Waste management

in small scale health care facilities:

protecting health and environment in rural and urban settings.

# Background and introduction

Healthcare waste is a recognised health and environmental threat, with half of the world’s population estimated to be at risk[[1]](#footnote-1). Waste may pose physical dangers, carry infection, or contain toxic materials such as mercury. In addition, burning in low tech incinerators or in pits will produce large amounts of dioxins and furans, targeted for elimination by the global Stockholm Convention. These hazards, and the fact that many waste workers are not properly trained or protected, can lead to violations of human rights[[2]](#footnote-2),[[3]](#footnote-3).

At present, this issue is poorly addressed in many low to middle income countries, though increasing efforts are under way in many places to improve the situation. Non-incineration disposal methods, which are recommended by the Stockholm Convention and the World Health Organisation, are becoming more widely used in low to middle income countries. However, priority is usually given to improving the situation in the largest facilities and the best established waste management technologies are designed for hundreds to thousands of kilos of waste per day.

These initiatives therefore have limited relevance for clinics and other small healthcare facilities that may generate only a few kilos of wastes, or may be too remote to transport waste to better equipped establishments.

However, there are a number of techniques and technologies that can be used to address not just the infectious waste, but other general wastes generated by clinics and healthcare providers. This project sets out to identify clinics that are determined to improve their waste management, and to work with them to design, implement and monitor systems that are tailored to their needs.

Some of the disposal techniques involved may not have been widely applied to medical waste management, so a proportion of participating facilities will be required to include some elements of experimentation in their programs. All facilities will monitor the implementation closely and optimise performance. Data including best practices, equipment performance, capital and operating costs will be gathered. Results will be collated and published with Health Care Without Harm and project partners to stimulate further research and implementation.

# Technologies to be employed

The technologies to be employed will vary depending on the waste stream, locally available recycling and disposal options, climate and regulations. Waste minimization and options for purchasing less toxic materials will be the first step in all cases.

## Infectious waste

Non-incineration methods are now established as the preferred methods for disinfecting medical waste. Of these, autoclaving is the best for small scale implementation, and models be purchased that operate on a variety of fuels. The current project would aim to utilise machines from approximately 20 to 60 litres volume.

The autoclaves would need to be tested regularly to ensure effective operation. This needs to be done with indicators which change colour when subjected to heat and self-contained biological indicators, which need to be incubated at 55-60oC. This may require a dedicated incubator if the facility does not already have one that can be used for this. An alternative is for one facility to assist in regular autoclave testing using a portable incubator.

## **Pathological wastes**

It is essential that laboratory cultures are disinfected at the point of origin, but other wastes, such as placenta or blood can be disposed of safely by other means. Blood can be disposed of into the sewer or in latrines so long as measures are in place to make sure that workers are not exposed to splashes. Placenta pits are well established, and can be very effective if designed properly. Anaerobic and aerobic biodigestion may also be applied in certain circumstances.

## Sharps waste

Syringes and other sharps make up one of the waste streams that cause the greatest concern. By employing needle cutters which cut through the tip of the syringe, the amount of sharps waste can be reduced drastically and the possibility of syringe reuse is eliminated. Depending on the local situation, this reduced volume of sharps can be disposed of in a variety of ways, including encasing in concrete or burial in a sharps vault. Syringe bodies can be disinfected in an autoclave, as with other infectious materials. It may then be possible to recycle them.

## Soft waste

Soft waste is bandages, gauze etc. Research in India indicates that worm compost bins can break this down, and even remove pathogens at the same time. Where facilities have capability to test the compost for pathogens, it will be valuable to repeat and verify these findings. Otherwise, the soft waste can be autoclaved and worm compost bins used as a final disposal method, reducing the amount that has to be landfilled and all the associated costs.

## Pharmaceutical and chemical waste

This is too often poured flushed down the drain, with potentially serious environmental consequences. A combination of toxics substitution (including mercury containing medical devices), return to supplier, neutralisation and encapsulation can be used to minimise the impact form this waste stream.

## Non-infectious organic waste

This will be tackled using a variety of composting methods, chosen according to waste stream characteristics and other local conditions, including minimum and maximum temperatures. Small scale anaerobic digestion can produce biogas, a renewable fuel that can be used for cooking or a variety of other uses. This will save money on fuel costs and help subsidise the costs of waste disposal.

## Paper, plastic and glass

This should be segregated and recycled wherever possible. Income from recycling can subsidise waste disposal systems as well as reducing the overall environmental impact of healthcare facility. Strategies to minimise the amount of waste will be discussed and reuse as much of possible of what remains. Paper which is not recyclable either because it is dirty (eg food wrappers) or because recycling facilities are not available can be turned into fuel briquettes, or added to composting systems.

# Budget estimation

All costs below are indicative and will vary from country to country. Shipping and taxes are not included. Any value recovered from sale of recyclable waste is also excluded. Selecting the correct technology and developing a detailed budget will a critical first step in the development of the project in each participating country.

