



# Ninewells Hospital & Medical School

## Ambulatory & Central BP measurement:

What is their Value in the Management of Essential Hypertension

Tom MacDonald

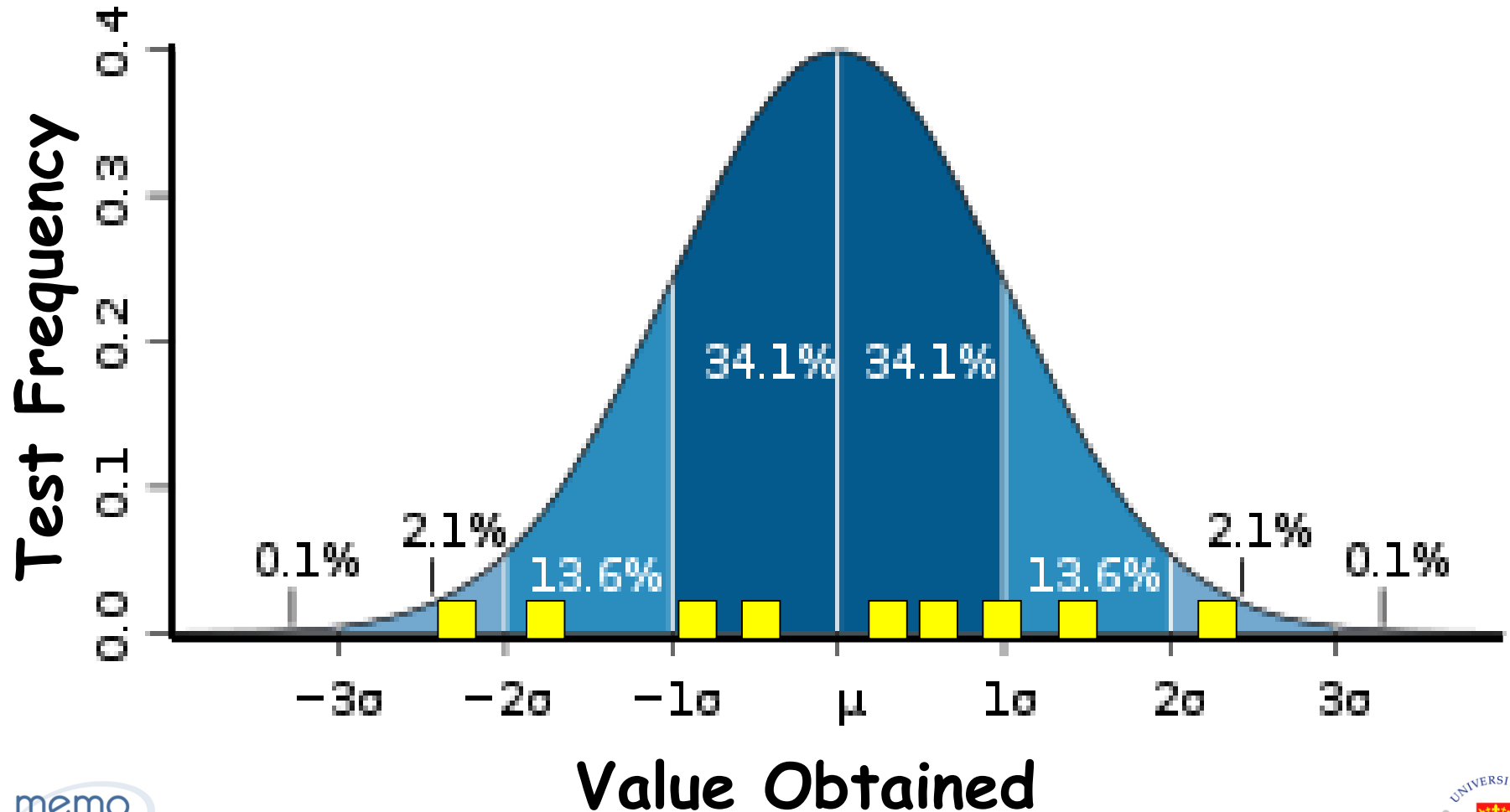
# Mercury Banned



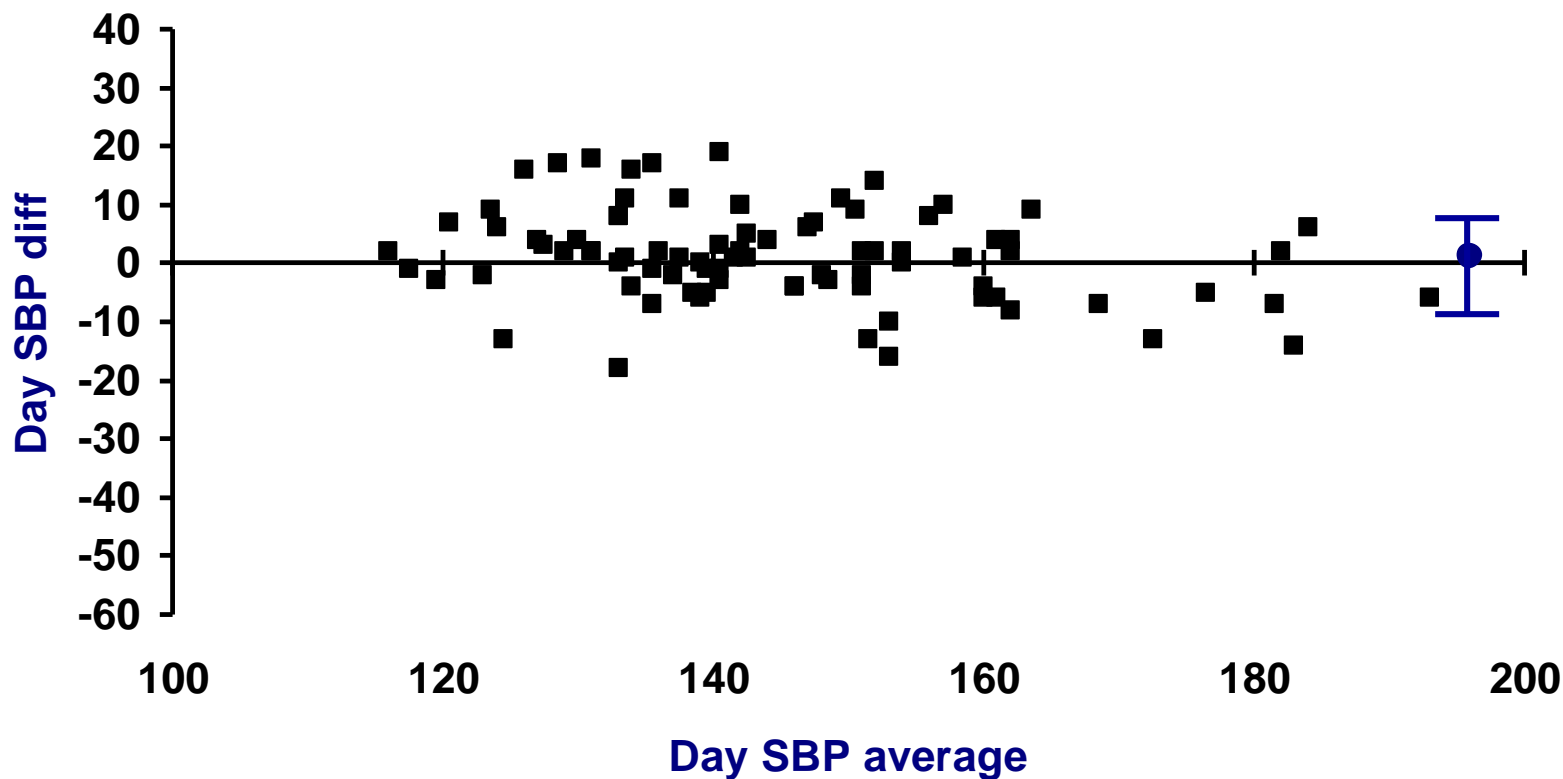
# Modern Blood Pressure Devices



# More Tests = Improved Precision



# Reproducibility of BP measurement ABPM systolic



**CV of repeated measures = 3.3%**

SDD values of 12.0 for Clinic SBP  
