

Healthcare or Health Risks?

Risks from Healthcare Waste to the Poor

A WELL study produced as part of task 326
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Executive summary

The purpose of this WELL study is to review and document key issues in the management and disposal of healthcare wastes in relation to the urban poor. This is done firstly through a review of the current literature and secondly by undertaking two short field studies in Pakistan and Bangladesh to identify good practice. A select bibliography, which includes contact details, is provided. The following issues are addressed:

- why healthcare waste is hazardous and what we know about the risks it poses;
- why the urban poor are considered to be most at risk from healthcare waste;
- ways in which these risks can be reduced; and,
- what can be learnt from examples of good practice in South Asia.

Healthcare waste is hazardous; it may include items such as:

- infectious waste which contains pathogens in sufficient quantity such that exposure could result in disease;
- 'sharp' waste such as needles, infusion sets and scalpels;
- pathological waste which may contain human tissues, fluids and viral cultures;
- pharmaceutical waste; and
- other wastes that pose hazards including chemicals, radioactive material, pressurised gas containers.

The review of literature does not provide any significant guidance about the actual risks associated with poor management of these wastes. Past research has focused on the specification of best practice rather than objective assessments of the actual impacts of poor practices. This leaves two key points unanswered:

- does responding to theoretical perceived risks, which may differ widely from the actual risks in many circumstances, result in the adoption of very high standards, using expensive and inappropriate technology that is unsustainable?
- has best practice based on these premises focused on technological or end solutions, with a resulting lack of guidance on the small intermediary steps which can be carried out at low cost.

The urban poor are potentially at greatest risk: firstly, their living environment suffers as a result of locally poor waste management and secondly, many people are forced to work with waste to provide a livelihood. The dilemma is that any improvements to healthcare waste management that involve reducing access to waste, so improving the environment, may have negative effects on the livelihoods of the poor. It is believed that the highest risk groups are those involved informally in reclaiming and recovering used healthcare waste material. This includes waste pickers who collect the recyclable portion of the waste and itinerant waste buyers who purchase the recyclable element of the waste that has been collected by the waste pickers in order to sell it on to recycling establishments. Awareness of the risks is generally low.

There are three broad approaches to mitigating the risks:

- actions which reduce the actual hazards arising from the nature of the waste, such as source separation and waste treatment;
- direct and indirect actions which reduce the contact between people and the hazardous waste, for example through improved containment and use of protective equipment; and
- measures which directly protect the population, such as immunisation.

It is important to consider appropriate actions at all stages in the healthcare waste stream, from generation to final disposal. Improvements in healthcare waste management involve a number of activities that can be undertaken as a series of small steps on the road to mitigating these risks.

Two field studies from Karachi, Pakistan and Savar, Bangladesh are reported in which healthcare establishments have attempted to improve the way that they deal with their waste. The following lessons can help improve healthcare waste management:

- improve practices at all stages of the waste stream and do not focus on one stage only, for example final treatment;
- separate the different types of waste at source: in particular keep infectious waste, pathological waste, sharps and chemical waste from being mixed with non-hazardous material;
- separation and sale of reusable but non-hazardous materials such as paper, plastic and glass can successfully take place under controlled conditions if the waste is separated at source;
- be prepared to improve the systems incrementally rather than look to 'once and for all' solutions such as incineration of all waste from the outset; small steps can have significant impacts;
- establish a distinct management responsibility for dealing with the waste generated;
- create a dedicated budget for waste management;
- provide all staff with training on handling waste; and
- work out detailed procedures for storage, handling, transfer and disposal of waste according to its characteristics and potential risks.

List of acronyms

BMC	Banga Bandhu Medical College
DFID	Department for International Development
KMC	Karachi Municipal Corporation
NGO	Non-governmental organisation
SKAT	Swiss Centre for Development Co-operation in Technology and Management
UWEP	Urban Waste Expertise Programme

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1. Purpose

The purpose of this WELL study is to review and document key issues in the management and disposal of healthcare wastes in relation to the urban poor. The following issues are addressed:

- why healthcare waste is hazardous and what we know about the risks;
- why the urban poor appear to be most at risk from healthcare waste;
- ways in which risks can be reduced; and
- what we can learn from examples of good practice in South Asia.

