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Respiratory Assessment-

Respiratory examination, Respiratory Rate, Respiratory Pattern and Sounds, Pulse Oximetry, Peak Flow reading using a Manual Peak Flow Meter

Rationale and Supporting Evidence

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Respiratory examination, Respiratory Rate, Respiratory Pattern and Sounds, Pulse Oximetry, Peak Flow reading using a Manual Peak Flow Meter

Rationale and Supporting Evidence

Document structure

The protocol is divided into four sections: **indications, pre-procedure, procedure** and **post-procedure**.

Each step in the protocol includes the **actions**, the **rationale** underlying the actions, additional **notes** and the supporting **evidence**.

Definition of procedure:

A complete respiratory assessment includes evaluating the respiratory rate, pattern and sounds. It can be divided into an airway assessment and breathing assessment. An airway assessment determines if there is an obstruction in the airway and a breathing assessment determines the patient's ventilation.

The purpose of a respiratory assessment is to evaluate the patient's respiratory status in order to identify critical patients and those at risk of deteriorating, to start stabilizing treatment and to appropriately admit patients based on clinical severity.

Respiratory rate is often the first vital sign to alter in a deteriorating patient, therefore, timely and accurate observations and subsequent interventions can greatly improve patient outcomes.

Indications and Contraindications for a respiratory assessment

Indications:

1. All patient's being consulted by a healthcare provider should have a complete respiratory assessment performed
2. Monitoring while receiving oxygen therapy/invasive or non-invasive ventilation
3. Monitoring before, during and after blood or blood product transfusions or intravenous fluids
4. Monitoring after administration of medications that affect the respiratory system e.g. opiates and bronchodilators
5. Monitoring the progress of a patient with chronic respiratory illnesses such as asthma or chronic obstructive pulmonary disease

Contraindications:

None

Patient requiring extra caution:

None

Important to note:



The healthcare provider is responsible to use his/her clinical judgment throughout the procedure. If the healthcare provider concludes values or clinical assessments beyond normal parameters, it is his/her responsibility to alert a senior staff member and/or the treating clinician as soon as needed.

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Respiratory Rate, Respiratory patterns and sounds and Pulse Oximetry

Pre-procedure for respiratory rate, respiratory patterns and sounds and pulse oximetry

Action	Rationale	Notes	Evidence
1. Perform hand hygiene 	<ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moment 1 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider is going to touch a patient. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Gloves are NOT indicated for a respiratory assessment; however, if the healthcare provider has a lesion, cut or sore on his/her hands, they should wear gloves before performing any act on a patient. Likewise, if the patient's skin is not intact, non-sterile gloves should be worn.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
2. Confirm the patient's identity	<ul style="list-style-type: none"> - To ensure the assessment is performed on the correct patient 	<p>Confirm identity by asking the patient his/her full name and date of birth.</p> <p>If the patient is unresponsive or unable to identify themselves, verify the patient's name, date of birth and patient number on their identification band and ask the caretaker the patient's full name and date of birth.</p>	(Médecins Sans Frontières, 2014)(NPSA, 2007)(RCN, 2010)(E)
3. Explain procedure to patient or caregiver in his/her preferred language and why he/she needs the procedure. Allow the patient/caregiver to ask questions and obtain verbal consent	<ul style="list-style-type: none"> - Understanding the procedure helps reducing fear and anxiety and ensures cooperation - A patient can only give consent if he/she understands the procedure 	<p>Explain to the caregiver if the patient is a child or a person unable to consent themselves.</p> <p>Caregivers maybe essential to ensure the cooperation of a paediatric patient.</p> <p>Once fully informed, the patient/caregiver has the right to refuse any medication or treatment. If this is the case, it must be clearly documented in the patient's file and the treating clinician informed.</p> <p>If the healthcare provider is meeting the patient and/or caregiver for the first time, he/she should introduce him/herself by name and explain that they are the patient's current healthcare provider.</p>	(Griffith, 2003)(International Council of Nurses, 2012) (World Health Organization, 2016)(E)

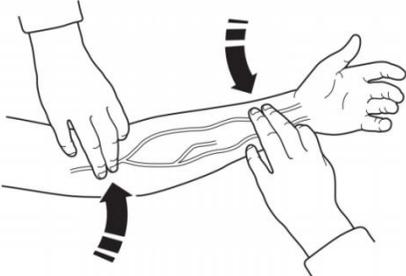
		<ul style="list-style-type: none"> - Obtaining consent is a fundamental in patient safety and is a legal requirement 		
4. Perform hand hygiene		<ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moments 4 & 5 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider has touched the patient and is now leaving the patient surroundings. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
5. Clean/disinfect tray/trolley, pulse oximeter and oximeter probe and allow to dry		<ul style="list-style-type: none"> - To create a general aseptic field - A surface is not aseptic until it has dried - To avoid cross-contamination and minimize chance of infection 	<p>Use a large plastic or metal tray as a general aseptic field. A tray is preferred, but if none available a trolley can be used.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material.</p>	(Médecins Sans Frontières, 2019a)
6. Gather equipment on dry tray/trolley:		<ul style="list-style-type: none"> - To avoid interruptions during the procedure 	<p>Pulse oximetry is an accurate, non-invasive measurement obtained using a machine that detects the estimated percentage of haemoglobin that is saturated with oxygen within the body at that given time.</p> <p>The healthcare provider must ensure that the reusable medical material is cleaned/disinfected before use.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material.</p>	(Médecins Sans Frontières, 2018b)(Médecins Sans Frontières, 2019a)(E)

hand OR respiratory counter			
e. Detergent/disinfectant for surfaces			
f. Alcohol-based hand rub			

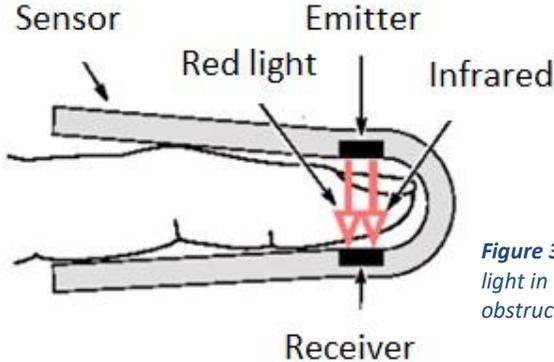
Procedure for respiratory rate, respiratory patterns and sounds and pulse oximetry

