IMAI second-level learning programme for district clinicians working at hospitals in limited-resource settings

Participant training manual:

Management of the severely ill patient with septic shock or respiratory distress

This training course is based on guidelines in the *IMAI District Clinician Manual: Hospital Care for Adolescents and Adults*

June 2014

Integrated Management of Adolescent and Adult Illness (IMAI)

World Health Organization

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Produced by IMAI-IMCI Alliance for WHO HSE/PED

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Development of the Quick Check+ training curriculum was supported by funding from the government of USA (DOD DTRA) and the Government of Japan through grants to WHO/HSE/ Pandemic and Epidemic Diseases (PED) (project manager Nikki Shindo) , with the support of WHO regional office for Africa (Francis Kasolo, Benido Impouma) and the WHO country offices in affected countries.

Produced by the IMAI-IMCI Alliance. Design and illustrations: Robert Thatcher

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Introduction to management of the severely ill patient with severe respiratory distress or septic shock (Part 2 of the Quick Check training)

This course builds on the *Quick Check Essentials: Triage and Emergency Treatments* (QC) training course, which is a prerequisite to this course. It is geared for nurses with district clinician support to provide further management for patients who are severely ill. The focus in this course is on severely ill patients with respiratory distress and/or septic shock; however, principles learned in the course will help in managing all patients who are severely ill.

This training assumes that participants can do the Quick Check assessment and can provide first-line emergency treatments. The district clinician has been called, and the clinical team now needs to provide further urgent medical management. It is recommended that this part of the training programme is done in tandem with the first part of the Quick Check training, as covered in the 4-day training course.

Chapter 1:
Caring for severely ill patients

Learning objectives

1. Learn how to care for severely ill patients.
2. Recognize abnormal physiology.
3. Record and respond.
4. Use the severely ill patient monitoring form.

Introduction

Severely ill patients suffer from acute, life-threatening problems such as severe pneumonia, septic shock from an overwhelming infection, or massive haemorrhage. Recognizing severely ill patients is challenging in a busy district hospital. However, identifying and treating these patients early will often greatly improve their chances of survival. These patients may present with symptoms at triage, or deteriorate while admitted to the hospital. As you have learned, the Quick Check system can be used to identify severely ill patients who require rapid evaluation and treatment. You will now be learning to use the relevant sections of the DCM to develop a differential diagnosis and guide further management. As always, these recommendations are meant to be used in conjunction with sound clinical reasoning and existing local guidelines in your hospital.

In this learning unit, you will learn about the general principles used to care for all severely ill patients. We will then cover specific clinical conditions such as septic shock and severe respiratory distress. Caring for severely ill patients requires a team approach as multiple tasks need to occur simultaneously. These tasks include frequently checking and recording vital signs, administering fluids or medications, carrying out necessary procedures, checking laboratory results and refining the differential diagnosis. Using an organized approach is useful for managing these complicated cases. Clear communication between team members is essential to deliver quality care.

When managing severely ill patients:

1. Recognize severe illness.
2. Fix abnormal physiology (i.e. low blood pressure, hypoxia).
3. Treat infections.
4. Monitor and record vital signs.
5. Respond as appropriate.

Other priorities include keeping the patient comfortable and safe, preventing complications, respecting patient dignity, communicating frequently with the patient, patient's family members, and other staff members.

The mortality of severely ill patients is high and some patients may not improve, despite appropriate treatment. Preserve the dignity and comfort of patients and their families in these difficult situations.

RECOGNIZE SEVERE ILLNESS

Severe illness is a general term used to describe any acutely ill patient with a life-threatening condition. Consider any patient with a Quick Check emergency sign as severely ill. Severely ill patients include those who require medical attention as well as those who require surgery. A severely ill patient can also develop more than one life-threatening condition at the same time. When you see a severely ill patient, immediately administer first-line emergency treatments and call the senior clinician for help. Once patients are diagnosed as severely ill, they require careful and frequent monitoring. In this learning unit you will learn how to use a recommended patient monitoring system. You can use this monitoring system to recognize changes in a patient's condition, and determine what steps you should take to treat the patient.

FIX THE PHYSIOLOGY

Respond to signs of abnormal physiology with appropriate treatments. Treatments include providing fluids or oxygen, and treating fever. These interventions prevent organ damage and support the patient through their illness. Ultimately an assessment and treatment of the underlying cause is required.

These recommendations are not meant to replace clinical reasoning or existing guidelines based on local epidemiology. For example, in a patient with known congestive heart failure you may choose to use more caution when giving IV fluids. In a patient with suspected dengue, you may choose to use existing country guidelines on the management of dengue instead.

Treat abnormal respiratory physiology

In the Quick Check you learned how to give oxygen and titrate flow. Some severely ill patients will not need oxygen. A patient with sepsis from a urinary tract infection for example, may not have respiratory distress or hypoxia. If you measure the oxygen saturation and it is >90% (in pregnancy oxygen saturation should be 92–95%), it is not necessary to administer supplemental oxygen. However, these patients must be monitored every 30–60 minutes for the first four to six hours to ensure they do not develop delayed hypoxia. If you are unable to carefully monitor these patients due to staff shortages, start them on oxygen until you can monitor them more closely or their condition improves. Remember, if a patient on oxygen is deteriorating, first check the equipment to make sure it is working correctly.

If hypoxia (SpO_2<90%), increasing RR, or worsening respiratory distress:

- Give oxygen and titrate to SpO_2 of 90%.
- Assess for and treat fluid overload.
- If wheezing give salbutamol.

Review what you learned in the Quick Check regarding the titration of oxygen by practicing the drill below.

DRILL 1-1: Oxygen

Go around the room and take turns answering the questions aloud.

1. A patient is on oxygen at 5 litres via nasal cannula. They have been stable for over 30 minutes. You check the oxygen saturation and it is 94%. What would you do next?

2. A patient is on oxygen at five litres via nasal cannula. The patient's respiratory rate is increasing and the patient is now having retractions. What would you do next?

3. A patient is admitted to the ward with a cellulitis and the following vital signs: RR 24 PR 122 BP 80/40 T 39.0 Sat 96% on Room Air. Would you start this patient on supplemental oxygen? How often would you monitor the patient's oxygen saturation?

4. A patient is admitted to the ward with pneumonia. The patient's initial measured oxygen saturation is 92%. Would you start this patient on supplemental oxygen? How often would you monitor the patient's oxygen saturation? What would you do if the next measured oxygen saturation was 88%?

Treat abnormal circulatory physiology

In addition to monitoring BP, pulse, and mental status, monitor urine output to assess perfusion. When you first start treating the patient, vital signs should be monitored every 30 minutes. Once the patient is stable, check vital signs every 60 minutes and reassess how the patient is responding to any new treatments. Urine output of 0.5–1 ml/kg/h indicates adequate perfusion to the vital organs (heart, lungs, kidney, and brain). Family members can be enlisted to measure urine output. If you cannot measure urine output, try to monitor and record whether the patient is urinating and the frequency of urination.

If signs of poor perfusion such as BP decreasing, pulse increasing, or urine output is low:

- Give IV fluid bolus.
- Assess for other causes of shock such as blood loss or anaphylaxis.

Immediately after delivering a bolus of IV fluid:

Check to see if the BP has increased and the HR decreased.

If BP remains low:

- Check IV tubing and site.
- Repeat fluid bolus.
- Look for ongoing blood loss.
- Reassess and continue looking for other causes of shock.

If blood pressure remains low (SBP<90) after appropriate fluid resuscitation, consider vasopressors.

- If a patient remains in shock and has clinical signs of poor perfusion (low BP, low urine output, altered level of consciousness) after appropriate IV fluid treatments, consider the use of vasopressor medications to temporarily support the circulation. Vasopressors have significant side-effects, and should be only be used in patients who have not responded to appropriate IV fluids or blood.

Specific recommendations for the administration of fluid to patients with severe respiratory distress or septic shock are covered later in this learning unit.

DRILL 1-2: Fluids

Go around the room and take turns answering the questions aloud.

1. A patient is admitted to the ward with septic shock from peritonitis. The patient has received one litre of lactated ringers. The blood pressure is now 80/40. What would you do next to manage circulation? When would you check the blood pressure next to monitor the patient?

2. A patient is admitted to the ward with pneumonia and severe respiratory distress. The blood pressure is 110/60 after receiving 500 ml of normal saline. What would you do next to manage the circulation? How often would you monitor the blood pressure?

3. A patient is admitted to the ward with sepsis and a urinary tract infection. The patient was given a one litre bolus of normal saline. The repeat blood pressure is 70/30. You check the IV site and notice that the intravenous fluids are infusing into the right arm, which is now swollen and tender. What would you do next?

4. A patient is admitted to the ward following a fall and complains of abdominal pain. Over the next hour the abdomen becomes distended and very tender. The patient has received two litres of normal saline and the blood pressure is now 80/40. What would you do next?

DRILL 1-3: Urine output

Go around the room and take turns answering the questions aloud.

1. You are taking care of a patient in septic shock who is 55 kg. After one hour, what is the minimum urine output that the patient should have?

2. You are taking care of a patient who is 70 kg. After 6 hours you measure the urine output and find the patient has made 70 cc of urine. Is this urine output adequate? The blood pressure is 80/40. What would you do next?

DRILL 1-4: Fix the physiology

Respond to the physiological problem in the patient. Go around the room and answer aloud what you would do next.

1. No urine output for 2 hours and BP 80/40	
2. Difficulty breathing and RR 40	
3. Cold extremities, BP 79/40, and pulse 130	
4. SpO_2 88%	
5. Wheezing and in respiratory distress	
6. BP 70/30 after receiving a 1 litre bolus of NS	

TREAT INFECTION

Early treatment with antimicrobials (antibiotics, antimalarials, antivirals) can save the lives of severely ill patients. For patients in septic shock, IV antibiotics should be given as soon as possible, within one hour of arrival at the hospital. Empirical, broad-spectrum antibiotics should be administered early in the course of treatment. Once more information is gathered and you have a more firm diagnosis, change the antimicrobials based on the likely source of infection. The choice of antibiotics should be determined by national guidelines and local resistance patterns.

MONITOR – RECORD – RESPOND

The clinical condition of severely ill patients may change very rapidly or slowly deteriorate. Regular and frequent ***monitoring*** using a patient flow chart to ***record*** the data, will help you ***recognize*** changing patterns in the patient's condition, take action, call for help, and determine the need for additional treatments. Severely ill patients should be cared for in a common area close to the nursing station where they are under frequent observation.

In the first 6 hours, monitor the following initially every 30 minutes, then every 60 minutes once the patient is stable:

- systolic blood pressure (normal: systolic >90)
- heart rate (normal: 60 –100)
- respiratory rate (normal: 12 to 16)
- SpO_2 (normal: >95%, give oxygen if < 90%)
- mental status (use AVPU scale: alert, responding to voice, responding to pain, unresponsive).

Monitor the following every 6 hours:

- temperature (normal 36–38°C)
- urine output (normal >30 ml/hour)
- physical examination of the respiratory and cardiovascular systems.

If you recognize a patient who is deteriorating, respond, treat, and call the senior clinician for help. When assessing the patient after any intervention, always look for the following:

- Is the BP decreasing? Is the pulse increasing?
- Is the SpO_2 decreasing or the RR increasing? Is there worsening respiratory distress?
- Is the urine output adequate?
- Is the patient becoming more confused or less responsive?

DRILL 1-5: Monitoring

Go around the room and each person say aloud:

1. During the initial management of a severely ill patient, what should be monitored every 30 minutes?
2. During the initial management of a severely ill patient, what should be monitored every 6 hours?

Severe illness monitoring form

The following monitoring form on pages 15-1, has been developed to help you monitor severely ill patients. This form gives you quick access to important information. You can track the patient's progress, easily review the patient's status at any moment, and communicate with other staff about your patient's clinical condition. With this form you will have access to the patient's most recent vital signs, laboratory results, medication list, and drug allergies. This information can ensure continuity of care for your patient and reduce provider error. If you go off your shift, the next provider will know exactly what your patient needs based on the information in this form. On the back of the monitoring form you will find benchmarks for best practices. As you care for your patient, use this form to check off the benchmarks as you achieve them. These forms can be used for quality improvement initiatives and continuing medical education of staff.

You will find a sample monitoring form on the next two pages. Fill in the form using the numbered guidelines below.

1. Fill in the patient's name, age, sex, patient clinic number, admission date and time.
2. Fill in the working diagnosis.
3. Fill in investigations. Circle the appropriate tests, if sent, and record the results.
4. For all women check if pregnant and, if so, note expected date of delivery (EDD).
5. Record any history of drug allergy and type of reaction.
6. Record the time of day at each monitoring point, starting with the time of arrival. The form specifies time monitoring intervals in minutes, starting at time 0. Alternatively, if the patient monitoring form is started after a patient has already been admitted, record the time of day at the start of the resuscitation.
7. Record the following clinical parameters every 30 minutes until stable, then every 60 minutes:
   - SpO_2
   - systolic BP in mmHg
   - pulse
   - respiratory rate per minute
   - consciousness level – use AVPU scale: **A**lert – Responds to **V**oice – Responds to **P**ain – **U**nresponsive. If trauma patient, fill in an initial Glasgow Coma Scale; repeat if head injury.
8. Record the following every 6 hours in column corresponding to time since arrival:
   - temperature in degrees Celsius
   - urine output in ml per hour. Record volume if Foley catheter used. If not, just enter checkmark (✓) if noted.
   - repeat glucose and haemoglobin if initial values abnormal.
9. Record results of glucose, haemoglobin.
10. Exam – record findings of patient examination.
11. Assess – record clinical assessment of major problems plus likely or differential diagnosis.
12. Response − indicate which treatment was given and at what time.
13. Initials − always write your initials after recording patient information.
14. Any additional notes − document any additional information about clinical history, examination, interventions, and response as necessary to communicate clinical course to other health workers.
15. Benchmarks achieved − these are a targeted list of interventions that should be completed within certain time frames. They serve as markers of delivering high-quality care to severely ill patients. For example, a patient with septic shock should be given empirical antimicrobials within 1 hour. Using a checklist like this can help health workers to deliver high-quality care.

