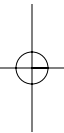
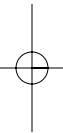
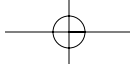


GUIDELINES

ON DISPOSING ~~MERCURY~~ CONTAINING
SPHYGMOMANOMETERS AND THERMOMETERS
IN MINISTRY OF HEALTH HOSPITALS



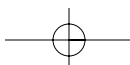
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Quality in Medical care Section
Medical Development Division
Ministry of Health Malaysia

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FOREWORD BY THE DIRECTOR GENERAL OF HEALTH MALAYSIA



Mercury is a liquid metal with unique properties that have made it an ideal choice for use in medical devices of measurement such as pressure (sphygmomanometers) and temperature (thermometers).

These mercury-containing devices have been an integral part of hospital operations for decades, which assist and strengthen the diagnosis of certain cases and also in the monitoring of ill patients.

The importance of these instruments is its role in the healthcare of patients where inaccurate blood pressure and temperature monitoring has a high impact on the morbidity and mortality of patients especially in cases such as pre eclampsia, arrhythmias, neonates, immuno compromised children, critically ill adults and children. It also has a vital role in cases with moderately elevated blood pressure where accurate blood pressure measurement is an important indicator of the current clinical condition and a powerful predictor of future cardiovascular and overall health.

Mercury has a very high volatility rate forming a colorless and odorless gas when exposed to the atmosphere. Direct exposure to spilt mercury from broken sphygmomanometers and thermometers can pose a health hazard to healthcare workers in hospitals who may inhale these gases or have direct contact with mercury.

The Ministry of Health (MOH), Malaysia is concerned with the exposure of its staff and others to mercury in view of the use of sphygmomanometers and thermometers and the possibility of breakage and spillage in the government hospitals.

Mercury sphygmomanometers and thermometers are safe to use as long as there is no breakage or leakage from these instruments. Exposure to mercury occurs during the cleaning up process and also from the improper disposal of mercury and materials used in the cleaning up of mercury spillage.

Considering the possibility of occurrence of such incidences, the Ministry of Health, Malaysia felt it necessary to prepare and circulate these “Guidelines on Disposing Mercury Containing Sphygmomanometers and Thermometers in Ministry of Health Hospitals” to ensure proper management of broken sphygmomanometers and thermometers.

These guidelines have been prepared with the objective of ensuring that the necessary precautions are taken by the MOH staff in the event of mercury spillage from unintentional breakage of thermometers and sphygmomanometers and their handling in an environmentally sound, safe and healthy manner. It also addresses the collection of spilt mercury, cleaning up procedures, storage; and disposal of the collected mercury and materials used in the clean up.

I am confident these guidelines will be an important tool for healthcare providers who may come in contact with mercury in the event of the instrument breakage.

I would like to congratulate the technical committee responsible for these guidelines and the Medical Staff Safety and Health Unit, Quality in Medical Care Section, Medical Development Division, Ministry of Health Malaysia for their commendable efforts in developing these guidelines. I hope these guidelines will be utilised by the MOH healthcare providers to ensure their own health and safety and of others in the hospitals.



Datuk Dr. Noor Hisham Bin Abdullah
Director General of Health, Malaysia
10th June 2013

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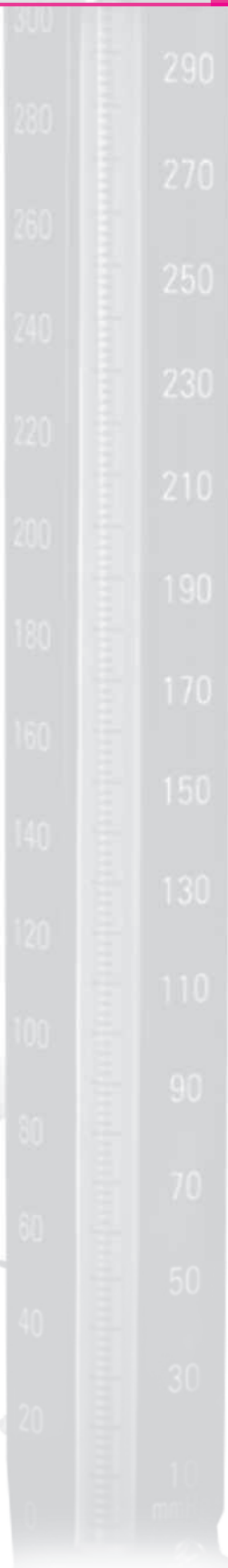
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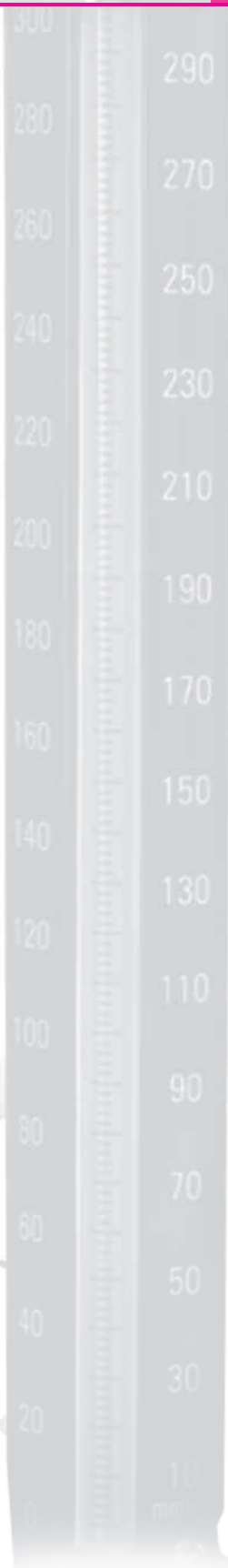
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GUIDELINES ON DISPOSING MERCURY CONTAINING SPHYGMOMANOMETERS AND THERMOMETERS IN MINISTRY OF HEALTH HOSPITALS

1. Scope of the Guidelines

These guidelines were produced for the proper disposal of broken and non functioning mercury containing sphygmomanometers and thermometers in the hospitals under the Ministry of Health.

2. Objectives of the Guidelines

To ensure the disposal of mercury from broken sphygmomanometers and thermometers is done in accordance to the Environmental Quality (Scheduled Wastes) Regulations 2005.

To ensure that healthcare workers and other persons present in the hospital vicinity are not exposed to mercury from broken sphygmomanometers and thermometers

To ensure that non functioning sphygmomanometers and thermometers are disposed in accordance to the Environmental Quality (Scheduled Wastes) Regulations 2005.

To ensure that the mercury from broken sphygmomanometers and thermometers do not contaminate the environment.

3. Introduction

Mercury is a metal that is liquid at room temperature. Liquid mercury is sometimes called metallic or elemental mercury. It looks like silvery-white beads or balls (globules).

The usefulness of mercury is from the uniqueness of its weight, ability to flow (only common liquid metal), chemical stability, high boiling point and relatively low vapor pressure; which makes it an ideal choice for use in medical devices that measure temperature such as clinical thermometers, laboratory

thermometers and freezer thermometers (Minimax thermometers); and also in sphygmomanometers which measure blood pressure.

In Malaysia, mercury containing thermometers are used to measure the body temperature of patients with dengue fever and sphygmomanometers are still considered the “gold standard” for measuring blood pressure in conditions such as pre-eclampsia and eclampsia.

The mercury thermometer is also easy to maintain, accurate, easily stored and cheap.

4. Properties of Mercury

When mercury is spilt from a broken sphygmomanometer or thermometer, it can break into multiple small droplets resulting in an increase of exposed total surface area. An increase of total surface area and/or an increase in room temperature causes the mercury to volatilize at a faster rate.

Accidental spill of liquid mercury can increase the levels of mercury in the air and also contaminate the wastewaters of a hospital. The spilt mercury may also get adhered to clothes, soles of the shoes and/or lab coats; and get transported to another location.

