

Haemodynamic Assessment-

Pulse measurement, capillary refill time and manual blood pressure measurement

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 haemodynamic assessment consists of pulse, capillary refill time and blood pressure measurements. The three should be assessed together, as below, in order to complete a haemodynamic assessment. Pulse is the number of times a heart beats within a minute and varies with age, physical condition and clinical condition. Capillary refill time (CRT) is the time taken for blood to refill empty capillaries. Blood pressure (BP) measures the force of the blood inside the vessels against the vessel walls. It is expressed as a fraction and in millimetres of mercury (mmHg). The top number represents the systolic pressure (heart muscle contraction) and diastolic pressure (heart muscle relaxation).

Indications and Contraindications of a haemodynamic assessment

Indications

1. All patient's being consulted by a healthcare provider should have a complete hemodynamic assessment performed (BP may be excluded in children under 5 unless specified by treating clinician). A haemodynamic assessment is used in combination with a respiratory, a pain and a temperature assessment for a complete assessment of the patient status
2. Severely ill patients e.g. patients with suspicion of shock
3. Monitoring before, during and after blood or blood product transfusions or intravenous fluids
4. Monitoring after administration of medications that affect the cardiovascular system e.g. beta-blockers or vasoconstrictors
5. Monitoring during pregnancy

Contraindications

Blood pressure should not be performed on a limb:

1. With a peripheral intravenous infusion in progress
2. With a history of upper arm trauma or brachial artery surgery
3. With paralysis
4. Over a burn or wound
5. With a known arteriovenous fistula (an abnormal connection or passageway between an artery and a vein)
6. With lymphedema or at risk of development (swelling caused by a lymphatic system blockage)

Patients requiring extra care

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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Pre-procedure for a haemodynamic assessment

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 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)(E)
3. Explain procedure to patient or caretaker in his/her preferred language and why he/she requires 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 - Obtaining consent is a fundamental in patient safety and 	<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 by name and explain that they are the patient's current healthcare provider. Regardless of the patient's level of consciousness, the healthcare provider should talk to the patient throughout the procedure as the sense of hearing is frequently unimpaired even in unconscious patients.</p>	(Griffith, 2003)(Médecins Sans Frontières, 2018c)(Nursing and Midwifery Council, 2015)(E)

		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, stethoscope and sphygmomanometer cuff 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 remaining equipment on dry tray/trolley:		<ul style="list-style-type: none"> - To avoid interruptions during the procedure - To reduce health care associated infection 	<p>It is best to measure the blood pressure with a sphygmomanometer cuff and stethoscope than using a mechanical blood pressure machine.</p> <p>If taking continual blood pressure, please refer to annex 1 for more information on how to use the mechanical blood pressure monitor.</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.</p>	(Elliott & Coventry, 2012)(Médecins Sans Frontières, 2019a)
<ul style="list-style-type: none"> a. Nurses watch or clock with a second hand b. Stethoscope c. Sphygmomanometer cuff d. Cleaning/disinfecting solution for surfaces e. Alcohol-based hand rub 				

Procedure for a haemodynamic assessment

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. Ensure the patient is calm, comfortable and in the correct position	<ul style="list-style-type: none"> - To obtain true readings 	<p>Ideally, the patient should be at rest for approximately 20 minutes before the start of the assessment and ideally have recently emptied their bladder. This may not be possible in a life-threatening situation; however, correct positioning is still needed.</p> <p>Factors such as exercise, smoking, room temperature and anxiety are known to alter heart rate, capillary refill time (CRT) and blood pressure. Fever may alter heart rate and blood pressure but has not been shown to alter CRT.</p> <p>It has been proven difficult to appropriately assess the CRT in poor lightening, ensure that the room is well lit before proceeding.</p> <p>If sitting, an older paediatric or adult patient should have their legs uncrossed and feet flat on the floor. If lying in bed, the patient should not cross their ankles as these positions can alter blood pressure measurement.</p>	(Ait-Oufella et al., 2014)(Dougherty & Lister, 2015)(Fleming et al., 2014)(Fleming et al., 2011)(Lowry et al., 2016)(Médecins Sans Frontières, 2018c)(Papat hanasiou et al., 2013)(Pickard, Karlen, & Ansermino, 2011)(Rawlings-Anderson & Hunter, 2008)(Turner, Burns, Chaney et al, 2008)

Pulse measurement:

9. Decide where the heart rate will be taken

- To choose appropriate site based on age



In neonates, the heart rate is usually palpated at the brachial or femoral arteries as it is difficult to evaluate at the radial arteries due to their small size. While neonates are calm or sleeping, the heart rate should be heard over the chest (apical) with a stethoscope.

