Promoting Best Practices to Reduce Health Care Waste and Avoid Dioxin and Mercury Releases

A GEF Concept Paper
Prepared By Health Care Without Harm

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based on the UNDP Concept Document for GEF Pipeline Entry

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Health Care Without Harm (HCWH) is a broad-based, international coalition consisting of 423 organizations in 51 countries and including community groups, environmental justice advocates, physicians, nurses, patients, scientists, religious institutions, and labor representatives. The mission of HCWH is to reform the environmental practices of the health industry without compromising safety. The efforts of HCWH include:

- advocating for policies to eliminate the indiscriminate incineration of medical waste,
- changing purchasing and materials management practices of hospitals and purchasing groups,
- promoting policies and procedures that work toward the minimization of waste volume and toxicity,
- researching and advocating safer waste disposal alternatives, and
- educating the broader public about dioxin, mercury, and endocrine-disrupting chemicals and the health care industry's contribution to these problems.

Please go to www.noharm.org for more information on HCWH.

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Summary

This paper presents a proposed framework for action and a description of a joint project to be implemented in seven countries. The project has been approved by the Global Environmental Facility (GEF) and involves the World Health Organization, United Nations Development Program, and Health Care Without Harm. The framework for action is geared towards the promotion and implementation of best environmental practices and best available techniques for the management of health care waste. The key elements of the framework are: development of model facilities with the goal of replicating the program at other facilities; building institutional capacity including management systems and structures; awareness-raising, training, and education at the local and national levels; sustainability; and regional information dissemination. This paper describes the framework and how the GEF project will be carried out. The relevance of evolving international agreements and programs is also examined. Two major environmental pollutants of concern (dioxins and mercury), the role of health care facilities in their production or release into the environment, and some global trends are reviewed in the Appendix. This paper is based on a UNDP Concept Document for GEF Pipeline Entry.[1]

Contents

Introduction

The dictum "First do no harm"—a concept reflected in the Hippocratic Oath and applied in public health practice—embodies an evolving environmental concept called the Precautionary Principle. The principle is explicitly mentioned in international agreements such as the Stockholm Convention on Persistent Organic Pollutants and the OSPAR Convention. The Precautionary Principle is stated in the Rio Declaration as follows: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[2] As shown by the tragic histories of benzene, asbestos, PCBs, and other toxic substances, the public health costs of ignoring early warnings about environmental releases and exposure to these substances can be significant.[3] Of concern today are persistent organic pollutants (POPs) and other persistent toxic substances (PTS).

POPs and other PTS enter the environment in quantities of significant concern as a result of the activities of health care delivery facilities and services. This occurs most directly from the incineration of health care wastes and as a result of the breakage of products that contain toxic substances and inappropriate disposal of waste. Dioxins and mercury are especially problematic because of their global migratory nature, their ability to bio-concentrate in the environment, enter the food supply, and cause serious health effects in human populations (see Appendix). The amount of POPs and other PTS released into the environment varies according to the specific characteristics of the health care facilities, the types of wastes generated, and the health care waste management systems used.

Incineration or burning of medical wastes is a major pathway through which dioxins and mercury enter the environment. In the last two decades, the US and other OECD countries have been shutting down medical waste incinerators and reducing the total amounts of waste sent to dedicated incinerators. Many hospitals have also begun to phase-out mercury uses and phase-in effective alternative devices that avoid the use of mercury. However, the trends and pressures in developing countries and countries in transition appear to be moving in the opposite direction as new medical waste incinerators are being proposed and built, often with little or no pollution control. Thus, as health service delivery improves and expands in many developing countries, the releases of POPs and other PTS to the environment may actually increase. This paper presents a strategy and project aimed at trying to reverse this disturbing trend.

Health care providers, environment and health agencies, and the health care industry in general have a responsibility to protect public health by taking action to eliminate or reduce toxic pollutants. Case studies of good practices that fulfill these responsibilities are emerging in multiple countries and are the basis for the seven-nation Global Environmental Facility (GEF) initiative to document, institutionalize and disseminate these practices nationally and regionally.

The GEF Project

On June 17, 2003, the Global Environmental Facility approved for entry into the GEF Pipeline a project "Demonstrating and Promoting Best Practices in Reducing Medical Waste to Avoid Environmental Releases of Dioxins and Mercury from Health Care Practice." The project involves the United Nations Development Program (UNDP) as the GEF implementing agency, in collaboration with the World Health Organization (WHO) as the executing agency, an international NGO coalition Health Care Without Harm (HCWH) as a cooperating agency, and governmental and non-governmental organizations in the following seven countries:

- Argentina
- India
- Latvia
- Lebanon
- Philippines
- Senegal
- Vietnam

The framework presented below is based on the strategy that emerged from a consensus process involving WHO, UNDP, HCWH, technical experts and representatives from governmental and non-governmental organizations from the seven participating countries meeting in New Delhi, India in February 18-20, 2003. The project proponents were motivated in large part by the need to support the Stockholm Convention, the Basel Convention, and operational programs of the GEF in relation to reducing or eliminating releases of dioxins and mercury into the environment.

International Treaties and Instruments Related to Dioxins and Mercury Releases

Various international agreements and instruments are relevant to the problem of dioxins and mercury and the promotion of best practices to reduce their releases to the environment. They include the Stockholm Convention on Persistent Organic Pollutants, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Convention for the Protection of the Marine Environment of the North-East Atlantic, resolutions from the World Summit on Sustainable Development, as well as mandates by the Governing Council of the United Nations Environment Program and operational programs of the Global Environmental Facility.