Severe illness monitoring form (first six hours)

Name: Patient No.: Birth date: ___/___/___ Age: Sex: M / F Admission date: Admission time:															
Diagnosis:						*Circle if test sent and record result:*		Electrolytes _____ Urine dipstick _____ Malaria _____ AFB _____ Blood culture _____ Gram stain _____ CXR _____ Other _____							
Pregnant:	Yes/No EDD:					Allergies:									
	Time of day														
	Monitoring interval (minutes) from arrival or start	0	30	60 (1 hr)	90	120 (2 hrs)	150	180 (3 hrs)	210	240 (4 hrs)	270	300 (5 hrs)	330	360 (6 hrs)	390
Q30 – 60 min (until normal)	SpO_2														
	Heart rate														
	Systolic BP														
	Respiratory rate														
	Conscious level (AVPU)														
Q1 – 6 hours, repeat if abnormal	Temperature (°C)														
	Glucose														
	Urine output*														
	Haemoglobin														
Exam															
Assess															
Response	Fluids (type, rate)														
	Oxygen (method, flow)														
	Salbutamol														
	Vasopressor (type, rate)														
	Glucose														
	Antibiotics														
	Antimalarial														
	Antiviral														
	Furosemide														
	Blood														
	Other														
Clinician (initials)															

Severe illness monitoring form (hours 7–24)*

Name: Patient No.: Birth date: ___/___/___ Age: Sex: M / F Time of transfer: Ward:																			
Diagnosis:							*Circle if sent and record result:*		Electrolytes _____ Urine dipstick _____ Malaria _____ AFB _____ Blood culture _____ Gram stain _____ CXR _____ Other _____											
Pregnant:	Yes/No EDD:						Allergies:												
	Time of day																		
	Monitoring interval (hours)	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Q 1 hour if SBP<90 or if on pressors, otherwise Q 2 hours	SpO_2																		
	Heart rate																		
	Systolic BP																		
	Respiratory rate																		
	Conscious level (AVPU)																		
Q 6 hours	Urine output*																		
	Temperature (°C)																		
Repeat if initial value abnormal	Glucose																		
	Haemoglobin																		
Exam																			
Assess																			
Response	Fluids (type, rate)																		
	Oxygen (method, flow)																		
	Salbutamol																		
	Vasopressor (type, rate)																		
	Glucose																		
	Antibiotics																		
	Antimalarial																		
	Antiviral																		
	Furosemide																		
	Blood																		
	Other																		
Clinician (initials)																			

***Use AVPU to record level consciousness: A**lert – Responds to **V**oice – Responds to **P**ain – **U**nresponsive. For urine output, record volume if foley or just √ if noted.

Additional notes (please note any changes from standard protocol).

BENCHMARKS – circle the relevant condition(s), then check if achieved

If severe respiratory distress, suspect pneumonia, or acute lung injury, within 30 minutes: ☐ **Oxygen started** ☐ **SpO_2 measured** ☐ **IV started** ☐ **If wheezing, salbutamol given** ☐ **Appropriate infection control** **Within 1 hour:** ☐ **Broad-spectrum antibiotics** ☐ **If malaria possible, antimalarial given** ☐ **If influenza possible, antiviral given**	**If acute pulmonary oedema, within 30 minutes:** ☐ **Oxygen started** ☐ **SpO_2 measured** ☐ **Furosemide 20 mg IV given** ☐ **If hypertensive, isosorbide dinitrate given** ☐ **If ischaemia (chest pain), aspirin given** **If wheezing, within 30 minutes:** ☐ **Salbutamol given** ☐ **If asthma/COPD, steroid given**	**If shock, within 30 minutes:** ☐ **IV line and rapid fluids started** ☐ **1000 ml fluid bolus given** **Within 1 hour, if fever or suspect septic shock:** ☐ **Antibiotics given** ☐ **If malaria possible, antimalarial given** ☐ **If influenza possible, antiviral given** **Within first 2 hours:** ☐ **3 litres IV fluids given**	**If altered level of consciousness/convulsing:** ☐ **Oxygen started** ☐ **Oxygen saturation measured** ☐ **Recovery position** ☐ **Glucose checked and given** ☐ **If convulsing, diazepam given** ☐ **If convulsing and pregnant, magnesium sulphate given** **If trauma, within 30 minutes:** ☐ **Oxygen started** ☐ **Oxygen saturation measured** ☐ **Spine immobilized until clear** ☐ **If shock, IV line and rapid fluid bolus** ☐ **If shock, surgical consult** ☐ **Hb and type and cross sent**

Activity: Practice filling out the monitoring form

Directions: Work in groups of two or three. Read the scenarios and practise filling out the form. Use the scenario number as the patient number and today's date/time for the admission date/time.

1. Mary S. is a 34 year-old female with cough, fever and shortness of breath. Her son said that she has had a rash on sulfa drugs. She is six months pregnant. Her chest X-ray shows bilateral patchy consolidations. Blood culture is pending. Mary S. is alert. Initial vitals: temperature 39°C HR 120 BP: 80/60 RR40 SpO_2 84%.
2. John B is a 60 year-old male who is brought in by family because he has been confused, feverish and very weak. Based on the Quick Check, he has cold hands with a delayed capillary refill. His pulse is faint. His BP is 70/40 and HR 130. Initial 1000 ml bolus of IV NS was started. Other initial vitals: temperature 40°C, RR 25 and SpO_2 90% on room air. Blood sugar is 110. Repeat vitals after 30 minutes: HR 120 BP 80/50 RR 30 SpO_2 89%, and John B is still confused.

General nursing care for the severely ill patient

Keep patient under close observation

- In the emergency department and on the ward, place the patient close to the nurses' station so that the staff can always see the patient or in an area designated for critically ill patients where they can be continuously observed.
- If the hospital is very busy, it may be necessary to enlist the help of family and caregivers to help watch the patient.

Prevent complications (pressure ulcers, skin breakdown, infections, deep venous thrombosis)

- Alternate the position of the patient so that he/she does not get pressure sores.
- Check IV cannula daily, and replace if there are local signs of inflammation/infection.
- Remove IV when it is no longer required.
- Change to oral fluids and antimicrobials as soon as possible.
- Initiate DVT prophylaxis as needed.

Nutrition for the severely ill patient

Early attention to nutrition is important for a patient's improvement and continued health. Once the patient has stabilized, start feeding the patient orally. Ideally oral feeding should occur within the first two days. Remember to assess the patient for aspiration before feeding. Coughing or spitting with feeds is a sign of aspiration. Patients should always be sitting in the upright position for feeds.

There are some patients who may not be able to take food orally, such as a patient with a gastrointestinal disorder (severe pancreatitis) or who recently had gastrointestinal surgery (ileus), or who cannot safely swallow due to a risk of aspiration (altered mental status, severely short of breath or severely unwell, on-going vomiting).

For those that cannot safely swallow, use a nasogastric tube to deliver feeds.

- Give pureed foods through the nasogastric tube.
- Give small amount initially, 20–40 ml/hour.
- Monitor NG aspirates to check for absorption.
- Increase rate of feeding as tolerated.
- Sit patient upright even when getting NG feeds to avoid aspiration.

All other patients should be provided with solid foods. Most patients have decreased appetites, so small frequent meals are better tolerated. In general give patients foods that are easy to digest such as mashed vegetables and soups. Also provide oral rehydration solution (ORS) and clean, boiled water.

Keep patient comfortable

Patients who have altered levels of consciousness, or who are unconscious, can still experience pain and anxiety. Since they cannot tell you they are in pain, look for other signs:

- Check for tachycardia, diaphoresis, anxiety, elevated blood pressure.
- Treat pain.
- Cover with blanket if patient cold.
- Treat fever with antipyretic.

Respect patient privacy

- Keep the patient covered.
- Do not discuss confidential patient information in front of others.

Families and caregivers

- If hospital staff is limited, families can be trained to carry out simple tasks such as measuring urine output, informing staff when IV fluids need to be replaced, and helping to position the patient.

Families and caregivers should be involved in the decisions surrounding their loved one and kept informed of the situation.

Limiting therapy and palliative care

Many patients with critical illness will die. Maintain their comfort and dignity, and support the family through this period. When you run out of treatment options the focus of care should be on providing comfort. Where possible, this decision should be made by a senior clinician after discussion with the family.

Summary of severely ill patients

Caring for severely ill patients requires a team approach, frequent monitoring, and timely response to clinical changes:

Recognize changes in clinical condition, vital signs, abnormal diagnostic results.
Record findings on severely ill patient monitoring form.
Respond to abnormal physiology.
Treat infection.
Prevent complications.
Start nutrition early.
Keep patient under close observation.
Keep patient comfortable.
Respect patient privacy.
Communicate with patient and family.

Assessment questions: Caring for the severely ill patient

Directions: Answer all the questions in the space provided.

1. What initial treatment would you give a patient with low blood pressure and no urine output?

2. At minimum, how often should you measure the blood pressure in an unstable severely ill patient?

3. At minimum, during the first 6 hours, how often should you record a physical exam in a severely ill patient?

4. A patient with respiratory distress and a measured oxygen saturation of 88% should be started on oxygen.
   True or False?

5. If you were caring for a patient on oxygen who seemed to be having increased difficulty breathing or decreasing oxygen saturation, you should first check the equipment to make sure that oxygen is flowing to the patient. True or False?

6. For a 60 kg female, what is the minimum acceptable urine output that should be produced in 1 hour?

7. List three things which should be done when caring for severely ill patients to ensure their comfort or dignity?

8. List two reasons why a severely ill patient may not be able to take food or fluid orally?

9. The following patients are seen in a district hospital. Circle the patients who should be cared for using the severe illness monitoring form:
   a. A 54 year-old female with pneumonia and an oxygen saturation of 82% on room air.
   b. A 24 year-old male with fever, cough, and congestion for two days, who is speaking in full sentences and has an oxygen saturation of 98%.
   c. A 36 year-old male with severe abdominal pain and a blood pressure of 70/30.
   d. A 16 year-old female with fever and painful urination, and a blood pressure of 110/60.
   e. A 26 year-old male who complains of feeling weak, appears very pale, and has a BP of 85/40.

Chapter 2:
Managing patients in septic shock

Learning objectives

1. Understand the types of shock.
2. Recognize septic shock.
3. Fix the physiology of patients in septic shock.
4. Treat the infection.
5. Use the severely ill patient form to monitor patients with septic shock.
6. Respond to abnormal signs and laboratory results.

Introduction

Shock is a general term used to describe the clinical condition when a decrease in blood pressure results in inadequate perfusion (blood flow) and oxygen delivery to vital organs. This lack of blood flow causes cell death in the organs such as brain, heart, kidneys and gut.

Patients in shock require rapid recognition and treatment to prevent further morbidity and mortality. Using the Quick Check you can see that patients in shock will often present with emergency signs of circulation, and other emergency or priority signs. Most often these patients will present with low blood pressure and fast pulse. Use the severely ill patient monitoring form when caring for patients with shock.

The first step is quickly recognizing a patient with shock. As you support the patient during the acute phase of shock, you will also be searching for and treating the underlying cause of shock. There are different types of shock:

- **Septic shock** results from an overwhelming infection.
- **Hypovolemic** shock results from severe dehydration or fluid loss (diarrhoea).
- **Cardiogenic** shock results from cardiac failure.
- **Anaphylactic** shock results from a severe allergic reaction.
- **Haemorrhagic** shock results from severe, acute blood loss.
- **Neurogenic** shock, which is less common, results from acute spinal injury.

Common signs of shock include:	
• Low BP (SBP<90) • Fast pulse • Pallor or cold extremities • Decreased capillary refill	• Dizziness or inability to stand • Decreased urine output (less than 30 ml/hour) • Difficulty breathing • Impaired consciousness, lethargy, agitation, and confusion.

When presented with a patient in shock, quickly identify the type of shock and treat accordingly.

Type of shock	Signs and symptoms
Septic	• temperature dysregulation • infective symptoms • sepsis can present as “hot shock“ (bounding pulse, warm hands) or “cold shock“ (vasoconstriction, cold extremities)
Hypovolaemia	• history of diarrhoea and vomiting • dehydration • burns • pancreatitis
Cardiogenic	• older patient • known cardiac history • chest pain and difficult breathing, sweaty
Anaphylactic	• very sudden onset angioedema and wheezing • new medication or known allergy
Haemorrhagic	• trauma • bleeding (internal or external) • pregnancy complications
Neurogenic	• -history of trauma to spine • -abnormal reflexes and tone • -urinary incontinence or retention

Take a history

- What are the main symptoms?
- Is there any history of preceding symptoms such as vomiting and diarrhoea, abdominal pain, or fever?
- How quickly did the symptoms develop? If sudden onset, were there any obvious precipitants such as possible exposure to an allergen or poison?
- Is there a history of trauma?
- What is the past medical and surgical history?
- Is the patient pregnant?

Perform a focused examination to identify likely cause

- Look for signs of bleeding: Rigid tender abdomen suggesting internal bleeding, vaginal bleeding, vomiting blood, external bleeding from trauma, bleeding from mucosa suggesting clotting disorder or viral hemorrhagic fever. Remember to always use standard precautions when examining patients.
- Look for signs of severe dehydration: Dry mucus membranes, sunken eyes, decreased skin turgor, confusion, and decreased urine output.
- Look for signs of sepsis: Fever, local signs of infection, and confusion.
- Look for signs of anaphylaxis: Rash, stridor, wheezing, and facial swelling.
- Look for signs of cardiac disease: Distended neck veins, cardiac murmur, lower extremity oedema, lung rales or crackles.

Develop a differential diagnosis

While gathering information, begin to develop a differential diagnosis to determine the need for further investigations and treatment. Take a few minutes to review the differential diagnosis table for shock in the DCM, Section 3.1. How many of these conditions do you frequently see in your hospital?

Send urgent investigations

When a severely ill patient is identified with shock, several laboratory and diagnostic investigations should be sent for immediately. These diagnostic investigations are based on a wide initial differential diagnosis. Often, you will need to begin treatments without the final diagnosis or you may need to treat the patient for more than one life-threatening condition. Do not delay ongoing, life-saving, treatments if results are not available.

Initial investigations may include:

- blood glucose
- haemoglobin
- pregnancy test for woman of childbearing years
- if available
  - BUN and creatinine
  - electrolytes.

If you suspect septic shock, try to identify the source of infection. Initial investigations may include:

- urine dipstick or microscopy
- malaria screen
- AFB smear and culture of sputum
- chest X-ray
- blood culture and gram stain
- lumbar puncture
- stool culture.

Treat for suspected diagnosis while supporting the patient

- “Fix the physiology” to continue support of the patient through the acute phase of the illness (i.e. give oxygen, fluids).
- If the underlying source of the shock is determined, treat the specific cause.

Septic shock

If an overwhelming infection is not treated immediately a patient can develop septic shock. Patients with compromised immune systems, particularly those with HIV and diabetes are at increased risk of developing septic shock. The risk of death from infection increases dramatically when the patient develops septic shock, and early treatment saves lives. Using the algorithms in the DCM, we will now review in detail the acute management of patients with septic shock. These are general recommendations for the treatment of septic shock. As you go through this module, refer frequently to the algorithms provided for the management of septic shock and severe respiratory distress. Take a few minutes before you get started to review these algorithms as a group.

If a specific diagnosis is made (pneumonia, dengue shock syndrome, etc.), use established local guidelines for treating the syndromes. Refer to table 3.1-16 of the DCM for the modified management of septic shock associated with specific infections. Remember to always use standard precautions and infection control measures.

