

# Ambulatory Blood Pressure Monitoring; Indications and Interpretation

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# Ambulatory Blood Pressure Monitoring

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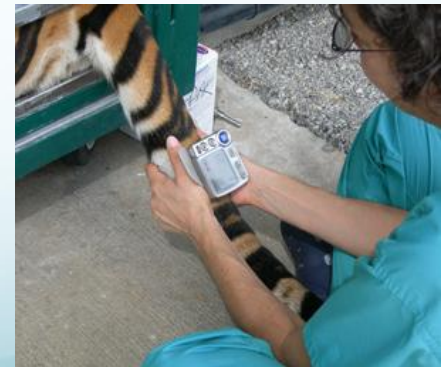
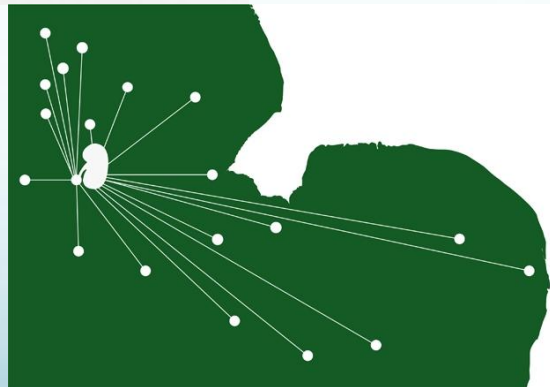
BY  
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# ABPM – An overview



World Health Organization

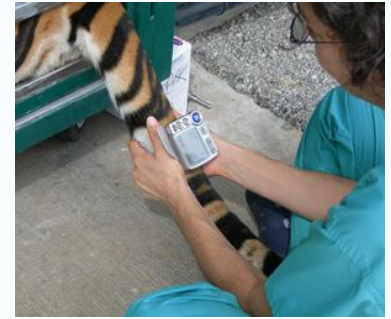


# ABPM – How?



**A tiger's blood pressure is measured by a cuff on the tail.**

# ABPM – How?



# ABPM – Why?



# ABPM – Why?



**Treated hypertensives**  
Pierdomenico et al. [41]  
126 MH/742, 63 events

Bobrie et al. [16]  
462 MH/4939, 324 events

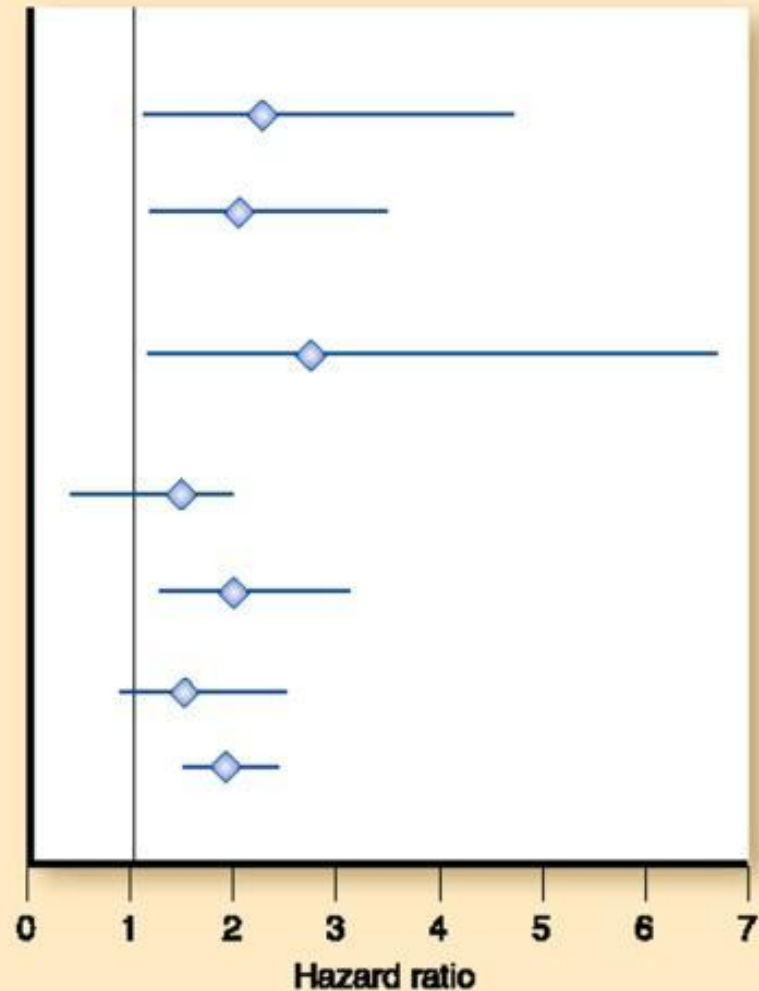
**Untreated hypertensives**  
Björklund et al. [29]  
82 MH/578, 72 events