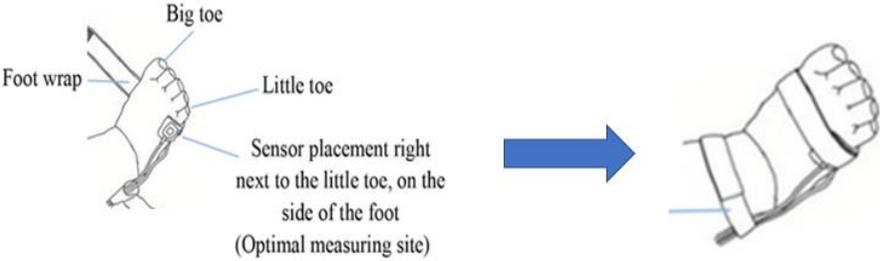
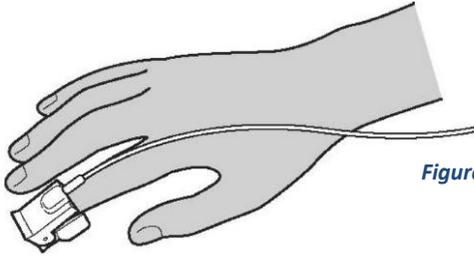
Action	Rationale	Notes	Evidence
7. Perform hand hygiene 	<ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moment 1 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider is going to touch a patient. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
8. While talking to the patient, assess respiratory status (listen and observe) and note positioning	<ul style="list-style-type: none"> - To obtain pertinent information about the patient's respiratory function and identify any potential problems - Ability to talk is an indication of respiratory status - Abnormal positioning can indicate an airway obstruction 	<p>It is best to assess breathing while the patient is sleeping or awake and resting unaware that you are observing them. If they are awake and resting please talk to the patient to keep them <i>distracted/calm/reassured</i>?</p> <p>A patient should be able to complete full sentences without becoming breathless.</p> <p>To assess breathing, listen for breath sounds and observe the following:</p> <ul style="list-style-type: none"> - patient's skin and mucous membranes colour, - use of accessory muscles, - rhythm, rate and depth of respiration –<i>To be done later in the procedure</i> - shape and expansion of the chest - cough with or without secretions <p>In paediatric patients who are not yet talking, include in your observations the following:</p> <ul style="list-style-type: none"> - the overall appearance of the infant: alert, orientated, - cough with or without secretions 	(Higginson and Jones, 2009; Kallet, 2012; “Paediatric Respiratory Assessment”, 2005)(Médecins Sans Frontières, 2018b)(Tayler, Grainge, Gove, Howarth, & Holloway, 2015)(E)

		<ul style="list-style-type: none"> - excessive drooling - nasal flaring - head bobbing <p>Normal breathing sound is quiet and effortless, and the patient should appear relaxed and comfortable.</p> <p>Patients with chronic respiratory illnesses or congenital cardiac malformations may have abnormalities to a baseline respiratory assessment that may put their respiratory parameters out of normal ranges but is '<i>normal for them</i>'.</p> <p>Please refer to annex 1 and table 1 below for more information and definitions of the terms above.</p>	
<p>9. In paediatric patients, assess respiratory rate</p> 	<ul style="list-style-type: none"> - To determine respiratory status without disruption 	<p>Paediatric patients may begin to cry while being undressed or upon application of the pulse oximeter. Crying will affect the respiratory rate. Determine the respiratory rate of a paediatric patient before moving or manipulating them.</p> <p>If needed, without disrupting the patient, lightly apply a hand on the chest or abdomen of a neonatal or paediatric patient to help with the respiratory measurement.</p> <p>For neonates and small infants, it is important to count respirations for a full minute as they could experience periodic breathing.</p> <p>Please refer to step 10 for procedure step on counting respiratory rate.</p>	<p>(MyHealth.Alberta, 2018)(Stanford Children's Health, n.d.)(Small, 2009)(E)</p>

<p>10. Ask the patient to remain silent while you palpate his/her pulse</p>	<ul style="list-style-type: none"> - To confirm that the device is working accurately (manual and machine pulse are the same) - To avoid distraction of the healthcare provider while counting heart rate 	<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">  <p>In neonatal and young paediatric patients, the healthcare provider should palpate at the brachial or femoral sites.</p> </div> <div> <p>In older paediatric patients and adults, the wrist is a suitable site.</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p><i>Figure 2: Palpating the brachial pulse in an infant.</i></p> </div> <div style="text-align: center;">  <p><i>Figure 1: Palpating the radial / brachial pulse in an adult.</i></p> </div> </div> <p>Please refer to the nursing care procedure on haemodynamic assessment for how to palpate a patient's pulse.</p>	<p>(Médecins Sans Frontières, 2018b, 2018a)</p> <p>Figures 1 & 2 done by A. Calvert</p>
<p>11. Assess rhythm, rate and depth of breathing.</p> <p>While keeping your fingers at the site of heart rate palpation count the respiration rate for a full minute.</p> <p>Assess the rhythm and depth of breathing, chest expansion and look for use of accessory muscles</p>	<ul style="list-style-type: none"> - Keep fingers on pulse to distract patient and to stop the patient altering their respirations with the knowledge that they are being counted - To ensure the site is suitable for 	<p>One breath consists of one inhalation followed by one exhalation and can be counted by observing the chest or abdomen expand and retract. The chest should expand symmetrically in all age groups.</p> <p>At the same time, observe for depth of breathing, which can be considered as shallow, regular or deep, and rhythm which can be regular or irregular.</p> <p>For optimal assessment of use of accessory muscles and skin colour, an infant or child should have their chest exposed (undressed) and stay in their most comfortable position.</p>	<p>(Elliott & Liu, 2010)(Hunter and Rawlings-Anderson, 2008; Kallet, 2012)(Médecins Sans Frontières, 2018b)(Moore, 2007; Paediatric Respiratory Assessment, 2005)(Wheatly, 2018)</p>