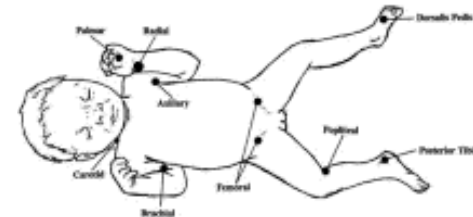


Figure 1: Anatomical locations for heart rate measurement in neonates.

In paediatrics heart rate is obtained by feeling the wrist (radial), arm (brachial) or groin (femoral) pulse or listening to the chest (apical) with a stethoscope.

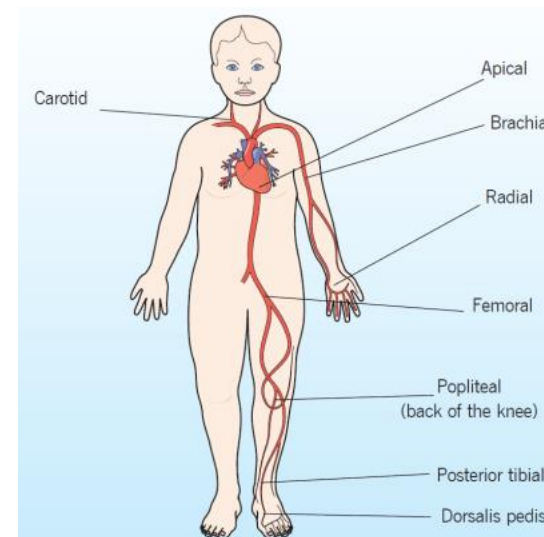


Figure 2: Anatomical locations for heart rate measurement in paediatrics.

(Médecins Sans Frontières, 2014)(Médecins Sans Frontières, 2018c)(Médecins Sans Frontières, 2018a)(Rodríguez, 2015)

Figure 1 retrieved from: <https://www.sciencedirect.com/science/article/pii/S1527336902700433>

Figure 2 retrieved from: (Howlin & Brenner, 2009)

Figure 3 retrieved from: <https://medical-dictionary.thefreedictionary.com/Pulse+points>

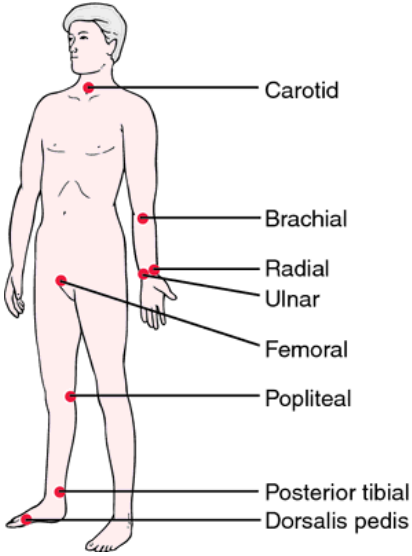
		<p>In adults, heart rate is most frequently taken at the radial site, however, can be taken from multiple sites, including the apex of heart via a stethoscope.</p>		
<p>10. Use middle and ring fingers to apply light pressure to the chosen site until a pulse is felt</p>	<ul style="list-style-type: none"> - Fingers are sensitive to touch - To avoid false results - To palpate the patient's pulse 	<p>An easy way to find the radial site is by following the contour of the patients thumb towards the inner wrist. The healthcare provider then places their fingers on the inside of the wrist and compresses until a pulsation is felt.</p> <p>Healthcare providers should be aware that the thumb and index finger have pulses of their own and thus, should not be used on their own to assess patients pulse as the healthcare provider may be assessing their own heart rate.</p> <p>Blood pressure has an impact on the palpation of peripheral pulses. If an adult patient is hypotensive (SBP<80mmHg) and the healthcare provider is having a hard time palpating a pulse at the radial site, the healthcare provider should attempt to find a pulse closer to the heart, such as the femoral site then the carotid site.</p>	<p>(Deakin & Low, 2000)(Docherty, & Coote, 2006)(Dougherty & Lister, 2015)(Médecins Sans Frontières, 2014)(Smith & Roberts, 2011)</p> <p>Figures 4 & 5 done by A. Calvert</p>	



Figure 4: Palpating the radial pulse in an adult.

