An international meeting on health-care waste was held in Geneva on June 20-22, 2007. The meeting was attended by 53 participants from about two dozen countries representing 33 organizations concerned with health-care waste management (HCWM). The specific objectives of the meeting were: to explore areas of collaboration between the International Solid Waste Association (ISWA) and key international partners on HCWM; to agree on a plan to update the WHO reference document on health-care wastes; to review the latest developments in projects related to HCWM; and to obtain agreement on core principles regarding funding of HCWM.

Potential areas of collaboration with ISWA and among different groups, especially in the areas of training and information sharing, were discussed. Reports were given on the modification of autoclaves in Vietnam and waste segregation and minimization experiences in the UK.

A plan to update the WHO key reference document Safe management of wastes from health-care activities (1999) was agreed upon. General and chapter-by-chapter revisions to the document were discussed in detail. The plan included a list of volunteer lead authors, chapter contributors, and editors, as well as a timeline to try to complete the revision in about a year.

Reports were presented from countries receiving GAVI support and WHO technical assistance in Africa, Eastern Mediterranean, the Americas, South East Asia, Western Pacific, Europe, and Central Asia. The reporting countries were: Côte D’Ivoire, Kenya, Mali, Rwanda, Madagascar, Yemen, Sudan, Pakistan, Bolivia, Honduras, Nicaragua, Nepal, Bangladesh, Solomon Islands, India, Mongolia, and Kyrgyzstan.

Countries provided updates on their health-care waste activities and shared information on problems, strategies, national plans, and immediate next steps. The country reports highlighted the major problems facing many developing countries, such as a lack of awareness of health-care waste issues, a low priority for HCWM, improper practices like disposal in open dumpsites and open burning, lack of a legal framework and standards, and inadequate technical capacity and resources. Support from GAVI, WHO, and other agencies have led to the formation of national steering committees and working groups with stakeholder participation to deal with HCWM. Many countries are now in the process of completing national assessments or baseline surveys, national action plans, and strategies. In general, national plans are addressing such issues as developing the legal and regulatory framework, evaluating treatment and disposal options, capacity building, training, encouraging public-private partnerships, and financing to sustain HCWM systems. National meetings and workshops have succeeded in raising the level of awareness and creating strategic alliances in many countries. Presenters also discussed current challenges and next steps.

International agencies and NGOs reported on their ongoing projects. The organizations represented were: UNDP Global Environmental Facility Project on Health-Care Waste, Programs for Appropriate Technology in Health, John Snow Inc.-Making Medical Injections Safer, Indira Ghandi National Open University, Health Care Without Harm, World Bank India, Toxics Link/Srishti, Etlog Health, and NHS Foundation Trust. A variety of projects were presented including: developing model facilities to demonstrate best practices and alternative technologies consistent with the Stockholm Convention, evaluating sharps disposal options, assisting developing...
countries in adopting practical waste management solutions, offering certificate programs on HCWM through distance education, conducting collaborative projects to promote waste minimization and environmentally sound treatment options, linking HCWM with environmental health and occupational safety, capacity building projects, legislative advocacy, and information dissemination.

New WHO costing tools, namely, the basic Cost Assessment Tool (CAT) and the Expanded Cost Assessment Tool (ECAT) for low, middle and high income countries were introduced and demonstrated. These tools are intended for managers, consultants, and decision-makers to estimate national costs and budgets for HCWM. The tools could also be used for awareness-raising and educational purposes.

The participants drafted a paper “WHO core principles for achieving safe and sustainable management of health-care waste” with recommendations to national governments, donors, and other groups. The paper recommends that all who are involved in financing and supporting health-care activities provide for the costs of managing health-care wastes resulting from their interventions. It also recommends that governments allocate budgets for establishing and maintaining HCWM systems. Organizations and institutions are invited to signal their commitment to the principles and WHO will maintain a public listing of all who have done so. The paper will be disseminated at the World Health Assembly and other international meetings as an advocacy paper to create a paradigm shift in the way HCWM is viewed by governments, international agencies, donors, NGOs, and the private sector.

HIGHLIGHTS

- Many developing countries lack a legal framework, technical capacity, management systems, environmentally sound treatment options, and financial resources to deal with health-care waste.

- Countries supported by GAVI and receiving WHO technical assistance have formed national steering committees and working groups with broad stakeholder participation, and are completing baseline assessments, national plans, and strategies.

- The need for funding to implement the national plans and strategies is urgent.

- International organizations and NGOs continue to share information and collaborate on training and other activities related to health-care waste.

- The WHO key reference document Safe management of wastes from health-care activities is being updated by a group of editors, lead authors, and contributors.

- WHO has developed new costing tools to estimate national costs and budgets for HCWM.

- The “WHO core principles for achieving safe and sustainable management of health-care waste” recommends that governments allocate budgets for HCWM and that all involved in health activities provide for the costs of managing wastes from their interventions. WHO will maintain a public listing of all groups committed to the WHO core principles.
## Contents

**DAY 1**

Welcome ........................................................................................................... 1
Introduction ..................................................................................................... 1
Agenda and Objectives ..................................................................................... 1

**International Solid Waste Association**

Overview of ISWA ............................................................................................ 1
Report: Etlog Health .......................................................................................... 1
Report: NHS Foundation Trust .......................................................................... 2

**Update of the WHO Reference Document**

Objectives ......................................................................................................... 3
Introduction ....................................................................................................... 3
Presentation of the Pre-Reviewed Document...................................................... 3
Roundtable Discussion ....................................................................................... 3
Chapter-by-Chapter Review ................................................................................ 3
Discussion on Structure and Priorities ............................................................... 3
Lead Authors, Chapter Contributors, and Timelines ......................................... 4

**DAY 2**

Objectives ........................................................................................................... 5

**African Region:**

Overview ........................................................................................................... 5
Côte D’Ivoire ..................................................................................................... 5
Kenya .................................................................................................................. 5
Mali ..................................................................................................................... 6
Rwanda .............................................................................................................. 6
Madagascar ....................................................................................................... 6

**Eastern Mediterranean Region:**

Overview ........................................................................................................... 7
Yemen ................................................................................................................ 7
Sudan ............................................................................................................... 7
Pakistan ........................................................................................................... 8

**Pan American Region:**

Overview ........................................................................................................... 8
Bolivia ............................................................................................................. 8
Honduras ........................................................................................................ 8
Nicaragua ...................................................................................................... 9

**South East Asian Region:**

Nepal ................................................................................................................ 9
Bangladesh ................................................................................................... 10

**Western Pacific Region:**

Overview ....................................................................................................... 10
Mongolia ......................................................................................................... 10

**European and Central Asian Region:**

Overview ....................................................................................................... 11
Kyrgyzstan .................................................................................................... 12
International and Non-Governmental Organizations:
- Global Environmental Facility / UNDP ............................................................ 12
- Program for Alternative Technology and Health .............................................. 13
- John Snow Inc. / Making Medical Injections Safer ........................................... 14
- Indira Gandhi National Open University .......................................................... 15
- Health Care Without Harm .............................................................................. 15
- World Bank India ............................................................................................ 16
- Toxics Link / Srishti ........................................................................................ 16

Side Session on HCWM Training .................................................................... 17

DAY 3
- Objectives ....................................................................................................... 19
- WHO Costing Tools ....................................................................................... 19
- WHO Core Principles of Safe and Sustainable HCWM ............................. 20
- Next Steps ....................................................................................................... 21
- Closing Comments .......................................................................................... 21
- Text of the WHO Core Principles ................................................................. 22

Annexes
- List of Participants .......................................................................................... 24
- Meeting Agenda .............................................................................................. 27
- Detailed Comments on the WHO Reference Document ............................. 32
- Roundtable Discussion on the WHO Reference Document ...................... 46
- Synthesis of Chapter Comments ................................................................... 49
- Lead Authors and Chapter Contributors ..................................................... 60

List of Figures
1. Destruction of syringe barrels by autoclaving
2. Recycling at the Heart of England NHS Foundation Trust
3. Cover of the Blue Book
4. Large incinerator ash pit in Côte d’Ivoire
5. Malfunctioning district incinerator
6. Children with medical wastes at a dumpsite
7. Improper collection and storage
8. Meeting with key partners in Honduras
9. Waste treatment autoclave in Nepal
10. Poster on segregation used in Bangladesh
11. Dissemination workshop in Mongolia
12. Countries that have ratified the Stockholm Convention
13. Needle removers from BD, BMDI, and Balcan
14. Low-cost sharps pit using a plastic barrel
15. Example of poor incineration practice
16. Training material used in India
17. Lack of a disposal mechanism leads to open burning
18. Training session in Bangladesh
19. Sample data from ECAT
Welcome: Jamie Bartram
Health-care waste management (HCWM) supports the United Nations millennium development goals. While HCWM remains a low priority in many countries, it is receiving greater attention. This meeting brings together different interests working towards a common framework. WHO is grateful to the many organizations and governments participating at this meeting and to the Gates Foundation for its support.

Introduction of Participants:
See Annex 1 for a list of participants.

Agenda and Objectives: Yves Chartier
The Agenda is found in Annex 2. There were four major goals of the meeting:
1. To explore areas of collaboration between the International Solid Waste Association and key international partners on HCWM
2. To agree on a plan to update the WHO reference document Safe management of wastes from health-care activities
3. To review the latest developments in projects related to HCWM
4. To obtain agreement on a set of core principles regarding funding of HCWM.

International Solid Waste Association

Overview of ISWA: Bill Townend
(Presentation: “ISWA”)  
The International Solid Waste Association (ISWA) is an international association promoting sustainable waste management worldwide, by supporting research and development and providing information, training, and professional advice. ISWA publishes Waste Management & Research. Within the ISWA organization is a scientific and technical committee and working groups on health-care waste, hazardous waste, and sanitary landfills. ISWA is a cooperating organization with the WHO and had worked with WHO in the mid to late 1990s on the development of the WHO reference document and training guide.

The next meeting of the ISWA working group on health-care waste is in Italy from November 7 to 9, 2007. Within the UK, a research group has been initiated at Northampton University to coordinate research on HCWM. It is currently working on a joint arrangement with an institute in the United States.

Discussion: ISWA could provide direct support to countries in Central and Eastern Europe free of charge but it would depend on the goodwill of ISWA members and availability of funds to cover travel budgets. ISWA has access to experts who can provide services for a fee. The ISWA requirement for national members to have approval from government authorities may be difficult for some non-governmental organizations in Latin America. AIDIS (Inter-american association of sanitary and environmental engineering) already exists in Central and South America. There are currently no ISWA members in Africa.

Report (Etlog Health): Jan-Gerd Kühling
Incineration is the dominant treatment technology in Vietnam and Indonesia but investment, operating, and maintenance costs are high and environmental impacts are severe. Autoclaves have lower investment, operating, and maintenance costs; lower environmental impacts; and hospitals already have experience with them. However, only gravity-displacement autoclaves are generally available. Etlog
Health modified used gravity-displacement autoclaves for infectious waste treatment. Tests indicate that the standard treatment cycle does not achieve sufficient levels of disinfection. Etlog Health found that ten-minute steam flushing at atmospheric pressure followed by two short pulses (dropping the pressure from 110 to 20 kPa) and then sterilization at 134ºC achieved the desired result. Syringe barrels were distorted and destroyed. Modifications of used autoclaves with a capacity of 5-10 kilograms per hour, including the addition of a condenser and HEPA filter, cost less than 10,000 euros.

![Figure 1. Destruction of syringe barrels by autoclaving](image)

**DISCUSSION:** Etlog Health found volume reductions of about 50% for standard autoclaves, and reductions greater than 50% for vacuum autoclaves. A dual-chamber incinerator with auxiliary burners cost about $20,000 to $30,000 with a high operating cost due to fuel usage and maintenance. Many developing countries cannot afford vacuum autoclaves. The UNDP GEF project is working on local manufacturing of alternative technologies in Africa to reduce cost and build local capacity for repair and maintenance.

**Report (National Health System Foundation Trust):** Paul Williams (Presentation: “Waste Management at Heart of England NHS Foundation Trust”) – [presented on Day 2 due to time constraints]

The Heart of England NHS Foundation Trust facility in the UK generates waste equivalent to 5,500 households, of which 44% are treated as clinical waste. However, up to 90% of the waste entering the clinical stream is actually domestic waste. The key issues in waste management are environmental impact, segregation, storage, packaging, recycling, waste minimization, and duty of care. Poor segregation can result in needles being placed in plastic bags. Rigid yellow containers should be used for sharps collection. The facility uses a tag recording system to identify the date, quantity, and location where the waste was collected. External waste storage areas are marked with hazard and no entry warnings, locked, and designed to blend with the building. Properly designed and designated internal storage areas and sluice areas avoid the piling up of waste. An analysis of costs shows that waste segregation and minimization can result in significant cost savings due to the higher cost associated with treatment and disposal of clinical waste compared to household waste. Waste segregation and minimization involve the use of balers, compactors, refurbished products, longer-lasting furniture, and recycling of paper, glass, etc. In the coming year, the facility plans to revise its waste management policy, ensure that the staff is aware of the policy, reduce the amounts of clinical waste, and significantly increase paper and cardboard recycling. Activities on the ward department level will entail waste stream analysis, fostering environmental champions, training, and monthly “green days.”

![Figure 2. Recycling at the Heart of England NHS Foundation Trust](image)
Update of the WHO Reference Document

Objectives: Yves Chartier
The specific objectives of this session were:
1. To agree on key chapters to be updated
2. To agree on section leaders, authors, and co-authors
3. To agree on how to proceed and on a timeframe
4. To identify potential sources of funding.

Introduction: Philip Rushbrook
The WHO reference document, entitled Safe management of wastes from health-care activities (edited by A. Prüss, E. Giroult, and P. Rushbrook, World Health Organization, Geneva, 1999) can be found on the WHO website.1 The document, commonly referred to as the Blue Book, was developed on the premise that doing nothing is not an option and the problem of health-care waste is solvable. The document met an urgent need at that time. While it remains usable, the document is in need of updating in light of new developments especially regarding waste handling, treatment methods, and emerging diseases.

Presentation of the Pre-Reviewed Document: Philip Rushbrook
A pre-meeting took place in London on April 18, 2007 to review the WHO reference document. Notes on the meeting are found in Annex 3.

Roundtable Discussion:
Participants were in general agreement on the value and importance of the document. Each participant was asked to comment on the major weaknesses of the document. The comments are summarized in Annex 4.

Chapter-by-Chapter Review:
Prior to the meeting, detailed comments were received from Glenn McRae, Jorge Emmanuel, and Lalji Verma (see Annex 3). The participants reviewed each chapter of the reference document. A synthesis of chapter-by-chapter comments—incorporating the meeting discussions, handwritten submissions, the April 18 meeting notes, and the three detailed comments—is presented in Annex 5.

Discussion on Structure and Priorities:
The participants discussed several basic options on structure:
1. Retain the current approach of integrating both policy and technical guidelines.
2. Create separate documents: one for policy-makers and decision-makers (planning, financing, regulations, etc.) and another for implementers and frontline workers (technical guidance on the components of HCWM).
3. Create two separate documents: one dealing with evidence-based technical material and another on recommendations.
4. Have a document with the core guidelines and current knowledge supplemented by annexes that can be updated periodically.
5. Separate the topics by system (policy, costing, training, evaluation) and technical information.

Because time constraints do not allow deep revisions in the structure, it was decided to keep the document more or less as it is, namely, a comprehensive guidance document for decision-makers to be adopted by governments according to their needs, as well as a technical document for frontline

---

1 The WHO document can be downloaded from: http://www.who.int/water_sanitation_health/medicalwaste/wastemanag/en/
users. Decision-makers could be national policymakers or local facility managers.

In addition to the roundtable discussion and chapter review, the following general comments were made:
- Keep the document no bigger than it currently is.
- The document should remain a technical reference at its core with evidence on why recommendations are made.
- The format should be readable and easy to navigate.
- Provide signposts where the reader could obtain more detailed information; provide links to more technical references.
- Emphasize useful examples and provide relevant photographs.

Lead Authors, Chapter Contributors and Timeline:
The volunteer authors and chapter contributors are shown in Annex 6. WHO will prepare a brief for the lead authors of each chapter, summarizing the scope, specific topics, format, and links to other chapters. WHO will also arrange for peer reviewers and final editing.

The following rough schedule is planned:
- Pre-draft finalized in 4 months
- Experts meeting in 6 months
- Finalized version in 9 months
- Printed version in 12 months.

WHO will move the process forward and adjust the timeline as needed.
OBJECTIVEs: Yves Chartier
The specific objectives of the session were:
• To review the latest developments in health-care waste activities of various projects with a focus on counties supported by GAVI and receiving technical support from WHO
• To define potential collaborations or ways forward.

African Region

Overview: Ahmed Nejjar (Presentation: “Healthcare Waste Management in African GAVI countries”)

The following countries in the African region are supported by GAVI:
• Group 1: Benin, Burkina Faso, Mali, Senegal, Central African Republic, Congo and Mauritania (Togo, Guinea)
• Group 2: Kenya, Rwanda, Tanzania, Uganda, Gambia and Ghana
• Group 3: Malawi, Madagascar, Zambia, Zimbabwe and Mozambique

Three WHO regional workshops were conducted in Kenya, Mali, and Mozambique to explain the GAVI project, discuss the next steps, and review various tools like the WHO Rapid Assessment Tool. Reports from participating countries highlighted the major challenges, which included the absence of policies and guidelines, lack of health-care waste management systems, inadequate resources, problems with existing small incinerators, and fund transfer issues. GAVI-supported countries have formed national steering committees and working groups, conducted baseline surveys and situational analyses, reviewed national policies, and have begun the development of national plans and strategies. The next steps include implementation of waste segregation and minimization at health-care facilities and installation of alternative technologies.

Among the recommendations are greater collaboration, support for operational research on improving HCWM processes, establishing national training and certification, and sustainability of interventions for HCWM.

Côte d’Ivoire: Adama Sawagodo (Presentation: “Waste Management Challenges during mass campaign with injectable vaccines: example in Côte d’Ivoire in 2005”)

A measles immunization mass campaign in Cote d’Ivoire in 2005 used 10 million AD syringes and 1 million mixing syringes, resulting in 110 tons (550 cubic meters) of waste. A national inventory identified three treatment sites in the south of the country where industrial steam generators burned agricultural residues to produce steam. Tests were conducted using the furnaces operating between 800 to 1200 °C. Safety boxes were collected and transported to the factories under supervision at a cost of US$60,000, excluding the cost of incineration. The ashes were buried in a large ash pit. Treatment and disposal would have been simpler if waste management capacity had been strengthened on the district level.