	<p>applying a pulse oximeter probe</p>	<p style="text-align: center;">Normal heart and respiratory rate by age</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Age</th> <th colspan="2">HR (Beats/min)</th> <th colspan="2">RR (Breaths/min)</th> </tr> <tr> <th>Tachycardia</th> <th>Bradycardia</th> <th>Bradypnoea</th> <th>Tachypnoea</th> </tr> </thead> <tbody> <tr> <td><2 months</td> <td>>160</td> <td><100</td> <td><30</td> <td>>60</td> </tr> <tr> <td>2 to 12 months</td> <td>>160</td> <td><90</td> <td><30</td> <td>>50</td> </tr> <tr> <td>>12 months to 5 years</td> <td>>140</td> <td><80</td> <td><25</td> <td>>40</td> </tr> <tr> <td>>5 to 12 years</td> <td>>120</td> <td><70</td> <td><20</td> <td>>30</td> </tr> <tr> <td>>12 years</td> <td>>100</td> <td><60</td> <td><14</td> <td>>20</td> </tr> </tbody> </table> <p style="text-align: center;"><i>Table 1: retrieved from (Médecins Sans Frontières, 2018b), pg 6</i></p> <p>Please refer to annex 1 and table 1 below for more information and definitions of the terms above.</p>	Age	HR (Beats/min)		RR (Breaths/min)		Tachycardia	Bradycardia	Bradypnoea	Tachypnoea	<2 months	>160	<100	<30	>60	2 to 12 months	>160	<90	<30	>50	>12 months to 5 years	>140	<80	<25	>40	>5 to 12 years	>120	<70	<20	>30	>12 years	>100	<60	<14	>20	
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>12 years	>100	<60	<14	>20																																	
<p>12. Decide where you will apply the pulse oximetry probe</p>	<p>- To ensure accurate results by applying sensor to a well-perfused area</p>	<p>A well-perfused area is determined by checking it is warm, with a proximal pulse and has a brisk capillary refill.</p> <p>Depending on the patient’s age, the probe may be applied to the patient’s hand or foot.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #d9e1f2;">Age</th> <th style="background-color: #d9e1f2;">Site</th> </tr> </thead> <tbody> <tr> <td>Neonates & young paediatric patients</td> <td>The paediatric probe may be wrapped around the foot or palm</td> </tr> <tr> <td>Older paediatrics and adults</td> <td>The probe should be applied to a finger</td> </tr> </tbody> </table> <p> CAUTION: The toe may be used for both probes, however, is the least reliable measurement and is a last resort site</p>	Age	Site	Neonates & young paediatric patients	The paediatric probe may be wrapped around the foot or palm	Older paediatrics and adults	The probe should be applied to a finger	<p>(Adam & Osborne, 2005)(Hamber et al., 1999)Jevon & Ewens, 2000; Levine, 2007)</p>																												
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<p>13. Once the site is decided, ensure it is clean. If using fingers or toes, ensure the site is free of nail polish or false nails</p>	<ul style="list-style-type: none"> - To obtain accurate results 	<p>Dirt or false nails can inhibit the transmission of light signals, causing inaccurate results. From existing literature/research it is unknown if nail polish inhibits the transmission of light signals causing inaccurate results. Further trials are needed. Therefore, if possible, we recommend removing nail polish and false nails.</p>  <p><i>Figure 3: Transmission of the infrared light in the pulse oximeter probe. If obstructed, no reading can be done.</i></p>	<p>(Booker, 2008; Moore, 2009) (Cicek et al., 2011)(Jubran, 2015)(Zhu, Mao, Tang, Zhou, & Liu, 2016)(Yont, Korhan & Dizier, 2014)</p>
<p>14. Select the correct pulse oximeter probe</p>	<ul style="list-style-type: none"> - To ensure good contact without excessive pressure. - To ensure an accurate reading 	<p>Appropriate probe is determined by site used, circulation and the manufacturer's instructions.</p>  <p><i>Figure 4: Adult probe</i></p>  <p><i>Figure 5: Neonatal/paediatric probe</i></p>	<p>(Levine, 2007; Johnson et al., 2012)</p> <p>Figure 3.1, 3.2 & 3.3 retrieved from: (Médecins Sans Frontières, 2018c)</p>

		 <p>Figure 6: Adhesive wrap, to be used to secure neonatal/pediatric probe</p>	
<p>15. Position the pulse oximeter probe onto the chosen site securely but not too tightly</p>	<ul style="list-style-type: none"> - To avoid inaccurate results caused by obstructed blood flow - To avoid pressure ulcers 	 <p>Figure 7: Applying the pulse oximeter probe onto the palm of a pediatric patient using the adhesive wrap.</p>  <p>Figure 8: Applying the pulse oximeter probe onto the foot of a pediatric patient using the adhesive wrap. A loosely wrapped gauze can be used to secure the cables</p>  <p>Figure 9: Use of an adult probe on a finger.</p>	<p>(Das, Shahidullah, Khanam, & Paul, 2017)(Howell, 2002)(Goodell, 2012; MHRA, 2010; Moore, 2009)(Moore, 2007)(Pennsylvania Patient Safety Authority, 2005)(E)</p> <p>Figure 7 reprinted with permission from <i>Oxygen therapy for children</i>. World Health Organization (WHO). Features of a pulse oximetry, page 16. Copyright 2016.</p> <p>Figure 9 done by A. Calvert</p>

		 CAUTION: If the pulse oximetry is to be continuous, avoid skin irritation and burns caused by the sensor by changing the site every 2-4 hours. For neonates, preterm infants, or patients with poor skin integrity, consider assessing skin and changing probe location every 2 hours.	
16. Turn on the pulse oximeter and read results displayed on the screen. Ensure that your manual verification corresponds to the reading on the device	<ul style="list-style-type: none"> - To obtain oxygen saturation - To ensure the pulse oximeter is operational 	<p>For neonates, aim oxygen saturation between 90-95%. For paediatric and adult patients SpO₂ should be >94%.</p> <p>If a large deviation is detected between manual pulse and pulse on display, this may indicate that the device is not working properly or that there is interference, such as movement, in the sensor.</p> <p>Relying on oxygen saturation levels alone is not a complete respiratory assessment and will not determine the patient's oxygen needs. Oxygen saturation levels may appear normal whilst a patient's respiratory rate and respiratory status is deteriorating therefore it is crucial to also count respiratory rate and assess respiratory patterns and sounds.</p> <p>Ensure the patient is not cold or shivering as this may distort findings on the pulse oximeter.</p> <p>If the pulse oximeter is not functioning or giving an inaccurate result, please consult annex 2 for troubleshooting options.</p> <p>  CAUTION: If the pulse oximetry is used for continuous monitoring; be sure to set the alarms according to the patient's condition and age (for HR limits). </p> <p>Inappropriately set alarm limits may cause the machine to ring unnecessarily. This can cause increased stress to the patient and healthcare providers.</p>	(Adam & Osborne, 2005) (Hartley, 2018)(Howell, 2002)(Levine, 2007)(Médecins Sans Frontières, 2018a, 2018b)(Moore, 2007)(World Health Organization, 2016)(E)