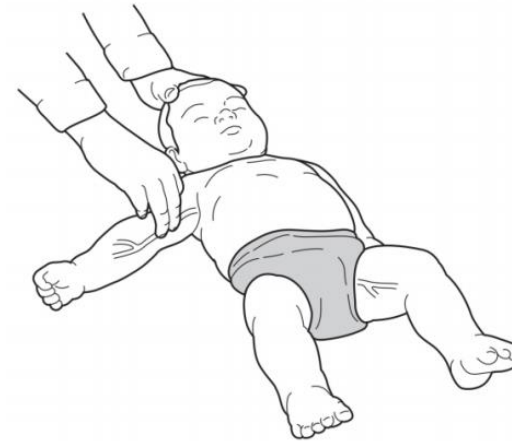

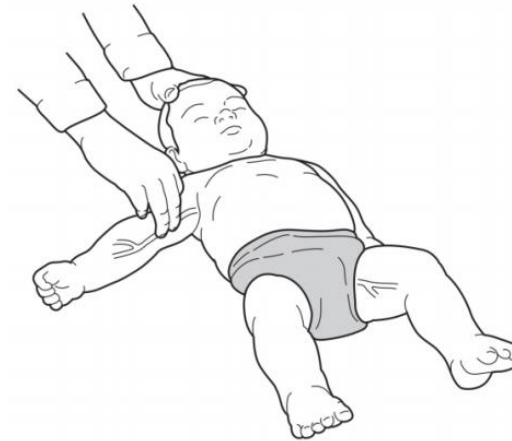
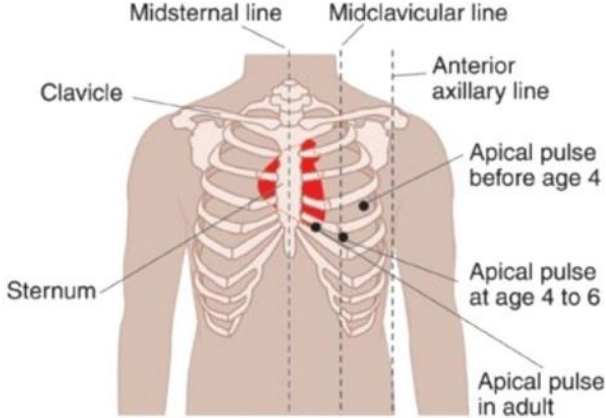