Proper/adequate ventilation in a room can dilute the mercury concentration in the air to a safe level.

5. Health Effects of Exposure to Mercury

The common modes of exposure to spilt mercury is:

- 1) Accidental skin contact with mercury
- 2) Inhalation of vaporized mercury

5.1 Skin

If a person comes in contact with mercury for a short period of time a small amount may pass through the skin, but not enough to cause harm.

5.2 Inhalation

Health effects caused by exposure to high levels of mercury vapor.

- Cough, sore throat
- Shortness of breath
- Chest pain
- Nausea, vomiting, diarrhea
- Increase in blood pressure or heart rate
- A metallic taste in the mouth
- Eye irritation
- Headache
- Vision problems

Chronic effects of Mercury

Weight loss, insomnia, erythrim, tremors, dysarthria, gingivitis, stomatitis, excessive salivation and metallic taste.

6. Mercury Spill Management

The Mercury Spill Kit is essential for the cleaning up of mercury spillage from broken thermometers and sphygmomanometers. Proper clean up prevents environmental and health effects of mercury.

7. Mercury Spill Kit (Appendix V)

- i. Torchlight to locate shiny mercury beads
- ii. Pieces of cardboard sheets or plastic-coated playing cards or even stiff paper
- iii. Disposable forceps to remove/pick-up broken glass pieces (from broken sphygmomanometers and thermometers)
- iv. 10 ml Syringe (without the needle) or eye dropper to draw up large mercury beads
- v. Two inch width transparent cellophane tape to pick up smaller mercury beads
- vi. Sulfur powder (absorbs mercury by forming mercuric sulfide hence suppressing the release of mercury vapor)
- vii. Paper towels to dab and remove the sulphur powder containing bounded mercury.

8. Containers for Collected Mercury

- i. Air-tight, sealable plastic bags (small and large sizes, thickness: 40 to 150 microns)
- ii. Air-tight, puncture-resistant, rigid plastic container with a wide opening for collecting mercury-contaminated glass from broken sphygmomanometers and thermometers. Example: urine container (for small broken pieces), 2.5 Liter sharps bin (for larger broken pieces)
- iii. Large plastic bags (thickness: 40 to 150 microns) to seal the collected mercury, material used for the clean up and used Personal Protective Equipment (PPE) for disposal.

9. Personal Protective Equipment (PPE) for Handling Mercury

No.	Protection	PPE
1.	Hand & Skin	Nitrile Gloves
2.	Eyes	Safety goggles
3.	Respiratory / Lungs	<ol style="list-style-type: none"> 1. Recommended - Full/half face piece air-purifying respirator with mercury vapor cartridges. OR 2. Face mask made of sandwiched activated charcoal-impregnated cloth OR 3. If the above masks are not available: use a face mask with a 0.3 micron HEPA filter to capture amalgam particles and mercury-laden dust OR 4. N95 facemask.
4.	Body	Disposable plastic apron
5.	Feet	Disposable shoe covers

10. Steps for Cleaning Up and Disposal of Mercury Spillage Due to Broken Sphygmomanometers and Thermometers in MOH Hospitals

If a mercury spill occurs, immediately:

- i). **Inform your clinic/ward supervisor and call for assistance.**
- ii). **Isolate the area using signages.** Block off any area where droplets of spilt mercury are visible using red and white striped tape (supplied by the concession company), and post a warning sign using a signage (Appendix III) supplied in the mercury spill kit.

Turn off the fan and air conditioner (where applicable) to avoid dispersing mercury vapour throughout the affected area and open the windows and doors (where applicable)

- iii). **Avoid walking on or touching any surface contaminated with mercury.**
- iv). **Start clean up immediately unless you are pregnant or have been injured by the broken instrument.** If you are pregnant, get your colleague or any other staff to do the clean up. If you are injured, get medical attention immediately.

Small spills of metallic mercury may be cleaned up safely by the personnel involved if they have had proper training and the correct PPE.

Areas contaminated with mercury caused by breakage of the mercury containing equipment shall be classified into two categories;

Small spill: From breakage of the sphygmomanometer and thermometer and spillage of 1-3 grams of mercury. Mercury contamination spreads into the broken area and surrounding area. In this case mercury contaminated area is located in one room.

Large spill: From breakage of large mercury-containing equipment, mercury contamination spreads in several rooms and buildings.

- v). **Remove jewellery:** Remove all jewellery from hands and wrists including your watch to prevent the mercury from combining (amalgamate) with the precious metals.
- vi). **Put on face mask:** In order to prevent inhalation of mercury vapor, wear respiratory protection from the mercury spill kit.
- vii). **Put on the apron/gown :** The disposable apron/gown must be discarded after use as they become contaminated in the mercury cleanup process. Use disposable shoe covers.
- viii). **Wear gloves :** Put on nitrile gloves and collect all the broken instrument glass pieces using the disposable forceps and place it into a container provided with a lid (urine container for small pieces, sharps bin for larger pieces). Secure the container with tape to make it air tight and label it as "ITEMS CONTAMINATED WITH MERCURY".
- ix). **Locate mercury beads:** Check a wide area beyond the spill when locating mercury beads because mercury beads spread in long distance on a flat surface; also check surface cracks and hard-to-reach areas of the floor.

Use the flashlight to locate glistening beads of mercury that may be missed especially in small cracks. Shine the flashlight at an angle and the beads of mercury will reflect the light from the flashlight.

After locating the mercury beads, use a stiff cardboard to push the smaller pieces of mercury beads together to form bigger ones.

- x). **Removal of mercury beads:**
- a) Use a syringe (without a needle) or eye dropper to suck the larger beads of mercury; or use the two pieces of cardboard sheets/two plastic-coated playing cards or even stiff paper to push the spilt beads of mercury together and scoop it all up. Slowly and carefully place the collected mercury into a rigid plastic container (eg. urine container) half filled with water. Once all the large mercury beads are collected, twist the lid tightly and seal it with tape to make it absolutely air tight.

b) Next use the two inch width transparent cellophane tape to collect smaller beads by gently pressing the tape directly on the mercury beads. Place the used tape with mercury in a puncture proof plastic bag or double layered plastic bag and secure tightly with a tie.

c) Removal of hard-to-see beads using powdered sulfur**. Sprinkle sulfur powder over the breakage area. The powder will bind with the hard-to-see mercury. Next press the damp paper towel on the sulphur powder to pick up the sulphur powder and bound mercury. Place all the used paper towels and collected sulphur powder in a double layered leak proof plastic bag and seal it tightly with a tie.

**Sulfur powder is used because it binds with the mercury hence suppressing the vaporization of mercury and also making it easier to remove.

xi). Collection of mercury contaminated items

Place all the material used during the cleanup, including the used PPE and mercury collected from the spill area into a double layer puncture proof plastic bag and seal it tightly. Label the bag according to the Environmental Quality (Scheduled Wastes) Regulations 2005 (Appendx IV).

The remaining parts of the sphygmomanometer (metal body, reservoir, tubing, cuff and bulb) are to be placed into a puncture proof double layered plastic bag since these parts may also be contaminated by mercury and sent to the respective concession company for disposal as these instruments are assets and need to be decontaminated and disposed off according to procedure.

xii) Post clean up: Keep windows open for 24 hours (where applicable) to ventilate the area after the cleanup. After ensuring all the mercury has been disposed, resume routine cleaning operations.

Never use a vacuum cleaner, mop or broom to clean up a mercury spill; and **NEVER DISPOSE MERCURY INTO THE SEWAGE SYSTEM, SINK, CLINICAL BIN, SHARPS BIN OR THE DUST BIN!!!**

Care must be taken not to take off the respirator and eye protection until the contaminated gloves are first removed.

