

# Medical waste: the dark side of healthcare

## *Resíduo hospitalar: o lado sombrio da assistência médica*

Iris Borowy<sup>1</sup>

<sup>1</sup> Distinguished Professor, College of Liberal Arts/Shanghai University, Shanghai – China.

orcid.org/0000-0001-7621-1195

irisborowy@shu.edu.cn

Received on 24 June 2019.

Approved on 3 Dec. 2019.

<http://dx.doi.org/10.1590/S0104-59702020000300012>

BOROWY, Iris. Medical waste: the dark side of healthcare. *História, Ciências, Saúde – Manguinhos*, Rio de Janeiro, v.27, supl., set. 2020, p.231-251.

### Abstract

Hospitals and other health facilities generate an ever-increasing amount of waste, approximately 15% of which may be infectious, toxic, or radioactive. The World Health Organization has been addressing the issue since the 1980s. After initially focusing on high-income countries, it then focused on low-income countries, with unsafe disposal methods in landfills and inadequate incinerators as major concerns. Gradually, the understanding of the issue has undergone several shifts, including from a focus on the component of medical waste considered “hazardous” to all forms of waste, and from accepting medical waste as a necessary downside of high-quality healthcare to seeing the avoidance of healthcare waste as a component of high quality healthcare.

Keywords: healthcare waste; medical waste; World Health Organization (WHO); incineration; recycling.

### Resumo

Hospitais e outros centros de tratamento de saúde geram um volume de resíduos cada vez maior, dos quais cerca de 15% podem ser infecciosos, tóxicos ou radioativos. A Organização Mundial da Saúde começou a enfrentar o problema na década de 1980. Inicialmente, concentrou-se nos países ricos, depois mudou o foco para os países pobres, onde métodos de eliminação inseguros, como aterros sanitários e incineradores inadequados, preocupavam. Aos poucos, a compreensão do problema passou por mudanças, inclusive do enfoque no conteúdo do resíduo hospitalar considerado “perigoso”, passando para todas as formas de resíduos, e da aceitação do resíduo médico como um inconveniente inerente aos cuidados de saúde de alta qualidade, até o conceito de que evitar a produção de resíduos hospitalares faz parte dos cuidados de saúde de alta qualidade.

Palavras-chave: resíduo hospitalar; resíduo médico; Organização Mundial da Saúde (OMS); incineração; reciclagem.



Health-care activities protect and restore health and save lives.  
But what about the waste and by-products they generate?  
(WHO, Feb. 2018)

## Background

According to World Health Organization (WHO) information on its website, medical or healthcare waste<sup>1</sup> represents a formidable global health challenge. Hospitals and other healthcare facilities, laboratories, research centers, mortuaries, autopsy centers, blood banks, and nursing homes all generate waste. About 85% of this waste is categorized as general, non-hazardous in nature, while approximately 15%, may be infectious, toxic, or radioactive. The potential risks are manifold: infectious material such as infected blood, human tissues, or body parts can spread diseases to other patients, health workers, and the public at large. Particularly problematic, this can involve drug-resistant pathogens from hospitals. Sharp objects can cause injuries, especially for people scavenging on waste disposal sites, a common practice in low-income countries. An estimated 16 billion injections are administered every year, and not all needles and syringes are discarded safely, resulting in a combined risk of injuries and infections. Inadequate incineration can release pollutants into the air and to the ground, including dioxins, furans, and toxic metals. Cytotoxic waste can have mutagenic, teratogenic, or carcinogenic effects. Radioactive waste can cause both short- and long-term health damage.

The WHO website bemoans a “lack of awareness about the health hazards related to health-care waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and the low priority given to the topic” (WHO, Feb. 2018). Apparently, a mere 58% of countries have adequate systems for healthcare disposal in place, and many countries either do not have a specific policy or have a policy that they do not enforce. Therefore, the site calls for a series of policies to address this issue, such as waste segregation, the safe and environmentally sound treatment of hazardous healthcare waste, and developing comprehensive systems and strategies based on increased problem awareness.

However, the site also reveals the potentially contradictory nature of these approaches. As one measure, it proposes “promoting practices that reduce the volume of wastes generated,” while at the same time it welcomes that a decline in the reuse of injection devices has reduced infections due to injections with contaminated needles and syringes (WHO, Feb. 2018). Individually, both statements make intuitive sense, but clearly, increasing the use of single-use syringes is not helpful for reducing the volume of waste generation.

One of the central purposes of technical international organizations is to provide guidance on technical questions, framing questions for research, facilitating debate between experts, and offering reliable information about state-of-the-art knowledge (Barnett, Finnemore, 1999). The WHO, like other organizations, often finds itself in the unenviable position of having to provide authoritative information and advice on complicated issues on which existing knowledge is patchy, evolving, and open to contradictory interpretations. With regard to waste, open questions go to the heart of defining what the issue is even

about. Depending on the process and context involved, the same discarded material may be either useless waste or valuable equipment for further use. A specific form of waste treatment can have positive short-term but negative long-term effects, or positive effects for some people and negative effects for others. Healthcare waste has medical, sanitary, environmental, economic, logistic, cultural, and financial implications, and the trade-offs between different factors act differently in different parts of the world.

The decisions at hand can be framed in medical terms. In therapeutic decisions that routinely involve the consideration of desired effects and undesired side-effects, the ambiguity may appear just like a standard fact of life. In this view, the positive outcome (reduced infections) is achieved at the expense of the negative side effect (increased waste generated through single-use syringes and needles). This view constructs medical waste as a regrettable but unavoidable outcome of improved treatment. A different, though compatible, frame is that of developmental asymmetry, whereby technology in medical institutions in middle- and low-income countries is sufficiently developed to make use of advanced equipment and instruments, but not developed enough to manage their adequate disposal. Here, the focus is on waste scavengers as the victims of incomplete modernization, and the problem of healthcare waste will solve itself as the ongoing economic development runs its natural course. Finally, healthcare waste can be interpreted as an example of the general struggle of societies with a seemingly inexorable increase in waste production, for which no end is in sight. This view suggests that healthcare waste is merely one component of a much larger problem of misguided economic development, and one that requires a fundamental rethinking of everyday processes in which modern societies satisfy their material needs. Depending on the choice of perspective, healthcare waste is mainly a technical problem, calling for better disposal methods, an organizational problem, calling for better coordination and management, or a social problem, calling for more holistic public and professional attitudes towards the transformation of resources for the benefit of societal health. Ultimately, the question is: does the solution require a focus on waste management or a comprehensive rethinking of the entirety of healthcare services?

This paper tries to unravel the various overlapping contexts of the question and the different choices of arguments and frames that have characterized the debates since its emergence in the 1980s. The focus is on the role of international organizations, notably the WHO, as authoritative voices in global public health. The paper shows how the framing of the question has shifted over the years, as answers and even discussions and questions have been shaped by costs, convenience, safety, and attitudes towards perceived modernity. It also argues that the profoundly ambivalent nature of healthcare waste at the crossroads of benefits and harm places it squarely at the center of the recent and future developmental challenges of global health.

### **The emergence of healthcare waste**

Global waste production increased tenfold between 1900 and 2000. It is expected to double again by 2025, meaning that waste “is being generated faster than other environmental pollutants, including greenhouse gases” (Hoornweg, Bhada-Tata, Kennedy, 2013, p.615).

There are many reasons for this development, involving a combination of population growth, rising wealth, increasing urbanization, shifts to purchasing methods that required packaging, and an increasing use of plastic, a material that is neither produced nor mended at home (Köster, 2016, p.34-39; Strasser, 1999, p.265-269). Overall, living in industrialized countries has often become cheaper and more convenient, and in the process, disposability has become an accepted, indeed an expected quality of many everyday products. It would have been strange if the healthcare field had remained untouched by this trend.