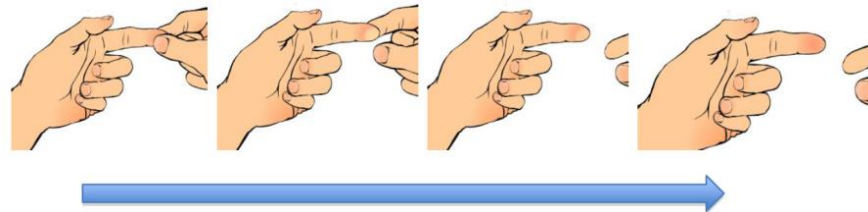


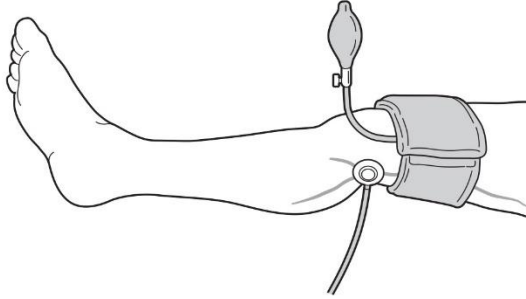
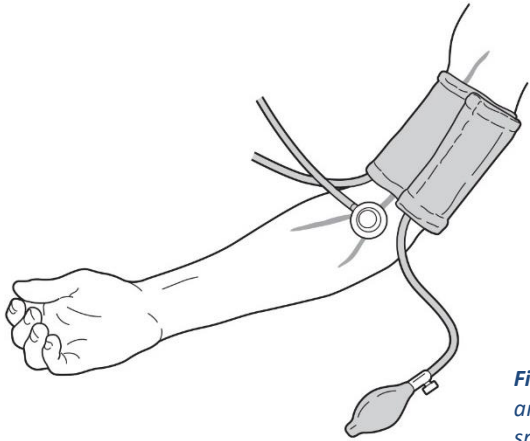
Figure 5: Palpating the brachial pulse in an infant.

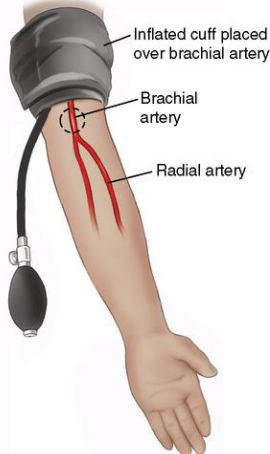
		 <p><i>Figure 4: Palpating the radial pulse in an adult.</i></p>  <p><i>Figure 5: Palpating the brachial pulse in an infant.</i></p>	
<p>11. Assess the patient's skin</p>	<p>- To evaluate circulation</p>	<p>The skin should be assessed for:</p> <ul style="list-style-type: none"> - colour (pink, pale, white or grey/dusty), - temperature (warm or cool to touch) and - moisture (diaphoretic (sweaty or perspiring) or clammy (damp or sticky to touch)). 	<p>(Médecins Sans Frontières, 2018c)(Rapin et al., 2016)</p>

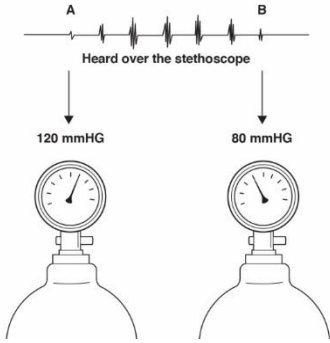
		The skin assessment is a good indication of the patient's circulation. If the skin colour, temperature or moisture is abnormal this could indicate poor perfusion.																					
12. Once pulse felt, use the watch to count the number of beats over one minute	- To obtain the heart rate	<p>If the heartbeat is palpated for less than 30 seconds an irregular heartbeat may be missed. Additionally, a healthcare provider should not rely entirely on the heart rate readings from a pulse oximeter as the results could be inaccurate if the patient shows signs of poor perfusion.</p> <table border="1" data-bbox="1151 501 1883 911"> <thead> <tr> <th rowspan="2">Age</th> <th colspan="2">HR (Beats/min)</th> </tr> <tr> <th>Tachycardia</th> <th>Bradycardia</th> </tr> </thead> <tbody> <tr> <td><2 months</td> <td>>160</td> <td><100</td> </tr> <tr> <td>2 to 12 months</td> <td>>160</td> <td><90</td> </tr> <tr> <td>>12 months to 5 years</td> <td>>140</td> <td><80</td> </tr> <tr> <td>>5 to 12 years</td> <td>>120</td> <td><70</td> </tr> <tr> <td>>12 years</td> <td>>100</td> <td><60</td> </tr> </tbody> </table> <p><i>Table 1: Normal heart rate by age</i></p>	Age	HR (Beats/min)		Tachycardia	Bradycardia	<2 months	>160	<100	2 to 12 months	>160	<90	>12 months to 5 years	>140	<80	>5 to 12 years	>120	<70	>12 years	>100	<60	<p>(Elliott & Coventry, 2012)(Médecins Sans Frontières, 2018c)(Rapin et al., 2016)</p> <p>Table obtained from (Médecins Sans Frontières, 2018c) pg. 6)</p>
Age	HR (Beats/min)																						
	Tachycardia	Bradycardia																					
<2 months	>160	<100																					
2 to 12 months	>160	<90																					
>12 months to 5 years	>140	<80																					
>5 to 12 years	>120	<70																					
>12 years	>100	<60																					
13. Whilst palpating, note the quality and regularity of the beats	- To assess perfusion	When palpating the pulse, also note the quality or amplitude (strong or weak) and whether or not the beat is regular or irregular. This information will give the healthcare provider an insight into the patient's clinical condition or response to treatment (e.g. blood volume or cardiac abnormality).	(Elliott & Coventry, 2012)(Rapin et al., 2016)(E)																				