11.Storage of Collected Mercury and Mercury Contaminated Items

- a) It is vital that the bag containing the mercury, broken glass pieces of the equipment and material used during the cleanup is labeled (refer Appendix IV) and stored in an enclosed area that is cool (to avoid evaporation) for disposal in accordance to Environmental Quality (Scheduled Wastes) Regulations 2005.

It is recommended that the mercury is disposed of within 180 days in accordance to the Environmental Quality (Scheduled Wastes) Regulations 2005.

- b) A copy of the Chemical Safety Data Sheet for mercury should be available along with the Mercury spill kit and in the chemical waste storage area.
- c) Only an authorized transporter (concession company) should be engaged for transportation of such substances.
- d) Mercury Spill Kits must be available in each work area where mercury is present.

Sphygmomanometers and thermometers which are intact (not broken or has no leakage) but are non-functioning are to be sent to the concession companies for disposal.

12. Illustrated Steps for Cleaning Up and Disposal of Mercury Spillage Due to Broken Sphygmomanometers and Thermometers in MOH Hospitals

MERCURY SPILL KIT



Put on PPE

Locate Broken Glass Pieces Of Sphygmomanometer/thermometer



Collect Broken Instrument Glass Pieces Using Disposable Forceps



**Put Broken Instrument Glass Pieces Into A
Puncture Proof Plastic Container And
Seal Tight With Tape – Smaller Pieces Into Urine Container**

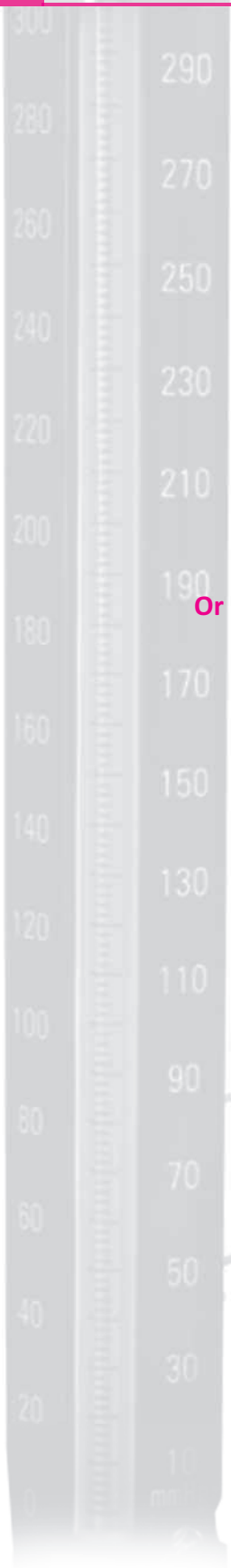
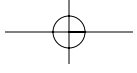


Larger Pieces Into Sharps Bin Container

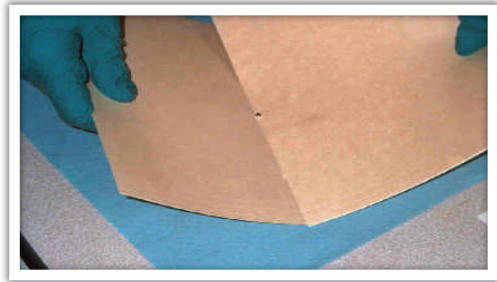


**Use Torchlight To Locate
Shiny Mercury Beads**

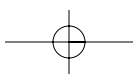
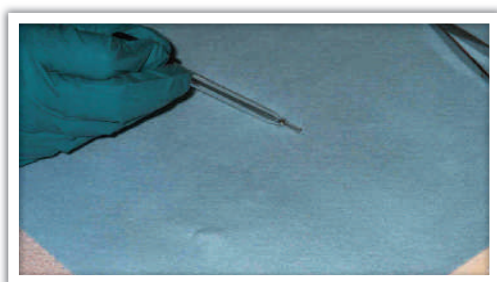




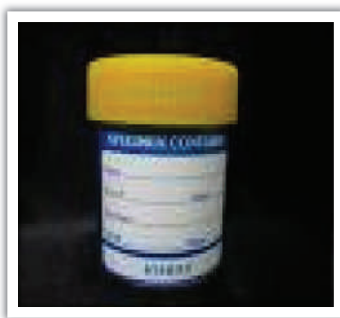
Collect The Larger Beads Using Card Boards



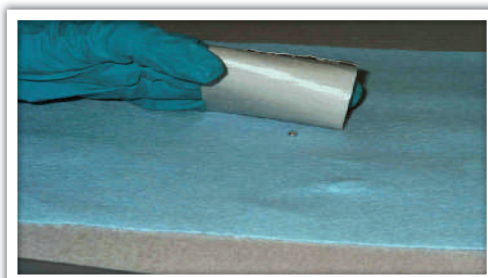
Or Collect The Larger Beads Using Syringe/eyedropper



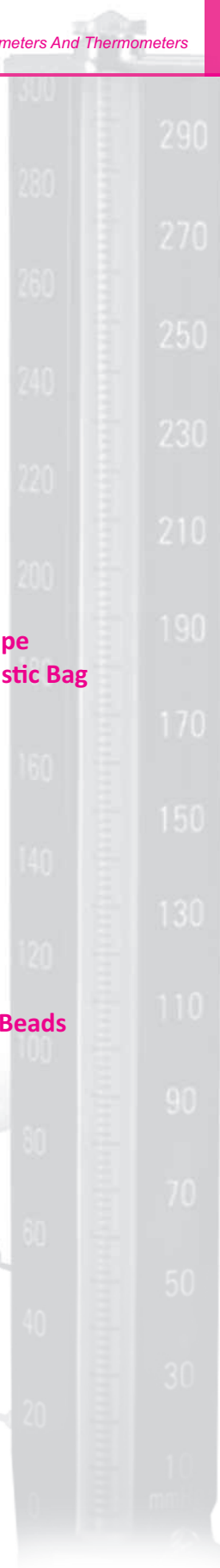
**Put Collected Mercury Into Urine
Container Half Filled With Water**



**Collect The Smaller Beads Using Cellophane Tape
and Put Into a Puncture Proof or Double Layered Plastic Bag**



**Coat Contaminated Area With
Sulphur Powder To Remove Hard-to-see Mercury Beads**



Next Press The Damp Paper Towel On The Sulphur Powder To Pick Up The Sulphur Powder And Bound Mercury

Put The Damp Paper Towels With Sulphur and Mercury Into A Double Layered Leak Proof Plastic Bag

