



# How to interpret an ambulatory blood pressure report

by Assoc Prof Harry Mond | OAM | MBBS | PHD | MD | FRACP | FCSANZ | FACC | FHRS

# About Cardiac Monitoring Service

Cardiac Monitoring Service's team of cardiac technicians meet the highest compliance and analytical standards, while delivering the latest heart monitoring software and devices.

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Over 30 years of reputable and trusted cardiac monitoring

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500k hearts analyzed and reported on each year

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Trusted by medical experts in 8 countries worldwide

## About Assoc Prof Harry Mond

Cardiac Monitoring Service Medical Director Assoc Prof Harry Mond is a founding member of Cardiac Monitoring Service and remains among the world's top experts in the interpretation of ECG and Holter studies.

As an international educator and author of 260+ peer-reviewed manuscripts and books, he provides regular training and professional development to our team of certified cardiac technicians to ensure the highest clinical standards.

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### Notable achievements

- Pioneer in Cardiac Pacing and Electrophysiology of the US Heart Rhythm Society
- Lifetime Achievement Award, Royal Melbourne Hospital
- Medal of the Order of Australia
- Founding member & Medical Director, CardioScan (Australia, Hong Kong, Singapore, United Kingdom)
- Medical Director, Cardiac Monitoring Service (USA)
- Fellow Royal Australasian College of Physicians
- Associate Professor University of Melbourne & Monash University
- Cardiac fellow Emory University, Atlanta, Georgia
- Honorary Fellowship, Hong Kong College of Cardiology

# Ambulatory blood pressure monitoring has in recent years become a recognized and reliable method for confirming hypertension.

The National Heart Foundation of Australia in its summary of recommendations states that “ambulatory blood pressure monitoring be offered to patients with a blood pressure  $\geq$  140/90 in order to confirm the blood pressure level”.

Indeed, United States, British and European guidelines recommend ambulatory blood pressure monitoring as a cost-effective, diagnostic tool for all patients with suspected hypertension. Sophisticated, automated, 24-hour ambulatory blood pressure monitors are now available. However, like all investigations, the results depend on the quality of the recordings and their interpretation in the clinical setting.

Ambulatory blood pressure monitoring should cover close to a 24-hour period with >70% of recordings being valid. Recordings are usually performed each 30 minutes during the day and at least hourly overnight. It is recommended that at least 14 recordings be performed during the daytime period. However, monitoring is not without its difficulties with the cuff inflation sometimes being painful and unacceptable and the patient removing the monitor overnight because of difficulty sleeping. Invalid recordings may occur if the cuff is not appropriately attached, removed and reattached by the patient or there is a leak or obstruction in the tubing.

Movement during the recording may also result in an invalid measurement. In these situations, measurements are frequently automatically repeated and there may be enough data (> 14 recordings) to establish a diagnosis even if the figure of valid measurements is < 70%. Other issues include faulty batteries, incorrect times recorded and failure to document sleep and wake times.

The interpretation of the results is a clinical assessment, taking in to consideration well established risk factors for cardiac disease. Consequently, the referring doctor can modify the report conclusions to suit the circumstances such as a young diabetic with renal disease who requires optimal control. The referring doctor and not the reporting physician should review the patient diary with the patient.

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**Table 1:** Accepted normal limits for ambulatory blood pressure recordings.

Ambulatory Blood Pressure	Systolic (mmHg)	Diastolic (mmHg)
Over 24 hours	≤ 130	≤ 80
Awake (daytime)	≤ 135	≤ 85
Asleep (night-time)	≤ 120	≤ 70
% allowed above limit	< 25%	< 25%


**Table 2:** Guidelines on severity of recorded pressures (Clinical and not 24 hour ambulatory recordings).

Ambulatory Blood Pressure	Systolic (mmHg)	Diastolic (mmHg)
Optimal	< 120	< 80
Normal	120-129	80-84
High normal	130-139	85-89
Isolated systolic	> 140	< 90
Grade 1: Mild	140-159	90-99
Grade 2 : Moderate	160-179	100-109
Grade 3 : Severe	≥ 180	≥ 110
Emergency	> 220	> 140

## So how do I interpret the report?

The front page provides patient details, mean blood pressures and conclusions. Remember, the requesting physician must interpret these conclusions in light of the clinical risk factors.

Six mean blood pressure values are reviewed; systolic and diastolic for 24 hour mean/awake/sleep periods. Each mean value should have 75% of the recordings at or below the normal level for it to be regarded as normal (**Table 1**). A single elevated mean value may not be clinically relevant and the report may still be regarded as normal. The severity of the hypertension will depend on an overall impression of the results and may differ from the clinical limits provided in **Table 2**.