<p>14. If using a stethoscope, place diaphragm directly on the skin at the apex of the heart and count for one minute</p>	<p>- To obtain the heart rate</p>	<p>In adults, the apex can be found at the 4th-5th intercostal space at the left midclavicular line.</p>  <p><i>Figure 6: Anatomical local to listen to apical heart rate</i></p> <p>The apical heart rate is used to obtain a more accurate count of the heart rate e.g. in infants or patients with irregular rhythms.</p>	<p>(Alexis, 2010)</p> <p>Figure 6 retrieved from: https://www.topregisterednurse.com/apical-pulse-definition-process-measurement/</p>
<p>Capillary refill time:</p>			
<p>15. Take the index finger, or alternative site, and lift it slightly above the level of the heart</p>	<p>- To acquire accurate results</p>	<p>Raising the hand above the heart will prevent the CRT being skewed/distorted due to passive venous filling.</p> <p>If a previous CRT had been recorded on the patient, it is important for the healthcare provider to use the same site for consistency of results.</p> <p>If assessing perfusion to lower extremities, the healthcare provider may perform the assessment on a big toe whilst the patient is lying down.</p> <p>In patients with pigmented skin, the nails beds (fingers or toes), or heel in young infants, may be the easiest sites to assess CRT.</p>  <p>In neonates and children less than 1 year it may be difficult to assess the CRT on the index fingers due to size. Sites such as the heel, forehead or chest may be used. CRT assessment on the</p>	<p>(Advanced Life Support Group, 2017)(Fleming et al., 2014)(Médecins Sans Frontières, 2018c)(Pickard et al., 2011)(E)</p>



		chest is the preferred site for neonates and young children due to its accuracy during states of shock.	
16. Apply pressure to the chosen site by compressing gently for 5 seconds until the skin blanches	- To lightly obstruct capillary blood flow	The healthcare provider should use his/her index and thumb to apply light pressure. The healthcare provider can look at the pink of the nail bed and blanching occurs when the pink has turned to white.	(Ait-Oufella et al., 2014)(Fleming et al., 2014)(Médecins Sans Frontières, 2018c; Pickard et al., 2011)
17. Release pressure from the chosen site and count the number of seconds it takes for the colour to return to normal	- To obtain the capillary refill time	CRTs are the same in both paediatrics and adults. A CRT taken at the finger of ≥ 2 seconds is considered delayed. However, <u>in neonates under 7 days the upper limit of a normal CRT can reach 3 seconds.</u> Delayed CRT can be a sign of hypothermia, impaired circulation or shock. In paediatrics, the CRT helps to identify the most severely ill children suffering from shock, moderate-severe dehydration and infectious diseases such as pneumonia, gastroenteritis, and malaria. 	(Ait-Oufella et al., 2014)(Fleming et al., 2014)(Médecins Sans Frontières, 2018c) (Médecins Sans Frontières, 2018a)(Pickard et al., 2011) Figure 7 used with permission from: (Rapin et al., 2016)
Manual blood pressure measurement:			
18. Ensure the arm is free of clothing, at the level of the heart and the correct sized cuff is used	- To prevent false readings	For measurement consistency, the right arm should be used to obtain blood pressure. If the right arm is not used, this should be documented for consistency in measurements. A cuff that is too small may give a false high measurement and a cuff that is too large may give a falsely low measurement.	(Mansoor et al., 2016)(Médecins Sans Frontières, 2018c)(Pickering et al., 2007)(Rapin et al.,