By the 1970s, hospitals and medical practitioners began embracing equipment made from plastics. They were used for countless products, including prosthetics, engineered tissues, microneedle patches for drug delivery, latex gloves, intravenous bags, dialysis tubes, absorbable sutures, and bone cement in total hip replacements, leading even authors critical of the health risks of plastics to marvel: “Plastics are cost-effective, require little energy to produce, and are lightweight and biocompatible. This makes them an ideal material for single-use disposable devices” (North, Halden, 2013, p.1). Early on, disposables were widely valued for their durability, reliable use, and patient comfort. Though shifts to chemical rather than thermal disinfection made it possible to reuse plastic material, the cheap price and convenience encouraged the use of disposables. This shift came with some real health benefits. Disposable plastic syringes proved very helpful for vaccination campaigns against smallpox and polio, encouraging their mass use. Similarly, when the emerging HIV epidemic increased the importance of hygienic practices in the 1980s, plastic disposables filled this need. Gradually, disposables began being perceived as a medical safety measure (Hodges, 2017). In addition to convenience and hygiene, there was also an economic incentive, as manufacturers of surgical instruments found producing disposables more profitable than reusables, and hospitals, in turn, could charge their patients substantially more for these instruments than they had previously (Hurd, 1997). Gradually, a steady stream of single-use disposables replaced a reliable supply of electricity and clean water as prerequisites of modern medical practice (Hodges, 2017). In the process, medical practice came to produce an ever-growing amount of waste, much of it plastic, often considered hazardous. Though other medical facilities play a role, hospitals have been by far the largest generators of healthcare waste. In the United States, hospitals comprise a mere one percent of all health-related facilities, but are responsible for over seventy percent of healthcare waste generated. Similar relations are believed to exist elsewhere (UNEP, 2012, p.3).

This increasing quantity has brought attention to its problematic nature. Traditional methods of disposal relied on landfills and incineration, which proved inadequate or no longer feasible at a time of tightening clean air legislation and rising concern about environmental dangers. High-income countries dealt with this new challenge with new legislation and guidelines for best practice. This was no easy task, since it was not even clear what exactly constituted medical waste and how its various components should be categorized, reflecting varying degrees of risks. During the 1980s, several national institutions produced their own definitions, each with different consequences. For instance, a relatively narrow definition used by the US Centers for Disease Control regarding “infectious waste” meant that 3% to 6% of hospital waste qualified as “infectious,” while the broader definition used by the US Environmental Protection Agency (EPA) resulted

in 7% to 15% (Klangsin, Harding, 1998, p.517). Given that the disposal of “infectious waste” was dramatically more expensive than that of “normal” waste, there was a clear incentive for healthcare providers to adopt a narrower definition. In short, in the early 1980s, healthcare waste was a new problem, and the health community was in need of guidance both for its understanding and to find possible solutions.

At the time, the work of the WHO was shaped by the aftermath of the conference of Alma-Ata. This conference fundamentally changed the discourse about global public health with a determined demand for primary healthcare as a comprehensive policy that “reflects and evolves from the economic conditions and socio-cultural and political characteristics of the country and its communities” (WHO, 1978). This approach highlighted “appropriate technology” and downplayed high-technology methods. Hospitals were included in the system, but in a comparatively minor capacity as one of many actors to be integrated into a larger, socio-economic-cultural program. Neither the Declaration nor the conference report of Alma-Ata included a reference to healthcare waste (WHO, 1978). One of the main purposes of primary healthcare was to shift the focus of healthcare systems in low-income countries away from expensive hospitals (which had often dominated them as expensive, urban institutions of little value to the majority of the population) to low-level interventions, such as vaccinations and breast feeding, and to socio-economic policies such as sanitation. For years, focusing on hospitals for public health in low-income countries had a connotation of being outdated or counterproductive. It was not a context that encouraged debates about hospital waste (Cueto, Brown, Fee, 2019, p.170-202).

The WHO first addressed the management of wastes from hospitals in 1983 in a workshop held in Bergen, Norway. Reflecting, on the one hand, the developments in hospitals in industrialized countries, and, on the other, the shift away from hospitals in the Global South, it was organized by the European Bureau rather than the headquarters in Geneva and focused specifically on European countries. Its main outcome was a definition of several categories of hospital/medical waste:

- general waste (similar to normal domestic waste);
- pathological waste (tissues, organs, body parts, human fetuses, animal carcasses, blood, and body fluids);
- radioactive waste (solids, liquids, and gases from analysis procedures and tumor treatments);
- chemical waste (which could be toxic, corrosive, flammable, reactive, genotoxic or non-hazardous);
- infectious waste (cultures from laboratories, waste from surgeries, autopsies, or patients in isolation wards);
- sharps (especially needles and blades);
- pharmaceutical wastes (surplus, spilled, outdated, or contaminated); and
- pressurized containers.

Comparisons between countries showed that the amount of all types of hospital waste generated per bed differed widely, ranging from 0.5kg for mental hospitals in the United Kingdom to 5.24kg in university hospitals in the United States (WHO/EURO, 1985). This

might have been a first step towards coming to terms with the topic, to be followed by further discussion on how to evaluate these different quantities and how to address the specific forms of waste. The focus on especially problematic forms of waste lent itself to a contextualization within the emerging category of hazardous waste, which was gaining traction around that time, in reaction to a series of high-profile, often scandalous cases of toxic waste found buried in residential areas with suspected or demonstrably negative health effects, like the ones connected to Nuneaton in Britain, Love Canal in the United States, Dortmund in Germany, and Lekkerkerk in the Netherlands (Williams, 2005, p.3; Newman, 2016, p.126; Köster, 2016, p.39; Blackman, 2001, p.30). It was an issue the WHO (1977) had already addressed years earlier with a report entitled *Toxic and other Hazardous Waste*. This report was meant to take stock of existing knowledge about the question, and reviewed existing disposal methods: dumping (either as tipping on land, or disposal at sea or in deep mines), incineration, or treatment through chemical, electrochemical, or biological processing. All these strategies resulted in the pollution of the surrounding environment, so no clear recommendation was easily possible (WHO, 1977).

Also, again, there was a difficulty of definition. While the US EPA and the Organisation for Economic Co-operation and Development defined hazardous waste on the basis of the harmful effects of the material on its environment, including ignitability, corrosiveness, reactivity, toxicity, radioactivity, infectiousness, phytotoxicity, teratogenicity, and mutagenicity, the European Economic Community provided a list of specific substances defined as “hazardous” (WHO, 1977). Six years later, a new report on the management of hazardous waste further elaborated on these questions. Its recommendations included that waste disposal plans should have “regard to waste reduction and waste avoidance” (WHO, 1983, p.40), but otherwise focused on different recycling, transportation, and, above all, disposal methods. Though the overlap to medical waste should have been obvious, at the time the connection to the management of hazardous waste was indirect, if it was made at all. In the 1983 report, pharmaceutical compounds were listed among other toxic or hazardous substances, but hospitals or other healthcare facilities were not mentioned among the main sources of hazardous waste (WHO, 1983, p.14).