Figure 4. Large incinerator ash pit in Côte d’Ivoire


Figure 4. Large incinerator ash pit in Côte d’Ivoire
Health-care waste is generated by over 3,300 hospitals, health centers, dispensaries, and private clinics in Kenya. In 2002, sixty de Montfort incinerators were constructed along with five diesel-powered incinerators. A 2005 survey found insufficient supplies for health-care waste management and inadequate internal transport of waste. The most common treatment methods were: incineration, open dumping at public dumpsites, burial in pits, and open burning. The majority of incinerators were broken or malfunctioning, and in many cases, the incinerators could only handle small amounts, had low chimneys contributing to local pollution, and could not withstand high temperatures. Gaps in training were identified, and segregation and color-coding were emphasized.

![Figure 5. Malfunctioning district incinerator](image)

Progress have been made with the completion of a national health-care waste management plan, draft national guidelines, the formalization of a national steering committee and working group on health-care waste, approval of the Environmental Sanitation and Hygiene policy, and formation of an inter-sectoral working group. Through the Making Medical Injections Safer (MMIS) program, HCWM activities have been taking place in various provinces. Among the current challenges are: the lack of budgetary allocation for HCWM, unavailability of affordable technologies, and little or no support supervision. Developing an inventory of facilities and stakeholders, establishing a comprehensive system for HCWM, strengthening training and support supervision, and monitoring and evaluation are some of the recommended next steps.

**Mali:** Boubacar Maiga and Fatoumana Sokona Maiga (Presentation: “Health care waste management in Mali”)

Currently, an assessment is being conducted and a national plan of action on HCWM is being developed in Mali, along with a training module and procedural manual. Equipment and materials for HCWM are being provided to facilities. A national steering committee and working group are being put in place. However, there is a lack of a legal framework, no waste management plans for national and regional hospitals, and a lack of disposal means in the urban centers. Air pollution from small incinerators is another problem. There may be funding opportunities from the multi-sectoral AIDS project, a measles vaccination campaign, GAVI, and a national budget allocation for HCWM.

**Rwanda:** Philbert Ciza (Presentation: “Rwanda – Gestion des déchet medicaux”)

Copies of the presentation were distributed.

**Madagascar:** Befelatanana Ambony Antananarivo (Presentation: “Politique Nationale de Gestion des Déchets des Établissements de Soins et de Sécurité des Injections”)

Copies of the presentation were distributed.

**DISCUSSION:** The national committees and working groups in Kenya are broadly representative, including the Ministries of Health and Environment, local authorities, major hospitals, NGOs such as JSI, and UN agencies such as UNICEF, UNEP, and the World Bank. Donors are important stakeholders. Ashok Agarwal noted that the brick incinerators in the photos shown had no pollution control and could not achieve high temperatures. A lack of standards for incinerators remains a major problem. Ahmed Nejjar and Adama Sawadogo mentioned pilot projects involving solar melters for plastic syringes. Financing is
also an issue. Carib Nelson pointed out that the cost of transport and disposal for Côte d’Ivoire amounted to less than half a cent per syringe. Ruma Tavorath described the positive experience in India with public-private partnerships, outsourcing to centralized treatment facilities, installation of easily maintained and operated autoclaves, and contractual arrangements that could streamline the system.

**GAVI Eastern Mediterranean Region**

**Overview:** Raki Zgondi (Presentation: “WHO/CEHA-GAVI project on healthcare waste management (HCWM) in the Eastern Mediterranean Region (EMR)"

The Eastern Mediterranean region involves 21 countries and the Palestinian territory. Photos showing improper segregation, overfilled containers, open dumping, open burning, scavenging in dumpsites, and liquid blood in open channels highlighted the need for sustainable HCWM plans in health-care facilities. A low-cost de Montfort incinerator at a dumpsite in Sudan was demonstrated but there is a need for low-cost cleaner technologies. The four-step process for the development of HCWM plans in the region entails national assessments, recommendations and strategies, draft plans, and the discussion and approval of plans at national workshops. The national plans address the legal and regulatory framework, HCWM practices at the facility level, capacity building and training, monitoring plans, pollution reduction, and financial resources. The plans are supplemented by national strategies for implementation. In the region, GAVI is supporting Yemen, Sudan, and Pakistan.

**Yemen:**

In Yemen, the project steering committee has been formed; it involves the Ministries of Health, Environment, and Interior; governorates, municipalities, universities, association of private hospitals, and the Social Development Fund. An assessment is being completed. The work plan and a proposal for capacity building in six governorates were discussed and approved at a two-day inception workshop. Press conferences after the workshop helped raise public awareness. The Yemeni parliament was sensitized to the risks of health-care waste and the Social Development Fund has expressed interest in co-financing HCWM activities. Preparation of the draft national plan and implementation of capacity building are the next steps.

**Sudan:**

In Sudan, the steering committee was formed, comprised of the Ministries of Health, Environment, Interior, and Legal Affairs; governorates, municipalities, and universities. The committee approved the work plan and capacity building proposal during its two-day inception meeting which included training sessions. A sectoral assessment is almost complete. As a result
of these activities, the awareness of senior Ministry of Health managers and steering committee members has been raised regarding the risks of health-care waste.

Pakistan:
The progress in Pakistan is similar to the other two countries. During the steering committee meeting, successful projects were presented. Following the advice of the Minister of Health and WHO representative, the steering committee discussed a proposal to implement two pilot projects to demonstrate application of the national rules on HCWM.

Raki Zgondi made the following overall recommendations: (1) implement the national plan with a focus on infectious and immunization wastes in select cities and rural areas to keep the momentum going; and (2) sponsor the development of national plans in other GAVI countries based on the experiences of the first group. To finance the implementation phase, he suggested that: governments request donors and partners to include HCWM and procurement of treatment facilities as part of their assistance; governments include provisions to sustain operation and maintenance of HCWM systems in their national budgets; and private sector involvement and private-public partnerships should be encouraged. A cost-recovery mechanism, such as a tax on disposable syringes, and a system of inspection are also important.

DISCUSSION: Aspects of sustainability were discussed at the start of the planning process. Thus, capacity building, awareness-raising, and funding by local governments in cash or in kind have become part of the process. There is a need to push for the implementation of national plans but financial support is urgently needed.

Pan American Region

Diego Daza and Hector Padilla
(Presentation: “AMRO Health Care Waste Management GAVI Project - Bolivia, Honduras & Nicaragua; and Work Plan GAVI-Honduras Project Health Care Waste Management HCWM PAHO/WHO*)

Overview:
Bolivia, Honduras and Nicaragua are the three countries in the region that have received GAVI funds supplemented by funds from the Pan American Health Organization (PAHO). The goal is for the countries to adopt national policies, plans, and strategies for HCWM by the end of 2007. The steps include an initial meeting of key partners, a national assessment, recommendations, national workshops to develop the plan, and a final meeting to approve it.

Bolivia:
Bolivia joined the project in April 2006. The GAVI project on HCWM is jointly managed by PAHO/Bolivia Immunizations and the Sustainable Development and Environmental Health Area (SDE), with Swiss Contact as a strategic ally. The objectives include the proposal of policies, strategies, and plans that cover generation, transport, final disposal, and training; as well as the involvement of the Bolivian Ministry of Health and Sports, Ministry of Education, Ministry of Labor, Social Security, and the Federation of Municipal Associations.

Honduras:
In Honduras, PAHO/WHO has been asked to assist in the development of policies, strategies, and plans for HCWM. Among the objectives are: to implement the “Health
Inside Health” PAHO/WHO policy in the region, to participate in the Honduras Solid Waste sectoral assessment, and to complete a HCWM plan of action by the end of 2007. In addition to PAHO/WHO and SDE, the partners include the Ministry of Health, Health Secretary, Secretary of National Resources and Environment, Tegucigalpa municipality, Swedish Agency for International Development, Inter-American Development Bank, Honduran Social Security Institute, Honduran Municipalities Association, and the Honduran Hospital Association. The project execution entails an initial meeting of key partners, national technical evaluation, analysis of the evaluation, national workshops, and a final meeting with partners leading to official approval and implementation of policies, strategies, and the action plan. With the Ministry of Health as the focal point, officials have participated in the activities with support from national and international partners, strengthening the legal framework and conducting a preliminary analysis of the technical evaluation. Training, sustainability, infrastructure investment, and involvement of Honduran government counterparts are important next steps to consider.

Nicaragua:
PAHO/WHO has also been asked by the Nicaraguan Ministry of Health to assist in the development of policies, strategies, and plans for HCWM, complementing earlier work supported by the European Union and World Bank. Among the objectives are: to strengthen the HCWM components in the existing Integral Solid Waste Management Policy and the National Health Policy, and to complete a HCWM plan and proposed treatment alternative for the Managua district (where half of all health-care wastes are produced) by the end of 2007. Key partners include the Ministry of Health and Ministry of Natural Resources, Managua Municipality, Municipal Promotion Nicaraguan Institute, Nicaragua Municipalities Association, Nicaragua Social Security, and the water and sewer commission. The ministry is financing the installation of two incinerators and a special transport vehicle is already in operation. Training on the district and national levels are ongoing.

DISCUSSION: “Health Inside Health” is a PAHO initiative that promotes occupational health with the goal of reducing risks to doctors, nurses, patients, and their relatives within the health care system.

Funding from GAVI and WHO is considered seed money. Mobilization, infrastructure development, and sustainability (as manifested by the government responding and taking ownership of the project) are major endeavors. This may be a window of opportunity to address HCWM gaps in the health sector plan under Health Systems Strengthening. In Africa, seeking funding under the health system has been difficult because of competing needs and demands.

South East Asia Region


Nepal generates about 365 tons of health-care waste per year, with amounts increasing due to population growth and urbanization. Health Care Foundation-Nepal is a non-profit NGO working on health care, environmental health, and disaster medicine. Health-care waste has been neglected, often ending up untreated in dumps. Nepal’s
largest hemodialysis center, National Kidney Center, established by Health Care Foundation-Nepal, began its HCWM approach with waste reduction, reuse-recycling of non-infectious and compostable waste, and the selection and installation of autoclave technology based on an evaluation of options. The challenges include lack of capacity building and the need to establish a citywide HCWM center in Kathmandu.

Video Documentary: Mr. Nakarmi showed a new video documentary by the Health Care Foundation-Nepal. The documentary explained the problems of pollution and scavenging at the dumpsite. It showed reprocessing of materials (used by the same patient, except for patients with hepatitis); the autoclaving of blood-contaminated plastics and their subsequent recycling; and the recycling of paper, plastics, and glass. At current market prices, 40% of handling costs are covered by the recycling revenues.

DISCUSSION: Participants found the video documentary very helpful. Mahesh Nakarmi explained that gloves are reused at the facility if there is no visible contamination and after they have been treated in the autoclave. Handlers and technicians follow safety guidelines when working with untreated health care waste.

Bangladesh: Andrew Trevett and AKM Saiedur Rahman (Presentation: “Bangladesh country presentation”)

A 1994 survey by the Directorate General Health Services found a lack of awareness and capacity related to health-care waste. HCWM was made an indicator for Annual Performance Reviews but there were no policies, guidelines, facilities, training opportunities, nor appraisal tools. In response, HCWM was instituted in four medical colleges and 20 district hospitals, baseline surveys were completed, bylaws drafted, and a pocketbook for nurses was published. The next steps include approval of national policies and guidelines, nationwide capacity building, development of reporting and monitoring mechanisms, and mobilization of resources including identification of cost-recovery mechanisms. Future plans are being developed to incorporate HCWM into the teaching curricula, support research programs, promote private sector involvement, and require tetanus and hepatitis B vaccination of health-care workers.

Western Pacific Region

Overview: Terrence Thompson (Presentation: “GAVI Supported Project on Integrated Health Care Management”)

The participating countries in the region are: Cambodia, Lao PDR, Mongolia, Papua New Guinea, Solomon Islands, and in the future, Kiribati and Vietnam. The activities include the formation of national working groups, situational assessments, review of assessments and recommendations, and the development and endorsement of integrated national HCWM plans. Initially, there was some hesitation by several countries that the national plan might be a paper exercise while others saw it as an opportunity to review laws or conduct assessments. The national plans would be meaningful if a financial plan is included.

Mongolia: Sh.Enkhtsetseg (Presentation: “Health Care Waste Management in Mongolia”)
Mongolia has 20 tertiary care facilities, 34 secondary health facilities, 570 primary care facilities, and 683 private hospitals and clinics. Regulations on HCWM were promulgated in 2002 along with policies and regulations on hazardous waste and municipal solid waste. A Health Sector Master Plan was approved in 2005. Poor HCWM and unsafe combustion practices were highlighted in a 2005 health-care waste characterization survey for Ulaanbaatar city. A multi-sectoral technical working group dealing with water, sanitation, hygiene and waste was established in November 2006. A GAVI-supported survey of 220 soums concluded that 11.6% of soum hospitals do not practice segregation of wastes, 53.4% burn wastes in low-temperature stoves or drums, 10.7% practice open burning on site, while only 7.0% considered it possible to spend their local budget for improving HCWM. The fundamental problems are: a lack of comprehensive guidelines and plans, inadequate financing mechanism, the absence of proper infrastructure, deficient knowledge and skills of health sector personnel, and poor occupational and environmental health practices.

GAVI funds supported workshops in Ulaanbaatar city and two provinces which lead to recommendations that were incorporated into the Health Sector Master Plan implementation framework. Consequently, the strategic actions under the Health Sector Master Plan placed a high priority on resource allocation and international support for HCWM and the disposal of expired drugs.

DISCUSSION: Many countries view HCWM as an add-on or even a luxury. Instead, it should be integrated into health systems planning. National plans are needed to lay the ground for sustainability, such as developing the legal framework. Future funds could be used for pilot projects or as an investment to mobilize governments, to leverage more financial and human resources, and to create strategic alliances. External pressure from donors to get governments to allocate budget lines for HCWM is valuable. The funds from GAVI are an opportunity to get governments to commit to HCWM and to get other donors to do the same. WHO could facilitate links with donors.

**European and Central Asian Region**

**Overview: Eric Laurent** (Presentation: “Healthcare Waste Management in GAVI EURO countries”)

The WHO Regional Office for Europe covers a very diverse area, from countries with a Gross National Product of less than $600 per capita to over $20,000 per capita. Starting 2003, the EURO Immunization Program began to provide technical support to Ministries of Health towards the development of national policies and action plans, and for pilot project. The target countries were: Ukraine (2003), Moldova (2004), Turkmenistan (2005), Kyrgyzstan (2006), Tajikistan (2007) and Azerbaijan (2007), in addition to projects in non-GAVI countries: Russian Federation (2006). Most of these countries are still currently supported through WHO, involving ETLog Health as an engineering firm. Different approaches have been taken.

Ukraine began with a pilot project on dealing with AD syringes and plastics recycling, followed by the setting up of a working group in 2005, a rapid assessment in 2006, and the development of national regulation in 2007. Kyrgyzstan created a national working group and steering committee in 2006 and is developing its
strategy and action plan. Tajikistan is conducting a situational assessment. Azerbaijan had only recently requested assistance. WHO is providing technical support to the steering committee and multi-sectoral working groups. The strategy entails a current assessment, legal framework, alternatives, monitoring, training, and financing, leading towards an action plan and implementation. Among the challenges are the lack of partnerships in the region and the limited funds in Eastern Europe. Poor inter-ministerial cooperation is also a problem as well as the widespread use of hypochlorite as a chemical disinfectant for waste.

Despite the challenges, activities have moved forward and about 60% of GAVI funds have already been spent for the 2006-07 biennium. The Ministries of Health are willing to work on HCWM but there remains a lack of staff resources, technical knowledge, finances, national standards, and guidelines. Countries themselves are demanding that the work on HCWM should not slow down but capital investment in equipment is badly needed.

**Kyrgyzstan:** Gulmira Djumalieva  
(Presentation: “Healthcare Waste Management in Kyrgyzstan”)

The development of the national strategy and action plan on HCWM in Kyrgyzstan is a collaborative effort involving the Ministry of Health (Deputy Ministers, Public Health Department, Immunoprophylaxis Center, Infection Control Center, Sanitary-Epidemiologic Center, and Health Insurance Fund), partner organizations (Swiss Red Cross, UNDP, and IEC), and the WHO Regional Office for Europe, with Etlog Health as experts. The Ministries of Finance and Environment, and municipalities, will be involved in drafting the strategic plan.

Currently, needles and syringes are separated, treated with chlorine solution, then either burned or dumped. Immunization sharps waste are collected in cardboard boxes and then burned or dumped. The steering committee and multi-sectoral working group were formed in October 2006. The first draft of the strategy and action plan is expected in July 2007. The objectives of the strategy are: improving the regulatory framework, providing adequate financing, identifying treatment technologies, and ensuring ecological safety. The challenges include: lack of financing and tight national budgets, outdated standards and guidelines, and insufficient knowledge of HCWM among health managers, staff, and municipal service workers. Among future steps are: a pilot project in Bishkek, advocating for operation and maintenance costs in the national budget, moving away from chlorine treatment, private sector involvement, and fundraising.

**International and Non-Governmental Organizations**

**Global Environmental Facility (GEF) / UNDP:** Jack Weinberg  
(Presentation: “GEF Project on Health Care Waste”)

The United Nations Development Program (UNDP), WHO, and Health Care Without Harm are collaborating on a global project entitled “Demonstrating and Promoting Best Techniques and Practices for Reducing Health Care Waste to Avoid Environmental Releases of Dioxins and Mercury” in eight countries (Argentina, India, Latvia, Lebanon, Philippines, Senegal, Tanzania, and Vietnam). The project is funded by the Global Environmental Facility (GEF), which helps developing countries meet their
obligations under the Stockholm Convention on Persistent Organic Pollutants. The Stockholm Convention, signed by 151 countries, requires the reduction and ultimate elimination, where feasible, of persistent organic pollutants including dioxins which are created by medical waste incinerators. Countries are obligated to require best available techniques (BAT) for new medical waste incinerators and to promote best environmental practices (BEP). Under the convention’s BAT/BEP guidelines, priority consideration should be given to alternative technologies that do not generate dioxins and stringent measures are required for medical waste incinerators.

The GEF project involves the creation of model health facilities to demonstrate best practices, deployment of alternative technologies, use of best practices for mercury management including mercury-free devices, national training and certification programs, national policies, and national, regional, and international dissemination. A special component is the design and local manufacture of low-cost treatment technologies for Africa. The GEF project involves broad stakeholder participation in national committees and working groups. Potential areas for networking and collaboration include: sharing of web links, technical material, toolkits, project outcomes and lessons; and involvement of others in advisory committees and GEF-sponsored conferences.