and 7.8 for ABPM

For a parallel trial to detect  
 $\Delta$  of 10 mmHg SBP,

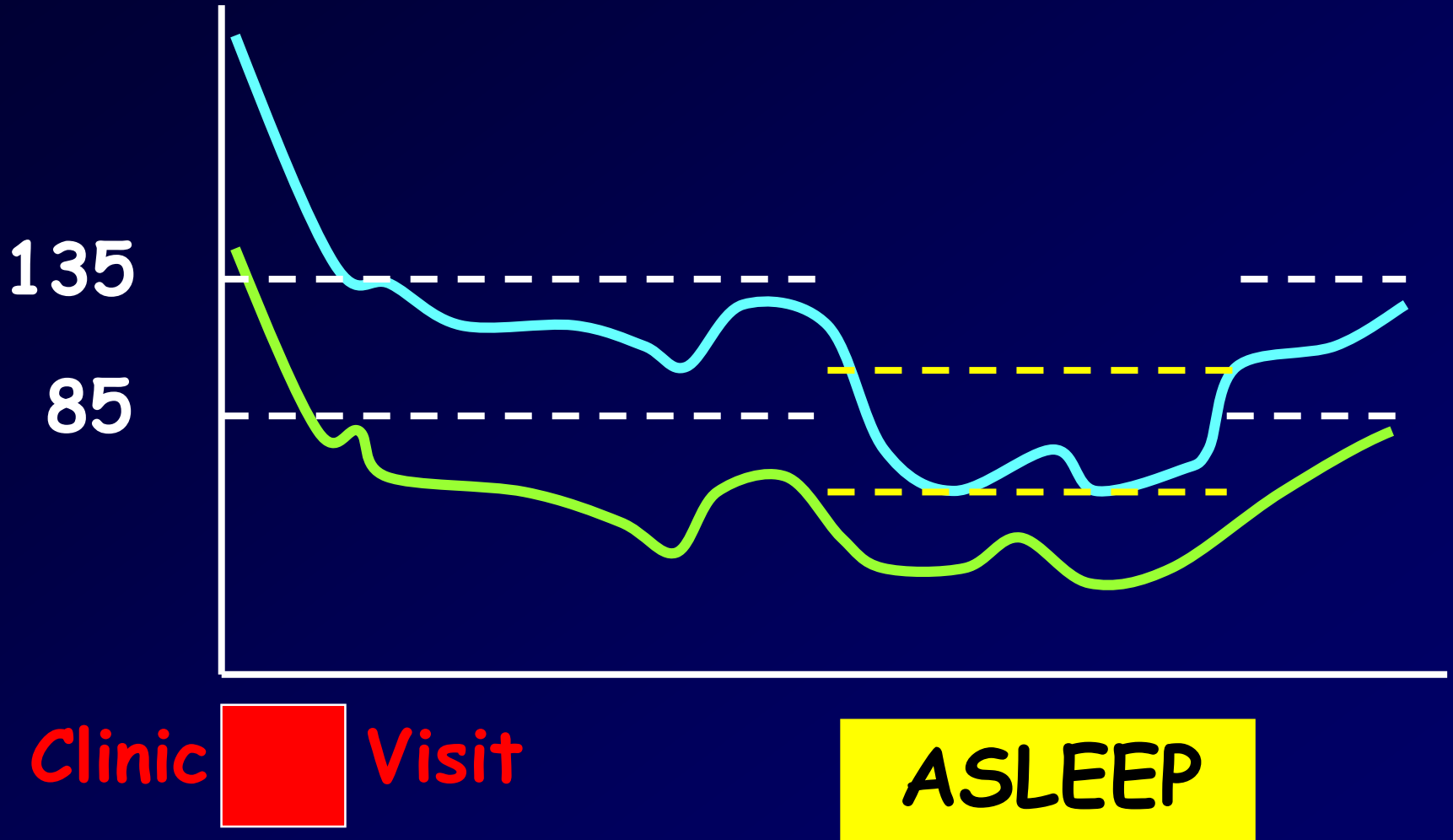
**51** subjects using Clinic SBP

v

**28** using ABPM

Am J Hypertens 2002;15:101-104

# 'White Coat' Effect



Clinic  
Pressure



140/85

White Coat  
Hypertension

Sustained  
Hypertension

True  
Normotension

**10-20%**

130/80



Ambulatory Pressure

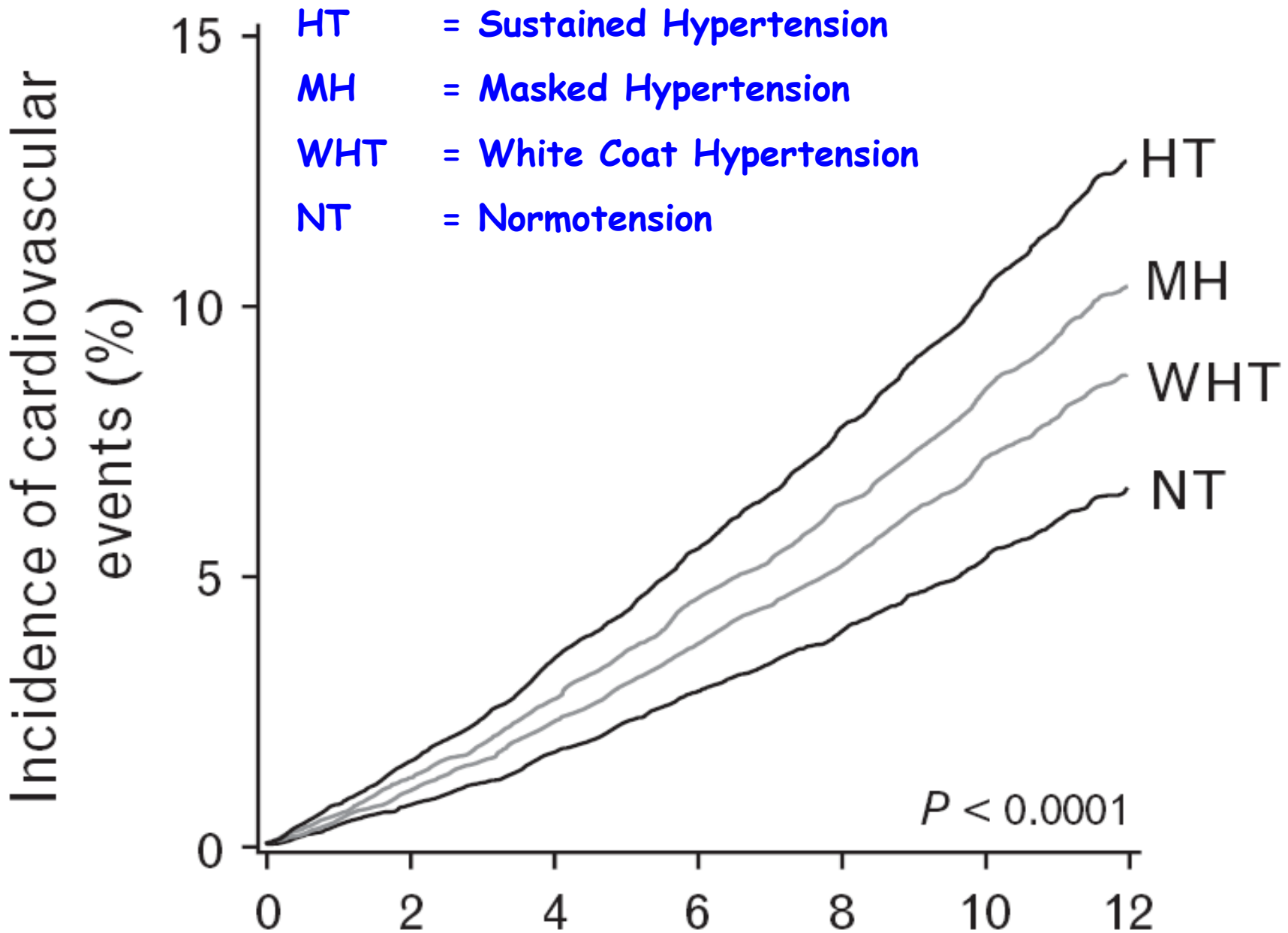
**Hypertens Res 2007;30:479-88.**



# Cameo: White Coat Hyp

Older, female, smoker with  
high clinic SBP and variable  
daytime readings

Am J Hypertens 2008;21:153-8





# **New NICE Guidelines**

**Hypertension  
must be  
diagnosed  
using ABPM**

# Cost-effectiveness of options for the diagnosis of high blood pressure in primary care: a modelling study



*Kate Lovibond, Sue Jowett, Pelham Barton, Mark Caulfield, Carl Heneghan, F D Richard Hobbs, James Hodgkinson, Jonathan Mant, Una Martin, Bryan Williams, David Wonderling, Richard J McManus*

## **Redefines hypertension**

### **Assumes ABPM every 5 years**

### **Not cost-effective if annual**

**Lancet 2011;378:1219-30**

No outcome studies of ABPM

# ABPM Diagnostic Thresholds

- **Optimal ABPM**
  - 115/75mmHg 24h
  - 120/80mmHg daytime
  - 100/65mmHg night time
- **Normal ABPM**
  - 125/75mmHg 24h
  - 130/80mmHg daytime
  - 110/70mmHg night time