For years, this conference appears to have been the only instance when the WHO paid any attention to the question. While discussions about the suitable treatment of toxic wastes entered mainstream debates in many countries, leading to regulations and legislation, these were tied to chemical companies, power plants, or industrial plants, not hospitals and doctors’ offices. And whatever discussion regarding medical waste emerged in the medical community, it did not reach the WHO. It was only in mid-1990 that the World Health Assembly addressed healthcare waste again in the context of a resolution on hazardous waste management, which included chemical and infectious wastes among the materials for which the Director-General was asked to initiate collaboration with member states, including the establishment of “practical technical guidelines” (WHA, 17 May 1990). His subsequent report framed the problem as one of deficient regulations:

In countries where appropriate legislation is lacking or rudimentary, efforts should be made either to set up a separate system of management for hazardous medical

wastes with the health sector, or to incorporate the treatment and disposal of medical wastes into existing or planned overall programmes for hazardous waste management (WHA, 24 Mar. 1990, p.14).

Shortly afterwards, this language was taken up by the report of the Secretary-General regarding the transfer of hazardous waste from industrial to low-income countries, which included a brief reference to medical waste. The report called on member states to better coordinate the handling and disposal of hazardous medical waste and to develop suitable guidelines either specifically for medical waste or as part of hazardous waste management (WHO, 26 Mar. 1990). This approach painted medical waste as an unavoidable problem that had to be dealt with through better management and coordination. It also tied medical waste to hazardous waste without, however, taking up the idea of waste avoidance found in the earlier sources.

This message was about to get distributed since, at the request of the governments of Hungary and Israel, the European office of the WHO began organizing hospital waste management courses in these countries (Giroult, 22 Sept. 1993). This is remarkable, given that the WHO itself was relatively ignorant about the real nature and scale of the challenge. In February 1992, Wilfred Kreisel, head of the Environmental Division at WHO headquarters in Geneva, contacted the directors of regional WHO offices asking them to prepare reports on the issue in their regions (Kreisel, 7 Feb. 1990).

The person who came to be in charge of this issue was Eric Giroult, a WHO official responsible for healthy housing and town planning. He drafted a working paper in which he outlined the challenge: though firm data were unavailable, he estimated that about 10% of deaths in hospitals in developing countries were due to mismanagement of infectious waste – a number that was subsequently corrected as really pertaining to infections rather than deaths (Ducel, 30 Apr. 1992). In addition, he argued that an unknown number of people were infected outside of hospital settings, with risk groups being waste pickers, wastes collectors, disposal operators, and children playing around dumping sites. An estimated 10% to 15% of waste had to be considered hazardous, divided into toxic chemicals (leftover pharmaceuticals, disinfectants, cleaning products, laboratory reagents), sharps (syringes, broken glass, discarded surgical instruments, often contaminated with human blood), soft infectious waste (human tissues, contaminated clothes, disposable towels, gloves), and radioactive waste. These types of waste, as well as liquid waste, including stools from patients with diarrheic diseases and cleaning water from operating rooms, should be stored separately. Generally, waste management should be “an integral component of the hospital hygiene and nosocomial infections control programme” (WHO, 11 Mar. 1992). However, this was easier said than done because, as the paper acknowledged, the most appropriate treatments of contaminated material – high-temperature incineration or irradiation – were usually feasible only in the relatively small number of high-income countries. This mismatch between recommendations and real-world possibilities was not the only weak point of the proposed guide: as a doctor of the university hospital of Geneva pointed out in his comments on the draft, no matter how inadequate the waste disposal methods, there could be no question of closing a hospital because of inadequate waste disposal

(Ducel, 30 Apr. 1992). He did not spell out the logical consequence of this argument: if no amount of waste mismanagement warranted ending medical treatment, investments into better waste management (in funds, time, and effort) became a secondary and possibly even counterproductive strategy, since they withheld scarce funds from other, potentially more useful fields.

### **Medical waste as an issue of the Global South**

This unspoken dilemma became something of an elephant in the room after WHO officials decided to focus on low-income countries in the Global South. This shift was justified on the assumption that “high-income countries have their own scientific capabilities and do not rely upon WHO guidance” (Ozolins, 11 Oct. 1993). This attitude reflected the view of scholars of the time who argued that the real challenge was in low- and middle-income countries, where most of the world’s population lived. In these areas, a lot of medical waste was left in dumps of sorts, and inadequate medical waste management could become the source of new infections because disposable injection equipment was reused or because waste pickers, working without protection, injured themselves when sorting the waste (Townend, 2001). Given the visible reality of waste pickers, this explanation made intuitive sense. But it glossed over the degree to which this discourse conceptualized the health risks of medical waste not as a function of healthcare practices or of particular waste groups, but of insufficient development, and thereby effectively consolidated the larger socio-economic system which was giving rise to growing quantities of waste.

In line with this approach, subsequent efforts focused on low-income countries and their perceived specific needs. In September 1992, scientists from universities and hospitals in India, the United Kingdom, Brazil, France, Italy, Japan, Malaysia, the United States, and Switzerland met at the WHO headquarters in Geneva to discuss these issues at a workshop entitled *Hospital/Infectious Wastes Management in Developing Countries*. The report, complemented by additional material, suggested a simpler categorization of wastes, consisting of non-hazardous hospital waste, sharps, infectious waste, chemical/pharmaceutical waste, and other hazardous waste. Trying to gauge the resulting health risk, the text had to draw on studies from the United States and Japan, each suggesting a substantial problem, especially with regard to sharp objects. A 1986 survey of Japanese hospitals had found that 67.3% of waste handlers inside hospitals had reported injuries from sharps and 44.4% of waste disposal workers working outside of hospitals had reported injuries from handling hospital waste. In some cases, children had apparently become infected when playing with discarded syringes they had stolen from hospital waste dumps. Overall, the Japanese scientific literature had documented “more than 500 cases of infections with medical waste and also more than 500 cases of intoxications with chemical waste from hospitals and more than 400 cases of bio-hazards from cyto-toxic drugs improperly discarded” (Giroult, 27 Jan. 1993, p.4). Much less was known about the situation in low-income countries, though it was estimated that the risk was considerably higher due to often insufficient separation of hazardous from general waste, the work of



waste pickers on dump sites, and the high percentage of incinerators that did not work satisfactorily. Despite these potentially alarming numbers, the report considered healthcare waste management an issue of limited importance, secondary to a reliable supply of safe water, basic sanitation facilities, or other factors with a more direct bearing on people's health. The main problem was one of technological deficiencies: hospitals in South America and in Arab countries often used incinerators that did not function well or not at all, while African hospitals often burned their waste in the open air. Some countries in southern and eastern Europe appeared little better than developing countries. Generally, the worst problems seemed to come from small-scale hospitals with neither facilities for nor awareness of the safe handling of medical waste. Incinerators worked best when very large and when operated in cold areas, so that the generated heat could be used (as opposed to places in hot climates, where there was no demand).

Consequently, recommendations focused on technical measures: using specific waste containers, separating hazardous from normal waste, disinfecting infectious waste before disposal, and crushing needles and syringes before disposal. Prevalent current methods, such as landfilling with municipal garbage, open-air burning, and burying, were listed as acceptable if hazardous material could be kept out of the reach of citizens and away from waste pickers. Only a small abstract addressed the question of waste avoidance, actually discouraging it as a high-risk practice of the poor:

Recycling and reuse of waste or of resources find [*sic*] in waste is on the agenda of sustainable development and there is a permanent temptation in hospital [*sic*] short of resources to recycle medical care supplies which must be discarded such as disposable syringes or contaminated bed clothes. Theoretically there would be no problems in reusing sterilized hospital supplies, but disinfection is not equivalent to sterilization and to avoid any risk of infection reuse of disinfected hospital waste should be avoided (Giroult, 27 Jan. 1993, p.9).