Stockholm Convention on Persistent Organic Pollutants

In December 2000, international negotiations were concluded on a global, legally binding convention to reduce and eliminate the release of persistent organic pollutants to the environment. The final version of the text of the Stockholm Convention was adopted by the Conference of Plenipotentiaries

meeting in Stockholm in May 2001. The signatories to the treaty represent 151 countries. It is now in the process of ratification or approval by countries.

Annex C of the Stockholm Convention deals with the "unintended production" of POPs. First in the list of three groups of POP chemicals are dioxins and furans. Part II of Annex C is a relatively short list of source categories that *"have the potential for comparatively high formation and release of these chemicals* [i.e. dioxins] *to the environment."* The very first entry on this list is: *"Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge."* Article 5 of the Stockholm Convention addresses measures that Parties to the Convention shall take to reduce releases of dioxins with the goal of their continuing minimization and, where feasible, ultimate elimination. Parties are required to promote best available techniques for both new sources and existing sources listed in Part II of Annex C — which (as indicated above) includes medical waste incinerators. For the new sources listed in Part II — which includes any new or any substantially modified facility for incineration or combustion of medical waste — Parties are ***required*** to use best available techniques. This requirement is to be *"phased in as soon as practicable but no later than four years after entry into force of the Convention for the Party."*

Best available techniques are addressed in Annex C, Part V (although further guidelines are to be developed by the Conference of the Parties). Part V, paragraph A, subparagraph (f) states:

> "When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste. Under this approach, public health concerns should be carefully considered."

In addition, paragraph B, subparagraph (b) states that when Parties are considering proposals to construct new facilities using processes that release dioxins (e.g. waste combustion processes): *"[P]riority consideration should be given to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of such chemicals* [i.e. dioxins and furans]."

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

The Basel Convention was ratified or approved by 157 countries and the European Community. It entered into force on May 1992. The Basel Convention created a framework for controlling the movement of hazardous wastes across international borders. The strategic implementation plan of the Basel Convention for this decade includes the active promotion and use of cleaner technologies, further reduction of the movement of hazardous and other wastes, improvement of institutional and technical capabilities especially for developing countries and countries with economies in transition, and the development of regional and subregional centers for training and technology transfer.

Under the Basel Convention, criteria and technical guidelines for environmentally sound management (ESM) of hazardous waste, including POPs as waste and biomedical and healthcare waste, have been developed. As a central goal of the Basel Convention, ESM is intended to protect human health and the environment by minimizing hazardous waste production through a life-cycle approach from generation to final disposal. The Basel Convention's Technical Guidelines on Environmentally Sound Management of Biomedical and Healthcare Waste are based on an approach of reducing hazardous and problematic waste streams to a minimum.

The Convention for the Protection of the Marine Environment of the North-East Atlantic

This Convention (also known as the "OSPAR Convention" because it came out of meetings of the Oslo and Paris Commissions) came into force in March 1998. It has been ratified or approved by 14 states and the European Union. The OSPAR Convention seeks to prevent and eliminate pollution of the marine environment from, among others, land-based sources, dumping, incineration, and offshore sources. The OSPAR Strategy with Regard to Hazardous Substances, adopted in 1998, promotes the use of best available techniques, best environmental practices, and substitution of hazardous substances with less hazardous or non-hazardous substances where available. Annex 2 of the

OSPAR Strategy is a List of Chemicals for Priority Action. Dioxins and furans are first in the list, along with mercury and organic mercury compounds. The objective of the OSPAR Strategy is:

> "[T]o prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances … with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances."

The timeframe of the OSPAR Strategy is stated as follows: *"[T]he Commission will implement this strategy progressively by making every endeavour to move towards the target of the cessation of discharges, emissions and losses of hazardous substances by the year 2020."*

The World Summit on Sustainable Development

The World Summit on Sustainable Development (WSSD) took place in Johannesburg, South Africa, in September 2002, about ten years after the historic Earth Summit at Rio de Janeiro, Brazil. Resolution 23 from the WSSD renewed the commitment to sound management of hazardous waste and of chemicals throughout their life cycle, with the goal that these chemicals be used and produced in ways that minimize significant adverse effects on human health and the environment by 2020. The resolution also encouraged partnerships to enhance environmentally sound management of chemicals and hazardous waste, awareness-raising, and development of information on chemicals. Part (g) of the resolution specifically called for the reduction of risks posed by heavy metals with specific mention of mercury and its compounds.

United Nations Environment Program

In February 2003, the Governing Council of the United Nations Environment Program (UNEP) concluded that there was "sufficient evidence of significant global adverse impacts from mercury and its compounds to warrant further international action to reduce the risks to human health and the environment…." UNEP urged that national, regional and global actions, both immediate and long-term, be initiated, including identifying exposed populations and ecosystems, reducing mercury releases from human activity, and capacity-building to support efforts of countries to deal with mercury pollution. UNEP, in conjunction with the Inter-Organization Program for the Sound Management of Chemicals, also encouraged partnerships with non-governmental organizations and the private sector.

The Global Environmental Facility

The GEF is a mechanism for international cooperation and financing of projects that address six critical threats to the global environment: biodiversity loss, climate change, degradation of international waters, ozone depletion, land degradation, and persistent organic pollutants. The GEF involves 173 member governments working with non-governmental organizations, the private sector, and international institutions. In addition to POPs, another of its operational programs deals with contaminants in international waters. The GEF has identified releases of mercury to the environment as a threat to international waters.