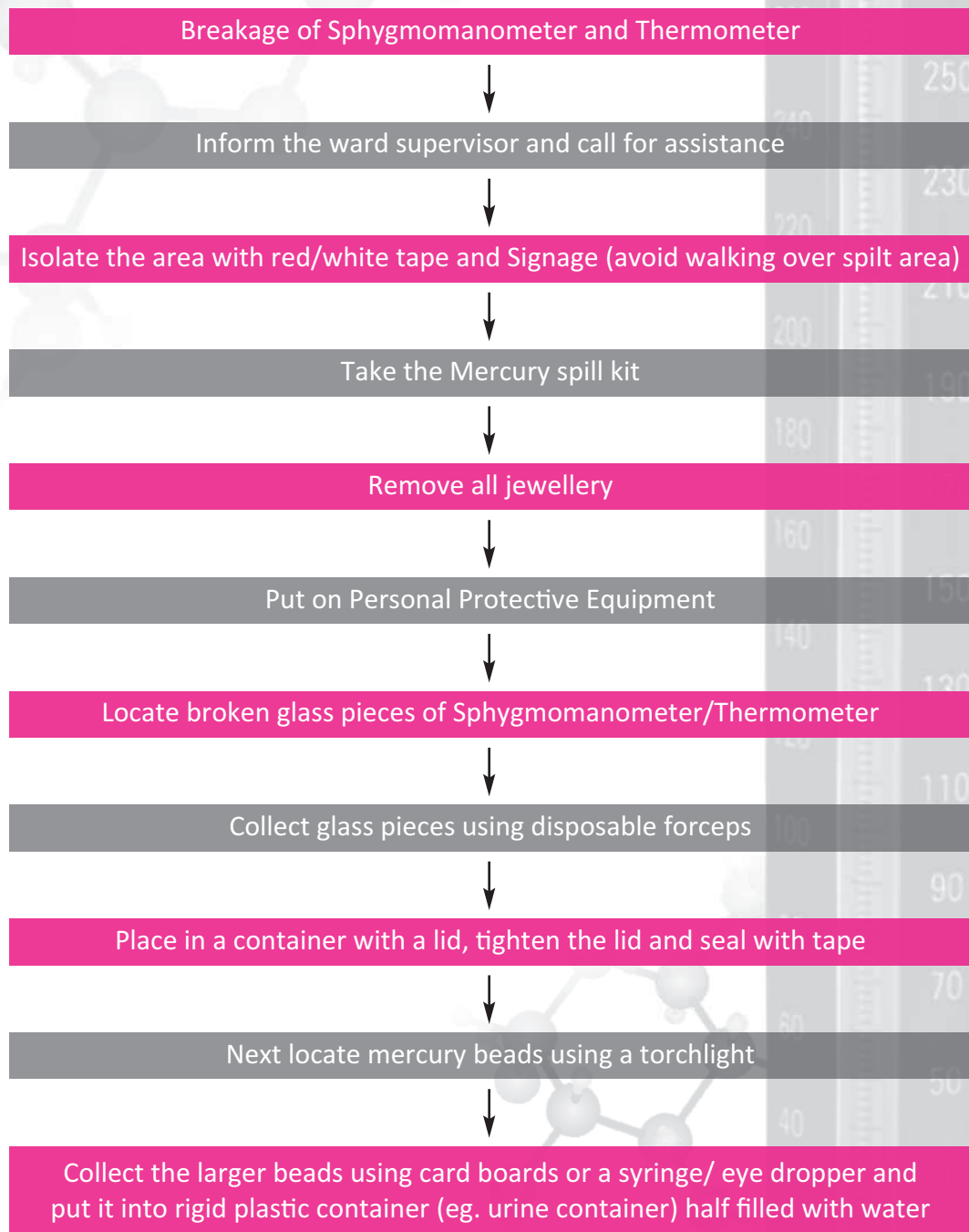


FINAL STEP

Put All The Collected Items And Used PPE Into A Single Bag (Double Layer) & Tie Securely And Label

APPENDIX I

Flow Chart for Cleaning Up and Disposal of Mercury Spillage from Broken Sphygmomanometers and Thermometers



Collect the smaller beads using cellophane tape and place into a puncture proof or double layered plastic bag

Coat the contaminated area with sulphur powder to remove hard-to-see mercury beads

Remove sulphur powder (bounded with mercury) using damp paper towel

Put the used damp paper towel with sulphur and mercury into leak proof doubled layered plastic bag

Put all the collected items and used PPE into puncture proof bag (double layer) & tie securely

Label according to Appendix IV

Transportation of mercury and used items to chemical waste storage area

Collect the remaining parts of the instrument, place into double layer bag and send to concession company

Collection by Kualiti Alam recommended within 180 days for disposal

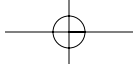
Replace used items in mercury spill kit

APPENDIX II

CHECKLIST FOR CONTENTS OF MERCURY SPILL KIT

<input type="checkbox"/> Torch light & batteries <input type="checkbox"/> Card-board - two pieces <input type="checkbox"/> 2 inch (width) transparent Cellophane Tape <input type="checkbox"/> Disposable forceps <input type="checkbox"/> Two 10 cc syringe / eye dropper <input type="checkbox"/> Sulphur powder - 250 grams <input type="checkbox"/> Self sealing plastic Bag (four bags) <input type="checkbox"/> Puncture proof plastic container for broken glass pieces of instrument (eg. urine container, sharps bin) <input type="checkbox"/> Puncture resistant plastic bag(Dustbin size) x 2 <input type="checkbox"/> Face Mask/Respirator	<input type="checkbox"/> Cable tie x 10 <input type="checkbox"/> Label for mercury disposal <input type="checkbox"/> Nitrile Gloves – 1 pair <input type="checkbox"/> Goggles <input type="checkbox"/> Disposable plastic apron x 1 <input type="checkbox"/> Disposable plastic gown x 1 <input type="checkbox"/> Disposable Shoe covers <input type="checkbox"/> Paper towels <input type="checkbox"/> Signage: Caution - Cleaning of Spilt Substance in Progress <input type="checkbox"/> Red and White striped tape
<input type="checkbox"/> Flow chart for Cleaning up and Disposal of Mercury from Broken Sphygmomanometer and Thermometer (Attached outside the Mercury Spill Kit)	
<input type="checkbox"/> Chemical Safety Data Sheet for Mercury (Kept with the Mercury Spill Kit)	

**** Check the contents of the Mercury Spill Kit every 6 months including
expiry date of battery and sulphur powder.**



APPENDIX III

MERCURY SIGNAGE




SIGNAGE X 2 UNITS (6 INCHES X 2 FEET)

Printed, laminated and kept with the Mercury Spill Kit. To be temporarily mounted on the "CAUTION - WET FLOOR" signage (Next Page) during clean up of mercury spillage.

**SIGNAGE MEASURE - 8 INCHES X 2 FEET**

This signage is available in the MOH Hospital wards. The "CAUTION - CLEANING OF SPILT SUBSTANCE IN PROGRESS" signage (previous page) can be mounted on this during Mercury Spillage clean up.

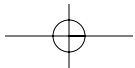
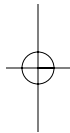
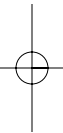
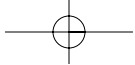
APPENDIX IV**LABEL FOR MERCURY DISPOSAL**

 TOXIC SUBSTANCES (WASTE)	
DATE OF GENERATION	
WASTE CATEGORY CODE	
NAME OF WASTE	
QUANTITY (in litre)	
PERSON IN-CHARGE	
CENTRE / UNIT / LAB	
TELEPHONE NO	

APPENDIX V**PICTURE OF MERCURY SPILL KIT**

References

1. <http://www.epa.gov/hg/spills/index.htm#disposal>
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GARISPANDUAN

CARA PELUPUSAN ALAT *SPHYGMOMANOMETER*
DAN *THERMOMETER* YANG MENGANDUNGI *MERCURY*.
DI HOSPITAL-HOSPITAL DI BAWAH
KEMENTERIAN KESIHATAN MALAYSIA

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GARISPANDUAN CARA PELUPUSAN ALAT SPHYGMOMANOMETER DAN THERMOMETER YANG MENGANDUNGI MERKURI DI HOSPITAL-HOSPITAL DI BAWAH KEMENTERIAN KESIHATAN MALAYSIA

1. Skop Garispuandu

Garispuandu ini dihasilkan supaya peralatan yang mengandungi merkuri, iaitu *sphygmomanometer* dan *thermometer* yang pecah atau tidak berfungsi di hospital-hospital di bawah Kementerian Kesihatan Malaysia dilupus dengan betul.

2. Objektif Garispuandu

Memastikan pelupusan merkuri dari *sphygmomanometer* dan *thermometer* yang pecah dikendalikan mengikut *Environmental Quality (Scheduled Wastes) Regulations 2005*.

Memastikan anggota kesihatan dan orang lain di hospital tidak terdedah kepada merkuri dari *sphygmomanometers* dan *thermometers* yang pecah.

Memastikan *sphygmomanometer* dan *thermometer* yang tidak berfungsi dilupus mengikut *Environmental Quality (Scheduled Wastes) Regulations 2005*.