The risk was considered higher in developing countries than in industrialized ones, involving not only infections with HIV or hepatitis B or C, but also the risk of staphylococcal diseases and cholera. In addition to nurses and other health and sanitary workers, who were high-risk groups in industrialized countries, waste pickers and the general public were also believed to be at substantial risk (Giroult, 27 Jan. 1993).

A fact-finding mission to Asia confirmed these deficiencies. Many hospitals had no effective segregation of clinical and non-clinical waste, used inadequate primary containment of clinical waste, and employed unacceptable disposal practices, notably disposal with non-clinical waste in municipal landfills, open burning and burial on hospital grounds, and the use of inappropriate on-site incinerators. Often, hospital staff lacked relevant training and had no clear chains of responsibility. Information gathered during the mission established the following state of affairs: of the 16 countries or territories visited, only four had governmental guidelines that were being enforced; in only one was there information about effective waste separation; in five countries medical waste was burnt in the open or in inadequate furnaces; in three it was dumped in landfills; and in several cases the practice was not clearly described.

Table 1: Medical waste management in east Asia and Oceania

Country	Governmental guidelines	Separation from general waste	Site of waste disposal	Methods used
Cambodia	No	No	Hospital	Open burning; burial
China	Yes, but rarely implemented			
Cook Islands	No		Hospital	Burning
Fiji	Yes		Hospital	Burning in incinerators
Indonesia	Yes	Theoretically		
Japan	Yes	Yes	Regional facilities	Incineration
Laos	No	No	Hospitals; municipal dumpsites	Burning; burial
Malaysia	Yes	Planned	Regional incinerators planned	Burning
Micronesia	No		Hospital; municipal dumpsite	Burning; land-filling
Papua/New Guinea	No	No	Hospitals	Burning in old incinerators
Philippines	Yes; unclear implementation			
Samoa	No		Hospitals	Burning in open ovens
Solomon Islands	European Commission project underway	No	Hospitals; dumpsites	Burning; dumping
Tonga	No	No	Municipal dumpsite	Dumping
Vanuatu	No		Hospitals	Burial; open burning
Vietnam	No	No	Hospitals; dumpsites	Dumping; burning in obsolete incinerators or open

Source: compiled by the author, based on Saw (1993).

The discussion of these data showed that the separation of “hazardous” healthcare waste was at the center of the WHO’s recommendations. They reflected the dominant view of health practitioners in high-income countries, but not those of their peers in low-income countries, where clinical waste was “not in general regarded as a special hazardous waste and is often handled as any other type of domestic waste” and the waste of healthcare institutions was “usually disposed of by open dumping or open burning either on-site or at municipal dumping grounds” (Saw, 3 Dec. 1993). A rapid Pan-American Health Organization (PAHO) assessment confirmed these findings for Latin America (Otterstetter, 7 Apr. 1992). Inadequate provisions for healthcare waste therefore seemed largely a symptom of a larger problem of inadequate sanitary services, which in turn was a symptom of poverty or underdevelopment.

Nevertheless, in its next report, the WHO focused on the technical possibilities of how to deal with collecting, disinfecting, and disposing of waste. All steps were complicated

by limited infrastructure, a large illiterate population, and stray animals. Generally, the risk appeared highest in countries where waste was treated as a resource, either because the reuse of waste was culturally expected or because sheer poverty gave real value to all materials. Staff involved in waste transportation could be moved through bribes or forced to allow access, and fences around disposal sites were easily broken. Keeping people who depended on scavenging for their livelihoods away from potentially dangerous medical waste was not only physically but also financially demanding. Theoretically, a 24-hour guard would be necessary – clearly an impossibility (Coad, 1994, p.23).

In a dilemma reminiscent of the choice regarding healthcare itself in low-income countries between a few highly trained doctors or many healthcare workers with limited training, guidelines for healthcare waste had to balance the desirable with the possible. In true Alma-Ata tradition, the report opted for the later, admitting that it would “not be possible for all medical establishments everywhere in the world to achieve the highest possible standards in a short time” (Coad, 1994, p.2). Instead, it would be better to aim at incremental, though imperfect, improvements.

The discussion was carried on by WHO Regional Offices. The offices for the Americas, the Eastern Mediterranean, the Western Pacific, West Asia, and Southeast Asia all held regional workshops in order to disseminate the findings of this meeting and also to carry the discussion further (Helmer, 31 Jan. 1994). These workshops seemed to prompt some interest, as indicated by a rising number of participants (WHO, Oct. 1996; WHO, 27 Mar. 1997). But they also confirmed the degree to which this was a neglected topic. Many countries of the region did not have specific national policies or guidelines for clinical waste management, so there could be no single set of guidelines for the entire region. Instead, existing guidelines would have to be locally adapted. However, there seemed to be little interest in such planning, since in most countries the topic was given low priority, and an awareness of existing risks was limited to personnel involved in waste management. There was also a lack of trained and experienced personnel and of funding (WHO, Feb. 1995).

To some extent, other international organizations helped meet these needs. The European Community Commission agreed to fund and implement a proposal of the PAHO to improve the management of hospital solid waste in Central American capital cities for a total of 6.5 million dollars. Involving approximately 20,000 out of the 45,000 hospital beds in the region, the project was set to affect roughly half of all hospital services (Otterstetter, 7 Apr. 1992). Similarly, the Asian Institute for Environmental Education and Development, together with the Hunan Provincial Government in China, Hunan Medical University, and the US EPA, prepared a First International Congress and Exposition on Medical Waste Management at Hunan Medical University (Finger, 22 Sept. 1993). In the following years, WHO regional offices organized two classes on the management of hazardous and clinical waste for public health engineers and hospital personnel in Malaysia and Lebanon (Saw, 1993; Giroult, 5 Dec. 1995).

Meanwhile, the WHO continued its preparations for a large, authoritative publication. The authors kept struggling with the question of how to reconcile perceived requirements of medical safety with local possibilities. In October 1994, when asked about methods for medical waste treatment, the WHO officer in charge of the topic, Eric Giroult (25 Oct.

1994, p.1), was quite clear: “WHO recommendations are that infectious medical wastes must be disinfected prior to their being disposed of as ordinary waste, and that recyclable syringes must be sterilized as disinfection will not be enough in case of reuse”. However, such recommendations could easily miss the needs of the intended audience. Thus, the Malaysian guidelines for clinical waste management were written by a consultant to the Malaysian Ministry of Health who appeared to draw heavily on his prior experience in the United Kingdom and, at least in the opinion of one WHO official, were clearly too sophisticated for most other developing countries (Ogawa, 19 May 1997). Similar issues affected the preparation of an authoritative WHO (2017) handbook *Safe management of wastes from health-care activities*. When a preliminary draft of the manuscript was sent to experts for comments, several people, including an official of the World Bank, criticized it as being overly geared towards the needs of high-income countries while being beside the point for developing countries. They urged that text be added to meet the needs of the latter (Ogawa, 19 May 1997; Siem Tjam, 5 June 1997; Bhide, 9 June 1997; Yoosuf, 10 June 1997; Pruess, 26 June 1997; Dijkman, 23 July 1997). Meanwhile, an officer who was just finishing the analysis of healthcare in Myanmar thought it important to stress that doing “something” regarding the disposal of hazardous healthcare waste, however limited, was better than doing “nothing” (Cole, 7 July 1997).

In reaction, authors added a last chapter to the report dedicated to “minimal programmes for health-care waste management” (Cole, 7 July 1997). However, this recognition of the special situation of countries in the Global South created as many problems as it solved. Holding high- and low-income countries to the same standard was clearly problematic, but so was applying different standards, as demonstrated by the attempt of the officer from Hong Kong to reduce the demands by self-categorizing as a low-income country. Giroult demurred, insisting, instead, that Hong Kong was “a high-income country and then should apply requirements for hospital waste disposal comparable to those enforced in Western Europe, Northern America or Japan” (Giroult, 22 Sept. 1993).