A Framework for Action

The practices that regularly emit dioxins and mercury from health care can be changed through the focused application of new management, training, and technology options, all of which are available today for operations on the scale of large tertiary urban hospitals to small rural clinics. How these are applied will vary from country to country—based on access to resources, current practices, strength of the regulatory infrastructure and cultural practices. Global guidelines and principles however can be established to guide further developments in health care waste management even as health systems expand.

The framework for action that has been proposed is geared towards the promotion and implementation

of best environmental practices and best available techniques for the management of health care waste. The key elements of the framework are:

- Development of model facilities with the goal of replicating the program at other hospitals and health care facilities
- Building institutional capacity including management systems and structures
- Awareness-raising, training, and education at the local and national levels
- Sustainability
- Regional information dissemination.

The overall method is to encourage innovation while establishing principles that allow site-specific approaches that are drawn from basic principles and that are replicable. Best techniques and practices will include, among others:

- Techniques for waste minimization and pollution prevention, such as:
  - Procurement policies that favor reusable equipment and supplies, when these can be deployed in a cost-effective manner without compromising safety and sanitation;
  - Site-specific procurement policies and practices aimed at identifying safe and effective supplies, chemicals and instruments that do not contain mercury, and/or that avoid material components or packaging materials mostly likely to contribute to formation and/or release of dioxins and other PTS during their life cycle;
  - Promotion of safe reuse and recycling of materials to keep them out of the waste stream;
  - Avoiding products with excessive packaging;
  - Instituting safe practices for use and management of existing mercury-containing equipment to reduce breakage or leaks while the equipment is still in use; and
  - Instituting best practices for the cleanup of mercury spills, ensuring safety and minimizing waste.

- Waste separation and segregation including:
  - Rigorous segregation of infectious wastes from ordinary wastes;
  - Identification of products and packaging containing chlorinated plastics (e.g. PVC), and segregation of these materials, whenever safely manageable, into waste streams that are recyclable or are disposed of in a manner that ensures no burning;
  - Training and education to ensure that toxic materials, such as broken mercury thermometers, do not end up in the infectious waste stream (e.g., sharps containers), but are treated as a hazardous chemical waste.

- Selection and utilization of appropriate technologies for treating potentially infectious waste. These include a range of available non-incineration waste treatment approaches such as autoclaves, microwaves, and other non-burn thermal and chemical disinfection processes. A wide range of well-established non-combustion infectious waste treatment technologies are commercially available and have been used and tested in many different settings and circumstances.

Since virtually all dioxin emissions and most mercury emissions from health care practice are presently related to the combustion of wastes from these facilities, the deployment of non-combustion treatment technologies, combined with the other techniques and practices listed above, will have an immediate and dramatic impact toward eliminating these emissions. The wide range of available options permits consideration of site-specific conditions and resources in the choice of approaches and technologies that best meets the needs of the facility and its practices and policies. This will also allow for a combination of approaches that will take into account the varying needs of more rural or more urban facilities.

Some of the approaches under the broad heading of pollution prevention have simple logical outcomes. For example, if a health care institution retires all its mercury equipment and then institutes a purchasing policy that avoids the procurement of new mercury-containing devices and materials, there would be a virtual elimination of mercury emissions from the facility. Similarly, if the total amount of waste generated by a health care facility is substantially reduced; and if total waste combustion is avoided or greatly reduced, then dioxins generated as a result of waste combustion will also be avoided or greatly reduced.[4]

The techniques and practices do not offer a "one size fits all" solution. The focus, rather, should be on education and training, and the careful section of instruments, products and technologies that can be applied in a wide variety of settings, taking on many different forms, but all deriving similar, replicable results.

In each country, the model facility would involve at least one large hospital and several smaller clinics and/or rural health or immunization programs. Staff at these facilities would develop and implement best techniques and practices to achieve the following objectives:

- Documentation of existing waste management practices and policies at each participating facility including purchase and product utilization policies;
- Documentation of national policies, laws and regulations regarding hospital waste management as a basis for formulating proposals for reform if needed;
- Establishment of targeted waste minimization and waste management objectives for each facility; and adoption of modifications in current practices and policies aimed at achieving these objectives;
- Creation of institutional capability to carry out the new policies and practices achieved by training managers and staff, by providing managers and staff with ongoing support and assistance, by monitoring and reviewing progress, and by revising approaches as needed;
- Establishment of management structures and management techniques to assure that new policies and practices introduced will continue to be properly carried out; and
- Selection and deployment of appropriate waste treatment approaches.

The following are objectives at the country level:

- Establishment of an ongoing countrywide training program that trains and certifies experts who can then implement similar best practices at other health facilities in the country;
- Dissemination of useful awareness-raising materials summarizing best practices in hospital waste management;
- National Conference on Health Care Waste Management in each country, at which Demonstration Project outcomes are presented;
- National dialogue toward the development of a National Health Care Waste Management Action Plan in each country;
- Review of existing national waste management legislation and regulations in close coordination with national authorities who are responsible for Stockholm Convention National Implementation Plan (NIP) preparation; and
- Reform of existing national waste management legislation and regulations, if needed and appropriate, and in close coordination with NIP preparation process.

The following are objectives on the regional level:

- Participation of interested health care facilities and organizations from other countries in the region in the training programs;
- Dissemination of Project outcomes through regional conferences and distribution of reports to selected governments, Intergovernmental Organizations (IGOs) and non-governmental organizations (NGOs) in the region;
- Visits by representatives of selected governments, IGOs and NGOs in the region to the model facilities in order to promote best practices throughout the region.