**Mixed**  
Fagard et al. [31]  
31 MH/391, 86 events

Ohkubo et al. [22]  
221 MH/1332, 152 events

Hansen et al. [32]  
211 MH/1700, 156 events

**Total**



# ABPM – Why?



**TABLE 3. Relative Risks (95% Confidence Interval) Per 10 mm Hg Increase in Systolic Blood Pressure and Per 5-mm Hg Increase in Diastolic Blood Pressure for Cardiovascular Mortality**

| Variables                 | Univariate        | Adjusted          |
|---------------------------|-------------------|-------------------|
| Ambulatory blood pressure |                   |                   |
| Systolic 24-hours         | 1.72 (1.48–2.01)‡ | 1.51 (1.28–1.77)‡ |
| Systolic daytime          | 1.70 (1.46–1.99)‡ | 1.50 (1.27–1.76)‡ |
| Systolic nighttime        | 1.61 (1.40–1.84)‡ | 1.41 (1.23–1.62)‡ |
| Diastolic 24-hours        | 1.38 (1.23–1.55)‡ | 1.43 (1.26–1.61)‡ |
| Diastolic daytime         | 1.35 (1.20–1.52)‡ | 1.40 (1.24–1.58)‡ |
| Diastolic nighttime       | 1.35 (1.22–1.51)‡ | 1.36 (1.22–1.51)‡ |
| Office blood pressure     |                   |                   |
| Systolic                  | 1.40 (1.25–1.57)‡ | 1.25 (1.10–1.42)† |
| Diastolic                 | 1.20 (1.07–1.34)* | 1.21 (1.08–1.35)† |

In multivariate analysis adjusted for age, and smoking status.

\* $P < 0.01$ .

† $P < 0.001$ .

‡ $P < 0.0001$ .