# NICE Rx Thresholds

- Day-time SABPM  $> 135\text{mmHg}$   
and CV risk  $> 20\%$
- OR  
Day-time SABPM  $> 150\text{mmHg}$

# ABPM Costs

- Expensive to buy
- Expensive to calibrate/service/repair
- Needs Computer Software
- Needs batteries
- Needs staff to:  
program/fit/support/remove
- Needs downloaded/stored/printed
- Needs interpreted & reported
- 1 Machine: 3 ABPM's / week maximum



# Self Monitoring at Home



# Patient Preference

81% preferred Home BPM to ABPM

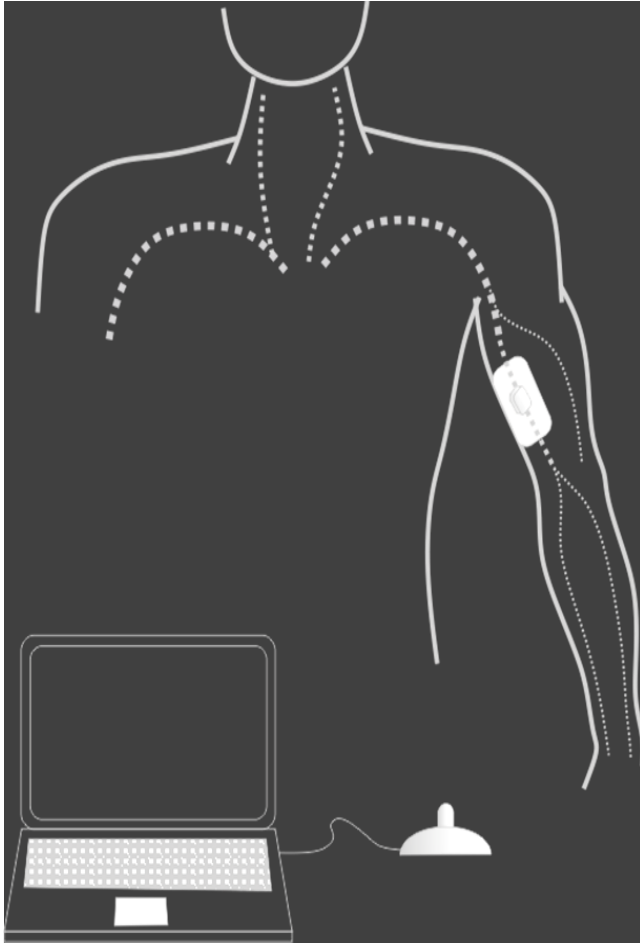


British Hypertension Society

**Which BP Monitor?**

**<http://www.bhsoc.org/>**

# Cuffless Blood Pressure



- Disposable patch
- Miniaturized electronics for data collection, processing, and storage
- Eliminates inflating cuff
- Continuous, non-interfering BP measurements