For purposes of sustainability, contracts or Memoranda of Understanding (MOUs) would be obtained with participating facilities under which they commit themselves to long-term waste minimization and other best waste management practices. Financial and/or institutional commitments would be identified to assure that the health care waste management expert training programs continue in operation. Furthermore, an agreement would be established with at least one participating facility in each country to assure that the training program retains its access to the facility as a way to demonstrate best practices in an actual health care setting.

As a global objective, the lessons learned would be relevant to policies and approaches under consideration by the World Health Organization, the Stockholm Convention and the Basel Convention. Therefore, reports and recommendations, as appropriate, could be prepared for submission to the World Health Assembly, and to the Conferences of the Parties of both the Stockholm and Basel Conventions.

Project Coordination/Implementation

The GEF project will be carried out under the guidance of a Global Project Steering Committee whose members will include one representative each from: UNDP as Project Implementing Agency; WHO as Project Executing Agency; a senior level official from each participating Government; HCWH as major donor and Principle Cooperating Agency; as well as other major donors, if any. Other GEF implementing agencies and the Stockholm Convention and Basel Convention Secretariats will also be invited to participate in the Steering Committee. Additionally, there will be a National Project Steering Committee in each participating country. A Project management and consulting team will provide project management, technical assistance and coordination.

The seven pilot countries were selected to incorporate a range of differing circumstances of human development. In selecting the countries, consideration was also given to assuring regional distribution (all 5 UNDP regions are represented) and language distribution (four of the six UN Languages are represented). All seven participating countries have signed the Stockholm Convention on POPs; Lebanon and Vietnam have already ratified it. All are reviewing their present laws and practices in order to better understand what changes might be required when they become a Party to the Convention. All incinerate at least some portion of their health care waste and recognize that some quantities of by-product POPs and mercury are released to the environment during this activity. Most are also entertaining proposals for the construction of new medical waste incinerators. All wish to explore the implementation of best techniques and practices that can protect public health through safer health care waste management. All wish, at the same time, to reduce the amount of health care waste generated, and by this and other means, to avoid environmental releases of dioxins and mercury from health care practice. Each of the seven participating countries has policies, action plans, and programs that address to some degree techniques and practices relating to health care wastes.

Each country also has active WHO programs and the majority have HCWH-affiliated NGOs that will play key roles in promoting civil society participation in the national waste minimization programs. UNDP offices in each country have also indicated their strong support for the proposed program including its linkage to their national programs and priorities.

An important aspect of the project is broad stakeholder participation. Country-based NGO groups and experts that are associated with HCWH will play important roles in the Project as national stakeholder groups, and also as sources of experienced, effective and affordable national experts. The focus on reducing and where possible eliminating the sources of mercury and dioxin releases from health care is the central theme of an international NGO campaign network, Health Care Without Harm, begun in 1996. The network is now composed of 423 organizations in 51 countries working to bring attention to these issues and promote practical solutions. HCWH has regional offices in North America, Latin America, Asia and Europe. The major HCWH-affiliated NGO in Argentina is the Asociación Argentina de Médicos por el Medio Ambiente. The HCWH-affiliated NGO in India, Srishti, works with hospitals and government agencies on health care waste management programs and projects and has been a key contributor to the current medical waste laws for India. HCWH has an office in the Philippines and works with health care facilities, NGOs and government agencies in the Philippines. The project may also include national public health associations (with assistance of the World Federation of Public Health Associations), as well as national and local health and environmental advocacy groups, community-based organizations, hospital associations, labor unions, professional associations, and others.

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Appendix

Dioxins

Polychlorinated dibenzo-p-dioxins and dibenzofurans (in this paper, they will simply be referred to as "dioxins") belong to a family of several hundred compounds of which about two dozen are extremely toxic in very small quantities. Dioxins persist in the environment and concentrate in the tissues of humans and other species through the food chain. These substances are found as mixtures in the environment. Since each dioxin compound has a different toxicity, the overall hazard of a mixture is characterized by the value of a "toxic equivalent" (TEQ).

There seems to be no "safe level" of exposure to dioxins. They are one of the most toxic chemicals known to humankind. At very low levels, dioxins interfere with the body's hormones which may result in immune system, reproductive, and developmental disorders. Children exposed in utero during critical periods of development seem to be the most sensitive and vulnerable to the effects of dioxin.[5] Dioxin exposure has been linked to disrupted sexual development, birth defects, IQ deficits, hyperactive behavior, and developmental delays.[6] Dioxins also pose a cancer risk. The International Agency for Research on Cancer classified dioxin as a known human carcinogen in 1997.[7]

Dioxins are formed by human activity—mainly through the burning of organic material. Among the major sources are medical waste incinerators, municipal waste incinerators, cement kilns, steel and secondary copper smelters, as well as some non-combustion sources such as pulp mills that use chlorine.

Mercury

Another major contaminant from health care practice is the heavy metal mercury. As a metallic element, it is a liquid at room temperature and evaporates readily to create potentially hazardous concentrations in air. Inhaled mercury vapor is readily absorbed into the blood stream. Studies in the United States have shown that an estimated ten percent of the mercury emissions to the environment from human activities come from medical waste incineration.[8] Mercury is a persistent toxic substance that is considered to be a "global contaminant" because it is transported long distances on air currents and is then subject to deposition from the atmosphere. Mercury is known to accumulate in living organisms and can pose human and ecosystem health risks. Mercury in the environment can be converted into an organic form, methylmercury, which is even more hazardous. Methylmercury is easily accumulated by fish and bio-concentrated along the food chain.