<b>Customer Name</b> <b>Ambulatory Blood Pressure Report</b>	
<b>Patient / Laboratory No:</b>	123456
<b>Surname:</b>	Doe
<b>First Name:</b>	Jane
<b>Date Of Birth:</b>	10/10/1950
<b>Gender:</b>	Female
<b>Referring Practitioner:</b>	Dr Smith
<b>Date of Commencement:</b>	29/09/2014
<b>Mean BP:</b>	121/73 mmHg
<b>Awake:</b>	123/75 mmHg
<b>Asleep:</b>	113/68 mmHg
<b>Conclusion:</b>	Normal 24-hour ambulatory blood pressure recording
<b>Reported By Consultant Cardiologist:</b>	Doctors Name
	
<b>Reported On:</b>	02/10/2014
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So how do I interpret the report?

**Page 2** summarizes the recorded data.

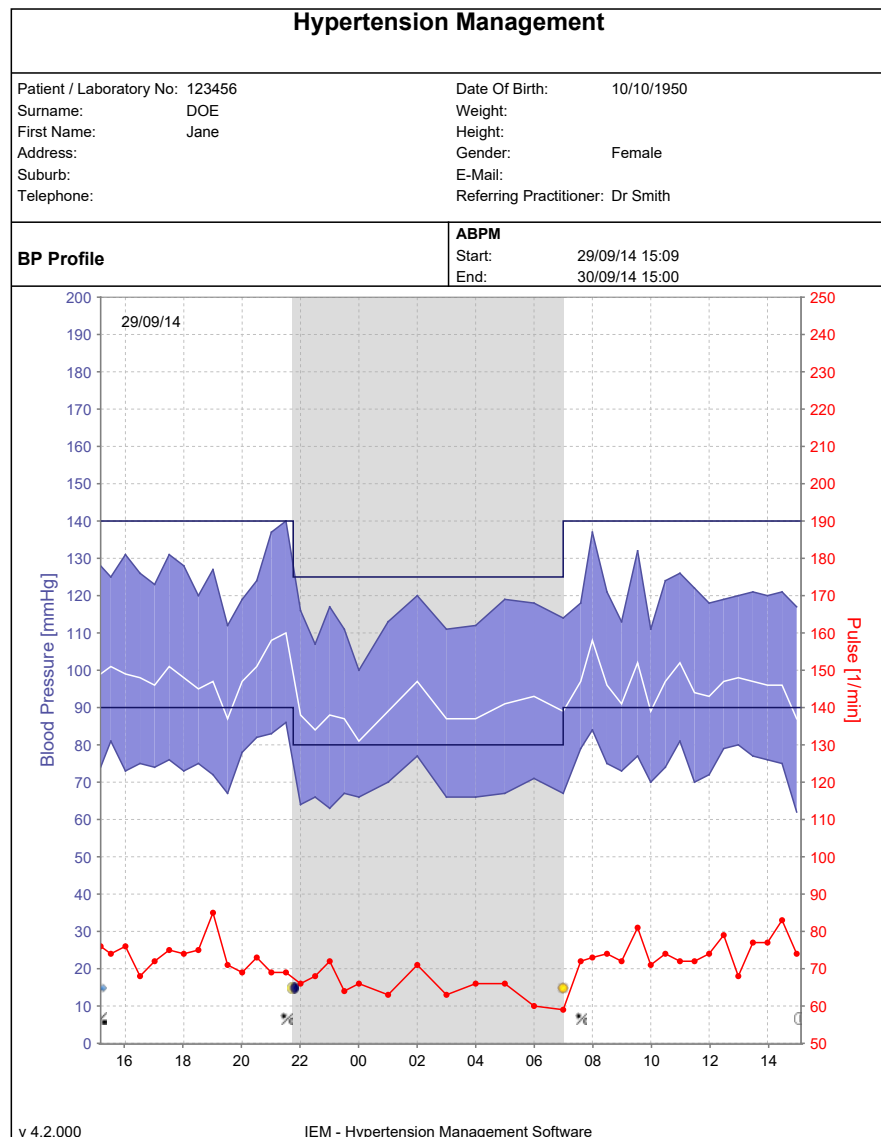
At least 14 valid recordings are required for a satisfactory study. Sometimes because of an incomplete study due to discomfort, a smaller number of recordings may be accepted rather than repeat the study. The mean pressures and percentage above the limit (<25%) are evaluated to determine if hypertension is present

