

SUBSTITUTING MERCURY SPHYGMOMANOMETERS

FACT SHEET, OCTOBER 2006

STAY HEALTHY!
STOP MERCURY



Why should healthcare professionals move to mercury-free blood pressure devices?

In spite of the availability of alternatives, the use of medical devices containing mercury, such as sphygmomanometers (blood pressure measuring devices), thermometers, thermostats and laboratory chemicals, continues to be widespread in many European countries. Although European authorities recently agreed to ban the sale of new mercury thermometers for home and healthcare use, sphygmomanometers remain an area of concern because they represent a large mass of mercury per device (approximately 80-100 g/unit in comparison with 1 g/unit in a thermometer)¹, and therefore pose a greater hazard in the event of breakage.

To eliminate potential risk to the health and safety of staff and patients, four European countries – Sweden, Denmark, the Netherlands, and Austria – have already phased out the use of mercury blood pressure devices, and national medical authorities including the British Hypertension Society and the UK Health and Safety Executive (HSE) are recommending that clinically tested mercury-free alternatives be used instead.

This fact sheet outlines the arguments for moving to mercury-free devices and exposes common misconceptions about the accuracy of non-mercury sphygmomanometers. At the end of this factsheet, health care professionals will find a list of non-mercury blood pressure devices that are suitable for clinical practice and have been evaluated by the British Hypertension Society, an independent authority that sets standards for accurate measurement of blood pressure.

"In practice, many healthcare professionals are already phasing out mercury sphygmomanometers."

Reasons to phase out mercury sphygmomanometers

› Difficulties managing mercury in hospitals

The EU authorities have recently stated that restricting mercury sphygmomanometers in professional settings is unnecessary as healthcare facilities generally conduct proper mercury waste management². However, this is not always the case. A survey in the Czech Republic showed that mercury waste from hospitals (estimated to 1000 kg/year) was generally not recycled but incinerated or landfilled as hazardous waste, thus contributing to potential contamination of the environment³.

› Higher costs of mercury devices

Mercury devices represent a significant financial burden for hospitals. Mercury devices must be collected separately and treated as hazardous waste. It can also be quite costly to clean a contaminated healthcare facility if a sphygmomanometer breaks. While non-mercury devices are sometimes more expensive to purchase than mercury devices, total life-cycle costs of mercury devices are often higher than the mercury-free alternatives. Reasons for the higher cost of mercury devices include: compliance with regulations around mercury handling; cleaning up after spills; need to train staff how to safely dispose of broken equipment; and hazardous waste management.

The increasing demand for mercury free devices is driving down prices for alternatives. The EU Commission now predicts that substitution will not bring with it significant cost increase. Market expansion is also increasing the number of

competitively-priced options for healthcare facilities⁴. Thus substituting mercury devices with safer mercury-free alternatives can be considered cost efficient.

› Safest solution – substituting mercury for safer alternatives

Substitution is generally regarded as the most powerful measure for preventing mercury pollution, because it reduces the amount of mercury in society, thereby preventing mercury entering the waste stream and being released into the environment from incinerator emissions and landfills⁵. In practice, many healthcare professionals are already phasing out mercury sphygmomanometers and moving to automated oscillometric devices or digital devices for the measurement of blood pressure. This phase out does involve changes of practice in reading blood pressure, but research has shown that this can be accomplished without any impairment of diagnostic accuracy⁶.

Since 1991, Sweden has gradually banned the use of almost all mercury instruments including blood pressure devices. A recent survey by the Swedish National Chemicals Inspectorate (KEMI) found that “there were only positive experiences reported from the phase out of mercury in the most wide spread equipment called sphygmomanometers, which today is complete. No negative medical, practical or economic experiences were found from the phase out of mercury containing sphygmomanometers.”⁷

Addressing concerns around Alternative Sphygmomanometers:

I. Accuracy of mercury-free blood pressure devices for clinical use

There are 3 types of non-mercury blood pressure devices: aneroid, semi-automated and automated devices. Both mercury and non-mercury sphygmomanometers will give accurate results when properly calibrated and used for the purpose for which they were designed. However, there is a large number of different types of automated blood pressure devices on the market, some intended for personal use, and others for various kinds of clinical use. Not all of these are accurate in all clinical applications.