Benchmarks are defined as standards of achievement or excellence. As timely management is extremely important in patients with septic shock, benchmarks for specified time points have been established. You should try to achieve these benchmarks as soon as you recognize that someone is in shock. We will review these benchmarks throughout this learning unit.

Benchmarks for treatment of septic shock

Record the following clinical parameters every 30 minutes until stable, then every 60 minutes:

- SpO_2
- systolic BP in mmHg
- pulse
- respiratory rate per minute
- consciousness level – use AVPU scale: **A**lert – Responds to **V**oice – Responds to **P**ain – **U**nresponsive. If trauma patient, fill in an initial Glasgow Coma Scale; repeat if head injury.

Record the following every 6 hours:

- temperature in degrees Celsius
- urine output in ml per hour. Record volume if Foley catheter used. If not, just enter checkmark (✓) if noted.
- repeat glucose and haemoglobin if initial values abnormal.

First 2 hours

RECOGNIZE

The clinical diagnosis of severe sepsis or septic shock is defined as follows:

Suspected infection, plus

Hypotension (systolic blood pressure <90 mmHg), plus

One or more of the following:

- pulse>100 beats per minute
- respiratory rate >24
- abnormal temperature (<36^{o}C or >38^{o}C).

It is important to note that the diagnosis does not require a fever to be present. A low temperature is also a cause for including a patient in the diagnosis.

FIX THE PHYSIOLOGY

Titrate oxygen to SpO_2

Patients with severe sepsis and septic shock are at risk of developing severe respiratory distress and hypoxia. Supplemental oxygen treatment is not needed if the SpO_2 is initially above 90%. However, these patients must be monitored closely for the initial 6 hours, as respiratory distress and hypoxia can develop over time.

Check SpO_2 every 30 minutes.

- If the SpO_2 is below 90%, then give oxygen and titrate to keep the SpO_2 above 90%.

Fluids

Weight-based fluid			
Target volume	**Small patient/ adolescent (30kg)**	**Medium patient (50kg)**	**Large patient (≥70kg)**
Initial bolus 20ml/kg	500ml	1000ml	1500ml
Fluid target between 1-2 hours (20-40ml/kg)	500-1000ml	1000-2000ml	1500-3000ml
Maintainence fluids (2ml/kg/h)	60ml/h	100ml/h	140ml/h

- **After initial bolus of 1000 ml, continue rapid fluids LR or NS at 20 ml/kg/hour – up to 60 ml/kg within first 2 hours.**

During the Quick Check, any patient with emergency signs of circulation should have received one litre of crystalloid fluid (NS or LR) as a first-line emergency treatment. Now, if you suspect septic shock, the patient should continue to be given IV crystalloid fluid for resuscitation. To guide fluid administration as these questions:

- Is the patient still in shock?
- What is the time interval (the recommendations are based on time from the start of resuscitation)?
- What is the patient's estimated weight?

The goal is to administer one litre of IV crystalloid fluid within initial 30 minutes AND up to 60 ml/kg by the end of hour 2 (this includes the initial one litre bolus given during the Quick Check).

Only use lactated ringers (LR) or normal saline (NS) for fluid resuscitation. Do not use D5W or ½ NS. If a patient is also hypoglycaemic, you can treat with IV dextrose as a bolus, but usually you should **not** add dextrose to the resuscitation fluids.

TREAT THE INFECTION

In a severely ill patient with septic shock, it is important to initially treat for all possible sources of infection, even if laboratory and diagnostic results are not yet available. For example, in a patient with suspected septic shock due to suspected pneumonia you may initially treat for bacterial pneumonia, malaria (if in endemic area), and influenza (if during influenza season or a pandemic). It may be several days or sometimes even weeks, before a specific microbiological diagnosis can be made. These severely ill patients will rapidly deteriorate if not treated quickly. **The goal is to administer antimicrobials to a patient in septic shock within the first hour of treatment.**

Antibiotics

Studies have shown that the slightest delay in treating a patient with septic shock may increase the patient's chances of death. During the Quick Check, you generally would have administered empirical antibiotics as an urgent treatment. Make sure this treatment has been given.

- Choice of antibiotics depends of presence of focal signs of infection, local patterns of disease, and availability of antibiotics.
- If you suspect severe community acquired pneumonia, refer to local guidelines. Common choices include ceftriaxone (1 gram daily) or ampicillin plus gentamicin (if community acquired pneumonia is suspected, add either a macrolide or respiratory fluroquinolone).
- Limit fluroquinolone use if alternative antibiotics are available, if TB is suspected, or if treating a pregnant patient.

Antimalarials when appropriate

If you suspect severe malaria as possible cause of shock, give antimalarials immediately. Malaria smears should be sent to evaluate and repeated if necessary, but antimalarials should not be delayed in cases of severe malaria.

Antiviral if suspect influenza

If influenza is suspected as cause of septic shock during influenza season or an influenza pandemic, treat the patient with appropriate antiviral immediately in accordance with recommendations for your hospital. Do not delay treatment to wait for viral testing results.

Identify source and control the infection

During this time, make sure that laboratory and other diagnostic tests have been sent. This may include blood cultures, malarial smear, chest X-rays, sputum for AFB and where available molecular testing for TB. Consider TB, especially in persons living with HIV. Always use universal precautions, and take appropriate infection control measures. If there is an infection that needs surgery or debridement such as empyema, necrotizing soft tissue infection or acute appendicitis, then consult a surgeon immediately. If a specific diagnosis is made, such as pneumonia, dengue shock syndrome or malaria, you may choose to use established national or international guidelines.

MONITOR – RECORD

Frequent and systematic clinical assessments should include a review of vital signs, physical examination findings and key laboratories. Record these findings on the severely ill patient monitoring form.

Every 30 minutes until stable then every 1 hour:
- SBP
- pulse
- respiratory rate
- SpO_2
- mental status (AVPU)
- JVP, auscultate for crackles (rales)

Check results of emergency laboratory:
- if haemoglobin <7 mg/dl (Hct <20) consider transfusion
- if glucose <3 mmol/l (54 mg/dl) then give D50 25–50 ml(see Quick Check page 19)

RESPOND

You should respond rapidly and appropriately to changes, new abnormalities, or diagnostic test results. If your patient with septic shock develops worsening respiratory distress (increasing RR, decreasing SpO_2):

- Titrate oxygen and check oxygen supply.
- If wheezing give patient salbutamol.
- If elevated JVP or increasing crackles suspect fluid overload. Slow down rate of fluid administration and call for help. If still in shock (SBP<90) the patient may need to be started on vasopressors to support their circulation.

DRILL 2-1: Management of septic shock initial two hours

You are caring for a patient and suspect septic shock.

1. During the Quick Check your patient was found to have emergency signs of circulation. You suspect septic shock. What is the clinical definition of septic shock in the IMAI DCM?

2. Your patient has been given one litre of crystalloid fluid and the BP is 80/40. What type of IV fluids would you now give to the patient and at what rate?

3. How much fluid should the patient in septic shock have received after two hours of appropriate treatment?

4. According to the IMAI benchmarks, antibiotics should be administered to patients in septic shock within one hour. True or False?

5. Patients with septic shock infected with HIV and TB are at high risk of clinical deterioration and death. True or False?

6. List at least 3 laboratory or diagnostic tests that can be sent to evaluate for a source of infection?

2-6 hours

RECOGNIZE

Re-assess the patient and recognize if the patient is responding to treatment. Reconsider your diagnosis of septic shock if the patient is worsening.

- Is the patient still in shock? If so, is there another cause other than suspected septic shock? Is there any evidence of active blood loss?
- Look at the results of any diagnostic tests that are now available. What is the etiology of septic shock? Does the patient require drainage or debridement of an infection?

FIX THE PHYSIOLOGY

Oxygen

It is often during this timeframe, that patients in septic shock may begin to develop severe respiratory distress and hypoxia. Hypoxia can result from a primary infection of the lungs, fluid overload, or injury to the lungs from the overwhelming infection.

- Check SpO_2 every 30 minutes.
- Give oxygen, if needed, titrate to SpO_2 ≥90%.

Fluids

Early fluid treatment for patients with septic shock is a key intervention that saves lives. By the end of the second hour the patient should have received up to 60 ml/kg of IV crystalloid fluid. For a 70 kg person this would be about 4.2 litres. Further management of fluid must continue, but the rate of fluid administration is dependent on the patient's condition. Continue to monitor the patient frequently over this time period. Assess for adequate perfusion using clinical indicators and urine output to determine whether the patient is still in shock.

If shock has improved (SBP >90):

- give IV crystalloid fluid (NS or LR) at rate of 2 ml/kg/hr.

If shock persists (SBP <90):

- give IV crystalloid (NS or LR) at rate of 5–10 ml/kg/hour
- consider starting vasopressors to support circulation (consult with senior physician).

Vasopressors

Despite appropriate initial treatment, there may be patients who do not respond and continue to have low blood pressure at the end of the second hour of management. If a patient remains in shock and has clinical signs of poor perfusion (low BP, low urine output, altered level of consciousness) after early, aggressive IV fluid treatments, and antibiotics, consider the use of vasopressor medications to temporarily support circulation. Vasopressors work by vasoconstriction and increasing the contractility of the heart. Examples of vasopressor medications include epinephrine (adrenaline) and dopamine.

The decision to use vasopressors should be made by a senior clinician.

A patient who has not been adequately fluid-resuscitated and treated with antimicrobials for the underlying cause of the septic shock will not improve on vasopressors. Vasopressor medications are meant for short-term use only to support a patient during an acute illness, and have dangerous side-effects if not used correctly.

Side-effects of vasopressors include tissue necrosis if the IV infiltrates, arrhythmias, and ischemia to organs (skin, gut, kidneys). You should use the minimum dose possible to maintain the blood pressure (target SBP of 90). Give vasopressors carefully by intravenous infusion and dose the medication based on the patient's weight.

- Always dilute vasopressor medication and give by infusion at a ***strictly controlled rate***.
- When preparing these drugs for infusion, have a colleague double check that all safety steps have been taken and the concentration and infusion rate is correct. Read the ampoule label 3 times to confirm the concentration before mixing.
- If administered through a peripheral vein, use the largest vein possible.
- Do not use the blood pressure cuff on the same arm through which the medication is infusing.
- Use a metal gate-clamp in the IV rather than the integral roller device. The roller can become loose and deliver the medication at the incorrect rate.
- Inspect infusion site regularly to avoid leaking of the medication into the tissues.
- Monitor patients frequently, continuous monitoring is preferred if available.
- If unable to continuously monitor, then initially monitor the BP and HR at least every five minutes until patient is at a stable infusion rate.

Use the table below to determine the appropriate dose and rate of infusion.

Mixing the correct concentration of vasopressor medication

How to give vasopressor by peripheral infusion						
Vasopressor		**Peripheral epinephrine infusion**		**Peripheral dopamine infusion (preferred for shock in severe malaria)**		
Commonly available concentrations		1 amp = 1 mg epinephrine (adrenaline) in 1 ml*		1 amp = 200 mg dopamine in 5 ml*		
Target infusion concentration		10 micrograms per ml		1000 micrograms per ml		
Mixing procedure to create target infusion concentration		Use: 2 amps in 200 ml normal saline** OR 10 amps in 1000 ml normal saline**		Use: 1 amp dopamine in 200 ml normal saline** OR 5 amps dopamine in 1000 ml normal saline**		
		Epinephrine		**Dopamine**		
Dose rate***		0.05 micrograms/ kg/minute	0.2 micrograms/kg/minute for very hypotensive	10 micrograms/ kg/minute	15 micrograms/ kg/minute	20 micrograms/ kg/minute
		Infusion rate (ml/hour)**				
Patient weight (kg)	50 kg	15 ml/hour	60 ml/hour	30 ml/hour	45 ml/hour	60 ml/hour
	60 kg	18 ml/hour	72 ml/hour	36 ml/hour	54 ml/hour	72 ml/hour
	70 kg	21 ml/hour	84 ml/hour	42 ml/hour	63 ml/hour	84 ml/hour

* 1 milligram (mg) is equal to 1000 micrograms (mcg).
** Read ampoule label **3 times** to confirm concentration before mixing.
*** Desired dose rate is weight based.
**** Infusion rate is commonly presented per hour
Infusion rate = desired dose rate/concentration of the infusion.

Titration of vasopressors:

- Use the lowest infusion rate possible to support the blood pressure
  - epinephrine start at 0.05 micrograms/kg/min
  - dopamine start at 10 micrograms/kg/min.
- Initially, monitor the pulse every minute and the BP every 2-5 minutes, or continuously if available.
- Continue to monitor the BP continuously or every 2–3 minutes until the patient has stabilized.
- If after 10 minutes the SBP is still <90, increase the infusion rate.
- Titrate the dose in small increments:
  - epinephrine-titrate dose in 0.05 microgram/kg/min increments to a maximum dose of 0.2 micrograms/kg/min
  - dopamine-titrate the dose in 2 microgram/kg/min increments up to a maximum dose of 20 micrograms/kg/min.
- Recheck the patient in 30 minutes. If the blood pressure and perfusion is improving, gradually decrease the infusion rate to keep the SBP>90 and adequate perfusion.
- Continue to administer intravenous fluids to patients who are receiving vasopressors.

Stop the infusion if:

- The drip has infiltrated the tissues.
- There is skin blanching.
- The patient develops an irregular pulse, arrhythmia, or dangerous tachycardia.
- The patient develops severe pain or swelling at the infusion site.

Example

A 60 kg female in septic shock has a blood pressure of 80/40 and no urine output, after receiving almost four litres of normal saline. The senior clinician decides to start vasopressors. The clinician orders an infusion of epinephrine (adrenaline) at a target infusion concentration of 10 micrograms per ml, and an initial dose rate of 0.05 micrograms/kg/minute. Ideally, the clinician should be at the bedside to monitor the patient when vasopressors are started.

Step 1: Get the epinephrine and read the label **three times,** to check the ampoule concentration.

Step 2: If the concentration of epinephrine is 1 mg epinephrine in 1 ml, mix two ampoules in 200 ml of normal saline. *Alternatively,* mix 10 amps in 1000 ml of normal saline if you suspect the patient will require the vasopressor for a longer period of time.

Step 3: Estimate the weight of the patient.

Step 4: Determine the desired dose rate for infusion. For a 60 kg patient, for a dose rate of 0.05 micrograms/kg/min, infuse the medication at 18 ml/hour.

Step 5: Check the patient immediately after the infusion is started to make sure the medication has not infiltrated.

Step 6: **Observe the patient. Monitor the pulse and blood pressure continuously if a monitor is available. If continuous monitoring is not available check the pulse and BP every two to three minutes until the patient is at a stable infusion rate.**

DRILL 2-2: Vasopressors

Use the table above from the DCM to help you.

1. You want to prepare a dilution of 10 micrograms of epinephrine per ml. Use the vasopressor table and list two ways to correctly mix the dilution?