Considering these challenges, the report remained bland. Published in 1999, the 242 page text merely summed up the findings and recommendations of recent years. Estimating that between 75% and 90% of waste generated in healthcare was general waste, comparable to domestic waste to be dealt with by normal municipal waste disposal procedures, it was “concerned almost exclusively with hazardous health-care waste (also known as ‘health-care risk waste’)” (Pruess, Giroult, Rushbrook, 1999, p.2). In line with earlier categorizations, this field was divided into infectious, pathological, pharmaceutical, genotoxic, radioactive, and chemical waste, as well as sharps, pressurized containers, and waste with high heavy metal content. It underscored the need for a long-term management plan and reduction efforts, but its recommended strategies to minimize waste generation appeared remarkably simple, if not downright banal: frequent ordering of small quantities rather than large amounts, using the oldest batch of a products first, using all the contents of each container, checking expiry dates, and reusing equipment when safely possible after sterilization (Pruess, Giroult, Rushbrook, 1999, p.59). The most innovative suggestion was arguably that of making use of the heat generated by waste incineration for the heating of hospital premises (p.60). Regarding final disposal, the report considered several methods, but clearly favored incineration as the safest

option. Although commentators had pointed out that this information was likely to be useless for the majority of the global population, who did not have access to adequate and reliable incineration technology, the report went into substantial detail about technicalities (p.106-107). It was a plausible choice, given the weaknesses of the other methods, but it betrayed the inherent flaws of a system whose functioning required a technology not accessible to people in most areas of the world. It was also patently at odds with the conviction expressed a few years earlier that WHO recommendation should focus on low-income countries because industrialized countries did not rely on the WHO for guidance.

A letter from the Ministry of Health in Chile further underscored a potential divide between the WHO and at least some of its audience in the Global South. An officer was skeptical about the wisdom of dedicating scarce resources to this issue, citing the lack of any epidemiological data suggesting a real risk of infection associated with hospital waste in developing countries (Otaiza, 22 Feb. 1995). In response, Giroult argued that the risk was mainly an occupational one, and the fact that data seemed not alarming in high-income countries, where standards were high, did not mean that conditions could not be substantially more serious in low-income countries, where conditions were more problematic. Medical waste management, he insisted, was “a significant public health problem” (Giroult, 16 Mar. 1995). While this seems to have been the only exchange of this kind, it does point to the problem that though the warnings about health risks associated with medical waste made intuitive sense, robust data remained limited to non-existent, with Japan as the only exception. In reality, nobody really knew if or to what extent different forms of disposal of healthcare waste really put people’s health at risk. In 1997, the WHO official Philip Rushbrook admitted that he did not know of any human disease occurring as a direct result of healthcare waste deposited in landfills, though there was growing evidence of waste pickers on landfills suffering unusually high rates of gastro-intestinal, parasitic, and eye infections. In a break with earlier approaches, he argued that attitudes regarding the health risks of medical waste depended more on the economic status of the societies in which they were discussed than on actual real-life risks:

In countries where there is a strong aversion to risk of any form, the situation commonly found in higher-income countries, disposal of healthcare waste to landfill in an untreated form is considered unacceptable. I should point out, though, that in these countries, for decades before they reached their current level of risk aversion, the healthcare waste was being deposited in landfills and, to my knowledge, caused no recorded disease outbreaks. Conversely, in countries where there is less public interest in healthcare waste, since other priorities are more important, it may well be the case that landfill disposal is the only viable option that can be sustained with their current finance and technical resources (Rushbrook, Aug. 1997).

Meanwhile, a different strand of debate emerged in the United States, aiming not so much at the components of waste categorized as hazardous as at the total quantity of waste produced. A small but growing group of observers, activists, and health practitioners reshaped the discussions by shifting the focus from the relatively small amount of material clearly connected to specific therapeutic measures to the large amount of waste generated in the course of the overall organization of healthcare institutions, above all hospitals.

## Medical waste as a sustainability challenge

Beginning with the late 1980s and increasingly in the 1990s, the social landscape of environmental awareness changed. Several scandals involving toxic waste discovered in or near residential areas as well as a generally increased awareness of environmental pollution forced authorities in many countries in Europe and North America to enact regulations regarding the disposal of waste. These laws made discarding waste more expensive and led to an increase in legal and illegal exports of hazardous waste from high- to low-income countries (Pellow, 2007, p.11-14). The outrage about such exports led to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, signed in 1989, and the Bamako Convention in 1991, which came into force in 1998 and prohibited all imports of hazardous waste to Africa (Clapp, 2001, p.3). The latter involved the energetic input of Greenpeace and other environmental NGOs, and the activism and publicity surrounding both agreements reflected a heightened public sensitivity to the topic. This declining tolerance for environmental and health threats resulting from waste formed the background for shifts in how healthcare waste was framed.

A survey paper published in 1988 claimed that as much as 85% of hospital medical equipment in the United States consisted of disposables (Souhrada, 1988). This number was impressive and would be routinely quoted by papers on healthcare waste well into the twenty-first century. Irrespective of whether this particular number was correct, the overall trend towards more disposables and more waste was indisputable, and it was not only an environmental but also a financial concern. In the United States, disposal costs in a typical landfill had risen from approximately US\$15/ton in 1980 to US\$250/ton in 1988 (Strohm, 1993). This squeeze between rising expectations for convenience and hygiene, on the one hand, and rising costs on the other, provoked studies such as one by a mid-sized hospital in Portland, Oregon, published in 1992. Concerned about rising landfill fees while seeing the amount of non-hazardous waste generated tripling in 17 years, researchers found that a combination of substitution, minimization, and recycling of disposable products could substantially reduce waste generation (Gilden, Scissors, Reuler, 1992).

In addition, healthcare providers and authorities in high-income countries became increasingly sensitive to the potential health risks resulting from the disposal of healthcare waste not in itself considered hazardous, notably dioxins generated by the incineration of plastic equipment. In 1995, the US EPA identified medical waste incinerators as the third-largest source of dioxin pollution in the United States, with dioxins being categorized as cancerogenic, immunosuppressing, and endocrine disrupting (Pierce, Jameton, 2004, p.58). In this vein, one study declared “polyvinyl chloride (PVC) plastic, as the dominant source of organically bound chlorine in the medical waste stream,” to be “the primary cause of ‘iatrogenic’ dioxin produced by the incineration of medical wastes” (Thornton et al., 1996, p.298). This representation was vigorously contradicted by the Chlorine Chemistry Council, whose managing director pointed out – correctly – that the EPA had subsequently walked back on its earlier statement. He argued that chlorine was a “basic element in the delivery of healthcare services” and curtailing its use would make quality healthcare unaffordable to many people (Howlett, 1996).

However, this killer argument failed to quell continuing concern about the topic, as information about the real and potential health risks of chloride plastics and other synthetic compounds kept accumulating (Amaral, 2014, p.13). If nothing else, the connection between medical waste and hazardous pollutants served to include the question in emerging international considerations regarding toxic pollutants. In May 1995, the Governing Council of the UN Environment Programme initiated an international and inter-organizational assessment process of a list of chemicals which, six years later, resulted in the adoption of the Stockholm Convention on Persistent Organic Pollutants. This convention, which entered into force in 2004 and has been repeatedly revised since, aimed at eliminating or restricting the production and distribution of listed chemicals. Annex C declared incinerators of medical waste as one source of persistent pollutants, and, among its suggestions for best environmental practices in part V, it urged:

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 (UNEP, 2017, p.63).

