigh more than two? Can you use a hammer to pound a nail? **Errors are counted when the patient incorrectly answers a question.** Command: Say to the patient, "Hold up this many fingers." (Hold up two fingers in front of the patient) "Now do the same thing with the other hand." (Do not repeat the number of fingers) *Note:* If patient is unable to move both arms, for second part of command ask patient to "Add one more finger". **An error is counted if patient unable to complete entire command.**	Combined number of errors > 1 →	☐
Overall CAM-ICU **CAM-ICU positive =** **Feature 1** _____ + **Feature 2** _____ + *either* **Feature 3** _____ *or* **Feature 4** _____	Criteria met →	☐ CAM-ICU positive (DELIRIUM present)
	Criteria not met →	☐ CAM-ICU negative (NO DELIRIUM)

Source: Ely et al (2001).

10.6 Flowchart and worksheet for the Confusion Assessment Method of the ICU for children (pCAM-ICU)

This tool is adapted from Smith et al (2011) (see References and resources).

pCAM-ICU flowchart



pCAM-ICU worksheet

Feature 1: Acute change or fluctuating course of mental status		
A. Is there an acute change from mental status baseline? Yes or No B. Has my patient's mental status fluctuated during the past 24 hours? Yes or No Evidenced by fluctuation on a sedation scale (RASS), SAS, GCS or previous delirium assessment.	If either answer YES then circle ⊕ →	+ / –
Feature 2: Inattention → FEATURE POSITIVE if SCORE 0–7 on Vigilance "A" test *or* ASE picture test		
Vigilance "A" test: I want my patient to squeeze my hand when I say ONLY the letter "A". I will read the 10-letter sequence in the same order every day, with my normal voice, saying each letter once every second. Directions to patient: "Squeeze my hand when I say the letter 'A'. Let's practise, 'A'". To score: When I say the letter "A" and the patient does not squeeze my hand, I subtract 1 point. When I say the other letters and the patient squeezes my hand, I subtract 1 point. A___B___A___D___B___A___D___A___A___Y___	If the SCORE is 0–7 then circle ⊕ →	+ / –
or		
ASE picture test: I will show the patient **"5 memory pictures"**. I want the patient to remember the 5 **"memory pictures"** when shown a larger **"deck"** of 10 pictures. Directions to patient: "I am going to show you 5 pictures that I want you to remember". (Show 1 **picture** every **3 seconds** and state object's name.) Directions if patient can verbalize: "Say yes when you see **1 of those 5 pictures** again". (Show all pictures from **deck** and state object's name.) Directions to intubated patient: "Nod your head yes when you see **1 of those 5 pictures** again". To score: If the patient nods or says "yes" to ONLY the **5 memory pictures** they have completed the task successfully – SCORE 10/10. If patient does not nod or say "yes" to 1 of the 5 memory pictures, I will subtract 1 point. If the patient nods or says "yes" to the other pictures in the deck, I will subtract 1 point. Memory picture: _____ / 5 Deck pictures: _____ / 5	If the SCORE is 0–7 then circle ⊕ →	+ / –
Feature 3: Altered level of consciousness → FEATURE POSITIVE if the current RASS score is anything other than 0		
At the time of sedation assessment the RASS score was _____		+ / –

Feature 4: Disorganized thinking		
Directions if patient can verbalize: "I am going to ask you 4 questions, say 'yes' or 'no' to answer". Directions to intubated patient: "I am going to ask you 4 questions, nod your head yes or no to answer". **Set A:** 1. Is sugar sweet? 2. Is ice cream hot? 3. Do birds fly? 4. Is an ant bigger than an elephant? **Set B:** 1. Is a rock hard? 2. Do rabbits fly? 3. Is ice cream cold? 4. Is a giraffe smaller than a mouse? 5. Directions to patient: "Hold up this many fingers." (Examiner hold up two fingers for patient to see) Directions to patient: "Now do the same thing with the other hand." (Do not show fingers again to patient) Directions to patient if unable to move **both** arms: "Now, add one more finger." (Do not show fingers again to patient) To score: If the patient answers a question incorrectly, I will subtract 1 point. If the patient is not able to complete the command no. 5, I will subtract 1 point.	If the SCORE is 0–3 then circle ⊕ →	+ / –
Paediatric delirium = **Feature 1** _____ + **Feature 2** _____ + *either* **Feature 3** _____ *or* **Feature 4** _____		

10.7 Procedure for assessing attention: attention screening exam (ASE) for adults

This procedure is to be used to assess for feature 2 (**inattention** – a cardinal feature of delirium), when the patient is unable to complete the letters attention test (SAVEAHAART). This happens in only about 10% of patients.

Step 1

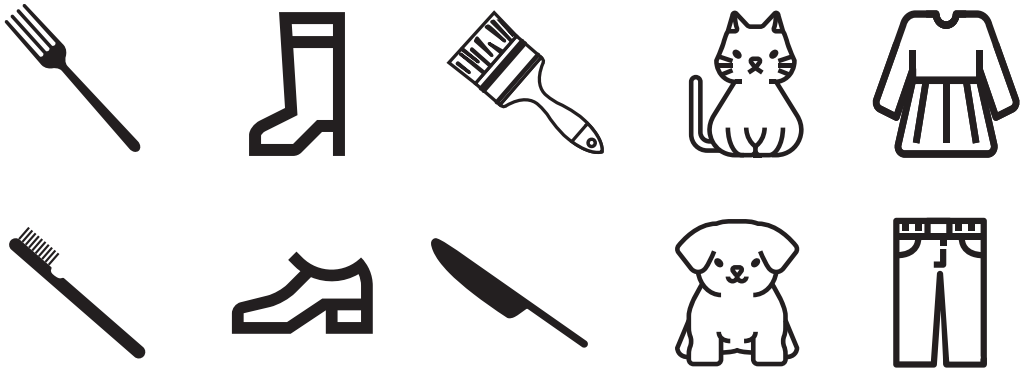
- Say to the patient: *"Mr or Mrs …, I am going to show you pictures of some common objects. Watch carefully and try to remember each picture because I will ask what pictures you have seen."*

- Present five pictures: naming them and showing them each for 3 seconds.

Step 2

- Say to the patient: *"Now I am going to show you some more pictures. Some of these you have already seen and some are new. Let me know whether or not you saw the picture before by nodding your head yes (demonstrate) or no (demonstrate)."*

- Present ten pictures (five new, five repeated): naming them and showing them each for 3 seconds.



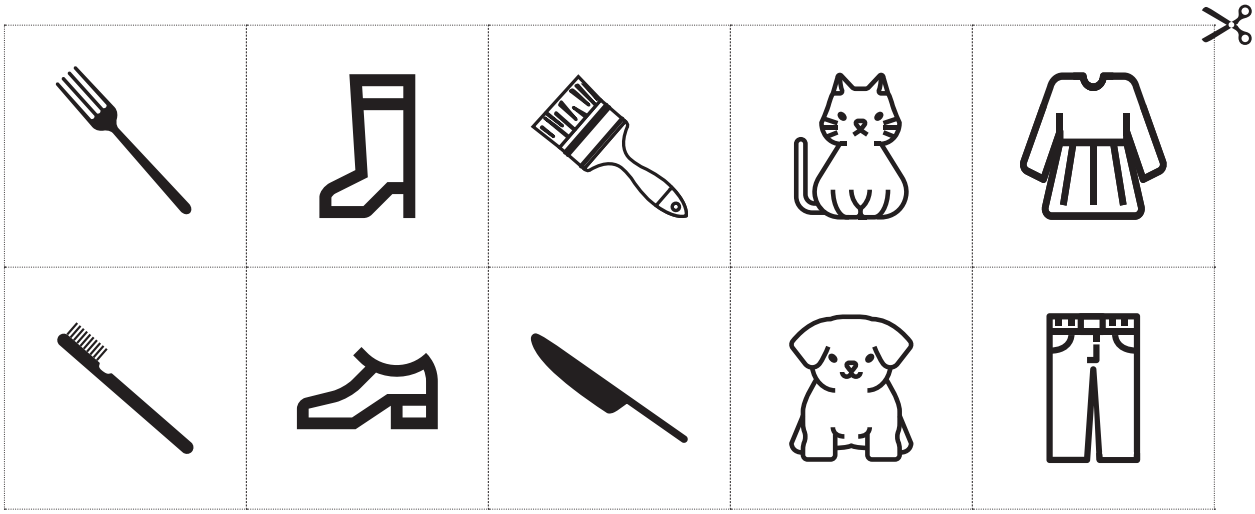
Scoring

This test is scored by the number of correct "yes" or "no" answers during Step 2 (out of a possible 10).

Important: Alternate daily between Forms A and B (see next tool) if repeat measures are taken. If a patient wears glasses make sure they have them on when attempting the ASE.

Source: Adapted from Ely and Vanderbilt University (2002).

Form A



Source: Adapted from Ely and Vanderbilt University (2002).

Form B

Source: Adapted from Ely and Vanderbilt University (2002).

10.8 Guide to commonly used sedatives in adults

There are many sedative medications available to treat agitation and anxiety. You will need to see which medications your hospital currently has and consider which medications you may want to use in the future. It is important to familiarize yourself with the basic pharmacokinetics and side-effects of any drug you use. The goal is to reach the sedation target with the lowest possible sedative medication to minimize toxicity. The doses provided below are intended to be used for patients who are intubated and receiving mechanical ventilation. Continuous infusions of benzodiazepines should be avoided when at all possible to reduce the risks of oversedation, prolonged days of IMV and delirium.

		Benzodiazepine[a]			
	Propofol	**Midazolam**	**Lorazepam**	**Diazepam**	**Dexmedetomidine[b]**
Onset	< 1 minute	1–5 minutes	5–20 minutes	2–5 minutes	1–3 minutes
Infusion	25–75 µg/kg/min	0.04–0.2 mg/kg/hr	0.01–0.1 mg/kg/hr (preferred vs midazolam)	Not used	0.2–1.5 µg/kg/hr
Time to arousal	10–15 minutes	1–2 hours	2–6 hours	2–4 hours	6–10 minutes
Risks	Respiratory depression Hypotension Idiosyncratic rhabdomyolysis and acidosis Raised triglycerides	Respiratory depression Hypotension Prolonged sedation with infusions due to active metabolite Reduce dose in renal and liver failure	Respiratory depression Hypotension Propylene glycol carrier may irritate veins and cause metabolic acidosis with prolonged administration	Respiratory depression Hypotension Oversedation with repeated boluses with accumulation of drug and active metabolite	Hypotension Bradycardia Atrial fibrillation More pronounced in elderly Safety data for up to 4 days of infusion Dose may need to be reduced in elderly depending on renal function

Notes:

[a] Reduce dose in the elderly;
[b] Less commonly available.