DISCUSSION: The special component to design low-cost technologies in Tanzania for sub-Saharan Africa will consider multiple energy options, such as electricity, gas, and solar energy. A simple mechanical shredder is also being considered. The plan is to work with local manufacturers to fabricate the technologies at low cost. At the Conferences of the Parties for both the Basel and Stockholm Conventions, there was a commitment to work together on BAT/BEP and with UNEP-Chemicals on mercury.

Program for Appropriate Technology in Health (PATH): Carib Nelson
(Presentation: “PATH Research and Evaluation of Medical Waste Technologies”)

PATH has been evaluating several alternative methods for sharps waste disposal. In a recent evaluation of needle removers, PATH concluded that these devices isolate the needle and prevent reuse, reduce risk to waste handlers and the community, reduce waste volumes, facilitate disposal options such as autoclaving and plastics recycling, but require regular maintenance for optimal operation. In India, 14,000 needle removers have been used in the last one to two years with no reports of device failures and no reports of needle-stick injuries. In addition to making health workers feel safer, the community also feels safer when they see that syringes are being cut and cannot be reused. PATH has also looked at low-cost needle poppers and needle cutters used with local plastic containers. The experience in India, Vietnam, Senegal, Kenya, Rwanda, Mozambique, and other countries indicate that these are practical tools that could simplify waste management.

In addition, syringe melters could provide an on-site final disposal option for facilities without centralized waste disposal. However, the prototypes evaluated by PATH have several weaknesses that must be addressed. Locally-manufactured safety boxes could be more affordable but, so far, the quality of materials and design do not consistently meet WHO specifications. Retractable syringes, while slightly more costly than auto-disable syringes, effectively disable and disarm needles and syringes at the point of use, enhancing worker and community safety during waste handling and disposal. Safe, simple, clean technologies and
Centralized collection and treatment should be encouraged and funded.

**DISCUSSION:** AD syringes lock up to prevent reuse. Retractable syringes are technically not AD syringes but they have features that prevent needle-stick injuries. The use of needle cutters may not be practical in situations where the health worker is busy giving many injections since it adds an extra step. In the absence of sharps containers, rigid plastic containers and cans meet many of the criteria. Having sharps containers within arms reach is a key principle. A WHO study is planned in Bangladesh to evaluate needle removers used in routine activities. An official position by WHO on needle removers is expected around the first quarter of 2008.

**John Snow Inc. (JSI) / Making Medical Injections Safer (MMIS): Marcia Rock**

(Presentation: “Making Medical Injections Safer: Improving Sharps Waste Management”)

The Making Medical Injections Safer (MMIS) program involves Haiti, Nigeria, Côte D’Ivoire, Rwanda, Ethiopia, Kenya, Tanzania, Uganda, Botswana, Mozambique, and South Africa. It combines WHO recommendations, PATH experiences, and country resources to create practical waste management solutions. Systems, people, and equipment comprise the critical elements. The MMIS activities include pilot projects, supporting national policy and planning, training, and making incinerators as safe as possible through waste minimization, segregation, incinerator repairs, regular maintenance, and proper operation. A hospital in Kenya reduced the amount of waste being incinerated by improving its segregation practices and a plastic barrel was used to construct a simple sharps pit. In Nigeria, the Ministries of Health and Environment formed a multi-sectoral steering committee with technical working groups reviewing the legal framework, and assessing waste generation, HCWM practices, and institutional capacities. Drafts of the HCWM guidelines, national plan, and budget will be approved in June 2007. There is a need for safer technologies especially in the remote rural areas, increased priorities for HCWM, and a better understanding of costs and benefits.

**DISCUSSION:** With regards to costing, the Mark 9 version of the de Montfort incinerator, using fired bricks and refractory mortar and with a capacity of 50 kilograms per hour, costs about US$3000. Fire-bricks are necessary to reach 800°C. Local solutions are being developed in Kenya to address the problems with the incinerator doors and chimney. PVC waste, however, needs temperatures much higher than 800°C to minimize creation of persistent organic pollutants. Segregation to eliminate PVC is important but often it is difficult to identify the chlorinated plastics. Some countries, such as India, discourage these incinerators since even with dual chambers it is difficult to maintain the high temperatures. In Nepal, incineration had been viewed as the best method but some hospitals now incinerate their wastes at night because of strong community opposition. However, for some low-income countries, improved operation of small-scale incinerators and sharps pits are interim options to prevent syringes from being thrown in open dumps, while cleaner and affordable alternatives are being developed. Decision-makers need to be aware of alternative technologies in order to move in that direction.
IGNOU: Ashok Agarwal (Presentation: “Our beautiful Planet”)

Every day, the ten countries in the WHO Southeast Asia region produce over 1000 tons of infectious health-care waste, most of which is poorly managed. Before 2004, only India and Thailand had HCWM legislation but today, more countries are in the process of promulgating HCWM laws. The Indira Ghandi National Open University (IGNOU) has a certificate program for HCWM through distance education for countries in the region. IGNOU is the largest university in the world, serving Asia, Africa, and the Caribbean with a presence in 35 countries, 125 programs, and 1.5 million students enrolled.

The objectives of the certificate program are: to sensitize health-care professionals and workers about health-care waste; acquaint them with legislation, knowledge and practices in the region; and equip them with skills to manage HCWM properly. The program package consists of self-instructional material, guides, videos, a six-day contact session, six teleconferences per year, and counseling. The courses cover environmental health fundamentals, legislation, HCWM concepts, technologies, training, and a project. The course materials are being translated into several languages. Since the program was launched in January 2006, 300 students have enrolled and a wide range of projects have been initiated. An evaluation by the WHO Southeast Asia Regional Office is planned for early 2008. As more study centers are being set up in the region, enrollment is expected to reach 1000 by 2008.

DISCUSSION: Continuing professional development is vital. The IGNOU program’s six-day contact period includes field visits, theoretical discussions, videos of treatment technologies, building model HCWM systems, etc. The contact period takes place at Program Study Centers.

Health Care Without Harm: Ruth Stringer (Presentation: “Experience in alternative healthcare waste management”)

Health Care Without Harm (HCWH), a coalition of 443 organizations in 52 countries, has been involved in collaborative projects pertaining to HCWM, including projects dealing with waste audits, waste minimization, training, non-incineration treatment of waste from immunization campaigns, and non-incineration technologies in Europe, Africa, Asia, and the Americas. Health Care Without Harm has investigated potential alternative technologies, costs of treatment, and the performance of small-scale incinerators. The coalition disseminates information on alternative technologies through reports, databases, CleanMed conferences, and case studies, such as its recent report on best practices in Philippine hospitals. Among its current projects are: a 12-month evaluation with JSI of alternative treatment in a district hospital in Tanzania, a two-year project to provide training capacity and foster change in Hubli-Dharwad, India; a joint project with JSI and PATH on selecting technologies for Botswana; and as a cooperating agency with UNDP and WHO in the eight-country GEF project on health-care waste. Health Care Without Harm seeks partners worldwide to promote alternative strategies.

DISCUSSION: HCWH has been working with iSTAATT and other groups on looking at standards for autoclave efficiency. Monitoring and evaluation systems are
needed to assess alternative treatment technologies. Evaluation of volatile organic compounds from autoclaves should also be examined. HCWH is opposed to the use of chlorine for treating waste because of occupational and environmental health impacts associated with chlorine use.

**World Bank: Ruma Tavorath** (Presentation: “Environment in HNP: An India Experience”)

The World Bank is the largest external financier of the health sector in India. Health projects are now categorized as “B” (i.e., health projects are considered to have a potential for adverse environmental impacts on human populations or environmentally important areas and therefore require an environmental management plan). The issues of environmental health, worker safety and HCWM are linked together in the Bank’s Health, Nutrition & Population (HNP) program. The Bank has not financed medical waste incinerators in India since the late 1990s. India’s regulatory framework includes regulations on HCWM and worker health and safety. HCWM is a prerequisite for reducing the risk of infection among health workers and the community. In light of the dichotomies of different programs and agencies, cross-cutting issues need greater integration.

**DISCUSSION:** HCWM should be seen as a framework that requires awareness, commitment, national ownership, and champions for change. How the World Bank deals with HCWM varies in different places.

**Toxics Link / Srishti: Ravi Agarwal** (Presentation: “Health Care Waste and Syringe Waste Management in India”)

The health care waste program of Toxics Link/Srishti dates back to 1994. The group’s early activities included assistance in drafting legislation related to HCWM in India, developing the first manual, and working on model hospitals. In 1998, India’s Bio-Medical Waste Handling and Mandating of common treatment facilities, enhanced partnerships with the private sector and NGOs, and an active NGO community) as well as bank-driven initiatives (such as an integrated approach across all disease programs, attention to awareness-raising and capacity building, dedicated funding allocation, operational guidelines, appropriate technology, and different models of partnerships with service providers). What has not worked include: inadequate implementation, lack of sustained behavior change, unsystematic and incomplete institutionalization of common treatment facilities, inadequate monitoring and enforcement, and lack of integration of water and sanitation issues.

Effective cradle-to-grave waste management requires a two-pronged approach: segregation and mutilation (to prevent reuse) at the facilities, and environmentally sound operation of common treatment facilities. Collaboration, integration among different programs, and planning and monitoring frameworks are necessary. Among the unresolved matters are: a legal framework that is too prescriptive, lack of HCWM in remote rural areas, disposal of AD syringes, ensuring effective private-public partnerships, and how to make HCWM replicable, sustainable, and integrated into health sector thinking.

Figure 16. Training material used in India
Management Rules prohibited incineration of PVC waste. The national guidelines for centralized waste treatment facilities, of which there are now over 150 in the country, require 90% autoclaving and 10% incineration for anatomical waste.

Figure 17. Lack of a disposal mechanism leads to open burning

Waste management has been a part of the second phase of India’s Reproductive and Child Health program, which prohibits incineration of syringe waste. The World Bank-funded State Health Systems Development Program (SHSDP) includes line items for HCWM. Some 20,000 primary health centers will have syringe waste disposal mechanisms, including needle cutters, needle pits, and deep burial pits for anatomical waste. In West Bengal, the state plan under the SHSDP involves non-burn technology options. The strategy suggests sharps pits, linking with central treatment facilities, on-site campus pits for anatomical waste, and small autoclaves (30-50 kg) at the block level. The estimated cost of deep burial pits, trolleys, and needle cutters at all primary health centers, sub-centers, and community health centers, plus autoclaves and shredders at all community health centers is $25 million, with an annual cost of consumables estimated at $7.2 million. The total cost of HCWM and infection management for a five-year period is about 1% of the total budget of the second phase Reproductive and Child Health program. Some of the challenges include: an inadequate focus on HCWM, lack of available experts, difficult government hospital management systems, no budget allocated in routine state programs, and insufficient experience in the primary and secondary systems.

DISCUSSION: On average, about 0.3 kilograms per bed per day is generated in India. Facility operators charge about 2.5 to 3.5 rupees per bed per day for collection, transport, and treatment but the service is often subsidized. The India experience shows that an unambiguous policy from government is important for sending a clear signal to the health sector.

Side Session on HCWM Training

A side session was held to discuss HCWM training and certification. Jan-Gerd Kühling proposed that standardized training on HCWM, similar to the standardized curriculum for Central Sterile Supply Departments, and an international organization to certify training courses should be established. Nelson Sabogal noted that Basel Regional Centers have developed training capacity at the 14 centers around the world. Ashok Agarwal explained that the IGNOU certification requires 14 credits and entails certification by the university and the WHO Southeast Asia Regional Office. Ed Krisiunas gave the examples of training and certification by the Association of Professionals in Infection Control and the American Biological Safety Association.
ISWA offered to do international certification, accredit curricula, and maintain records, including records of refresher courses.

Jack Weinberg explained that the UNDP GEF Project is working on training and certification on the national levels, and expressed concern that international certification should not be heavily European or U.S. based in light of the different conditions and needs in developing countries. International certification should have the institutional endorsement of international bodies including WHO, the Basel Secretariat, and the World Federation of Public Health Associations. Diego Daza emphasized that training and certification in the Americas would have to be coordinated with AIDIS and PAHO.
Objectives: Yves Chartier
The objectives of the session were:
• To obtain global agreement on a set of WHO core principles
• To agree on ways forward for implementation
• To better understand the funding mechanisms for health care waste
• To discuss linking other environmental health issues in health care settings with health care waste.

WHO Costing Tools
Jorge Emmanuel (Presentation “WHO Costing Tools for Health Care Waste Management”)

The purpose of the costing tools is to help senior managers, trained personnel, consultants, and national policymakers estimate costs and annual budgets related to HCWM. In the costing tools, costing is done at the facility and national levels and calculations use key indicative values and the equivalent annualized cost method which annualizes capital costs based on a discount rate and equipment lifespan. There are four costing tools: the basic Cost Assessment Tool (CAT) and three Expanded Cost Assessment Tools (ECAT) for low, middle, and high income countries.

The CAT requires input data such as amount of waste generated per year, total number of beds, and total number of health-care facilities, along with indicative values (such as an average cost to treat a kilogram of waste) to compute initial estimates of national costs. It also allows the user to input typical values for small, medium, and large facilities (e.g., the number of bins or number of safety boxes needed in a small health facility) to compute annual capital and recurrent costs. The CAT then adds up the annualized capital costs and recurrent costs for the three sizes of facilities, multiplies them by the corresponding total numbers of each size of facility, and computes the total costs and cost per kilogram for the whole country.

The ECAT expands on the basic CAT by differentiating between low, middle, and high income countries, and defining specific size categories of health-care facilities: small - 0 to 4 beds; medium - 5 to 99 beds; large A - 100 to 499 beds; large B - 500 beds or higher. The ECAT allows the user to specify decentralized treatment, centralized treatment (for a small cluster of health facilities up to 1000 kilograms per day or for a large cluster), or a combination of centralized and decentralized treatment for the country. In addition, the ECAT has various treatment options, e.g., autoclaves, autoclaves-shredders, microwaves, advanced steam treatment, and incinerators that meet international standards for high income countries; autoclaves, autoclave-shredders, sharps pits, needle removers, small incinerators that do not meet international standards, ash pits, etc. for low-income countries. Potential revenues from the sale of sterilized plastic parts that can be remelted are also computed. Input data include total population, a breakdown of health-care facilities according to bed sizes, wage rates, electrical rates, etc. Default values for key indicative values, such as infectious waste generation rates in kilograms per bed per day, are based on typical international averages or can be adjusted if country-specific values are available. The ECAT computes total national costs, total costs according to facility sizes, costs per kilogram of waste, costs of sharps treatment alone, as well as costs per population and other national averages.

The CAT and ECAT Excel programs were demonstrated using actual data from various low, middle, and high income countries. The results were used to compare national costs.
of centralized versus decentralized treatment, the comparative costs of different treatment methods, and costs for treatment of sharps waste. Annual costs per bed, costs per kilogram of infectious waste, and costs per syringe compared well with available published data. WHO would like to build a knowledge base of costing information. Cost studies, and results and experiences using the costing tools could be sent to 

hcwaste@who.int.

Figure 19. Sample data from ECAT: Sharps disposal costs per syringe comparing (1) autoclaving and (2) incineration options using data of various countries

**DISCUSSION:** With regards to calculating transportation costs associated with centralized treatment, ECAT computes the number and cost of transport vehicles, and accounts for the wages of drivers and an average cost per day for operating a collection vehicle (input value). The latter should include costs of fuel, oil, annual maintenance, etc.; this cost is difficult to model because of differences in fuel prices, road and traffic conditions, and travel distances, all of which would affect gas mileage. A more complicated model is one where all distances traveled are estimated and used to factor in the cost of fuel. For sharps, it would be useful to come up with a cost per syringe for treatment and disposal, for instance, 2 cents per syringe. The tool can be used to estimate costs for campaign immunizations by redefining some of the input and output values. For example, “national” values could be redefined to correspond only to the areas where the mass immunizations will take place. The tool may be useful in developing multi-year plans. Although the tool sums up national costs, in many countries, much of the facility-level costs are covered by local private hospitals, not by national budgets. Hence, the user might input only government hospital data to compute the national budget funded by the national government. The tool could be helpful in education and advocacy.

**WHO Core Principles of Safe and Sustainable HCWM**

The participants agreed to develop a set of core principles related to financing of HCWM. Organizations represented at the meeting and other organizations and institutions would be asked to signal their commitment to the core principles. The WHO Core Principles would be posted in websites and promoted at the World Health Assembly and other international conferences. Furthermore, it could serve as an advocacy paper to create a paradigm shift when dealing with national governments, international agencies, donors, project partners, NGOs, the private sector, and health facilities.

During a roundtable discussion, the participants proposed the following relative to the content of the WHO core principles:

- The principles should focus on financing.
- It should focus on infectious waste but include all wastes from health-care.
- The responsibility (duty of care) of generators, as well as of donors and recipient countries, should be mentioned. Donors should provide funds for the management of wastes associated with their interventions. Recipient countries should institute sustainable and environmentally sound HCWM systems.
- HCWM should be seen as integral to health systems.
- The principles should touch on occupational safety and infection control.
- Countries should identify and progressively allot sufficient budgets.
- Funding of HCWM should result in measurable outcomes, such as
reductions in needle-stick injuries, lower
disease burdens, economic savings, etc.
• The costs of HCWM should be viewed
  as a new category of overhead costs
  built into programs, just as
  administrative costs are seen as the
  normal cost of doing business.
• Determining what proportion of cost
  sharing would be covered by donors
  versus governments is not clear. Cost
  sharing and operationalization would
  have to be worked out.
• There is a need for research and
  development of alternatives to allow
  environmentally sustainable methods.
• The duty of care at the institutional level
  as well as the responsibilities of
  manufacturers of products should also
  be mentioned.

Maria Neira, WHO Director of Public
Health and Environment, recommended that
WHO and its partners develop strategies and
proposals with the private sector on
innovative solutions to reduce the amounts
of waste produced. Moreover, international
movements should ensure that HCWM is
taken into consideration in health systems
strategies. For example, the Commission on
Social Determinants of Health should
consider HCWM, and the patient safety
movement, primary health care movement,
and urban health networks should also
include HCWM in their strategies. The final
text of the WHO core principles is shown on
page 22.

Next Steps:
The WHO core principles will be brought
back by participants to their organizations,
institutions, or ministries. Formal letters
signaling their commitment to the core
principles should be sent in by July 31, 2007,
after which the paper will be disseminated
widely.

Closing Comments

Closing: Maria Neira
Dedicating resources to deal with health-
care waste issues is consistent with the need
to tackle the root causes of diseases and with
the Alma Ata Declaration to protect and
promote the health of all peoples. The public
health community can realize the benefits of
cooperation towards sound HCWM. This
strategy aligns well with the public health
mission. The WHO core principles should
be given high visibility. WHO is grateful to
all the participants.