As a potent neurotoxin, mercury attacks the body's central nervous system. It can cross the blood-brain barrier and harm the brain. Mercury poisoning is characterized by slurred speech; impaired hearing, peripheral vision and walking; muscle weakness; mood swings; memory loss and mental disturbances. Mercury can also affect kidneys and lungs. Mercury is particularly harmful to growing children. The risks of damage to the nervous systems of developing fetuses and young children have led to fish-consumption advisories, discouraging pregnant women, women of child-bearing age and young children from eating too much fish that may be contaminated with organic mercury.

Incineration or combustion of medical wastes is a major pathway through which mercury enters the environment. In addition, mercury enters the environment directly as a result of breakages, spills, and improper disposal of mercury-containing health care products. Mercury is widely used in health care practice in thermometers, blood pressure gauges, dental amalgams, various batteries, mercury lamps, old skin antiseptics such as mercurochrome or merbromin, pharmaceutical products and vaccines containing the preservative thimerosal, and others. Significant amounts of mercury are released in the wastewater from dental facilities while some spilled mercury is discharged in the wastewater of other health care facilities. The main exposure pathway of mercury from health care institutions to the environment is from mercury releases to the air as a result of incineration or volatilization, followed by deposition of the mercury from the air into the soil or bodies of water.

Global Pollutants

Although other pollutants are also of concern, dioxins and mercury are of special interest because of their global migratory nature, and also because of their ability to bio-concentrate in the environment, enter the food supply, and cause serious health effects in human populations. At present, many health professionals have a limited knowledge and awareness about toxic contaminants that enter the environment from health care practice. They often see burning or incineration of health care wastes to be a positive public health measure. Health care professionals, however, are generally very receptive to information about environmental contaminants and the health injuries they can cause. When made aware of this problem, most health care professionals will support alternative waste management approaches that avoid generating and/or releasing toxic pollutants to the environment, so long as these alternatives are practical and can achieve good results. By doing so, health care professionals can make an important contribution toward global efforts at public information, awareness and education about persistent organic pollutants and persistent toxic substances.

Dioxins From Health Care Practice

Incineration or burning of medical wastes is a major pathway through which dioxins enter the environment. While there is much data on environmental releases of dioxin in some highly industrialized countries, there is only limited quantitative data on dioxin emissions and releases from medical waste incinerators in developing countries and countries with economies in transition.

The US EPA in reference year 1995 listed medical waste incinerators (MWIs) as the third largest source of dioxin emissions in the country (following municipal solid waste incineration and secondary copper smelting).[9] The 1995 dioxin emissions represent a substantial decrease from those in a previous US EPA 1987 report. The decrease was largely achieved by the shut down of many dedicated medical waste incinerators in that period, and also in reductions in the amount of health care waste incinerated or combusted. US EPA's central estimate of dioxin emissions from MWIs in its 1987 Report was 2,470 g TEQ/yr - a full five times higher than the amount reported for 1995. According to the 1995 Report:

> "the total number of operating MWIs and the total amount of waste combusted decreased by more than 50 percent [between 1987 and 1995]. Certain activities caused this to occur, including more stringent air pollution control requirements by State regulatory agencies and the development of less expensive medical waste treatment technologies, such as autoclaving (Federal Register, 1997b). Because many MWIs have small waste charging capacity (i.e., about 50 metric tons per day), the installation of even elementary APCDs [air pollution control devices] proved not to be cost effective. Thus, a large number of facilities elected to close rather than retrofit." [10]

The reductions in dioxin emissions achieved in the US between 1987 and 1995 amounted to almost 2,000 g TEQ/yr. Putting this number in context, the total reported US dioxin emissions from all reported sources in 1995 were less than 3,000 g TEQ/yr.

Dioxin release inventories for Europe have been compiled by UNEP Chemicals.[11] In general, according to the European inventory, 62% of dioxin emissions are due to four processes alone: municipal solid waste incinerators, iron ore sinter plants, nonferrous metal industry, and clinical waste incinerators. Data for Belgium shows that dioxin emissions from medical waste incineration accounted for 14% of the total emissions to the air in 1995. Similarly, estimates of atmospheric emissions of dioxins in the Slovak Republic for 1993 indicate that hospital waste incinerators accounted for 14% of the total or the fourth highest source of among 21 source categories. According to a 1997 Danish Ministry of Environment and Energy study, incineration of hospital clinical waste was the third or fourth largest source of atmospheric dioxins from among 16 process groups. Hospital waste incinerators and crematoria together accounted for 10% of total air emissions of dioxins in Switzerland and were the fourth largest source from among 23 source categories.