Post-procedure for respiratory rate, respiratory patterns and sounds and pulse oximetry

Action	Rationale	Notes	Evidence
17. Clean/disinfect pulse oximeter and oximeter probe	- To avoid cross-contamination and reduce microbial load before storage	Please refer to the intersectional IPC document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material. The maintenance and decontamination of reusable devices promotes their sustainability. 	(Médecins Sans Frontières, 2019a)
18. Perform hand hygiene 	- To protect the healthcare provider from contamination and minimise the risk of dissemination of patient flora in the environment - As per moments 4 & 5 of hand hygiene	This hand hygiene should be performed as the healthcare provider has had possible exposure to a patient’s body fluids, has touched the patient and is now leaving the patient surroundings. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u> , if visibly soiled, using soap and water. Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
19. Document in the patient’s file and/or appropriate vital signs sheet: a. assessment date b. assessment time c. vital signs obtained	- To maintain accurate records of all assessments and care provided	The healthcare provider should compare results with any previous results document. If any abnormalities or major changes from previous results documented, noted the healthcare provider should notify the treating clinician immediately.	(NMC, 2010)(E)

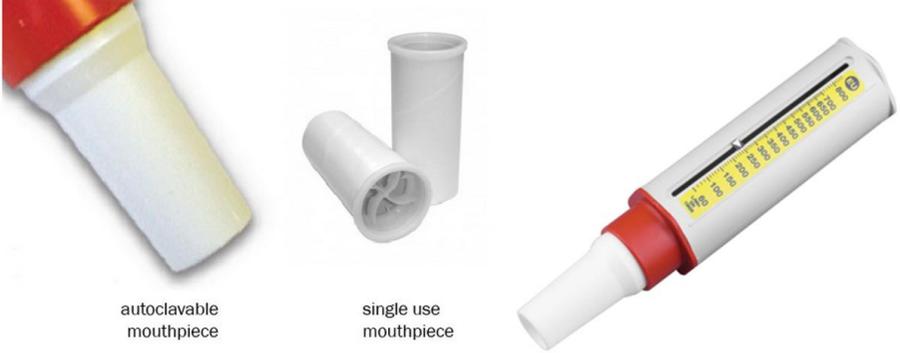
Peak Flow Reading using a Manual Peak Flow Meter

Peak expiratory flow can be used to monitor the efficacy of treatment and the progression of lung disease for older paediatric or adult patients e.g. asthma or chronic obstructive pulmonary disease. It is a simple objective procedure used to measure how hard a patient can blow out air from the lungs and should be performed following a medical prescription. A single measurement should not be evaluated in isolation.

Pre-procedure for peak flow reading

Action	Rationale	Notes	Evidence
1. Perform hand hygiene 	<ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moment 1 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider is going to touch a patient. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Gloves are not indication for a haemodynamic assessment; however, if the healthcare provider has a lesion, cut or sore on his/her hands, they should wear gloves before performing any act on a patient. Likewise, if the patient's skin is not intact, non-sterile gloves should be worn.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
2. Confirm the patient's identity	<ul style="list-style-type: none"> - To ensure the assessment is performed on the correct patient 	<p>Confirm identity by asking the patient his/her full name and date of birth.</p> <p>If the patient is unresponsive or unable to identify themselves, verify the patient's name, date of birth and patient number on their identification band and ask the caretaker the patient's full name and date of birth.</p>	(Médecins Sans Frontières, 2014)(NPSA, 2007)(RCN, 2010)(E)
3. Explain procedure to patient or caregiver in his/her preferred language and why they need the procedure. Explain the risks and benefits of the procedure. Allow the patient/caregiver to ask questions and obtain verbal consent	<ul style="list-style-type: none"> - Understanding the procedure helps reducing fear and anxiety and ensures cooperation - A patient can only give consent if he/she understands 	<p>Explain to the caregiver if the patient is a child or a person unable to consent themselves.</p> <p>Caregivers may be essential to ensure the cooperation of a paediatric patient.</p> <p>Once fully informed, the patient/caregiver has the right to refuse any medication or treatment. If this is the case, it must be clearly documented in the patient's file and the treating clinician informed.</p> <p>If the healthcare provider is meeting the patient and/or caregiver for the first time, he/she should introduce him/herself and her/his role in the</p>	(Frew & Doffman, 2012)(Griffith '2003)(Nursing and Midwifery Council, 2015)(E)

	<p>the procedure</p> <ul style="list-style-type: none"> - Obtaining consent is a fundamental in patient safety and is a legal requirement 	patient care.	
4. Ask the patient or caregiver if he/she has undergone peak flow measurements in the past. If yes, what were their previous results?	<ul style="list-style-type: none"> - To compare current and previous results 		(British Thoracic Society/Scottish Intercollegiate Guidelines Network, 2012)
5. Perform hand hygiene	 <ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moments 4 & 5 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider has touched the patient and is now leaving the patient surroundings. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
6. Clean/disinfect tray/trolley and peak flow meter and allow to dry	<ul style="list-style-type: none"> - To create a general aseptic field - A surface is not aseptic until it has dried - To avoid cross-contamination and minimize chance of infection 	<p>Use a large plastic or metal tray as a general aseptic field. A tray is preferred, but if none available a trolley can be used.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material.</p>	(Médecins Sans Frontières, 2019a)

<p>7. Gather equipment:</p> <ol style="list-style-type: none"> Peak flow meter Disposable OR autoclavable mouthpiece Peak flow documentation chart Measuring tape Alcohol-based hand rub 	<ul style="list-style-type: none"> - To avoid interruptions throughout the procedure - To ensure consistent readings with the same device 	 <p style="text-align: center;"><i>Figure 10: A plastic flow meter and mouthpieces</i></p> <p>If using a multiple patient use device, ensure that it is valved and has a disposable single patient use or autoclavable mouthpiece.</p> <p>Regular use of a manual flow meter can cause the meter spring to become slack and the readings may become inaccurate.</p> <p>If the patient has his/her own meter that is functional they should use their own.</p> <p>The healthcare provider must ensure that the reusable medical material is cleaned/disinfected before use.</p> <p>Please refer to the intersectional infection and prevention control document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material.</p>	<p>(British Thoracic Society/Scottish Intercollegiate Guidelines Network, 2012; Médecins Sans Frontières, 2018c)(Médecins Sans Frontières, 2019a)</p> <p>Figure 10 retrieved from: (Médecins Sans Frontières, 2018c)</p>
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Procedure for peak flow reading

