

Measuring blood pressure Part 1: Equipment

Naomi Stetson, formerly Lead Nurse, Peart-Rose Clinic, Imperial College Healthcare NHS Trust, London

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Arterial blood pressure is measured frequently throughout clinical practice. The readings provide part of an overall assessment of the patient's condition and are vital in the monitoring and treatment of long-standing hypertension. Blood pressure is the pressure that the blood exerts against the inner walls of the blood vessels, and the force that keeps blood circulating continuously, even between heartbeats (Marieb & Kellor, 2018). The pressure of blood varies throughout the body. Blood emerges from the left ventricle into the arterial system at a pressure of about 120–140 mmHg, falling to about 35 mmHg in the arteriolar capillaries. Arterial blood pressure can be measured directly and indirectly. The direct method, seen in acute care units, involves placing a small cannula in an artery to directly measure the pressure, which is then transduced to a monitor to provide a trace. Indirect measurement involves using a sphygmomanometer to record the blood pressure electronically, or manually via auscultation (listening to the Korotkoff sounds of blood pressure) with a stethoscope.

A sphygmomanometer comprises a cuff, an inflation bladder inside the cuff, a bulb used to inflate the cuff (in manual versions) and a measuring unit. The cuff encircles the arm and is usually held in place with Velcro attachments. The cuff is attached to the measuring unit via tubing, with a plastic or metal connector. Mercury, aneroid and digital (oscillometric) sphygmomanometers are available. The mercury sphygmomanometer measures pressure using a mercury manometer; aneroid devices use a needle pressure gauge with standard markings ranging from 0 to 300 mmHg, marked in intervals of 2 mm; digital sphygmomanometers use pressure sensors and display the blood pressure reading on a screen. Mercury sphygmomanometers were the mainstay of blood pressure recordings and management for many years.

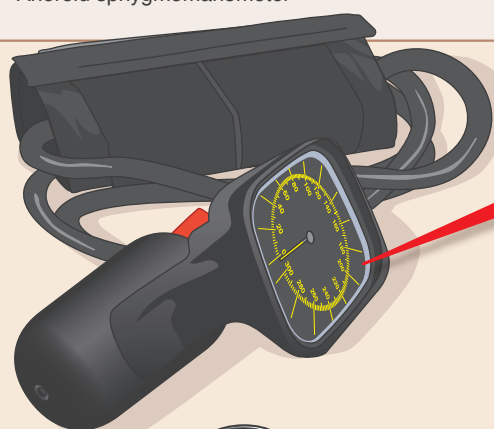
Although they are reliable and have formed the gold standard of measurement, mercury devices are being withdrawn internationally for health and safety reasons—notably the problem of dealing safely with mercury spillages and the ultimate disposal of mercury (EA, 2014). Alternatives to mercury sphygmomanometers are now required for routine clinical use; however, aneroid devices may be less accurate than mercury sphygmomanometers and their alternatives, particularly over time (NICE, 2019) and electronic devices may not measure blood pressure accurately if the patient has an irregular pulse (NICE, 2019). Assess and evaluate published literature about the accuracy of the devices available. The British and Irish Hypertension Society (BIHS) provides a list of validated sphygmomanometers (see: <https://bihsoc.org>).

There has been much research highlighting the inaccurate way in which healthcare professionals record blood pressure (Hatchett *et al.*, 2007). The care and accuracy of the person taking the measurement and the efficiency of the equipment all influence the readings. Use a standardised approach and consider factors that may influence the reading, such as patient anxiety and the effects of exercise. Palpate the patient's brachial or radial artery before measuring blood pressure and, if the pulse is irregular, take the blood pressure manually with auscultation over the brachial artery (Carvalho *et al.*, 2020; NICE, 2019). If a patient is obese, and cuffs for electronic monitors do not fit, measure the blood pressure manually (Platini, 2018).