The readership for the study comprises DFID Advisers, their local project partners in government, NGOs who are supporting and facilitating both government and donor projects, and consultants involved in the identification and preparation of projects related to improvement of local healthcare facilities.

2. Key issues in healthcare waste management

In many low-income countries, healthcare waste rarely receives special attention; rather, it is handled as part of the municipal waste stream. However, awareness of the potential and actual problems of handling and disposal of healthcare waste is now increasing, as instanced by the number of relevant studies undertaken in the last three years by the Swiss Centre for Development Co-operation in Technology and Management (SKAT), the Urban Waste Expertise Programme (UWEP) and the Bangladesh Centre for Advanced Studies.

Whilst it is thought that poor management of healthcare wastes present a higher risk to health than poor management of municipal waste, there is little guidance available on the actual extent of the risks involved. A survey of the existing literature on healthcare waste management has revealed that very few studies have been carried out into quantifying the actual health and socio-economic impacts of existing practices. There are a limited number of useful case studies that give insights into the likely impacts on the urban poor; these are included in the Bibliography. The findings presented in this study draw principally upon these sources and our own short studies in Karachi, Pakistan and Dhaka, Bangladesh.

Work has tended to focus on the adoption of 'best practice', which are based on the perceived risks of poor healthcare waste management rather than the actual risks which exist. This is significant in that it may lead to the implementation of inappropriate and expensive measures. Furthermore, the 'best practice' that have been developed tend to focus on technological solutions or end solutions, with a resulting lack of emphasis on the smaller intermediary steps that can be carried out at low cost.

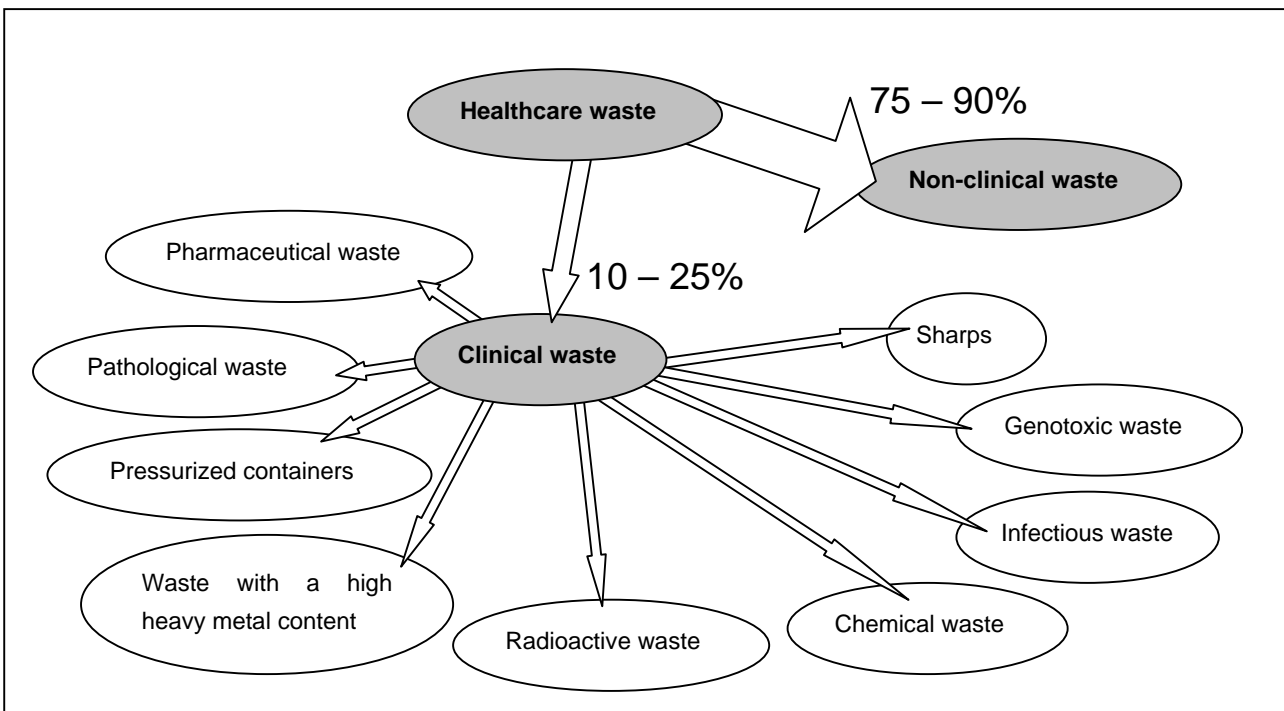
Those studies into the actual risks and impacts have focused upon practices within healthcare establishments. There is an important need to broaden the scope of future studies to include other groups who come into contact with healthcare waste in order to ascertain the level of risk and hence to define actions which can reduce this risk to an acceptable level.