2. You want to prepare a dilution of 1000 micrograms of dopamine per ml. Use the vasopressor table above and list two ways to correctly mix the dilution?

3. You are asked to start an infusion of epinephrine on a 60 kg female because the blood pressure has remained low after three litres of normal saline have infused. The blood pressure is now 80/40 and you would like to start the infusion at 0.05 micrograms/kg/minute. Using a dilution of 10 micrograms/ml describe how you would mix the correct dilution and at what rate per hour you would infuse the medication.

4. Despite starting the epinephrine, the blood pressure has remained low and you are asked to increase the infusion to 0.2 micrograms/kg/minute. How fast would you run the infusion?

TREAT THE INFECTION

Between hours 2–6, results from laboratory tests may be available to assist you in determining the cause of septic shock. Continue broad-spectrum antibiotics until a senior clinician can make changes to the antibiotic orders based on focal signs of infection or laboratory results.

MONITOR – RECORD – RESPOND

Carry out frequent and systematic clinical assessments and include a review of vital signs, physical examination findings and key laboratories. Respond rapidly and appropriately to changes or new abnormalities.

- Check vital signs every 30 minutes (BP, HR, RR, SpO_2, AVPU).
- Check urine output.
- Examine the patient. Has the mental status changed? Look for evidence of the development of pulmonary oedema (elevated jugular venous distension, crackles).
- If evidence of pulmonary oedema, slow down the fluids and call the senior clinician for help.

- Recheck Hb if initial value abnormal. Refer to local guidelines regarding blood transfusion protocols.
- Recheck glucose, if initial value abnormal.

DRILL 2-3: Managing septic shock 2–6 hours

You are caring for a patient with septic shock. After two hours of appropriate fluid therapy, your patient remains in shock with a blood pressure of 80/40.

1. What type of intravenous fluid would you administer?

2. What rate would you administer the fluid?

3. How long would you continue fluid at this rate?

4. Would you start vasopressors?

5. List two reasons to stop the infusion of a vasopressor medication?

6. The patient is started on a dopamine infusion. When the medication is initially started, how often should the HR and BP be assessed?

7. The SBP rises above 90 mmHg and your patient is on epinephrine (adrenaline) at 0.2 mcg/kg/min, how would you adjust the vasopressor rate (use vasopressor table to help determine correct answer)?

8. The SBP is above 90 mmHg for one hour. Your patient is not currently on vasopressors. How would you adjust the fluid administration rate?

6-24 HOURS

RECOGNIZE

Continue to assess the patient and recognize if the patient is responding to treatment. Reconsider the diagnosis if the patient is not responding and the blood pressure remains low. At 6-24 hours often you will have some results available to determine the source of infection, including if the patient requires surgery.

FIX THE PHYSIOLOGY

Oxygen

During the 6–24 hour time frame, continue to monitor for the development of severe respiratory distress and hypoxia. Titrate oxygen for SpO_2 ≥90%. If the SpO_2 has been stable and above 90%, then monitor every two hours or when the patient's condition changes.

Fluids

Depending on the rate of fluid administration between 2-6 hours, by the end of hour 6 a 70 kg person would have received between 5 and 7 litres of IV crystalloid fluid. At the onset of the seventh hour, continue fluids but decrease the rate to 2 ml/kg/hr in all patients regardless if the patients remains in shock or not.

Vasopressors

As discussed before, vasopressors are intended to be used only temporarily.

If shock has improved (SBP >90):

- titrate the vasopressors (decrease rate) and eventually off.

If shock persists (SBP <90):

- titrate vasopressors (increase rate).

TREAT THE INFECTION

Between hours 6–24, additional results from diagnostic tests may assist you in determining cause of septic shock. Continue with broad-spectrum antimicrobials until a senior clinician makes changes based on focal signs of infection:

- give additional antimicrobials if indicated based on suspected source of infection
- drain or debride infections, if indicated
- give next dose of antimicrobials when indicated.

MONITOR – RECORD – RESPOND

Continue to carry out frequent and systematic clinical assessments and include a review of vital signs, physical examination findings and key laboratories. Respond rapidly and appropriately to changes or new abnormalities.

- Check vital signs, mental status, and evaluate for the development of pulmonary oedema every 1–2 hours.
- Every 6 hours:
  - monitor urine output
  - recheck Hb, if previously abnormal, suspect ongoing haemorrhage, or after a blood transfusion
  - recheck blood glucose if previously abnormal result was treated.
- Despite all treatments, some patients with septic shock may not be improving. Make sure to communicate clearly with the family during this difficult situation.

DRILL 2-4: Management of septic shock 6–24 hours

You are caring for a patient in septic shock. After 6 hours your patient remains in shock and is on a peripheral epinephrine infusion at 0.05 mcg/kg/min.

1. What type of fluid would you administer and at what rate?

2. If the blood pressure is now 80/40, how would you adjust the vasopressor infusion (use vasopressor table to help)?

3. How often would you measure the blood pressure in this patient?

4. The patient was given a dose of an antibiotic on arrival to the hospital, eight hours ago. The antibiotic is scheduled to be given every eight hours. You still do not know the definite source of infection in your patient. Should you give the second dose of antibiotic, yes or no?

5. Your patient is developing worsening respiratory distress. The previous oxygen saturation had been 98% on room air so the patient is not currently on oxygen, but the oxygen saturation is now dropping and it is 94%. What actions would you take? Would you start the patient on oxygen?

POST-RESUSCITATION

RECOGNIZE

In the post-resuscitation period, it is important to determine the etiology of the septic shock and determine the specific treatment course for the infection.

- When possible, narrow antimicrobial coverage and determine length of treatment.
- Use IMAI DCM for disease-specific treatment guidance.

FIX THE PHYSIOLOGY

Oxygen

During the post-resuscitation period, continue to monitor the $SpO_2$and titrate the oxygen. However, if the SpO_2 has been stable and above 90%, then monitor every 8 hours or when patient develops a change in any clinical parameter.

Fluids

In the post resuscitation period, start patients who are improving and recovering their appetite on oral fluids while IV crystalloid continues at 2 ml/kg/hr. Once the patient is taking sufficient fluids orally, discontinue intravenous fluids.

TREAT THE INFECTION

Continue with a full course of antimicrobial treatment as determined by the senior clinician. Switch to oral antimicrobials when possible.

NUTRITION

As discussed in the previous module, nutrition therapy is important in the recovery of severely ill patients. Once shock is treated, it is safe to begin to feed patients orally. Most patients lose their appetite when ill, and may find soft foods and oral fluids easier to tolerate. Small frequent meals are often tolerated better.

Before feeding a patient assess their aspiration risk. Does your patient have altered consciousness, severe respiratory distress or ongoing vomiting?

- If so, consider NG feeding using pureed foods.
- Give a small amount initially, such as 20–40 ml/hour and monitor NG aspirates to check for absorption.
- Increase the rate of feeding as tolerated.

MONITOR – RECORD – RESPOND

Check the patient's vital signs every eight hours and record. Remember to watch for the development of complications. Turn patients frequently to prevent the development of bedsores.

If your patient develops respiratory distress during the course of their illness, be prepared to treat them immediately. Measure the SpO2 and start and oxygen therapy. The next chapter will guide you through the management of patients with severe respiratory distress.

We have now reviewed the management of patients in septic shock. Practice your management of fluids for patients in septic shock with the following drill.

DRILL 2-5: Fluid management in patient with septic shock

How would you manage the fluids? What type of fluid and at what rate? Calculate based on patient's weight.

1. 22 year-old 70 kg male arrives at the hospital with weakness and fever. Temp 39°C BP 80/40 HR 120 RR 26.

2. 36 year-old 60 kg female with septic shock. After 30 minutes the patient has received a 1000 ml NS bolus. You recheck the vital signs: BP 70/30 HR 110 RR 22.

3. 18 year-old 65 kg male with septic shock. After two hours the patient has received 3 litres LR. You recheck the vital signs: BP 60/40 HR 122 RR 28.

4. 55 year-old 60 kg female with septic shock. After two hours the patient has received three litres LR. You recheck the vital signs: BP 110/60 HR 105 RR 22

5. 37 year-old 55 kg female with septic shock. The patient has received two litres LR since arrival 4 hours ago. The BP had initially improved to 100/60 after the first one litre bolus and had been stable for past 3 hours. When you recheck the patient, the vital signs are now: BP 70/30 HR 130 RR 26.

Summary of septic shock

Recognize septic shock

- suspected infection, plus
- hypotension (systolic blood pressure <90 mmHg), plus

One or more of the following:

- pulse>100 beats per minute
- respiratory rate >24
- abnormal temperature (<36^{o}C or >38^{o}C).

Fix the physiology

- Monitor SpO2, give and titrate oxygen to target SpO2 of 90%
- Give early and aggressive IV fluid resuscitation in the first six hours
- Use vasopressors only after two hours of resuscitation if SBP remains <90.

Treat the infection

- Give early empiric antibiotics, antimalarials (endemic areas) and antivirals (when appropriate)
- Obtain surgical consultation for drainage or debridement of infection, if needed.

Monitor – record – respond to abnormal signs and laboratory results

- Reassess patient frequently, every 30 minutes initially
- Look for changes in vital signs, urine output, laboratories and physical examination
- Record all clinical information on the patient monitoring form
- Use clinical reasoning to process information and guide further management.

Assessment questions: Septic shock

1. What are the clinical criteria for severe sepsis and septic shock?

2. During the first two hours, how often should you monitor the vital signs for a patient in septic shock?

3. List four tests that you may consider that may help to recognize the source of infection for a patient in septic shock?

4. You should wait for blood culture results to come back, before starting antibiotics on a patient in septic shock. True or False

5. If the respiratory function of a patient in septic shock is worsening, list two things that you would check for?

6. What type of fluid should be used for resuscitation for a patient in septic shock?

7. How much intravenous fluid should a patient in septic shock receive in the first two hours of management?

Practice cases:

Get together in small groups and discuss how you would manage these patients.

1. A 35 year-old female presents with fever, chills, abdominal pain. She has had these symptoms for three days. The patient is not pregnant. On exam she is lethargic and

confused, and her extremities are cool with weak peripheral pulses.

Pulse: 123 BP: 70/30 RR: 33 T: 40°C SpO_2: 95% on room air

- What initial actions need to be taken to stabilize the patient?
- What is the differential diagnosis?
- What laboratory or diagnostic evaluations would you initially order?
- What do you think is the source of infection? What antibiotics would you prescribe?
- What challenges would you face caring for this patient at your hospital?

2. A 32 year-old male with known HIV and recently diagnosed with TB presents with generalized weakness and fever. The CD4 count is unknown and the patient is not currently taking any medications. On exam the patient is weak and complains of headache, vomiting, diarrhoea, and a productive cough. You notice thrush in the patient's mouth. The patient has no meningismus, the lungs have bilateral wheezing, and the heart is regular. The abdomen is soft and non-tender.

   Pulse: 122 BP: 82/40 RR 36 T: 38.5°C SpO2: 87% on room air

   - What initial actions need to be taken to stabilize the patient?
   - What is the differential diagnosis?
   - What laboratory or diagnostic evaluations would you initially order?
   - What do you think is the source of infection? What antibiotics would you prescribe?
   - What challenges would you face caring for this patient at your hospital?

Chapter 3:
Managing patients in severe respiratory distress

Learning objectives

1. Review initial management of patients with severe respiratory distress.
2. Develop a differential diagnosis of severe respiratory distress.
3. Manage patients with severe pneumonia and/or acute lung injury.
4. Manage patients with severe bronchospasm.
5. Manage patients with acute pulmonary oedema.
6. Monitor patients with severe respiratory distress using patient monitoring form.

Introduction

Using the Quick Check you learned to rapidly screen patients for emergency signs and give emergency first-line treatments including treatment of any rapidly reversible causes. Patients presenting with Quick Check emergency signs of airway or breathing, and who do not rapidly improve with emergency treatments, have severe respiratory distress. They will require ongoing resuscitation, management, and monitoring. Patients may present with severe respiratory distress from a primary problem in the lungs such as pneumonia, or from a secondary cause such as sepsis or head injury. If untreated, the patient may develop respiratory failure, which can lead to death. It is very important to recognize patients with severe respiratory distress and to treat them early.

If any of the following signs and symptoms are present, consider the patient to be in severe respiratory distress:

- very fast or very slow respiratory rate
- use of accessory muscles to breath (neck, intercostal, or abdominal)
- inability to speak in full sentences due to respiratory distress
- central cyanosis
- respiratory distress with depressed level of consciousness (confusion, lethargy, agitation)
- SpO_2 less than 90%.

Infection control!

- Use standard precautions for all patients (see DCM p. 39). When managing the airway, using nebulized drugs or advanced airway measures, perform hand hygiene and wear personal protective equipment (gloves, gowns, eye protection, mask, particulate respirator as indicated).
- If suspect acute respiratory disease, promote cough etiquette, separate from other patients, and use particulate respirator.

While supporting the patient with lifesaving first-line emergency and urgent treatments, try to identify the cause of severe respiratory distress and treat accordingly.

Refer to the table in the DCM for the detailed differential diagnosis of respiratory distress (3.2-25-3.2-27). Below is a table that can be used to help you quickly remember the causes of severe respiratory distress.

Categories of severe respiratory distress

	Severe respiratory distress – consider DDx in these categories			
	Respiratory	**Cardiac**	**Blood**	**Drug toxicity**
Common	Pneumonia **bacterial** **influenza** **PCP** Pleural effusion COPD Asthma	Pulmonary oedema (acute heart failure)	Anaemia	Opioid Organo-phosphate
Less common	Pulmonary embolism *Pneumothorax Acute lung injury (malaria, severe sepsis, TB)	*Tamponade (traumatic, malignancy, TB)	Acidosis (malaria, diabetic ketoacidosis)	ART (lactic acidosis)

* Although not common, these conditions need to be identified rapidly because they require an urgent therapeutic procedure.

Take a history:

- What are the main symptoms? When did the symptoms start?
- Are there symptoms suggesting infection: Fever, chills, cough, body aches, headache, or other systemic signs?
- Are there symptoms suggesting TB: History of TB, weight loss, night sweats, productive cough?
- Are there symptoms suggesting an allergic reaction: Rash, facial swelling, difficulty swallowing, allergen exposure?
- Are there symptoms suggesting heart failure: Difficulty lying down, shortness of breath with exertion, swelling of legs?
- Are there symptoms suggesting a myocardial infarction: Chest pain, sweating, or nausea?
- Are there symptoms or medical history suggesting a blood clot (pulmonary embolus): Recent surgery, history of cancer, swelling of one leg, pleuritic chest pain, or hemoptysis?
- Are there symptoms suggesting severe anaemia: Bleeding, pallor, or shortness of breath with exertion?
- Is there a history of aspiration?
- Is there a history of recent trauma, snake-bite, fire or smoke inhalation?