According to the 1999 updated inventory by Environment Canada, releases of dioxins from medical waste incinerators in Canada dropped from 130 g I-TEQ/yr in 1990 to 25 g I-TEQ/yr in 1999.[12] During that intervening period, a significant number of medical waste incinerators closed down in Manitoba, Newfoundland, Quebec, and Nova Scotia, as well as all medical incinerators in British Columbia. On December 20, 2002, the Ministry of the Environment of the Canadian province of Ontario finalized a regulation to close down all medical waste incinerators at Ontario hospitals by

December 6, 2003.[13] The Environment Minister Chris Stockwell stated that emissions from incinerators are the fourth-largest source of mercury, and the largest source of dioxins in the province. He also said that closing down all hospital incinerators will ensure wastes are treated by state-of-the-art technologies that provide better environmental protection.[14]

There is limited quantitative data for developing countries. A major study was carried out in Thailand in which dioxin release measurements were taken for seven different dioxin sources including medical waste incineration. The Pollution Control Department (PCD) of the Ministry of Science, Technology, and Environment of the Government of Thailand sponsored this study with assistance from the German aid agency GTZ, and with assistance also from the United Nations Environmental Programme (UNEP) Chemicals and Euro Chlor. The study report is dated September 2001 and it is available from UNEP Chemicals in Geneva.[15]

Of the seven sources investigated in Thailand, medical waste incineration had by far the highest concentrations of dioxins emitted to the air and the highest emission factors—more than 1,200 ug I-TEQ per metric ton of waste burned. The investigators tested both the flue gases and the solid and liquid residues of two medical waste incinerators that were relatively new, built in the mid-1990s. Extrapolating the measured results to annual operation, the study estimates that each unit releases emissions of more than 700 mg I-TEQ of dioxins to the air per year.

According to this report, experts estimated that there exist about 1,500 hospital waste incinerators operating in Thailand, nationwide. Based both on the measured results and also on evaluating operating characteristics of Thailand's medical waste incinerators, the report reaches conclusions about estimated total air emissions from Thailand's medical waste incinerators. It states: *"Due to the problematic waste and the poor combustion conditions, PCDD/PCDF emissions of several hundred grams I-TEQ per year can be assumed."* To put this estimate of dioxin emissions into context, the report goes on to say: *" This would be more than the total emission inventory for countries such as Great Britain, Germany, Sweden, Austria, Switzerland, etc."*

The report also found extremely high concentrations of dioxins measured in solid and liquid wastes from the medical waste incinerator: *"At an absolute scale and when compared to results obtained at the municipal solid waste incinerator, the concentrations found in the bottom ashes of this hospital waste incinerator are about the highest ever reported in the literature."* The report notes that: *"all waste from the hospitals* [in Bangkok] *are incinerated without any presorting [and] that waste avoidance plans have not been developed."*

In a recent meeting of ten Southeast Asian and South Pacific countries, country experts ranked dioxins, furans, and polynuclear aromatic hydrocarbons (PAHs) as the second, fifth and sixth PTS of concern respectively for the purpose of identifying priorities in the region. Medical waste incinerators are major sources of these three unintended byproducts of combustion processes.

Mercury from Health Care Practice

In the United States, according to the US EPA in a 1997 report, medical waste incinerators may have been responsible for as much as 10% of all mercury air releases.[17] According to a 1999 report, health care facilities may also have been responsible for as much as 5% of all mercury releases in wastewater.[18] Environment Canada estimates that 30% of mercury emissions to the air in 1995 were due to biomedical waste incinerators and that more than one-third of the mercury load in sewage systems is due to dental practice.[19]

In the United Kingdom, an estimated 1 tonne of mercury per year from thermometers used in health care is disposed in clinical waste according to a report submitted to the OSPAR Commission.[20] In addition, about 7.41 tonnes per year of mercury from dental amalgam is discharged to the sewer, atmosphere or land, with another 11.5 tonnes per year sent for recycling or disposed with the clinical waste stream. Together, dental amalgam and laboratory and medical instruments account for about 53% of the total emissions from the use of mercury in products. Waste incineration and crematoria are also listed as major sources of mercury emissions to the atmosphere from industrial sectors. A report to the Helsinki Commission showed that Denmark released about 0.5 metric tons per year of mercury to water in 1998 via municipal wastewater.[21] The mercury resulted from the disposal of mercury-con-

taining health care products, mainly from dental clinics and thermometers.

Quantitative information on mercury releases from health care facilities in developing countries and countries in transition is more difficult to find. An assessment by the Pollution Control Department of the Thai Ministry of Science, Technology and Environment concluded that hospitals and dental facilities are sources of mercury releases to the environment, and that proper disposal of mercury waste is a concern; however, no actual data were available.[22]

UNEP and the Inter-Organization Programme for the Sound Management of Chemicals (IOMC) have begun a process to develop a global assessment of mercury; about 80 countries have submitted information.[23] Panama, for example, estimates about 3,280 kg of mercury imported in 2000 as components of pyrometers and mercury thermometers many of which would presumably be for medical uses. Many countries, such as Armenia, Cameroon, Ghana, Honduras, Pakistan, and Peru, recognize the contributions from hospital thermometers, dental amalgams, hospital waste and/or medical waste incinerators but lack quantitative data. Senegal notes that in addition to mining and certain industrial sectors, the increasing importation of mercury-containing apparatus such as thermostats and manometers are another source. Despite the lack of data, there is good reason to believe that mercury releases from the health sector in general are substantial.