Note: Early in the course of severe ARDS, however, deep sedation targets may be needed to safely achieve LPV targets and reduce asynchrony. In cases when NMB are administered, remember to also give a continuous sedative for amnesia and analgesic for pain.

10.9 Guide to commonly used opioid analgesics in adults

There are several opioids available to treat pain. You will need to see which medications your hospital currently has and consider which medications you may want to use in the future. Familiarize yourself with the basic pharmacokinetics and side-effects of any drug you use. Be sure to set a therapeutic analgesia plan and communicate to all caregivers for a consistent approach.

These considerations are adapted from the *Clinical practice guidelines for the sustained use of sedatives and analgesics in the critically ill adult* (Jacobi et al, 2002) (see References and resources).

The doses provided below are suggestions and will need adjustment based on the amount of pain and whether the patient is receiving mechanical ventilation.

	Morphine	Hydromorphone	Fentanyl
Intermittent dose IV	0.01–0.15 mg/kg every 1–2 hr	10–30 µg/kg every 1–2 hr	0.35–1.5 µg/kg every 0.5–1 hr
Infusion	0.07–0.5 mg/kg/hr	7–15 µg/kg/hr	0.7–10 µg/kg/hr
Half-life	3–7 hr	2–3 hr	1.5–6 hr
Equianalgesic IV dose[a]	10 mg	1.5 mg	200 µg
Situations where drug is preferred	Intermittent dosing	Intermittent dosing Haemodynamic instability Renal failure	Rapid onset in acutely distressed patients Haemodynamic instability Renal failure
Risks[b]	Histamine release causing hypotension Prolonged effect in renal failure due to metabolite		Rigidity with high doses Repeated dosing may cause accumulation and prolonged effects

Notes:

[a] These doses produce approximately the same analgesic effects;
[b] Side-effects common to all agents include respiratory depression, coma and delirium, hypotension (especially with morphine) and ileus.

Note: Meperidine and codeine may be available at many hospitals. However, meperidine has an active metabolite that causes neuroexcitation (apprehension, tremors, delirium and seizures) and may interact with antidepressants (contraindicated with monoamine oxidase inhibitors and best avoided with selective serotonin-reuptake inhibitors), so it is not recommended for repetitive use. Codeine lacks analgesic potency and is thus not useful for most patients.

10.10 Guide to using neuromuscular blockers in adults

In patients with moderate-severe ARDS (PaO_2/FiO_2 < 150), neuromuscular blockade by continuous infusion should not be routinely used.

A trial found that neuromuscular blockade improved survival in adult patients with severe ARDS without causing significant weakness (Papazian et al, 2010), but results of a recent larger trial found that use of neuromuscular blockade with high PEEP strategy was not associated with a survival benefit when compared with a light sedation strategy without neuromuscular blockade (NHLBI PCTN et al, 2019). Continuous neuromuscular blockade may still be considered in patients with ARDS, both adults and children, in certain situations: ventilator dyssnchrony despite sedation, such that tidal volume limitation cannot be reliably achieved; or refractory hypoxaemia or hypercapnia.

	Pancuronium	Vecuronium	Cisatracurium
IV dose	Intermittent: 0.08–0.1 mg/kg Infusion: 0.2–0.6 µg/kg/min (usually 1–2.5 mg/hr)	Intermittent: 0.08–0.1 mg/kg Infusion: 0.2–0.8 µg/kg/min (usually 1–4 mg/hr)	Intermittent: 0.15–0.20 mg/kg Infusion: 3 mcg/kg/min for first 20 minutes then reduce to 1–2 mcg/kg/min (range: 0.5–10 mcg/kg/min)
Common points on dosing	Tailor intermittent dose to patient response. Titrate infusion dose clinically or to achieve one or two twitches with train of four stimulation on peripheral nerve stimulator, if available		
Onset	< 4 minutes	2–3 minutes	
Specific risks	Long duration of activity: ~90–160 minutes Accumulation in hepatic and renal dysfunction Dose-dependent increased HR and blood pressure (due to vagolytic and weak sympathomimetic effects)	Intermediate duration of activity: ~30–45 minutes Accumulation in hepatic and renal dysfunction	Duration of action: ~45–75 minutes Slight accumulation in hepatic and renal dysfunction
Common risks	Appropriate sedation and analgesia should be administered concurrently since these drugs have neither effect HR and blood pressure should be routinely monitored; increases may indicate inadequate sedation or analgesia ICU-acquired weakness if used for prolonged period		

10.11 Guide to commonly used antipsychotics (haloperidol) in adults

Antipsychotic agents can be used to control delirium. Haloperidol is a typical antipsychotic that has been available for many years. Atypical antipsychotics can also be used (e.g. quetiapine, olanzapine and risperidone). Dexmedetomidine is a newer agent that has both sedative and anti-delirium effects.

Haloperidol	
Loading dose	Begin with 2–5 mg IV Double dose every 15 minutes until desired effect is achieved **Do not** exceed total of 20 mg/day
Onset	10–20 minutes
Risks	Torsade de pointes arrhythmia, do not use if the QTc interval on ECG is prolonged to > 460 milliseconds Suspect neuroleptic malignant syndrome if patient develops hyperthermia, muscle rigidity and rhabdomyolysis

Dosing recommendations	
Quetiapine	Begin with 50 mg po twice daily Increase up to 200 mg po twice daily (halve dose in elderly)
Olanzipine	Begin with 5–10 mg IV/IM/po Repeat dose in 2 hours to maximum of 30 mg/day
Risperidone	Begin with 1–2 mg po daily Increase to maximum of 6 mg po daily

Side-effects of atypical antipsychotics are prolonged QTc interval and extrapyramidal effects (less common than with typical antipsychotic agents).

10.12 Guide to paediatric analgesics, sedatives and neuromuscular blockers

There are several agents available for analgesia, sedation and neuromuscular blockade. You will need to see which medications your hospital currently has and consider which medications you may want to use in the future. Familiarize yourself with the basic pharmacokinetics and side-effects of any drugs you use. The doses provided below are suggestions and will need titration in individual patients based on the amount of pain and whether the patient is receiving mechanical ventilation. Appropriate sedation and analgesia should be administered concurrently with neuromuscular blockade, which has no sedative or analgesic properties.

Propofol is contraindicated for sedation in children < 16 years old in the ICU because of the risk of propofol infusion syndrome (acidosis and rhabdomyolysis).

	Drug	Enteral dose	Bolus IV dose	IV infusion
Analgesia	Paracetamol	10–15 mg/kg po/pr 6 hrly	N/A	N/A
	Oxycodone	0.05–0.2 mg/kg/dose po 4–6 hrly	N/A	N/A
	Ibuprofen	5–10 mg/kg/dose po 6–8 hrly	N/A	N/A
	Morphine	0.2–0.4 mg/kg po 6 hrly	0.1–0.2 mg/kg	0–40 µg/kg/hr
	Fentanyl	N/A	1–2 µg/kg	0–8 µg/kg/hr
Sedation	Midazolam	N/A	0.1–0.2 mg/kg	0–4 µg/kg/min
	Diazepam		0.1–0.2 mg/kg	N/A
	Chloral hydrate	30–50 µg/kg pr 6 hrly	N/A	N/A
	Triciofos	30–50 µg/kg pr 6 hrly	N/A	N/A
	Allmemazine	1 mg/kg po 6 hrly	N/A	N/A
Neuromuscular blockade	Vecuronium	N/A	0.1 mg/kg as required	0–4 µg/kg/min

11 Liberation from invasive mechanical ventilation

11 Liberation from invasive mechanical ventilation

Summary

Use a daily coordinated spontaneous breathing trial (SBT) protocol to liberate patients from mechanical ventilation as soon as possible as this improves patient outcomes!

In patients who fail SBT, recognize and treat reason for failure, and try again the next day. In patients who pass SBT, consider extubation after evaluation of upper airway.

After extubation, monitor the patient over the next 48 hours for signs of respiratory failure and need for prompt re-intubation.

Consider tracheostomy after 10–14 days if prolonged need for mechanical ventilation persists.

Tools

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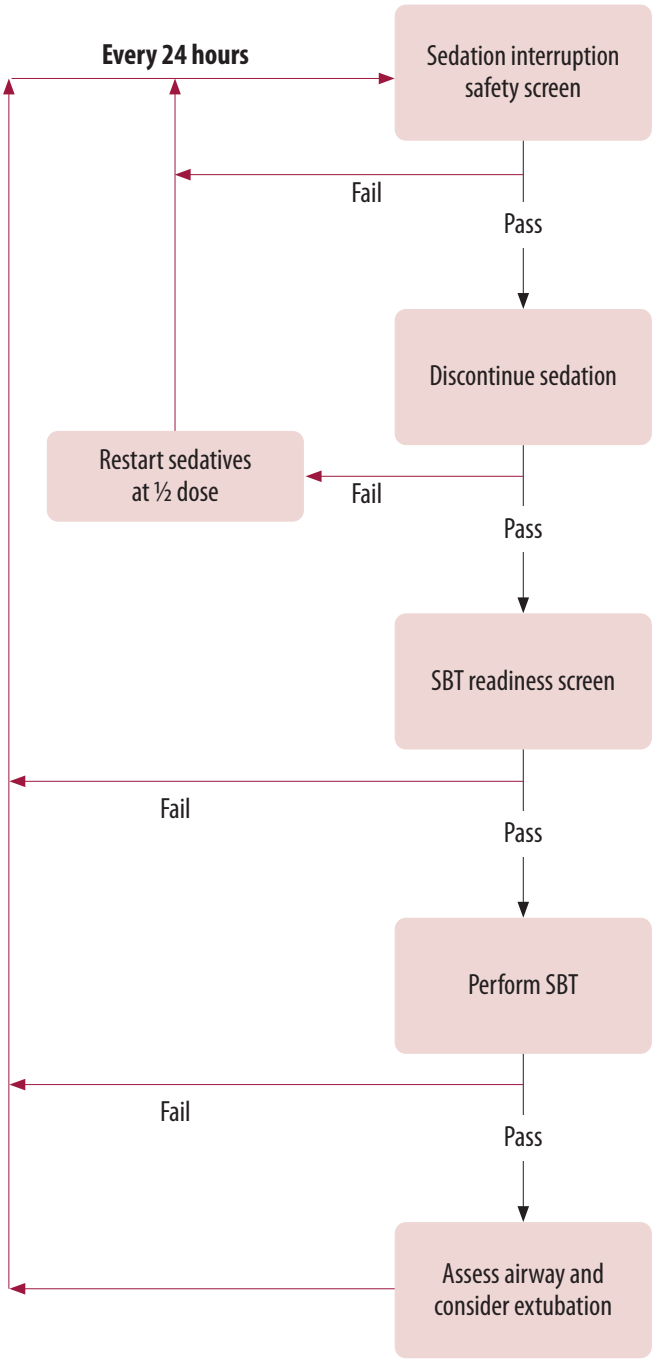
11.1 Algorithm for coordinating daily sedation interruption with daily SBT

Consider using an algorithmic framework to systematically assess if your patient is ready to have their sedation interrupted and be liberated from the ventilator. This is adapted from the *Awakening and Breathing Controlled trial* (Girard et al, 2008) and can be adapted to your ICU.