Final Note and Appreciation: Yves
Chartier
Attending the meeting were 53 participants
from some two dozen countries representing
33 organizations. The meeting was very
dynamic and productive, with virtually full
attendance throughout the meeting until the
end. It was an example of good
collaboration and partnership.

Thanks are due particularly to:
- Beth Woolnough and Stephanie who
  helped make the meeting a success,
- Philip Rushbrook and Bill Townend for
  chairing the first day sessions,
- Colleagues from Health Care Without
  Harm for the reception,
- Jorge Emmanuel and Melissa Wright of
  the UNDP GEF Project for their work as
  rapporteurs and their support before,
during, and after the meeting sessions,
- Mahesh Nakarmi for the video on Nepal,
  and
- The Gates Foundation (Steve Landry and
  Mito Alfieri) for their support which
  made the meeting happen.

Next page: Text of the “WHO core principles for
achieving safe and sustainable management of
health-care waste”
### WHO core principles

**for achieving safe and sustainable management of health-care waste**

The safe and sustainable management of health-care waste is a public health imperative and a responsibility of all. Improper management of health-care waste poses a significant risk to patients, health-care workers, the community and the environment. This problem can be solved. The right investment of resources and commitment will result in a substantive reduction of disease burden and corresponding savings in health expenditures.

### Background:

Health-care waste can cause serious harm if not managed properly. For example, in 2000, WHO estimated that injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections), two million hepatitis C virus (HCV) infections (40% of all new infections) and 260 000 HIV infections (5% of all new infections). In addition, health-care activities generate significant amounts of hazardous waste such as mercury and expired pharmaceuticals, as well as large amounts of general waste.

The management of health-care waste is an integral part of a national health-care system. A holistic approach to health-care waste management should include a clear delineation of responsibilities, occupational health and safety programs, waste minimization and segregation, the development and adoption of safe and environmentally-sound technologies, and capacity building.

Recognizing the urgency of this problem, a growing number of countries have taken initial steps to respond to this need. These include the establishment of regulatory frameworks, development of national plans, and the demonstration of innovative approaches. However, funding for health-care waste management remains very inadequate.

### Recommendations:

The WHO core principles require that all associated with financing and supporting health-care activities should provide for the costs of managing health-care waste. This is the duty of care. Manufactures also share a responsibility to take waste management into account in the development and sale of their products and services.

The establishment and sustained maintenance of sound systems for health-care waste management depend on the availability of resources. Therefore, in keeping with the WHO core principles, WHO recommends that:
<table>
<thead>
<tr>
<th>Governments should:</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ allocate a budget to cover the costs of establishment and maintenance of sound health-care waste management systems</td>
</tr>
<tr>
<td>□ request donors, partners and other sources of external financing to include an adequate contribution towards the management of waste associated with their interventions</td>
</tr>
<tr>
<td>□ implement and monitor sound health-care waste management systems, support capacity building, and ensure worker and community health.</td>
</tr>
<tr>
<td>Donors and partners should:</td>
</tr>
<tr>
<td>□ include a provision in their health program assistance to cover the costs of sound health-care waste management systems.</td>
</tr>
<tr>
<td>Non-governmental organizations should:</td>
</tr>
<tr>
<td>□ include the promotion of sound health-care waste management in their advocacy</td>
</tr>
<tr>
<td>□ undertake programs and activities that contribute to sound health-care waste management.</td>
</tr>
<tr>
<td>The private sector should:</td>
</tr>
<tr>
<td>□ take responsibility for the sound management of health-care waste associated with the products and services they provide, including the design of products and packaging.</td>
</tr>
<tr>
<td>All concerned institutions and organizations should:</td>
</tr>
<tr>
<td>□ promote sound health care waste management</td>
</tr>
<tr>
<td>□ develop innovative solutions to reduce the volume and toxicity of the waste they produce and associated with their products</td>
</tr>
<tr>
<td>□ ensure that global health strategies and programs take into account health-care waste management.</td>
</tr>
</tbody>
</table>

All concerned institutions and organizations are invited to express their commitment to the WHO core principles on achieving safe and sustainable management of health-care waste by writing to: hcwaste@who.int. WHO will maintain a public listing of entities that subscribe to the WHO core principles at http://www.who.int/water_sanitation_health/en/
### Annex 1
### List of Participants

<table>
<thead>
<tr>
<th>Region</th>
<th>Participant</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African Region</strong></td>
<td>Ahmed Nejjar, WHO AFRO, Gabon Tel: + 241 740140, GPN: 34833 <a href="mailto:Nejjara@ga.afro.who.int">Nejjara@ga.afro.who.int</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adama Sawadogo, WHO AFRO, Burkina Faso Tel: 226 76670156 <a href="mailto:sawadogoa@bf.afro.who.int">sawadogoa@bf.afro.who.int</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>W. Ndegwa, WHO AFRO, Kenya Tel: 254-20-2717902 <a href="mailto:ndegwaw@ke.afro.who.int">ndegwaw@ke.afro.who.int</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>K. Ombacho, Chief Public Health Officer, Ministry of Health, Kenya Tel: +254-20717077 + 254-20710055, <a href="mailto:Kombacho@yahoo.com">Kombacho@yahoo.com</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fatoumata Sokona Maiga, WHO MALI <a href="mailto:maigaf@ml.afro.who.int">maigaf@ml.afro.who.int</a> Tel: (00223) 222-37-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boubacar A. Maiga, Chef de Division Hygiene/salubrité, Ministere de la Santé/ Ala Direction Nationale de la Santé, MALI Tel: 223 676 27 16 <a href="mailto:bamaiga@dnsmali.org">bamaiga@dnsmali.org</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Philibert Ciza, Ministry of Health, Rwanda Tel: +250 08841626 <a href="mailto:cizaphilpert@yahoo.fr">cizaphilpert@yahoo.fr</a></td>
<td></td>
</tr>
<tr>
<td><strong>Pan American Region</strong></td>
<td>Diego Daza, CEPIS, Peru PAHO Solid Waste Regional Adviser, Th: 4371077 (Lima/Peru) <a href="mailto:DDAZA@CEPIS.OPS-OMS.ORG">DDAZA@CEPIS.OPS-OMS.ORG</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hector W. Padilla Sierra, Ministry of Health of Honduras Tel: 504 (221-1887/1886) (Tegucigalpa) <a href="mailto:hwpadilla@yahoo.es">hwpadilla@yahoo.es</a></td>
<td></td>
</tr>
<tr>
<td><strong>Eastern Mediterranean Region</strong></td>
<td>Raki Zghondi, CEHA, Amman, Jordan tel: 962 6 5531657 <a href="mailto:Zghondir@ceha.emro.who.int">Zghondir@ceha.emro.who.int</a></td>
<td></td>
</tr>
<tr>
<td><strong>European Region</strong></td>
<td>Eric Laurent, CDS/VPI, WHO Regional Office for Europe, Scherfigsvej, 8 - DK-2100 Copenhagen – Denmark <a href="mailto:ERL@euro.who.int">ERL@euro.who.int</a> +45 39171244</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gulmira Djumalieva, Kyrgyz National Center of Infection Control, prospect Mira 67/18 post box 541 Bishkek,Kyrgyzstan <a href="mailto:gdju@yandex.ru">gdju@yandex.ru</a> Fax: 312996 660762 (720044</td>
<td></td>
</tr>
<tr>
<td><strong>South East Asia Region</strong></td>
<td>Mahesh Nakarmi, Director, Health Care Waste Management Program, Health Care Foundation Nepal, G.P.O. Box 10861, Bhairav Bhawan 204, Banasthali, Balaju Ringroad, Kathmandu 16, Nepal, Tel: +977 1 4363452; 4360876; 4360889; Cell: +977 98510 25549; Fax:+977 1 433453; e-mail: <a href="mailto:mahesh.nakarmi@gmail.com">mahesh.nakarmi@gmail.com</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Andrew Trevett, WHO Bangladesh, G.P.O. Box 250, Dhaka 1000, Bangladesh Tel: 880-2-9343372 <a href="mailto:trevetta@SEARO.who.int">trevetta@SEARO.who.int</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A.K.M. Saiedur Rahman, Hospital &amp; Clinic Section, Directorate General of Health Services, Molakhali,Dhaka, Bangladesh, <a href="mailto:saidur62002@yahoo.com">saidur62002@yahoo.com</a> Tel: 880-2-8829493</td>
<td></td>
</tr>
<tr>
<td><strong>Western Pacific Region</strong></td>
<td>Terrence Thompson, Regional Adviser in Environmental Health, World Health Organization, Western Pacific Regional Office, P.O. Box 2932, Manila 1000, Philippines Tel: +632-528-9890 (Fax: +632-521-1036)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shinee Enkhtsetseg, Water, Sanitation and Hygiene Programme Officer, WHO Mongolia - <a href="mailto:ehhktsetseg@mog.wpro.who.int">ehhktsetseg@mog.wpro.who.int</a> Tel: +976-11-320-183 Fax: +976-11-324683</td>
<td></td>
</tr>
</tbody>
</table>
Leonard Olivera, Chief Health Inspector, Ministry of Health, P.O. Box 349, Honiara, Solomon Islands Tel: 677 21805 oliveraleonard@yahoo.com.au

### Donors, International Organizations, and NGOs:

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arnold Fang</td>
<td>Global Alliance for Vaccines and Immunization (GAVI)</td>
<td>Tel. + 41 22 909 65 14 e-mail : <a href="mailto:afang@gavialliance.org">afang@gavialliance.org</a></td>
</tr>
<tr>
<td>Ashok Agarwal</td>
<td>Indira Gandhi National Open University (IGNOU) School of Health Sciences, Raman Block, Maidan Garhi, New Delhi-110068 <a href="mailto:akagarwal@ignou.ac.in">akagarwal@ignou.ac.in</a> office + 911 29533078</td>
<td></td>
</tr>
<tr>
<td>Bill Townend</td>
<td>International Solid Waste Association (ISWA)</td>
<td><a href="mailto:w.townend@ntlworld.com">w.townend@ntlworld.com</a> +44118 978 7079</td>
</tr>
<tr>
<td>Carib Nelson</td>
<td>Program for Appropriate Technology in Health (PATH)</td>
<td><a href="mailto:cnelson@path.org">cnelson@path.org</a> tel: 1-206-285-3500</td>
</tr>
<tr>
<td>Cesta Hrdinka</td>
<td>Health Care Without Harm Europe (HCWH)</td>
<td>+420 222 515 494, CESTMIR. <a href="mailto:HRDINKA@HCWH.ORG">HRDINKA@HCWH.ORG</a></td>
</tr>
<tr>
<td>Christie Keith</td>
<td>Health Care Without Harm International (HCWH)</td>
<td>+1 510 883 9490 ext 104</td>
</tr>
<tr>
<td>Desiree Narvaez</td>
<td>United Nations Environment Programme (UNEP Chemicals)</td>
<td>Tel. +41 (22) 9178865 e.mail <a href="mailto:DNarvaez@chemicals.unep.ch">DNarvaez@chemicals.unep.ch</a></td>
</tr>
<tr>
<td>Ed Kristiunas</td>
<td>WNWN International, P.O. Box 1164, Burlington, Connecticut USA 06013</td>
<td>P-1-860-615-1217 M 1-860-839-3993 F 18606751311 <a href="mailto:eKrisiunas@aol.com">eKrisiunas@aol.com</a></td>
</tr>
<tr>
<td>Franck Bouvet</td>
<td>WES Emergency Officer, Regional Office for West &amp; Central Africa, UNICEF, PO Box 29720, Dakar, Senegal, Tel 221 863 58 66 Fax 221 820 89 64 <a href="mailto:fbouvet@unicef.org">fbouvet@unicef.org</a></td>
<td></td>
</tr>
<tr>
<td>Jack Weinberg</td>
<td>Global Environment Facility project (GEF /UNDP), 408 S. Deorborn Suite 1500, Chicago, IL USA 60605</td>
<td><a href="mailto:JackWein@uic.edu">JackWein@uic.edu</a> 1-312-566-9314</td>
</tr>
<tr>
<td>Jan Gerd Kühling</td>
<td>ETLog Health EnviroTech Logistics GmbH, Linienstrasse 72, 10119 Berlin, Germany - <a href="http://www.etlog-health.de">www.etlog-health.de</a></td>
<td>Tel: +49-30-443187-30; Fax + 49-30-443187-49 email: <a href="mailto:kuchling@etlog-health.de">kuchling@etlog-health.de</a></td>
</tr>
<tr>
<td>Jeffrey McFarland</td>
<td>United Nations Children Funds (UNICEF HQ), 3 UN Plaza NYC, New York, USA 10017 tel: +1 212 326 7345 e.mail <a href="mailto:jmcfarland@unicef.org">jmcfarland@unicef.org</a></td>
<td></td>
</tr>
<tr>
<td>Jorge Emmanuel</td>
<td>Global Environment Facility project (GEF /UNDP), 2550 Appian Way, Suite 202, Pinole, CA 94564 USA</td>
<td><a href="mailto:jemmanuel@mindspring.com">jemmanuel@mindspring.com</a> 1-510-758-2525</td>
</tr>
<tr>
<td>Leo Leest</td>
<td>ZAVIB CV <a href="http://www.zavin.nl">www.zavin.nl</a> <a href="mailto:1.leest@chello.nl">1.leest@chello.nl</a> / <a href="mailto:info@zavin.nl">info@zavin.nl</a></td>
<td></td>
</tr>
<tr>
<td>Marcia Rock</td>
<td>John Snow Inc (JSI) / Making Medical Injections Safer (MMIS) <a href="mailto:mrock@jsi.com">mrock@jsi.com</a> 1616 North East Myer Drive, Arlington, VA 22209 703-528-744 202-270-5684</td>
<td></td>
</tr>
<tr>
<td>Melissa Wright</td>
<td>Global Environment Facility project (GEF /UNDP)</td>
<td>1-510-435-4131</td>
</tr>
<tr>
<td>Michel Zaffran</td>
<td>Global Alliance for Vaccines and Immunization (GAVI)</td>
<td>Tel: +41 22 909 6510 e.mail <a href="mailto:nzaffran@gavialliance.org">nzaffran@gavialliance.org</a></td>
</tr>
<tr>
<td>Mito Alfieri</td>
<td>Gates Foundation</td>
<td></td>
</tr>
<tr>
<td>Nelson Sagobal</td>
<td>Secretariat of the Basel Convention (UNEP / SBC), Senior Programme Officer, Secretariat of the Basel Convention, International Environment House 1 - 12 chemin des Anémones, CH-1219 Châtelaine, Geneva, Switzerland Tel: +41 22 917 8212 Fax: +41 22 797 3454 email: <a href="mailto:Nelson_Sagobal@unep.ch">Nelson_Sagobal@unep.ch</a> <a href="http://www.basel.int">www.basel.int</a></td>
<td></td>
</tr>
<tr>
<td>Paul Williams</td>
<td>ISWA Waste Manager-Heart of England NUS Foundation Trust, 8 Bonneville Close, Millisons Wood, Coventry CV5 9GM, UK <a href="mailto:Paul@williams168.fsnet.co.uk">Paul@williams168.fsnet.co.uk</a></td>
<td></td>
</tr>
<tr>
<td>Philip Rushbrook</td>
<td>10 Great George Street, London SW1P 3AE, UK</td>
<td><a href="mailto:philiprushbrook@tiscali.co.uk">philiprushbrook@tiscali.co.uk</a> Tel: +44 771 200 1668</td>
</tr>
<tr>
<td>Ravi Agrawal</td>
<td>Toxics Links H-2 Jangpura EXT, New Delhi 110014, India</td>
<td><a href="mailto:Ravi1@vsn.com">Ravi1@vsn.com</a> + 91 112 432 1747 (F) <a href="mailto:ravigl@vsnl.com">ravigl@vsnl.com</a></td>
</tr>
<tr>
<td>Name</td>
<td>Organization</td>
<td>Address/Contact Information</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Raymond Schelker</td>
<td>Schelker environmental consulting, Austrasse 9c, P.O. Box 234, CH-4153 Reinach BL1, Switzerland</td>
<td>Tel: +41 (0) 61 713 1888 Fax: +41 (0) 61 713 1889 <a href="mailto:r.schelker@bluewin.ch">r.schelker@bluewin.ch</a></td>
</tr>
<tr>
<td>Robert Ferris</td>
<td>United States Agency for International Development (USAID), 1300 Pennsylvania Ave NW, 5 10-11 RRB, Washington D.C. 20523</td>
<td><a href="mailto:r.ferris@usaid.gov">r.ferris@usaid.gov</a> (202) 712 1783</td>
</tr>
<tr>
<td>Ruma Tavorath</td>
<td>World Bank South Asia, 70 Lodi Estate, New Delhi 110003</td>
<td>Tel: 91 11 41479139; Fax: 91 11 41479393 <a href="mailto:r.tavorath@worldbank.org">r.tavorath@worldbank.org</a></td>
</tr>
<tr>
<td>Ruth Stringer</td>
<td>Health Care Without Harm International (HCWH), 49 Oxford Road, St James, Exeter, EX4 6QX, UK</td>
<td>+44 787 4274 fax: +44 1392 670809 - <a href="mailto:r.stringer@hcwh.org">r.stringer@hcwh.org</a> skype.ruthcwh</td>
</tr>
<tr>
<td>Selenic Dejana</td>
<td>Center for Diseases Control (CDC), 16200 Clifton Road MS E04, Atlanta, GA 30333 USA <a href="mailto:D.selenic@cdc.gov">D.selenic@cdc.gov</a> (404) 639 8012</td>
<td></td>
</tr>
<tr>
<td>Ute Pieper</td>
<td>EnviroTech &amp; Logistics (ETLog Health), Linenstrop 72, 10119 Berlin, Germany</td>
<td>Tel: 0049-30-44318742 <a href="mailto:pieper@etlog-health.de">pieper@etlog-health.de</a></td>
</tr>
</tbody>
</table>

**WHO-HQ**

Dr Maria Neira, Director, Public Health and Environment (PHE)

Dr Jamie Bartram, Public Health and Environment (PHE)/Coordinator Assessing and Managing Environmental Risks to Health (AMR)

Yves Chartier, PHE/AMR WHO Geneva Tel: +41 22 791 1607 chartiery@who.int

Beth Woolnough, PHE/AMR

Department members - Immunization Vaccines and Biological (IVB)

Diana Chang - Immunization Vaccines and Biological (IVB) Tel. +41 22 791 4895 e.mail changblancld@who.int