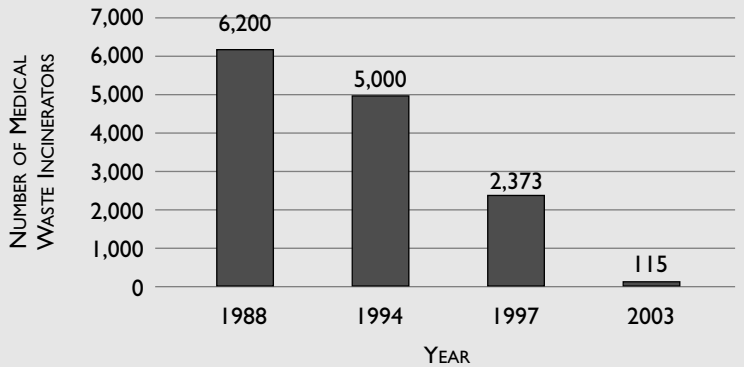
Global Trends on Incineration and Medical Waste Management

The US and other OECD countries have been shutting down medical waste incinerators and reducing the total amounts of waste sent to dedicated MWIs. This has helped them substantially decrease dioxin emissions. The figure below shows the dramatic decrease in MWIs in the United States. In 1988, the number of medical waste incinerators in the United States was estimated at about 6,200 incinerators, decreasing to 2,373 in 1997. By 2003, the number dropped dramatically to about 115 incinerators nationwide.[24]

However, the trends and pressures in developing countries and countries in transition appear to be moving in the opposite direction. New MWIs are being proposed and built in these countries, very often ones with small waste charging capacities and with little or no pollution control. In many cases, exported incinerators lack a market in their home countries because it would be impossible or prohibitively expensive for them to comply with regulatory requirements such as those prevailing in the EU and North America. The perceived need for purchase and construction of large numbers of new, dedicated MWIs in developing countries is based on two very legitimate considerations:

1. Biomedical wastes—especially sharps—when improperly handled and treated are a significant vector for infectious disease transmission; including significant transmission of hepatitis B, hepatitis C, and HIV.
2. The total amount of wastes generated by health care institutions is increasing rapidly for at least two reasons: the welcome expansion in health care systems and services in many countries; and because of the increased use of single use items in health care, together with increases in the amount of packaging used for health care products.

Figure A.
Decline in the Number of Medical Waste Incinerators in the United States



Monitoring
Many developing countries do not have and will not likely soon acquire the infrastructure that would be needed to regularly monitor, test and regulate emissions and other releases from MWIs sufficient to assure compliance with protective regulations that include stringent release limit values for dioxins, mercury, and other PTS. In the absence of effective regulation based on regular monitoring and testing, one can reasonably assume that substantial increases in the amount of health care waste combusted will translate into increases in the corresponding amount of dioxins, PAHs and some other PTS that will be released to the environment.

Regulation
The lack of a regulatory infrastructure with the capacity to regularly monitor dioxin emissions and releases makes developing countries an attractive market for vendors of dedicated MWIs, especially when this market is shrinking or disappearing in many highly industrial countries. Some argue that for developing countries to require strict dioxin emission limit values for MWIs comparable to those in force in the EU and North America would be a luxury developing countries cannot afford. This argument ignores the health impacts of POPs and PTS, and the fact that fully satisfactory alternatives exist that allow for efficient and cost-effective health care waste management.

Product substitution
In many industrialized countries, health care institutions have begun to phase-out mercury uses and phase-in effective alternative devices that avoid the use of mercury. Many health care institutions have also instituted housekeeping and management practices to better control mercury releases from sources still present in their facilities. Such policies and practices substantially decrease releases of mercury to the environment. However, much remains to be done. In a developing country setting where medical instruments are in such great demand, the retirement of mercury-containing instruments would only be practical when an adequate supply of alternatives is available. Since many health care institutions in highly industrial countries are phasing out their own mercury-containing instruments, some manufacturers of these instruments may redirect marketing of these instruments to health institutions in developing countries. Additionally, health care institutions in highly industrial countries may donate mercury-containing instruments to developing countries. In the absence of programs that promote the use of non-mercury alternatives and programs to assure proper cleanup and disposal of mercury, the total amount of mercury released by health care institutions in developing countries could increase as the availability of health care expands.

Responsibility
Both the World Bank, in funding health projects, and the World Health Organization, in providing guidance and carrying out global health initiatives, have recognized the hazards associated with the generation, treatment and disposal of wastes from health care practice. These hazards range from the immediate threat to personnel and patients to the production of transglobal pollutants creating long-lasting environmental damage and impacts on public health. According to a World Bank guidance paper:

> "The mismanagement of healthcare waste poses risks to people and the environment. Healthcare workers, patients, waste handlers, waste pickers, and the general public are exposed to health risks from infectious waste (particularly sharps), chemicals, and other special HCW [health care wastes]. Improper disposal of special HCW, including open dumping and uncontrolled burning, increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion."[25]

As the WHO Report "Safe Management of Wastes from Health Care Activities" states:

> "Hospitals and other health care establishments have a "duty of care" for the environment and for public health, and have particular responsibilities in relation to the waste they produce. The onus is on such establishments to ensure that there are no adverse health and environmental consequences of their waste handling, treatment, and disposal activities."[26]