- Is there a suspected drug ingestion or overdose?
- Is there a significant medical history which can lead to respiratory distress: ischemic heart disease, rheumatic heart disease, heart failure or cardiomyopathy, asthma or chronic obstructive pulmonary disease COPD, HIV, hypertension, diabetes, or neuromuscular disease?
- Is there a current or recent pregnancy?
- Does the patient smoke?

Perform a focused examination to identify likely cause:

- Check vital signs BP, HR, RR, Temperature, SpO_2, AVPU

Look/listen for:

- Signs of upper airway obstruction
  - stridor or hoarse voice
  - swelling of the face, lips, or tongue.
- Signs of respiratory distress
  - cyanosis
  - fast, shallow, or laboured breathing very
  - retractions, use of accessory muscles, or nasal flaring
  - unable to speak in full sentences without pausing to catch breath
  - agitated, confused, unconscious, or uncooperative.
- Signs of fluid overload (pulmonary oedema)
  - unable to lie flat, sitting forward to breathe easier
  - elevated jugular venous pressure
  - peripheral oedema
  - abdomen distended or tender
  - liver enlarged.
- Signs of anaemia
  - pallor
- Signs of acute bronchospasm
  - wheezing, rhonchi, prolonged exhalation.
- Signs of effusion or consolidation (pneumonia)
  - dullness to percussion of lungs
  - decreased breath sounds.
- Signs of chest trauma (rib fractures, pneumothorax, haemothorax)
  - abnormal chest wall movements
  - crepitus or crackling under the skin.
- Signs of tension pneumothorax
  - trachea deviated to one side
  - decreased breath sounds.

- Signs of pericardial effusion
  - heart sounds muffled, rub.
- Signs of cardiac disease
  - fast HR or irregular HR or heart murmur.
- Signs of poisoning or intoxication
  - pupils constricted or dilated.
- Signs of blood clot
  - unilateral calf or leg swelling or calf tenderness.

Develop a differential diagnosis

While gathering information, begin to develop a differential diagnosis to determine the need for further investigations and treatments. Take a few minutes to review the differential diagnosis table for respiratory distress in the DCM section 3.2. (DCM 3.2-25 – 3.2-27). How many of these conditions do you frequently see in your hospital?

Send urgent investigations:

- pulse oximetry to measure SpO_2
- chest X-ray
- haemoglobin
- HIV test if status unknown
- if fever, send blood cultures and other specimens for culture as clinically indicated
- if suspect malaria, do rapid malaria test
- if suspect TB, sputum for prompt AFB smear and culture (other diagnostics if suspect extrapulmonary TB)
- if wheezing, check peak flow
- if suspect fluid overload, check creatinine and potassium
- if suspect cardiac problem check ECG to evaluate ischemia or arrhythmias
- if suspect cardiac problem, perform limited echocardiography to evaluate cardiac function, mitral stenosis, or pericardial effusion
- check pregnancy test if woman of childbearing age.

Treat for suspected diagnosis while supporting the patient:

Key initial treatments should then be given (if not yet given) and continued for the most likely and most serious diagnosis. Appropriate laboratory tests and chest X-ray may assist in narrowing the differential diagnosis, but DO NOT delay treatments while waiting for results. At district hospitals, chest X-rays may require the patient to leave the emergency area. If this is the case, it is safer for the patient to get the chest X-ray when their clinical condition is more stable. In the DCM (3.2-28) characteristic chest X-ray results for certain clinical conditions are listed. During your hospital visits, try to identify some of these X-ray results in patients you see with severe respiratory distress. In the table below you will see key initial treatments for common diseases. Remember, the patient may have more than one disease, so it is important to identify the most likely cause, initiate appropriate treatments, and reassess frequently.

Key initial treatments for severely ill patients with respiratory distress

Likely diagnosis	Initial treatments
Upper airway obstruction	Manage airway. See Quick Check page 12−13.
Anaphylaxis	Give epinephrine. See Quick Check page 11 and DCM Section 3.1.3.
Pneumothorax	If tension, insert needle and/ or chest tube, see Quick Check page 22.
Pericardial tamponade	Drain pericardial fluid, see DCM Section 7.
Pneumonia	Non-severe pneumonia, see DCM Section 10.6. Severe pneumonia, see DCM Section 3.2.3. Give empirical broad-spectrum antimicrobials within one hour. If PLHIV, also give empirical PCP treatment as well. If suspect influenza, give antivirals. If shock, see DCM Section 3.1.5.
Acute bronchospasm	Give salbutamol immediately. See Quick Check page 17 and Section 3.2.4. If suspect asthma or COPD, give hydrocortisone 100 mg IV or equivalent oral dose.
Acute pulmonary oedema (fluid overload condition)	Give furosemide 20 mg IV. For severe hypertension, give vasodilator. See DCM Section 3.2.5.
Acute lung injury (e.g. severe malaria)	Treat underling cause. See DCM Section 3.2.3 If severe malaria, give antimalarials. If severe sepsis, give empirical broad spectrum antimicrobials
Anaemia	See DCM Section 10.18
Opioid overdose	Give naloxone. See Quick Check page 18.
Poisoning	See DCM Section 3.8

Severe respiratory distress without shock: Suspect pneumonia or acute lung injury

Severe respiratory distress may develop from a large number of different causes. Make sure you have looked for and treated any rapidly reversible conditions and given first-line emergency treatments and urgent treatments, while searching for the etiology of the respiratory distress. Common causes of respiratory distress to consider are bacterial (community acquired), viral (influenza-seasonal or pandemic), TB-related, or PCP in PLHIV. A chest X-ray may be helpful in distinguishing pathogens, but **do not** delay empirical antibiotic treatments.

Acute lung injury (ALI) is the result of massive inflammation in the lungs. ALI may develop as a complication of a primary lung infection or from a non-pulmonary source such as sepsis, severe malaria, pancreatitis, or trauma with massive haemorrhage.

Suspect severe pneumonia if:

- fever or suspected infection
- cough
- RR more than 30
- severe respiratory distress
- SpO_2 less than 90.

Suspect acute lung injury (ALI) if:

- severe hypoxemia (patient requires high flow oxygen therapy) with rapid deterioration
- chest X-ray with diffuse infiltrates
- no clinical evidence of volume overload from poor cardiac function
- known precipitating cause:
  - infectious – pneumonia, severe sepsis, severe malaria, severe dengue
  - non-infectious – acute pancreatitis, poisonings, transfusion-related, severe haemorrhage, fat emboli
  - in pregnant patients – pre-eclampsia/eclampsia and tocolytic medication.

Remember to look for signs of fluid overload, and if present consider acute pulmonary oedema from cardiac or renal causes and treat appropriately:

- elevated JVP, hepatomegaly or ascites, bilateral lower extremity oedema
- chest X-ray with fluffy bilateral opacities, peri-hilar distribution, bilateral effusions.

In the septic shock chapter you learned a time-based approach to management. You learned what to do in the first two hours, two to six hours, six to 24 hours, and post resuscitation. Use the same principles of time-based approach to management when caring for with respiratory distress from suspected severe pneumonia or acute lung injury is the same as septic shock:

- recognize
- fix the physiology
- treat infection
- monitor – record – respond.

Quality care

Benchmarks are defined as standards of achievement or excellence. Because of the importance of timely treatment in the management of patients with severe respiratory distress, benchmarks have been established for you to achieve as soon as you recognize that someone is in severe respiratory distress.

If the patient presents with severe respiratory distress suspect pneumonia or acute lung injury. The lists below represent the benchmarks you should achieve within 30 minutes and 1 hour of the patient's arrival.

Within 30 minutes:

- oxygen started
- SpO_2 measured
- IV started
- if wheezing, salbutamol given
- appropriate infection control measures taken.

Within 1 hour:

- broad-spectrum antibiotics started
- if malaria suspected, antimalarial given
- if influenza suspected, antiviral given.

These guidelines are intended to help you manage patients with severe respiratory distress, but may not be appropriate for all patients. The district clinician may determine that the guidelines need to be modified if the situation is complicated by other underlying co-morbidities (i.e. cardiac disease renal failure, severe anaemia) or diseases (dengue fever, severe malaria). You may also choose to follow protocols developed by your hospital adapted to the local epidemiology. While these management principles may be used for most patients, they are not intended to replace sound clinical judgement by trained clinicians*.*

FIRST 2 HOURS

RECOGNIZE

Severe respiratory distress without shock:

- If respiratory rate >30 or SpO_2<90 and
- SBP >90 mmHg and
- no heart failure
- then, suspect pneumonia or acute lung injury.

Measure the respiratory rate. Is the RR>30?

Consider any patient with a RR>30 to be in severe respiratory distress. Although the respiratory rate will increase if the patient has a primary lung problem, it can also commonly increase from fever, pain, and metabolic acidosis.

Measure the oxygen saturation. Is the SpO_2<90%

Patients with pneumonia or acute lung injury develop hypoxemia from inflammation resulting in pus or fluid filling the airspaces (alveoli). This inflammation slows down gas exchange between the air and blood supply.

Measure the blood pressure

Evaluate for shock. If the systolic BP is <90 mmHg with signs of poor perfusion, the patient is in shock. Use the guidelines for the management of shock discussed in the previous chapter. The guidelines in this chapter are intended for patients with severe respiratory distress who are **not** in shock.

Evaluate for fluid overload from acute heart failure

Suspect heart failure if there is a history of cardiac disease or congestive heart failure, and/or if the following are present:

- lower extremity oedema
- crackles on auscultation
- elevated jugular venous pressure (JVP)

If heart failure is suspected, you should use the guidelines found later in this learning unit for management of heart failure.

FIX THE PHYSIOLOGY

Oxygen

Titrate SpO_2 90%. Review what you learned in the Quick Check Essentials, regarding the administration and titration of oxygen using pulse oximetry.

Fluids

Give fluids at 1 mg/kg/hour or orally if tolerated.

- Patients with severe pneumonia are usually mildly dehydrated. Use caution when administering fluids to these patients because overly aggressive fluid therapy may worsen hypoxemia and respiratory distress.
- Monitor blood pressure and urine output to determine if hydration is adequate.
- If the patient is able to take oral fluids without aspiration risk, oral rehydration is preferable.
- Do not limit oral fluids. If urine output is low, encourage the patient to drink more fluids. If patient is unable to take fluids, give NS or LR at 1 ml/kg/hour.
- Monitor closely for worsening hypoxemia.
- If there is evidence of fluid overload, use recommendations for management of pulmonary oedema. Do not give fluid bolus unless in shock or specific cause of acute lung injury requires more aggressive fluid therapy (e.g. acute pancreatitis, severe haemorrhage).

If wheezing, give salbutamol

Treat patients with wheezing and respiratory distress immediately with inhaled salbutamol. Although wheezing can result from many different causes including pulmonary oedema, certain types of pneumonias (e.g. viral) can also present with severe wheezing, while other types (e.g. community acquired) may precipitate acute attacks of asthma or COPD. Make sure you are not confusing stridor with wheezing. Stridor is more commonly heard on inspiration and near the neck and should prompt emergent treatments for upper airway obstruction. Salbutamol acts to dilate the airways and improve flow of air in and out of the lungs in patients with bronchospasm. As salbutamol works directly on the airways, it is most effective if delivered directly to the airways with an MDI or nebulizer.

See Quick Check page 17 for how to deliver sequential bronchodilator therapy.

The next section will cover in more detail how to manage severe wheezing from all causes.

TREAT INFECTION

For severe pneumonia, give empirical antimicrobials within one hour (refer to national or institutional guidelines).

Common choices include:

- ceftriaxone 1–2 grams once daily PLUS a macrolide (preferred); OR
- ampicillin 2 grams IV 4 times a day PLUS gentamicin 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 (for example, levofloxacin).
- Caution! Use of respiratory quinolones should be avoided in high-prevalence TB areas unless TB can be excluded. The safety of respiratory quinolones in pregnancy has not been established.
- If suspect influenza, also give antivirals according to regional recommendations:
  - Treat your patient for severe or complicated influenza infection if influenza is known to be circulating in your community and patient has influenza-like illness and clinical evidence of pneumonia or worsening chronic disease (e.g. acute asthma, COPD exacerbation, diabetic crisis)
- If PLHIV or suspect HIV infection:
  - Give broad-spectrum empirical PCP treatment early.
  - Consider TB and obtain prompt AFB smear, chest X-ray and sputum for culture.
  - Empirical TB treatment may need to be started early in patients who are critically ill based on suggestive chest X-ray or clinical judgement. Call for help from senior clinician.

For acute lung injury, treat the underlying etiology

- If you suspect severe sepsis, give broad spectrum antimicrobials within one hour.
- If you suspect severe malaria, check smear and give antimalarials early.
- If you suspect aspiration, stop oral feeds and monitor for pneumonia.
- For poisoning, acute pancreatitis, or pre-eclampsia/eclampsia give appropriate treatments as described in appropriate DCM sections.

MONITOR – RECORD

As in patients with septic shock, monitor BP, HR, RR, oxygen saturation, and mental status every 30 minutes until stable and then every hour after that. Check the results of laboratory investigations. Record all vital signs, test results, and treatments given on the severely ill patient monitoring form.

RESPOND

If respiratory function is worsening (increasing RR and decreasing SpO_2) for a patient on oxygen:

- Check that the cylinder still has sufficient oxygen.
- Check that oxygen is flowing out of the prongs or face mask (hold the end close to your hand and you will feel the airflow).
- Check that there are no leaks in the connections of oxygen tubing.

Next, check for signs of fluid overload? In the first two hours of treatment it is uncommon for a patient with no history of heart failure and who has not received large amounts of intravenous fluid to develop fluid overload.

- Has the patient been given large amounts of intravenous fluid?
- Is the amount of intravenous fluid given much more than urine output?
  - If YES, stop IV fluids if signs of fluid overload and treat using guidelines for management of pulmonary oedema.

If patient develops shock:

If a patient who initially presents with severe respiratory distress but is not in shock (SBP>90), develops shock (SBP<90) with signs of poor perfusion, follow the guidelines from the septic shock chapter.

- Give a rapid bolus of one bag (500-1000) ml of LR or NS.
- Reassess. If BP improves after the fluid bolus, continue to monitor the patient closely and try to match the fluid input and output.

Inform the district clinician of the patient's ongoing condition to help guide further management.

DRILL 3-1: Management of severe respiratory distress first two hours

You are caring for a 24 year-old male who presented today with severe respiratory distress and suspected pneumonia.

1. You recheck the vital signs and the BP is now 120/60. A 500 ml bolus of fluid that was started during the Quick Check has just finished. The patient is not able to take oral fluids due to his severe distress. What type of fluid would you now run through the IV line, and at what rate?

2. The patient is on oxygen at 5 litres via nasal cannula. The patient is developing worsening respiratory distress and the SpO_2 is now 87%. How would you titrate the oxygen?