Sedation interruption safety screen

- No active seizures
- No alcohol withdrawal
- No agitation
- No neuromuscular blockade
- No myocardial ischemia
- No elevated ICP

Sedation interruption failure

- Anxiety, agitation or pain
- Respiratory rate > 35/min
- SpO_2 < 90%
- Respiratory distress
- Haemodynamic instability

SBT readiness screen

- Spontaneous breathing efforts
- Resolving/stable disease
- SpO_2 ≥ 90% on FiO_2 ≤ 0.50 and PEEP ≤ 8 cm H_2O
- pH > 7.3 and MV ≤ 15 L/min
- No significant vasopressor use[a]
- No myocardial ischemia
- No elevated ICP

SBT failure

Any sign of respiratory failure

- Respiratory rate > 35/min
- Apnea
- SpO_2 < 90%
- Hypoventilation

≥ Two signs of intolerance

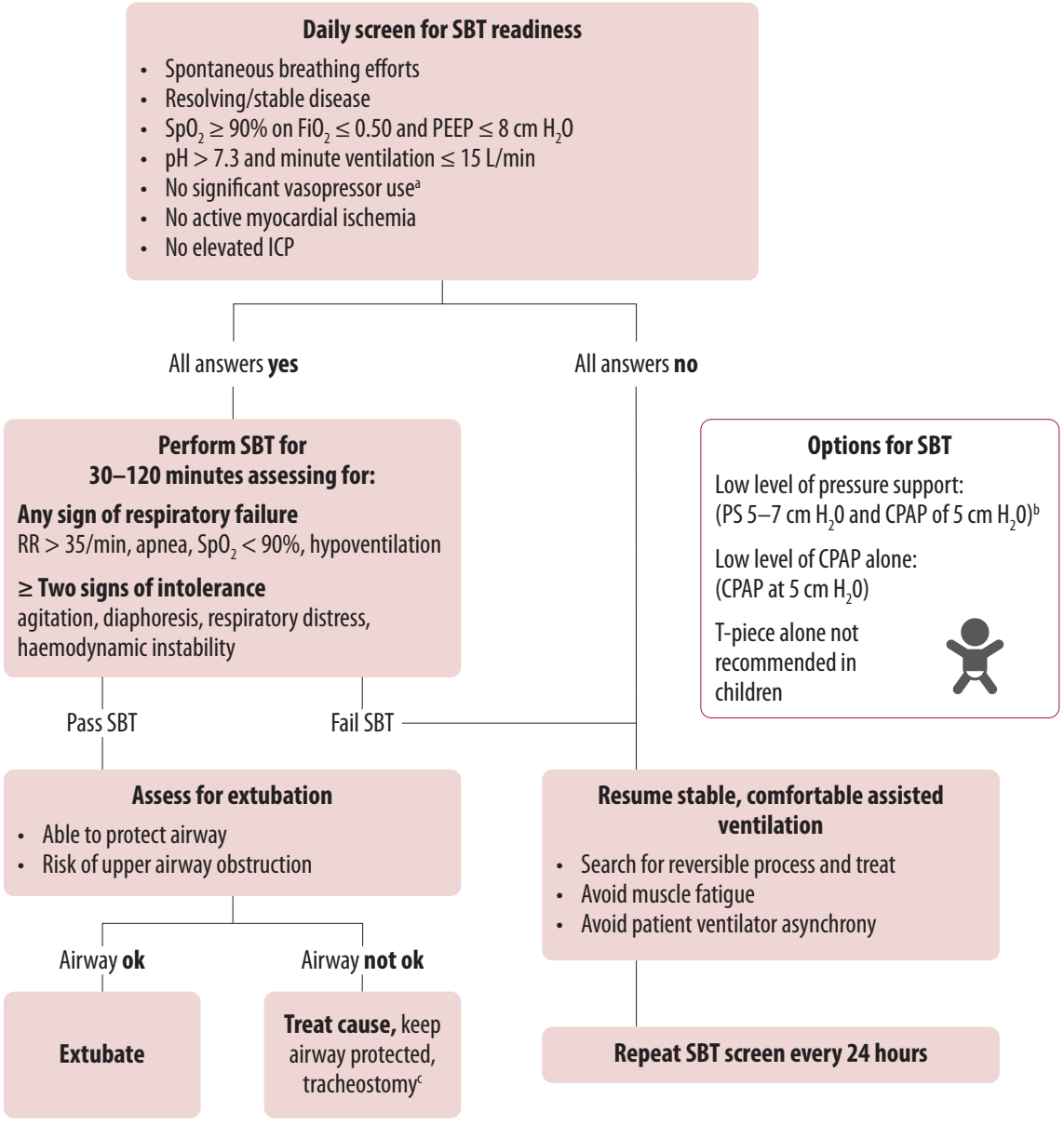
- Agitation
- Diaphoresis
- Accessory muscle
- Haemodynamic instability

Notes:

[a] Dopamine ≤ 5 ug/kg/min or equivalent;
ICP – intracranial pressure; MV – mechanical ventilation.

11.2 Algorithm for liberating patient from invasive mechanical ventilation

Consider using an algorithmic framework to systematically assess if your patient is ready to be liberated from the ventilator. This is adapted from the review article entitled *Discontinuing mechanical ventilatory support* (MacIntyre, 2007).



Notes:

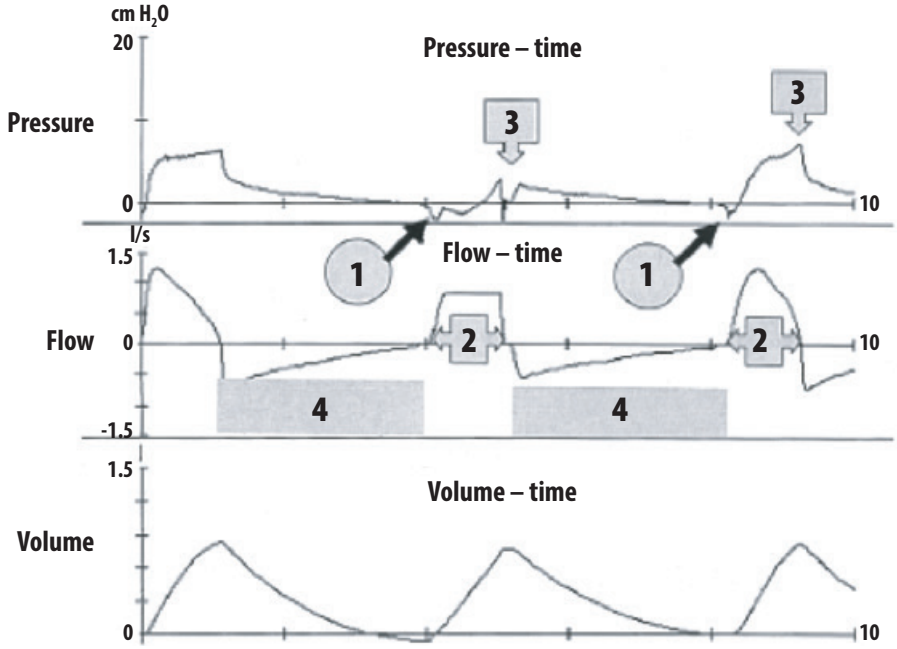
[a] Dopamine ≤ 5 ug/kg/min or equivalent;
[b] PS in children may be higher (10 cm H_2O) given increased resistance in ETT;
[c] Consider tracheostomy based on local practice.

11.3 How to perform a cuff leak test

1. Patient should be sedated or the test done when the patient is asleep to prevent measurement artifacts.
2. Standard vent settings: volume controlled ventilation with TV of 8–10 mL/kg, RR ~10–12, flow rate 50–60 L/min.
3. Suction mouth.
4. Measure the expired TV.
5. Deflate the ETT cuff.
6. Re-measure the expired TV over six breaths:
   - cuff leak is the difference in TV with cuff inflated and deflated;
   - expired TV should decrease by > 100 mL;
   - a value > 130 mL has 85% sensitivity and 95% specificity;
   - reinflate the cuff.

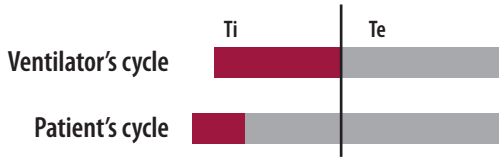
11.4 How to recognize and treat patient–ventilator asynchrony

This is taken from Nilsestuen et al (2005) (see References and resources).

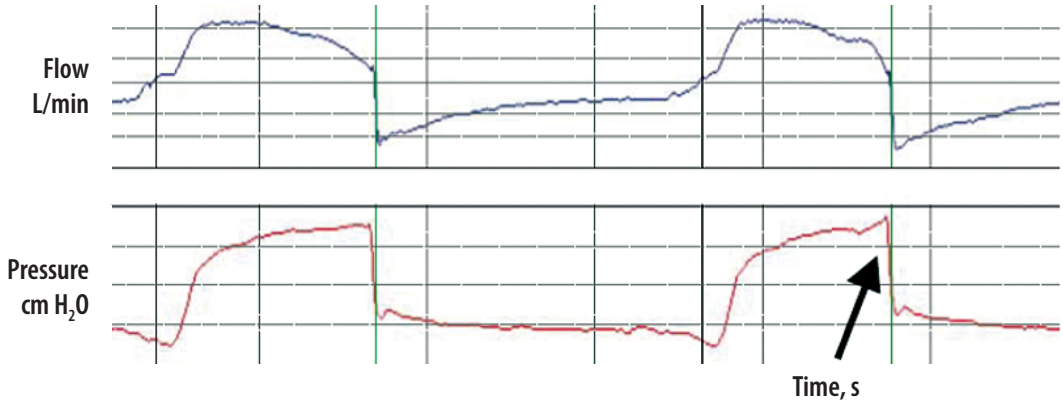


1. Inspiratory triggering
2. Inspiration
3. Termination of inspiration
4. Expiration

Delayed cycling

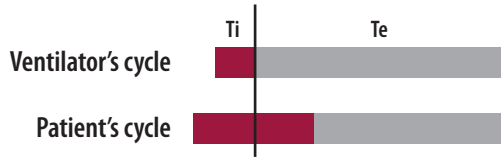


Ventilator inspiratory time is
LONGER
than patient's natural inspiratory time

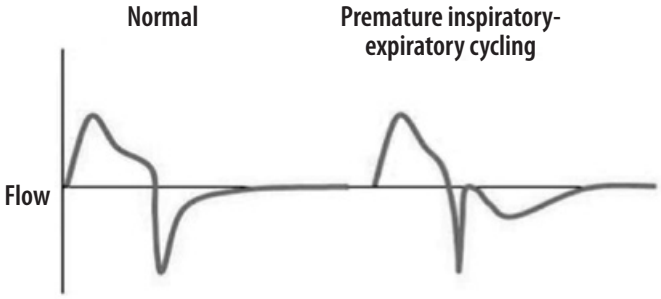


Causes	Interventions
1. Long Ti in controlled modes	Shorten inspiratory time
2. High pressure support in PSV	Decrease pressure support level
3. Auto-PEEP	Treat auto-PEEP
4. Inappropriate rise time	Increase rise time to 40–50%