# ABPM – Who?



01

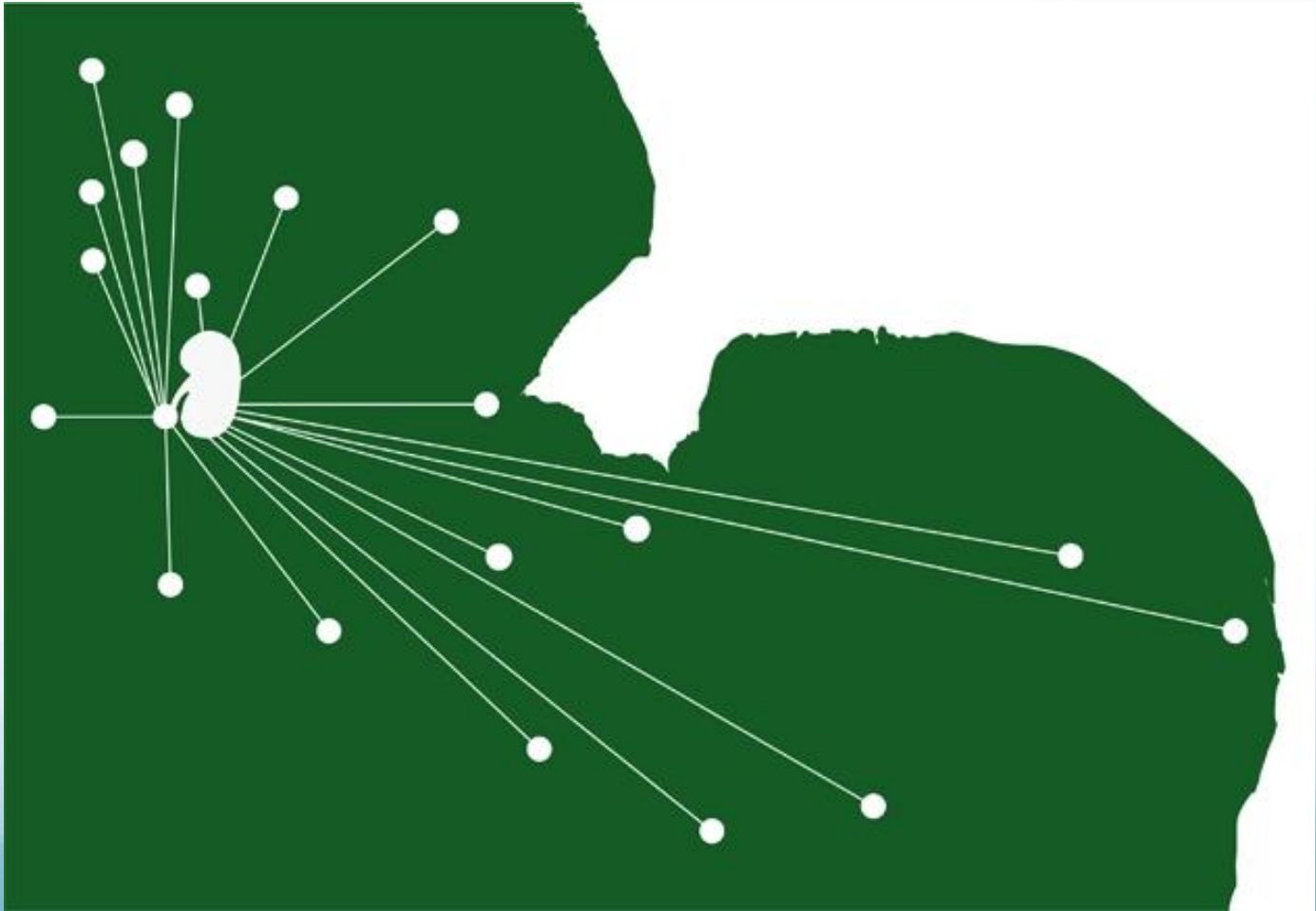
240

# ABPM – When?

- Diagnosis
- At risk patients
  - Diabetes
  - CKD
  - Transplant
- Treated patients



# ABPM – Where?



# ABPM – What?

## in•ter`pre•ta'tion

- **a.** An explanation or conceptualization by a critic of a work of literature, painting, music, or other art form; an exegesis.
- **b.** A performer's distinctive personal version of a song, dance, piece of music, or role; a rendering.



# ABPM – What?



- **Systolic Blood Pressure Centile**
  - Age, height, gender specific
- **Blood Pressure Load**
  - Proportion of time above limits
  - Normal < 25%
- **Nocturnal Dipping**
  - Difference between day and night readings
  - Normal > 10%