It is therefore very important to purchase devices that meet the accuracy standards of a respected authority on blood pressure measurement, such as British Hypertension Society or the European Society for Hypertension and to ensure that

the devices are used in their intended context. Purchasing officers in healthcare facilities should be aware that protocols exist for validating blood pressure devices, and that evidence of independent validation of a device should always be demanded from manufacturers.

In practice health care facilities in Austria, Denmark, the Netherlands and Sweden have reported only positive experiences in the use of mercury-free devices. In Sweden, KEMI has found that mercury-free blood sphygmomanometers are causing no problems in clinical diagnosis and monitoring, including in the presence of arrhythmias, preeclampsia and in accelerated (malign) hypertension⁸.

II. Calibration

One of the main concerns healthcare practitioners have about digital and other non-mercury devices is that of accuracy. Examples of both inaccurate mercury and mercury-free sphygmomanometers can be found in the medical literature, though this inaccuracy is typically related to poor maintenance and calibration^{9, 10}.

Welch Allyn, the manufacturer of both mercury and alternative sphygmomanometers states, "Any device – mercury, aneroid or digital – requires routine calibration checks to insure accuracy as part of a regular preventative maintenance program. To imply otherwise gives false expectations for the reliability of mercury manometers and raises unnecessary concerns over the accuracy of aneroid and digital devices¹¹."

The British Hypertension Society (BHS) recommends that mercury blood pressure devices should be calibrated at least once a year and that aneroid devices should be calibrated twice a year. Mercury-free sphygmomanometers, when properly calibrated, are as accurate as the older mercury models. For automated devices, the BHS recommends to undertake the calibration according to manufacturers' instructions.

It is also not advisable to use a mercury device for calibration as there is a higher probability of error. Instead, it is preferable to use a digital device whose accuracy is 0.1 +/- of mercury. It is also good practice to delegate the task of ensuring regular calibration checks and maintenance to a designated individual.

III. Availability of Alternatives

Many healthcare practitioners are concerned about the availability of alternatives at competitive pricing. In fact, there are many mercury-free sphygmomanometers on the European market from major medical equipment suppliers. Many of these devices satisfy the criteria of professional organisations such as the British Hypertension Society, the European Hypertension Society and the Association for the Advancement of Medical Instrumentation. Some of these brands include: Omron, Rudolf Riester, Heine Optotechnik, BOSH + SOHN, Braun, Terumo, Seinex, Welch Allyn, Microlife, SunTech Medical, American Diagnostics Corporation (A&D) and Trimline Medical Products.

The British Hypertension Society (BHS) has created a list of vendors of sphygmomanometers that have met the BHS criteria and are currently available in the UK.

Clinical trial protocols:

It is important that alternatives to mercury sphygmomanometers meet standards set out in clinical trial protocols. Some examples are given below:

1. O'Brien E, Petrie J, et al. The British Hypertension Society protocol for the evaluation of blood pressure measuring devices. *Journal of Hypertension* 11 (Suppl 2): S43-S62. 1993
2. American National Standard for electronic or automated Sphygmomanometer. ANSI/AAMI SP10 2002. www.aami.org
3. S Mieke. Non-invasive sphygmomanometers – Clinical Investigation. Deutsches Institut fuer Normung E.V. (German Institute for Standardisation). DIN 58130: 1996. Available from BSI www.bsonline.bsi-global.com
4. E O' Brien, T Pickering, et al. International Protocol for validation of blood pressure measuring devices in adults. Working Group on Blood Pressure Monitoring of the European Society of the Hypertension. *Blood Pressure Monitoring* 7:3-17. 2002

5. Non-invasive sphygmomanometers – Test procedures to determine the overall system accuracy of automated non-invasive sphygmomanometers. BS EN 1060-4. 2004 Available from BSI www.bsonline.bsi-global.com

Based on these protocols, the British Hypertension Society lists individual types and brands of sphygmomanometers that have passed the validation tests. The information is intended primarily for the UK medical audience. However the BHS is among the three most-cited and respected authorities concerned with precise blood pressure measurement. A large number of the manufacturers mentioned in the table are international companies which sell their products in EU countries.

