



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.

Over 30 years of reputable and trusted cardiac monitoring

500k hearts analyzed and reported on each year

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.

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**.

Customer Name Ambulatory Blood Pressure Report	
Patient / Laboratory No: 123456 Surname: Doe First Name: Jane Date Of Birth: 10/10/1950 Gender: Female Referring Practitioner: Dr Smith Date of Commencement: 29/09/2014	
Mean BP: Awake: Asleep:	121/73 mmHg 123/75 mmHg 113/68 mmHg
Conclusion: Normal 24-hour ambulatory blood pressure recording	
Reported By Consultant Cardiologist: Doctors Name 	
Reported On:	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:	
First Name:	Jane	Height:	
Address:		Gender:	Female
Suburb:		E-Mail:	
Telephone:		Referring Practitioner:	Dr Smith

Diagnostic Findings						ABPM
						Start:
						29/09/14 15:09
						End: 30/09/14 15:00

Time	Total		Day		Night	
	Value	Target	Value	Target	Value	Target
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	
Measurements						
Total	42		31		11	
valid	42		31		11	
valid %	100	>70	100		100	
Average: over single measurements						
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
Std-Dev.						
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
Values above limit						
Systole	%	2		3 <25 (1)		0 <25 (3)
Diastole	%	0		0 <25 (2)		0 <25 (4)
Maximum						
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
Minimum						
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

Dipping						
Systole	%	8.3	(Non-Dipper)			
Diastole	%	10.5	(Normal)			

Dipping <0% Inverted; <10% Non-Dipper; <20% Normal; >=20% Extreme

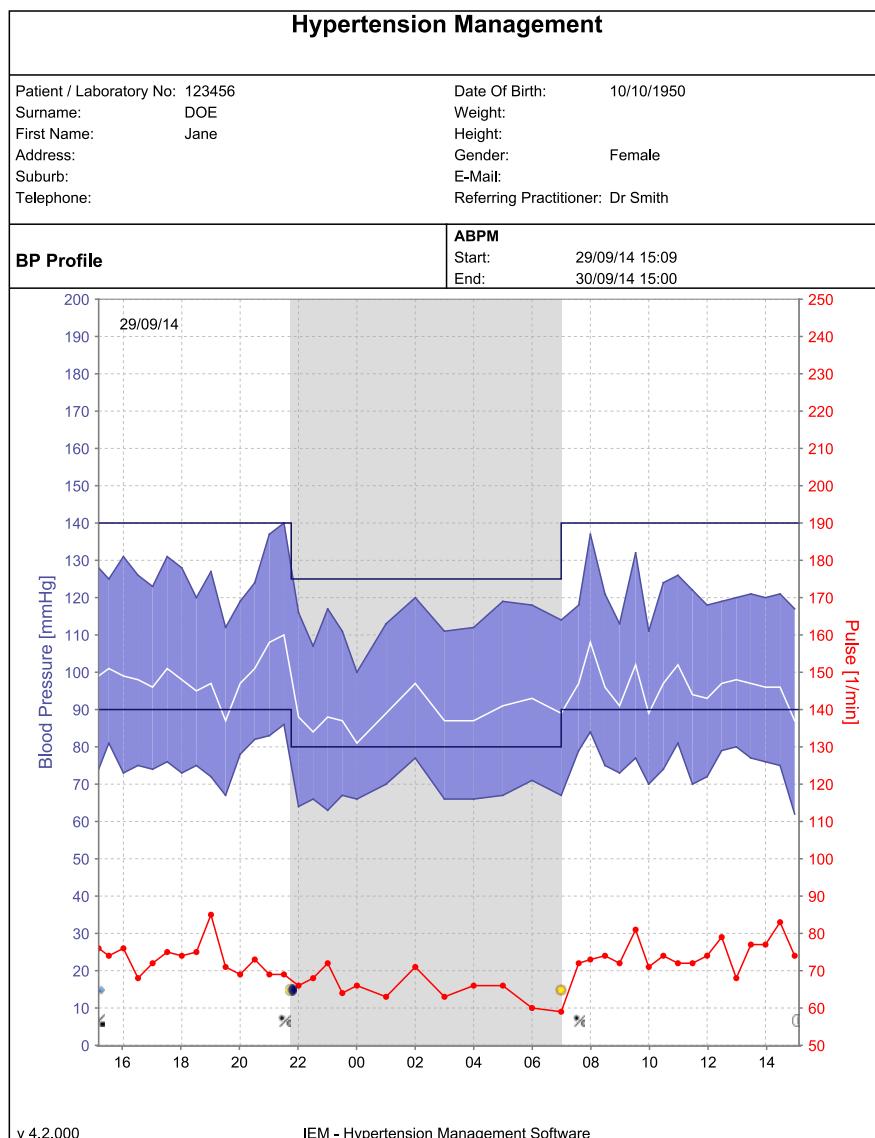
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IEM - Hypertension Management Software

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									
Table				ABPM							
				Start: 29/09/14 15:09							
				End: 30/09/14 15:00							
No.	Date	Time	sys	Avera	Dia	Pulse	Code				
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 frame				
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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CardioScan, the parent company of Cardiac Monitoring Service, was established 40+ years ago by 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.