Premature cycling



Ventilator inspiratory time is
SHORTER
than patient's natural inspiratory time



Causes	Interventions
1. Short Ti in controlled modes	Prolong inspiratory time
2. Low pressure support in PSV	Increase pressure support level
3. Inappropriate rise time	Reduce rise time to 10%

12 Best practices to prevent complications

12 Best practices to prevent complications

Summary

Key interventions to reduce the risk of complications in the ICU include:

- For patients on invasive mechanical ventilation, perform oral care, semi-recumbent patient position when supine, and appropriate circuit management to prevent ventilator-associated pneumonia (VAP).
- Perform a checklist during all central venous catheter (CVC) insertions to prevent blood stream infection (BSI).
- Give anticoagulants to prevent venous thromboembolism (VTE) for adults and adolescents, unless high risk of bleeding.
- Start early enteral nutrition (EN) to prevent gastric ulcers and infections.
- Conduct early mobilization to prevent ICU-acquired weakness.
- The ABCDE bundle – a set of evidence-based interventions that when coordinated and implemented together can improve patient outcomes.

Tools

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12.1 Checklist for central venous catheter (CVC) insertion

☑ In the literature, a research collaborative found that **using a central line checklist** as a reminder for the inserter **significantly reduced the incidence of central venous catheter-related blood stream infections**. This checklist is adapted from *An intervention to decrease catheter-related blood stream infections in the ICU* (Provonost et al, 2006).

☐ Hand hygiene before the procedure.

☐ Wear maximal barrier precautions on insertion:
- ☐ full sterile gown
- ☐ face mask
- ☐ face shields
- ☐ sterile gloves
- ☐ hair cover
- ☐ cover the patient in a full sterile sheet from head to toe.

☐ Use chlorhexidine 2% in 70% isopropyl alcohol for skin preparation and apply in a back and forth friction rub motion for 30 seconds.

☐ Let dry completely before puncturing site. It should not be blotted dry.

☐ Choose the optimal site: subclavian or internal jugular vein preferred in adults; internal jugular or femoral vein preferred in children depending on age.

☐ Once in place, evaluate the continuing need for the central line on a daily basis.

☐ Remove line immediately when no longer needed or when non-functional.

12.2 Checklist for preventing ventilator-associated pneumonia (VAP)

☑ In order to prevent VAP, a complication of endotracheal intubation and invasive mechanical ventilation, consider the following procedures, when possible:

- ☐ Oral intubation instead of nasal intubation.
- ☐ Keep the patient in a semi-recumbent position (head of bed elevated up to ≥ 30–45°).
- ☐ Use a closed suctioning system.
- ☐ Periodically drain and remove condensation in tubing.
- ☐ Use a new ventilator circuit for each patient. Change if soiled or damaged.
- ☐ Do not routinely change ETT or ventilator circuit, only if malfunctions.
- ☐ Change heat and moisture exchanger when malfunctions, soiled, or every 5–7 days.
- ☐ Perform regular antiseptic oral care with chlorhexidine gel or mouthwash.
- ☐ Discontinue invasive ventilation in a safe and prompt manner:
  - ☐ Daily sedation interruption of continuous sedative infusions.
  - ☐ Daily evaluation for SBT readiness (see Chapter 11).
  - ☐ Extubation to non-invasive ventilation when appropriate (i.e. primarily for patients ventilated because of a COPD exacerbation, and only in centres with sufficient expertise in non-invasive ventilation).
  - ☐ ABCDE bundle.

Note: Heat and moisture exchangers are not routinely used in infants and small children as they significantly increase dead space. Use heated humidifiers instead.

12.3 Checklist for preventing urinary tract infections (UTI)

☑ Prevention of UTI requires an appropriate technique for catheter insertion as well as appropriate management of indwelling catheters. Consider the following procedures when possible:

Catheter insertion

- ☐ Insert catheter only when necessary.
- ☐ Hand hygiene before procedure.
- ☐ Use aseptic technique and sterile equipment.
- ☐ Use as small a catheter as possible, consistent with proper drainage.

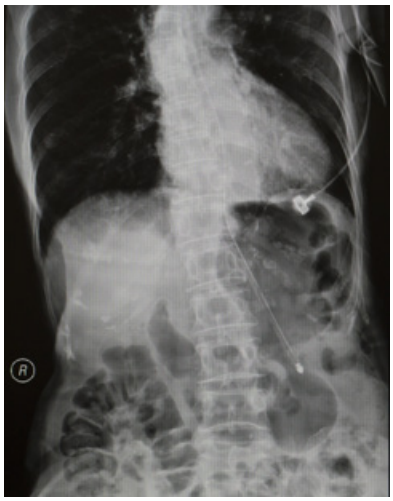
Catheter management

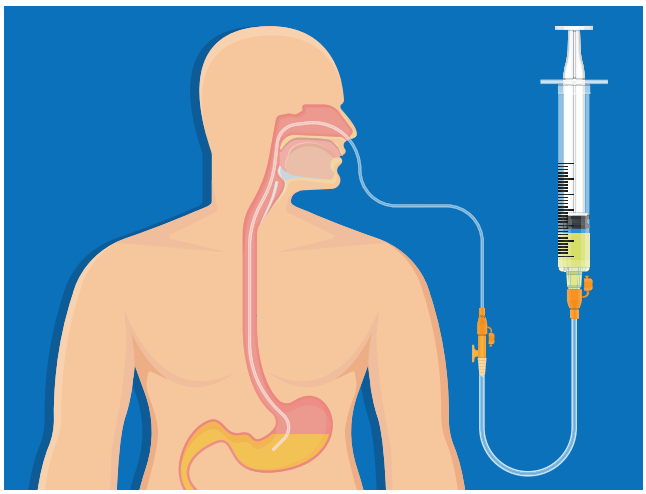
- ☐ Maintain unobstructed urine flow.
- ☐ Empty collection bag regularly:
  - ☐ Separate collecting container for each patient.
  - ☐ Do not allow draining spigot to touch collecting container.
- ☐ Keep collecting bag below level of bladder at all times.
- ☐ Cleaning urethral meatus with antiseptic is unnecessary. Routine cleaning is adequate.
- ☐ Secure catheter to prevent movement and urethral traction.
- ☐ Sterile, continuously closed drainage system.
  - ☐ Do not disconnect catheter and drainage tube unless catheter must be irrigated.
  - ☐ Replace collecting system aseptically and after disinfecting catheter-tubing junction if following occur:
    - break in aseptic technique
    - disconnection
    - leakage.
- ☐ Remove as soon as there is no indication.

12.4 Procedure for providing enteral nutrition (EN) for adults

The goal is to start enteral nutrition, even in small volumes, as soon as the patient is stable. This tool can be used to start enteral nutrition.

1. Place a feeding tube.
2. Confirm placement with radiograph (gastric [NG] or small bowel [NJ] feeding are acceptable).
3. Once the feeding tube has been confirmed, start with an infusion of up to **30 mL/hr of clear fluid or feed**.
4. Aspirate the NG tube every 4 hours.
5. Gradually increase the volume of feed with the aim of building up to full feeding within 48 hours.





Feeding intolerance

Intolerance of feeding may result from poor gastric emptying and lead to high residual gastric volumes.

The absolute value that is too high and should prompt cessation of tube feeds is not clear.

Stop feeding when:
- volumes high (between 250–500 mL)
- clinical signs of intolerance (abdominal pain, abdominal distension and diarrhoea).

None of the features are specific for feed intolerance.

Possible treatments include advancing the feeding tube into the small bowel (can be done at the bedside) or adding prokinetic medications (e.g. metoclopromide intravenously).

Note: With an NJ tube, only continuous feeds can be delivered (no bolus) and residuals cannot be checked.

Set caloric target and aim to reach this within a few days

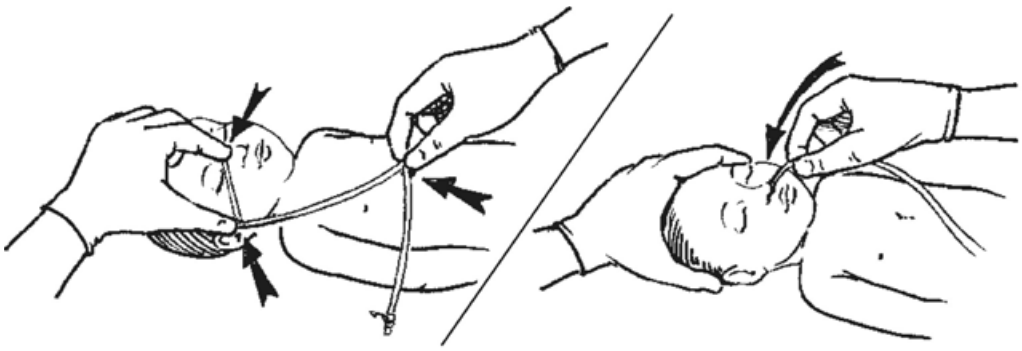
Estimate the patient's daily caloric needs, or basal energy expenditure (BEE). Adjust for fever and stress:
- BEE (kcal/day) = 25 × body weight (kg)
- fever: BEE × 1.1 (for each degree above the normal body temperature)
- mild to moderate stress: BEE × 1.2–1.4
- moderate to severe stress: BEE × 1.4–1.6.

Estimate your patient's daily protein requirements:
- normal 1.2– 2.0 g/kg
- hypercatabolism: 2–3 g/kg
- ratio of non-protein calories to nitrogen (70:1–100:1).

Note: Hypocaloric feeding (40–60% of non-protein caloric needs) may be as beneficial as full caloric feeds (> 70%).

12.5 Procedure for providing enteral nutrition (EN): paediatric considerations

Enteral feeding via NG tube is the preferred method of providing maintenance fluid.



Source: Pocket book of hospital care for children (WHO, 2013).