Dr. Mark Jones  
www.myclinic.com

# ABPM – What?

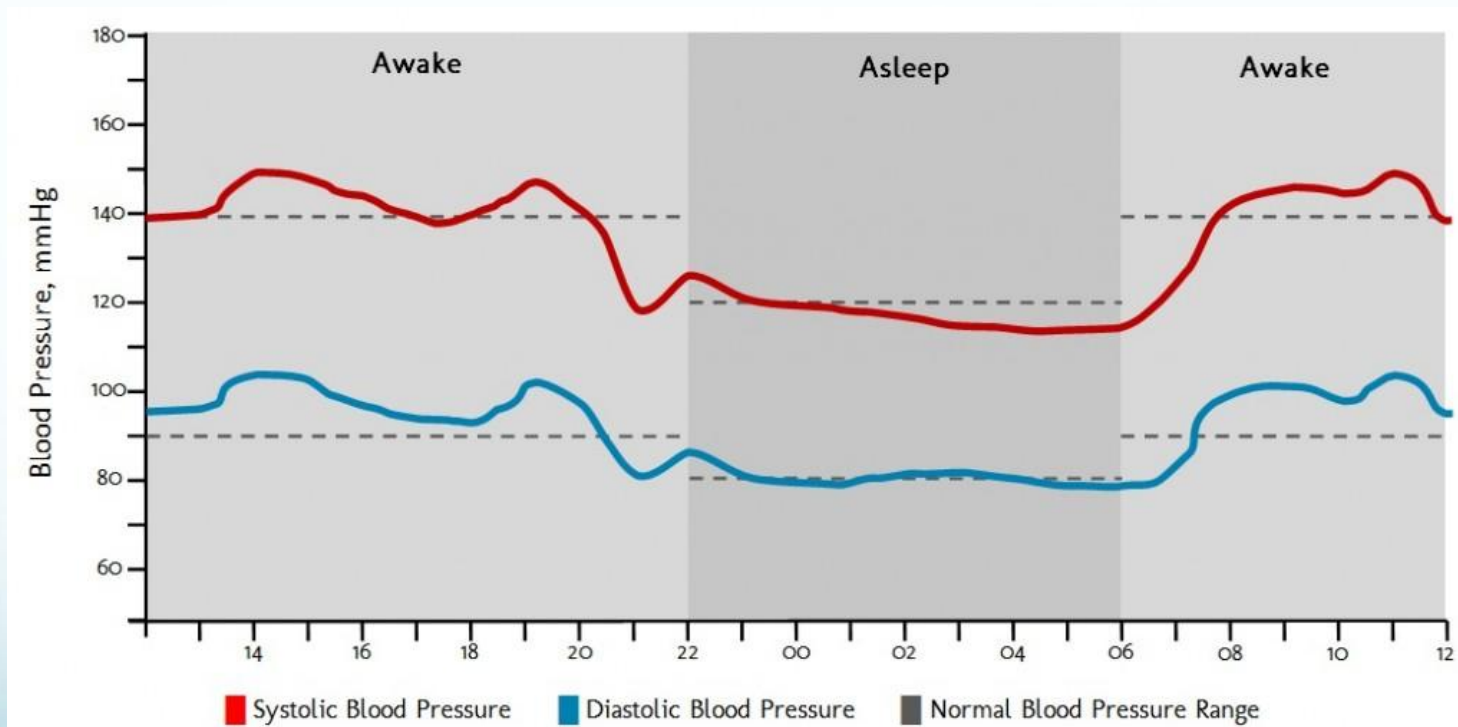


## ABPM Report

| Complete (88 Total: 76 Included, 1 Excluded, 2 Events, 9 Errors) |                                     |            |      |        |
|------------------------------------------------------------------|-------------------------------------|------------|------|--------|
|                                                                  | Min                                 | Mean       | Max  | StdDev |
| Systolic                                                         | 114                                 | 135.7      | 168  | 11.4   |
| Diastolic                                                        | 72                                  | 88.4       | 100  | 6.4    |
| Pulse                                                            | 44                                  | 59.1       | 76   | 7.3    |
| MAP                                                              | 85                                  | 107.9      | 125  | 9.1    |
| Pulse Pressure                                                   | 26                                  | 47.3       | 71   | 8.5    |
| Rate Pressure Product                                            | 1222                                | 2826.0     | 4940 | 751.3  |
| AASI (R <sup>2</sup> )                                           |                                     | 0.62 (45%) |      |        |
| Actigraphy                                                       | 0.01                                | 0.52       | 2.92 | 0.73   |
| Actigraphy, Filtered                                             | 0.01                                | 0.44       | 2.69 | 0.57   |
| Actigraphy State                                                 | 12% Minimal, 34% Medium, 53% Active |            |      |        |
| Systolic > 140 mmHg                                              | 38.2 %                              |            |      |        |
| Diastolic > 95 mmHg                                              | 14.5 %                              |            |      |        |

| Mean Difference between Awake and Asleep |               |        |
|------------------------------------------|---------------|--------|
|                                          | Δ mmHg        | % drop |
| Systolic                                 | 14.3          | 10 %   |
| Diastolic                                | 6.5           | 7 %    |
| Pulse                                    | 10.7          | 17 %   |
| MAP                                      | 11.9          | 10 %   |
| Pulse Pressure                           | 7.8           | 16 %   |
| Rate Pressure Product                    | 944.5         | 31 %   |
| Normality                                | High Normal   |        |
| Dipper Status                            | Normal Dipper |        |
| White-coat                               | Not Detected  |        |