Hypertension Management							
Patient / Laboratory No: 123456			Date Of Birth: 10/10/1950				
Surname: DOE		Weight:		Height:			
First Name: Jane		Gender: Female		E-Mail:			
Address:		Referring Practitioner: Dr Smith		Telephone:			
<b>Diagnostic Findings</b>			<b>ABPM</b>				
			Start: 29/09/14 15:09		End: 30/09/14 15:00		
		Total		Day		Night	
		Value	Target	Value	Target	Value	Target
<b>Time</b>							
Start		29/09/14 15:09		07:00		21:45	
End		30/09/14 15:00		21:44		06:59	
Duration		23:51		14:36		09:15	
<b>Measurements</b>							
Total		42		31		11	
valid		42		31		11	
valid	%	100	>70	100		100	
<b>Average: over single measurements</b>							
Systole	mmHg	121	<130	123	<135	113	<120
Diastole	mmHg	73	<80	75	<85	68	<70
Average Arterial Pressure	mmHg	95		97		88	
Pulse	1/min	72		73		66	
Pulse Pressure	mmHg	47		48	<60	46	
<b>Std.-Dev.</b>							
Systole	mmHg	8.1		7.1	<17	5.6	<13
Diastole	mmHg	6.0		5.2	<13	3.7	<10
Average Arterial Pressure	mmHg	6.4		5.4		4.1	
Pulse	1/min	5.6		4.8		3.3	
Pulse Pressure	mmHg	5.7		5.7		5.4	
<b>Values above limit</b>							
Systole	%	2		3	<25 (1)	0	<25 (3)
Diastole	%	0		0	<25 (2)	0	<25 (4)
<b>Maximum</b>							
Systole	mmHg	140	21:30	140	21:30	120	02:00
Diastole	mmHg	86	21:30	86	21:30	77	02:00
Pulse	1/min	85	19:00	85	19:00	72	23:00
<b>Minimum</b>							
Systole	mmHg	100	00:00	111	10:00	100	00:00
Diastole	mmHg	62	15:00	62	15:00	63	23:00
Pulse	1/min	59	07:00	59	07:00	60	06:00
Values above limit(1) >= 140 (2) >= 90 (3) >= 125 (4) >= 80							
<b>Dipping</b>							
Systole	%	8.3 (Non-Dipper)					
Diastole	%	10.5 (Normal)					
Dipping <0% Inverted; <10% Non-Dipper; <20% Normal; >=20% Extreme							
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So how do I interpret the report?

**Page 3** graphs the measurements above and below the systolic or diastolic limits with night (asleep) values being shaded.

Occasional peaks indicate a temporary rise in pressure although the mean levels and the % above the limit (25%) are still within normal limits. If the monitor exceeds 24 hours, then another day is graphed, even though there may only be few recordings.



So how do I interpret the report?

**Page 4** lists the individual recordings including those which were not valid and the reasons for this.

Nocturnal measurements are in the shaded areas. This may extend over two pages. Abnormal values are in red.

The final report may include another four pages which present the data in graph form. For clinical usage, this is unnecessary, but included in the final report as some physicians request information in this format.

Hypertension Management							
Patient / Laboratory No: 123456				Date Of Birth: 10/10/1950			
Surname: DOE				Weight:			
First Name: Jane				Height:			
Address:				Gender: Female			
Suburb:				E-Mail:			
Telephone:				Referring Practitioner: Dr Smith			
<b>Table</b>						<b>ABPM</b>	
						Start: 29/09/14 15:09	
						End: 30/09/14 15:00	
No.	Date	Time	sys	Avera	Dia	Pulse	Code Comment
29/09/14	15:09	128	99	74	76	100	Start of a manual measurement
29/09/14	15:30	125	101	81	74		
29/09/14	16:00	131	99	73	76		
29/09/14	16:30	126	98	75	68		
29/09/14	17:00	123	96	74	72		
29/09/14	17:30	131	101	76	75		
29/09/14	18:00	128	98	73	74		
29/09/14	18:30	120	95	75	75		
29/09/14	19:00	127	97	72	85		
29/09/14	19:30	112	87	67	71		
29/09/14	20:00	119	97	78	69		
29/09/14	20:30	124	101	82	73		
29/09/14	21:00	137	108	83	69		
29/09/14	21:30	140	110	86	69		
29/09/14	21:31					124	The day/night button was not pressed during the set time fra
29/09/14	22:00	116	88	64	66		
29/09/14	22:30	107	84	66	68		
29/09/14	23:00	117	88	63	72		
29/09/14	23:30	111	87	67	64		
30/09/14	00:00	100	81	66	66		
30/09/14	01:00	113	89	70	63		
30/09/14	02:00	120	97	77	71		
30/09/14	03:00	111	87	66	63		
30/09/14	04:00	112	87	66	66		
30/09/14	05:00	119	91	67	66		
30/09/14	06:00	118	93	71	60		
30/09/14	07:00	114	89	67	59		
30/09/14	07:36	118	97	79	72	123	The day/night button was pressed during the set time frame,
30/09/14	08:00	137	108	84	73		
30/09/14	08:30	121	96	75	74		
30/09/14	09:00	113	91	73	72		
30/09/14	09:33	132	102	77	81		
30/09/14	10:00	111	89	70	71		
30/09/14	10:30	124	97	74	74		
30/09/14	11:00	126	102	81	72		
30/09/14	11:30	122	94	70	72		
30/09/14	12:00	118	93	72	74		
30/09/14	12:30	119	97	79	79		
30/09/14	13:00	120	98	80	68		
30/09/14	13:30	121	97	77	77		
30/09/14	14:00	120	96	76	77		
30/09/14	14:30	121	96	75	83		
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Cardiac Monitoring Service was established 30+ years ago by our Medical Director Assoc Prof Harry Mond, and has grown today to one of the largest services of its kind globally, overseeing more than 500k+ heart studies annually – operating in 10 countries including UK, US, Australia, Hong Kong, Malaysia and Singapore, among others.