Initial fitting

1. Measure the distance from the nose to the ear and then to the epigastrium.
2. Insert NG tube to the measured distance.
3. Check correct placement of tube:
   - check the pH of aspirate using pH indicator strips
   - position can be seen on chest X-ray
   - if in doubt remove and replace.
4. Secure the NG tube by taping to the cheek avoiding upwards pressure on the nares.
5. Once correct placement has been confirmed, flush the tube with water. It is now safe to use the tube for administration of feed and medication.
6. Flush the NG tube with sterile water after administration of NG drugs otherwise it will block.

Ongoing checks

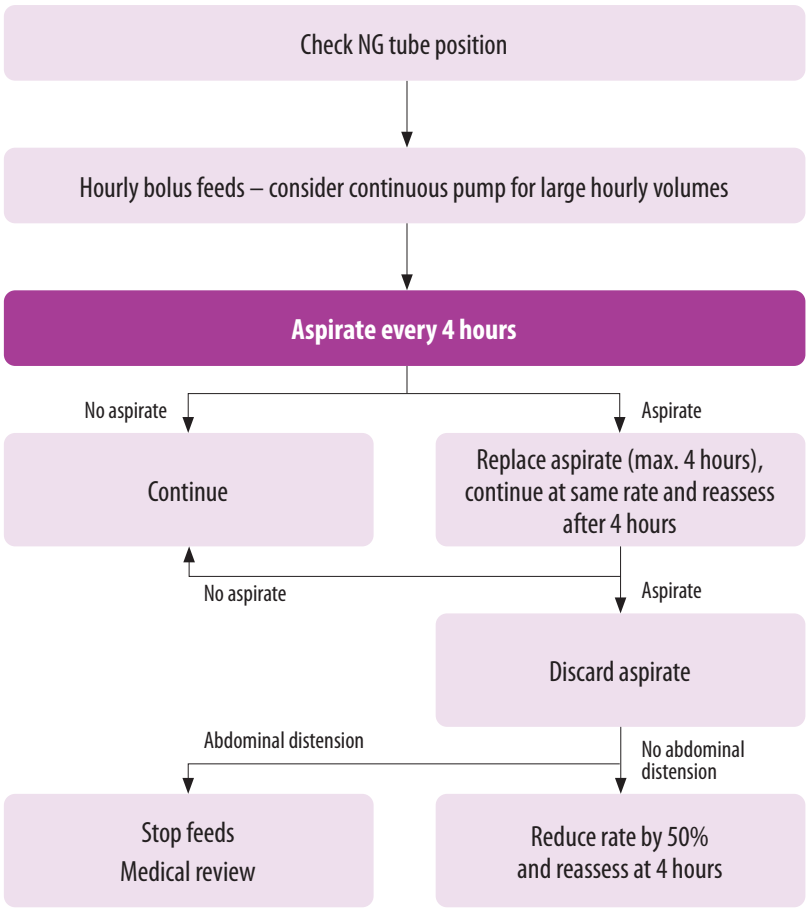
Check the position of the NG tube:

- before each use
- every 6 hours if continuous feeds
- after episodes of vomiting or retching, increased respiratory distress or excessive coughing
- if the tube looks dislodged (i.e. with more tubing visible).

NG tube sizes

This is only a rough guide; the bore of tube must fit easily in the child's nostril.

Description of patient	Tubes sizes
< 2 kg, preterm	4 Fr
2–4 kg	6 Fr
Term to 1 year	8 Fr
Younger children	10 Fr
Older children and adolescents	12 Fr
Small adult	14 Fr
Large adult	16 Fr

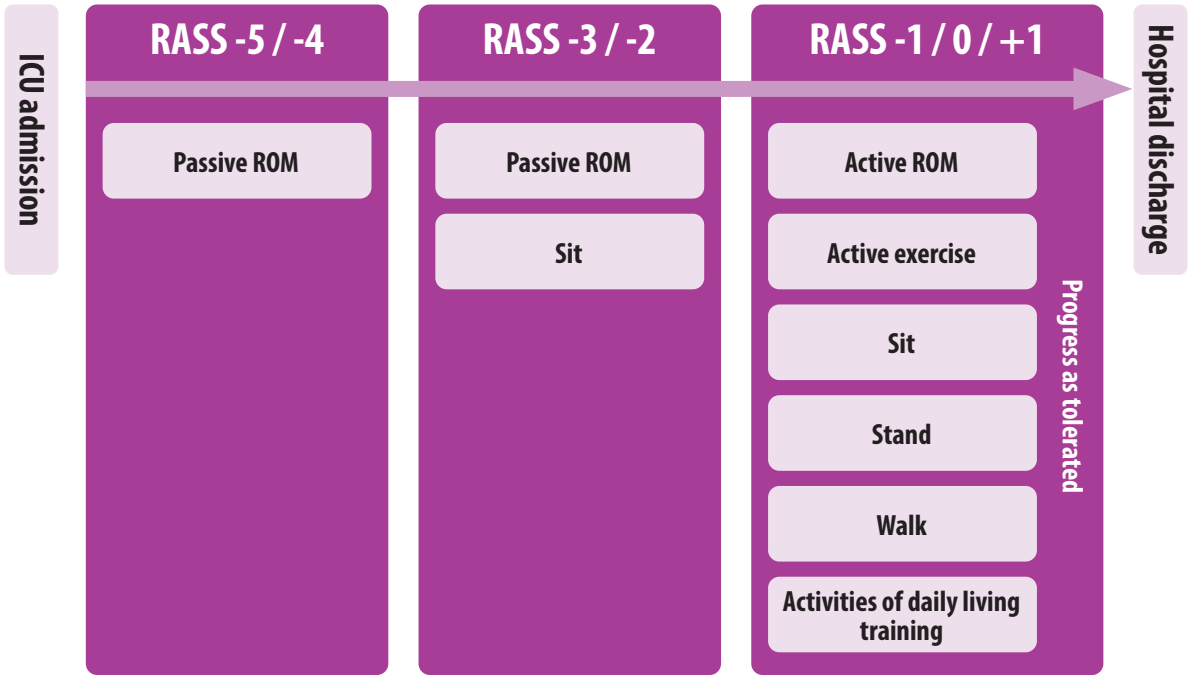

Check NG tube position
Hourly bolus feeds – consider continuous pump for large hourly volumes
Aspirate every 4 hours
No aspirate
Aspirate
Continue
Replace aspirate (max. 4 hours), continue at same rate and reassess after 4 hours
No aspirate
Aspirate
Discard aspirate
Abdominal distension
No abdominal distension
Stop feeds
Medical review
Reduce rate by 50% and reassess at 4 hours

12.6 Algorithm for early mobility in the ICU

An adapted early mobility algorithm is presented below. It is adapted from Balas et al (2014).

The patient's level of consciousness will be determined prior to the daily physical rehabilitation session using the Richmond Agitation-Sedation Scale. A patient who is only arousable to physical stimulation (RASS -4/-5) will undergo passive range of motion (ROM) exercises. Once a patient can open their eyes to voice (RASS -2/-3), passive ROM exercises will be performed, and the patient will be placed in the chair position in bed. Finally, once a patient is alert and calm, they will progress from active ROM up through ambulation as they are able. Sessions will continue until hospital discharge or a patient meets certain functional milestones.

Physical rehabilitation protocol

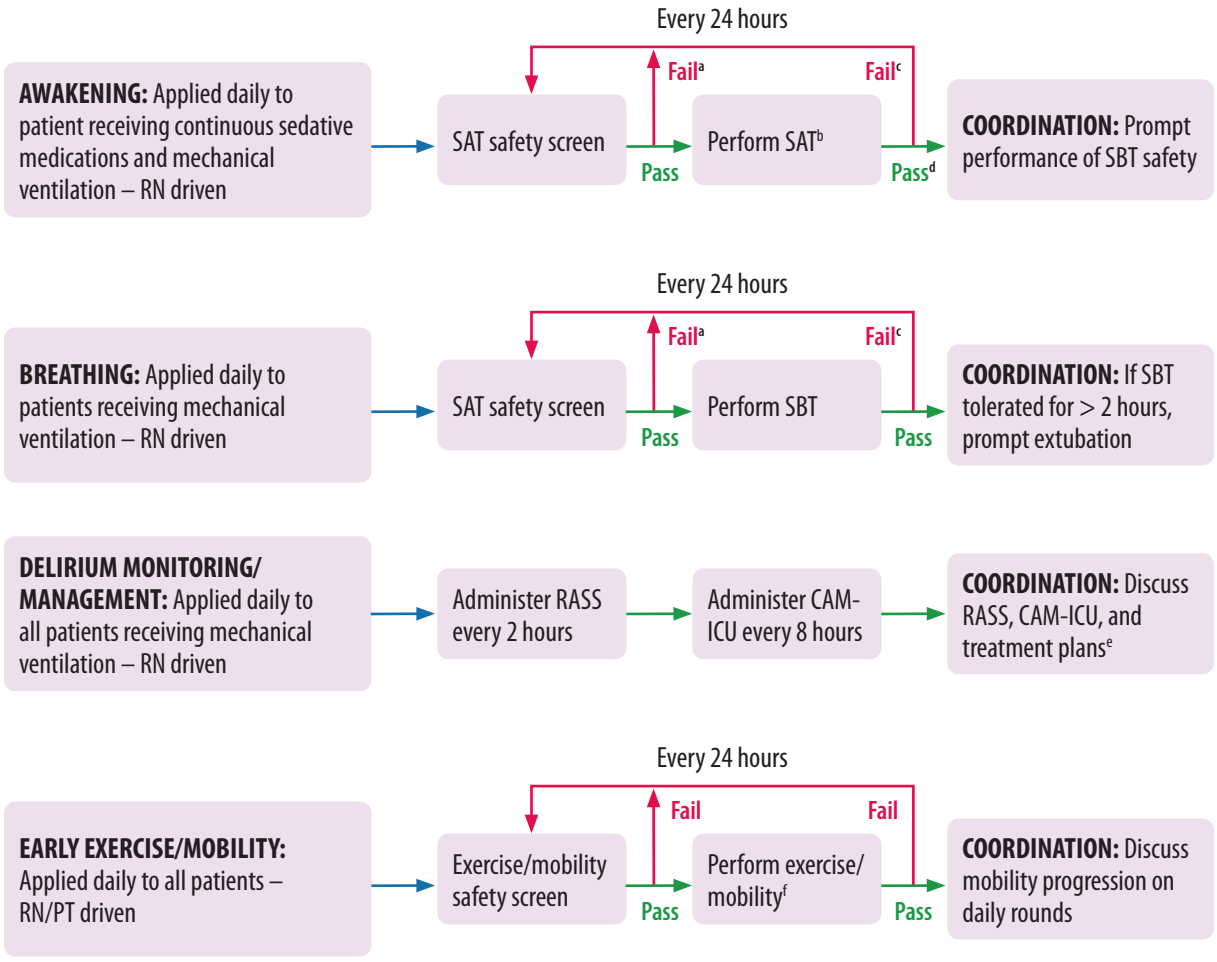


12.7 ABCDE bundle

This algorithm is adapted from Balas et al (2014) (see References and resources). Implementing this bundle reduced the number of days patients spent on invasive mechanical ventilation by 3. Additionally, patients experienced less delirium and were more likely to be mobilized.