		<p>If the arm is contraindicated or not possible, the leg can be used to obtain blood pressure. To obtain accurate results, lay the patient flat with the legs at the same level as the rest of the body. The steps for performing a blood pressure measurement on the leg are the same as for the arm, however, the cuff should be placed mid-thigh and by listening over the popliteal artery.</p>  <p><i>Figure 8: Sphygmomanometer cuff on the leg</i></p> <p>If continual mechanical blood pressure monitoring is necessary, please refer to annex 1 for more information.</p>	<p>2016)(Smith, 2005)(Williams, Poulter, Brown et al., 2004)</p> <p>Figure 8 done by A. Calvert</p>
<p>19. Wrap the sphygmomanometer cuff around the arm with the bladder centred over the brachial artery and 2-3cms above the elbow crease</p>	<ul style="list-style-type: none"> - To obtain accurate readings - To allow for easy palpation of the artery 	 <p>Often there is an arrow on the cuff. Align this area with the brachial artery.</p> <p><i>Figure 9: Locating the brachial artery with the sphygmomanometer in place</i></p>	<p>(BHS, 2006)(NICE, 2011)(E)</p> <p>Figure 9 done by A. Calvert</p>

20. Ask the patient not to move their arm, talk or eat during the procedure	- To avoid false results due to activity		(BHS, 2006)(Mansoor et al., 2016)(E)
21. Ensure the pumping valve is closed and palpate the brachial artery. Begin pumping air into the cuff using the bulb. Once the pulse can no longer be felt, rapidly inflate the cuff a further 20–30 mmHg by observing the needle on the gauge	- To confirm cuff placement - To prevent unnecessary discomfort	Inflating the cuff to only 20–30 mmHg above the predicted systolic level prevents undue discomfort	(Bickley & Szilagy, 2009)
22. Slowly deflate the cuff by releasing the valve and note the point at which the pulse is once again detected. Then deflate the cuff completely	- To approximate the systolic pressure		(BHS, 2006)(Curran, 2009)(NICE, 2011)(O'Brien, Asmar, Beilin et al., 2003)(Tortora & Derrickson, 2011)
23. Apply the diaphragm of the stethoscope over the site of the brachial artery	- To hear all audible sounds without interference	Do not apply too much pressure over with the stethoscope as this may partially occlude the artery and alter results.	 <p>(O'Brien et al., 2003)(E)</p> <p>Figure 10 retrieved from: https://radiologykey.com/medical-techniques-and-patient-care/</p>
24. Inflate the cuff again to 20-30mmHg above the predicted systolic blood pressure	- To obtain an accurate measurement	<p><i>Figure 10: The stethoscope should be placed over the brachial artery.</i></p>	(Bickley & Szilagy, 2009)(NICE, 2011)

<p>25. Whilst listening via the stethoscope slowly release the air from the cuff until the first tapping sounds are heard</p>	<p>- To obtain the systolic blood pressure</p>	<p>Do not deflate the cuff too rapidly as this may result in the healthcare provider misreading the point at which the tapping sounds are first heard.</p> <p><i>Figure 11: The healthcare provider should note at what value he/she first hears tapping and again when the tapping sound stops.</i></p>		<p>(O'Brien et al., 2003)(Patton & Thobideau, 2009)(Rapin et al., 2016)</p> <p>Figure 11 done by A. Calvert</p>											
<p>26. Continue to slowly deflate the cuff whilst listening via the stethoscope. Note the point at which the tapping sounds can no longer be heard</p>	<p>- To obtain the diastolic blood pressure</p>	<p>- In healthy adults, a normal blood pressure is 120/80 mmHg. - Hypotension is considered with a result less than 90/60 mmHg. - Hypertension is considered with a result more than 140/90mmHg.</p> <p>It is not routine to measure blood pressure in children less than 5 years old. In paediatrics, blood pressure should be measured when specified by the treating clinician.</p> <p style="text-align: center;">Normal systolic blood pressure by age</p> <table border="1" data-bbox="1128 868 1912 1078"> <thead> <tr> <th>Age</th> <th>SBP (mm Hg)*</th> </tr> </thead> <tbody> <tr> <td>1-2 months</td> <td>≥50</td> </tr> <tr> <td>>2 to 11 months</td> <td>≥60</td> </tr> <tr> <td>1 to 5 years</td> <td>≥70</td> </tr> <tr> <td>>5 to 12 years</td> <td>≥80</td> </tr> <tr> <td>>12 years</td> <td>>90</td> </tr> </tbody> </table> <p>*Only the normal minimum value for systolic blood pressure as defined by age is given because hypertension is not a common emergency problem among children.</p> <p>The healthcare provider may ask the patient his/her baseline blood pressure as some people have low pressure under normal circumstances.</p>	Age	SBP (mm Hg)*	1-2 months	≥50	>2 to 11 months	≥60	1 to 5 years	≥70	>5 to 12 years	≥80	>12 years	>90	<p>(Bickley & Szilagy, 2009)(Médecins Sans Frontières, 2015, 2018b)</p> <p>BP table retrieved from (Médecins Sans Frontières, 2018c) pg. 10.</p>
Age	SBP (mm Hg)*														
1-2 months	≥50														
>2 to 11 months	≥60														
1 to 5 years	≥70														
>5 to 12 years	≥80														
>12 years	>90														
<p>27. Completely deflate the cuff by opening the valve</p>	<p>- To prevent venous congestion to the arm</p>		<p>(O'Brien et al., 2003)</p>												