3. The patient is noted to have bronchospasm and was given a nebulized salbutamol treatment. The patient still has breathlessness and wheezing. What would you do next?

4. Your patient begins to get drowsy and you are having difficulty waking him up. This means that he is getting better and starting to relax. True or False?

5. How often should you monitor this patient's vital signs during the first 2 hours?

6. You recheck the patient's vital signs and the BP is now 80/40. How would you manage the patient's fluids?

DRILL 3-2: Management of fluids in patient with severe respiratory distress

Review the tables for the management of patients with severe respiratory distress. How would you manage the fluids? Determine the route (oral or IV), fluid type, and the rate.

1. A 22 year-old 70 kg male initially presents with severe respiratory distress. BP 120/60 HR 110 RR 35 sat 92% on 5 litres NC.

2. A 38 year-old 60 kg female with severe pneumonia 2 hours after arrival. She initially received a 500 ml NS bolus. BP 110/60 HR 122 RR 40 Sat 93 % on 4 litres NC.

3. A 56 year-old 75 kg male with severe respiratory distress 4 hours since arrival. He initially received 500 ml bolus LR. BP 130/80 HR 115 RR 42 Sat 91% on 3 litres NC.

4. A 28 year-old 70 kg male with severe pneumonia 1 hour after arrival. He initially received 1 litre bolus NS. BP 80/40 HR 130 RR 36 Sat 93% on 6 litres via FM.

5. A 62 year-old 70 kg male with severe pneumonia on arrival. BP 120/60 HR 110 RR 26 sat 92% on 4 litres NC.

2-6 HOURS

RECOGNIZE

Is the patient still in severe respiratory distress? Is the patient's condition worsening or improving?

Despite adequate therapy, patients with severe pneumonia who initially improve on oxygen may worsen over the first few days as inflammation and infection worsen. Patients who initially present with severe respiratory distress and are improving still require frequent observation, as their condition may rapidly change.

If a patient is not improving with the initial therapies (oxygen, salbutamol if wheezing, IV fluids, and antibiotics) reconsider your diagnosis. Results from initial laboratory investigations and chest X-ray may be available to assist in determining the etiology of severe respiratory distress.

- Does the patient have another type of pneumonia? For example, PCP, TB or fungal.
- Does the patient have another cause of severe respiratory distress, instead of or in addition to pneumonia or acute lung injury? Consider pneumothorax, pleural effusion, fluid overload/heart failure, or poisoning.
- Does the patient have acute lung injury? If so, what is the cause of the acute lung injury? Has the cause been treated appropriately?

FIX THE PHYSIOLOGY

Oxygen

Titrate SpO_2 90%. Titrate the oxygen flow to keep the SpO_2>90%. Some patients with severe pneumonia and acute lung injury may remain hypoxic (SpO_2<90%) despite maximal oxygen flow. These patients have developed respiratory failure and may need *advanced airway management*. The district clinician should be immediately called if a patient on oxygen is worsening and you are unable to keep the SpO_2 greater than or equal to 90%. If indicated, advanced airway management may require transfer to a higher level of care.

If wheezing, give salbutamol

- Give sequential bronchodilator therapy. See next section for more detailed discussion on management of severe wheezing.

Fluids

Give fluids at 1 mg/kg/hour or orally. Do not limit oral fluids. If possible, monitor urine output and try to match input and output.

- Oral rehydration is preferred.
- If oral route not possible, then continue LR or NS IV fluids at 1 ml/kg/hour IV.
- Watch for the development of fluid overload or worsening hypoxemia.

TREAT INFECTION

Results from laboratory tests and the chest X-ray may now be available to assist in prioritizing differential diagnosis.

- Continue broad spectrum, empirical antimicrobials until the senior clinician makes changes based on the likely pathogen causing the pneumonia or the source of infection causing severe sepsis with acute lung injury (e.g. peritonitis).
- Re-dose antibiotics if indicated.
- Check that correct antibiotic has been given and correct dose.
- Drain surgical infection if required.

MONITOR – RECORD

Continue to monitor the blood pressure, RR, SpO_2, and mental status every 30 minutes until stable, and then every hour. Record your findings on the patient monitoring form.

- Check for JVP and ausculate for crackles (rales), to determine if the patient is developing pulmonary oedema.
- At 6 hours recheck the temperature, check urine output, and repeat the blood glucose and Hb if the initial result was abnormal.

RESPOND

- If patient develops shock (SBP<90), manage as septic shock.
- If respiratory function is worsening check oxygen supply, titrate oxygen flow rate, and evaluate for fluid overload.
- If wheezing give patient salbutamol.
- Check that antimicrobials have been given, and the district clinician may consider broadening antimicrobial coverage.
- If there are signs of fluid overload and patient is not in shock:
  - stop IV fluids
  - give furosemide 20 mg iv
  - raise head of bed.

DRILL 3-3: Managing severe respiratory distress 2–6 hours

You are caring for a 45 year-old female who presented to the hospital about 2 hours ago with severe pneumonia and respiratory distress. She has just been transferred to the ward.

1. You check the vital signs. Temp 39°C, BP 110/60, RR 35, pulse 90, Sat 88% on 3 litres NC. The patient is no longer in severe respiratory distress. True or False?

2. How would you titrate the oxygen flow?

3. The patient is unable to take oral fluids. What type of fluid would you give IV and at what rate?

4. The patient is wheezing and breathless, but has already been given a dose of salbutamol. Would you give another dose of salbutamol?

5. How often should you monitor vital signs on this patient?

6. Some diagnostic test results are back. The malaria smear is positive. Given the positive malaria smear, would you continue antibiotics to cover the patient for a possible bacterial pneumonia in this patient?

7. List the actions you would take if the patient develops worsening respiratory distress?

6-24 HOURS

RECOGNIZE

By this time, the patient's condition may have worsened, improved, or stabilized. At 6–24 hours, patients who have been in severe respiratory distress for many hours may begin to tire and can rapidly deteriorate during this period. Review the differential diagnosis and determine the appropriate treatment based on any new information. If patient has poor response to treatment, reconsider pneumothorax, pleural effusion, heart failure, poisoning, TB, PCP pneumonia.

FIX THE PHYSIOLOGY

Oxygen

Titrate SpO_2 90%.Consider advanced airway management if not responding to maximal oxygen therapy.

Fluids

- Oral rehydration is preferred.
- If oral route not possible, then continue LR or NS IV fluids at 1 ml/kg/hour IV.
- Watch for the development of fluid overload or worsening hypoxemia.

If wheezing, give salbutamol

- Continue to give the patients sequential bronchodilator therapy.
- Watch for development of symptomatic tachycardia or dysrhythmias in patients who have had continuous salbutamol treatments.

TREAT INFECTION

Review diagnostic results. Senior clinician may choose to narrow antibiotic spectrum if clear source is identified.

MONITOR – RECORD

Continue to monitor patient as you did during 2–6 hour phase and record results on severely ill patient monitoring form.

RESPOND

Respond to patient's changing condition as discussed during the 2–6 hour period.

DRILL 3-4: Managing severe respiratory distress 6–24 hours

You are caring for a 36 year-old female with severe pneumonia and respiratory distress who presented to the hospital 12 hours ago.

1. The SpO_2 is 94% on 5 litres NC. How would you titrate the oxygen flow?

2. The patient is taking a few sips of fluid, but not very much. Would you continue IV fluids and if so at what rate?

3. The patient received a dose of antibiotics 8 hours ago, and the antibiotic is scheduled to be given every 8 hours. The patient is improving. Since the patient is improving you do not need to give the second dose of antibiotics. True or False?

4. How often would you monitor vital signs for this patient?

POST-RESUSCITATION

RECOGNIZE

The post-resuscitation phase starts when the patient has had stable blood pressure and oxygenation requirements for at least six hours. These patients still are considered severely ill and require a high level of attention, but their clinical condition is stable.

If the blood pressure falls or oxygenation requirements increase, the patient is not considered stable, and should be monitored frequently as during the resuscitation phase.

FIX THE PHYSIOLOGY

Oxygen

- Titrate oxygen to SpO_2 of 90%.

Discontinue oxygen when SpO_2 is 90% on room air.

Fluids

- If patient is alert and not at risk for aspiration, transition to oral fluids, if patient is not yet taking fluids by mouth.
- If patient is not alert and continues to require intravenous fluids, transition to maintenance fluids (D51/2 NS) at 1 mg/kg/hr. Match input and output.

If wheezing, give salbutamol

- Continue to give sequential bronchodilator therapy.

TREAT INFECTION

- Give the next dose of antimicrobials.
- Give appropriate antibiotic regimen (type and course) as determined by district clinician.

NUTRITION

Early attention to nutrition is important to help patients recover. Oral nutrition or NG feeds should be started at this time. Watch for risk of aspiration. Use guidance on nutrition discussed in previous section on septic shock.

MONITOR – RECORD

Patients who are admitted to the hospital with severe respiratory distress, may develop a hospital acquired infection and septic shock during the course of illness.

- Check vital signs every eight hours and record using the patient monitoring form.

RESPOND

- Respond quickly to any changes in the patient's clinical condition.

DRILL 3-5: Managing severe respiratory distress post-resuscitation

You are caring for a 55 year-old male who has been treated for severe pneumonia. The patient is now improving.

1. For how many hours should the blood pressure and oxygenation requirements remain stable to determine that he is in the post-resuscitation phase?

2. The patient's HIV test is positive. What specific respiratory infection should also have been considered in this patient?

3. The SpO_2 is 94% on 2 LNC. You decide to stop the oxygen and the patients SpO_2 remains >90% when you monitor the patient over the next hour. The oxygen should be discontinued at this time. True or False?
4. The patient has not had anything to eat or drink. You assess the patient, and he is awake and alert He is not at risk of aspiration and is asking for something to drink. Would you allow the patient to drink something at this time?

5. How often would you monitor vital signs in this patient?

Severe respiratory distress from acute bronchospasm (wheezing)

Wheezing results from narrowing of the airways or bronchioles within the lungs. Wheezing is also known as bronchospasm. Imagine breathing through a straw. The patient must work harder for each breath and uses accessory muscles to do the extra work. A patient with severe, acute wheezing will rapidly deteriorate if not treated emergently.

During the Quick Check chapter on **A**irway and **B**reathing, you learned how to deliver sequential bronchodilator therapy to patients with wheezing. The key message is to give inhaled salbutamol immediately and then to reassess the patient for a clinical response. At this time, continue with bronchodilator treatment, as determined by severity of wheezing. Perform a targeted history and physical examination and prioritize your differential diagnosis and give appropriate urgent treatments.

Why is wheezing dangerous?

It is important to remember that oxygen levels may still be normal when patient is in severe distress from acute bronchospasm. Impaired ventilation occurs when carbon dioxide and acid accumulate in blood. This results in decreased oxygen levels. If hypoxemia develops, it is usually easily corrected with oxygen therapy, but impaired ventilation can still persist. Once the ventilation becomes inadequate, the patient will develop altered level of consciousness and respiratory failure. If mechanical ventilation is not available, death can ensue. Early and aggressive bronchodilator therapy can prevent this poor outcome.

Why is inhaled bronchodilator therapy important?

Airway narrowing usually results from a combination of inflammation (swelling) of the tissue surrounding the airways, constriction of the smooth muscles surrounding the airways, mucous accumulation, and plugging of airways. Bronchodilator therapies act immediately upon the airway smooth muscles by relaxing them and opening them up so the patient can breathe easily. Inhaled salbutamol works almost immediately on the airways. The effects of salbutamol may not be sustained, so frequent or continuous dosing is essential until there is sustained improvement. Bronchodilator therapy saves lives when given correctly.

Consider the patient to have severe respiratory distress from acute bronchospasm if wheezing and any of the following are present:

- breathless at rest
- cannot complete sentences in one breath
- respiratory rate ≥25 breaths/minute
- pulse ≥ 100.

When you provide sequential bronchodilator therapy, you must also consider the etiology of the wheezing. You should treat the underlying cause in a timely fashion. Below is a table of common causes of acute bronchospasm.

Etiology of acute wheeze	In favour
Acute bronchitis	Diffuse wheezing and/or rhonchi Productive cough Preceded by viral upper respiratory tract infection (e.g. fever, cough, runny or stuffy nose)
Bacterial or viral pneumonia	More common in viral pneumonia Diffuse or localized wheezing Usually acute onset fever and productive cough Chest X-ray with infiltrate
Foreign body aspiration	Localized wheezing Acute onset, can have cough and shortness of breath
Asthma attack	Episodic chest tightness, shortness of breath and diffuse wheezing Night time symptoms and cough are common Precipitated by exercise, viral syndrome, strong smells Personal history of asthma or allergies Family history of asthma
COPD exacerbation	Increase in baseline breathlessness, cough, sputum quantity and/or purulence Diffuse wheezing and rhonchi Personal history of COPD or exposure to long term tobacco smoke or indoor air pollution (e.g. open fire stoves)
Inhalation of airway irritants (e.g. smoke, chemicals, vapours)	Diffuse wheezing and breathlessness Immediately precipitated by inhalation of large amounts of irritating agent
Etiology of acute wheeze	**In favour**
Ingested poisons see DCM Section 3.8	Organophosphate poisoning− pinpoint pupils, urination, defecation, lacrimation
Bronchiectasis	Wheeze can be diffuse or localized Increase in baseline or new cough productive of purulent sputum Haemoptysis is common Personal history of TB infection or severe pneumonia
Cancer	Localized wheeze Chronic cough, haemoptysis are common Associated with weight loss, anorexia Personal history of exposure to tobacco smoke, exposure to indoor air pollution (e.g. indoor coal stoves)
Acute pulmonary oedema	Atypical presentation with diffuse wheezing and crackles (rales) Fluid overload (elevated JVP, lower extremity oedema) History of cardiomyopathy, valvular heart disease, hypertension, ischaemia, renal disease

Take a history

- What are the main symptoms? Is there chest tightness, shortness of breath, cough, wheezing?
- When did the symptoms start?
- Are there other associated symptoms such as fever?
- Are there any acute precipitating factors such as cold weather, exercise, strong smell, or a viral syndrome?
- Are other risk factors for developing wheezing present such as exposure to tobacco smoke or indoor air pollution?
- What is the past medical and surgical history? In patient with a history of asthma or COPD, is there a history of previous hospitalizations?

- What medications is the patient taking? Has the patient recently used salbutamol or steroids?

Perform a focused examination to identify likely cause

- Check vital signs.
- Determine the level of breathlessness: is the patient breathless at rest, with talking or with walking?
- Listen to the patient speaking. Is the patient silent, unable to speak, speaking in single words, in phrases, or in full sentences?
- Look for accessory muscle use, chest wall excursion.
- Listen for wheezing. The chest may be silent in very severe bronchospam because very little air is moving. Determine if breath sounds are equal on both sides. If unequal breath sounds consider pleural effusion of pneumothorax.
- Look for signs of chest trauma.
- Look for evidence of congestive heart failure such as elevated jugular venous pressure, lower extremity oedema. These patients may also develop wheezing.