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TABLE 1: Automatic Digital Blood Pressure Devices for Clinical Use and also suitable for Home/Self Assessment

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
A+D-767	BHS A/A	£69.99 (Feb 2006)	Small adult (18-22), Standard adult (22-32) Large adult (32-45)
A+D-779	International Protocol	£71.36 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A+D-787	International Protocol	£79.99 (Feb 2006)	Small adult (18-22), Standard adult (easy cuff, 26-36, included) Large adult (32-45)
A&D UA-774	BHS A/A	£89.99 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A&D UA-767 Plus	BHS A/A	£79.99 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A&D UA-767PC With capacity to store up to 126 readings & optional software for use with a PC	BHS A/A	£120.00 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A&D UA-767V With voice to speak reading	BHS A/A	£149.99 (Feb 2006)	Small adult (18-22), Standard adult (easy cuff, 26-36, included) Large adult (32-45)
A&D UA-767 Plus Memory With memory capacity to store up to 30 readings	BHS A/A	£84.99 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A&D UA-767P- BT With Bluetooth output only available to telemedicine service providers	BHS A/A	£176.25 (Feb 2006)	Small adult (18-22), Standard adult (22-32, included) Large adult (32-45)
A&D UA-704	BHS A/A	£39.99 (Feb 2006)	Standard adult (22-32, included) Large adult (32-45)
Boots Upper Arm (Omron HEM-742-UK)	International Protocol	£49.95	Small adult (17-22), Standard adult (22-32) Large adult (32-42)
Boots Upper Arm Intellisense (Omron HEM-757-UK)	International Protocol	£79.95	Small adult (17-22), Standard adult (22-32) Large adult (32-42)
Microlife 3AG1 Last reading memory	BHS A/A	£39.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Microlife As easy as 123 Single button operation. Last reading memory	BHS A/A	£44.98 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42, available from Microlife)
Microlife 3BT0-A	BHS A/A	£49.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Microlife BP A100 Derivative of 3BT0-A Pulse arrhythmia detection. Last reading memory	BHS A/A	£59.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Microlife 3BT0-A(2) Also validated for use in pregnancy see 'BP Devices for use in Special Cases'	BHS A/A	£69.95 (Aug 2006)	Medium adult (22-32) and large adult (32-42) cuffs both included to ensure accurate BP measurements in pregnancy as weight and arm circumference increase.
Microlife BP 3AC1-1 60 reading memory capacity.	International Protocol	£69.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Microlife BP A100 Plus Derivative of 3BT0-A. Automatic averaging of 3 readings, arrhythmia detection, 200 reading memory capacity.	BHS A/A	£79.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Microlife BP 3AC1-1PC Derivative of BP 3AC1-1 Automatic averaging of 3 readings, arrhythmia detection, 99 reading memory capacity. PC Link included	International Protocol	£89.95 (Aug 2006)	Standard adult (22-32, included) Large adult (32-42)
Omron 637-IT (R7 HEM-637-E2 [EU])Wrist Monitor Also validated for use in obese adults and the elderly see 'BP Devices for use in special cases	International Protocol	£149.95	Fits 13.5-21.5

TABLE 1: Automatic Digital Blood Pressure Devices for Clinical Use and also suitable for Home/Self Assessment

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
Omron M5-I (HEM-757-E)	International Protocol	£89.95 (Feb 2006)	Small adult (17-22), Standard adult (22-32) Large adult (32-42)
Omron 705-IT (HEM-759-E [EU])	BHS A/A, International Protocol (Feb 2006)	£169.95	Small adult (17-22), Standard adult (22-32) Large adult (32-42)
Omron 705-CPII (HEM-750P-E2 [EU])	International Protocol	£149.95 (Feb 2006)	Small adult (17-22), Standard adult (22-32) Large adult (32-42)
Omron MX2 Basic (Same algorithm as HEM 737)	International Protocol	£52.95 (Feb 2006)	Small adult (17-22), Standard adult (22-32, included) Large adult (32-42) NB Cuff depth on Small is 11 cm, Standard is 15 cm and Large is 17.5 cm. The Standard and Large cuffs are deeper than average.
Omron MX3 Plus (HEM-742-E [EU])	International Protocol	£59.95 (Feb 2006)	Small adult (17-22), Standard adult (22-32, included) Large adult (32-42) NB Cuff depth on Small is 11cm, Standard is 15cm and Large is 17.5 cm. The Standard and Large cuffs are deeper than average.
Omron M4-I (HEM-752-E [EU]) Derivative of 705-IT	International Protocol	£79.95 (Feb 2006)	Small adult (17-22), Standard adult (22-32, supplied) Large adult (32-42)
Omron M6 (Same Algorithm as 705-IT) (HEM-7001-E [EU])	International Protocol	£79.99 (Feb 2006)	Small adult (17-22), Standard adult (22-32, supplied) Large adult (32-42)
Seinex (Fore-Care) SE-9400	International Protocol	£49.99	Small adult (18-22), Standard adult (23-33) Large adult (33-45)