Post-procedure for a haemodynamic assessment

Action	Rationale	Notes	Evidence
28. Clean/disinfect stethoscope and sphygmomanometer cuff	- 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.</p> <p>The maintenance and decontamination of reusable devices promotes their sustainability. </p>	(Médecins Sans Frontières, 2019a)
29. Perform hand hygiene 	<p>- To protect the healthcare provider from contamination and minimise the risk of dissemination of patient flora in the environment</p> <p>- As per moments 4 & 5 of hand hygiene</p>	<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, 2013)(World Health Organization, 2009)
30. Document procedure date, time and results obtained in the patient’s file	- To maintain accurate records of all assessments and care provided	<p>The healthcare provider should compare results with any previous results document.</p> <p>The healthcare provider should document where the heart rate and CRT were taken to promote consistency and reduce inter-observer variability.</p> <p>If any abnormalities, or major changes from previous results documented, noted the healthcare provider should notify the treating clinician immediately.</p>	(NMC, 2010)(Pickard et al., 2011)(E)

Reference List

- Advanced Life Support Group (2017). *Advanced Paediatric Life Support A Practical Approach to Emergencies*. Sixth edition, AUSTRALIA AND NEW ZEALAND
- Ait-Oufella, H., Bige, N., Boelle, P. ., Pichereau, C., Alves, M., Bertinchamp, R., ... Guidet, B. (2014). Capillary refill time exploration during septic shock. *Intensive Care Medicine*. <https://doi.org/10.1007/s00134-014-3326-4>
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- (E) is based on clinical experience.

Annex 1: Continual blood pressure monitoring with a mechanical blood pressure monitor

Occasionally, blood pressure needs to be performed at regular intervals as per the patient's clinical status and medical orders. A mechanical blood pressure monitor, such as the Dinamap model, may help the healthcare provider by automatically performing the blood pressure checks.

Before beginning the automatic measurements the following steps should be performed:

- Follow the same patient and cuff positioning steps as for manual blood pressure monitoring (above)
- Ensure the appropriately sized cuff is chosen and that it is compatible with the machine being used (see below for a guide for mechanical cuff sizing)
- Set the mode to paediatric or adult (this will change the initial inflation pressure)
- Set the alarm limits for both systolic and diastolic blood pressure according to the patient's age and clinical condition/medical order. This includes the lower and upper limits
- Set measurement frequency as per medical order (e.g. continual, every 1minute, 5minutes, 15minutes, 30minutes)

While the automatic measurements are being performed:

- Ensure proper positioning of the patient (e.g. lying on his/her back, no legs crossed)
- When an alarm sounds or flashes, the healthcare provider **MUST** go and verify what is abnormal. If the alarm limits were set, then the alarm will only ring if a measurement is abnormal. The alarm may be temporarily silenced while further investigation is being performed
- Verify the limb being monitored regularly for discomfort, ischemia, purpura and/or neuropathy
- To prevent skin damage and limit patient discomfort, change the location of the blood pressure cuff at least once per shift
- Note in the patient's file each measurement and the location of the measurement (right or left arm or leg)