Adapt this bundle to fit your ICU and implement using a quality improvement mechanism.

ABCDE bundle algorithm



Notes:

[a] Continuous sedative medications maintained at previous rate if spontaneous awakening trail (SAT) safety screen failure. Mechanical ventilation continued, and continuous sedative medications restarted at half the previous dose only if needed due to SBT safety screen failure.

[b] Continuous sedative infusions stopped, and sedative boluses held. Bolus doses of opioid medications allowed for pain. Continuous opioid infusions maintained only if needed for active pain.

[c] Continuous sedative medications restarted at half the previous dose, and then titrated to sedation target if SAT failed. Interdisciplinary team determines possible causes of SAT/SBT failure during rounds. Mechanical ventilation restarted at previous settings, and continuous sedative medications restarted at half the previous dose only if needed if SBT failed.

[d] SAT pass if the patient can open their eyes to verbal stimulation without failure criteria (regardless of trial length) or does not display any of the failure criteria after 4 hours of shutting off sedation.

[e] Each day on interdisciplinary rounds, the RN will inform the team of the patient's target RASS score, actual RASS score, CAM-ICU status, and sedative and analgesic medications the patients is receiving. If delirium is detected, team will discuss possible causes, eliminate risk factors, and employ non-pharmacologic management strategies.

[f] Each eligible patient is encouraged to be mobile at least once a day, with the specific level of activity geared to their readiness. Patients progress through a three-step process, embarking on the highest level of physical activity they can tolerate. Progress includes sitting on edge of bed, standing at bedside and sitting in chair, and walking a short distance. Use of the protocol ends when the patient is discharged from the ICU.

CAM-ICU = confusion assessment method for the intensive care unit; PT – physical therapist; RASS – Richmond Agitation-Sedation Scale; RN – registered nurse; RT – respiratory therapist; SAT – spontaneous awakening trial; SBT – spontaneous breathing trial.

ABCDE bundle safety screen questions and success/fail criteria

ABCDE bundle component	Safety screen criteria: conditions for exclusion	Pass/fail criteria: conditions denoting failure
Spontaneous awakening trial	1. Active seizures 2. Alcohol withdrawal 3. Neuromuscular blockade 4. Control of increased ICP 5. ICP > 20 mmHg 6. Receiving ECMO 7. Documentation of MI in past 24 hours 8. Current RASS > 2	1. RASS score > 2 for ≥ 5 minutes 2. Pulse oximetry < 88% for ≥ 5 minutes 3. Respirations > 35 BPM for ≥ 5 minutes 4. Acute cardiac arrhythmia 5. ICP > 20 mmHg 6. Two or more of the following: (heart rate increase ≥ 20 BPM, heart rate < 55 BPM, use of accessory muscles, abdominal paradox, diaphoresis or dyspnea)
Spontaneous breathing trial	1. Chronic ventilator dependence 2. Pulse oximeter reading < 88% 3. FiO_2 > 50% 4. Set PEEP > 7 5. ICP > 20 mmHg 6. Receiving mechanical ventilation in attempt to control ICP 7. Documentation of MI in past 24 hours 8. Increasing doses of vasopressor medications 9. Lack of inspiratory effort	1. RR > 35 BPM for ≥ 5 minutes 2. RR < 8 3. Pulse oximetry < 88% > 5 minutes 4. ICP > 20 mmHg 5. Mental status changes 6. Acute cardiac arrhythmia 7. Two or more of the following: • use of accessory muscles • abdominal paradox diaphoresis • dyspnea
Early exercise/ mobility	1. RASS < −3 2. FiO_2 > 0.6 3. Set PEEP > 10 cm H_20 4. Increasing doses of vasopressor infusions in the last 2 hours 5. Evidence of active MI 6. Administration of a new antiarrhythmic agent 7. Receiving therapies that restricted mobility (e.g. ECMO, open-abdomen, etc.) 8. Injuries in which mobility is contraindicated (e.g. unstable fractures, etc.)	1. Symptomatic drop in mean arterial pressure 2. Heart rate < 50 or > 130 BPM ≥ 5 minutes 3. RR < 5 or > 40 BPM ≥ 5 minutes 4. Systolic blood pressure > 180 mmHg ≥ 5 minutes 5. Pulse oximetry < 88% ≥ 5 minutes 6. Marked ventilator dyssynchrony 7. Patient distress 8. New arrhythmia or evidence of active MI 9. Concern for airway device integrity or endotracheal removal 10. Fall to knees

Notes: ABCDE – Awakening and Breathing Coordination, Delirium Monitoring/Management and Early Mobility Bundle; BPM – beats per minute; ECMO – extracorporeal membrane oxygenation; FiO_2 – fraction of inspired oxygen; ICP – intracranial pressure; MI – myocardial ischemia; PEEP – positive end-expiratory pressure; RASS – Richmond Agitation-Sedation Scale; RR – respiratory rate.

Bedside checklist for ABCDE protocol

Date:_____/_____/_____

A B C Awakening and Breathing Coordination

	Check if yes or indicate reasons
SAT screen passed? If not, why?	
SAT done? If not, why?	
SBT screened passed? If not, why?	
SBT done? If not, why?	
SAT and SBT coordinated/paired?	

D Delirium nonpharmacologic interventions

Intervention	Check if done
Pain assessment/management	
Orientation	
Sensory (eyes/ears)	
Sleep (nonpharm)	
Check any intervention that was performed during your shift (including night shift)	

E Early Exercise and mobility

Intervention	Check if done
Active ROM	
Sitting up on side of bed	
Standing	
Walking	
Check any level of activity the patient performed during your shift (including night shift)	

Notes: ROM – range of motion; SAT – spontaneous awakening trial; SBT – spontaneous breathing trial.

13 Quality in critical care

13 Quality in critical care

Summary

Quality is the provision of safe, timely, effective, efficient, equitable, and patient-centred care.

Systematic and continuous quality improvement work is essential because health care delivery is complex and imperfect, even with the best efforts.

Quality measures are related to ICU resources/structure, processes of care and patient outcomes. The focus should be on processes of care, instead of hard-to-measure outcomes.

Use the iterative, real-time, **plan-do-act-check** cycle to test changes/improvement.

Create an inclusive team and culture of change for a successful and sustainable quality improvement programme.

Tools

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13.1 Checklist for daily best practices

☑ Consider using this checklist to assess if your patient is receiving appropriate preventative interventions.

Patient: . . . . . **Date:** . . . . .

Light sedation target

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Spontaneous breathing trials

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Head of bed elevation

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Skin breakdown assessment

- ☐ Yes
- ☐ Not done, why?

. . . . . .

Enteral nutrition

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Deep venous thrombosis prophylaxis

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Gastric ulcer prophylaxis

- ☐ Yes
- ☐ Not a candidate, why?

. . . . . .

Antibiotics

- ☐ Yes
  (day . . . . . of . . . . .)
- ☐ No

Early mobility

- ☐ Yes
- ☐ No, why?

. . . . . .

Needs Foley catheter

- ☐ Yes
- ☐ No

Needs central venous catheter

- ☐ Yes
- ☐ No

Source: Adapted with permission from San Francisco General Hospital, San Francisco (CA).

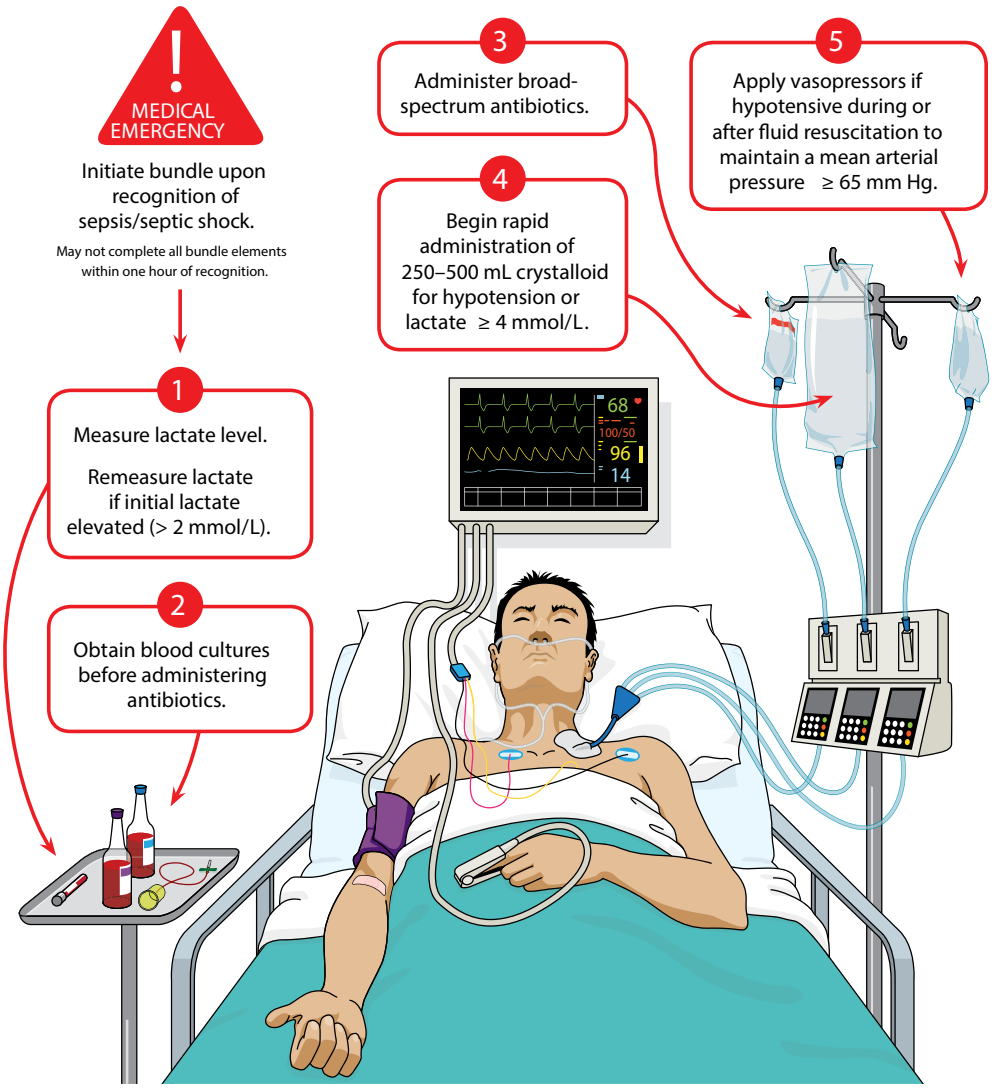
13.2 Surviving Sepsis Campaign bundles

Consider using an adapted version of this tool to monitor performance for sepsis care. This bundle was recently revised based on the most recent version of these tools. See the Surviving Sepsis Campaign website for full details (https://www.sccm.org/getattachment/SurvivingSepsisCampaign/Guidelines/Adult-Patients/Surviving-Sepsis-Campaign-Hour-1-Bundle.pdf?lang=en-US).

