Training on Medical Waste Management

in Collaboration with
Al-Essa Medical & Scientific Equipment Co. W.L.L

WHO Definitions of Waste

Kuwait University
Health Science Center
29 January – 1 February, 2012
Safe Management of Wastes from Health-Care activities

WHO European Centre for Environment and Health
Rome, Italy

World Health Organization
Geneva
1999

(Being updated for 2012)
Definitions

Health-care waste
Total waste stream from HCW generators
(major and scattered sources)

Hazardous health-care waste
75 - 90% of general waste (similar to domestic waste)
10 - 25% is hazardous (infectious, toxic etc.)
Health-care activities (for humans) generating waste include:

- Diagnosis
- Treatment
- Prevention of diseases
- Alleviation of disablement
- Associated research
Hazardous health-care waste

- Infectious
- Pathological
- Sharps
- Pharmaceutical
- Genotoxic
- Chemical
- Heavy metals
- Pressurized containers
- Radioactive
## Categories of health-care waste

<table>
<thead>
<tr>
<th>Waste category</th>
<th>Description and examples</th>
</tr>
</thead>
</table>
| Infectious waste                     | Waste suspected to contain pathogens  
e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta |
| Pathological waste                   | Human tissues or fluids  
e.g. body parts; blood and other body fluids; fetuses        |
| Sharps                                | Sharp waste  
e.g. needles; infusion sets; scalpels; knives; blades; broken glass         |
| Pharmaceutical waste                 | Waste containing pharmaceuticals  
e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes) |
| Genotoxic waste                      | Waste containing substances with genotoxic properties  
e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals |
| Chemical waste                       | Waste containing chemical substances  
e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents |
| Wastes with high content of heavy metals | Batteries; broken thermometers; blood-pressure gauges; etc.                              |
| Pressurized containers               | Gas cylinders; gas cartridges; aerosol cans                                               |
| Radioactive waste                    | Waste containing radioactive substances  
e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources |
Infectious - Cultures and Stocks
Infectious - Cultures and Stocks

Swarming *Proteus mirabilis*
Infectious Human Blood and Blood Products

This waste shall include:

(I) discarded waste human blood, discarded blood components (e.g. serum and plasma), containers with free flowing blood or blood components or discarded saturated material containing free flowing blood or blood components; and

(II) materials saturated with blood or blood products.
Pathological Wastes
Animal Waste and Animal Bedding
Typical Laboratory Hazardous Wastes

Which are hazardous?
What is RCRA?

RCRA is the Resource Conservation and Recovery Act, which was enacted by Congress in 1976. RCRA's primary goals are to protect human health and the environment from the potential hazards of waste disposal, to conserve energy and natural resources, to reduce the amount of waste generated, and to ensure that wastes are managed in an environmentally sound manner.

RCRA mandated regulations are found in the Code of Federal Regulations at Title 40 (40 CFR)

www.gpo.gov CFR...Title 40...Parts 260-280
RCRA Hazardous Waste / Hazardous Drug Categories

Two Categories of RCRA Hazardous Waste:

- **Listed Waste**
  - P – Listed (Acutely Hazardous) Includes 1 Chemo Agent
  - U – Listed (Chemotherapy Drugs)

- **Characteristic Waste - 4 characteristics**
  - Ignitability, Corrosively, Reactivity, Toxicity

- **Hazardous Waste is Compatible or Non-Compatibile**
  - Compatible – can be placed in a container without danger of reaction
  - Non-Compatibile – potential for chemical reaction if co-mingled
Characteristics of Hazardous Waste (D Number)

Ignitability - Aqueous Solution containing 24% alcohol or more by volume & flash point<140° F., D001 Waste.

Corrosivity - An aqueous solution having a pH <= 2 or >= to 12.5, D002 Waste.

Reactivity - Must meet eight separate criteria identifying certain explosive and water reactive wastes. D003 waste. Nitroglycerin formulations are excluded federally from the P081 listing as non-reactive as of August 14, 2001 under FR: May 16, 2001. Some states have adopted the exclusion.

Toxicity - Approximately 40 chemicals which meet specific leaching concentrations. Examples of potential toxic pharmaceuticals: Arsenic, Barium, Mercury, Cadmium, Chloroform, Selenium, Chromium, Silver (Specific D Numbers)
Characteristic Hazardous Waste (D Number)

- D004 - Arsenic
- D005 - Barium
- D006 - Cadmium
- D007 - Chromium
- D008 - Lead
- D009 - Mercury
- D010 - Selenium
- D011 - Silver

Toxicity = Heavy Metals
Examples of P - Listed Pharmaceutical Waste

• Arsenic trioxide       P012
• Epinephrine            P042
• Nicotine               P075
• Nitroglycerin          P081
• Phentermine (CIV)      P046
• Physostigmine          P204
• Physostigmine Salicylate P188
• Warfarin >0.3%          P001
### Examples of U – Listed Pharmaceutical Waste