TABLE 2: Automatic Digital Blood Pressure Devices for Clinical Use*

*These blood pressure monitors are robust and so are most suitable in wards and clinics where they are frequently moved

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
Accutorr Plus	BHS A/A	£1495 (April 2004)	Children (l 13.8-21.5 cm), Standard adults (l 27.5-36.5 cm) Large adult (32-45)
A&D TM-2564G	BHS A/A	Details Awaited	Details Awaited
A&D TM-2655 Validated for self assessment in pharmacies etc.	BHS A/A	Details Awaited	Automatically adjustable
BpTRU BPM 100 Includes wall/desk fixing bracket. Auto BP measurement with 1st reading filtering & averaging	BHS A/A	£395	Small adult (18-26 cm), Standard adult (26-34 cm) Large adult (34-43 cm). All three cuffs included Also available: Child cuff (13-18 cm) Extra large (41-52 cm)
BpTRU BPM 200/300 Same algorithm as BpTRU BPM 100 Includes wall/desk fixing bracket & mobile trolley fixing bracket Auto BP measurement with 1st reading filtering & averaging	BHS A/A	£545	Small adult (18-26 cm), Medium adult (26-34 cm) Large adult (34-43 cm). All three cuffs included Also available: Child cuff (13-18 cm) Extra large (41-52 cm)
Omron 907 Same as HEM 907 See also Manual BP Devices for Clinical use	International Protocol	£350.95 (Sept 2005)	Small adult (l 17-22 cm), Standard adult (l 22-32 cm) Large adult (l 32-42 cm)
Smart signs SL 500 AC (same as BPM-100)	BHS A/A	£ 495 (April 2004)	Small adult (9 x 17 cm), Standard adults (12 x 33 cm) Large adults (15 x 33 cm)
Smart signs SL 500 BAT (same as BPM-200)	BHS A/A	£ 575 (April 2004)	Small adult (9 x 17 cm), Standard adults (12 x 33 cm) Large adults (15 x 33 cm)
Smart signs SL 510 AC (same as BPM-300)	BHS A/A	£ 750 (April 2004)	Small adult (9 x 17 cm), Standard adults (12 x 33 cm) Large adults (15 x 33 cm)

= same algorithm as the SL 500 AC. NB the Smartsigns range is marketed overseas under model names BPM-100, BPM-200 and BPM-300

TABLE 3: Aneroid Sphygmomanometers for Clinical Use

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
Maxi Stabil 3	BHS A/A	£87.00	Details Awaited

TABLE 4: Blood Pressure Devices for Use in Special Cases

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
Microlife 3BTO-A(2) Validated for use in pregnancy	BHS A/B	£59.95 (April 2005)	Standard adult (22-32 cm) and Large adult (32-42 cm) cuffs both included to ensure accurate BP measurement in pregnancy as weight and arm circumference increase
Omron 637-IT Wrist Monitor Validated for use in obese adults and the elderly International Protocol		Details Awaited	Details Awaited