The Paediatric Surviving Sepsis Campaign Bundle can be found in Chapter 8 (Tool 8.3) or on the Surviving Sepsis website (https://www.sccm.org/getattachment/SurvivingSepsisCampaign/Guidelines/Pediatric-Patients/Initial-Resuscitation-Algorithm-for-Children.pdf?lang=en-US).

Hour-1 bundle: initiate bundle upon recognition of sepsis/septic shock

May not complete all elements within first hour.



Remember

1. Act quickly upon sepsis and septic shock recognition; 2. Minimize time to treatment – sepsis and septic shock are medical emergencies; 3. Monitor closely for response to interventions; 4. Communicate sepsis status in hand-offs.

13.3 Checklist: high-quality use of invasive mechanical ventilation for ARDS

☑ Consider using this tool if you are using IMV to deliver quality care to your patients with ARDS.

Technical competence

- ☐ Type of mechanical ventilator available.
- ☐ Able to deliver PEEP.
- ☐ Able to measure plateau airway pressure.
- ☐ Able to deliver high concentrations of oxygen.
- ☐ Intubation equipment readily available.
- ☐ Infection prevention materials readily available (airborne precautions).
- ☐ Skilled person to intubate available.
- ☐ Skilled personnel to use and troubleshoot IMV.
- ☐ Arterial blood gas analyser available and working.
- ☐ Pulse oximeter available and working.

Safety

- ☐ Plan for difficult airway (e.g. backup personnel, equipment, and plan – e.g. cricothyrotomy).
- ☐ Plan for IMV complications (e.g. chest tube for pneumothorax, sedation for agitation).
- ☐ Plan for prevention while on IMV (e.g. daily SBT evaluation, daily sedation interruption, VAP prevention).

Process measures

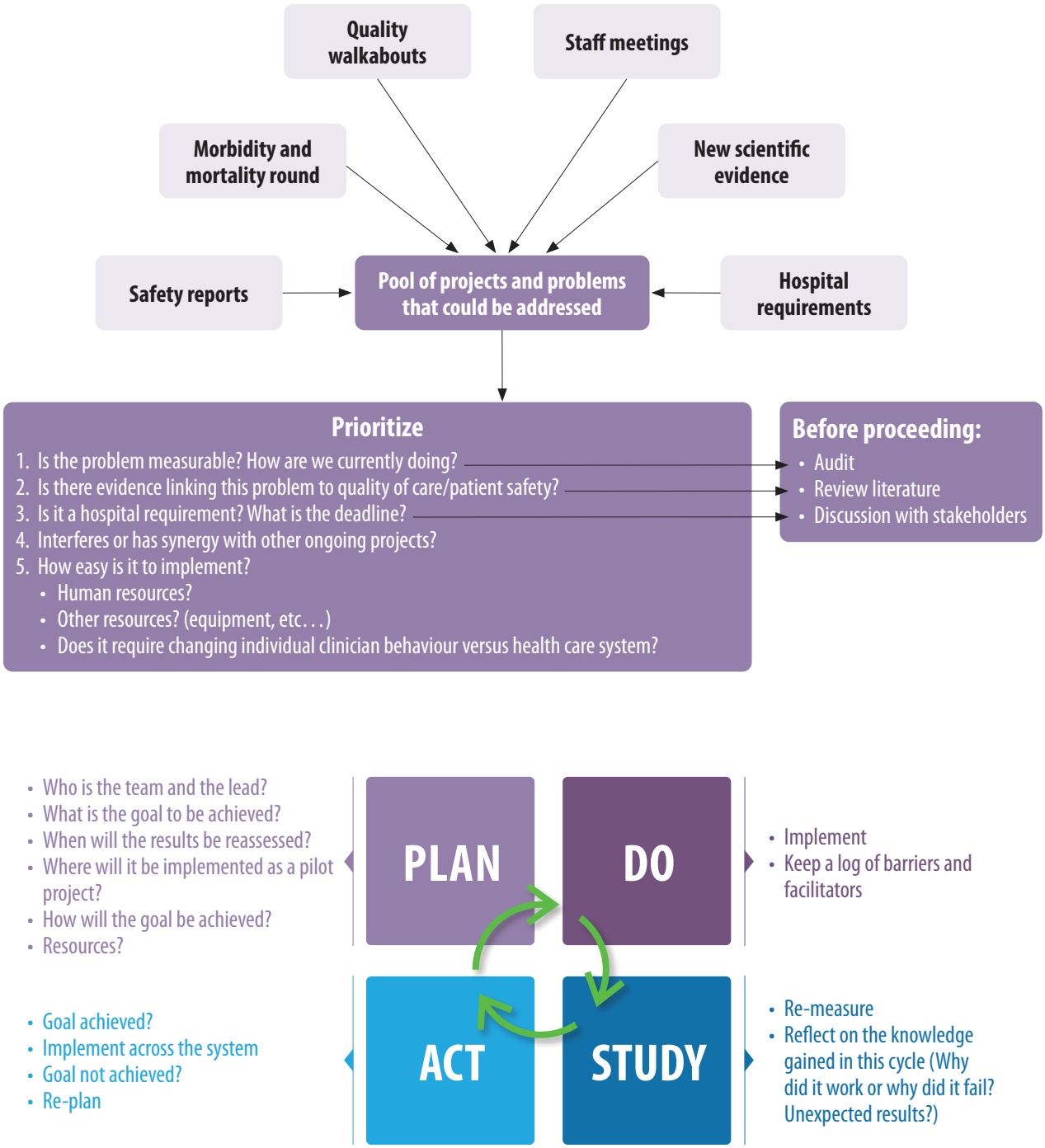
- ☐ Process measures (e.g. lung protective targets met).

Outcome measures

- ☐ Complications (e.g. VAP, pneumothorax).

13.4 Process for selecting problem to focus on in the ICU and quality improvement process

This flowchart provides a framework for selecting a problem to focus on for quality improvement among the many that might be considered. It also shows the essential steps in the **plan-do-study-act** cycle (used with permission from Dr Andre Amaral, Sunnybrook Health Sciences Centre and University of Toronto, Toronto, Canada).



13.5 Checklist for initiating, improving, evaluating, and sustaining a quality improvement programme

☑ This checklist provides steps for initiating, improving, evaluating and sustaining a quality improvement programme in the ICU (adapted from Curtis et al, 2006) (see References and resources).

Initiating or improving a quality improvement programme

- ☐ Do background work: identify motivation, support team and develop strong leadership.
- ☐ Prioritize potential projects and choose the projects to begin.
- ☐ Prepare for the project by operationalizing the measures, building support for the project and developing a business plan.
- ☐ Do an environmental scan to understand the current situation (structure, process or outcome), the potential barriers, opportunities and resources for the project.
- ☐ Create a data collection system to provide accurate baseline data and document improvement.
- ☐ Create a data reporting system that will allow clinicians and other stakeholders to see and understand the problem and the improvement.
- ☐ Introduce strategies to change clinician behaviour and create the change that will produce improvement.

Evaluating and sustaining a quality improvement programme

- ☐ Determine whether the target is changing with ongoing observation, periodic data collection and interpretation.
- ☐ Modify behaviour change strategies to improve, regain or sustain improvements.
- ☐ Focus on sustaining interdisciplinary leadership and collaboration for the quality improvement programme.
- ☐ Develop and sustain support from the hospital leadership.

Common ICU quality indicators

- ☐ Deep venous thrombosis prophylaxis – number of patients receiving prophylaxis per eligible day.
- ☐ Stress ulcer prophylaxis – percentage of patients receiving prophylaxis per eligible day.
- ☐ Ventilator-associated pneumonia prevention strategies – percentage of patients receiving ventilator-associated pneumonia bundle per eligible day.
- ☐ Central venous catheter blood stream infection prevention strategies – percentage of patients receiving checklist per eligible central venous catheter insertion.

14 Ethical considerations

14 Ethical considerations

Summary

During a pandemic, the need for critical care services can exceed available resources. Triage decisions may need to be made on how to allocate scarce resources and prioritize patients.

Five ethical principles that can guide triage include: utility, maximum life-years saved, first-come first-served, random selection, and life cycle.

Public engagement in pandemic preparedness is essential to develop a prioritization strategy that is fair, transparent and builds trust.

Tools

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14.1 Ethical principles

Ethical analysis involves identifying relevant principles, applying them to a particular situation, and making judgements about how to weigh competing principles when it is not possible to satisfy them all.

Key ethical principles and descriptions

Ethical principle	Description
Justice	Encompasses *equity* – fairness in the distribution of resources, opportunities and outcomes – and procedural justice – a fair process for making important decisions.
Equity	Treating like cases alike, avoiding discrimination and exploitation, and being sensitive to persons who are especially vulnerable to harm or injustice.
Procedural justice	Includes: • Due process – notice to persons and an opportunity to be heard • Transparency – clear, accurate information about the basis for decisions and decision-making process • Inclusiveness/community engagement – ensuring all relevant stakeholders participate • Accountability – allocating and enforcing responsibility for decisions • Oversight – ensuring appropriate mechanisms for monitoring and review
Beneficence	Acts done for the benefit of others (e.g. efforts to relieve individuals' pain and suffering). In the public health context, it is society's obligation to meet the basic needs of individuals and communities (e.g. nourishment, shelter, good health, security).
Utility	Actions are right insofar as they promote the well-being of individuals or communities. Efforts to maximize utility require consideration of proportionality – balancing potential benefits against risks of harm – and efficiency – achieving the greatest benefits at the lowest possible cost.
Respect for persons	Treating individuals in recognition of our common humanity, dignity and inherent rights. Key aspects include: autonomy; informed consent; privacy; confidentiality; social, religious and cultural beliefs; important relationships (e.g. family); and transparency and truth telling in public health and research.
Autonomy	Letting individuals make their own choices based on their values and preferences.
Informed consent	Process in which a competent individual authorizes a course of action based on sufficient relevant information, without coercion or undue inducement.
Liberty	Includes a broad range of social, religious and political freedoms (e.g. freedom of movement, peaceful assembly, speech), many of which are protected as fundamental human rights.
Reciprocity	Consists of making a "fitting and proportional return" for contributions that people have made.
Solidarity	Social relation in which a group, community, nation, or global community stands together. Justifies collective action in the face of common threats and supports efforts to overcome inequalities that undermine the welfare of minorities and groups that suffer from discrimination.