<table>
<thead>
<tr>
<th>Substance</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloral Hydrate (CIV)</td>
<td>U034</td>
</tr>
<tr>
<td>Chlorambucil</td>
<td>U035</td>
</tr>
<tr>
<td>Cyclophosphamide</td>
<td>U058</td>
</tr>
<tr>
<td>Daunomycin</td>
<td>U059</td>
</tr>
<tr>
<td>Melphalan</td>
<td>U150</td>
</tr>
<tr>
<td>Mitomycin C</td>
<td>U010</td>
</tr>
<tr>
<td>Streptozotocin</td>
<td>U206</td>
</tr>
<tr>
<td>Lindane</td>
<td>U129</td>
</tr>
<tr>
<td>Saccharin</td>
<td>U202</td>
</tr>
<tr>
<td>Selenium Sulfide</td>
<td>U205</td>
</tr>
<tr>
<td>Uracil Mustard</td>
<td>U237</td>
</tr>
<tr>
<td>Warfarin&lt;0.3%</td>
<td>U248</td>
</tr>
</tbody>
</table>
Common Chemo / Genotoxic Wastes

Common Chemotherapeutic / Antineoplastic Wastes

- Chlorambucil [Leukeran] U035
- Cyclophosphamide [Cytoxan, CTX, Neosar] U058
- Daunomycin [Daunorubicin, Cerubidine] U059
- Melphalan [Alkeran, L-PAM] U150
- Mitomycin C [Mitomycin, Mutamycin] U010
- Streptozotocin, Chlornaphazine [Zanosar] U206
- Uracil Mustard U237
- Ethyl Carbamate U238
- Azaserine U015
- 3-Methylcholanthrene U157
- Arsenic Trioxide (Trisenox) P012
- Bevacizumab (Avastin) Non-RCRA Hazardous
- Carmustine (Bicnu) Non-RCRA Hazardous
- Irinotecan Hydrochloride (Camptosar) Non-RCRA Hazardous
- Doxorubicin Hydrochloride (Doxil) Non-RCRA Hazardous
- Oxaliplatin (Eloxatin) Non-RCRA Hazardous
What Percentage of Drugs are RCRA Hazardous?*

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal hazardous</td>
<td>4,686</td>
<td>4%</td>
</tr>
<tr>
<td>Risk Management Hazardous</td>
<td>10,973</td>
<td>10%</td>
</tr>
<tr>
<td>“Non-Hazardous”</td>
<td>99,240</td>
<td>86%</td>
</tr>
<tr>
<td>Total Products</td>
<td>114,899</td>
<td></td>
</tr>
<tr>
<td>Total Hazardous Products</td>
<td>15,659</td>
<td>14%</td>
</tr>
<tr>
<td>Total Products containing mercury</td>
<td>482</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

*Based on PharmEcology Wizard data as of March 18th, 2004
P Listed Waste

- Acutely Hazardous
- Includes Epinephrine, Nicotine, Nitroglycerin, Phentermine, Physostigmine, Warfarin, Arsenic trioxide (chemo drug)
- Empty containers (except for used syringes) are hazardous waste – not RMW
- P-listed waste containers are not “RCRA empty”, unless they are triple rinsed (resulting rinsate must be discarded as hazardous waste).
U-Listed Hazardous Waste

- Toxic
- Chemo Drugs

Empty U–listed drug containers can be disposed of as RMW if:

✓ All contents have been removed using normal means

AND

✓ No more than 3% by weight remains

If BOTH conditions are not met, empty U-listed drug containers must be treated as hazardous waste.
Typical Laboratory Hazardous Wastes

Which are hazardous?
Mercury
Laboratory Thermometers
More Laboratory Thermometers

NIST-Traceable Thermometer
Mercuric Chloride is **highly toxic**

**Zinc Chloride** can cause irritation of the nose and throat and conjunctivitis.

Replace with this
Switches

• Vacuum System Barostats
• Boiler Barostats
• Boiler Water Level Switch
• Mercury Room Thermostat
• Sump Pump Switch
• X-Ray Tube
Thermostats containing Mercury
Non-Mercury Thermostat
Fluorescent Lighting