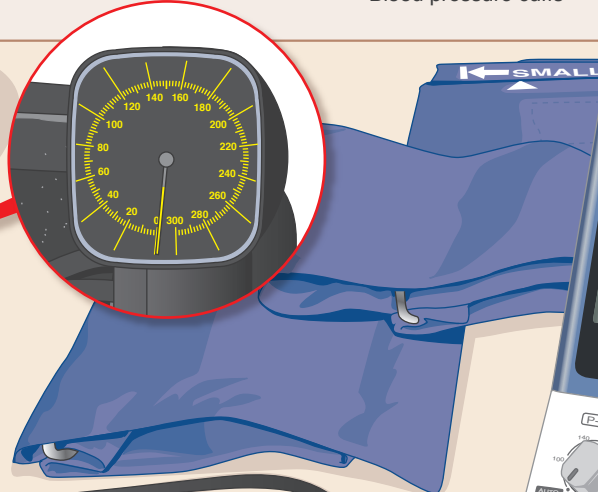
Updated local infection control policies have been created to combat the spread of COVID-19. When measuring blood pressure and cleaning any equipment, follow local guidelines (NICE, 2020).

Equipment

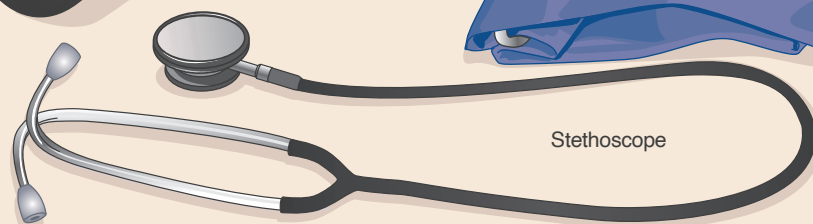
Aneroid sphygmomanometer



Blood pressure cuffs



Stethoscope



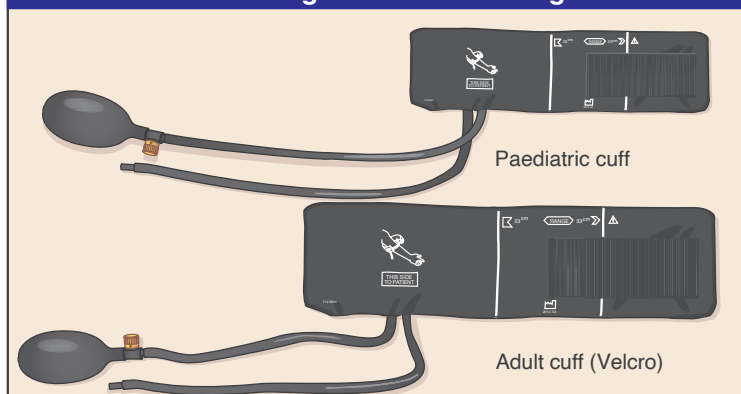
Digital sphygmomanometer

Aneroid (non-mercury) sphygmomanometers are still seen in practice. These devices work via a lever and bellows system (NICE, 2019). Before using, check the needle is at zero. Aneroid devices should be properly maintained and regularly calibrated (BIHS, 2020).

Do not undertake or attempt any procedure unless you have been assessed and signed off as competent by a properly trained, experienced and competent mentor. Always first explain the procedure to the patient and obtain their consent, in line with the policies of your employer or educational institution.

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Select a cuff containing a bladder of the right size



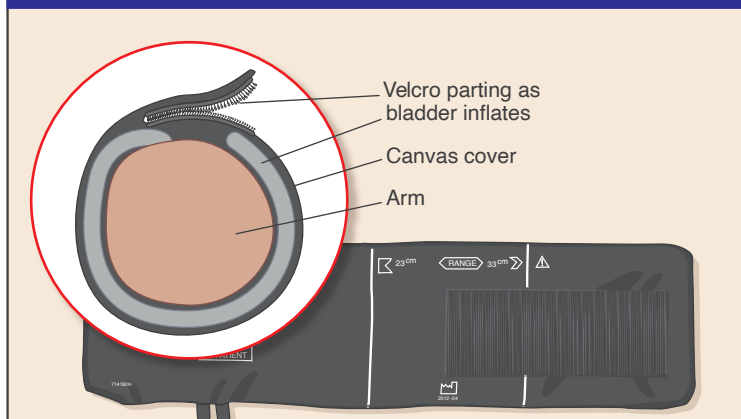
A range of cuffs is available for clinical use. Choose the correct cuff for the monitor you are using: cuffs are only validated for use with a specific monitor or machine—for example, cuffs from manual devices cannot be used with automated machines.

