



# Recommendations for devices for measuring ambulatory blood pressure based on validation evidence

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Over the last twenty or so years, the accuracy of the conventional Riva-Rocci/Korotkoff technique of blood pressure measurement has been questioned and efforts have been made to improve the technique with automated devices<sup>1</sup>. In the same period, recognition of the phenomenon of white coat hypertension, whereby some subjects with apparent elevation of blood pressure have normal, or reduced, blood pressures when measurement is repeated away from the medical environment, has focused attention on methods of measurement, which provide profiles of blood pressure behaviour rather than relying on isolated measurements under circumstances that may in themselves influence the level of blood pressure recorded<sup>2-4</sup>. Ambulatory blood pressure measurement (ABPM), which provides a profile of blood pressure behaviour over the 24-hour period, is now accepted as a valuable investigation in the diagnosis and management of hypertension, and the technique is being used increasingly in primary care<sup>1</sup>. The British Hypertension Society has published recommendations for the use and interpretation of ABPM in clinical practice<sup>5</sup>, and recently the European Society of Hypertension published recommendations on blood pressure measuring devices, including devices for ABPM<sup>6</sup>. For the primary care physician contemplating the use of ABPM, the first issue is that of purchasing a device.

## WHICH MONITOR TO BUY?

A large variety of ambulatory blood pressure measurement devices are now available on the market, and the number will increase as the technique of ambulatory blood pressure measurement becomes more widespread<sup>6</sup>. A number of factors should in-

fluence this choice, among which the most important is to ensure that the device has been validated independently according to either the protocol of British Hypertension Society<sup>7</sup>, and or that of the Association for the Advancement of Medical Instrumentation<sup>9</sup>. The ABPM devices that have fulfilled the criteria of these protocols are shown in table 1.

## PRESENTING THE DATA

Ambulatory blood pressure measurement devices are usually sold with individual software packages, which present data in a variety of ways. It would facilitate practice if the graphic presentation of ambulatory blood pressure measurement data were standardised, much as is the case for ECG recordings, so that the presentation of data would be independent of the type of monitor used. The DABL™ Program (ECF Medical Ltd, Blackrock, Co. Dublin) can provide a graphic display of ambulatory blood pressure measurement data (on screen or printout) with a visual time/pressure graph with blood pressure plotted on the vertical axis and time on the horizontal axis, and levels of normality can also be shown<sup>9,10</sup>. The

**Tabla 1.** Ambulatory blood pressure measuring devices which have fulfilled validation criteria of the BHS and AAMI protocols and are recommended for general clinical use (from reference 6\*)

A & D TM-2420 Model 6	Meditech ABPM-04
A & D TM-2420 Model 7	Profilomat I
A & D TM-2421	QuietTrak
A & D Takeda 2430	Save 33, Model 2
CH-DRUCK	Schiller BR-102
Daypress 500	SpaceLabs 90202
DIASYS Integra	SpaceLabs 90207
ES-H531	SpaceLabs 90217

\*This review extends to January 2000.

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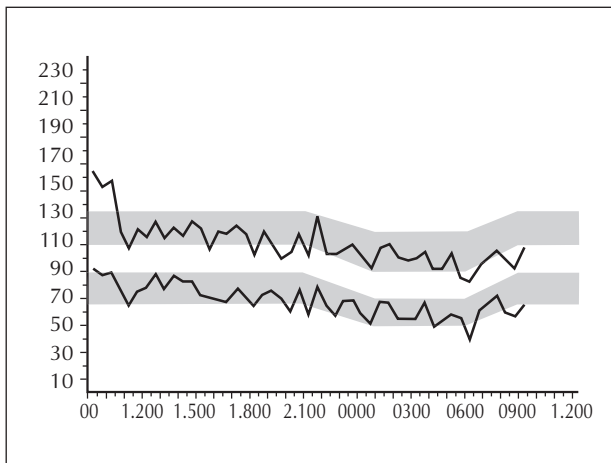


Fig. 1.—Computer generated DABL™ Report for ABPM: This 24-hour ABPM indicates white coat hypertension with pressures in the first hour averaging 162/90 mmHg, but thereafter day and night time blood pressures are within normal limits.

program also provides a printed report derived from the ambulatory blood pressure measurement data (fig. 1) This facility reduces the cost of performing ABPM by removing the need for a physician to have to interpret and report on each ABPM.