# ABPM – What?



# ABPM – What?



**Table 2. Suggested Schema for Staging of Ambulatory BP Levels in Children**

| Classification                                                   | Clinic BP*       | Mean Ambulatory SBP† | SBP Load, % <sup>70,75</sup> |
|------------------------------------------------------------------|------------------|----------------------|------------------------------|
| Normal BP                                                        | <95th percentile | <95th percentile     | <25                          |
| WCH                                                              | >95th percentile | <95th percentile     | <25                          |
| Masked hypertension                                              | <95th percentile | >95th percentile     | >25                          |
| Prehypertension                                                  | >95th percentile | <95th percentile     | 25–50                        |
| Ambulatory hypertension                                          | >95th percentile | >95th percentile     | 25–50                        |
| Severe ambulatory hypertension<br>(at risk for end-organ damage) | >95th percentile | >95th percentile     | >50                          |

Modified from Lurbe et al,<sup>74</sup> with permission.

BP indicates blood pressure; SBP, systolic blood pressure.

\*Based on the National High Blood Pressure Education Program Task Force Standards.

†Based on ABPM values of Soergel et al or the smoothed values of Wühl.

# ABPM – What?





Pause -  
Any questions?

# Case - 15 year old girl

- Known to be quite anxious
- Surgical clinic BP 130/80 mmHg
- Height 148.9 cm
- BP > 95<sup>th</sup> centile



# Case – 15 year old girl

## SUMMARY

|                                                           | MIN           | MEAN | MAX           | STD   |      |
|-----------------------------------------------------------|---------------|------|---------------|-------|------|
| Systolic                                                  | 113 (1-21:28) | 142  | 159 (1-10:51) | 8.69  | mmHg |
| Diastolic                                                 | 63 (1-21:11)  | 90   | 109 (1-14:48) | 10.55 | mmHg |
| MAP                                                       | 76            | 108  | 135           | 10.93 | mmHg |
| Heart Rate                                                | 31            | 71   | 102           | 16.71 | BPM  |
| Percent of Systolic Readings above period limits: 92.3 %  |               |      |               |       |      |
| Percent of Diastolic Readings above period limits: 76.9 % |               |      |               |       |      |
| Percent of time Systolic was above period limits: 92.7 %  |               |      |               |       |      |
| Percent of time Diastolic was above period limits: 80.2 % |               |      |               |       |      |

## SUMMARY PERIOD: 6:00 to 22:00

|                                                | MIN           | MEAN | MAX           | STD   |      |
|------------------------------------------------|---------------|------|---------------|-------|------|
| Systolic                                       | 113 (1-21:28) | 142  | 159 (1-10:51) | 8.76  | mmHg |
| Diastolic                                      | 63 (1-21:11)  | 90   | 109 (1-14:48) | 10.68 | mmHg |
| MAP                                            | 76            | 108  | 135           | 11.04 | mmHg |
| Heart Rate                                     | 31            | 72   | 102           | 16.68 | BPM  |
| Percent of Systolic Readings > 128 mmHg 92.1 % |               |      |               |       |      |
| Percent of Diastolic Readings > 81 mmHg 76.3 % |               |      |               |       |      |
| Percent of time Systolic > 128 mmHg 87.7 %     |               |      |               |       |      |
| Percent of time Diastolic > 81 mmHg 74.7 %     |               |      |               |       |      |