Action	Rationale	Notes	Evidence
8. Perform hand hygiene 	<ul style="list-style-type: none"> - To avoid cross-contamination and minimize chance of infection - As per moment 1 of hand hygiene 	This hand hygiene should be performed as the healthcare provider is going to touch a patient. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u> , if visibly soiled, using soap and water. Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
9. Measure the patient’s height using the measuring tape	<ul style="list-style-type: none"> - To compare to normal peak expiratory values 	If a recent height is already recorded in the patient’s file, the height does not need to be re-measured. Please refer to the nursing care procedure on anthropological measures for more information on how to perform a height measurement.	(E)
10. Assemble equipment by putting disposable or autoclavable mouthpiece in meter	<ul style="list-style-type: none"> - To prevent cross-infection 		(Bongers and O’Driscoll, 2006; Booker, 2007)
11. Ask the patient to either stand or sit while keeping their neck relaxed	<ul style="list-style-type: none"> - To reach maximal lung volume - To avoid positional obstructions 	If the patient has undergone the procedure in the past, they should adopt the same position to enable comparisons with previous results. Standing is the preferred position for the procedure; however, a patient may sit if he/she is unable to stand.	(Booker, 2009; Quanjer et al., 1997)
12. Ensure the needle gauge is at zero	<ul style="list-style-type: none"> - To ensure accurate results 		(Booker, 2009)
13. Have the patient hold the peak flow horizontally ensuring their fingers are not obstructing the gauge	<ul style="list-style-type: none"> - To allow easy movement of the gauge 		(Booker, 2009; Frew & Doffman, 2012)
14. Ensure the patient has nothing in his/her mouth and ask him/her to breath in as much as they can through their mouth and	<ul style="list-style-type: none"> - To ensure they do not aspirate contents of 		(Frew and Doffman, 2012; Quanjer et

hold	<p>mouth</p> <ul style="list-style-type: none"> - To ensure maximum lung capacity 		al., 1997; Small, 2009)
15. Ask the patient to immediately tighten their lips around the mouthpiece	<ul style="list-style-type: none"> - To ensure a tight seal around the mouthpiece - To prevent obstruction by tongue or teeth 	The inspiration held should not last longer than 2 seconds at total lung capacity.	(Booker, 2009; Quanjer et al., 1997)
16. Ask the patient to blow out, using a sharp 'huff', through the meter as hard as they can	<ul style="list-style-type: none"> - To obtain accurate results 	The exhalation should be quick and only last 1 second. Results can be inaccurate if the patient does not quickly and forcefully blow.	(Booker, 2009; Quanjer et al., 1997; Small, 2009)
Note the initial reading. Allow the patient to rest, return the meter to zero and repeat steps 12-15 two more times, each time allowing the patient to rest and noting the reading	To obtain the highest result	<p>The reading is found on the side of the peak flow meter and is measured in L/min.</p> <p>There should not be a difference of more than 20 L/min between each reading.</p> <p>If there is more than 40 L/min difference in the recordings, two additional blows can be performed.</p> <p>The highest of the three acceptable readings should be documented. State the time and if the patient has taken any medication prior to the procedure.</p>	(Frew and Doffman, 2012; Miller et al., 2005; Quanjer et al., 1997)(NHS, 2018)

Post-procedure for peak flow reading

Action	Rationale	Notes	Evidence
17. If mouthpiece disposable, dispose of according to local procedure. If mouthpiece autoclavable, place to be sterilized	<ul style="list-style-type: none"> - To ensure safe disposal of materials - To avoid exposure to medical waste - To avoid reuse of material 	Please follow the local waste management procedure for sorting and disposal of waste.	(DH, 2005)(Médecins Sans Frontières, 2013)
18. Clean/disinfect flow meter	<ul style="list-style-type: none"> - To avoid cross-contamination and reduce microbial load before storage 	<p>Please refer to the intersectional IPC document “IPC-Pillar 2: Environmental Decontamination” for appropriate solution and technique to clean/disinfect surfaces and reusable material.</p> <p>The maintenance and decontamination of reusable devices promotes their sustainability.</p>	(Médecins Sans Frontières, 2019a)
19. Perform hand hygiene 	<ul style="list-style-type: none"> - To protect the healthcare provider from contamination and minimise the risk of dissemination of patient flora in the environment - As per moments 4 & 5 of hand hygiene 	<p>This hand hygiene should be performed as the healthcare provider has touched the patient and is now leaving the patient surroundings. Hand hygiene should be performed preferably using alcohol-based hand rub <u>OR</u>, if visibly soiled, using soap and water.</p> <p>Please refer to the intersectional IPC document “IPC-Pillar 1: Hand Hygiene” for more information on the WHO 5 moments of hand hygiene.</p>	(Fraise & Bradley, 2009)(Médecins Sans Frontières, 2019b)(World Health Organization, 2009)
20. Document the highest reading in the patient’s file and analyze results	<ul style="list-style-type: none"> - To maintain accurate records of all 	If the patient has had a previous flow reading test done, compare to previous results. Compare the results to predicted values according to age or	(NHS, 2018)(NMC, 2010)