- Fluorescent Tubes
- Bilirubin Lights
## Batteries

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Description</th>
<th>Format</th>
<th>Use</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline and Carbon Zinc</td>
<td>• Small</td>
<td>• AA</td>
<td>• Camera</td>
<td>• Can leak with age</td>
</tr>
<tr>
<td></td>
<td>• Sealed</td>
<td>• AAA</td>
<td>• Handheld electronics</td>
<td>• Non-toxic</td>
</tr>
<tr>
<td></td>
<td>• Non-rechargeable</td>
<td>• D-cell</td>
<td></td>
<td>• Non-spillable</td>
</tr>
<tr>
<td></td>
<td>• Labeled general purpose or heavy duty</td>
<td>• C-cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 9V</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Button cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid Automotive</td>
<td>• Large</td>
<td>• Large pack of small cells</td>
<td>• Hybrid automobile</td>
<td>• Non-spillable</td>
</tr>
<tr>
<td></td>
<td>• Most common: NiMH &amp; Li-ion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery Type</td>
<td>Size</td>
<td>Shape/Dimensions</td>
<td>Applications</td>
<td>Hazards</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lead Acid Gel</td>
<td>Small to medium</td>
<td>Rectangular</td>
<td>Wheelchairs, Portable tools and instruments</td>
<td>Non-spillable, gelled electrolyte, Toxic, Can cause fire if short-circuited</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td>Custom sizes in hard plastic case</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithium (Primary)</td>
<td>Small</td>
<td>Button cells</td>
<td>Camera, Handheld Electronics, Alarms, Memory backup, High-temperature applications, Pacemakers</td>
<td>Non-spillable, Non-toxic, Can overheat or explode if short-circuited</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithium-ion (Li-ion)</td>
<td>Small</td>
<td>Custom sizes in hard plastic case, Small-cylinder, Button cells</td>
<td>Laptop computers, Power tools, Hybrid automobiles, Video camera, Handheld electronics</td>
<td>Non-spillable, Non-toxic</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>Small</td>
<td>AA, 9V, Small-cylinder, Custom sizes</td>
<td>Camera, Medical devices</td>
<td>Non-spillable, Toxic, Never incinerate, Produces highly toxic vapors</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel-Cadmium (NiCd)</td>
<td>Small</td>
<td>AA, AAA, C-cell, D-cell, Small-cylinder, Poly-wrapped cell packs, Custom sizes</td>
<td>Laptop computers, Power tools, Handheld electronics, Medical equipment</td>
<td>Non-spillable, Toxic, Never incinerate, Produces highly toxic vapors</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel Metal Hydride (NiMH)</td>
<td>Small</td>
<td>AA, AAA, C-cell, D-cell, Poly-wrapped cell packs, Small-cylinder, Custom sizes</td>
<td>Laptop computers, Power tools, Hybrid automobile, Camera, Handheld Electronics</td>
<td>Non-spillable, Non-toxic</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver Oxide</td>
<td>Small</td>
<td>Button cells, High-voltage, Small-cylinder, Large Custom sizes</td>
<td>Hearing aids, Camera</td>
<td>Non-spillable, Non-toxic</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc Air</td>
<td>Small</td>
<td>Button cells, 9V, Custom sizes</td>
<td>Hearing aids, Mechanically Recharged Electric vehicles</td>
<td>Non-spillable, Non-toxic</td>
</tr>
<tr>
<td></td>
<td>Sealed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-rechargeable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Radioactive Waste

Radionuclides or radioisotopes that are commonly used for medical/clinical reasons grouped into 3 groups as shown below (Table 1).

<table>
<thead>
<tr>
<th>Nature</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long-lived α emitters</td>
<td>Long-lived β or γ emitters</td>
<td>Short-lived β or γ emitters</td>
</tr>
<tr>
<td>Examples</td>
<td>²⁴Na, ²⁴Na, ⁶⁰Co, ⁶⁵Zn, ¹³⁴Sb, ¹⁹³Ir, ¹⁸²Ta</td>
<td>⁷⁷As, ⁵⁹Fe, ¹¹¹In, ⁴⁶Sc, ⁸⁵Sr, ¹⁹⁸Au, ⁶⁷Ga, ¹⁴⁰In, ⁷⁵Se, ⁹⁰Sr, ⁸²Br, ¹⁵³Gd, ⁹⁵Nb, ¹⁵³Sm, ⁶⁸Co, ²⁰³Hg, ⁸⁴Rb, ¹¹³Sn, ¹⁸F, ¹³¹I, ⁸⁵Rb, ¹²³Sn, ¹⁴C, ³H</td>
<td>³⁶Cl, ⁸¹Kr, ¹⁸⁸Re, ²⁰¹Tl, ⁵⁷Co, ⁹⁸Nb, ¹⁰³Ru, ¹²⁷Xe, ⁴⁵Ca, ⁵¹Cr, ⁶³Ni, ³⁵S, ¹³³Xe, ¹⁰⁹Cd, ³²P, ⁸⁵Sr, ⁹⁶Y, ¹³³Ce, ¹²³I, ³³P, ⁹⁹Tc, ¹⁶⁹Yb, ¹⁴⁴Ce, ¹²⁵I, ¹⁸⁶Re, ⁹⁹mTc</td>
</tr>
</tbody>
</table>
$^{14}\text{C}$-Urea Breath Test

$^{14}\text{C}$-Urea Breath Test for Presence of $H.\ pylori$

User's Guide
Radiation Safety

What is the risk from the $^{14}$C? The $^{14}$C-urea breath test gives a maximum Effective Dose Equivalent (EDE) to the patient of 0.3 mrem. This is approximately the same radiation dose as 24 hours of normal background radiation.

What is the dose to the people performing the test? Are they at risk? The Nuclear Regulatory Commission (NRC) has performed an analysis of the radiation dose estimates for personnel working the $^{14}$C-urea breath test and concluded that the risks to those performing the test is insignificant. The NRC has exempted the performance of this test from their regulations.
Waste Disposal

What do I do with the packaging considering it was used with radioactive material?
All references to radioactive material and the radiation symbol should be defaced prior to disposing in the regular trash.
Final Note:

HTM 07-01 NHS UK

Is this what it really looks like???