The urban poor are potentially at greatest risk: firstly, their living environment suffers as a result of locally poor waste management and secondly, many people are forced to work with waste to provide a livelihood. The dilemma is that any improvements to healthcare waste management that involve reducing access to waste, to improve the environment, may have negative effects on the livelihoods of the poor. It is therefore essential to research the actual health risks and benefits associated with the improvement of healthcare waste systems. In this way, alleviation of poverty may be aided by the careful improvement of the environments in which people live without unjustifiably depriving people of a potential source of income.

3. Hazards of healthcare waste

Healthcare waste is the total waste stream that is generated by hospitals, healthcare establishments, research facilities and laboratories. However, there is also a portion of healthcare waste that is generated from other sources, such as healthcare in the home. A total of 75 - 90 per cent of healthcare waste is classified as non-clinical, or general waste, and contains items such as kitchen and office waste (WHO, 1988). This part of the waste presents no higher risk to the community than general municipal waste and is considered to be non-hazardous. The remaining 10 - 25 per cent is clinical waste, which could present a higher risk to the public and is hazardous; this can be further categorised as shown in Figure 1.

Figure 1. The categories of healthcare waste



Examples of different types of healthcare waste are given in Table1.

Table 1. Examples of types of healthcare waste

Category	Examples
Infectious waste containing pathogens in sufficient quantity that exposure could result in disease	Lab cultures and stocks of infectious agents, wastes from isolation wards, tissues, materials or equipment that have been in contact with infected patients
Pharmaceutical waste	Expired or unnecessary pharmaceuticals and drugs
Pathological waste containing human tissues or fluids	Body parts, human foetuses, blood, other body fluids.
Chemical waste	Solid, liquid and gaseous chemicals from diagnostic and experimental work, cleaning materials
Sharp wastes	Needles, infusion sets, scalpels, broken glass

Category	Examples
Radioactive waste	Radioactive substances including used liquids from radiotherapy or lab work
Pressurised containers	Gas cylinders, cartridges and aerosol cans
High heavy metal content	Batteries, broken thermometers, blood pressure gauges

A hazard has the potential to become a risk depending upon the local conditions. If healthcare waste is properly managed, the hazards are controlled and the subsequent risks to people are minimal. When badly managed, the hazardous clinical part of the waste has the potential to endanger the health both of those who work with healthcare waste and local communities; it also poses risks to the environment. These risks are considered greater than those caused by the poor management of municipal waste and include:

- spread of disease by vectors and other animals;
- air and water contamination; and
- local fire risks from the production of methane during the degradation of organic matter.

In many low-income countries, there are no national health authorities; even where they exist, they are often ineffective and suffer from very low levels of funding. This means that visiting a doctor and buying drugs can be very expensive. As a result many low-income families turn to unscrupulous doctors, who offer a cheaper service, often using recycled syringes and out-of-date or unsuitable medicines, which may have originated from the local hospital's dumping ground. This happens because waste is frequently mixed with municipal waste and often left exposed; it becomes a prime target for waste picking activities, which are endemic to most low-income countries. The situation is further exacerbated by the low awareness of waste pickers, the 'doctors' and the general public of the inherent dangers of contact with, and reuse of, many constituents of healthcare waste.