Memastikan merkuri dari *sphygmomanometer* dan *thermometer* yang pecah tidak mencemarkan alam sekitar.

3. Pengenalan

Merkuri adalah logam yang berbentuk cecair pada suhu bilik. Merkuri cecair juga dikenali sebagai *metallic* atau *elemental mercury*. Rupanya seperti manik-manik atau bebola berwarna perak berkilauan.

Disebabkan beratnya, kebolehan mengalir, sifat kimia yang stabil, suhu mendidih yang tinggi dan tekanan wap yang rendah, merkuri adalah sangat sesuai digunakan dalam alat perubatan yang menyukat suhu seperti *thermometer* klinikal, *thermometer* makmal dan *thermometer* peti sejuk (*Minimax thermometers*); dan juga dalam alat *sphygmomanometer* untuk menyukat tekanan darah.

Di Malaysia *thermometer* merkuri masih digunakan untuk mengukur suhu badan pesakit demam denggi dan *sphygmomanometer* masih digunakan sebagai “*gold standard*” untuk mengukur tekanan darah kes-kes tertentu seperti *pre-eclampsia* dan *eclampsia*.

Thermometer merkuri juga senang digunakan, diselenggarakan, disimpan dan adalah murah.

4. Ciri-ciri Merkuri

Apabila merkuri tertumpah daripada *sphygmomanometer* atau *thermometer* yang pecah, merkuri tersebut akan pecah kepada titisan-titisan kecil dan ini akan meningkatkan jumlah keluasan permukaan merkuri yang terdedah. Peningkatan jumlah keluasan permukaan dan/atau peningkatan suhu bilik akan mengakibatkan merkuri menguap dengan kadar yang lebih cepat.

Merkuri yang tertumpah boleh meningkatkan paras merkuri di udara dan juga mencemar air buangan hospital. Merkuri yang tertumpah juga boleh melekat pada pakaian, tapak kasut atau/dan kot makmal; dan dibawa ke tempat lain.

Pengudaraan bilik yang mencukupi boleh mengurangkan paras merkuri di udara.

5. Kesan Kesihatan Disebabkan Pendedahan Kepada Merkuri

Cara pendedahan kepada bahan merkuri yang tertumpah biasanya adalah melalui:

- 1) Sentuhan kulit dengan bahan merkuri
- 2) Sedutan wap merkuri

5.1 Kulit

Sekiranya seseorang tersentuh kepada merkuri untuk tempoh masa yang singkat, kemungkinan paras merkuri yang meresap ke dalam kulit adalah sangat rendah dan tidak mencukupi untuk mengakibatkan kemudaratan kepada kesihatan.

5.2 Pernafasan

Kesan kepada kesihatan akibat pendedahan kepada paras wap merkuri yang tinggi:

- Batuk, sakit tekak
- Kesusakan nafas
- Sakit dada
- Loya, muntah, cirit-birit
- Peningkatan tekanan darah atau denyutan jantung
- Perasaan deria rasa seperti timah di mulut
- Gatal mata
- Sakit kepala
- Masalah penglihatan

Kesan Kronik Pendedahan Merkuri

Kehilangan berat badan, kurang tidur, *erythrim*, gegaran, *dysarthria*, *gingivitis*, *stomatitis*, air liur berlebihan dan *metallic taste*.

6. Pengendalian Merkuri Tertumpah

Mercury Spill Kit perlu digunakan untuk pembersihan bahan merkuri yang tertumpah dari alat *sphygmomanometer* atau *thermometer* yang pecah. Kaedah pembersihan yang betul adalah penting untuk mengelakkan pencemaran alam sekitar dan juga kesan merkuri terhadap kesihatan.

7. Mercury Spill Kit (Apendiks V)

- i. Lampu suluh untuk mencari lokasi merkuri yang berkilau.
- ii. Kertas kadbod, kad daun terup atau kertas yang tebal.
- iii. Forsep pakai buang untuk mengambil serpihan gelas yang pecah (daripada alat *sphygmomanometer* atau *thermometer* yang pecah)
- iv. Picagari 10 ml (tanpa jarum) atau *eye dropper* untuk menghisap manik-manik merkuri yang besar
- v. Pita selofen telus dengan kelebaran 2 inci untuk mengutip manik-manik merkuri yang kecil.
- vi. Serbuk sulfur (menyerap merkuri)
- vii. Tuala kertas untuk melap serbuk sulfur yang mengandungi merkuri.

8. Bekas Untuk Merkuri Terkumpul

- i. Beg plastik kedap udara (besar dan kecil, dengan ketebalan 40 hingga 150 mikron)
- ii. Penakung plastik kuat yang kedap udara, tahan bocor, mempunyai penutup ketat dan pembukaan yang besar untuk mengutip gelas yang tercemar dengan merkuri dari alat *sphygmomanometer* atau *thermometer* yang pecah. Contoh : *urine container* (untuk serpihan gelas kecil), *sharps bin* 2.5 Liter (untuk serpihan gelas yang besar).
- iii. Beg plastik besar (ketebalan: 40 hingga 150 mikron) untuk menyimpan dan pelupusan semua merkuri yang telah dikumpulkan, bahan yang telah digunakan dalam pembersihan dan juga Alat Pelindung Diri yang telah digunakan.

9. Alat Pelindung Diri untuk Pengendalian Merkuri

No.	Kawalan	Alat pelindung tersendiri
1.	Tangan dan kulit	Sarung tangan Nitril
2.	Mata	<i>Safety goggles</i>
3.	Paru-paru	<ol style="list-style-type: none"> 1. Dicadangkan - jenis <i>full/half face piece air-purifying respirator</i> dengan <i>mercury vapor cartridges</i> ATAU 2. <i>Face mask</i> diperbuat dengan lapisan kain yang terhimpit dengan <i>activated charcoal</i> ATAU 3. Sekiranya <i>facemask</i> di atas tidak didapati, guna <i>face mask</i> dengan 0.3 micron <i>HEPA filter</i> untuk menangkap zarah-zarah amalgam dan debu merkuri. ATAU 4. <i>N95 face mask</i>.
4.	Badan	Apron plastic jenis pakai buang
5.	Kaki	Penutup kasut jenis pakai buang

10. Panduan Cara Pembersihan dan Pelupusan Merkuri yang Tertumpah Dari Alat *Sphygmomanometer dan Thermometer* yang Pecah di Hospital-hospital Kementerian Kesihatan Malaysia.

Sekiranya terjadi tumpahan merkuri, dengan secepat mungkin:

- i) **Beritahu penyelia wad atau klinik dan panggil untuk bantuan.**
- ii) **Asingkan tempat tumpahan menggunakan petanda.** Buat sekatan menggunakan pita berjalur merah dan putih (boleh didapati dari syarikat konsesi) di sekeliling tumpahan merkuri dan gunakan petanda (Appendiks III) yang tersedia dalam *mercury spill kit*.

Padamkan kipas dan alat hawa dingin untuk mengelakkan wap merkuri dari merebak dan buka tingkap dan pintu (di mana dibenarkan)
- iii) **Elak daripada berjalan diatas atau menyentuh permukaan yang telah dicemar dengan merkuri.**
- iv) **Mulakan pembersihan dengan segera melainkan jika anda mengandungi atau tercedera oleh serpihan gelas daripada alat yang pecah.** Jika anda mengandungi, dapatkan anggota wad yang lain untuk menjalankan kerja pembersihan. Sekiranya anda tercedera, dapatkan rawatan kecemasan dengan segera.

Tumpahan kecil merkuri boleh dibersihkan oleh anggota kesihatan terlibat jika anggota tersebut telah menerima latihan dan juga telah dibekalkan dengan Alat Pelindung Diri yang sesuai.