By targeting the pollution resulting not from waste usually labelled “hazardous,” but from the treatment of regular waste, similar to municipal waste, this recommendation addressed the way healthcare itself was organized in hospitals and other health institutions. In the process, it seemed increasingly doubtful whether it made sense to separate medical waste into “hazardous” and unproblematic. Thus, a World Bank officer, commenting on a WHO publication, pointedly asked why, if non-risk healthcare waste was equal to domestic waste, it was nevertheless listed as creating more health hazards than mismanaged domestic garbage (Dijkman, 23 July 1997). There was no dramatic change in policy, but a noticeable shift in emphasis in attitude in international publications, which downgraded the hygienic benefits of single-use equipment while upgrading the health burden it created through its connection to problematic waste disposal. This context made recycling appear an increasingly beneficial component in the overall management of healthcare provisions.

A case in point was a report by the German Society for Technical Cooperation (Deutsche Gesellschaft for Technische Zusammenarbeit, GTZ) on the management of solid and liquid wastes at small health facilities in developing countries. It corroborated earlier WHO categories of waste on the basis of risks (adding genotoxic hazards as a potential health risk of improperly handled waste) and the need for clear waste management plans and responsibilities. However, it differed from the WHO approach by addressing healthcare waste primarily as normal household waste, citing the standard waste management hierarchy of avoidance before utilization, with disposal only as a last resort: “The basic idea of the waste management hierarchy is to give ‘priority to waste reduction and recycling’ before it comes to the treatment and final disposal of the waste” (GTZ, 1997, p.12; emphasis in original). In order to reduce the amount of waste, especially hazardous waste, the report specifically recommended making maximum use of multi-way articles, choosing products with a minimum of packaging and produced from environmentally friendly materials, and

giving preference to less harmful chemicals whenever possible. It boldly stated the future motto of the circular economy: “Waste in general is a source for so-called secondary raw material” (GTZ, 1997, p.13). Accordingly, it encouraged selling recyclable material such as metals, glass, plastics, and paper, which “might generate some additional funds” (p.14). Only the leftover waste should be disposed of through incineration or landfilling after biological, physical, or chemical treatment designed to lower its hazardous potential (p.14).

Indeed, such recycling was happening quasi-automatically in low-income countries, where hospital waste had never ceased to have material value. Thus, research at 14 hospitals in Chennai, India, between 2007 and 2010 revealed a widespread trade in used gloves, tubing, pumps, medicine bottles etc., part of which was informal, involving low-level waste workers like the drivers of transportation vehicles, and part of which was well-organized (though technically illegal) by specialized companies. These practices were criticized as the neoliberalization of healthcare practices at the expense of the poor (Hodges, Nov. 2013), but they can also be regarded as a beneficial method of waste reduction, with profit-seeking driving recycling in a form that was sub-optimal in form but beneficial in principle.

These practices were less prevalent in high-income countries, though independent studies found that hospitals could tap into substantial recycling potential of plastic waste at hospitals by changing regulations, separating infected and non-infected waste at source, developing a suitable recycling infrastructure, and educating workers and managers accordingly (Lee et al., 2002). In that vein, it seemed increasingly questionable whether it was accurate to assume a big divide between high- and low-income countries in their mastery of healthcare waste management. A crucial point was the sheer quantity of waste generated in the former, where reduction required changes not only in disposal, but also in therapeutic practices. Proposals for waste minimization included segregating wastes, recovering silver from photographic chemicals, and eliminating PVC-free plastic products, but also reducing unnecessary injections, estimating that “as much as 70% of all injections may be unnecessary” (Batterman, 2004, p.12). In 2004, the WHO adopted this line of argument in a policy paper that listed the risks inherent to medical waste, notably discarded syringes, but, as a new item, also stated that “health-care waste management options may themselves lead to risks to health and no perfect readily achievable solution to manage health-care waste exists” (WHO, 2004). It divided its strategy recommendation into short-, medium-, and long-term measures, all in various forms designed to limit human exposure to healthcare waste in solid or emitted form by adapting the choice of equipment, therapy, and disposal accordingly.

A few years later, it partnered with the United Nations Development Programme (UNDP) and a non-governmental organization named Health Care Without Harm (HCWH). The origins of HCWH went back to the report by the US EPA in 1995 regarding medical waste as a source of dioxins. The episode had prompted a group of 28 healthcare institutions to create a new NGO dedicated to finding ways of reducing the environmental footprint of healthcare. From its origins in the United States, the initiative quickly expanded to many other countries. At the time of writing in 2019, the group claimed to have “hundreds of organizations in 52 countries, with offices in Arlington, VA, Brussels, Buenos Aires and Manila” (Treating Sharps..., n.d.). Though its field of work has increasingly included other topics, notably climate change, medical waste has remained at the center of its program.



In 2008, HCWH cooperated with the WHO and UNDP to provide resources for seven countries (Argentina, India, Latvia, Lebanon, the Philippines, Senegal, and Vietnam) to “implement best health care waste management practices in a way that is both locally appropriate and globally replicable” (History..., n.d.). The aim of this project was to enable model hospitals in these countries to adjust their waste-related practices in line with the Stockholm Convention and to develop pilot demonstration projects and guidance documents (Global Health..., n.d.). Though the details about this project remain to be investigated, HCWH labelled it a “success,” and in 2018 a follow-up project focused on four African countries, where project hospitals were supposed to use autoclaves made in South Africa and specifically designed for conditions in Africa, find substitutes for mercury, and/or develop a waste digester (What HCWH..., 2018).

Further WHO recommendations followed in this vein. In 2014, an updated version of its 1999 handbook, *Safe management of wastes from health-care activities*, added another 100 pages to the original text (Chartier et al., 2014). The new material included two new chapters addressing, respectively, healthcare waste management in emergencies and an overview of the new challenges facing waste management, such as pandemics, drug-resistant pathogens, climate change, and technology advances. There were also some changes of principle. Rather than focusing exclusively on hazardous waste, the handbook now also included “general waste,” mainly paper, cardboard, and plastics, explaining:

In the past, all or most normal hazardous and municipal waste was discarded in dumps or landfills or burnt in municipal incinerators. Greater awareness of the environmental impacts of waste and the recognition that most of the non-hazardous waste from health-care facilities is potentially recyclable or compostable have changed the approaches to managing general waste (Chartier et al., 2014, p.8).

Thus, recycling now forms an integrated part of the management considerations throughout, while the chapter on waste minimization and recycling has become substantially more elaborate. In addition to practical suggestions with regard to recyclable (plastic) materials, it also includes totally new items such as food composting (Chartier et al., 2014, p.67-75). Rather than being the method of choice, incineration is now proposed to be phased out and replaced by other technologies in order to minimize the health burden emanating from dioxins and furans (p.46). Also, comparisons between high- and low-income countries highlight the vastly larger quantities in the former and, thereby, the degree to which healthcare waste is a challenge everywhere, including and especially in high-income countries.

Meanwhile, HCWH has gone further by actively providing information for alternatives. At the time of writing, its website places at the disposal of any practitioner a database of non-incineration treatment technologies from around the world, searchable by company, name, technology, capacity, and country (Healthcare Waste..., n.d.). Admittedly, it is too early to tell if or to what extent this tendency will prove to signal a long-term development. The picture is still evolving, and a recent summary of healthcare waste management recommendations did not highlight waste reduction (WHO, 2017). Nevertheless, findings appear sufficiently strong to warrant establishing a new phase in the global conceptualization of healthcare waste management.