Susan Wilburn - Occupational Environmental Health (PHE/OEH) Tel. +41 22 791 4780 e.mail wilburns@who.int
Day 1 - 20 June 2007

International Solid Waste Association (ISWA) / Working Group on Health Care Waste

Objectives
- To discuss health care waste activities worldwide and new developments
- To explore areas of collaboration between ISWA and key international players

Detailed agenda

08h30 to 09h00 - registration

09h00 to 10h45

1. Welcome by WHO Representative: Dr Jamie BARTRAM
2. Introduction of participants
3. Introduction of ISWA - Chair: Bill TOWNEND
4. Approval of the agenda
5. Approval of the minutes of the last meeting.
6. Matters arising from the minutes
7. Approval of the Technical Policy Document
8. Report from the Chair
9. Report from the General Secretariat
10. Country Reports (ETLog Health, NHS Foundation Trust)
11. Work and Meetings Programme

10h45 to 11h00 - break

Foreseen next steps
- Future collaboration through expertise at global and local level, research and potential funding

Objectives
- To agree on key chapters to be updated
- To agree on section leaders, authors and co-authors
- To agree on how to proceed and time frame
- To identify potential sources of funding

Detailed agenda

11h00 to 11h15 - presentation of the session and election of a Chair person for the session

11h15 to 12h00 - Presentation of the pre reviewed document and discussion about a proposed new format - Philip RUSHBROOK

12h00 to 12h30 - Links to and co-operation with WHO

12h30 to 14h00 - lunch break

14h00 to 16h00 - review of chapters and definition of sections to be updated

16h00 to 16h15 - break

16h15 to 17h30 - review of chapters and definition of sections to be updated

17h30 to 17h45 - definition of section leaders, authors and co-authors

17h45 to 18h00 - time frame and resources

Foreseen next steps
- Pre draft finalized in 4 months
- Experts meeting in 6 months
- Finalized version in 9 months
- Printed version in 12 months
Ongoing project Discussions

Objective
- To review the latest developments in health-care waste activities of various projects with a focus on countries supported by GAVI and receiving technical support from WHO
- To define potential collaborations or ways forward

Detailed agenda

08h30 to 08h45 - presentation of the day and election of a Chair person for the day

08h45 to 09h00 - introduction of new participants

09h00 to 10h00 - African Region – Ahmed NEJJAR, Adama SAWADOGO, Kepha OMBACHO and Wilfred NDEGWA, Boubacar MAIGA and Fatoumata Sokona MAIGA

10h00 to 10h15 - break

10h15 to 10h45 - Eastern Mediterranean Region - Raki ZGHONDVA

10h45 to 11h15 - European Region - Eric LAURENT, Gulmira DJUMALIEVA

11h15 to 11h45 - Pan American Region - Diego DAZA and Hector PADILLA

11h45 to 12h15 - South East Asia Region – Mahesh NAKARMI, Andrew TREVETT and AKM Saiedur Rahman

12h15 to 12h45 - Western Pacific Region - Terrence THOMPSON, Shinee ENKHTSETSEG

12h45 to 14h00 - lunch break

14h00 to 14h30 - Global Environmental Facility project (GEF) - Jack WEINBERG

14h30 to 15h00 - Program for Appropriate Technology in Health (PATH) - Carib NELSON

15h00 to 15h30 - John Snow Inc (JSI) / Making Medical Injections Safer (MMIS) - Marcia ROCK

15h30 to 15h45 - break
15h45 to 16h15 - Indira Gandhi National Open University - Ashok AGARWAL

16h15 to 16h45 - Health Care Without Harm - Ruth STRINGER, Cesta HRDINKA, Christie KEITH

16h45 to 17h15 - INDIA / Ruma TAVORATH (World Bank) and Ravi AGRARWAL (Toxics Links)

Discussion on collaboration, networking…..

**Foreseen next steps**
- Reinforced collaboration and networking
- Prevention of overlaps and improved coordination
- Similarity in project development
Day 3 - 22 June 2007

Costing of health care waste

Objectives
- To obtain global agreement on the WHO statement (overhead cost for waste in medical activities)
- To agree on ways forward for implementation
- To better understand the funding mechanisms for health care waste
- To discuss linking other environmental health issues in health care settings with health care waste

Detailed agenda

09h00 to 09h15 - presentation of the day and election of a Chair person for the day

09h15 to 09h30 - introduction of new participants

09h30 to 10h15 - presentation of the statement paper and discussion - Yves CHARTIER

10h15 to 10h30 - break

10h30 to 11h30 - presentation of the WHO costing tool and discussion - Jorge EMMANUEL

11h30 to 12h30 - discussion on way forwards for implementation

12h30 to 14h00 - lunch break

14h00 to 15h30 - discussion on way forwards for implementation

15h30 to 15h45 - break

15h45 to 16h30 - potential statement around costing and Health Care Waste Management

16h30 to 17h30 - how the HCWM dynamic can be beneficial to environmental health activities in health care settings

Foreseen next steps
- Implementation of a costing strategy for waste in health care activities
- Agreement from key players to cost HCW in health care activities
- Better knowledge of funding mechanisms for health care waste
- Pre-defined steps to link the HCWM issue with other environmental health priorities in health care settings
Note for the record and future actions from the brainstorming which took place in London on April 18th.

Participants:
Bill Townend
Philip Rushbrook
Yves Chartier

Global comments:
- The present document as it stands is OK. It is a very good document, widely used and is a reference for several countries to support the development of national plans.
- It was felt that chapter 16 (on minimum measures) which is a simplified summary of the full document should be removed and spread throughout all chapters. This in line with the document developed by WHO/CEHA: Better health care waste management, 2005 - should be used to provide each beginning of chapter with key information such as on: basic questions to answer, key points to remember, and general principles.
- The document should consider all waste produced by a health care centre or the increasing use of home care to manage medical conditions. Meaning that, e.g.: food, wastewater, lab samples should be also considered.
- All data, figures, tables, numbers throughout the document should be checked and updated. The several waste quantities tables need to be rationalised.
- Ensure that the information flows well throughout the document and move from basic to complex methods and processes.
- We should add in design of hospitals to take into account better handling of waste materials, also include the concept of designing clean and dirty routes within buildings. Designer and architect are target groups.
- Also introduce the measurement of the efficacy of waste treatment methods and reproduce or link to standards established by other organisations.

Questions to ask the group:
- To what extend we should include in the book complex approaches seen in Europe or should we keep it general and of use for all?
- Should chapter 7: segregation, storage and transport be one or 3 chapters?
- Land disposal in chapter 8 may require a stand alone chapter
- Should we keep infection control as chapter 14 or move it as an annex?
- Should we add something on auditing and performance monitoring at local and national level? This could fit under project management in chapter 5.

Chapters in detail

Chapter 1
- Should be mentioned to who this document is targeted (architect and building designer to be included)
- A WHA announcement related to HCW should be included (recall one linked with injection safety)
Third Para on sustainability to be expanded. It should consider the increase of disposable. Also add the result (potential statement) of the June meeting on the over head cost for HCWM in medical activities.

Chapter 2
- Last line of the second para starting by: This handbook is concerned almost exclusively…. Should be removed.
- The category of health-care waste in table 2.1 should be expanded
- Box 2.3 should be moved into 2.1.10 under radio active waste
- Box 2.4 should show, as example, the % these sources producing waste represents for a couple of countries. Home care should be included.
- Box 2.5 should be joined with box 2.4
- This Chapter has far too many boxes, tables…. And it create confusion in the flow of information and smooth reading of the information. This should be reduced or summarized.

Chapter 3
- Chapter 3 should be linked with numbers in Chapter 2 this to support RA and RM which help to define priorities, to mobilize resources…..
- Table 3.1 should add ‘high profile’ diseases such as H5N1, SARS, MRSA, *C. difficile*…
- The part on Cytotoxic waste should be checked by an expert
- The issue around Fetus should be covered

Chapter 4
- The role and responsibilities of the MoH and the MoE regarding HCWM should be defined under 4.2
- Complete / replace this blue book Chapter by pages 24, 25, 26 from the CEHA / WHO doc and expand
- This Chapter needs more references
- Include the introductory work led by Raki Zghondi (WHO/CEHA Amman) in a draft document on economic and planning

Chapter 5
- Explain the benefit of planning at local level. Local level should come fist into this Chapter
- Add information on project management for implementation such as steps, procedures, monitoring tools….
- In step 1 the policy commitment, resources…. Should be vested into the MoH
- Table 5.1 should be updated if there is a more recent one and one should be also produced for local action plan
- The questionnaires should be reviewed and moved as an annex
- Food and non hazardous or infections health care waste should be included in the questionnaires
- Table 5.2 is missing waste handlers

Chapter 6
- Box 6.1 should consider all waste produced in a health care setting
- Include examples in boxes 1
- Waste minimization should also refer to WHO specifications and views from manufacturers
- See specification e.g. for bags

Chapter 7
- Segregation is a key step and maybe worth a stand alone Chapter (see question above)
- Examples are necessary
- This part should be expanded
- Segregation should be linked with training
- Also be updated according to new regulations
- Cross check transport regulations with ADR (road transport regulations)
- Fig 7.5 is out of date and B is wrong
Fig 7.6 should refer to the ADR regulations and box 7.2 updated based on fig 7.6.
The ISWA international policy n°11 should be integrated in this Chapter

Chapter 8
- This Chapter should reflect the WHO policy on incineration and health care waste management
- The introduction should be reviewed to provide a general description of all technologies and introduce the above policy. It should provide information on contexts, funds, availability, related to regional contexts and could provide a checklist.
- Pyrolytic needs clarification to see if well used here and its text length shortened.
- Drum incinerators should only appear as an ultimate option for emergency contexts
- The picture in Fig 8.6 should be removed and others too
- Data should be checked in able 8.2 as well as all table and numbers
- All pictures should be reviewed and simpler similar technologies shown (fig 8.8 for a steam autoclave or the fig 8.10 for a microwave)
- In presenting the technical options, incineration should be last and performing incinerator shown.
- This Chapter should refer to the WHO healthcare waste web site
- More recent technologies such as plasma should also appear
- Steps of land disposal should be better defined. This may require a stand alone Chapter because of security issues, management, physical and chemical, treated / non treated, uncontrolled, controlled, sanitary, remote site….
- Reference should be made to the ISWA policy document

Chapter 9
- The disposal of pharmaceutical wastes should include vaccines and more or liquid and solid. To be expanded and in line with the WHO document on the management of pharmaceuticals in emergency situations
- One IAEA reference mentioned - in press! Must be finished by now.
- Table 9.1 should be in the introduction of Chapter 8
- Refer to the WHO policy on mercury, also battery, silver
- The Chapter on radioactive need a review from experts

Chapter 10
- The introduction should reflect that the duty is to understand where it goes. It requires a map of the systems, a system of sampling for monitoring….
- This needs to be expanded and include blood, vaccine, lab samples…
- Should include the use of reeds beds for treatment
- Lagooning should include retention time information as well as aeration

Chapter 11
- See new development taking place at WHO
- Include or cross link with the work done by CEHA
- Revise table 11.1
- Link this Chapter to the costing tool on the healthcare waste website

Chapter 12
- HB vaccine of staff should not only be introduced but seen as a policy
- The use of gloves, mask… should be explained why
- We have to involved the WHO Occupational staff on this Chapter
- Add a drawing on hand hygiene (patient safety poster)

Chapter 13
- Add pictorial on spillage and check actual WHO protocol

Chapter 14
- See above question to the group
Chapter 15

- Add a notion around motivation of staff. People should feel as part of the system.
- Refer to documents, training courses (IGNOU, ISWA…)

Glossary

- Cross check and expand glossary with ISWA glossary

Annexes need to be reviewed by experts to ensure that are still valid

FROM: Glenn McRae, Ph.D., CGH Environmental Strategies, Inc.
6-14-07  glenmmcrae@aol.com

Since 1999 I have observed the book in use in a number of countries, most usually at the level of government agencies, development organizations, funding institutions and NGOs. I have seldom seen it directly in use on the level of health care institutions as an operational guide. It has been quoted or extracts have been taken directly from it (with and without citation) and used in scholarly papers, guides to health care waste management, project proposals, EIA’s for health projects, institutional policies, government policies and national and local regulation. I believe it is important for WHO to produce and update such a resource regularly as other institutions now expect WHO to recommend a standard and provide guidance in these areas. I am interested in participating in updating and developing such a document and believe it falls in the scope of work that will need to be performed as part of the GEF health care waste global demonstration project as well in the coming year. I have some general as well as specific recommendations on how to proceed that are outlined below.

Scope of the Resource

In observing the actual use of the document my first recommendation is that a revised and updated version of the book be specifically oriented toward policy makers to inform policy, regulation and standards, and that it limit its scope in attempting to offer direct operational guidance. There are two reasons for this. First, a generic operations guide has limited value in the diversity of settings that health care facilities operate in around the globe. Even “best practices” past a set of goals and principles are somewhat limited in usefulness to directors and managers operating hospitals and other health facilities. Second, there has been a surge of guides and documents that have emerged from health ministries, NGOs, and hospitals themselves that are available, as well as many resources that can be adapted to best fit a national or local situation. A document that is designed and written so that essential information and principles and the “structure” of policies, plans, goals and best practice sections can be adapted and modified to be used locally will be of most value and will have the longest lifespan.

My second general recommendation is that the new volume be web based (with a print on demand format for the basic text). In 2000 and 2001 when the book was first known, it was unavailable to many countries (government, NGO and health sector). There is no need for that any longer. In addition, as new information and experience becomes available it should be added in regular updates, not every 7-8 years. WHO’s current web based information on health care waste management should somehow be integrated or connected to the new volume so that the two sources of information and guidance are in concert and not contradictory.

Organization of the resource

I would recommend reorganizing the resource in a manner that a policy maker, a high level institutional manager or a trainer might use it.

A. Introduction

B. Definition and characterization of health-care waste
C. Health and environmental risks of mismanagement or exposure to health care wastes
- This section would need to start out (and continue the discussion from the introduction and definition sections) emphasizing that most health care wastes, properly segregated, do not pose a risk to health or the environment (at least no more risk than general municipal solid waste). I use the term “risk” rather than “impact” as there is no uniform “impact.” There are levels of risk that arise from various strategies employed that have to be managed.

D. Understanding waste generation, handling, treatment and disposal
- What was missing from the original volume was the presentation of picture was waste management systems up front. I think the volume would be more user friendly and practical if it gave the reader two scenarios, one from a clinic or small hospital in a low-resource area, and the other from an urban hospital. This section is not meant to be a management model, but rather to paint a picture for the user before they delve into the more detailed sections.

1. Understanding the materials used in delivering health care. All materials/supplies end up as waste. Procurement decisions (or acceptance of donations) will determine waste generation.
2. Generating wastes – a look at different departments and activities, and the personnel who generate wastes and are responsible for disposal decisions.
3. Handling wastes – containers, collection, storage, segregation.
4. Treatment of wastes – different wastes require different treatment to ensure safe reuse, recycling or disposal, and to lower risk to workers and the general population and limit improper reuse or scavenging.
5. Final disposal – this is a critical stage often lost in the thought process and needs to be raised up front in this resource. If there is no real solid waste or hazardous waste infrastructure run at the municipal or regional level, as is often the case, then actions back down the chain (#1-4) need to be adjusted appropriately.

E. Health care waste management planning
- This section would provide an overview of the frameworks that must be in place for a good system of waste management from national guidelines and laws to individual institutional practice and policies.

1. A national framework for health care waste management
   1.1 International laws, standards, recommendations and best practices
   1.2 National plans
   1.3 Legislative regulatory and policy aspects
   1.4 A national management plan
   1.5 Policies to govern donation of equipment and supplies (e.g., pharmaceuticals) to avoid “dumping”
2. Institutional plans
   2.1 Types of health care waste generators and the need for planning
   2.2 Understanding roles and responsibilities
   2.3 Integrating institutional plans with municipal and regional authority plans
   2.4 Staff education and training
   2.5 Setting goals, identifying priorities
      2.5.1. Sharps management first and foremost
      2.5.2. Segregation to minimize volume of higher hazard wastes
      2.5.3. Protecting workers
      2.5.4. Ensuring safe communities
   2.6 Managing wastes from scattered small sources (clinics, etc.)
   2.7 Managing wastes from international projects (e.g., university research, foreign aid)

F. Worker Safety
G. Community Safety

H. Costing health care waste management

I. Health care waste management and hospital hygiene and infection control

K. Resources to develop best practices
- The remaining sections of the resource book should outline and provide guidance in areas of health care waste management but should not be presented in a manner that offers up “the best practice.” Each section should begin with a set of principles, reference to several case studies, implications for regulation and oversight by governmental agencies, and referrals to sites for the more up to date information for policy makers and practitioners.

1. Waste minimization, recycling and reuse
   1.1 Principles
   1.2 Case studies
   1.3 Implications for regulation and oversight by governmental agencies
   1.4 Resources for up to date information

2. Procurement for waste reduction and risk minimization
   2.1 Principles
   2.2 Case studies
   2.3 Implications for regulation and oversight by governmental agencies
   2.4 Resources for up to date information

3. Handling, Storage and Transportation of health care wastes
   3.1 Principles
   3.2 Case studies
   3.3 Implications for regulation and oversight by governmental agencies
   3.4 Resources for up to date information

4. Treatment of health care wastes
   4.1 Principles
   4.2 Case studies
   4.3 Implications for regulation and oversight by governmental agencies
   4.4 Resources for up to date information

5. Emergency Response
   5.1 Principles
   5.2 Case studies
   5.3 Implications for regulation and oversight by governmental agencies
   5.4 Resources for up to date information

6. Disposal of health care wastes
   6.1 Principles
   6.2 Case studies
   6.3 Implications for regulation and oversight by governmental agencies
   6.4 Resources for up to date information

7. Collection and disposal of wastewater
   7.1 Principles
   7.2 Case studies
   7.3 Implications for regulation and oversight by governmental agencies
   7.4 Resources for up to date information

* Glossary
Annex 1 – Further information on treatment technologies and the application of treatment and disposal methods to health care waste categories.
Annex 2 – Issues related to wastes from nuclear medicine and radioactive wastes
Annex 3 – Special issues with cytotoxic drugs
Such a reorganization of the guide would put the emphasis on planning and building an infrastructure for good systems of health care waste management that must be developed and implemented against the background of a wide variety of local resources and circumstances.

**Specific notes on the content of the current resource book**

**2. Definition and characterization of health-care waste**

Section 2.1.1 offers a good basic definition. The waste categorizations that follow have been adopted, in many cases uncritically, by regulatory regimes in a number of countries. As organized however they do not necessarily provide the best structure for promulgating appropriate regulations or standardizing good practices. An alternative categorization by the nature of the risk that each type of waste poses will provide a logical link to the both the type of management strategy needed and the appropriate regulatory authority to oversee it.