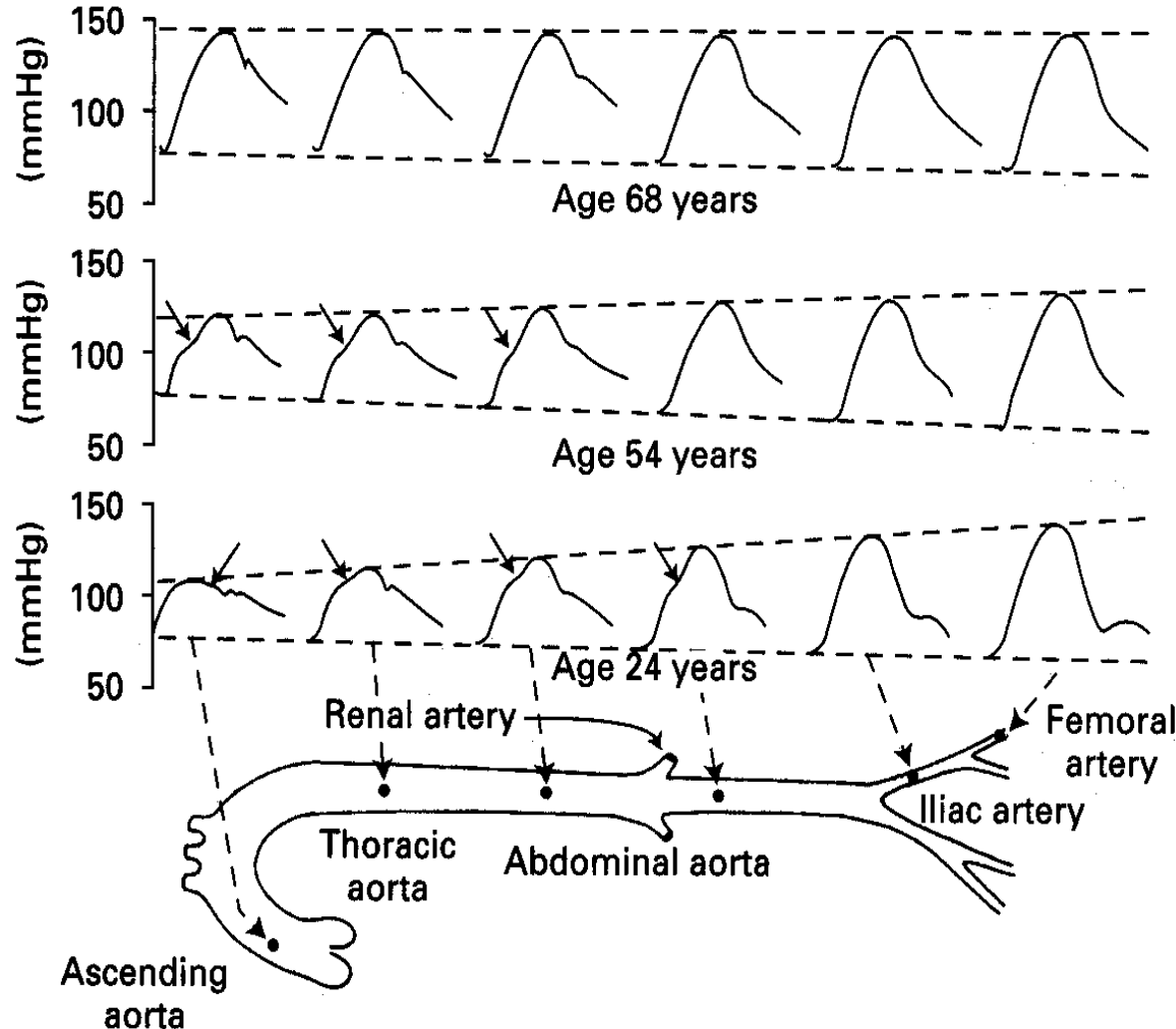
Bioimpedance: See e.g. S. Grimnes and Ø. G. Martinsen, *Bioimpedance and Bioelectricity Basics*, AP Oxford 2008

# Blood Pressure-Sensing Underpants



<http://www.newscientist.com/article/dn13929-invention-bloodpressuresensing-underpants.html>

# Pressure Pulse Amplification



Measured brachial SBP and PP are higher than aortic root pressure

The difference diminishes with age

# Evolution of Methods to Measure Central Aortic Pressure

Atcor -SphygmoCor  
GTF  
Static measurements

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Omron HEM 9000AI  
SBP2  
Static measurements

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HealthSTATS – BPro, CASPro  
NpMA  
Static and  
Ambulatory measurements

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Oscillometric Brachial Pulse contour methods  
GTF  
Static/Ambulatory measurements

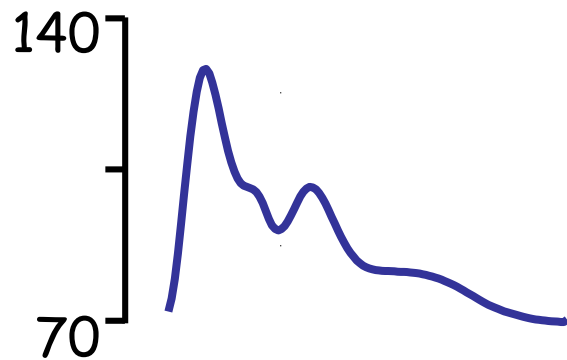
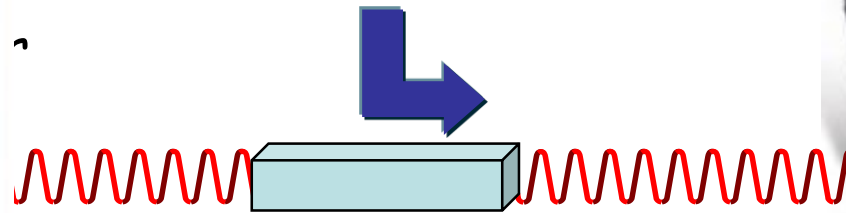