## Final considerations

Healthcare waste emerged as a topic of health concern of high-income countries in the 1980s, and was framed as an issue for which predominantly low-income countries required international support soon after. In the following forty years, the treatment of the question by and within international organizations has experienced several shifts in purpose and emphasis in which changes in geographical focus overlap with changes in problem conceptualization.

One shift has gone from a focus on the component of medical waste considered “hazardous” to all forms of waste. This change was brought about by the increasing use of disposables and/or of equipment made of synthetic polymers. This development drastically increased the quantity of waste but also introduced a form of waste whose disposal involved environmental and health repercussions, which were serious but not very different from those created by the exploding quantities of normal solid municipal waste. Consequently, the lines between different forms of waste blurred. As the view regarding the health threat posed by the 15% of hazardous waste was gradually shifted downward and the threat believed to come from the 80% to 85% “normal” waste was shifted upward, it was no longer clear what exactly constituted “hazardous” waste and how medical waste formed part of it.

Another change of approach involved a shift from accepting medical waste as a necessary downside of high-quality healthcare to seeing the avoidance of healthcare waste as a component of high-quality healthcare. This change necessitated a shift from seeing the problem as a technical challenge of waste disposal through end-of-pipe measures to making a re-evaluation of certain healthcare practices such as surplus injections. This, in turn, meant moving from the view that problems of medical waste management were primarily a developmental deficiency, reflecting poverty and generally a low level of healthcare proficiency in low-income countries, to a view of the problem as a function of the reckless use of disposables or, if you will, of over- or maldevelopment. A key point of this change was the understanding of incineration. Initially considered the method of choice for which high-income countries possessed the necessary equipment and know-how, incineration is now portrayed as a method of last resort, to be used only when prevention, recycling, and all other forms of disposal are not possible.

In most or, arguably, all of these shifts, the WHO has seemed to be following rather than leading. By contrast, important stimuli have come from the US EPA, when it pointed to the importance of healthcare waste as a major source of dioxins, as well as from independent scientific research. In addition, HCWH, an independent research entity with origins in the US but with a rapidly internationalizing membership and work program, has taken an active role in the issue. With its projects, it seems like HCWH invites the WHO and UNDP to cooperate, instead of vice versa. In the process, healthcare waste has evolved from a predominantly technical issue, largely mastered by industrialized countries but for which low-income countries required assistance, to a challenge of sustainable development, relevant on a global scale.

In the process, within a little over a quarter century, the issue has come full circle: what began as a consideration of high-income countries has come back to be regarded in

those terms, having gone through a phase of being perceived as a discussion for the Global South. This evolution has followed a similar shift in broader developmental thinking from development as a category of Southern deficiency to one of global challenge.

#### ACKNOWLEDGEMENTS

Thank you to two anonymous reviewers, whose comments have been very help for improving the paper.

#### NOTES

<sup>1</sup> Though not strictly identical, the difference between these terms is immaterial for the discussion in this paper, and the words will be used interchangeably here.

#### REFERENCES

- AMARAL, Maria José.  
*Non-toxic Healthcare: Alternatives to Phthalates and Bisphenol A in Medical Devices*. Brussels: Healthcare Without Harm. Available at: <<https://noharm-europe.org/sites/default/files/documents-files/3192/HCWH%20Europe%20report%20-%20Non-Toxic%20Healthcare.pdf>>. Access on: 17 Nov. 2019. 2014.
- BARNETT, Michael; FINNEMORE, Martha.  
The Politics, Power and Pathologies of International Organizations. *International Organization*, v.53, n.4, p.699-732. 1999.
- BATTERMAN, Stuart.  
*Findings on an Assessment of Small-Scale Incinerators for Health-care Waste*. Genève: WHO. 2004.
- BHIDE, A.D.  
A.D. Bhide to Richard Helmer. E10-374-13, J.3 (World Health Organization Archive, WHOA). 9 June 1997.
- BLACKMAN, William.  
*Hazardous Waste Management* (basic 3rd ed.). Boca Roca: Lewis Publishers. 2001.
- CHARTIER, Yves et al. (Ed.).  
*Safe management of wastes from health-care activities*. Genève: WHO. Available at: <[https://www.who.int/water\\_sanitation\\_health/publications/wastemanag/en/](https://www.who.int/water_sanitation_health/publications/wastemanag/en/)>. Access on: 16 May 2020. 2014.
- CLAPP, Jennifer.  
*Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries*. Ithaka; London: Cornell University Press. 2001.
- COAD, Adrian (Ed.).  
*Managing Medical Wastes in Developing Countries*. Genève: WHO. 1994.
- COLE, Eugene.  
Eugene Cole to Annette Pruess. E10-374-13, J.3 (WHOA). 7 July 1997.
- CUETO, Marcos; BROWN, Theodore; FEE, Elizabeth.  
*The World Health Organization. A History*. Cambridge: Cambridge University Press. 2019.
- DIJKMAN, Marleen.  
Marleen Dijkman to Philip Rushbrook. E10-374-13, J.3 (WHOA). 23 July 1997.
- DUCEL, G.  
G. Ducel to Eric Giroult. E10/87/6, J.1 (WHOA). 30 Apr. 1992.
- FINGER, Stanley.  
Stanley Finger to Wilfred Kreisel. E10/87/6, J.2 (WHOA). 22 Sept. 1993.
- GILDEN, D.J.; SCISSORS, K.N.; REULER, J.B.  
Disposable products in the hospital waste stream. *The Western Journal of Medicine*, v.156, p.269-272. 1992.
- GIROULT, Eric.  
Travel Report Summary. E10/87/6, J.2 (WHOA). 5 Dec. 1995.
- GIROULT, Eric.  
Eric Giroult to Fernando Otaiza and P. Brenner. E374/13, J.1 (WHOA). 16 Mar. 1995.
- GIROULT, Eric.  
Eric Giroult to B. Smeulders. E10-374-13, J.1 (WHOA). 25 Oct. 1994.
- GIROULT, Eric.  
Eric Giroult to May-Ling Lu. E10/87/6, J.2 (WHOA). 22 Sept. 1993.
- GIROULT, Eric.  
Eric Giroult to "colleagues". E10/87/6, J.1 (WHOA). 27 Jan. 1993.
- GLOBAL HEALTH...  
Global Health Care Waste Project. *Health Care Without Harm – Europe*. Available at: <<https://noharm-europe.org/issues/europe/global->

health-care-waste-project>. Access on: 24 Nov. 2019. n.d.

GTZ.

Gesellschaft für Technische Zusammenarbeit. *Management of solid and liquid wastes at small health facilities in developing countries*. Eschborn: GTZ. 1997.

HEALTHCARE WASTE...

Healthcare Waste Treatment Technologies Database. *Health Care Without Harm*. Available at: <<http://medwastetech.info>>. Access on: 11 Nov. 2019. n.d.

HELMER, Richard.

Richard Helmer to I. Sheikh, Regional Director, EMRO. E10-133-3 (WHO). 31 Jan. 1994.

HISTORY...

History and Victories. *Health Care Without Harm – US & Canada*. Available at: <<https://noharm-uscanada.org/content/us-canada/history-and-victories>>. Access on: 20 June. n.d.

HODGES, Sarah.

Hospitals as factories of medical garbage. *Anthropology & Medicine*, v.24, n.3, p.319-333. 2017.

HODGES, Sarah.

Medical Garbage and the Making of Neoliberalism in India. *Economic & Political Weekly*, v.48, n.48. Available at: <<https://www.epw.in/journal/2013/48/special-articles/medical-garbage-and-making-neo-liberalism-india.html>>. Access on: 16 June 2020. Nov. 2013.