Measuring for bladder and cuff size



Selecting the correct bladder size is crucial for an accurate blood pressure reading (MHRA, 2021; BIHS, 2017). For example, when the bladder is too small (under-cuffing), you can overestimate the blood pressure (NICE, 2019; MHRA, 2013). With a tape measure, record and document the circumference of the mid upper-arm in centimetres. The width and length of the bladder should be about 40 per cent and 80 per cent of the circumference, respectively (MHRA, 2021; BIHS, 2017). Check manufacturers' markings on the cuff that indicate the appropriate arm circumference.

Check the cuff for wear and tear



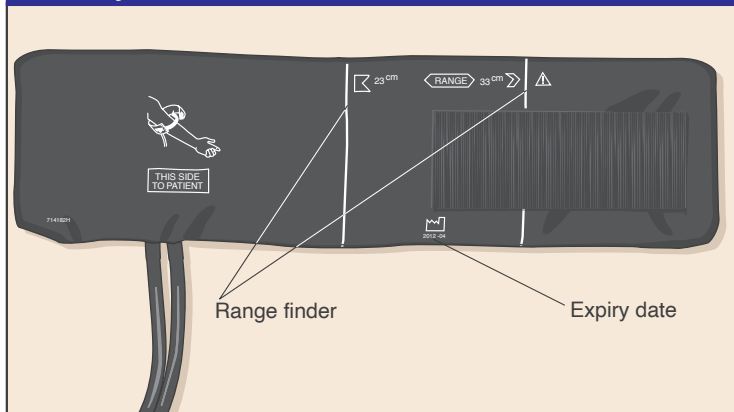
Check the cuff for signs of wear and tear (such as fluffing of the Velcro fastening). Over time, stitching can deteriorate and Velcro can slip during inflation (see inset). A loose cuff will not grip properly when inflated. Most cuffs have an expiry date; check that the cuff you are using has not gone past this date. The average life expectancy for a cuff is 18 months.

Disposable cuffs and sleeves



Due to COVID-19, when possible use disposable cuffs, or disposable sleeves to prevent cuffs from touching the arm (NICE, 2020).

Ensure you are familiar with the cuff



A cover surrounds the bladder. Usually the cuff is fastened by Velcro; sometimes the free end of the material is tucked in. The range finder is marked by two lines. When wrapped around the arm, the end of the cuff must fall within these two lines. If it does not, it is the wrong size.