# Non-Invasive Derivation of Central Aortic Pressure

Oscillometric  
BP Device

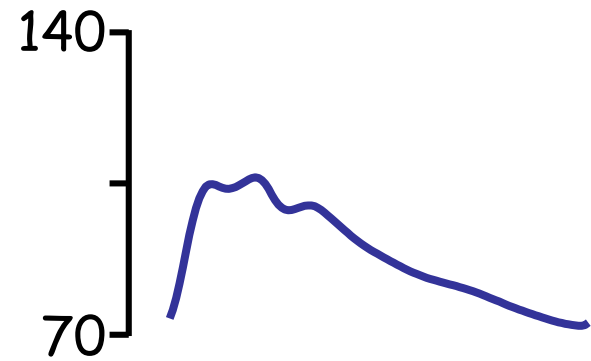


Brachial Blood  
Pressure



Brachial Artery wave form  
detected using oscillometrics

Mathematical  
Conversion



Central Aortic  
pressure wave

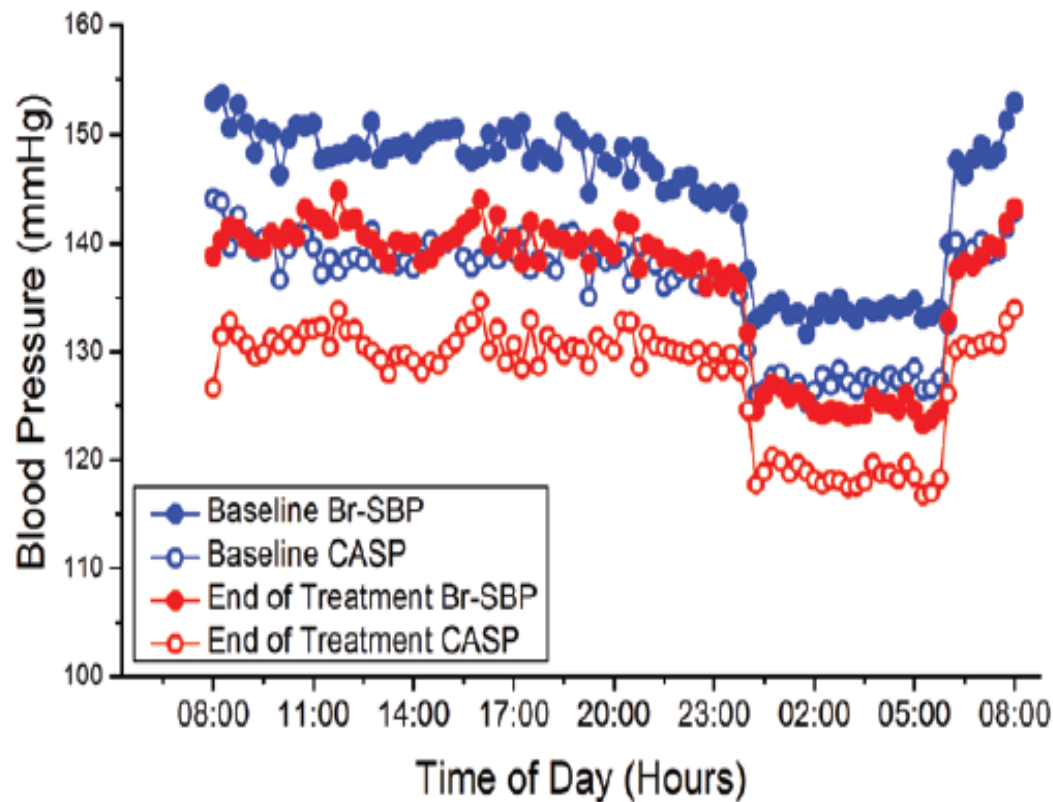


# Novel Description of the 24-Hour Circadian Rhythms of Brachial Versus Central Aortic Blood Pressure and the Impact of Blood Pressure Treatment in a Randomized Controlled Clinical Trial

## The Ambulatory Central Aortic Pressure (AmCAP) Study

Bryan Williams, Peter S. Lacy, Fabio Baschiera, Patrick Brunel, Rainer Düsing

American Heart Association "Clinical Science Paper of the Year"