	assessments, treatment or care provided and the outcome	clinician's predicted values. If abnormalities noted, report findings to treating clinician or senior healthcare provider as this could be a sign of exacerbation of current condition. If life-threatening abnormalities noted, i.e. less than 50% of personal best result, respond with bedside emergency equipment and ask for help. Please refer to tables 2 & 3 for normal peak flow rates according to age.	
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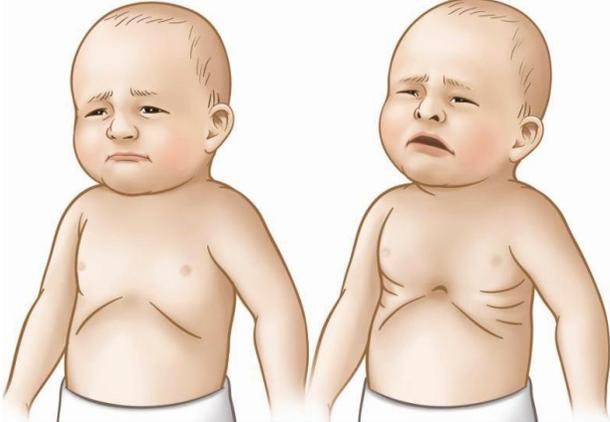
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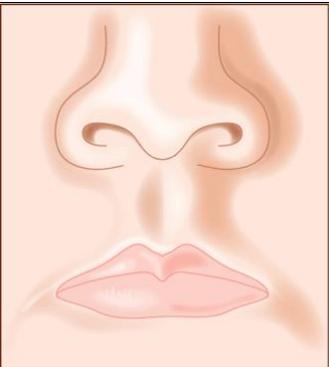
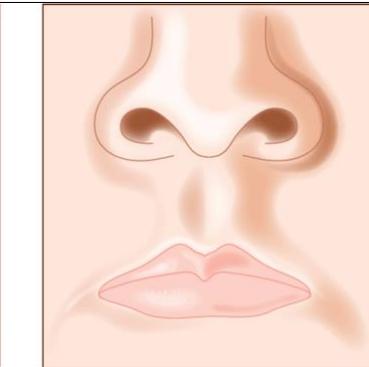
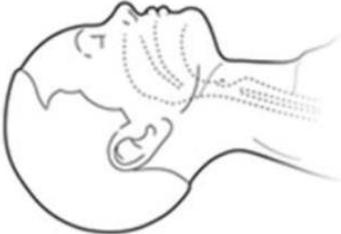
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- (E) is based on clinical experience.

Annex 1: Definitions

Term	Definition	Evidence
Abdominal breathing	Characterized by thoracoabdominal dissociation (in which the chest collapses and the abdomen protrudes/sticks out on inspiration), is a sign of respiratory muscle fatigue seen in young children or in patients with poor muscle tone.	(Médecins Sans Frontières, 2018b)
Accessory muscle use	The use of accessory muscles (such as supraclavicular, intercostal and/or substernal groups) is to increase air entry in patients with inadequate oxygenation or ventilation.	<div data-bbox="1317 427 1848 901" data-label="Image"> </div> <p data-bbox="1877 411 2040 646">(Brashers & Huether, 2016)(Médecins Sans Frontières, 2018b) Image retrieved from: Brashers & Huether, 2016</p>
Airway sounds	Sounds produced when a patient breathes. Abnormal airway sounds that can be heard without a stethoscope are often an indication of respiratory distress; these include stridor, snoring, grunting and wheezing.	(Médecins Sans Frontières, 2018b)
Apnoea	Transient absence of breathing, e.g. 20 seconds.	(Médecins Sans Frontières, 2018b)
Bradypnoea	Slow breathing according to age.	(Médecins Sans Frontières, 2018b)
Breath sounds	Specific sounds generated by the movement of air through the respiratory system. These may be easily audible or identified through auscultation of the respiratory system through the lung fields with a stethoscope. These include normal breath sounds and adventitious or 'added' sounds such as crackles, wheezes, pleural friction rubs and stridor. See table 1 below for details.	(Médecins sans Frontières, 2018)

Chest indrawing	<p>When the chest wall is retracted inwards when the patient breathes in. The indrawing can be observed at the intercostal, substernal and substernal muscle groups.</p>		<p>(Médecins Sans Frontières, 2018b)</p> <p>Image reprinted with permission from: (Rapin et al., 2016)</p>
Cheyne-Stokes	<p>Characterized by an irregular breathing pattern followed by short periods of no breathing (apnoea).</p>	<p>(Hunter & Rawlings-Anderson, 2008)</p>	
Cyanosis	<p>Blue lips, tongue and fingertips. Can be described as central (lips and tongue) or peripheral (fingertips). NB. If the child is anaemic, he or she may not be cyanosed even if hypoxic.</p>	<p>(Hunter & Rawlings-Anderson, 2008)(Médecins Sans Frontières, 2018b)</p>	
Grunting	<p>A sound at the end of expiration and is a sign of moderate to severe respiratory distress in young infants and children with lower airway disease, such as pneumonia, atelectasis or pulmonary oedema.</p>	<p>(Médecins Sans Frontières, 2018b)</p>	
Hypoxia	<p>Insufficient oxygen levels in the cells.</p>	<p>(Hunter & Rawlings-Anderson, 2008)</p>	
Kussmaul respirations	<p>Deep, regular, sighing breaths that may be rapid, slow or normal in rate and suggests metabolic acidosis, sepsis, or dehydration.</p>	<p>(Médecins Sans Frontières, 2018b)</p>	

<p>Nasal flaring</p>	<p>Exaggerated opening and closing of the nostrils. It is a subtle form of severe accessory muscle use and is commonly seen in infants.</p>			<p>(Higginson & Jones, 2009)(Médecins Sans Frontières, 2018b) Image retrieved from:(Higginson & Jones, 2009)</p>
<p>Periodic breathing</p>	<p>A small infant could breathe rapidly and pause for a maximum of fifteen seconds before resuming normal breathing.</p>			<p>(Médecins Sans Frontières, 2018b)</p>
<p>Positioning</p>	<p>Refers to the way in which a child orients his or her body to maximise airway opening when there is obstruction. For example, a child may assume the sniffing position (neck flexed, head mildly extended) to align the airway axes and improve airflow. For older children and adults, the tripod position, in which the child is sitting up and leaning forward on outstretched hands, may be preferred.</p>	 <p style="text-align: center;">Tripod position</p>	<p style="text-align: center;">Sniffing position</p> 	<p>(Médecins Sans Frontières, 2018b) (Paediatric Respiratory Assessment, 2005)(Small, 2009) Tripod image retrieved from: (Small, 2009) Sniffing image retrieved from: (Médecins Sans Frontières, 2018b)</p>
<p>Respiratory pattern</p>	<p>Description of breathing (rapid or slow, deep or shallow) and may provide a clue to the aetiology of respiratory distress. For example, rapid, shallow breathing with prolonged exhalation is typically seen with air trapping, as occurs with asthma or bronchiolitis. It may also result from chest or abdominal pain or chest wall dysfunction.</p>			<p>(Médecins Sans Frontières, 2018b)</p>

Stridor	A high-pitched musical breath sound resulting from turbulent airflow in the larynx. It can be heard on inspiration in croup.	(Médecins Sans Frontières, 2018b)
Tachypnoea	Fast breathing according to age.	(Médecins Sans Frontières, 2018b)