Tempat yang tercemar dengan tumpahan merkuri disebabkan pecahan alat mengandungi merkuri diklasifikasikan kepada dua kategori;

Tumpahan kecil: Tumpahan merkuri sebanyak 1-3 gram akibat daripada pecahan *sphygmomanometer dan thermometer* akan mencemari kawasan yang terlibat dan juga kawasan persekitarannya. Dalam keadaan tersebut, kawasan pencemaran merkuri adalah terhad kepada satu bilik.

Tumpahan besar: Tumpahan berlaku akibat daripada pecahan alat yang mengandungi merkuri yang banyak dan pendedahan/pencemaran merangkumi beberapa bilik ataupun bangunan.

- v) **Tanggalkan semua barangan kemas:** Tanggalkan semua barangan kemas dari tangan dan pergelangan tangan termasuk jam tangan untuk mengelakkan merkuri bergabung dengan barangan berharga.
- vi) **Pakai face mask:** Untuk mengelakkan dari menghidu wap merkuri, pakai alat pelindung pernafasan dari *mercury spill kit*.
- vii) **Pakai apron/gown:** *Apron/gown* jenis pakai buang perlu dibuang selepas digunakan disebabkan tercemar dengan merkuri semasa proses pembersihan. Pakai penutup kasut pakai buang.
- viii) **Pakai sarung tangan:** Pakai sarung tangan nitril dan kutip serpihan gelas alat yang pecah menggunakan forsep pakai buang dan masukkan ke dalam bekas dengan penutup (*urine container* untuk serpihan kecil, *sharps bin* untuk serpihan besar). Tutup penutup dengan ketat dan gunakan pita supaya bekas adalah kedap udara dan label dengan "BARANGAN TERCEMAR DENGAN MERKURI".
- ix) **Cari manik-manik merkuri:** Periksa kawasan yang luas iaitu melebihi kawasan tumpahan untuk mengesan manik-manik merkuri termasuk retakan di permukaan dan tempat yang sukar dicapai di kawasan lantai.
- Gunakan lampu suluh untuk mengesan manik-manik merkuri berkilau yang ketinggalan terutama sekali dalam retakan kecil. Pancarkan lampu suluh pada sudut di mana manik-manik merkuri yang kecil akan berkilau disebabkan cahaya dari lampu suluh.
- Setelah mengenalpasti lokasi manik-manik merkuri tersebut, gunakan kadbod untuk mengumpulkan manik-manik merkuri yang kecil untuk dijadikan manik merkuri yang besar.
- x) **Penyingkiran manik-manik merkuri:**
- a) Gunakan picagari (tanpa jarum) atau *eye dropper* untuk menyedut manik-manik merkuri yang besar; ataupun gunakan kepingan-kepingan kadbod, kad permainan dilapisi plastik ataupun kertas kaku untuk mengumpul manik-manik merkuri yang tertumpah. Dengan berhati-hati letakkan merkuri yang terkumpul ke dalam satu bekas plastik yang keras (contohnya *urine container*) yang diisi separuh dengan air. Sebaik sahaja semua merkuri dimasukkan, tutup bekas dengan ketat dan gunakan pita supaya bekas tersebut adalah kedap udara.

- b) Seterusnya, gunakan pita selofan telus dengan kelebaran dua inci untuk mengutip manik-manik yang lebih kecil dengan menghimpit dengan perlahan pita secara terus ke atas manik-manik merkuri yang kecil. Kemudian letakkan pita selofan yang telah digunakan ke dalam satu beg plastik kuat (*puncture proof*) atau gunakan beg plastik dua lapisan dan ikat menggunakan pengikat.
- c) Kumpulkan manik merkuri yang sangat kecil (susah dilihat) menggunakan serbuk sulfur**.
- Taburkan serbuk sulfur di atas kawasan di mana alat terpecah. Serbuk sulfur tersebut akan bergabung dengan manik merkuri yang sangat kecil (susah dilihat). Berikutnya tekan tuala kertas lembap di atas serbuk sulfur untuk mengutip serbuk sulfur yang telah bergabung dengan merkuri. Letakkan semua tuala kertas yang terpakai dan serbuk sulfur yang dikutip ke dalam satu beg plastik dua lapisan kalis air dan ikat dengan ketat menggunakan pengikat.

**Serbuk sulfur digunakan kerana ia bergabung dengan merkuri maka mengelak pengewapan merkuri dan juga menjadikan merkuri lebih mudah disingkir untuk pembuangan.

- xi) **Pengumpulan bahan tercemar dengan merkuri:**
Letakkan semua bahan yang telah digunakan semasa pembersihan, termasuk Alat Pelindung Diri yang terpakai dan tumpahan merkuri yang dikutip dari kawasan tumpahan ke dalam beg plastik yang kuat (dua lapisan) dan ikat dengan ketat. Labelkan beg mengikut *Environmental Quality (Scheduled Wastes) Regulations 2005 (Appendix IV)*.

Kumpulkan bahagian peralatan yang tertinggal (*metal body, reservoir, tubing, cuff and bulb*) dan masukkan ke dalam beg (dua lapisan) yang kuat dan hantar ke syarikat konsesi disebabkan bahagian-bahagian tersebut mungkin tercemar dengan merkuri dan perlu di bersih dan dilupus mengikut prosidur pelupusan asset.

- xii) **Selepas pembersihan:** Biar tingkap terbuka selama 24 jam (dimana sesuai) untuk ventilasi selepas pembersihan. Setelah memastikan semua merkuri telah dilupuskan, operasi pembersihan biasa boleh disambung semula.

Jangan gunakan vakum, pengelap lantai ataupun penyapu untuk membersihkan tumpahan merkuri dan **JANGAN SEKALI DIMASUKKAN MERKURI KE DALAM SISTEM KUMBAHAN, SINKI, CLINICAL BIN, SHARPS BIN ATAU TONG SAMPAH!!!**

Ambil perhatian supaya *respirator/ face mask* dan *goggle* tidak ditanggalkan sehingga sarung tangan yang tercemar dibuka dan dibuang dahulu.

11. Penyimpanan Merkuri Terkumpul dan Bahan Buangan Tercemar Dengan Merkuri

- a) Adalah amat penting bahawa beg yang mengandungi merkuri, gelas dari peralatan yang pecah dan bahan yang digunakan semasa pembersihan dilabelkan (merujuk Appendix IV) dan disimpan di tempat tertutup yang dingin (untuk mengelakkan peruapan) untuk dilupus selari dengan *Environmental Quality (Scheduled Wastes) Regulations 2005* bersama dengan bahan kimia lain.

Dicadangkan bahawa merkuri dilupus dalam 180 hari selaras dengan *Environmental Quality (Scheduled Wastes) Regulations 2005*.

- b) Satu salinan *Chemical Safety Data Sheet* untuk merkuri perlu ada bersama dengan *Mercury Spill Kit* dan juga di kawasan penyimpanan bahan kimia untuk pelupusan.
- c) Hanya syarikat pengangkut yang diberi kebenaran boleh mengangkut bahan-bahan tersebut. (syarikat konsesi)
- d) *Mercury Spill Kit* perlu disediakan di setiap tempat kerja yang menggunakan merkuri.

***Sphygmomanometer* dan *thermometer* yang tidak pecah atau tiada kebocoran tetapi tidak berfungsi lagi perlu dihantar ke syarikat konsesi untuk pelupusan.**

12. Gambar Panduan Cara Pembersihan Dan Pelupusan Merkuri Yang Tertumpah Dari Alat *Sphygmomanometer* Dan *Thermometer* Yang Pecah Di Hospital-hospital Kementerian Kesihatan Malaysia.