Table 2.1 is entitled “Categories of health-care waste” but then only focuses on the small percentage of what the introduction labeled hazardous health care waste or health care risk waste). Such a table should be re-labeled if it does not include the category of non-hazardous (or general, or municipal solid waste). The hazardous health care waste could be best grouped into four categories rather than the nine in the table:

1. Sharps
2. Infectious waste
   - Includes Pathological waste, cultures and stocks of infection agents, waste from patients in isolation with a known infectious disease, and then a careful definition of other wastes that may be contaminated with infectious agents, usually blood and body fluids.
3. Chemical waste
   - Waste containing heavy metals (mercury, lead, cadmium, etc.)
   - Chemicals from labs, including solvents, alcohol, formalin
   - Other chemicals, e.g., disinfectants, oils,
   - Pharmaceuticals – expired, partially used
   - Cytotoxic agents (chemotherapy wastes, genotoxic or antineoplastic wastes)
4. Radioactive waste

Each of these broad categories represents an independent regulatory, management, treatment and disposal track. Sharps are differentiated because of the special recognized risk that they pose.

**Section 2.3 – Health Care waste generation**

My experience in observing generation rates in a number of countries is that there are few “comparables” that make sense in setting standards. Generation rates are totally dependent on resource availability (varies with a number of factors from availability of supplies, to reuse rates, to foreign aid and donations) that varies between and within countries making for little predictability in quantifying it in any meaningful way. It also depends on definitional issues (e.g., what is considered infectious wastes), localized concerns (e.g., high rates of HIV), and local practices in health care institutions (e.g., family care of patients in hospital, scavenging rates). Generation rates will also rise as low resourced institutions and countries get access to more reliable and safe supplies of medical equipment and materials, most of which are now manufactured to be disposable. This increase in resources that may result in better outcomes for patients may inversely have a negative impact on generation rates that were low because there were no materials to be disposed of.

Rather than focusing on elusive numbers that might set standards for good or bad generation rates, giving countries and individual institutions the tools to conduct baseline surveys and then monitor changes in practice and generation rates as new practices are put in place will be more valuable. What are needed are principles of good management not artificial benchmarks with confusing distinctions such as kg/bed or kg/patient. In some countries the number of beds is declining as more outpatient treatment is being introduced. In other countries with an aging demographic more beds are being added and patients are being treated for more chronic conditions. All of this makes some global measure of generation rates irrelevant.
3. Health impacts of health-care waste
A great deal of new information is available and research has been done in this area warranting a full update. Specific sections should be added about the health impacts of mercury exposure and the hazards associated with incineration of health care (or other) wastes.

4. Legislative, regulatory, and policy aspects
A number of new guidelines and international policy documents have been released since 1999. The new guidelines under the Stockholm Convention on medical waste management should be added. The initiatives by UNEP and WHO on mercury should be added. There are good documents outlining generic national policies and regulations on health care waste management.

5. Health-care waste management planning
As previously noted this section should be policy oriented presenting frameworks, not set up as a management guide. The same is true for sections 6 – 10 that follow.

6. Waste minimization, recycling, and reuse
This is a key section. Reference to it should be up front in the volume. With proper segregation and minimization, the actual hazardous health care waste can be reduced to far less than 10% in most health care settings. Procurement strategies to reduce waste should also be more emphasized in this section.

7. Handling, storage, and transportation of health-care waste
Keep to principles, not specific management techniques.

8. Treatment and disposal technologies for health-care waste
Provide an outline of issues but move the specific information on actual technologies to an Annex. Separate the discussion of treatment and disposal. Too often I have interviewed operators of various treatment technologies, especially incinerators, who believe that treatment = disposal. This section will best serve the reader to understand
A. The need for treatment
   - Making the waste non-hazardous
B. The treatment is specific to the characteristic of the waste. A treatment that renders a biological risk waste non-hazardous may have no impact on a chemical or radioactive waste, and in fact may increase the risk by concentrating or disbursing it.
C. Combining all treatment technologies under one header gives the reader the erroneous idea that all health care wastes can be treated with each of these, which unfortunately reinforces a common belief held in many areas that has resulted in increased pollution and risk.

9. Application of treatment and disposal methods to health-care waste categories
-A great deal of new information and research is available on this.
-A specific section on mercury should be developed (managing existing technology safely, transitioning to non-mercury technology, managing broken or unusable equipment, mercury spills and clean-up, storage and disposal options for waste)
-Review emerging treatment technologies
-Provide guidance in evaluating alternatives and reference further information in the annex and in external sources

12. Health and safety practices for health-care personnel and waste workers
Put an emphasis on chemical safety for workers. While there is a high level of concern and awareness of the risk from biological agents, many workers from physicians to waste handlers are quite ignorant of the very direct risks associated with handling and disposing of many chemical agents used in health care.
14. Hospital hygiene and infection control
There is an opportunity here to link training, education and advancing good practices parallel to new approaches in waste management. I have observed several models for combining these efforts.

15. Training
Principles not specifics.
Differentiate groups for training by the management regime that they are likely to be responsible to:

- Health care institutions (government and private)
- Municipalities
- Private haulers and waste treatment and disposal facility operators
- Scavengers

Training needs and opportunities will be determined differently in each group.
This section would benefit from case studies and examples as opposed to specific instructions.

16. Minimal programmes for health-care waste management
I am not sure that this section lives up to its name as a “minimal” programme, as I have observed many much more minimal efforts that are good, given the resources at hand. This section might best be replaced by a set of representative case studies at both the national and institutional level to illustrate principles and the application of the guidelines illustrated elsewhere in the guide.

From: Jorge Emmanuell
June 6, 2007

Chapter 2. Definition and characterization of health-care waste
Many regulations in developing countries have simply copied Table 2.1, but it does not provide as useful a guidance to policy-makers and health workers. I think it would be more helpful to align the classifications with the nature of the risks (biological, chemical, radioactive, etc.) and the required segregation system. Doing so provides a more logical system of classification and sub-classification while helping the reader think through the types of risk and the different systems of management that each waste component requires. Also, providing details of what comprises infectious waste from an infection control perspective would offer more guidance to policy-makers and health professionals. Therefore, I would reorganize the list as follows, and begin each listing with the category with the highest risk:

Categories of health-care waste:
1. Sharps
2. Infectious waste
   a. Waste contaminated with blood or other body fluids*
   b. Cultures and stocks of infectious agents
   c. Pathological waste including tissues, organs, body parts, and contaminated animal carcasses
   d. Waste from infected patients in isolation wards**
3. Cytotoxic waste***(genotoxic or antineoplastic waste, chemotherapy waste)
4. Pharmaceutical waste
5. Chemical waste
   a. Waste containing heavy metals (mercury, cadmium, lead, etc.)
   b. Other chemical waste (spent solvents, waste disinfectants, lab chemical waste, etc.)
6. Radioactive waste
7. Non-hazardous (general or “domestic”) waste, including recyclable or compostable waste

#1 poses both a biological and physical hazard and is responsible for the most cases of disease transmission; #2 poses a biological hazard; #3, 4, and 5 pose chemical toxic hazards; and #6 pose a radioactive hazard. A small health facility would typically have a three-bin system to segregate #1, 2 and 7. Large complex health facilities would have multi-bins to segregate each of the above components and some
sub-components depending on the management system. The listing as shown above is also helpful from a regulatory perspective in that #1 to 4 are generally under the authority of health ministries, #5 is under environmental ministries, and #6 is under nuclear regulatory or environment agencies.

Notes:
* Some regulations specify only materials with liquid blood or soaking in liquid blood should be considered infectious since the risk of disease transmission from dried blood is significantly reduced. However, in light of poor handling practices, lack of PPE, and open access to dumpsites in many developing countries, “contaminated with blood” would be appropriate.
** Some would argue that only the waste from patients with diseases that are transmitted by contact (that is, isolation rooms that require Contact Precautions) need be considered infectious. However, since some developing countries do not have well-developed infection control procedures, it would be appropriate to include a general “isolation ward waste” category.
*** I think cytotoxic is a more general term (toxic to cells) as opposed to genotoxic (damages DNA) or antineoplastic (inhibiting tumor growth), although many regulations use these terms interchangeably. Chemotherapeutic is also used but it may be too confusing since it also has a non-oncology meaning (e.g., antibiotic therapy).

In my experience, pressurized cylinders are generally refilled and are not considered waste. Because of the Montreal Protocol, I rarely see any aerosol cans nowadays in many health facilities. If this category is added, I think it should be a footnote and not on the same level as sharps and infectious waste.

Section 2.3:
- Update the health-care waste generation section (see, for example, my tabulated survey of global waste generation rates)
- Include more “infectious waste” generation rates so facilities can compare the effectiveness of their segregation practices
- Explain distinctions between kg/bed, kg/occupied bed, kg/patient, etc. which has been a source of confusion in the literature.

Chapter 3. Health impacts
- Update the section with more recent data from Salkin, Gisselquist, etc.
- Add information on survival of pathogens in the environment
- Add information on the hazards of mercury (e.g., UNEP information)
- Add information on the health impacts of incineration.

Chapter 4. Legislative, regulatory, and policy aspects
- Under the basic principles, add the principles of “informed consent” or “right to know” and “public participation”
- Add the Stockholm Convention and mention the new guidelines on medical waste under the Stockholm Convention
- Add the initiatives by UNEP and WHO policy on mercury

Chapter 5. Health-care waste management planning
- Section 5.2: Include Basel and Stockholm recommendations for waste management; provide weblinks
- Section 5.3.2: Include stakeholder participation in development of policies and plans
- Section 5.3.2, perhaps as a separate step: Include “Ensure sufficient allocation of funds in national and local government budgets for health-care waste management” and describe working with legislatures to ensure budget line items for HCWM
- Section 5.5: Include prison clinics and funeral parlours/mortuaries as other possible sources of infectious waste.

Chapter 6. Waste minimization, recycling, reuse
I recommend that this section be expanded more fully, with contributions from Dr. Glenn McRae and others. The statement in section 6.2 (“Recycling is usually not practised by health-care facilities, apart, perhaps from the recovery of silver …”) is incorrect and should be deleted. Also, distinction should be
made between recycling and reuse of non-hazardous health-care waste, and the problems of reuse and recycling of syringes and other medical devices.

Some of the topics to be added or enhanced are:
- The important benefits of waste minimization
- Basic principles of waste minimization, the waste minimization hierarchy, and approaches
- Examples of recyclable non-hazardous health-care waste
- Composting of hospital kitchen waste
- Principles of environmentally preferable purchasing (EPP)
- Inventory control
- Waste minimization options for hazardous chemical health-care waste.

Chapter 7. Handling, storage, and transportation of health-care waste
- Begin the chapter with a discussion of the minimum three-bin system, and expand to multiple bins for more complex facilities
- Add the importance of responsibilities, monitoring, training, and corrective action with regards to segregation
- Include a discussion on placement of bins and determining the number of bins
- Add more information on minimum standards for plastic bags
- Include information on standards for safety boxes
- Add reusable (e.g., autoclavable) sharps containers, and autoclavable infectious waste containers
- Link container selection to the system of collection, treatment, and disposal
- Add different storage time limits for sharps waste (unlike other infectious waste, sharps boxes or sharps containers especially in small health-care facilities may take days or weeks to fill up; unlike the case of putrescible infectious waste, a longer time limit for sharps waste is appropriate)

There may be recent updates on international packaging and transport requirements.

Chapter 8. Treatment and disposal technologies for health-care waste
- Make the hierarchy of choices more consistent with WHO policy (incineration as an interim option) and the Stockholm Convention (priority consideration should be given to alternative technologies that do not generate persistent organic pollutants)
- Align the incineration section with the Stockholm Convention guidelines on medical waste incineration, especially regarding environmental control and emission standards, and special considerations related to ash and ash disposal
- There are typos or errors in Table 8.2: the emission limits for dioxins/furans, HCl, and cadmium are wrong for medium and large incinerators
- There is an error in Table 8.3: the emission standard for dioxins and furans should be in nanograms per cubic meter (not milligrams per cubic meter)
- Section 8.2: Consider deleting sections on formaldehyde, ethylene oxide and glutaraldehyde treatment as treatment options in view of the significant health risks associated with these chemicals and the fact that they are not widely used for this purpose; for chemical treatment, focus instead on commercially available alkali, lime, peracetic acid, and other safer options.
- Add alkaline hydrolysis and promesion as alternative technologies for tissue, anatomical waste, and human remains.
- Section 8.3: Expand the section on autoclaves (description, types of autoclaves, pros and cons of different types of autoclaves, maintenance requirements, costs, etc.)
- Section 8.3: Add a sub-section on advanced steam treatment systems (hydroclaves, rotoclaves, etc.)
- Update the section on microbial inactivation tests including the new scientific names for the bacillus spores
- Add sharps pits as a special case, include sample design and construction
- Add discussion of the pros and cons of the different treatment approaches (on-site treatment, centralized treatment, treatment within a cluster, mobile treatment) including infrastructure requirements.
Chapter 9. Application of treatment and disposal methods to health-care waste categories
- Modify some of the recommended applications, e.g., autoclaving and shredding, or microwaving and shredding, for sharps
- Add a new topic on the management of suction canisters, i.e., fluid management systems
- Add a special section on mercury (mercury management, storage, disposal options, non-mercury alternatives)
- Add a special section on prion waste including management and treatment options
- Add a special section on highly infectious waste (i.e., waste from BSL-3 and BSL-4 agents, such as Ebola, Lassa, viral hemorrhagic fever, etc., NOT highly infectious waste as defined in Chapter 16, section 16.2). I recommend that the term “highly infectious” be reserved for BSL-3 and BSL-4 agents.
- Mention emerging technologies being developed (e.g., UNIDO Project) – eg. wet oxidation, gas phase hydrogenation, superheated steam, etc. for chemical waste; ozonation for infectious waste.
- Add factors to consider in selecting treatment technologies
- Add factors to consider in evaluating new or emerging treatment technologies.

Chapter 10. Collection and disposal of wastewater
- Expand on the hazards of pathogens, including data on survivability in wastewater, fate and transport of chemicals, and problems of pharmaceuticals (e.g. antibiotics, cytotoxics, etc.) in wastewater
- Add a description of a primary treatment system
- Add a basic septic system as an option.

Chapter 11. Costs related to health-care waste management
- Add a box on the costs of a central autoclave treatment plant
- Update data on costs including sharps treatment costs
- Mention the new WHO costing tools
- Mention the WHO policy paper on sustaining HCWM systems.

Chapter 12. Health and safety practices for health-care personnel and waste workers
- Introduce the concept of the hierarchy of occupational safety & health measures as a framework
- Section 12.2.6: Add information on post-exposure prophylaxis or include in Chapter 13
- Add a section on Chemical Safety
- Add a section on health and safety in relation to treatment technologies
- Add a section on developing health & safety plans for health-care facilities.

Chapter 13. Emergency response
- Section 13.2: Add a box listing the contents of a spill kit for infectious waste, and a spill kit for mercury spills
- Add post-exposure prophylaxis procedures/plans here or in Chapter 12
- Mention the importance of training and immunization, and refer to those respective sections.

Chapter 14. Hospital hygiene and infection control
- Section 14.2: Use the concept of the chain of infection as a framework
- Introduce transmission-based precautions as an approach to standard precautions
- Section 14.3.6: Add alcohol/glycerine-based hand sanitizers as an option and mention the new WHO guidelines on hand hygiene

Chapter 15. Training
- Add the caveat that training alone does not necessarily result in behavior change. Training must be linked to provision of supplies and resources, monitoring and evaluation, use of incentives, corrective action, periodic training, etc.
- Mention different training techniques (interactive methods, role playing, games, testing, practicum, etc.)
Chapter 16. Minimal programmes for health-care waste management

Much of section seems a repetition of previous sections. Instead I would suggest that this chapter describe a phased approach to assist health-care facilities that have no HCWM system. The chapter could explain priorities (e.g., sharps waste management), minimum programs (e.g., a minimum 3-bin system to segregate non-hazardous, infectious, and sharps waste); and expanding towards a desired system. The examples of treatment and disposal should also reflect the priorities given to cleaner alternative technologies.

Annex 2: Chemical destruction methods for cytostatic drugs

I do not know if there are updates from IARC but there may be other new cytostatic agents not listed which could be included under one or more of the destruction methods.

From: Lalji K Verma
March 3, 2007

1. Contents - Should include
   i) Waste Water Treatment, in chapter Definition and Characterization of healthcare waste
   ii) Risk Management, in the chapter Health impacts of healthcare waste
   iii) Impact of infected water, in the chapter Public health impact of healthcare waste,
   iv) Historical development and conflict in the legislative framework of the developing countries, in the chapter Legislative, regulatory, and policy aspects
   v) Stepwise development of healthcare waste management plan, in the chapter Healthcare waste management planning,
   vi) Beauty parlors, acupuncture centers, diagnostic centers, blood banks, and waste arising from domiciliary treatment needs to be added to the chapter - Healthcare waste management planning,
   vii) Accident reporting should be added to the chapter - Handling storage and transportation of waste. It should also contain aspect of damage control,
   viii) SARS and Avian flu should be added to the chapter - Hospital hygiene and infection control,
   ix) Training to politicians, fund providers, and policy makers should be deliberated at the chapter - Training,
   x) Microwave and Plasma torch technology should be described at the chapter - Treatment and disposal of hazardous healthcare waste,
   xi) Mutagenesis in healthcare waste - a possibility.

Some specific points:

1. At Ch 2, Para 2.1.1 - It is stated that general waste should be dealt with by municipal waste disposal mechanism. This would be possible only when segregation is practiced as it should be in a healthcare facility. If not treating supposedly non-infected waste (which in actual sense may be infected) as municipal solid waste may be dangerous.

2. At Para 2.3 - Why healthcare waste generation in the middle or low income group of countries is low should be explained. Mainly it is due to less use of disposables in these low income group countries.

3. Table 2.3 - Annual?

4. Box 2.11 - Food waste should be considered infected if it has come in contact with patients.

5. Para 3.1.3 - Differentiate between hollow and suture needle as far potential to infect is concerned.

6. Table 3.1 - Add SIRS and Avian flu. Add 'Body fluids' at AIDS column.

7. Para 3.1.4 - Leaching of chemicals is an important factor of pollution, and should be described.

8. Para 3.2.1 - Health impact of particulate emission from incinerators should be described in detail.
9. Table 3.3 - Viral hepatitis, Is it 3-5 % or 30 %? please check.