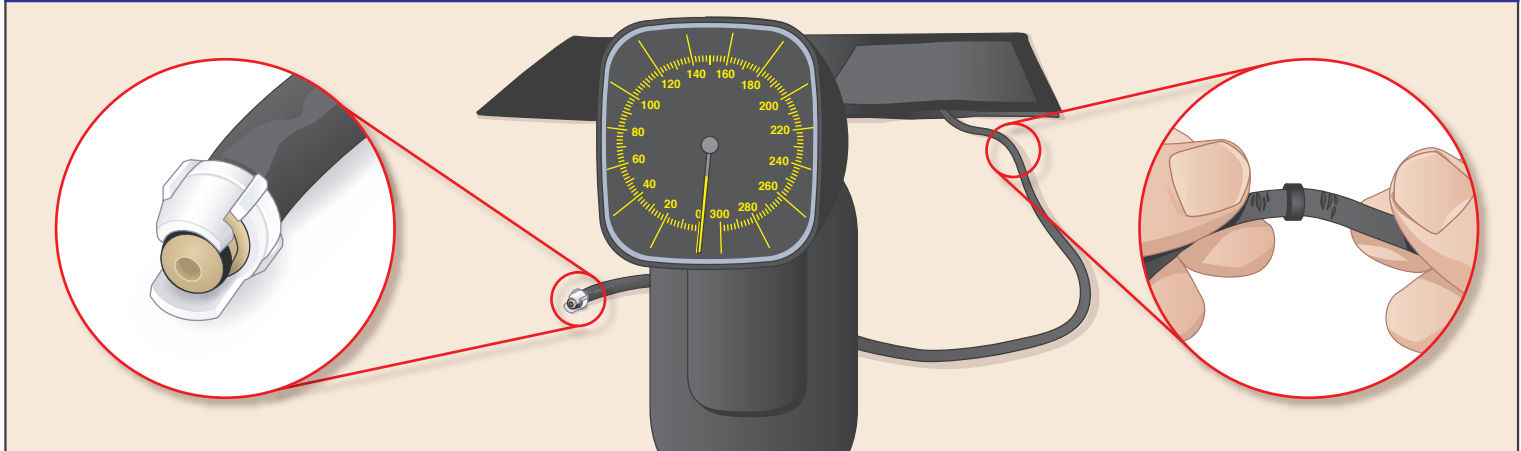
Cleaning or disposing of the cuff or sleeve



If using a reusable cuff, wipe it clean after each patient in line with local infection prevention and control policy. If using disposable sleeves or cuffs, follow local policy about their disposal (NICE, 2020).

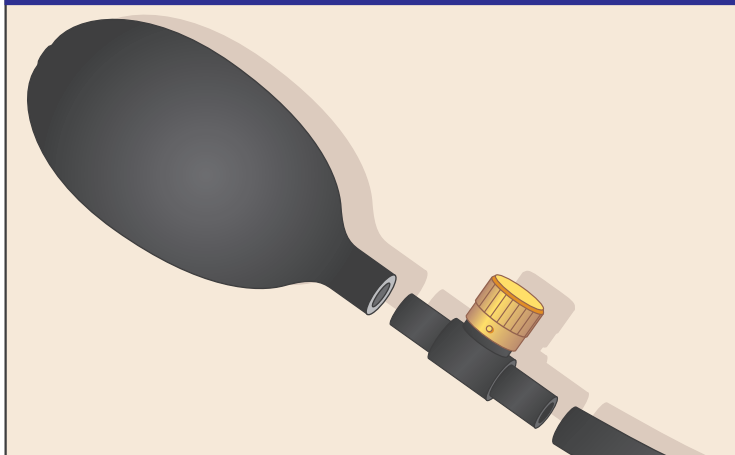
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Check the tubing for leaks



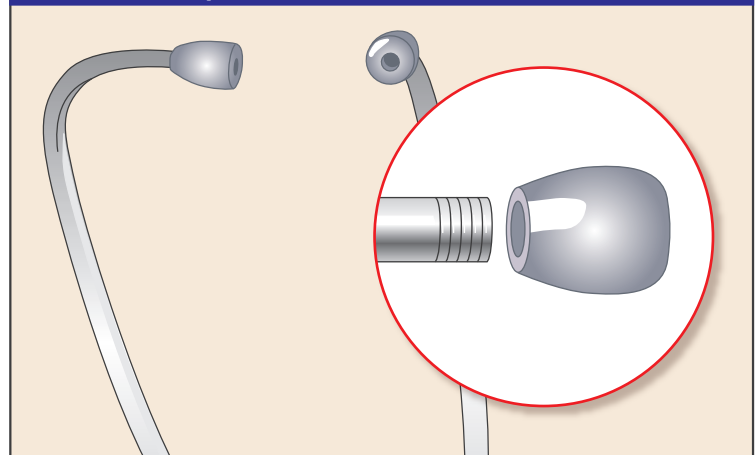
It is important to assess the quality of the tubing for cracks or any signs of perishing. Take time to check there are no leaks in the tubing system, such as where connectors join the various parts of the system. Cracked and leaking rubber tubing can make cuff deflation hard to control, resulting in an underestimation of systolic readings and overestimation of diastolic readings (NICE, 2019).