### CLINICAL INDICATIONS FOR AMBULATORY BLOOD PRESSURE MEASUREMENT

Though in practice, the average day (or night-time) blood pressures are used to govern decisions, the clinical use of ambulatory blood pressure measurement has allowed for a number of phenomena in hypertension to be more clearly identified than is possible with other methods of blood pressure measurement<sup>10,11</sup>. (fig. 2). ABPM is recommended in the following categories of hypertension<sup>5</sup>.

#### Patients with white coat hypertension

The most popular definition is that blood pressure measured by conventional techniques in the office, clinic or surgery is above 140/90 mmHg, but when ABPM is performed the blood pressures are normal throughout the 24-hour period, except perhaps during the first hour of the 24-hour recording when the patient is under the pressor influence of the medical environment while having the monitor fitted<sup>5,12</sup>. (fig. 1) WCH is common being present in about a quarter of people who appear to have hypertension with conventional measurement<sup>2,13</sup>.

#### Patients with clinic borderline hypertension

The same reasoning applies to patients with borderline elevation of blood pressure, especially young subjects, in whom life-long drug therapy may be inappropriately prescribed, and who may be penalised for insurance or employment if the diagnosis of «hypertension» is misapplied.

#### Elderly patients in whom treatment is being considered

The results of the ambulatory study of the Systolic Hypertension in Europe (Syst-Eur) Trial show that systolic blood pressure measured conventionally in the elderly may average 20 mmHg higher than daytime ambulatory blood pressure<sup>14</sup>, thereby leading to inevitable over-estimation of isolated systolic hypertension in the elderly and probable excessive treatment of the condition. Moreover, results from this study also show that ambulatory systolic blood pressure was a significant predictor of cardiovascular risk over and above conventional systolic blood pressure. A number of ambulatory patterns are found in the elderly, among which are a number of hypotensive states due to baroreceptor or autonomic failure. As the elderly can be particularly susceptible to the adverse effects of blood pressure lowering drugs, identification of hypotension becomes particularly important<sup>15</sup>, though its management may present a considerable therapeutic challenge.

#### Nocturnal hypertension

Ambulatory blood pressure measurement is the only non-invasive blood pressure measuring technique that permits measurement of blood pressure during sleep. The relevance of nocturnal hypertension is still controversial, but there is increasing evidence that night-time blood pressure may provide important information. Nocturnal blood pressure levels, for example, are independently associated with end-organ damage<sup>16,17</sup>, over and above the risk associated with daytime values. It has also been shown that absence of nocturnal «dipping» of blood pressure to lower levels than during the day is associated with target organ involvement, and may be a useful (though non-specific) clue as to the presence of secondary hypertension.

#### Patients with resistant hypertension

In patients whose conventional blood pressure remains consistently above 150/90 mmHg in spite of