Given the variation in costs from country to country it is hard to estimate the total costs of a system. Finding out more about the costs is one of the goals of this project. The maximum anticipated for a non-bedded clinic to buy the equipment and operate it for one year is $1000-2000. For a small hospital, USD5000 would cover most needs, though further funds might be needed to construct a waste storage and treatment area if no suitable space exists, or a biodigester which would convert food and other organic waste into biogas that can be used as a fuel and liquid fertiliser to be used in the hospital grounds.

Monitoring equipment can be expensive, but will guarantee that autoclaves are working effectively. Portable incubators can be shared between facilities to save costs. Once the correct parameters are known, only a few test indicators will be needed.

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| Technology | Approximate costs (US$) | Notes |
| Protective clothing | $20-50 | Includes apron/long sleeved overalls, boots, gloves, face mask and goggles. |
| Autoclaves | $50-700 | More expensive models include a biomass fuelled 60 litre model |
| Incubator | $175-300 | Small portable incubator for autoclave biological indicators (SCBIs); only manufacturer’s SCBIs may fit. One of these cab be shared between facilities to reduce costs |
| SCBIs | $160-200 | For 100 biological indicators. One box could last |
| Steam integrators | $35-300 | Rapid indicators used during autoclave validation. Price varies from $0.14- $0.4 per unit |
| Autoclave tape | $5 - $15 | Autoclave tape, for tracking which waste has been autoclaved |
| Bins | $2-50 each | Depending on size and design |
| Bags | $100-500 | 4-20 small bags per day |
| Autoclavable shparps container | 30-100 | This can be used for years. Dressing drums, designed for autoclaving, can be used, or a local metal workers can make one to fit the facility autoclave. |
| Pathogen testing |  | To be done in-house where possible. Price and availability highly variable |
| Needle/hub cutters | $2 to 200 | Low cost models are often disposable or liable to breakdown. Mechanical and electrical models available |
| Placenta pit | $250-1000 | WHO recommends two be built |
| Biodigester | $1000-15000 | Appropriate for larger waste streams |
| Compost system | $30-500 | Depending on size, |
| Fuel |  | Variable |
| Briquette maker | $30-200 | Depending on size |
| Sharps disposal | $50-500 | Either solidifying in concrete or building a concrete vault |
| Pharmaceutical waste disposal | $50-500 | Neutralisation/solidification chemicals and/or a concrete vault. |
| Waste treatment and storage centre | $0-5000 | Only needed for larger facilities |

# Essential steps in setting up a medical waste management system

* Planning
  + Management approval of project
  + Assessment of current waste production and disposal practices
  + Review of relevant policies
  + Outline project plan, including data requirements and budget
  + Investigate waste reduction options/alternative products
  + Assess various waste treatment, recycling and disposal options
  + Identify available products and technologies
  + Finalise project plan, including data requirements and budget
* Preparation
  + Undertake any building/infrastructure changes required
  + Procure and conduct preliminary tests with alternative products
  + Procure waste treatment equipment
  + Train staff with new products and processes
  + Create appropriate management/reporting structures eg medical waste management committee.
  + Validate autoclaves and any other equipment requiring setup before use
  + First draft of facility level waste treatment policy (UNDP/GEF model policy)[[4]](#footnote-4)
* Implementation
  + Commence routine use of new products
  + Initiate new waste treatment system
  + Close monitoring of new system
  + Comparison of alternate versions of different technologies
  + Troubleshooting and optimisation
  + Project inception report
* Monitoring and optimisation
  + Regular monitoring and feedback
  + Troubleshooting and optimisation
  + Investigation of any new products becoming available
  + Review and if necessary update facility medical waste management policy
  + Publication of report after 6 months in operation
  + Outreach/liaison with other clinics who can benefit from the knowledge gained in this project

After this, routine monitoring and reporting will continue in the longer term and the clinic would review its policies each year to make sure that everything is functioning well and to see if any further improvements can be made.

1. Harhay, M.O., Halpern, S.D., Harhay, J.S. & Olliaro, P.L. (2009) Health care waste management: a neglected and growing public health problem worldwide. Tropical Medicine and International Health 14(11): 1414-1417 [↑](#footnote-ref-1)
2. Georgescu, Calin; Human Rights Council, Eighteenth session, Agenda item 3; “Promotion and protection of all human rights, civil, political, economic, social and cultural rights, including the right to development”; Report of the Special Rapporteur on the adverse effects of the movement and dumping of toxic and dangerous products and wastes on the enjoyment of human rights. [↑](#footnote-ref-2)
3. Stringer, R., Altaf, A., Athar, Q.A., Euripidou, R., Ferrer, M., Ismawati, Y., Karliner, J., Livschitz, A., Nakarmi, M. & Odriozola, V. (2011) Medical Waste and Human Rights Submission to the UN Human Rights Council Special Rapporteur. Publ: Health Care Without Harm, 68pp, http://noharm.org/lib/downloads/waste/MedWaste\_Human\_Rights\_Report.pdf [↑](#footnote-ref-3)
4. UNDP/GEF (2009) Elements of a Model Facility Policy on Healthcare Waste Management. <http://gefmedwaste.org/downloads/Elements%20of%20a%20Model%20Facility%20Policy%20April%202009%20UNDP%20GEF%20Project.pdf> [↑](#footnote-ref-4)