10. Para 3.4 - Research is also required in the areas of mutagenesis in the hospital waste, and in system application.

11. Para 4.2 - Conflict between Min of Environment and Ministry of Health in most of the developing countries needs to be covered in this Para. Add waste audit to be included in the law. Add water quality (Act) in the relevant national legislation,

12. Para 5.3.2 - Policy commitment and responsibility should be vested with health ministry,

13. Add 'food waste' in the survey questionnaire at page 38 & 39,

14. Para 5.3.2 - Step 4 requires to rewritten to include concept of 'multi-option' in a healthcare facility,

15. Para 5.3.2 - Step 4 - Concept of nodal hospitals for healthcare waste treatment and disposal of waste from smaller healthcare facilities may be considered,

16. Para 5.3.2 - Step 4 - 'Regional and Cooperative treatment facilities' may also include some research in the USA which supports the view that 'on site' treatment of healthcare waste at large facility is cheaper,

17. Concept of nodal hospitals should be included at 'step 6',

18. Para 5.4 - i) Most importantly, waste management plan should include steps required to develop the waste management plan, ii) Rep waste handler group should be included in the waste management team. In fact Chief pharmacist and Radiation Officer may be excluded from the list since they will already be included in the list as heads of departments,

19. Para 5.4.2 - Development of hospital/ department specific waste management plan should also be in the list of responsibility of head of Hospital,

20. Fig 5.2 - Waste handlers should be in the loop.
Annex 4
Roundtable Discussion on the WHO Reference Document

Participants’ comments on major weaknesses of the WHO reference document

Raki Zgondi
- Document should focus on cleaner technologies, even for those in remote rural areas
- Minimum requirements should follow CEHA document

Ute Piepper
- Retain the fundamentals and refer to different technical guidelines

Ruma Tavorath
- Maintain a two-pronged approach of targeting both policy-makers (e.g., legal framework) and operations personnel (implementation)
- Add information on what to do with obsolete pesticides
- Mention the special waste problem created by AD syringes

Ruth Stringer
- Include new and emerging technologies (e.g., supercritical water oxidation for pharmaceutical waste, alkaline hydrolysis for anatomical waste)
- Add guidance for architects and hospital designers
- Add more detail on the wastewater section
- Enhance the section on waste minimization (especially the minimization of non-risk waste)
- Requires a holistic framework

Eric Laurent
- Redefine objectives and target population
- Revise format
- Refer to other existing WHO guides
- Have section for decision-makers and sections for operators
- Reorganize the structure as follows: Proposal for HCWM “Blue Book” - revision

I. Organizational aspect of the HCW
   a. Legislative, regulatory, and policy aspects
   b. Health-care waste management planning
   c. Costs related to health-care waste management

II. Technical references for HCW
   a. Definition and characterization of health-care waste
   b. Health impacts of health-care waste
   c. Waste minimization, recycling, and reuse
   d. Handling, storage, and transportation of health-care waste
   e. Treatment and disposal technologies for health-care waste
   f. Collection and disposal of wastewater

III. Operational aspect of HCW
   a. Standard operating procedure for HCW staff
   b. Health and safety practices for health-care personnel and waste workers
   c. Emergency response
   d. Hospital hygiene and infection control
   e. Training
Cesta Hrdinka
- Waste minimization is key: expand the waste minimization section
- Expand the section on non-incineration technologies
- Results of the Stockholm Convention guidelines should be reflected in the document (e.g., no drum or brick incinerators)

Kepha Ombacho
- Need a popular version of the document
- Policy and legislation should be the entry point, followed by training and technologies

Ravi Agarwal
- A lot of experience has been gained especially in developing countries in the last decade; different challenges and solutions should be reflected as signposts
- Promote innovation and experimentation to deal with challenges in specific settings; the document should not be presented as the last word

Ed Krisiunas
- Need to reach out to both policymakers and frontline workers
- Pharmaceutical waste is a key waste stream
- Add new treatment technologies

Mahesh Nakarmi
- Focus on developing country needs; e.g., it is not possible to buy yellow sharps containers
- Add a section on how to audit hospitals

Paul Williams
- Add more pictures in the chapters as a practical day-to-day guide
- Update the teacher’s guide

Saiedur Rahman
- Include information on hospital design
- Add more information on liquid waste management

Wilfred Ndegwa
- Avoid generalities
- Focus on gaps in HCWM
- Who is the professional that should be trained?

Jack Weinberg
- Add more on management of existing mercury waste and on non-mercury alternatives
- The challenges posed by different circumstances should be acknowledged; in some cases, new systems are being applied for the first time
- For those developing a HCWM system for the first time, a hierarchy of objectives or decision-tree should be added

Jan Kühlning
- The reference document should be harmonized with the Basel Convention guidelines
- The role of HCWM in a hospital should be clarified: part of infection control, housekeeping, etc.?
Carib Nelson
- The document should be a national planning guide not a guide for health-care facilities

Diego Daza
- Include a cost-benefit analysis process
- Include a process to analyze the adequacy of technologies

Susan Wilburn
- Include the hierarchy and decision-making analysis of occupational safety and health from a public health approach of emphasizing prevention rather than control
- Harmonize the section on hand hygiene with existing WHO guidances
- Include the epidemiology of risk of transmission and the global burden of disease from waste

Desiree Narvaez
- Use the term “guidance” in the title to reflect the purpose
- Include alternatives to mercury in the waste minimization section

Ashok Agarwal
- Focus on the essential (minimum requirements) then supplement with more sophisticated approaches
- HCWM committees should be integrated with hospital hygiene/nosocomial infection committees

Bill Townend
- The document should cover all health-care waste
- Emphasize recycling of non-risk waste which is the bulk of health-care waste

Trevor Olivera
- The role of doctors and nurses in HCWM should not be confused
- Training in HCWM should be incorporated in colleges and universities
- Add certification
- Concern with the size of the document

Dejana Selenic
- Include concerns of small health posts or health centers

Other general comments
- Add more boxes for examples
- Add photos or pictures
Annex 5
Synthesis of Chapter Comments

[This synthesis includes the general comments on day 1 of the June 20-22, 2007 meeting in Geneva where applicable, the chapter by chapter discussion on day 1, the summary of the April 18 meeting, handwritten comments submitted during the meeting, and the detailed comments submitted prior to the Geneva meeting.]

Chapter 1

- Reinforce the fact that this is a guidance document.
- Explain who the audience is and include architects and hospital designers.
- Link HCWM to nosocomial infection and infection control.
- Involve the health-care facility manager.
- Elaborate on sustainability and affordability.
- Emphasize that HCWM is part of a health system and requires human resources.
- Mention that lack of funding is a problem; a budget line item for HCWM is necessary (it could be seen as an overhead cost for all health service delivery).
- Mention the WHO core principles from the Geneva meeting.
- Mention World Health Assembly announcement related to HCW (the one linked to injection safety).
- Under duty of care, add social responsibility.
- Introduce a risk-based approach or risk-based decision-making.
- Also introduce evidence-based practices.

Chapter 2

- The title should reflect all health-care waste including general waste (i.e., domestic or municipal solid waste).
- The relative amounts of the different waste streams should be reflected in the chapter (i.e., put in more information on general waste, reduce the amount of information on radioactive and cytotoxic waste).
- Mention the increase in waste due to the increase in disposables used.
- Mention the special waste problem created by AD syringes.
- Mention other sources of waste: beauty parlors, acupuncture centers, diagnostic centers, blood banks, prison clinics, mortuaries, and waste arising from domiciliary treatment. Home health-care waste (e.g., from HIV/AIDS patients at home) is especially significant in Africa.
- Include the concerns of small health posts or health centers.
- Differentiate hospital health-care wastes from wastes from clinics, doctors’ offices, primary health care; for example, cytotoxic waste would only be found in a small number of large health-care facilities.
- Basel, Stockholm and WHO definitions should be harmonized and simplified.
- For radioactive waste, make references to international regulations; differentiate sealed versus unsealed sources.
- Mercury should have special mention; it is highly toxic yet very common in health-care facilities.
- Infectious waste requires a different external transport.
- Update the health-care waste generation section. Mention the factors that affect variability (e.g., available resources, reuse rates, country definitions, local concerns and practices, amount of disposables used, outpatient versus inpatient, etc.). Generation rates
are useful for computing initial estimates of sizes of treatment systems where site-specific data does not exist.

- Include “infectious waste” generation rates so facilities can compare the effectiveness of their segregation practices. Explain distinctions between kg/bed, kg/occupied bed, kg/patient, etc. which is a source of confusion in the literature.

- Provide tools to conduct baseline surveys and then monitor changes in practice and generation rates.

- The waste categorizations do not necessarily provide the best structure for promulgating appropriate regulations or standardizing good practices. An alternative categorization by the nature of the risk (biological, chemical, radioactive, etc.) that each type of waste poses will provide a logical link to the both the type of management strategy needed and the appropriate regulatory authority to oversee it.

Proposed system of classification:

1. **Sharps**

2. **Infectious waste**
   a. Waste contaminated with blood or other body fluids*
   b. Cultures and stocks of infectious agents
   c. Pathological waste including tissues, organs, body parts, and contaminated animal carcasses
   d. Waste from infected patients in isolation wards**

3. **Chemical waste**
   a. Waste containing heavy metals (mercury, cadmium, lead, silver in x-ray waste, etc.)
   b. Other chemical waste (spent solvents, waste disinfectants, lab chemical waste, oils, asbestos, developers and fixers in x-ray waste, etc.)
   c. Pharmaceutical waste (expired drugs, partially used drugs, etc.)
   d. Cytotoxic waste (genotoxic or antineoplastic waste, chemotherapy waste)

4. **Radioactive waste**

5. **Non-hazardous (general or “domestic”) waste, including recyclable or compostable waste**

Notes:

- #1 poses both a biological and physical hazard; #2 poses a biological hazard; #3 poses chemical toxic hazards; and #4 poses a radioactive hazard. In general, #1 and 2 are under the health ministry, #3 is under the environmental ministry, #4 is under a nuclear regulatory or environment agency; and #5 is under the environment or interior ministry or local governments.
- Some regulations specify that only materials with liquid blood or soaking in liquid blood be considered infectious since the risk of disease transmission from dried blood is significantly reduced. However, in light of poor handling practices, lack of PPE, and open access to dumpsites in many developing countries, “contaminated with blood” may be an appropriate description.
- Some would argue that only the waste from patients with diseases that are transmitted by contact (that is, isolation rooms that require Contact Precautions) need be considered infectious. However, since some developing countries do not have well-developed infection control procedures, it would be appropriate to include a general “isolation ward waste” category.

Specifics:

- This chapter has far too many boxes and tables. It creates confusion in the flow of information and reading. This should be reduced or summarized.
- Box 2.3 should be moved into 2.1.10 under radioactive waste
- Box 2.4 should show, as example, the % these sources producing waste represents for a couple of countries. Home care should be included.
- Box 2.1.5 should be joined with box 2.4.
- Para 2.1.1 - It is stated that general waste should be dealt with by municipal waste disposal mechanism. This would be possible only when segregation is practiced.
- Para 2.3 - Why healthcare waste generation in the middle or low income group of countries is low should be explained. Mainly it is due to less use of disposables.
- Table 2.3 - Annual?
- Box 2.11 - Food waste should be considered infected if it has come in contact with patients (depending on the type of infection).
- Table 2.6., p. 13. There should be categories in this table and in others that are in line with categories that are described in this chapter. The name of line 3 combustible packaging is not clear here. Include only tables with corresponding categories described in the blue book.

Chapter 3

- Retain this chapter since it gives the rationale, but move the chapter closer to the Introduction.
- This chapter should be renamed. Instead of health impact of health care waste, it should introduce the broader concept of environment health impacts related to HCWM. Environmental health is a priority in the EU.
- Mention both benefits of HCWM and the hazards.
- Link this with Chapter 14 on health & safety practices.

- Link health and environment, i.e., health effects of environmental contaminants; add the adverse health impacts related to poor incineration (e.g., health effects of particulate matter, heavy metals, dioxins, furans, etc.) as well as the environmental impacts (e.g., impact of acid gases).
- Include risk associated with improper disposal of pharmaceuticals, such as water contamination, antibiotic resistant microorganisms, etc.
- Specific sections should be added about the health and environmental impacts of improper mercury disposal.

- Include a discussion of the chain of infection.
- Include the epidemiology of risk of transmission and the global burden of disease from waste. Update the section with more recent data from Salkin, Gisselquist, etc. Update data on hepatitis B, etc.
- Add information on survival of pathogens in the environment.
- Add the impact of infected water.

- Add a donor perspective (i.e., the opportunity to tie in “polluter pays” such as with pharmaceutical firms or donors providing methods of disposal for waste from their activities).

- This chapter should be linked with numbers in Chapter 2 to support RA and RM which help to define priorities and mobilize resources.
- The part on cytotoxic waste should be checked by an expert.
- The issue around the fetus should be covered.

- Add monitoring and indicators and link with evaluation.

Specifics:
- Table 3.1 should add ‘high profile’ diseases such as H5N1, SARS, MRSA, C. difficile, etc.
- Para 3.1.3 - Differentiate between hollow and suture needle as far as the potential to infect is concerned.
- Table 3.1 - Add SARS and Avian flu. Add 'body fluids' in AIDS column.
- Para 3.1.4 - leaching of chemicals is an important factor of pollution, and should be
• Para 3.2.1 – the health impact of particulate emission from incinerators should be described in detail.
• Table 3.3 - Viral hepatitis, Is it 3-5 % or 30 %? Please check.
• Para 3.4 - Research is also required in the areas of mutagenesis in the hospital waste, and in system application.

Chapter 4

• Reflect international conventions especially Basel and Stockholm. The chapter needs substantial expansion especially with regards the new medical waste guidelines of the Stockholm Convention. Add new developments in the technical guidelines on HCWM under Basel.
• Review laws to harmonize with international laws.
• Give examples of how countries have met the international conventions.
• Include WHO policy paper regarding medium- and long-term strategies and provide more information to help developing countries select technologies.
• Target both ministries of health and of environment and describe the need for inter-agency linkages (e.g., MOEs deal with Stockholm yet MOHs require incineration); the roles/responsibilities of the MoH and the MoE regarding HCWM should be defined under 4.2.
• The text cannot be too prescriptive.
• Outline steps to take to develop a legal and regulatory framework.
• Give examples of how countries have developed their regulations; there are good documents outlining generic national policies and regulations on health care waste management.
• Add a box on examples of key legislation.
• Incorporate pages 24, 25, and 26 from the CEHA / WHO document and expand.
• This chapter needs more references.
• Under the basic principles, add the principles of “informed consent” or “right to know” and “public participation”
• Add the initiatives by UNEP and WHO policy on mercury.
• Add waste audit to be included in the law.
• Add water quality in the list of relevant national legislation.

Chapter 5

• Differentiate planning within and outside health-care establishments.
• Add information on project management for implementation such as steps, procedures, and monitoring tools; describe the stepwise development of the healthcare waste management plan.
• Refer to national planning in the yellow book (National planning in sub-Saharan Africa).
• Note national plans developed under the GAVI project.
• Include Basel and Stockholm recommendations for waste management; provide weblinks (Section 5.2).
• Include civil society in the planning process (Section 5.3.2).
• Add WHO policy on HCWM and mercury.
• Note historical development and conflict in the legislative framework of the developing countries.
• Explain the benefit of planning at local level. Local level should come first into this chapter.
The role of HCWM in a hospital should be clarified: part of infection control, housekeeping, etc.?

Mention savings due to good HCWM.

Add costs in terms of percentages: what % of cost is for health-care manager?

Section 5.3.2, as a separate step, include: “Ensure sufficient allocation of funds in national and local government budgets for health-care waste management” and describe working with legislatures to ensure budget line items for HCWM.

Add guidance for architects and hospital designers.

On Step 4: balance off-site (centralized) treatment versus on-site treatment.

Review the structure; the waste management committees section is too prescriptive; describe these as ideal recognizing that many members are too busy.

Need to be flexible in use of terms (e.g., “Waste Management Officer”).

Figure 5.2 needs to be more practical.

Table 5.1 should be updated and one should also be produced for a local action plan.

The questionnaires should be reviewed and moved to an annex.

Non-hazardous and non-infectious health-care waste should be included in the questionnaires.

Table 5.2 is missing waste handlers.

Section 5.5: include prison clinics and funeral parlors/mortuaries as other possible sources of infectious waste.

Para 5.3.2 - Policy commitment and responsibility should be vested with the health ministry.

Add 'food waste' in the survey questionnaire on pages 38 & 39.

Para 5.3.2 - Step 4 should include the multi-option concept in a healthcare facility; the concept of nodal hospitals for healthcare waste treatment and disposal of waste from smaller healthcare facilities may be considered; also 'Regional and Cooperative treatment facilities' may include some U.S. research indicating that 'on site' treatment at large facility is cheaper.

Concept of nodal hospitals should be included at 'step 6',

Para 5.4 - i) Most importantly, the waste management plan should include steps required to develop the plan; ii) Representatives of the waste handler group should be included in the waste management team. The chief pharmacist and radiation officer may be excluded from the list since they are already included as heads of departments.

Para 5.4.2 - Development of the waste management plan should among the responsibilities of the head of hospital.

Fig 5.2 - Waste handlers should be in the loop.

Chapter 6

This section should be expanded fully. Refer to it up front in the volume. Give concrete practical examples. Provide signposts to keep current especially for developing countries.

Add benefits of waste minimization, including financial benefits.

Add basic principles of waste minimization, the waste minimization hierarchy, and approaches; source reduction is very important; add principles of environmentally preferable purchasing; emphasize procurement policies to reduce waste; add inventory control, also composting of hospital kitchen waste. Recycling of regular waste is important (give examples of recyclable regular waste).

Present waste minimization options for hazardous chemical health-care waste (substitution of less toxic cleaners, solvent recovery, silver recovery, etc.).

Link to environmental management systems (ISO 14001).
- On single-use vs disposables: discourage single-use when there is no health reason for it.
- Distinction should be made between recycling and reuse of non-hazardous health-care waste, and the problems of reuse and recycling of syringes and other medical devices.
- Be careful with the terminology: recycling and reuse have different meanings in relation to syringes or single-use devices. Refer to other documents regarding reprocessing of instruments.
- Recycling of treated plastics from syringes has income benefits and also discourages health-care workers from “recycling” syringes in the illegal market. Describe how this should be done safely from an occupational safety and health perspective.
- Waste minimization should also refer to WHO specifications and views from manufacturers; see specification e.g. for bags.