Endnotes

1. This paper, prepared by Jorge Emmanuel, Glenn McRae, Jack Weinberg and Firuzeh Mahmoudi for HCWH, is based on the UNDP Concept Document for GEF Pipeline Entry for the project "Demonstrating and Promoting Best Techniques and Practices for Reducing Health Care Waste to Avoid Environmental Releases of Dioxins and Mercury" which was approved on June 17, 2003 by the Global Environmental Facility.
2. Principle 15, United Nations Rio Declaration on Environment and Development, 1992.
3. *The Precautionary Principle in the 20th Century: Late Lessons From Early Warnings*, Edited by P. Harremoes et al., European Environmental Agency, 2002.
4. This approach is already contemplated in the *Stockholm Convention*, see Annex C, Part V, Paragraph A (f).
5. Pluim, HJ, Koope, JG, Olie, K., et al. 1994. "Clinical laboratory manifestations of exposure to background levels of dioxins in the perinatal period." Act Paediatr 83:583-587; Koopman-Esseboom C, Morse DC, Weisglas-Kuperus N, et al. 1994. "Effects of dioxins and polychlorinated biphenyls on thyroid hormone status of pregnant women and their infants." Pediatr Res 36: 468-473; Pluim HJ, de Vijlder JJM, Olie, K, et al. 1993. "Effects of pre and postnatal exposure to chlorinated dioxins and furans on human neonatal thyroid hormone concentrations." Environmental Health Perspectives 101: 504-508; Weisglas-Kuperus N, Sas TCJ, Koopman-Esseboom C, et al. 1995. "Immunologic effects of background prenatal and postnatal exposure to dioxins and polychlorinated biphenyls in Dutch infants." Pediatr Res 38: 404-410; Huisman M, Koopman-Esseboom C, Fidler V, et al. 1995. "Perinatal exposure to polychlorinated biphenyls and dioxins and its effect on neonatal neurological development." Early Human Development 41: 111-127. As cited in www.noharm.org
6. See, for example, "Workshop[s] on Perinatal Exposure to Dioxin-like Compounds. I-VI. Summar[ies]," Environmental Health Perspectives Supplements, Vol. 103, Supplement 2, March 1995; Health Assessment Document For 2,3,7,8-Tetrachlorodibenzo-P-Dioxin (TCDD) And Related Compounds, Vol. 1 of III, and Vol. II of III, USEPA, Office of Research and Development, EPA/600/BP-92/001b and EPA/600/BP-92/001c, external review draft; and Devito, M.J. and Birnbaum, L. S. (1994) "Toxicology of dioxins and related chemicals." In Dioxins And Health, Arnold Schecter, ed., NY: Plenum Press, 139-62, as cited in Dying From Dioxin: A Citizen's Guide To Reclaiming Our Health And Rebuilding Democracy, Gibbs, L.M. and the Citizens Clearinghouse for Hazardous Waste, Boston: South End Press, 1994, pp. 138-139. See also www.noharm.org
7. "IARC Evaluates Carcinogenic Risk Associated with Dioxins," International Agency for Research on Cancer press release, February 14, 1997.
8. Mercury Study Report to Congress, Volume I: Executive Summary, USEPA Office of Air, December 1997. p. 3-6.
9. Inventory of Sources of Dioxin in the United States (EPA/600/P-98/002Aa), National Center for Environmental Assessment, US EPA, April 1998, p. 2-13.
10. Inventory of Sources of Dioxin in the United States, US EPA, *ibid*.
11. "Dioxin and Furan Inventories: National and Regional Emissions of PCDD/PCDF," prepared by UNEP Chemicals (Geneva, Switzerland) for the Inter-Organization Programme for the Sound Management of Chemicals, May 1999. The report is available in the web at http//:www.chem.unep.ch/pops/pdf/dioxinfuran/difurpt.pdf
12. Table 5a in "Inventory of Releases of PCDDs/PCDFs," Updated Edition, Environment Canada, February 2001. This report is available in the web at http://www.ec.gc.ca/dioxin/download/inventory.pdf
13. Regulation to Amend Regulation 347, Section 29, Environmental Protection Act R.R.O.1990
14. CBC News, December 20, 2002; *The Windsor Star*, December 21, 2002; *The Standard*, St. Catharines, Ontario, December 21, 2002
15. The study is titled: "*Dioxin Sampling and Analysis Program in Thailand*" PN 1997.2001.2-001.00, prepared by Heidelore Fiedler of the United Nations Environment Programme-Chemicals. It is available on the web at http://www.gtzth.org/library/files/gtzth_1997_2001_2_1.pdf
16. "First Technical Working Group Meeting: Sources and Concentrations of Persistent Toxic Substances," Region VIII, Singapore, 6-9 February 2002. The report is available on the web at http://www.chem.unep.ch/pts/meetings/reg8/TWs/minutes_1stTW.pdf
17. US EPA Mercury Study Report to Congress, 1997.
18. Public Health Report, July-August 1999
19. "Submission by Canada to UNEP Global Mercury Assessment," Environment Canada, September 2001. The report can be downloaded from http://www.chem.unep.ch/mercury
20. "OSPAR Background Document on Mercury and Organic Mercury Compounds," OSPAR Commission 2000. The report can be downloaded from www.ospar.org
21. "Mercury: A compilation of the information given by the Contracting Parties with the focus on legislative situation, current uses, stockpiles and releases," Working Document, Baltic Marine Environmental Protection Commission, Helsinki Commission, Update: October 2001. The report is available on the web at http://www.helcom.fi/a/hazardous/Mercury_Answers_CP.PDF
22. "Mercury Assessment in Thailand," report by the Pollution Control Department, Ministry of Science, Technology and Environment, Thailand, submitted to United Nations Environment Programme (UNEP) Chemicals, October 2001. The report can be downloaded from http://www.chem.unep.ch/mercury
23. Mercury assessment reports submitted by governments to UNEP Chemicals for the Global Mercury Assessment can be found in the website: http://www.chem.unep.ch/mercury
24. "Hospital Waste Combustion Study-Data Gathering Phase," US EPA, December 1988; "Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Medical Waste Incinerators," US EPA, January 1996; "Status of Current HMIWI Efforts," Fred Porter, US EPA, presented at the Medical Waste Institute, June 2003.
25. Healthcare Waste Management Guidance Note (2000), The World Bank Group, Urban Development Division, Infrastructure Group, Environment Department & HNP
26. Safe Management of Wastes from Health Care Activities (1999), World Health Organization.