Develop a differential diagnosis

While gathering information and treating the patient, begin to develop a differential diagnosis to determine the need for further investigations and treatment. Take a few minutes to review the differential diagnosis table above from the DCM. How many of these conditions do you see frequently in your hospital?

Send urgent investigations

- Pulse oximetry to measure SpO_2.
- Peak flow after initial bronchodilator, if available, compare to predicted or personal best.
- Measure pulsus paradoxus.
- Chest X-ray if suspect pneumonia.

Treat for suspected diagnosis while supporting the patient

The general principles to manage a patient with respiratory distress from bronchospasm are the same as described before.

- Manage airway.
- Give oxygen therapy.
- Give sequential bronchodilator therapy.
- Treat underlying cause.
- Monitor and record.
- Respond.

How to give sequential bronchodilator therapy for moderate, severe or life-threatening wheezing

RECOGNIZE

Determine if the patient has life-threatening, severe, or moderate wheezing.

- Suspect life-threatening wheezing if one or more of the following are present:
  - silent chest

- cyanosis
- poor respiratory effort
- altered consciousness, confusion, or patient is combative or agitated
- exhaustion.

- Suspect severe wheezing if one or more of the following are present:
  - breathless at rest
  - cannot complete sentences in one breath
  - respiratory rate ≥25 breaths/min
  - pulse ≥100.
- Suspect moderate wheezing if:
  - wheezing with no features of life-threatening or severe wheezing.

*Caution: some patients with severe bronchospasm may present with *no wheezing at all*. This occurs because air movement is so limited that no noise is made. These patients have life-threatening wheezing.

When available, a peak flow metre measurement can assist in assessing the severity of wheezing. When not available, a pulsus paradoxicus can be measured with a stethoscope and cuff at the bedside.

SpO_2<90 on room air Peak flow <33% of predicted or personal best Absence of pulsus paradoxicus (when respiratory arrest imminent, absence suggests muscle fatigue)	**LIFE THREATENING WHEEZE**
SpO_2>90% Peak flow 33-50% of predicted or personal best Pulsus paradoxus >25 mm Hg	**SEVERE WHEEZING**
SpO_2>90% Peak flow 50-75% of predicted or personal best Pulsus paradoxus may be present – 10–25 mmHg	**MODERATE WHEEZING**

FIX THE PHYSIOLOGY

Life-threatening wheezing:

Mange airway (see Quick Check pp. 12–13).

Give oxygen (see Quick Check pp. 14–16).

Give salbutamol by continuous nebulizer. See Quick Check p. 17 for how to give sequential bronchodilators.

Reassess immediately, do not leave patient alone.

If no improvement, give salbutamol continuously. Add ipratropium by nebulizer.

If no improvement, give intravenous magnesium (2 grams over 20 minutes).

If fever, give IM/IV antibiotic.

Severe wheezing:

Give oxygen (see Quick Check pp. 14–16).

Give salbutamol by nebulizer (continuous or every 20 minutes). See Quick Check p. 17 for how to give sequential bronchodilators.

Reassess immediately (15–30 minutes).

If not improving, give more salbutamol every 20 minutes or continuously if deteriorating. Add ipratropium by nebulizer.

If deteriorating, also give magnesium (2 grams over 20 minutes).

If fever, give IM/IV antibiotic.

Moderate wheezing:

Give oxygen.

Give salbutamol by primed spacer with 5 puffs then give 2 puffs via spacer every 2 minutes.

If patient with wheezing is clearly improving, then give salbutamol less frequently.

If on continuous, titrate to every 20 minutes.

If every 20 minutes, titrate to every one or two hours.

Common side-effects in patients who are given repeat doses of salbutamol include tachycardia, tremulousness, and nausea. The tachycardia is usually well-tolerated in most patients but should be monitored, and extra caution is required in elderly patients. These side-effects usually resolve spontaneously within 1 hour after the last dose of medication is given.

If there is no inhaled salbutamol available, consider either of the following for severe bronchospasm
Salbutamol 250 mcg slowly by IV for severe acute bronchospasm and if there is no inhaled salbutamol available (beware that this can lead to hypokalaemia). Aminophylline 5 mg/kg slowly over 20 minutes. Epinephrine 0.5 mg (0.5 ml of 1:1000) IM. Note that theophylline and aminophylliine are not recommended due to toxicity and therefore not included on the WHO Model List, but may be effective by slow IV if no other drugs are available.

Treat the cause

If you suspect acute asthma or COPD, give steroids immediately. Steroid treatment is necessary to decrease the inflammation and swelling around the airways in patients with asthma or COPD. It usually takes several hours to see improvement, so the earlier you give it, the sooner you will see results. Remember, this may be the first presentation of the patient with either asthma or COPD, so look for other clues.

- Suspect COPD if there are risk factors such as history of tobacco or exposure to indoor smoke from cooking over open fires.
- Suspect asthma if there is history of allergies or episodic chest tightness and wheezing precipitated by exercise, cold, or strong smells.
- Give either 100 mg hydrocortisone IV or 40–60 mg methylprednisolone IV or oral prednisone 40–60 mg.

If fever, give empirical antimicrobials. Initially, it may be difficult to assess if there is also a concurrent community acquired pneumonia, or if the patient has asthma or COPD or if the etiology of acute wheezing is non-infectious.

- Give empirical antibiotics early for possible community acquired pneumonia.
- If influenza is circulating and patient has had symptoms of ILI and now has acute wheezing, consider severe or complicated influenza infection and give antivirals.
- Remember to adjust antimicrobial regimen once the etiology of wheeze is known.

MONITOR – RECORD – RESPOND

- Do not leave patients with life-threatening wheezing alone. These patients need continuous monitoring and treatments.
- Patients with severe wheezing need to be assessed every 15–30 minutes and after every salbutamol treatment so that sequential bronchodilator treatment can be administered.
- Monitor similar clinical parameters as done for other severely ill patients but also include peak flow.
- If patient fails to improve, consider the following:
  - Is oxygen supply working?
  - Is salbutamol delivery system working?
  - If suspected acute asthma or COPD, have steroids been given?
  - Is there an alternate diagnosis? Pneumothorax, fluid overload/pulmonary oedema

Quality care

Benchmarks are defined as standards of achievement or excellence. Because of the importance of time in the management of patients with severe respiratory distress, benchmarks have been established for you to achieve as soon as you recognize that someone is in severe respiratory distress.

If the patient presents with severe respiratory distress from acute bronchospasm (wheezing), within 30 minutes:

- salbutamol given
- if asthma/COPD, steroid given.

DRILL 3-6: Wheezing

1. A patient with asthma and wheezing is able to speak in full sentences without signs of distress. The patient should be monitored using the severe illness patient monitoring form. True or False?

2. Read the scenarios listed below. Does the patient have severe wheezing?
   - 34 year-old female who is breathless at rest. Yes or No
   - 26 year-old male who is speaking in single words. Yes or No
   - 18 year-old male who is breathless when talking. Yes or No
   - 38 year-old female who is breathless only when walking. Yes or No
   - 45 year-old male who is comfortable lying down. Yes or No
   - 48 year-old female who is speaking in incomplete phrases. Yes or No
   - 35 year-old female who is confused, agitated, and anxious and appears breathless. Yes or No
   - 55 year-old male who is speaking in full sentences. Yes or No
   - 22 year-old female who has a presents with a silent chest (you hear no wheezing and very little breath sounds when listening to chest) with cyanosis. Yes or No

3. A 22 year-old previously healthy male presents with severe wheezing. You have started the patient on oxygen, and given salbutamol two puffs via MDI with spacer. The patient appears to be worsening and is now is only able to speak in single words secondary to the respiratory distress. What would do next for the patient?

4. Salbutamol tablets are *not* as effective as salbutamol via a nebulizer or MDI with spacer. True or False?

Managing a patient with acute pulmonary oedema

Pulmonary oedema occurs when the lungs are abnormally full of fluid. A common cause of oedema is congestive heart failure. This occurs because the heart does not pump normally due to valve problems or weak heart muscles. This increased pressure in the heart also affects the small vessels of the lungs by pushing the fluid out of the vessels and into the lung tissues. Increased pressure is also caused by severe kidney disease, hypertension, toxins, or snake-bites.

During the Quick Check, you provided emergency treatments. Now, it is time to identify patients with acute pulmonary oedema or fluid overload so that urgent treatments are given. Take a history and perform a physical examination.

Recognize patients with severe acute pulmonary oedema:

- respiratory rate more than 30
- SpO_2 less than 90
- bilateral crackles or rales on auscultation
- signs of fluid overload, elevated JVP, hepatomegaly or ascites, bilateral lower extremity oedema
- chest X-ray with fluffy bilateral infiltrates, peri-hilar distribution, bilateral effusions
- history or signs of cardiac or kidney disease.

Take a history

- How quickly did symptoms develop, over months, weeks, days or hours?
- Are there any associated symptoms such fever, cough, chest pain, or abdominal pain?
- Is there difficulty breathing at rest, during exercise (exertional dyspnoea), when lying flat (orthopnoea), at night that wake the patient from sleep (nocturnal dyspnoea)?
- Are there any precipitating factors such as increased intake of salty foods, recent infection, irregular heart palpitations (atrial fibrillation), chest pain, or a history of a toxin exposure, drug overdose, or snake-bite?
- What is the past medical history? Are there any chronic diseases such as HIV infection, cardiomyopathy, liver disease, renal disease?
- Is the patient pregnant? Women with mitral stenosis will often decompensate in the middle of their pregnancy. Peripartum cardiomyopathy develops in the last month of pregnancy or within six months of delivery. Women with pre-eclampsia or eclampsia may have convulsions, high blood pressure and develop pulmonary oedema.
- What medications is the patient currently taking? Has the patient been compliant with his or her medications?
- What are the patient's wishes for intensity of therapy? Patients with very advanced heart failure may not want intensive therapies.

Perform a focused examination to identify likely cause

- Look for tachycardia: A pulse more than 120 is common in acute heart failure.
- Check the blood pressure: Depending on the cause, the patient's blood pressure may be high, low or normal. A wide pulse pressure (such as 120/30 mmHg) suggests possible severe aortic insufficiency.
- Check for fever which may suggest concurrent and/or exacerbating pneumonia or other infection.
- In patients with congestive heart failure or renal failure check the patient's weight and compare to previous weights.
- Look for poor perfusion (blood flow): cold extremities.

Cardiovascular system:

- Check for displaced point of maximum impulse, extra heart sounds, or loud murmurs.
- Check for distended neck veins and lower-extremity oedema.

Respiratory:

- Listen for bilateral crackles.
- Listen for decreased breath sounds at bases.

Gastrointestinal:

- Palpate for haepatomegaly and ascites.

Send urgent investigations:

- creatinine, potassium, haemoglobin
- recommend HIV test
- if suspect infection, check blood cultures and other cultures as appropriate
- chest X-ray
- ECG: evaluate for ischaemia, ventricular hypertrophy, arrhythmias
- Limited echocardiography: Assess cardiac function, presence of mitral stenosis, or a pericardial effusion. This does not require a cardiologist or a radiologist and can be done with basic ultrasound equipment without Doppler.

Treat for suspected diagnosis while supporting the patient

The general principles of managing a patient with acute pulmonary oedema are similar to the management of other patients with acute severe respiratory distress, with the addition of treating with diuretics and treating severe hypertension.

- Have patient assume a position of comfort.
- Manage the airway.
- Give oxygen therapy.
- Give diuretic therapy.
- Treat severe hypertension.
- Treat precipitating cause.
- Monitor and record.
- Respond.

As in earlier sections, use a time-based approach to manage patients with acute pulmonary oedema.

Quality care

Benchmarks are defined as standards of achievement or excellence. Because of the importance of time in the management of patients with severe respiratory distress, benchmarks have been established for you to achieve as soon as you recognize that someone is in severe respiratory distress.

If the patient presents with severe respiratory distress and suspect acute pulmonary oedema, within 30 minutes:

- oxygen started
- SpO2 measured
- furosemide 20 mg IV given
- if hypertensive, isosorbide dinitrate given
- if ischaemia (chest pain), aspirin given.

SEVERE ACUTE PULMONARY OEDEMA/FLUID OVERLOAD

FIRST 2 HOURS

RECOGNIZE

The clinical diagnosis of severe acute pulmonary oedema/fluid overload should be suspected when:

- respiratory rate >30 or SpO_2 <90
  and
- bilateral crackles on lung exam
- signs of volume overload: distended neck veins, hepatomegaly, ascites, lower-extremity oedema
- history of cardiomyopathy or kidney disease.

FIX THE PHYSIOLOGY

Give oxygen: Titrate to SpO_2 90

As with other diseases, give oxygen as you learned to do in the Quick Check.

Give furosemide 20 mg IV

Diuretic therapy helps reduce congestion in the lungs. The required dose of furosemide depends on whether the patient has been taking this drug as an outpatient and whether the patient has kidney disease. Furosemide works rather quickly at the level of the kidney, so expect to see an increase in urine output within 30 minutes. Remember, IV furosemide is twice as effective as the oral form. Patients with kidney disease will likely need higher doses than those with normal kidney function.

- If patient has not been on furosemide as an outpatient, then give furosemide 20 mg IV.
- If patient has been on furosemide, then give the oral dose as an IV dose.
- Monitor urine output and SBP. Hypotension can occur if urine output is brisk.

TREAT THE TRIGGER

Patients with cardiomyopathies or chronic kidney disease usually decompensate and develop acute pulmonary oedema because of a triggering event. You should try to identify the cause and treat it appropriately. Common cardiac causes include myocardial ischemia, arrhythmia, severe hypertension, and pericardial effusion. Other causes include pneumonia, medication non-adherence, increased salt and water intake, pulmonary embolism.

Treat severe hypertension, if present

Decreasing the blood pressure will help to reduce the congestion in the lungs as well.

- Start with low dose of isorbide dinitrate 5 ml sublingual. This can be repeated in 15 minutes if still hypertensive, but do not give more than 10 mg every 2 to 3 hours.
- If isorbide dinitrate is not available, give hydralazine 5 mg IV. This can be repeated in 30 minutes if still hypertensive.

If suspect myocardial ischemia, give aspirin 300 mg.

If suspect infection, give empirical antimicrobials.

MONITOR – RECORD

Patients with acute pulmonary oedema need close monitoring, just as you learned to do with other patients. However, there are key distinctions that are different.

- Urine output needs to be monitored very closely (within 30 minutes of first dose) to assess the early response to furosemide and in order to effectively titrate furosemide therapy.
- Potassium and creatinine must also be measured once to monitor for side-effects of diuresis with furosemide.