**Specifics:**
- Box 6.1 should consider all waste produced in a health care setting.
- Include examples in box 1.

## Chapter 7

- Split this chapter; segregation is a key issue and could be a chapter by itself. Link segregation to training. Add the importance of responsibilities, monitoring, training, and corrective action with regards to segregation. Include a discussion on placement of bins and determining the number of bins for effective segregation.
- Include low-income countries in examples.
- The ISWA international policy n°11 should be integrated in this chapter.
- Follow waste stream by types of wastes.
- Begin the chapter with a discussion of the minimum three-bin system, and expand to multiple bins for more complex facilities.
- Differentiate practices for wards, surgical theaters, labs, intensive care units, etc.
- Provide protocols for sensitive areas (microbiology labs, hemodialysis and handling of blood).
- Include waste outside the hospital setting (immunizations, home health-care).
- Distinguish between high loads (mass immunization campaigns) and low loads (small rural health posts); consider small health-care facilities, remote clinics, mobile clinics, health camps.
- How should waste during disasters and conflicts be handled? Provide signposts to WHO documents on response to tsunamis and UNICEF cluster.
- Add more information on minimum standards for plastic bags.
- Include information on minimum standards for safety boxes; promote local manufacture but require minimum standards.
- Add reusable (e.g., autoclavable) sharps containers, and autoclavable infectious waste containers as options.
- Link container selection to the system of collection, treatment, and disposal.
- Add different storage time limits for sharps waste: sharps boxes or sharps containers especially in small health-care facilities may take days or weeks to fill up and unlike putrescible waste, a longer time limit for sharps waste may be appropriate.
- Differentiate between internal and external logistics (e.g., transport).
- Cross-check transport regulations with ADR (European road transport regulations); check for other updates on international packaging and transport requirements.
- Transport needs more thought and examples (e.g., requiring that infectious waste vehicle should not be used for anything else is not practical in developing countries).
- Add information on waste audits.
- Accident reporting should be added to the chapter, and also aspects of damage control.
**Add information for designers; for example, provide guidance to planners on clean versus dirty routes.**

**Specifics:**
- Fig 7.5 is out of date and B is wrong.
- Fig 7.6 should refer to the ADR regulations and box 7.2 updated based on Fig. 7.6.

---

**Chapter 8**

- This chapter needs extensive re-writing; it should refer to the WHO healthcarewaste website.
- Sustainability and maintenance are important.
- For technologies: budget, training, maintenance, spare parts, and monitoring are key.
- Emphasize that the goal of treatment is to make the waste non-hazardous. Treatment is specific to the characteristic of the waste. A treatment that renders a biological risk waste non-hazardous may have no impact on its chemical or radioactive properties. Combining all technologies under one header gives the erroneous idea that all health-care wastes can be treated with each of these.
- This chapter should reflect the WHO policy on incineration and health care waste management. The introduction should be reviewed to provide a general description of all technologies and introduce the above policy. It should provide information on contexts, funds, availability, related to regional contexts, and could provide a checklist.
- Incorporate assessment criteria; provide minimum standards for all technologies.
- Add a discussion of different treatment approaches (on-site treatment, centralized treatment, treatment within a cluster, mobile treatment) including infrastructure requirements.
- Add pros and cons of technologies, what types of waste they are used for.
- Include the Stockholm Convention obligations which require that when a new medical waste incinerator is built or an existing one is substantially modified, parties should require best available techniques/best environmental practices (BAT/BEP). Align the incineration section with the Stockholm Convention BAT/BEP guidelines especially regarding pollution control and emission limits, special considerations related to ash and ash disposal, as well as priority consideration of alternative technologies. There should be a hierarchy of decisions, from priority on non-incineration methods to incinerators that meet standards down to incinerators with no pollution control as stop-gap interim solutions. In presenting the technical options, incineration should be last and performing incinerator shown. The document should focus on cleaner technologies, even for those in remote rural areas.
- Reduce the incineration section and expand on the alternatives including advanced steam treatment systems.
- Flue gas cleaning is important (minimum requirement?). Use a dual-chamber pyrolytic incinerator with pollution control as an example in the annex; the term pyrolytic needs clarification and its text length shortened. A combination of non-incineration technologies and incineration (for hazardous chemical wastes) such as high temperature rotary kilns may be needed. Reflect experiences and practical problems with small-scale incinerators in Africa (e.g., cracked bricks, broken doors, breakdowns). Improvements on existing incinerators are a progression for low-income countries that do not have alternatives. Drum incinerators should only appear as an ultimate option for emergency situations; the picture in Fig 8.6 should be removed and others too.
- Monitoring of emissions of incinerators is important although many countries lack full capability for stack testing.
- Include pilots using solar energy.
- Include new and emerging technologies (e.g., supercritical water oxidation for
pharmaceutical waste, pros and cons of new plasma systems, etc.). Add alkaline hydrolysis and promesion as new alternative technologies for tissue, anatomical waste, and human remains.

- Landfill disposal should be separated from treatment.
- Steps of land disposal should be better defined. This may require a stand alone chapter because of issues of security, management, physical and chemical, treated/non treated, uncontrolled/controlled, sanitary, remote site, etc.

Specifics:
- Data should be checked in all table and numbers.
- All pictures should be reviewed and simpler similar technologies shown (Fig. 8.8 for a steam autoclave or Fig 8.10 for a microwave).
- There are errors in Table 8.2: the emission limits for dioxins/furans, HCl, and cadmium are wrong for medium and large incinerators.
- There is an error in Table 8.3: the emission standard for dioxins and furans should be in nanograms per cubic meter at standard conditions (not milligrams per cubic meter).
- Section 8.2: Delete sections on formaldehyde, ethylene oxide and glutaraldehyde treatment as treatment options in view of the significant health risks associated with these chemicals and the fact that they are not widely used for this purpose; for chemical treatment, focus instead on commercially available alkali, lime-based, peracetic acid, and other safer options.
- Section 8.3: Expand the section on autoclaves (description, types of autoclaves, pros and cons of different types of autoclaves, maintenance requirements, costs, etc.).
- Section 8.3: Add a sub-section on advanced steam treatment systems (hydroclaves, rotoclaves, etc.).
- Update the section on microbial inactivation tests and use the new scientific names for the bacillus spores.
- Add sharps pits as a special case for low-income countries; include sample design and construction.
- p. 78, 3rd paragraph says: “Most large, modern incinerators include energy-recovery facilities.” This statement is incorrect for the EU. The European Court of Justice ruling (Case C-458/0) defines an incinerator based on primary purpose. Since the primary purpose of incinerators is to dispose waste (even if they include energy recovery) they are considered disposal facilities, not energy-recovery facilities. This position was reinforced by the European Parliament but remains contentious.
- p. 81 last paragraph, remove 1st sentence: “Adequately maintained and operated pyrolytic incinerator, …. do not require exhaust-gas cleaning equipment.” Pyrolytic incinerators generally require gas cleaning to meet emission limits. Since medical products in health care are not labeled, a hospital is not able to distinguish PVC from non-PVC materials; while separating halogenated plastics is a good idea, it is not achievable in practice.
- Figures 8.2, 8.3, 8.5 and 8.6 should be removed.
- Table 8.2 may be outdated. A reference to the EU directive on incineration from 2000 should be presented (Table 8.3).
- Show some small, table-top advanced autoclaves or microwaves as alternative treatment technologies.

Chapter 9

- Do we need this chapter? Perhaps a shorter section with basic principles?
- Mention the need for research and development of new technologies and new applications, procurement policies, and coordination of research.
- Keep donors, international agencies and manufacturers in mind – provide clear signal that there could be a market for alternative technologies that meet local needs and
international convention requirements.
- Add factors to consider in selecting treatment technologies, or in evaluating new or emerging treatment technologies.
- Refer to the WHO policy on mercury, also battery, silver.

- Have a specific section on sharps management.
- Address issue of needle destroyers; present information on suitability and their limitations.

- Add a new topic on the management of suction canisters, i.e., fluid management systems.
- Add a special section on mercury (mercury management, dealing with broken or unusable equipment containing mercury, spills, storage, disposal options, transition to non-mercury alternatives).
- Add a special section on prion waste including management and treatment options.
- Add a special section on highly infectious waste (i.e., waste with biosafety level-3 (BSL-3) and BSL-4 agents, such as Ebola, Lassa, viral hemorrhagic fever, etc., NOT highly infectious waste as defined in Chapter 16, section 16.2). The term “highly infectious” should be reserved for BSL-3 and BSL-4 agents.
- Have a section looking at the future: emerging technologies, new horizons. Mention new technologies (e.g., alkaline hydrolysis, dry heat treatment), emerging technologies (e.g., UNIDO Project, wet oxidation, gas phase hydrogenation, superheated steam, etc. for chemical waste; ozonation for infectious waste; syringe melting; etc.). Add references and external sources.

- Add information on what to do with obsolete pesticides related to vector-borne diseases.
- The disposal of pharmaceutical wastes should include vaccines and more. Expand on this issue in line with the WHO document on the management of pharmaceuticals in emergency situations.
- Co-processing in cement kilns is a possibility; discuss pros and cons; need to see if this is a “back door” approach with negative ramifications.
- On radioactive waste, one IAEA reference mentioned is in press or must be finished by now. The section on radioactive waste needs expert review.

- Table 9.1 should be in the introduction of chapter 8.
- Modify some of the recommended applications, e.g. add autoclaving and shredding, or microwaving and shredding, for sharps.

Chapter 10

- Change the title.
- The introduction should reflect that the duty is to understand where liquid waste goes. It requires a map of the systems, sampling, monitoring, etc.
- Address the lack of wastewater systems in developing countries. What should one do if a sewer system does not exist? What should one do if the hospital is linked to a sewer system?
- Cross-reference other WHO documents.

- Add hazards of pharmaceuticals, antibiotics, cytotoxics in wastewater; the issue of blood and lab samples in sewers; discuss longevity of pathogens in the wastewater; discuss the fate and transport of chemicals and the hazards to the groundwater.

- Include specific recommendations on do’s and don’ts. What can and cannot be dumped in the sewer? There should be a “do not dump” list, e.g., do not dump mercury, antibiotics, etc. in the sewer.

- How does one handle blood, vaccine, lab samples?
- What can be handled by dilution?
- Describe basic septic systems, different types of treatment and pre-treatment; add a
description of a primary treatment system; add alternative systems, such as reed beds.

- Lagooning should include retention time information as well as aeration.
- Mention the need to develop better methods for liquid waste where alternatives do not exist.

- What should one do with liquid hazardous waste: solvents, pharmaceuticals?
- Provide information on containment, repacking, storage, e.g., safe long-term storage of mercury. Promote mercury spill kits.

Chapter 11

- Change the title to “Economics of HCWM”.
- Highlight the issue of cost and get the reader’s attention.
- Mention the WHO core principles for achieving safe and sustainable HCWM from the Geneva meeting.

- Include the introductory work led by Raki Zghondi (WHO/CEHA Amman) in a draft document on economics of HCWM and accounting.
- Include cost in the planning process; include or crosslink with the work done by CEHA.
- Include cost-benefit analysis; include costs of having to deal with HIV and hepatitis due to improper disposal; include other hidden costs such as environmental costs.

- Add information on the costing tools; link the chapter to tools on the healthcarewaste website.

- Note incentives to stop co-mingling of infectious and non-risk waste. Segregation leads to cost reductions. Waste minimization including environmentally preferable purchasing results in savings.
- Often actual costs of HCWM are lower than what people think they are.
- Give examples of on-site versus centralized treatment costs.

- Include advanced financial mechanisms: incentives similar to carbon credit schemes? Social franchising? Etc.
- Who pays in the case of a centralized system?
- Reflect local costs.

- Add technology benchmarking.

Specifics:
- Revise table 11.1.
- Add a box on the costs of a central autoclave treatment plant.
- Update data on costs including sharps treatment costs.
- Include cost of emission monitoring (e.g. dioxin sampling and analysis).
- Include the cost of post-exposure prophylaxis.

Chapters 12 and 13 together

- We have to involve the WHO Occupational staff on this chapter.
- Use the summary chart with Chapter 3.
- Introduce the concept of the hierarchy of occupational safety & health control measures as a framework: shift from response to prevention.
- Refer to existing guidelines regarding refugees, temporary camps, earthquakes, and situations with no established infrastructure.

- Mention the need to protect “third party” people such as waste haulers and scavengers at landfill sites.
- Mention the need to protect workers from machinery hazards.
- Mention the importance of training and immunization, and refer to those respective sections.
• HB vaccine of staff should not only be introduced but seen as a policy.
• Retain good information on personal protection, ventilation.
• Give the rationale for the use of gloves and masks.
• Add a drawing on hand hygiene (patient safety poster).
• Add what to do with blood spills.
• Add spill kits, including kits for chemical spills. Add a box listing the contents of a spill kit for infectious waste, and a spill kit for mercury spills; note the new NIOSH guidelines on spills of chemotherapeutic agents.
• Add a pictorial on spillage and check actual WHO protocol.
• Reflect the new guidelines on post-exposure prophylaxis; include the cost of post-exposure prophylaxis in costing section.
• Add a section on Chemical Safety. While there is a high level of concern and awareness of the risk from biological agents, many workers from physicians to waste handlers are ignorant of the risks associated with handling and disposing of many chemical agents used in health care.
• Add ergonomic issues.
• Add a section on health and safety in relation to treatment technologies.
• Add a section on developing health & safety plans for health-care facilities.

Chapter 14

• Review the title of the chapter.
• Move this section towards the front and keep it separate.
• Add how HCWM integrates with infection control.
• Mention the impact of SARS, avian flu, etc.: increases the amount of waste during the outbreak.
• Add other issues: multi-drug resistant strains (overuse of antibiotics), C. difficile, MRSA, etc.
• Note the need for prompt removal of health-care waste.
• Note the importance of hygiene and cleaning of carts and other tools.
• Note the problems with glutaraldehyde use.

Specifics:
• Section 14.2: Use the concept of the chain of infection as a framework; introduce transmission-based precautions as an approach to standard precautions.
• Section 14.3.6: Add alcohol/glycerine-based hand sanitizers as an option and mention the new WHO guidelines on hand hygiene.
• Include new references on hygiene (e.g., Rutala).

Chapter 15

• Review the title: one cannot “train the public”; instead use “training, education and awareness”.
• This section would benefit from case studies and examples as opposed to specific instructions. Present principles not specifics.
• Training section should cover the target audience, topics, package (content), and methods.
• Differentiate the groups for training including health-care institutions (government and private), municipalities, private haulers and waste treatment and disposal facility operators, and scavengers. Training needs and opportunities will be determined differently in each group.
Annex 6
Lead Authors and Chapter Contributors

Update - Second edition: Safe management of wastes from health-care activities

Editorial group
- Bill Townend
- Philip Rushbrook
- Raki Zghondi
- Ruth Stringer
- Yves Chartier

Introduction
Lead author: Philip Rushbrook
Contributors: Jorge Emmanuel, Yves Chartier

Definition and characterization of health-care waste
Lead author: Jorge Emmanuel
Contributors: Ed Krisiunas, Nelson Sabogal, Raymond Schelker, Saiedur Rahman, Ute Pieper

Health impacts of health-care waste
Lead author: Andrew Trevett
Contributors: Ashok Agarwal, Christie Keith, Ruth Stringer, Yves Chartier

Legislative, regulatory, and policy aspects
Lead author: Bill Townend
Contributors: Jack Weinberg, Donata Rugarabamu, Philip Rushbrook, Ravi Agarwal, Ruma Tavorath, Shinee Enkhtsetseg

Health-care waste management planning
Lead author: Yves Chartier
Contributors: Franck Bouvet, Marcia Rock, Nelson Sabogal, Raki Zghondi, Ruma Tavorath, Sawadogo Adama

Waste minimization, recycling, and reuse
Lead author: Andrew Trevett
Contributors: Ahmed Nejjar, Cesta Hrdinka, Glenn McRae, Mahesh Nakarmi, Saiedur Rahman

<table>
<thead>
<tr>
<th>Segregation and on-site handling</th>
<th>Storage and transportation of health-care waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead author: Ruth Stringer</td>
<td>Lead author: Ute Pieper</td>
</tr>
<tr>
<td>Contributors: Carib Nelson, Ravi Agarwal</td>
<td>Contributors: Paul Williams, Ruma Tavorath</td>
</tr>
<tr>
<td>Treatment technologies for health-care waste</td>
<td>Application of treatment methods to health-care waste categories</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Lead author: Ed Krisiunas &amp; Leo Leest</td>
<td>Lead author: Ed Krisiunas &amp; Leo Leest</td>
</tr>
<tr>
<td>Contributors: Carib Nelson, Cesta Hrdinka, Jan Gerd Kühling, Jorge Emmanuel, Uffe Petersen</td>
<td>Contributors: Jorge Emmanuel, Raymond Schelker, Sawadogo Adama</td>
</tr>
</tbody>
</table>

**Final disposal options**

- **Lead author:** Philip Rushbrook
- **Contributors:** Christie Keith, Leo Leest

**Collection and disposal of wastewater**

- **Lead author:** Jan Gerd Kühling
- **Contributors:** Ahmed Nejjar, Ed Krisiunas, Ruth Stringer, Raki Zghondi

**Economics of health-care waste management**

- **Lead author:** Paul Williams
- **Contributors:** Cesta Hrdinka, Raki Zghondi, Ravi Agarwal

**Health and safety practices for health-care personnel and waste workers**

- **Lead author:** S. Wilburn
- **Contributors:** Bob Ferris, Mahesh Nakarmi, Paul Williams, Selenic Dejana

**Emergency response (spills clean up….) Possibly combined with health and safety**

- **Lead author:** Franck Bouvet
- **Contributor:** Ed Krisiunas

**Hospital hygiene and infection control**

- **Lead author:** Ed Krisiunas
- **Contributors:** Bob Ferris, Jan Gerd Kühling, Selenic Dejana

**Training, education and public awareness**

- **Lead author:** Nelson Sabogal
- **Contributors:** Ashok Agrawal, Bill Townend, Jack Weinberg, Jan Gerd Kühling, Mahesh Nakarmi, Raki Zghondi

**Health care waste management in emergencies**

- **Lead author:** Raki Zghondi
- **Contributors:** Diego Daza, Ed Krisiunas, Frank Bouvet, Mahesh Nakarmi, Philip Rushbrook, Ruth Stringer, Yves Chartier
Future issues (or incorporate into an expanded introduction)

<table>
<thead>
<tr>
<th>Lead author: Ruth Stringer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributors:</td>
</tr>
<tr>
<td>Ed Krisiunas</td>
</tr>
</tbody>
</table>

Case studies, Photos, examples - all

Glossary and definitions
Lead: Yves Chartier with contributions from editorial group

Note: cross chapter theme contributions: mercury and architecture - Christie Keith + support from HCWH experts