## SUMMARY PERIOD: 22:00 to 6:00

|                                                 | MIN           | MEAN | MAX           | STD  |      |
|-------------------------------------------------|---------------|------|---------------|------|------|
| Systolic                                        | 147 (1-22:08) | 147  | 147 (1-22:08) | 0.00 | mmHg |
| Diastolic                                       | 92 (1-22:08)  | 92   | 92 (1-22:08)  | 0.00 | mmHg |
| MAP                                             | 103           | 103  | 103           | 0.00 | mmHg |
| Heart Rate                                      | 55            | 55   | 55            | 0.00 | BPM  |
| Percent of Systolic Readings > 113 mmHg 100.0 % |               |      |               |      |      |
| Percent of Diastolic Readings > 65 mmHg 100.0 % |               |      |               |      |      |
| Percent of time Systolic > 113 mmHg 0.0 %       |               |      |               |      |      |
| Percent of time Diastolic > 65 mmHg 0.0 %       |               |      |               |      |      |

# Case – 15 year old girl

- Learning point
- Anxious patients can be hypertensive

# Case 17 year old boy

- Bilateral renal scarring
- Surgical Clinic BP 160/90 mmHg
- Repeat BP 146/82 mmHg
- No height



# Case 17 year old boy

|                                    | AVG | STD   |      | MIN            | MAX             | Dipping |
|------------------------------------|-----|-------|------|----------------|-----------------|---------|
| Systolic:                          | 116 | 12.16 | mmHg | 87 (08:17 Fri) | 136 (19:17 Thu) | 0.9%    |
| Diastolic:                         | 66  | 10.79 | mmHg | 42 (07:20 Fri) | 87 (12:24 Thu)  | 7.5%    |
| MAP:                               | 81  | 9.05  | mmHg | 62             | 99              | 3.7%    |
| Pulse Pressure:                    | 50  | 8.30  | mmHg | 31             | 65              |         |
| Heart Rate:                        | 66  | 15.94 | bpm  | 37             | 104             |         |
|                                    |     |       |      | Reading(s)     | Time            |         |
| Percent of Systolic above limits:  |     |       |      | 3.8%           | 7.0%            |         |
| Percent of Diastolic above limits: |     |       |      | 15.1%          | 24.9%           |         |

## Wake Period(s) 06:00 - 22:00

|                                         | AVG | STD   |      | MIN            | MAX             |  |
|-----------------------------------------|-----|-------|------|----------------|-----------------|--|
| Systolic:                               | 116 | 12.28 | mmHg | 87 (08:17 Fri) | 136 (19:17 Thu) |  |
| Diastolic:                              | 67  | 11.06 | mmHg | 42 (07:20 Fri) | 87 (12:24 Thu)  |  |
| MAP:                                    | 82  | 9.30  | mmHg | 62             | 99              |  |
| Pulse Pressure:                         | 49  | 8.10  | mmHg | 31             | 65              |  |
| Heart Rate:                             | 68  | 15.62 | bpm  | 37             | 104             |  |
|                                         |     |       |      | Reading(s)     | Time            |  |
| Percent of Systolic readings > 143mmHg: |     |       |      | 0%             | 0%              |  |
| Percent of Diastolic readings > 84mmHg: |     |       |      | 6.7%           | 7.1%            |  |