4. What do we know about the actual risks?

The hazards of healthcare waste can become risks to the population at large if pathways exist between the two. Possible pathways include:

- direct contact;
- contact through vectors;
- airborne transmission; and
- the pollution of water sources or local environment.

Each sub-category of clinical waste has the potential to pose different risks: Table 2 outlines the risks that may be posed by healthcare waste and the associated hazards and pathways.

Table 2. Risks, pathways and hazards of healthcare waste

Risk	Pathway	Hazard
Contraction of disease/infection	Direct or indirect contact through a carrier	Pathological wastes and infectious wastes may transmit disease and infection through direct contact or via vectors
Cuts	Direct contact	Sharp waste including syringes, glass and scalpels may cause cuts which provide an entry into the body for infection: for example, used syringes may be recycled by unscrupulous medical practitioners, or played with by children and are potential transmission routes for HIV and Hepatitis B
Ineffective medical care	Direct	Consumption of expired pharmaceuticals possibly through inappropriate prescription by unscrupulous medical practitioners
Cancer	Direct or indirect contact, or proximity to waste	Radioactive waste
Burns and skin irritation	Direct or indirect contact, proximity to waste	Toxic chemicals
		Radioactive waste
Injury from explosion	Being within the vicinity when explosion occurs	Pressurised containers
Pollution of groundwater, surface water and the air	Direct or indirect contact with polluted water or release to the atmosphere	Toxic chemical wastes
		Pharmaceuticals
		Waste with high heavy metal content

Whilst these theoretical risks can be foreseen, little is known of the actual risks to which health workers, waste workers and waste pickers are exposed. Most assessments of risk are qualitative in nature and there is very little research that attempts a quantitative assessment. This may be due in part to the difficulties inherent in undertaking such a task. For example, when attempting to evaluate the health impact of waste picking it is also necessary to assess the health characteristics of the local community as a baseline. Some of the health problems associated with waste picking are also associated with poor living conditions; disaggregating cause and effect is problematic.

Of those quantitative studies which have been carried out into the incidence of injury or infection resulting from contact with healthcare wastes, most have focused on injuries from sharps because:

- it is easier to quantify the number of sharps injuries directly related to handling of healthcare waste than it is to quantify infections caused as a direct result of contact with other categories of healthcare waste; and
- many sharps injuries are recorded due to the perceived high risks of contracting HIV and Hepatitis B from such injuries.

Perception of risk is an important and complex issue; the example in Box 1 below serves to illustrate the complexity of this.

Box 1. Perceived and actual risks

In the USA, there is a high perceived risk of HIV infection from healthcare waste. However, it is estimated that the occupational health risk of healthcare workers developing AIDS is between 1 in 500 000 and 1 in 750 000 per year. This contrasts with the average rate of HIV infection of 1 in 7354 per year amongst the whole population as a whole. Thus, the actual risk posed by working with healthcare waste is relatively low compared with the risk of infection from other routes. Conversely, the actual risk of contracting Hepatitis B from the handling of healthcare waste is higher than the risk of infection from other routes.

The example of Box 1 refers to the USA where there are strict regulations on the handling and disposal of healthcare waste and a high level of awareness amongst healthcare workers of the hazards and potential risks. In low-income countries where fewer measures are taken to protect against infection and hazards in healthcare wastes, the levels of awareness are much lower.

The review of literature does not provide any significant guidance about the actual risks associated with poor management of these wastes. Past research has focused on the specification of best practice rather than objective assessments of the actual impacts of poor practice. This leaves a number of key questions unanswered:

- does responding to theoretical perceived risks (which may differ widely from the actual risks in many circumstances) result in radical changes to procedures through the adoption of very high standards, using expensive and inappropriate technology?
- has 'best practice' based on these and similar premises tended to focus on technological or end solutions, with a resulting lack of guidance and emphasis on small intermediary steps which can be carried out at low cost; and
- how can the positive benefits of reducing occupational health risks be offset against the negative impact on livelihoods?