Table 1: Breath sounds

Name	Continuous/ discontinuous	Frequency/ pitch	Inspiratory/ expiratory	Quality	Associated conditions
Wheeze (can be heard without a stethoscope when severe)	Continuous	High pitched, with higher-pitched wheezes indicative of more severe obstruction	Normally expiratory, can be inspiratory if very severe	Whistling/ sibilant, musical, hissing or shrill	Diffuse wheezing: asthma, bronchiolitis Unilateral wheezing: foreign body in the lower airway
Rhonchi	Continuous	Harsh, low pitched	Both	Snoring quality	Airway obstruction from secretions, oedema or inflammation
Stridor	Continuous	High	Inspiratory	Whistling or barking	Epiglottitis, croup, foreign body
Inspiratory gasp/whoop	Intermittent	High	Inspiratory	Whoop	Whooping cough
Crackles/ crepitations or rales	Discontinuous and brief	High and soft (fine) or low (coarse), non-musical	Inspiratory, especially when the child is crying and takes a deep breath in	Cracking, clicking, rattling	Coarse crackles: pneumonia Fine crackles: pulmonary oedema

Table 2 retrieved from (Médecins Sans Frontières, 2018b), pg 299

Annex 2: Trouble shooting the pulse oximeter

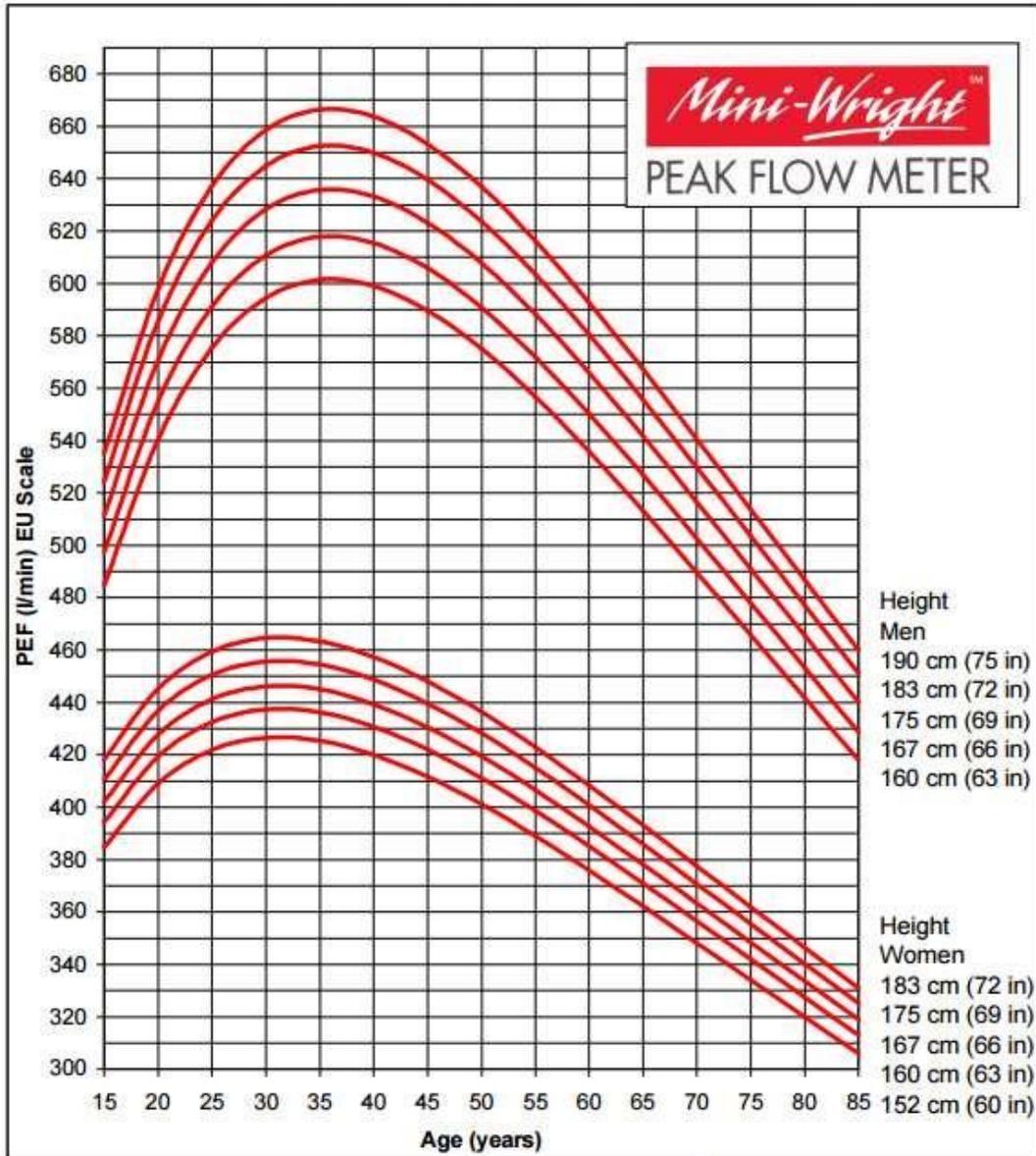
Problem	Cause	Prevention	Action
Poor tracing or inconsistent reading	<p>Sensor reading can be affected by movements such as shivering, seizures or tremors (Levine, 2007; Moore, 2007).</p> <p>Inconsistent reading can be affected by direct light, nail polish or false nails and some medical conditions e.g. methemoglobinemia, corboxyhemoglobin. (Jubran, 2015) (Yont, Korhan & Dizer, 2014)(Moore, 2007)(Zhu et al., 2016)(E).</p>	<p>Encourage the patient to keep as still as possible. If poor tracing consists, consider using a different site with less movement, for example earlobe. (Levine, 2007)(Moore, 2007).</p> <p>The correct site for the age of the patient should be chosen. The toe has the lowest accuracy of pulse oximetry tracing (Hamber et al., 1999)(E).</p> <p>Avoid performing a pulse oximetry measurement under direct sunlight as this can interfere with the infra-red sensor (Howell, 2002).</p>	<p>If finger site was chosen, take radial pulse and compare pulses. If different, then the oxygen saturation reading will be inaccurate and further investigations into the patient's clinical situation need to be done, example arterial blood gases if available (Levine, 2007).</p> <p>The pulse oximetry reading should always be cross-checked with the patient's clinical signs.</p> <p>If the patient is wearing nail polish or false nails, an attempt should be made to remove it (Jubran, 2015) (Yont, Korhan & Dizer, 2014)(Moore, 2007)(Zhu et al., 2016)(E).</p>
Low saturation results which do not correlate with the patient's clinical condition	<p>Poor choice of site due to inadequate blood perfusion or cold extremities (Adam and Osborne, 2005). Light sensor interference due to excessive environmental lighting (Médecins Sans Frontières, 2018b).</p>	<p>Proper assessment before probe placement and choosing appropriate site for the age of the patient. The site needs to have good proximal pulse, be warm and have a rapid capillary refill.</p> <p>Avoid performing a pulse oximetry measurement under direct sunlight.</p>	<p>Reposition sensor to new site or warm the limb. Shield the sensor with a towel or blanket.</p> <p>If it remains low, arterial blood gases may need to be considered (Adam & Osborne, 2005)(Médecins Sans Frontières, 2018b).</p>