TABLE 5: Ambulatory Blood Pressure Measuring Devices Oscillometric Mode

DEVICE	GRADE	COST (INCL VAT)	CUFF SIZES (CM)
SL90217		£1995 (Sept 2005)	Children (l 13-20 cm), Small adult (l 17-26 cm) Standard adult (l 24-32 cm), Large adult (l 32-42 cm) Extra large adult (l 38-50 cm)
SL90207		£1500 (Sept 2005)	Children (l 13-20 cm), Small adult (l 17-26 cm) Standard adult (l 24-32 cm), Large adult (l 32-42 cm) Extra large adult (l 38-50 cm)
A&D TM-2430 Data output facility to PC or printer, includes software	BHS A/A	£1468.75 (Feb 2006)	Small adult (l 15-22 cm), Standard adult (l 20-31 cm) Large adult (l 28-36 cm)
A&D TM-2421 Includes software	BHS A/A	£1,169.00	Small adult (l 15-22 cm), Standard adult (l 20-31 cm)
ABP-2000	BHS A/B	tbc	Tbc
Mobil O Graph	BHS A/B	tbc	Small adult (l 20-24 cm), Standard adult (l 24-32 cm) Large adult (l 32-42 cm)
Daypress 500 BHS A/B	tbc	Tbc	
ES-H531	BHS B/B	Details not found	Details not found
Meditech ABPM-04	BHS B/B	tbc	Small adult (l <24 cm), Standard adult (l 24-32 cm) Large adult (l 32-42 cm), Extra large adult (l 42-55 cm)
Tensioday		Details not found	Details not found
Save 33 Model 2	BHS B/B	Details not found	Details not found
Nissei DS-240	BHS B/A	Details not found	Details not found
Oscar 2	International Protocol	tbc (June 2005)	Small adult 19-27 cm, Standard adult 27-42 cm (included) Large adult 35-50 cm Available From Sept 05: Small adult orbit 18-27 cm, Standard adult orbit 25-35 cm (included), Adult plus orbit 33-40 cm (included), Large adult orbit 39-46 cm
Agilis Distributor & other details awaited	International Protocol	tbc	tbc

For references please refer to the British Hypertension Society website: www.bhsoc.org/blood_pressure_list.stm

UK Distributors for Table 1.

A&D Instruments Ltd

24 Blacklands Way
Abingdon Business Park
Abingdon
Oxon
OX14 1DY
Tel. Freephone 0800 616 140,
ext 121
Fax. 01235 550 485
www.aandd.net

Omron Healthcare (UK) Limited

Opal Drive
Fox Milne,
Milton Keynes
MK15 0DG
Tel. 0870 750 2771
Fax. 0870 750 2772
Email. info.omronhealthcare.uk@
eu.omron.com
www.omron-healthcare.com

KSM Healthcare Ltd

(Seinex)
78 Burnthill Road
Newtownabbey
Co. Antrim
BT36 5HF
Tel. 028 90848454

Tyrrell Healthcare Ltd

(Microlife range)
Pinewood, Greenways, Henfield
West Sussex
BN5 9TZ
Tel. 0845 2225123 (local rate call)
Tel. 01273 494401 (24hr answering
service)
Fax. 01273 493986
Email. info@tyrrellhealthcare.com
www.tyrrellhealthcare.com
(including online ordering)

UK Distributors for Table 2.

Datascope Medical Co. Ltd

(Accutorr Plus)
Lakeview Court
Ermine Business Park
Huntingdon
PE29 6XR
Tel. 01480 423600
Fax. 01480 423638
www.datascope.com

Omron Healthcare (UK) Limited

Opal Drive
Fox Milne,
Milton Keynes
MK15 0DG
Tel. 0870 750 2771
Fax. 0870 750 2772
Email. info.omronhealthcare.uk@
eu.omron.com
www.omron-healthcare.com

Huntleigh Healthcare Ltd

(Smartsigns)
35 Portmanmoor Road
Cardiff
CF24 5HN
Tel. 02920 485885
Fax. 02920 492529
www.huntleigh-healthcare.com"

Tyrrell Healthcare Ltd

(Microlife range)
Pinewood, Greenways, Henfield
West Sussex
BN5 9TZ
Tel. 0845 2225123 (local rate call)
Tel. 01273 494401 (24hr answering
service)
Fax. 01273 493986
Email. info@tyrrellhealthcare.com
www.tyrrellhealthcare.com
(including online ordering)

UK Distributors for Table 3.

Welch Allyn UK Ltd

Cubington Rd
Aston Abbotts
Buckinghamshire
HP22 4ND
Tel. 0207 3656780
Fax. 0207 3659694
Email.
welchallyn@mail.welchallyn.com
www.datascope.com

UK Distributors for Table 4.

Microlife Health Management Ltd

6 & 7 Henfield Business Park
Shoreham Rd
Henfield
West Sussex
BN5 9SL
Email. info@microlife.uk.com
www.microlife.uk.com

UK Distributors for Table 5.

