

# **Guidelines for blood pressure measurement in children**

Children's Kidney Centre  
University Hospital of Wales  
Cardiff  
CF14 4XW

*DISCLAIMER: These guidelines were produced in good faith by the author(s) in conjunction with the paediatric nephrology team at the University Hospital of Wales, Cardiff reviewing available evidence/opinion. They were designed for use by paediatric nephrologists at the University Hospital of Wales, Cardiff for children under their care. They are neither policies nor protocols but are intended to serve only as guidelines. They are not intended to replace clinical judgment or dictate care of individual patients. Responsibility and decision-making (including checking drug doses) for a specific patient lie with the physician and staff caring for that particular patient.*

Dr Graham Smith

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## **Summary**

These guidelines are aimed at providing recommendations for measuring blood pressure in children.

## **Introduction**

Blood pressure measurement in children is just as important as in adults. Although hypertension is less common, it is often associated with an underlying cause. There are also an increasing number of children with hypertension associated with diet and obesity. Therefore, all children should have their blood pressure measured as part of routine examination and ward admission procedure.

## **Measurement**

The cuff used must be of an adequate size and the bladder width (not the cloth covering) should be approximately 40% of the arm circumference midway between the olecranon and the acromion. The cuff bladder will usually cover 80-100% of the circumference of the arm.

The bladder of the cuff should be placed over the artery and surround at least two thirds of the arm.

There are 2 common pieces of equipment in day to day use:-

- Anaeroid sphygmomanometer – with auscultation, palpation or pocket doppler
- Dinamap (or Hewlett Packard) equipment

In some high dependency patients, an arterial line may be used. Whilst undoubtedly very accurate if used correctly, there are certain rules which must be observed when using this and if you are not familiar with them, enquire.

## **Manual sphygmomanometer**

This is the generally accepted standard measurement. Sometimes it can be difficult to hear the pulse through the stethoscope. In which case a Doppler probe may be placed on the brachial artery (arm) or the posterior tibial / dorsalis pedis artery (leg) to enable easy auscultation. This may be particularly useful in infants and babies. A baby is "too small" to have its blood pressure taken.

Occasionally, the child may be so wriggly, or the clinical situation may dictate the blood pressure is taken by palpation. This is perfectly acceptable and gives a reasonable systolic measurement. The 'Hush' method can be used if palpation is difficult. The pocket doppler can also be used to detect the pulse.

The blood pressure cuff should be rapidly inflated to a pressure approximately 20 mmHg greater than that needed to occlude the brachial pulse. It is then recommended that the cuff is deflated at about 2-3 mmHg/s whilst listening over the brachial artery with the bell of the stethoscope. Systolic blood pressure is taken as the point when the "tapping" Korotkoff sounds (K1) are first heard. It is important to palpate the brachial pulse as the cuff is inflated, as in some instances the K1 sounds disappear as pressure is reduced and then reappear at a lower level - the auscultatory gap. If inflation pressure is then judged on the basis of auscultation, the

systolic pressure may be underestimated. The systolic pressure has been an easily defined point, in contrast to the controversy over the definition of diastolic pressure in children. The fourth Korotkoff sound (K4) is the point at which there is a distinct abrupt muffling of sounds, which become soft and blowing in quality. The fifth Korotkoff sound (K5) is the point at which all sounds disappear completely. It is recognised that there may be a significant difference between K4 and K5. Sinaiko et al. in a study of 19,274 children aged between 10 and 15 years, found that in 20% the K4-K5 difference was 5-10 mmHg, in 11% it was 11-20 mmHg and in 3% it was greater than 21 mmHg. In younger children it is also possible to hear Korotkoff sounds down to 0 mmHg, although when this occurs it is felt that diastolic hypertension is excluded. Because of these difficulties with assessing K5, the Second Task Force Report used K4 for children up to 13 years of age and K5 in older children. This approach has been modified in the most recent update and K5 has now been recommended in all age groups. However there is an ongoing debate, with some evidence that K4 is a more reliable measure of diastolic blood pressure in childhood and a better predictor of the development of hypertension in adult life than K5. In order to ensure that measurement of blood pressure in an individual patient is consistent it may be sensible to record all the relevant information e.g. BP: 120/75/69 mmHg, right arm, sitting with 9cm cuff.

However, the arguments over the measurement of diastolic pressure may in practice be of little consequence as there has been a move, particularly in adult practice, from an emphasis on diastolic blood pressure to a recognition that the systolic blood pressure may be of greater clinical importance. The previous preoccupation with diastolic blood pressure arose from the observation that systolic blood pressure rises with age whereas diastolic blood pressure does not. Recruitment into adult studies of hypertension therefore tended to be based on the detection of a diastolic blood pressure greater than 90 mmHg, regardless of systolic blood pressure. Data from adult studies now indicate that systolic hypertension is far more common than diastolic hypertension and that elevated systolic blood pressure, independent of diastolic blood pressure, shows a linear relationship with coronary heart disease death rates, at every level of diastolic blood pressure. Two intervention studies have also demonstrated the clinical importance of systolic hypertension.

### **Dinamap**

A Dinamap may be used for routine monitoring with the following conditions:

1. The Dinamap pulse must be equal to the patients pulse and this must be observed on each occasion.
2. All renal patients must have their blood pressure measured manually on admission.
3. All abnormally high or unexpected blood pressures must be re-checked with a manual sphygmomanometer. This is particularly important if considering using therapy (eg Nifedipine) for treating the blood pressure.

### **Normal blood pressure**

Children's' blood pressure is related to age and height – the younger or shorter the child, the lower the normal blood pressure. Thus a systolic pressure of 120, normal in an adult, might be dangerously high in a newborn baby.

If you are not certain that a blood pressure is normal for the age of the child from whom you are taking it, you should check it on a centile chart. These are readily available in the filing cabinet.

If a blood pressure is more than the 95th centile, it is abnormally high and should be re-checked.

### **High blood pressure**

A persistently elevated BP should be treated and investigated. If possible, hypertension should be further assessed using a 24 hour blood pressure recording. This is becoming the gold-standard for blood pressure assessment and normal values are available for children. Such studies can be carried out by the adult cardiology department, who have suitable sized cuffs for use in children.

No child should be discharged with a BP > 15 mm Hg above 95th centile. Inpatients with renal disease should have a line drawn on the observation chart at the level of the 95th centile and Nifedipine prn prescribed if the BP is above the safe level (usually 15 mm Hg above 95<sup>th</sup> centile).

If blood pressure is treated using a drug (eg Nifedipine) it must be re-checked manually 15-30 minutes later, and this result must be charted. If it has not responded to treatment adequately, further steps must be taken immediately to control it (calling doctor if appropriate).

### **Treatment**

See [Management of Hypertension](#).