Check creatinine, potassium on admission

Monitor every 30 minutes until stable then every 1 hour:
- SBP, pulse, RR, SpO_2, mental status (AVPU), urine output
- JVP, auscultate for crackles (rales)

Check weight on admission.

RESPOND

If respiratory distress fails to improve or worsens and not adequate urine output:
- Check oxygen supply, increase oxygen flow.
- Give furosemide IV 40 mg (double dose).
- If renal failure, call for help and consider higher doses of furosemide and additional diuretics.

2-6 HOURS

RECOGNIZE

As with other causes of severe respiratory distress, patients with acute pulmonary oedema need to be reassessed to see if they are improving or not. If the patient is not improving, consider the following:

- Is the furosemide dose effective? Has there been sufficient urine output (150–200 ml)?
- Are the triggers being treated? Is there ongoing myocardial ischemia? Is there still severe hypertension?
- If diuresis has been effective and the patient is not improving, is there another cause of the severe respiratory distress?
- If poor response to initial treatment reconsider your diagnosis. Look for severe pneumonia, acute lung injury, pneumothorax, pleural effusion, poisoning, TB, PCP in PLHIV, severe malaria.

FIX THE PHYSIOLOGY

Give oxygen: Titrate to SpO_2 90

Continue to give oxygen as you learned to do in the Quick Check.

Give higher furosemide dose, if inadequate urinary response to first dose

- If urine output less than 150-200 ml after first dose of furosemide, give furosemide 40 mg IV. If urine output adequate, do not give additional dose of furosemide.
- Monitor urine output and SBP. Hypotension can happen if urine output is brisk.

TREAT THE TRIGGER

Continue to treat severe hypertension, if still present.

- Give additional isorbide dinitrate 5–10 ml sublingual every 2 to 3 hours.

If concern for cardiac ischemia, give aspirin. Refer to section 3.5 of DCM for additional information.

If suspect arrhythmia, refer to section 3.5 of DCM for specific treatment of arrhythmias.

If fever, give empirical antimicrobials.

MONITOR – RECORD

Continue to monitor the patient closely and record observations on patient monitoring form.

Every 30 minutes until stable then every 1 hour:

- SBP, pulse. RR
- mental status (AVPU)
- urine output
- JVP, auscultate for crackles (rales)

RESPOND

If respiratory function declining:

- Check oxygen supply and increase flow rate.
- If **unresponsive** to escalating diuretic therapy (i.e. low urine output after administration of diuretics), call for help from senior clinician to give higher dose of furosemide or add another diuretic agent. If in renal failure, *consider transfer to a centre with haemodialysis.*
- If **responsive** to diuretic therapy (i.e. patient with increased urine output after administration of diuretics), consider alternate diagnosis – pneumonia, acute lung injury, pneumothorax, pleural effusion.

If patient develops shock (SBP <90 and signs of poor perfusion):

- stop diuresis
- give 250 LR or NS bolus
- call for help from senior clinician – if cardiogenic shock consider vasopressors.

6-24 HOUR

RECOGNIZE

As with other causes of severe respiratory distress, patients with acute pulmonary oedema need to be reassessed to see if they are improving. Use laboratory results and chest X-ray to prioritize the differential diagnosis. If the patient is not improving, consider the following:

- Is the furosemide dose effective? Has there been sufficient urine output (150–200 ml)?
- Are the triggers being treated? Is there ongoing myocardial ischemia? Is there still severe hypertension?

If diuresis has been effective and the patient is not improving, is there another cause of the severe respiratory distress?

FIX THE PHYSIOLOGY

Give oxygen: titrate to SpO_2 90

Repeat effective furosemide dose

- Once effective dose has been determined, repeat this dose every 6-8 hours.
- Monitor urine output and SBP. Hypotension can happen if urine output is brisk.

TREAT THE TRIGGER

Treat hypertension

- If the patient has responded well to vasodilator therapy, transition to oral ace inhibitor of creatinine is normal, such as enalapril 5 mg daily by mouth. If patient does not have normal renal function, discuss other antihypertensive options with senior clinician.
- If it is determined that the patient has another trigger such as myocardial ischemia, arrhythmia, or pneumonia, give next dose of medication to treat the trigger.

MONITOR – RECORD

Continue to monitor patient closely.

Every hour if SBP <90 or on vasopressors, otherwise every 2 hours:

- SBP, pulse
- respiratory rate
- oxygen saturation
- mental status (AVPU)
- JVP, auscultate for crackles (rales).

Monitor every 6 hours:

- temperature
- urine output.

Repeat glucose and Hb if initial value is abnormal.

RESPOND

Using similar guidance as in 2-6 hours, respond to changes in the patient's respiratory or cardiovascular status.

POST-RESUSCITATION

RECOGNIZE

Now that the patient is stabilized, make sure you are treating underlying chronic conditions and acute triggers according to national or hospital guidelines.

FIX THE PHYSIOLOGY

Give oxygen: Titrate to SpO_2 90

Titrate oxygen down and discontinue when room air is SpO_2 90%.

Continue to give furosemide if signs of fluid overload persist

Continue to give furosemide at effective dose until signs of fluid overload are improved. Titrate down frequency to every 8-12 hours, and switch to oral dose.

TREAT THE TRIGGER: POST-RESUSCITATION

Give the next dose of medication to treat hypertension, myocardial ischemia, or arrhythmia.

NUTRITION

As discussed earlier in the chapter, nutrition therapy is important in the recovery of severely ill patients. Once the patient has stabilized, begin nutrition via nasogastric tube. If patient is able to tolerate it, start oral feeds. If uncontrolled hypertension or congestive heart failure is the suspected etiology of the pulmonary oedema, feed the patient a low sodium diet.

MONITOR – RECORD

Continue to monitor the patient and record observations on patient monitoring form.

Every 8 hours (check SBP hourly if weaning off vasopressors) then daily:
- SBP
- respiratory rate
- oxygen saturation
- mental status (AVPU).

RESPOND

Respond to changes in the clinical condition.

GROUP EXERCISE: Acute pulmonary oedema

Do the following exercises in groups and discuss your answers.

1. A 35 year-old woman with history of some type of heart disease arrives with severe respiratory distress and is started immediately on oxygen therapy, her saturation is now 90% on 5 litres/minute. Her vitals are: SBP 135/70, HR 110, T=36, RR 25. On examination, she has elevated JVP, a loud murmur, crackles on ausculation of her lungs and bilateral lower leg oedema. What do you do next?

2. After 30 minutes, you evaluate her urine output. She has produced only 20 ml of urine, her clinical parameters have not changed. What do you do next?

3. 50 year-old man with known ischemic cardiomyopathy, takes 40 mg oral furosemide daily as an outpatient but has missed a few doses recently because he has had an influenza-like illness and is too fatigued to get out of bed. He is started on oxygen therapy and his saturation is 92% on 5 litres/minute and his other vitals are: T=39, SBP 175/85, HR 120, RR 30 and has signs of fluid overload. What would you do now?

4. After 30 minutes, you evaluate his urine output and other vitals. Urine output is about 150 ml and SBP is now 130/50. He still has signs of severe respiratory distress, his saturation remains at 92% on 5 litres/minute, his RR is 30 and HR is 115. What other urgent treatments should this patient get?

5. 50 year-old man who smokes and has diabetes presents with chest pain and severe respiratory distress. He is started on oxygen therapy and his saturation is 94% on 5 litres/minute. His other vitals sings are: BP 110/60, HR 110, T=36, RR 25. On examination, he has signs of fluid overload and pulmonary oedema. What do you do next?

6. After 30 minutes, the chest pain has resolved, but his BP is now dropped to 85/55. What do you do next?

Summary of severe respiratory distress

Recognize severe respiratory distress

If respiratory rate >30 or SPO2<90, and

- SBP >90 mm Hg and
- no heart failure
- then, suspect pneumonia or acute lung injury.

If bilateral crackles or rales

- signs of fluid overload (increased JVP, hepatomegalay, ascites, or lower extremity oedema)
- chest xray with fluffy bilateral infiltrates, peri-hilar distribution, bilateral effusions
- history or signs of cardiac or kidney disease
- then suspect acute pulmonary oedema.

Fix the physiology

Monitor SpO_2, give and titrate oxygen to target SpO_2 of 90%.

Treat wheezing with salbutamol.

Give conservative fluids orally or through IV as indicated, and monitor for pulmonary oedema.

If possible monitor urine output to match input and output.

If patient develops hypotension (SBP<90), treat as shock.

Treat acute pulmonary oedema with diuretics.

Treat the infection

Give early empirical antibiotics, antimalarials (endemic areas) and antivirals (when appropriate).

Reconsider diagnosis and choice of treatment if patient not improving.

Monitor – record – respond to abnormal signs and laboratory results

Reassess patient frequently, every 30 minutes initially

Look for changes in vital signs, urine output, laboratories and physical examination

Record all clinical information on the patient monitoring form.

Assessment questions: Severe respiratory distress

1. True/False. Any patient with emergency signs of airway or breathing, who do not rapidly respond to treatment, should be considered to have severe respiratory distress.

2. During the first two hours, how often should you monitor the vital signs for a patient in severe respiratory distress?

3. For a patient in severe respiratory distress, oxygen saturation should be titrated to what SpO_2?

4. List three diagnostic tests that may help you determine the cause of a patient's severe respiratory distress?

5. You should wait for a chest X-ray results to come back, before starting antibiotics on a patient with suspected pneumonia. True or False?

6. If the respiratory function is declining in a patient in severe respiratory distress who is on oxygen, list four things that you would do?

7. What type of fluid should be given in the first hour for a patient in severe respiratory distress and a respiratory rate of 40? How much fluid should be given?

8. If you check the vital signs in a patient in severe respiratory distress and their blood pressure is now 70/30 you should at that point begin to use the recommendations in the section on septic shock to guide the resuscitation of the patient. True or False?

9. What is the initially recommended dose of furosemide for a patient with suspected acute pulmonary oedema who is not on chronic diuretic therapy?

10. True or False. Salbutamol, when available, should always be given inhaled.

Practice cases

CASE 3-1

JR is a 22 year-old male who was admitted to the ward with a diagnosis of pneumonia. When walking past his bed, you note that he appears to be breathing very fast, shallow, and is only able to speak in one or two words. He is not on oxygen. You call for help and ask the nursing assistant to get you oxygen.

While waiting for the oxygen to arrive you check the vital signs:

RR: 34 HR: 125 T: 37°C BP: 130/80 SpO_2: 88%

1. Does this patient meet the criteria for severe respiratory distress?

2. How would you administer oxygen to JR (flow/method)

3. How often would you monitor the oxygen saturation?

CASE 3-2

RH is a 24 year-old female who was admitted to the ward with pneumonia. RH is awake, alert, and not vomiting.

The vital signs are: RR: 26 HR: 110 T: 37 °C BP: 122/70 SpO_2: 92 on 5 L via NC

1. Over the first hour, how would you administer fluids to RH and at what rate?

CASE 3-3

HS is an 18 year-old male who was diagnosed with influenza and is having difficulty breathing. You can hear diffuse wheezing when you listen with your stethoscope. HS can speak 3-4 words at a time. His vital signs are: BP 130/70, HR 110, RR 35.

1. What would you do next?

2. After 2 puffs with a salbutomol MDI, HS is still in moderate distress and wheezing loudly. SpO_2 is 98. What would you do next?

3. After 10 minutes, you note that HS is worsening and he is in severe distress, wheezes are less loud. What other medications can you give?

CASE 3-4

BL is a 56 year-old HIV positive female who was admitted for pneumonia. She has received oxygen, antibiotics and antivirals. After 6 hours she is not improving, she continues to have fever and respiratory distress. You call the district clinician for help, who reconsiders the initial diagnosis.

1. What are general reasons the patient may not be improving?

2. List other diagnoses that you would consider.

CASE 3-5

HT is a 16 year-old female with a history of asthma who has had fever, cough, and shortness of breath for 3 days. She was started on oxygen 5 L, given antibiotics, and given salbutamol via nebulizer for wheezing. After 3 hours, she is having increased breathlessness, the RR is now 40 and SpO_2 is 85.

1. List things that you would do to respond at this time?

CASE3-6

TG is a 30 year-old male know to be HIV positive for 6 months but not on ART. He was initially started on cotrimoxazole but discontinued 3 months ago because of abdominal discomfort. He presented with dry cough and fever which he has had for 3 weeks. He is alert but restless. He is breathing fast and unable to speak a full sentence, and has a weak and fast pulse.. His lips appear blue. His weight is estimated to be 50 kg.

RR: 44/min HR: 130/min BP: 85/60 T: 39.5 °C SpO_2: 85
White patches in the mouth
Bilateral lower lung crackles

1. List any Quick Check emergency signs that are present.

2. What first-line emergency treatments would you start?

3. What urgent treatments would you give?

4. How often would you monitor the patient?

Record the patient's clinical data using blank severe illness monitoring form.

After 30 minutes of arrival patient's breathing is still laboured and restless.
RR: 40/min HR: 120 BP: 100/60 SpO_2: 86
The district clinician evaluated the patient and his chest X-ray and started CTX and prednisone.

Update the monitoring form.

5. What actions would you take?

Patient re-evaluated after 60 minutes since arriving.
He is calm and breathing is less laboured now.

Vital signs:
RR: 32/min BP: 100/60 HR: 110 T: 38 °C SpO_2: 90

Update the monitoring form.

6. List the benchmarks for this patient and circle which benchmarks were achieved.

CASE3-7

TR is a 26 year-old male who presented with a 1 week history of difficulty breathing and wheezing. TR has a history of asthma and has no medications at home. Over the past week, he has had slight cough, fever, and myalgia. A family member was diagnosed with H1N1 last week. Today, TR's symptoms became much worse and he is in severe respiratory distress. He can speak 2–3 words at a time. He does not have upper airway obstruction. His pulse is strong and fast. His mental status is normal. Estimated weight is 60 kg.

1. List any Quick Check emergency signs that are present.

2. What would you do for this patient?

You check the vital signs and note:
RR: 44 BP:130/80 T: 38.6 °C PR: 120 SpO_2: 98 on 5 L nc
He is wheezing in both lungs

Record this patient's clinical data in the monitoring form.

3. What other treatments are needed?

After 30 minutes:
Breathing is less laboured, but TR is still having diffuse inspiratory and expiratory wheezing. He can speak in full sentences now, but becomes very short of breath with minimal exertion.

RR: 28 BP: 120/60 PR: 135 SpO_2: 98 on 5L

Update the monitoring form.

4. If TR is symptomatically improving, why do you think his pulse now is higher?

5. Circle the benchmarks achieved?
    - Oxygen started
    - SpO_2 measured
    - IV started
    - Antibiotics given
    - If wheezing, salbutamol given
    - If malaria area, antimalarials given
    - Appropriate infection control

6. How often would you now monitor TR?