Pulse reading does not correlate with manual pulse	Not all pulsations are being detected by pulse oximeter.	Proper assessment before probe placement and choosing appropriate site for the age of the patient. The site needs to have good proximal pulse, warmth and rapid capillary refill.	Try another probe or pulse oximeter machine (Moore, 2007).
No reading	Absence of reading may be related to positioning of the probe, issues with the device, or patient's circulatory condition (shock) (E).	<p>Proper assessment before probe placement and choosing appropriate site for the age of the patient. The site needs to have good proximal pulse, warmth and rapid capillary refill.</p> <p>Check proper functioning of equipment/batteries prior to use or on regular basis.</p> <p>Please refer to biomedical protocol for user maintenance for more information.</p>	<p>Verify the position of the probe and ensure there is contact with the patient's nail bed or skin (E).</p> <p>Verify that the connection between the device and the cable and between cables. Wiping the probe with an alcoholic solution may help remove any particles disrupting the reading. If problem persists, try another probe or pulse oximeter machine (Moore, 2007)(E).</p>

Table 2: Normal Peak Flow Rates in adults (>15 years)

PEAK EXPIRATORY FLOW RATE - NORMAL VALUES

For use with EU/EN13826 scale PEF meters only



Adapted by Clement Clarke for use with EN13826 / EU scale peak flow meters from Nunn AJ Gregg I, Br Med J 1989;298;1068-70

Chart 1 retrieved from: <https://patient.info/health/asthma-leaflet/features/peak-flow-diary>

Table 3: Normal Peak Flow Rates in paediatrics

PEAK EXPIRATORY FLOW RATE

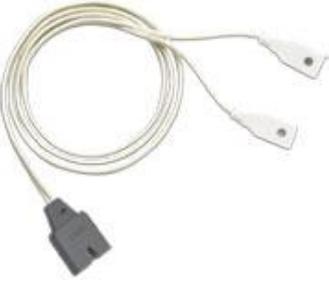
For use with EU / EN13826 scale PEF meters only

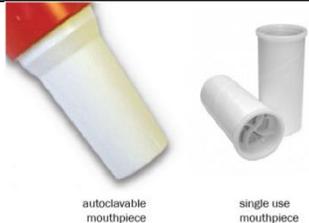
Height (m)	Height (ft)	Predicted EU PEFR (L/min)		Height (m)	Height (ft)	Predicted EU PEFR (L/min)
0.85	2'9"	87		1.30	4'3"	212
0.90	2'11"	95		1.35	4'5"	233
0.95	3'1"	104		1.40	4'7"	254
1.00	3'3"	115		1.45	4'9"	276
1.05	3'5"	127		1.50	4'11"	299
1.10	3'7"	141		1.55	5'1"	323
1.15	3'9"	157		1.60	5'3"	346
1.20	3'11"	174		1.65	5'5"	370
1.25	4'1"	192		1.70	5'7"	393

Chart 2 retrieved from: <https://rbpaonline.com/asthma-peak-flow-chart-printable/asthma-peak-flow-80-3/>

Annex 3: List of necessary equipment for respiratory assessment

Code	Label	Notes/Pictures
EMEQCLOCN1- EEMDPOXE4--	NURSES WATCH OXYMETER, PULSE (Masimo RAD-5) + accessories	 <p>The new model of Masimo RAD-5 has a red connection and needs a red connection cable LNC-04 ref. 2055 for the sensors/probe. The pre-2010 model with white connector need the white connection cable LNC-4 ref. 2017 for the sensors/probe.</p>
EEMDPOXA406	(oxymeter Masimo) CABLE, extension, red, LNC-04 2055	

<p>EEMDPOXA401</p>	<p>(oxymeter Masimo) SENSOR adult, reus. LNCS-DCI 1863</p>	
<p>EEMDPOXA402</p>	<p>(oxymeter Masimo) SENSOR multisite paed/neon LNCS-YI 2258</p>	
<p>EEMDPOXC404</p>	<p>(oxymeter Masimo) WRAP adhesive for LNCS sensor, 1597</p>	
<p>EMEQTIME1--</p>	<p>TIMER, breath counting</p>	

EMEQPEFM1--	PEAK-FLOW METER	
EMEQPEFM1MP	(peak flow meter) MOUTH PIECE, cardboard, s.u.	 autoclavable mouthpiece single use mouthpiece
EANTMEAA1P-	MEASURING APPARATUS, tape, vertical, 200 cm	
DEXTALCO5S-	ALCOHOL-BASED HAND RUB, solution, 500 ml, bot	
SDISSUQA2B-	DETERGENT/DISINFECTANT for surfaces, 2 l tin + dosing pump	Or equivalent solution available in the project.

History of this nursing care procedure

Date	Author	Version	Details
03-10-2018	Brigitte Ireson-Valois	1	No previous document: shared with NCCG
23-10-2018	BIV	2	Compilation of feedback and edits by NCCG. Shared with NCCG
09-11-2018	BIV	3	Compilation of feedback and edits by NCCG. Shared with Critical care and Paediatric working groups
13-03-2019	BIV	4	Includes feedback and edits by external working groups. Re-viewed by NCCG
29-03-2019	BIV	4.1	Compilation of feedback and edits by NCCG. Questions pending to be discussed with NCCG
10-04-2019	BIV	5.0	Compilation of feedback and discussions by NCCG. Sent for external proof-reading
16-08-2019	BIV	6.0	Compilation of feedback from proof-readers. Discussed with NCCG
08-10-2019	BIV	7.0	Finalized by the NCCG. Awaiting illustrations
22.03.2020	AM	v1.0-2020	Finalized.