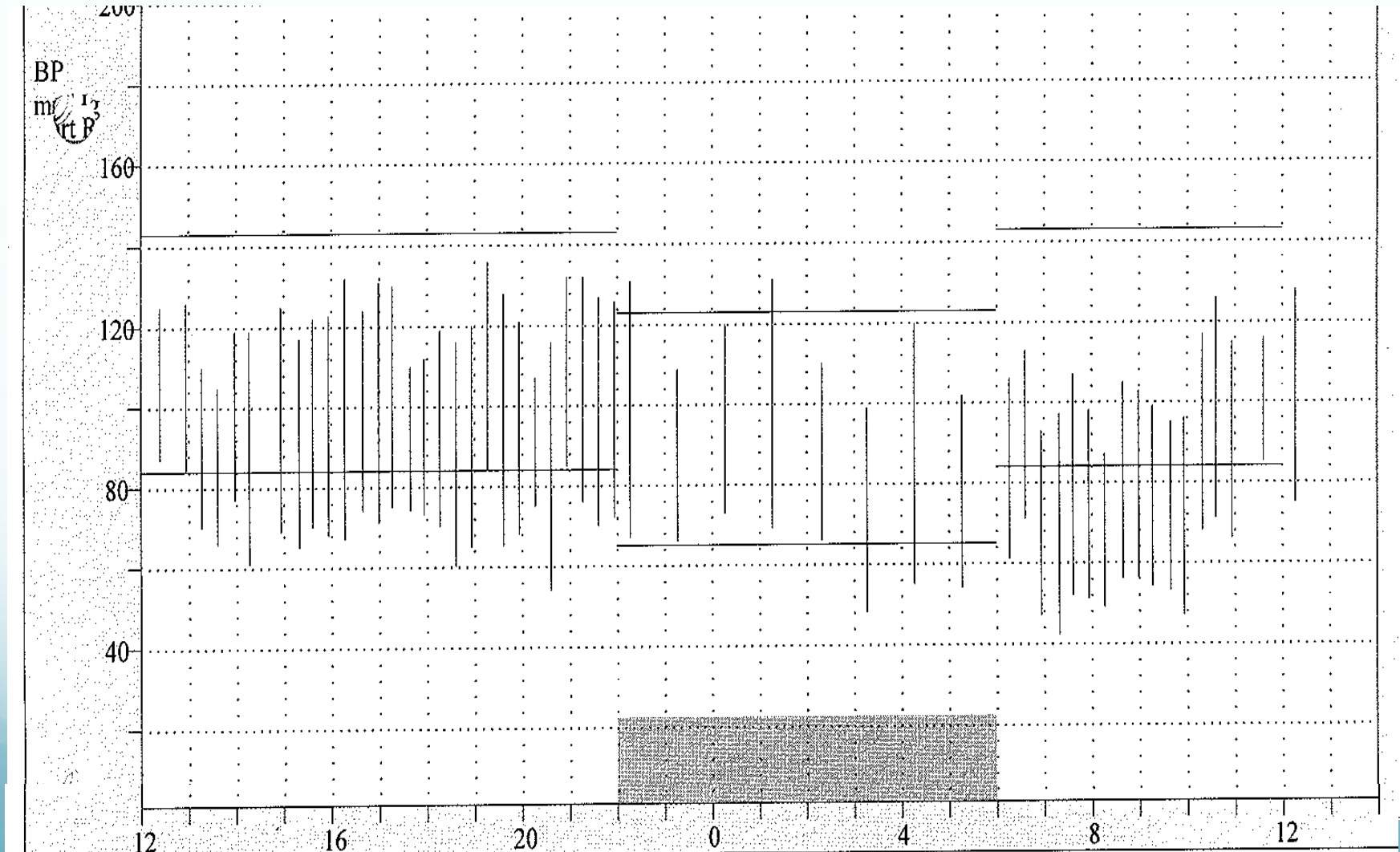
Number of Wake Period(s) readings: 45

## Sleep Period(s) 22:00 - 06:00

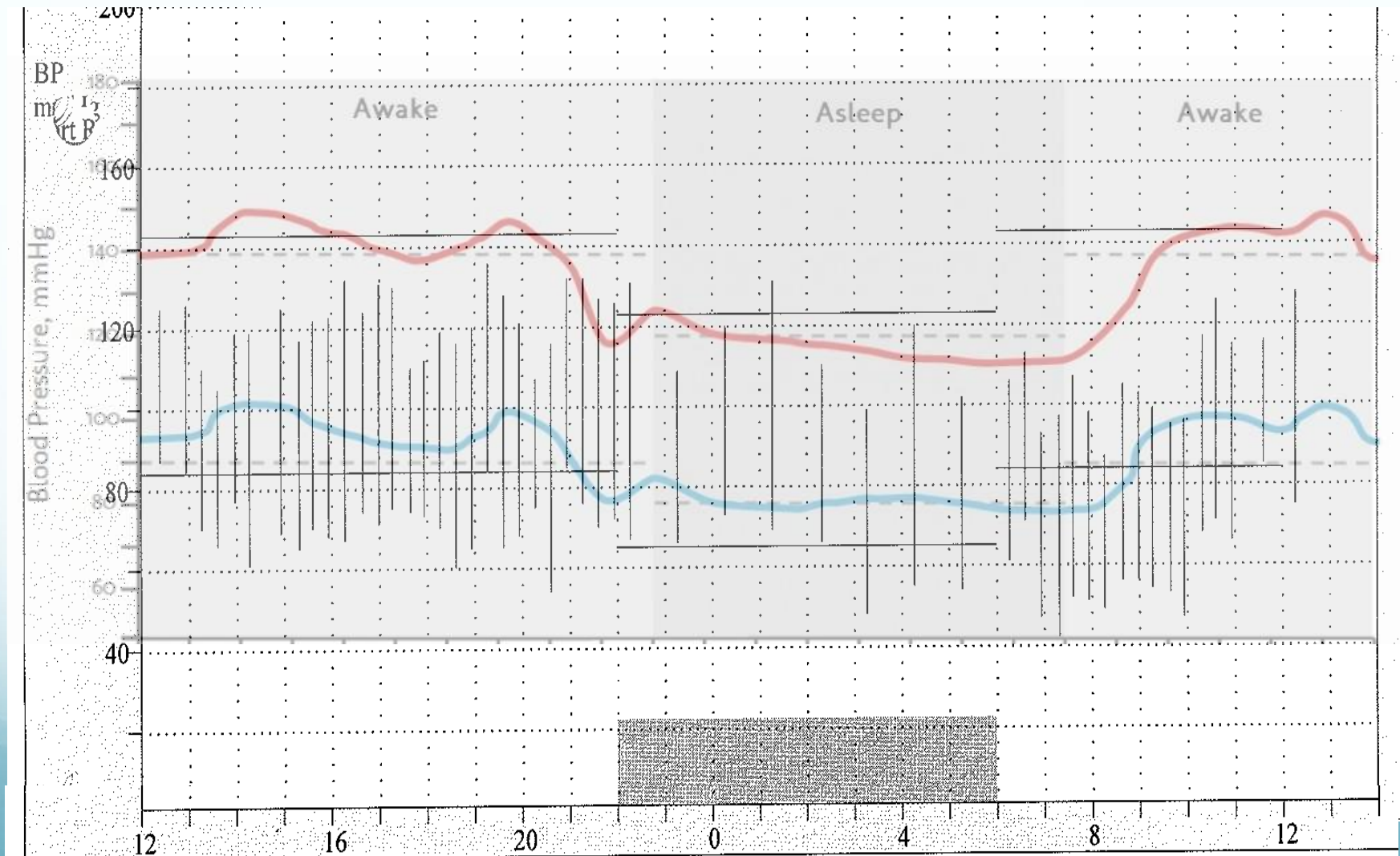
|                                         | AVG | STD   |      | MIN            | MAX             |  |
|-----------------------------------------|-----|-------|------|----------------|-----------------|--|
| Systolic:                               | 115 | 12.23 | mmHg | 99 (03:17 Fri) | 131 (22:17 Thu) |  |
| Diastolic:                              | 62  | 8.75  | mmHg | 48 (03:17 Fri) | 73 (00:17 Fri)  |  |
| MAP:                                    | 79  | 7.37  | mmHg | 68             | 89              |  |
| Pulse Pressure:                         | 53  | 9.20  | mmHg | 43             | 65              |  |
| Heart Rate:                             | 51  | 6.82  | bpm  | 42             | 60              |  |
|                                         |     |       |      | Reading(s)     | Time            |  |
| Percent of Systolic readings > 123mmHg: |     |       |      | 25.0%          | 21.7%           |  |
| Percent of Diastolic readings > 65mmHg: |     |       |      | 62.5%          | 64.5%           |  |

Number of Sleep Period(s) readings: 8

# Case 17 year old boy



# Case 17 year old boy



# Case 17 year old boy

- Learning point
  - Need to look at ABPM report as a whole

# ABPM - Summary



- Indications
  - Diagnosis
  - At risk groups
  - Monitor treatment
- Interpretation
  - SBP centiles
  - Assess load
  - Define dipping
  - Review report as a whole



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