HOORNWEG, Daniel; BHADA-TATA, Perinaz; KENNEDY, Chris.

Environment: Waste production must peak this century. *Nature*, v.502, p.615-617. 2013.

HOWLETT, C.T.

Dioxin data contested. *Public Health Report*, v.3, p.473-474. 1996.

HURD, William.

There's a hole in my bucket: the cost of disposable instruments. *Fertility and Sterility*, v.67, n.1, p.13-15. 1997.

KLANGSIN, Pornwipa; HARDING, Anna.

Medical Waste Treatment and Disposal Methods Used by Hospitals in Oregon, Washington, and Idaho. *Journal of the Air & Waste Management Association*, v.48, n.6, p.516-526. 1998.

KÖSTER, Roman.

Hausmüll, Industriemüll. In: Kersten, Jens (Ed.). *Inwastement*. Bielefeld: transcript Verlag. p.29-54. 2016.

KREISEL, Wilfred.

Wilfred Kreisel to various Regional Directors, E10/87/6, J.1 (WHO). 7 Feb. 1990.

LEE, Byeong-Kya et al.

Analyses of the recycling potential of medical plastic waste. *Waste Management*, v.22, p.461-470. 2002.

NEWMAN, Richard.

*Love Canal: A Toxic History from Colonial Times to the Present*. Oxford: Oxford University Press. 2016.

NORTH, Emily; HALDEN, Rolf.

Plastics and Environmental Health: The Road Ahead. *Review of Environmental Health*, v.28, n.1, p.1-8. 2013.

OGAWA, Hisashi.

Hisashi Ogawa to Annette Pruess. E10-374-13, J.3 (WHO). 19 May 1997.

OTAIZA, Fernando.

Fernando Otaiza to Tord Kjellstrom. E374/13, J.1 (WHO). 22 Feb. 1995.

OTTERSTETTER, Horst.

Horst Otterstetter to Hiroshi Nakajima, 7 April 1992, Hospital Solid Wastes Project in Central America, WHO, E10/87/6, J.1. 7 Apr. 1992.

OZOLINS, Guntis.

Guntis Ozolins to Jayne Pilot. E10/87/6, J.2 (WHO). 11 Oct. 1993.

PELLOW, David.

*Resisting Global Toxics*. Cambridge, Mass.: MIT Press. 2007.

PIERCE, Jessica; JAMETON, Andrew.

*The Ethics of Environmentally Responsible Health Care*. Oxford: University Press. 2004.

PRUESS, Annette.

Annette Pruess to Richard Helmer. E10-374-13, J.3 (WHO). 26 June 1997.

PRUESS, Annette; GIROULT, Eric; RUSHBROOK, Philip (Ed.).

*Safe management of wastes from health-care activities*. Genève: WHO. 1999.

RUSHBROOK, Philip.

Philip Rushbrook to Bernard Kearsley-Pratt. E10-374-13, J.3 (WHO). Aug. 1997.

SAW, C.B.

WHO Western Pacific Regional Environmental Health Centre. Executive summary of a Mission Report. 13-24 Sept. 1993, E10/87/6, J.2 (WHO). 1993.

SAW, C.W.

Executive summary of a Mission Report. E10/87/6, J.2 (WHO). 11-29 Oct. 1993. E10/87/6, J.2 (WHO). 3 Dec. 1993.

SIEM TJAM, Ferdinand.

Ferdinand Siem Tjam to Annette Pruess, E10-374-13, J.3 (WHO). 5 June 1997.

- SOUHRADA, L.  
Reusables revisited as medical waste adds up. *Hospitals*, v.62, n.20, p.82. 1988.
- STRASSER, Susan.  
*Waste and Want: A Social History of Trash*. New York: Henry Holt & Company. 1999.
- STROHM, Laura.  
The Environmental Politics of the International Waste Trade. *Journal of Environment and Development*, v.2, n.2, p.129-153. 1993.
- THORNTON, Joe et al.  
Hospitals and Plastics: Dioxin Prevention and Medical Waste Incinerators. *Public Health Reports*, v.111, n.4, p.298-313. 1996.
- TOWNEND, William.  
Book announcement: safe management of wastes from health care activities. *Bulletin of the World Health Organization*, v.79, n.2, p.171. 2001.
- TREATING SHARPS...  
Treating Sharps Waste. *Health Care Without Harm – Global*. Available at: <<https://noharm-global.org/issues/global/treating-sharps-waste>>. Accessed: 10 Nov. 2019. n.d.
- UNEP.  
United Nations Environment Programme. Text of the Convention. Stockholm Convention. Available at: <<http://chm.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx>>. Access on: 20 Nov. 2019. 2017.
- UNEP.  
United Nations Environment Programme. *Compendium of Technologies for Treatment and Destruction of Healthcare Waste*. Nairobi: UNEP. 2012.
- WHA.  
World Health Assembly. Resolution: Hazardous Wastes Management, WHA 43.25. E10/87/6, J.1 (WHA). 17 May 1990.
- WHA.  
World Health Assembly. Hazardous wastes: safe disposal and control of health risks: report of the Director-General. World Health Organization, E10/87/6, J.1 (WHA). 24 Mar. 1990.
- WHAT HCWH...  
What HCWH is Doing. *Health Care Without Harm – Global*. Available at: <<https://noharm-global.org/issues/global/what-hcwh-doing-waste>>. Access on: 25 Nov. 2019. 2018.
- WHO.  
World Health Organization. *Health Care Waste*. Disponible on: <<https://www.who.int/news-room/fact-sheets/detail/health-care-waste>>. Access on: 10 Nov. 2019. Feb. 2018.
- WHO.  
World Health Organization. *Safe Management of Wastes from Health-Care Activities: A Summary*. Genève: WHO. 2017.
- WHO.  
World Health Organization. *Safe health-care waste management*. Policy Paper. Genève: WHO. 2004.
- WHO.  
World Health Organization. Report of a Regional Consultation: Sound Management of Hospital Waste, Thailand, SEA/EH503, E374/13, J.3 (WHA). 27 Mar. 1997.
- WHO.  
World Health Organization. Mission Report: Workshops on hospital waste management, Vietnam, E374/13, J.3 (WHA). Oct. 1996.
- WHO.  
World Health Organization. Workshop on Clinical Waste Management, held 28 Nov.-2 Dec. 1994. E10-133-4, 7 (WHA). Feb. 1995.
- WHO.  
World Health Organization. Hospital and Medical Wastes Management in Developing Countries, attachment to Giroult to Director of RHE, E10/87/6, J.1 (WHA). 11 Mar. 1992.
- WHO.  
World Health Organization. Hazardous Wastes: Safe Disposal and Control of Health Risks, Report of the Director-General, A43/9. 26 Mar. 1990.
- WHO.  
World Health Organization. *Management of Hazardous Waste*. Genève: WHO. 1983.
- WHO.  
World Health Organization. Conference on Primary Health Care, USSR, 6-12 September 1978. Genève: WHO. 1978.
- WHO.  
World Health Organization. *Toxic and other Hazardous Waste*. Genève: WHO. 1977.
- WHO/EURO.  
World Health Organization/EURO. Report Series E.R.S. 97, Working Group held in Bergen (Norway), June 1983, "Management of Wastes from Hospitals", Copenhagen. 1985.
- WILLIAMS, Paul.  
*Waste Treatment and Disposal*. Chichester: Wiley & Sons. 2005.
- YOOSUF, Abdul Sattar.  
Abdul Sattar Yoosuf to Chief UEH/HQ. E10-374-13, J.3 (WHA). 10 June 1997.