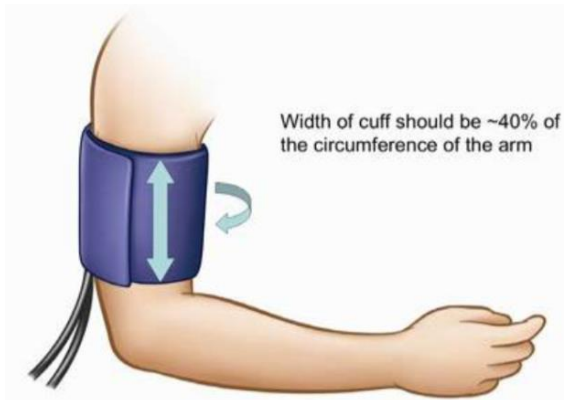


CAUTION: If the blood pressure monitor results do not correspond to the patient's clinical condition, or if the screen is blank, a manual blood pressure must be performed.

Please consult the blood pressure machine's user guide for more information on machine programming.

Annex 2: Cuff size by age and/or arm circumference

Currently within MSF there are only 2 sizes available for performing a manual blood pressure; paediatric or adult.



If using a mechanical blood pressure machine, such as the Dinamap model, there are a variety of sizes available. The appropriate size should be chosen depending on the patient age, in paediatrics, or the patient size, in adults.

The ideal cuff size may be estimated by the rule of '80/40'; cuff bladder **length** is $\geq 80\%$ of the patient's arm circumference and cuff bladder **width** is $\geq 40\%$ of the patient's arm circumference.

If performing a blood pressure measurement on the thigh, the rule of '80/40' still applies; cuff bladder **length** is 75-80% of the patient's thigh circumference and cuff bladder **width** is $\geq 40\%$ of the patient's thigh circumference. (Smith, 2005)

Figure 12: Assessing appropriate cuff size. Reprinted with permission from: (Rapin et al., 2016)

Cuff size according to age (Smith, 2005)

By Age	Recommended Cuff Size (width x length in cm) in paediatrics
Newborns and premature infants	4 x 8 cm (neonate)
Infants	6 x 12 cm (infant)
Older children	9 x 18 cm (child)

Cuff size according to arm circumference (Smith, 2005)

Arm Circumference (cms)	Recommended Cuff Size (width x length in cm) in adults
22 – 26	12 x 22 (small adult)
27 – 34	16 x 30 (adult)
35 – 44	16 x 36 (large adult)
45 – 52	16 x 42 (extra-large adult)

Annex 3: List of necessary materials needed for a haemodynamic assessment

Code	Label	Notes/Pictures
EMEQCLOCN1-	NURSES WATCH	
EMEQSTET1--	STETHOSCOPE, single head, adult diaphragme	
EMEQSTET2--	STETHOSCOPE, dual head, 2 diaphragms, adult/child	
EMEQSTET4--	STETHOSCOPE, dual head, infant (Littmann Classic II)	
EMEQSPHY1A-	SPHYGMOMANOMETER, one-hand manometer, velcro, adult	Designed to fit around an arm or thigh. The nylon cuff measures 57 x 14.5 cm
EMEQSPHY1P-	SPHYGMOMANOMETER, one-hand manometer, velcro, paediatric	Designed to fit around an arm or thigh. The nylon cuff measures 53 x 10.5 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
20-11-2018	Brigitte Ireson-Valois	1	No previous document: shared with NCCG
13-12-2018	BIV	2	Compilation of feedback and edits by NCCG. Shared with NCCG
09-01-2019	BIV	3	Compilation of feedback and edits by NCCG. Shared with Critical care and Paediatric working groups
21-03-2019	BIV	4	Includes feedback and edits by external working groups. Re-viewed by NCCG
04-04-2019	BIV	4.1	Compilation of feedback and edits by NCCG. Questions pending to be discussed with NCCG
17-04-2019	BIV	5.0	Compilation of feedback and discussions by NCCG. To be sent for external proof-reading
14-08-2019	BIV	6.0	Compilation of feedback from proof-readers. Discussed with NCCG
07-10-2019	BIV	7.0	Finalized by the NCCG. Awaiting illustrations
22.03.2020	AM	v1.0-2020	Finalized.