Source: Adapted from *Guidance for managing ethical issues in infectious disease outbreaks* (WHO, 2016).

14.2 Sequential Organ Failure Assessment (SOFA) score

The SOFA score is commonly used to describe and quantify organ failure and can also be used to predict outcome. The SOFA score has been proposed for use in triage strategies because it helps to quantify the principle of utility. To use the SOFA scoring system for triage, add the points for each clinical characteristic at presentation and then at 48 hours. Both the initial and 48-hour scores are predictive of mortality. The maximum score is 24. In the publication by Ferreira et al (2001) (see References and resources), an initial SOFA score of > 11 was associated with 95% mortality, whereas ≤ 9 was associated with 33% mortality.

Except for initial scores of > 11, a decreasing score during the first 48 hours was associated with a mortality rate of < 6%. An unchanged or increasing score during the first 48 hours was associated with a mortality rate of 37% when the initial score was 2–7; and 60% when the initial score was 8–11.

Note: More recent evaluations of this triage performance tool have not shown such consistent predictive value. This score uses the following triage variables. Also, this score has not been validated in children.

Sequential Organ Failure Assessment (SOFA) score

Variables	0	1	2	3	4
Respiratory PaO_2/FiO_2, mmHg	> 400	≤ 400	≤ 300	≤ 200[a]	≤ 100[a]
Coagulation Platelets × $10^3/\mu L$[b]	> 150	≤ 150	≤ 100	≤ 50	≤ 20
Liver Bilirubin, mg/dL[b]	< 1.2	1.2–1.9	2.0–5.9	6.0–11.9	> 12.0
Cardiovascular Hypotension	No hypotension	Mean arterial pressure < 70 mmHg	dop ≤ 5 or dob (any dose)	dop > 5, epi ≤ 0.1, or norepi ≤ 0.1[c]	dop > 15, epi > 0.1, or norepi > 0.1[c]
Central nervous system Glasgow Coma Score Scale	15	13–14	10–12	6–9	< 6
Renal Creatinine, mg/dL[d] 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

Notes:
[a] Values are with respiratory support;
[b] To convert bilirubin from mg/dL to µmol/L, multiply by 17.1;
[c] Adrenergic agents administered for at least 1 hour (doses given are in µg/kg per minute);
[d] To convert creatinine from mg/dL to µmol/L, multiply by 88.4;
Norepi – norepinephrine; dob – dobutamine; dop – dopamine; epi – epinephrine; FiO_2, – fraction of inspired oxygen.

14.3 Paediatric Logistic Organ Dysfunction (PELOD–2) score

Multiple organ dysfunction syndrome is a frequent cause of death in adult and paediatric ICUs. The Paediatric Logistic Organ Dysfunction score was developed to describe the severity of age-specific organ dysfunction in children and has since been validated in many settings. This descriptive score relies on ten variables that correspond to five different organ dysfunctions. Any increased organ dysfunction in the PELOD-2 score is closely related to an increased risk of mortality, but neurologic and respiratory dysfunctions are the most critical. In the population in which the PELOD-2 was developed, a score of 10 was associated with ~10% probability of mortality, while a score of 20 was associated with > 90% probability of mortality. However, the predicted risk of death is population specific and varies with resource availability.

Scoring the Paediatric Logistic Organic Dysfunction (PELOD-2) score

Organ dysfunctions and variables[a]	Points by severity levels						
	0	1	2	3	4	5	6
Neurologic[b]							
Glasgow Coma Score	≥ 11	5–10			3–4		
Pupillary reaction	Both reactive					Both fixed	
Cardiovascular[c]							
Lactatemia (mmol/L)	< 5.0	5.0–10.9			≥ 11.0		
Mean arterial pressure (mmHg)							
0 to < 1 mo	≥ 46		31–45	17–30			≤ 16
1–11 mo	≥ 55		39–54	25–38			≤ 24
12–23 mo	≥ 60		44–59	31–43			≤ 30
24–59 mo	≥ 62		46–61	32–44			≤ 31
60–143 mo	≥ 65		49–64	36–48			≤ 35
≥ 144 mo	≥ 67		52–66	38–51			≤ 37
Renal							
Creatine (µmol/L)							
0 to < 1 mo	≤ 69		≥ 70				
1–11 mo	≤ 22		≥ 23				
12–23 mo	≤ 34		≥ 35				
24–59 mo	≤ 50		≥ 51				
60–143 mo	≤ 58		≥ 59				
≥ 144 mo	≤ 92		≥ 93				
Respiratory[d]							
PaO_2 (mmHg)/FiO_2	≥ 61		≤ 60				
$PaCO_2$ (mmHg)	≤ 58	59–94		≥ 95			
Invasive ventilation	No			Yes			
Haematologic							
WBC count (x 10^9/L)	> 2		≤ 2				
Platelets (x 10^9/L)	≥ 142	77–141	≤ 72				

[a] All variables must be collected, but measurements can be done only if justified by the patient's clinical status. If a variable is not measured, it should be considered normal. If a variable is measured more than once in 24 hours, the worst value is used in calculating the score. FiO_2: fraction of inspired oxygen.
[b] Neurologic dysfunction: Glasgow Coma Score: use the lowest value. If the patient is sedated, record the estimated Glasgow Coma Score before sedation. Assess only patients with known or suspected acute central nervous system disease. Pupillary reactions: nonreactive pupils must be > 3 mm. Do not assess after iatrogenic pupillary dilation.
[c] Cardiovascular dysfunction: heart rate and mean arterial pressure: do not assess during crying or iatrogenic agitation.
[d] Respiratory dysfunction: PaO_2 used: use arterial measurement only. PaO_2/FiO_2 ratio is considered normal in children with cyanotic heart disease. $PaCO_2$ can be measured from arterial, capillary or venous samples. Invasive ventilation; the use of mask ventilation is not considered invasive ventilation.

Logit (mortality) = -6.61 + 0.47 x PELOD-2 score.

Probability of death = 1(1 + exp [-logit(mortality)])

Source: Leteurtre et al (2013).

14.4 Framework for critical care triage during pandemic or disaster: American College of Chest Physicians consensus statement

This is adapted from the recently published American College of Chest Physicians consensus statement (Biddison et al, 2014) (see References and resources). It is presented as a framework only, and has not been validated in any population.

Conceptualized framework for how the critical care (tertiary) triage process and decisions would flow in a disaster or pandemic

Triage process decision flow

1 Inclusion criteria:

a) Refractory hypoxia require ventilation
b) Hypotension refractory to volume resuscitation and requiring vasopressor/inotropic support

2 Exclusion criteria:

a) Low probability of survival criteria
   i. Cardiac arrest
   ii. Severe trauma
   iii. Severe burns
   iv. Severe irreversible neurologic event or condition
   v. Severe prematurity

b) Short life expectancy criteria
   i. Metastatic malignancies
   ii. Haematologic malignancies with poor prognosis
   iii. End-stage organ failure with expected survival < 1 year
   iv. Very advanced age
   v. Advanced and irreversible immunocompromise
   vi. Congenital anomalies with expected survival < 1 year

3 Prioritization:

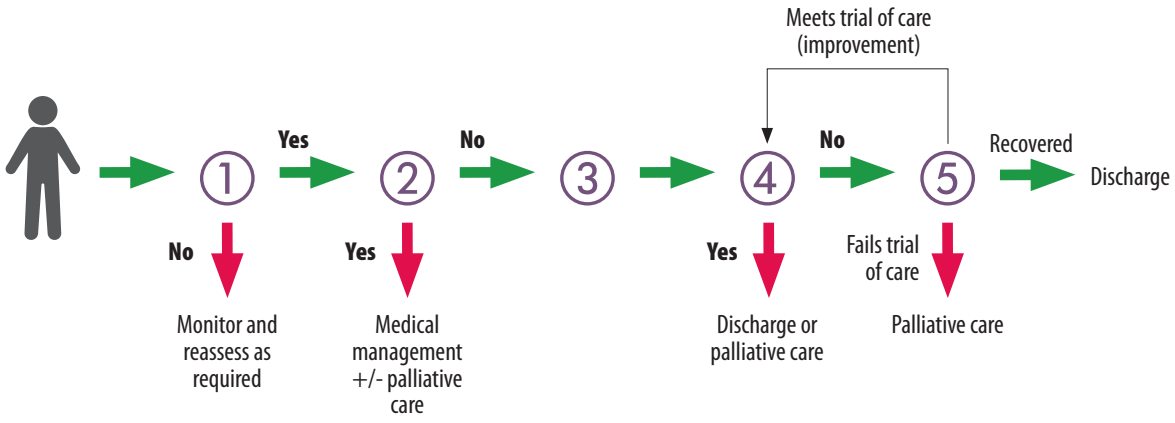
Admit to ICU based upon priority and as bed available

4 Daily reassessment:

Assess for development of exclusion criteria or discharge criteria

5 72 hour trial of care:

Did patient meet the goals of the trial of care is showing significant evidence of improvement?



14.5 Framework to guide allocation of scarce mechanical ventilators during disasters

Proposed strategy for ventilator allocation in epidemics of novel respiratory pathogens

		Point system			
Principle	**Specification**	**1**	**2**	**3**	**4**
Prognosis for short-term survival	Adults (SOFA) or paediatrics (PELOD-2)	SOFA score: ≤ 8 PELOD-2: ≤ 12	SOFA score: 9–11 PELOD-2: 12–13	SOFA score: 12–14 PELOD-2: 14–16	SOFA score: > 14 PELOD-2: ≥ 17
Prognosis for long-term survival	Prognosis for long-term survival (assessment of comorbid conditions)	—	—	Severe comorbid death likely within 1 year	—
Secondary considerations					
Lifecycle considerations	Prioritize those who have had the least chance to live through life's stages (age)	Age 0–49 years	Age 50–69 years	Age 70–84 years	Age ≥ 85 years

Examples of severe comorbid conditions with associated life expectancy < 1 year. This list is meant as a guideline and is not exhaustive. Patients meeting the criteria of < I year predicted survival based on which of the listed or other similar conditions should be assigned a score of 3.

1. NYHA class IV heart failure. 2. Advanced lung disease with FEV_1 < 25% predicted, total lung capacity < 60% predicted, or baseline PaO_2 < 55 mmHg. 3. Primary pulmonary hypertension with NYHA class III or IV heart failure. 4. Chronic liver disease with Child-Pugh score > 7. 5. Severe trauma. 6. Advanced untreatable neuromuscular disease. 7. Metastatic malignant disease or high-grade brain tumors.

NYHA – New York Heart Association.

Source: Daugherty-Biddison et al (2019).

For more information, please contact:

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