MERCURY SPILL KIT



Pakai Alat Pelindung Diri

Cari Serpihan Gelas Dari Alat *Sphygmomanometer*/ *Thermometer* Yang Pecah



Kutip Serpihan Gelas Alat Yang Pecah Menggunakan Forsep Pakai Buang



Masukkan Serpihan Gelas Ke Dalam Bekas Plastik Yang Kuat Dan Tutup Penutup Dengan Ketat Serta Gunakan Pita— Serpihan Gelas Kecil Ke Dalam Urine Container



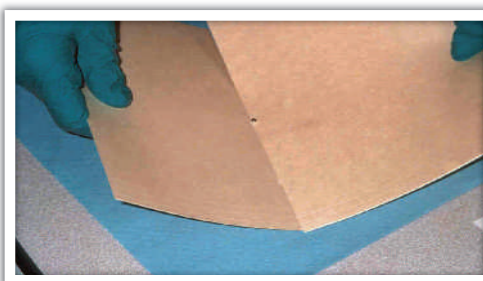
Serpihan Gelas Besar Ke Dalam Sharps Bin



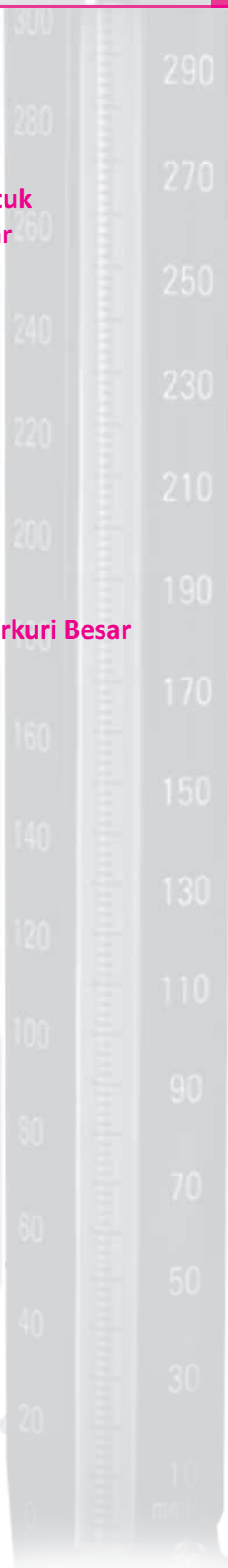
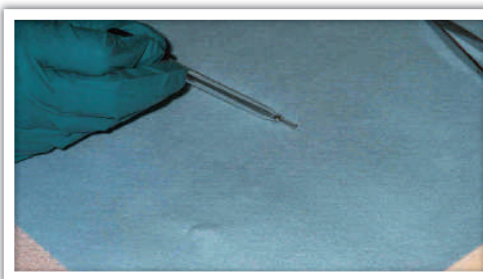
Gunakan Lampu Suluh Untuk Mengesan Manik-manik Merkuri



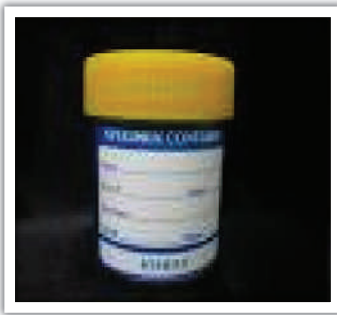
Gunakan Kepingan-kepingan Kadbod Untuk Mengumpul Manik-manik Merkuri Besar



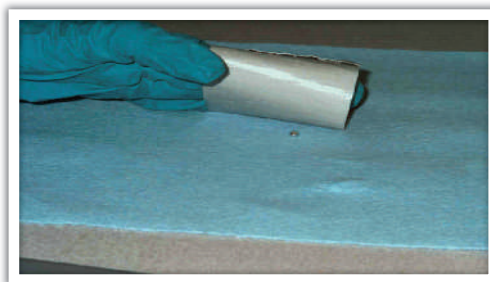
**Atau Gunakan Picagari (Tanpa Jarum)/
Eye dropper Untuk Mengumpul Manik-manik Merkuri Besar**



Masukkan Merkuri Terkumpul Ke Dalam Satu Bekas Plastik Yang Keras (Contohanya *Urine Container*) Yang Diisi Separuh Dengan Air



Gunakan Pita Selofan Telus Untuk Mengutip Manik-manik Yang Lebih Kecil dan Masukkan Ke Dalam Beg Plastik Kuat atau Beg Plastik Dua Lapisan



Taburkan Serbuk Sulfur Di Atas Kawasan Terlibat Untuk Mengumpul Manik Merkuri Yang Sangat Kecil (Susah Dilihat)



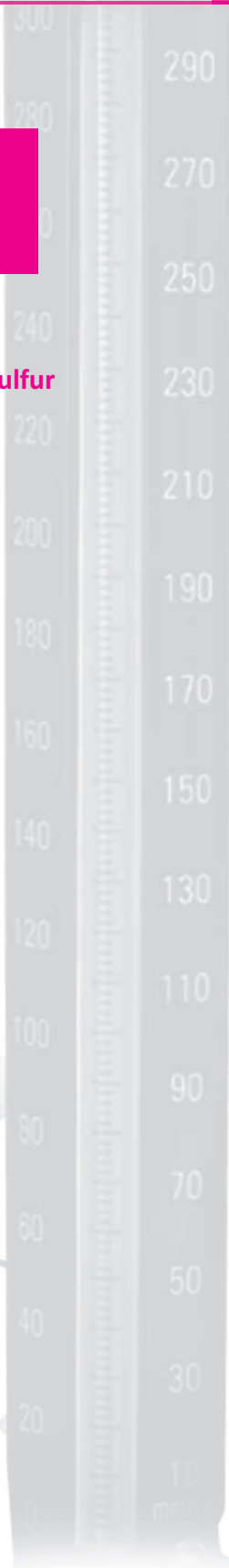
Tekan Tuala Kertas Lembap Di Atas Serbuk Sulfur Untuk Mengutip Serbuk Sulfur Yang Telah Bergabung Dengan Merkuri

Masukkan Tuala Kertas Lembap Dengan Serbuk Sulfur Ke Dalam Beg Plastik Kalis Air (Dua Lapisan)



Langkah Terakhir

Letakkan Semua Bahan Yang Telah Dikumpul Semasa Pembersihan, Termasuk Alat Pelindung Diri Yang Terpakai Ke Dalam Satu Beg (Dua Lapisan) & Ikat Dengan Ketat Dan Label



APPENDIKS I

Carta Aliran Panduan Cara Pembersihan dan Pelupusan Merkuri yang Tertumpah dari Alat *Sphygmomanometer* dan *Thermometer* yang Pecah.