Inflation–deflation bulb



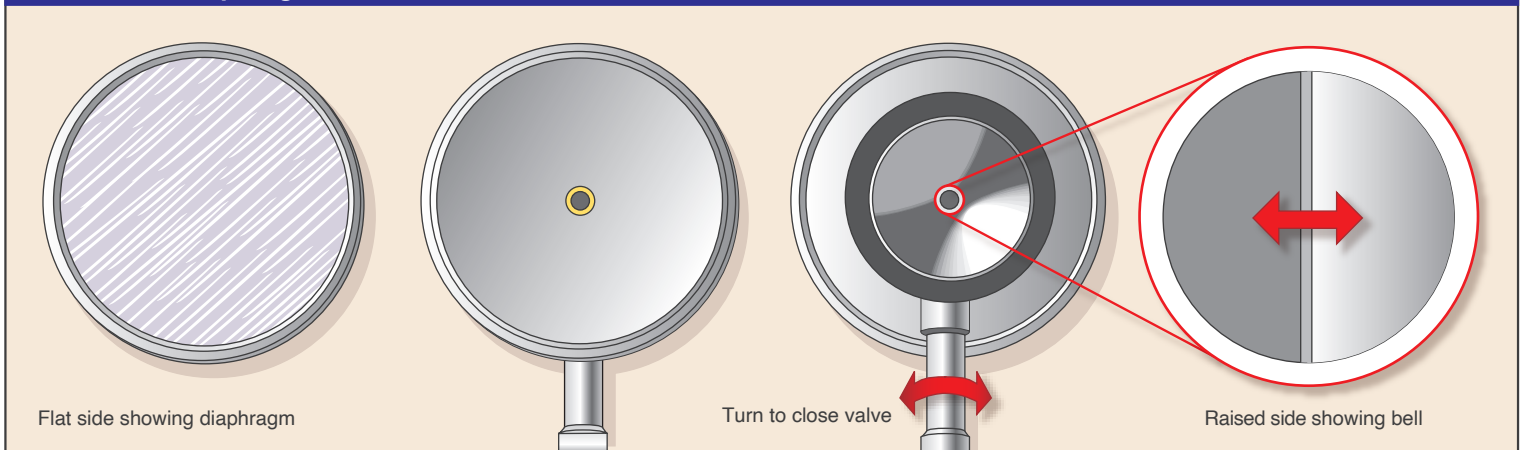
If a bulb is supplied with the device, it must work effectively, allowing the bladder to quickly inflate and deflate. Sometimes the control valve can become leaky. This is a problem not only for inflation of the bladder, but in allowing a steady deflation, which should be approximately 2 mmHg per second (NICE, 2019).

The stethoscope



It is best to buy your own stethoscope for taking manual blood pressures, to reduce the risk of cross-infection of the ears. Detachable ear pieces make it easy to check they are clear (see inset); they also rotate for a more comfortable fit. Follow local infection prevention and control policy. If a stethoscope is visibly contaminated, dismantle it and clean it thoroughly with alcohol or some other surface cleaner.

The bell and diaphragm



The stethoscope head has two sides, a raised bell-shaped side and a flat diaphragm. The diaphragm is often used in practice because it is easier to use; but the bell is designed to amplify low-frequency sounds. Familiarise yourself with both sides of the stethoscope and their uses. Clean the diaphragm or bell before and after placing it on the patient, using an alcohol-based cleaner.

Do not undertake or attempt any procedure unless you are, or have supervision from, a properly trained, experienced and competent person. Always first explain the procedure to the patient and obtain their consent, in line with the policies of your employer or educational institution.