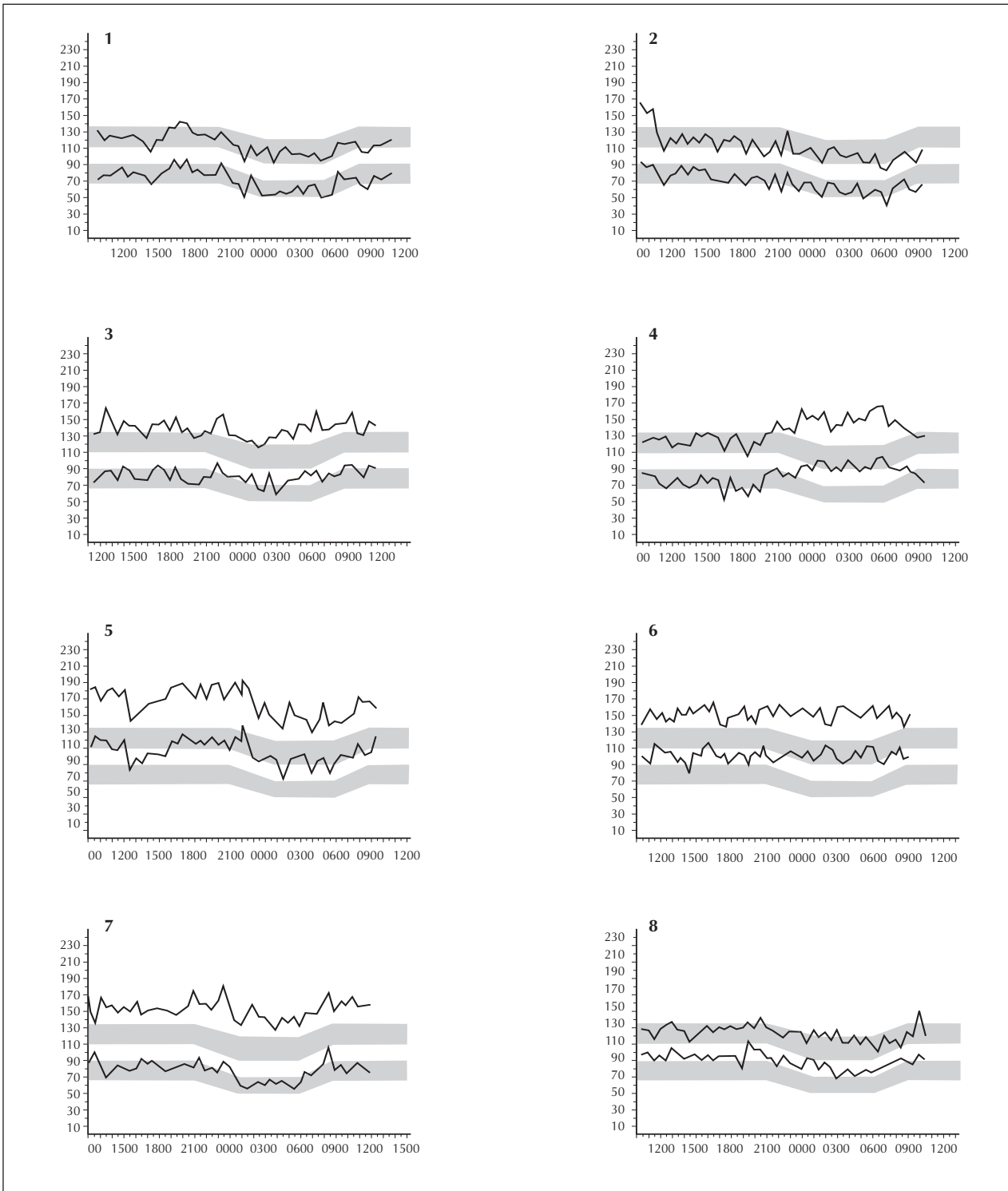


Fig. 2.—Examples of ambulatory blood pressure patterns plotted by the DABL Program. Vertical axis - blood pressure level; horizontal axis - 24-hour clock times; horizontal bands - normal levels for 24-hour systolic and diastolic blood pressures; shaded vertical area - night-time; vertical bar on left - office blood pressures. Pattern examples: (1) normotension; (2) white-coat hypertension; (3) borderline hypertension; (4) nocturnal hypertension; (5) systolic and diastolic hypertension, dippers; (6) systolic and diastolic hypertension, non-dippers; (7) isolated systolic hypertension; (8) isolated diastolic hypertension.

treatment with three antihypertensive drugs, ABPM may indicate that the apparent lack of response is due, in fact, to the white coat phenomenon, or the presence of a non-dipping nocturnal pattern may suggest secondary hypertension.

### **Ambulatory blood pressure measurement in pregnancy**

As in the non-pregnant state, the main use for ambulatory blood pressure measurement in pregnancy is the identification of white coat hypertension, which may occur in nearly 30% of pregnant women. [18] Its recognition is important so that pregnant women are not admitted to hospital or given antihypertensive drugs unnecessarily or excessively.

### **Ambulatory hypotension**

Reference has already been made to the clinical use of ambulatory blood pressure measurement in identifying hypotensive episodes in the elderly, but it may also be used in young patients in whom hypotension is suspected of causing symptoms<sup>15</sup>. Ambulatory blood pressure measurement may also demonstrate drug-induced drops in blood pressure in treated hypertensive patients, which may have untoward effects in patients with a compromised arterial circulation, such as those with coronary and cerebrovascular disease<sup>19</sup>.

### **Ambulatory blood pressure measurement as a guide to drug treatment**

The role of ambulatory blood pressure measurement in guiding drug treatment is currently the subject of much research, and its place in this regard has not yet been fully established. However, recent reviews of the clinical value of ambulatory blood pressure measurement, have highlighted the potential of 24-hour recordings of blood pressure in guiding antihypertensive medication<sup>20,21</sup>. Furthermore, a recent well-controlled study showed that when ambulatory blood pressure measurement was used as the basis for prescribing rather than clinic blood pressure, significantly less antihypertensive medication was prescribed<sup>3</sup>.

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