R L Dolby & Co Ltd

(SL range)
Monitor House
Kerse Rd
Stirling
FK7 7RZ
Tel. 01786 446640
www.dolby-ltd.co.uk
Email. sales@dolby-ltd.co.uk "

A&D Instruments Ltd

(TM range)
24 Blacklands Way,
Abingdon Business Park,
Abingdon,
Oxon,
OX14 1DY
Tel. Freephone 0800 616 140,
ext 121
Fax. 01235 550 485
www.aandd.net

Biotrac, Inc

(ABP-2000)
7215 NW 46th Street
Miami
FL 33166
U.S.A.
Tel. (305) 594-7474
Fax. (509) 267-2283
www.biotracmed.com

I.E.M. GmbH

(Mobil O Graph)
Cockerillstraße 69,
D-52222 Stolberg/Germany
Tel. +49 (2402) 95 00-0,
Fax. +49 (2402) 95 00-11
www.iem.de

Meditech Ltd

(Medictech).
200 Ulloi ut, Budapest
H-1191 Hungary
Tel. +36 1 280 8232;
+36 1 280 82 33
Fax. +36 1 282 9388
Email. meditech@meditech.hu

SunTech Medical Ltd Europe

(Oscar 2)
Oakfield Industrial Estate
Stanton Harcourt Rd
Eynsham
Oxford
OX29 4TS
Tel. (01865) 884234
Fax. (01865) 884235
www.suntechmed.com

Resources

Health Care Without Harm: www.noharm.org/europe/mercury/sphygmom
 "A New Era: The Elimination of Mercury Sphygmomanometers", factsheet, June 2002.

Professional Associations

British Hypertension Society: www.bhsoc.org/blood_pressure_list.stm
European Society of Hypertension: www.eshonline.org/
Association for the Advancement of Medical Instrumentation: www.aami.org

Other Resources

KEMI – Swedish Chemical Inspectorate:
 Mercury-free blood pressure measurement equipment – Experiences in the Swedish healthcare sector.
www.noharm.org/details.cfm?type=document&id=1167

UK Medical Devices Agency:
 Blood Pressure Measurement Devices – Mercury and Non-mercury
www.mhra.gov.uk/home/idcplg?IdcService=GET_FILE&dDocName=CON007351&RevisionSelectionMethod=LatestReleased

DABL Educational Trust:
 Manufacturers site on validation and classification of blood pressure devices
www.dableducational.org/sphygmomanometers.html

Sustainable Hospitals Project:
 Database of manufacturers and brand types (mainly for the US)
www.sustainablehospitals.org

Welch Allyn:
 Clarification on the Efficacy of Aneroid and Digital Blood Pressure Devices
www.noharm.org/library/docs/Welch_Allyn_Clarification_on_the_Efficacy_of_A.pdf

References

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8. *Ibid.*
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10. Markandu NK, Whitcher F, Arnold A, Carney C. *The Mercury sphygmomanometer should be abandoned before it is proscribed. Journal of Human Hypertension 14(1): 31-6. 2000.*
11. *Welch Allyn: Clarification on the Efficacy of Aneroid and Digital Blood Pressure Devices. See www.noharm.org/library/docs/Welch_Allyn_Clarification_on_the_Efficacy_of_A.pdf*



Health Care Without Harm
 HCWH Europe
 Chlumova 17, 130 00 Praha 3, Czech Republic
 Phone/Fax: +420 222 782 808
 Email: europe@hcwh.org
www.noharm.org



Health and Environment Alliance (HEAL) *
 28 Bld Charlemagne, B1000 Brussels, Belgium
 Phone: +32 2 234 3640 Fax: +32 2 234 3649
 E-mail: info@env-health.org
www.env-health.org

* Formerly known as EPHA Environment Network (EEN)

"Stay Healthy, Stop Mercury" campaign

Health and Environment Alliance (HEAL) and Health Care Without Harm Europe (HCWH) are joining forces to mobilise the health community in Europe for a global ban on mercury. The activities are focused on raising awareness of the risks to health, especially for babies and pregnant women, and on working with women and health care professionals on how they can protect themselves and the environment from mercury exposure.