Sphygmomanometer / Thermometer pecah

Maklumkan kepada ketua wad atau penyelia dan minta bantuan

Asingkan tempat tumpahan menggunakan pita berjalur merah putih dan penanda

Ambil *Mercury Spill Kit*

Tanggalkan semua barangan kemas

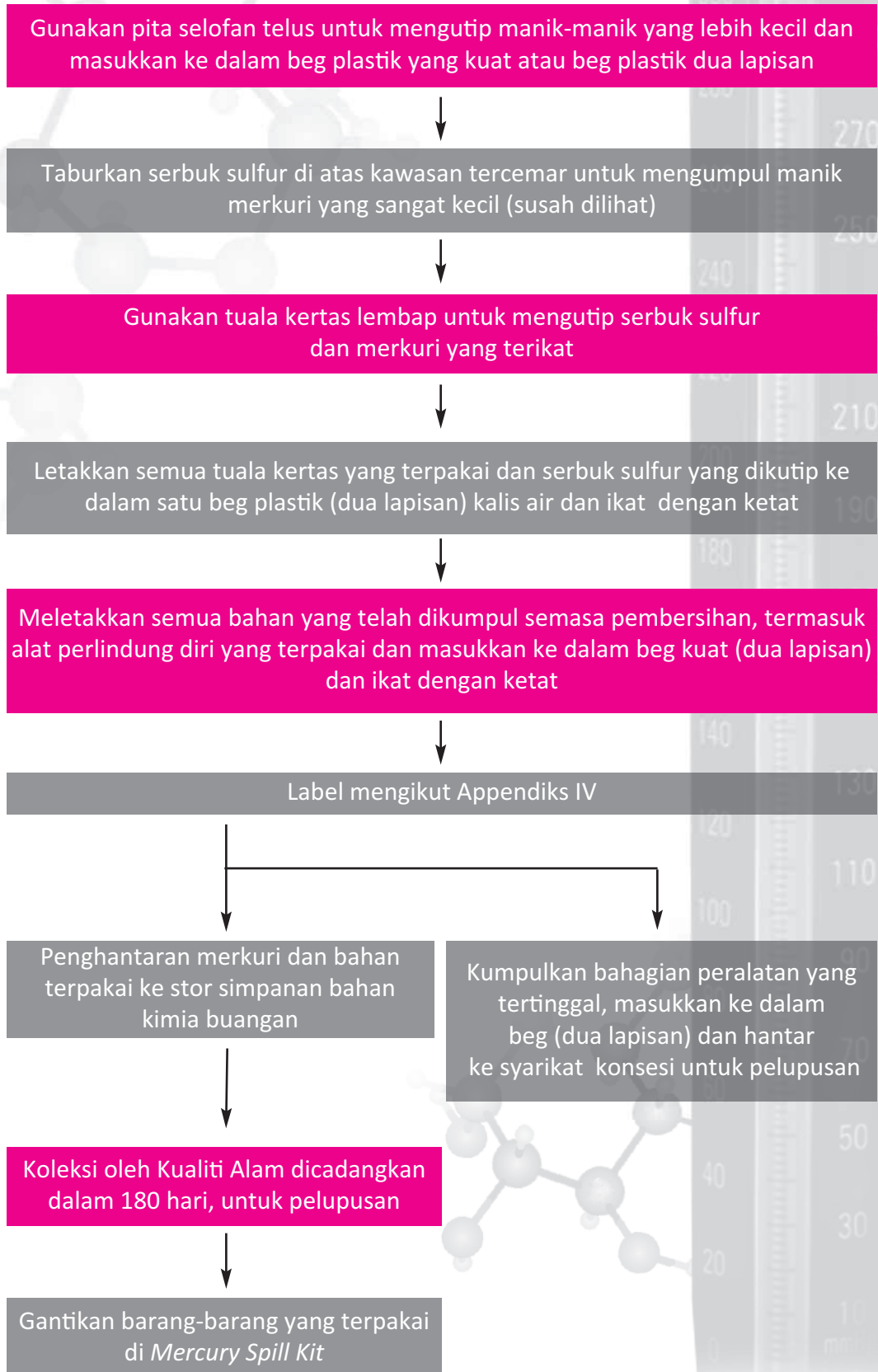
Pakai Alat Pelindung Diri

Kutip serpihan gelas alat *Sphygmomanometer/ Thermometer* yang pecah menggunakan forsep pakai buang

Masukkan ke dalam bekas dengan penutup dan tutup dengan ketat serta gunakan pita

Gunakan lampu suluh untuk mengesan manik-manik merkuri

Gunakan picagari (tanpa jarum) /*eye dropper* ataupun kepingan-kepingan kadbod untuk mengumpul manik-manik merkuri yang besar dan letakkan ke dalam satu bekas plastik yang keras (contohnya *urine container*) yang diisi separuh dengan air



APPENDIKS II

Senarai Semakan Untuk Kandungan *Mercury Spill Kit*

<input type="checkbox"/> Lampu suluh dan bateri	<input type="checkbox"/> Pengikat kabel x 10
<input type="checkbox"/> Kadbod - dua keping	<input type="checkbox"/> Label untuk pelupusan merkuri
<input type="checkbox"/> Pita selofan telus, kelebaran dua inci	<input type="checkbox"/> Sarung tangan Nitril – 1 pasang
<input type="checkbox"/> Forsep pakai buang	<input type="checkbox"/> <i>Goggle</i>
<input type="checkbox"/> Dua picagari 10 cc / <i>eye dropper</i>	<input type="checkbox"/> <i>Apron</i> plastik pakai buang x 1
<input type="checkbox"/> Serbuk Sulfur - 250 gram	<input type="checkbox"/> <i>Gown</i> plastik pakai buang x 1
<input type="checkbox"/> Bag plastik (<i>self sealing</i>) X 4	<input type="checkbox"/> Penutup kasut pakai buang
<input type="checkbox"/> Bekas plastik yang kuat untuk gelas instrumen yang pecah (Contoh <i>urine container</i> dan <i>sharps bin</i>)	<input type="checkbox"/> Tuala Kertas
<input type="checkbox"/> Beg plastik yang kuat (Saiz tong sampah) x 2	<input type="checkbox"/> Penanda Merkuri - Awas Pembersihan Bahan Tumpahan Sedang Dijalankan
<input type="checkbox"/> <i>Face Mask/Respirator</i>	<input type="checkbox"/> Pita berjalur merah dan putih
<input type="checkbox"/> Carta Aliran Panduan Cara Pembersihan dan Pelupusan Merkuri yang Tertumpah dari Alat <i>Sphygmomanometers</i> dan <i>Thermometers</i> yang Pecah (dilekat di luar <i>Mercury Spill Kit</i>)	
<input type="checkbox"/> <i>Chemical Safety Data Sheet</i> untuk Merkuri (disimpan bersama merkuri spill kit).	

“Periksa kandungan *mercury spill kit* setiap 6 bulan termasuk tarikh luput bateri dan serbuk sulfur”.

APPENDIKS III

PETANDA MERKURI

AWAS !

**PEMBERSIHAN BAHAN
TUMPAHAN SEDANG
DIJALANKAN**

JAUHKAN DIRI !!

CAUTION !

**CLEANING OF SPILT
SUBSTANCE IN PROGRESS**

KEEP AWAY !!

PETANDA X 2 UNITS (6 INCI X 2 KAKI)

Dicetak, Dilaminasi Dan Disimpan Dengan *Mercury Spill Kit*.
Diletakkan Secara Sementara Diatas Petanda "CAUTION -
WET FLOOR" (Seperti Dimukasurat Sebelah) Semasa
Pembersihan Tumpahan Merkuri.




PETANDA "CAUTION - WET FLOOR"- 8 INCI X 2 KAKI

Petanda ini boleh didapati di wad-wad Hospital KKM . Petanda "PEMBERSIHAN BAHAN TUMPAHAN SEDANG DIJALANKAN" boleh diletakkan diatas petanda ini secara sementara semasa pembersihan tumpahan bahan Merkuri.

APPENDIKS IV

LABEL UNTUK PELUPUSAN MERKURI

	
DATE OF GENERATION	
WASTE CATEGORY CODE	
NAME OF WASTE	
QUANTITY (in litre)	
PERSON IN-CHARGE	
CENTRE / UNIT / LAB	
TELEPHONE NO	

APPENDIKS V

GAMBAR MERCURY SPILL KIT



Rujukan

1. <http://www.epa.gov/hg/spills/index.htm#disposal>
2. <http://www.atsdr.cdc.gov/mercury/docs/HealthEffectsMercury.pdf>
3. http://www.health.ny.gov/environmental/chemicals/hsees/mercury/cleaning_up_a_small_mercury_spill.htm
4. <http://www.osha.gov/SLTC/etools/hospital/hazards/mercury/mercury.html>
5. www.epa.gov/hg/thermometer-main.html
6. www.epa.gov/hg/effects.htm
7. www.atsdr.cdc.gov/toxprofiles/tp.asp?id=115&tid=24
8. http://www.safework.sa.gov.au/uploaded_files/ds10i.pdf