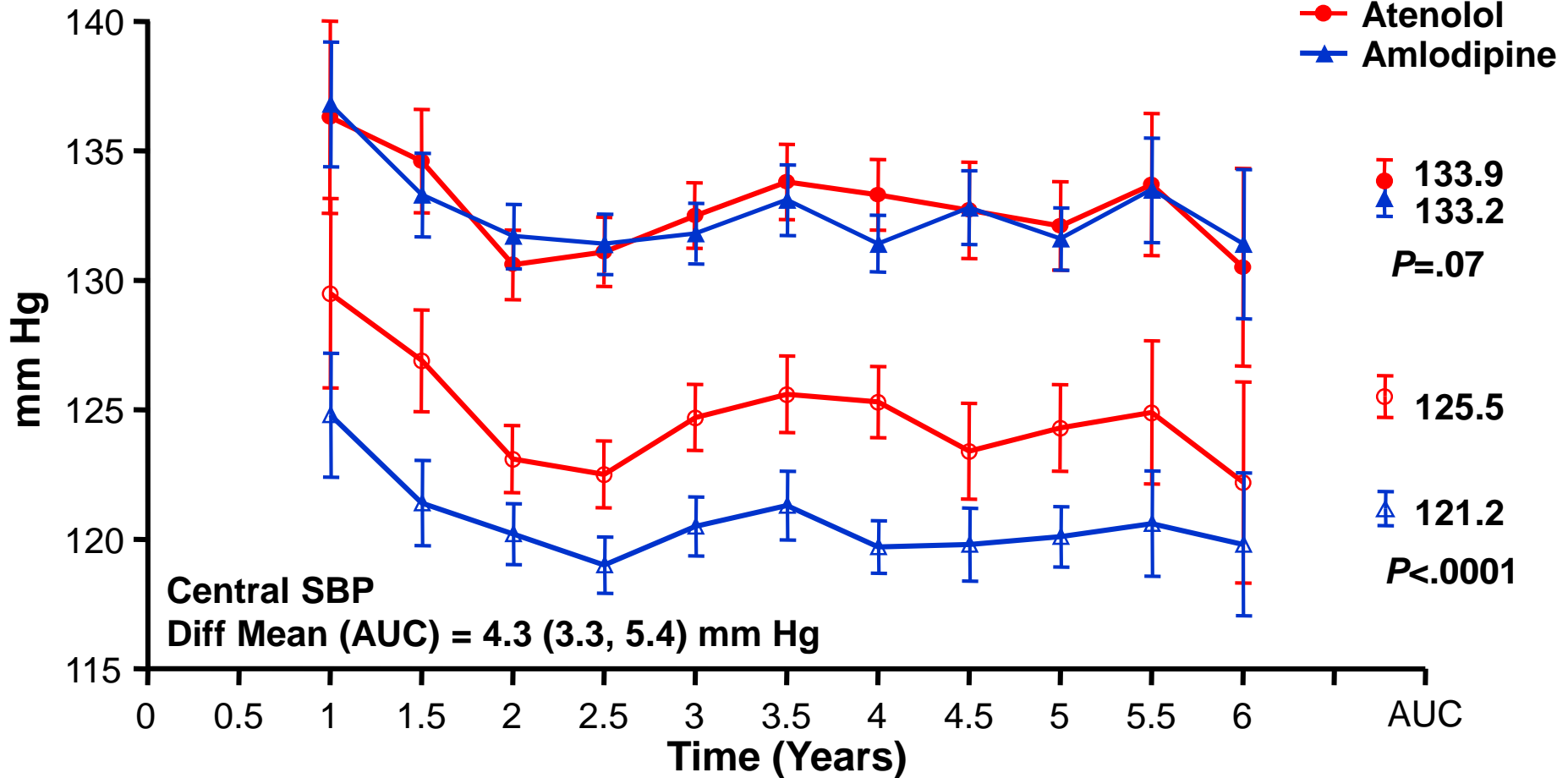


Hypertension  
2013;61:1168-76.

# Brachial & Central Aortic SBP

## Brachial SBP

Diff Mean (AUC) = 0.7 (-0.4, 1.7) mm Hg



# Conclusions

- ABPM is here to stay
  - Home BP widely used
- Central aortic BP might valuable for defining hypertension in the young (especially males)
- Both ABPM and Central BP need further research