Box 2. Unanswered questions: the dilemma of living with waste

Consider the effect of prohibiting waste picking on landfill sites that are used for the disposal of healthcare waste. For the scavenger who relies on the income that he/she gains through the sale of recovered waste the economic effects are serious; changes to healthcare waste management which protect them from its dangers also destroys their livelihood; however, improved occupational health reduces family expenditure on healthcare, fewer working days lost due ill health, and less illness is spread to the immediate family.

5. Groups most at risk

The impacts of poor healthcare waste management differ from one population group to another. Specific groups who come directly into contact with healthcare waste include:

- waste pickers;
- waste recyclers;
- drug addicts (who scavenge for used needles and disposed medicines);
- hospital sweepers and other low-grade hospital staff.

They can be affected in two ways:

- through direct contact with waste every day of their working lives as a result of poor healthcare waste management practices;
- through dependency on existing healthcare waste practices for their livelihoods.

In Tables 3, 4 and 5 we have attempted a qualitative comparison of relative risk levels for different groups of the population

Table 3. Risks to informal actors

	Group	Risk Level	Why
Informal actors	Waste pickers	Very High	<ul style="list-style-type: none"> • Close and direct contact with waste. • No alternative method of income generation - healthcare waste often provides greater economic return than other waste. • Low level of education and low awareness of risks. • Little use of protective equipment due to cost, low awareness and the fact that it hinders their work. • Often low resistance to disease and infections due to poor diet and poor living conditions. • Poor access to healthcare. • More likely to use unscrupulous doctors and be affected by the primary recycling of products. • Residential areas likely to be near/on waste sites. • Contamination of living environment.
	Recycling industry: <ul style="list-style-type: none"> • Itinerant waste buyers • middle dealers • main dealers 	High	<ul style="list-style-type: none"> • Close contact with waste but less than waste pickers. • Exposure to by-products from waste processing. • No alternative - livelihood depends on contact with waste. • Low level of education and low awareness of risks. • Little use of protective equipment due to cost, low awareness and it often hinders their work. • Often low resistance to disease and infections due to poor diet, poor living conditions etc. but usually have higher income and quality of life than waste pickers. • Poor access to healthcare. • Likely to use unscrupulous doctors and be affected by the primary recycling of healthcare products. • Contamination of environment.

Informal actors come into direct contact with healthcare waste but are often invisible to organisations and institutions. They usually act on an independent, self-employed basis although individuals may join into groups to form small micro-enterprises. Their income is highly variable and insecure; it is largely dependent on their personal day to day activities/work patterns and good fortune. Informal waste workers are usually considered as outcasts of society and their opinions are rarely considered. They usually come from very poor backgrounds and have little education, turning to waste picking as the only option left open for them to earn money. Itinerant waste buyers and those involved in the recycling industry have slightly more secure jobs and are slightly higher up the social scale.

Table 4. Risks to formal actors

	Group	Risk Level	Why
Formal actors	Healthcare workers	Medium	<ul style="list-style-type: none"> • Highest awareness of dangers. • May have undergone training in best practices therefore more likely to apply these routines. • Involved in creation of waste but have little contact with waste after its generation i.e. are usually not involved with waste collection. • If working within healthcare establishment may be provided with free healthcare and likely to be immunised against certain diseases that can be transmitted through waste. • Contamination of living environment.
	Healthcare waste workers <ul style="list-style-type: none"> • Sweepers in hospitals • Other low grade hospital staff 	High	<ul style="list-style-type: none"> • Some awareness of dangers as may have undergone training in best practices. • Often supplied with protective equipment but may be reluctant to use it. • Relatively high level of contact with waste. • If working within healthcare establishment may be provided with free healthcare and likely to be immunised against certain diseases that can be transmitted through waste. • Contamination of environment.
	Municipal waste workers	High	<ul style="list-style-type: none"> • If co-disposal practised may come in close contact with healthcare waste. • Low awareness of dangers - reluctance to use protective equipment even if provided. • May not be aware that they are in contact with healthcare waste. • Often also involved in waste picking activities. • Close/direct contact with waste. • Higher/more stable income than waste pickers therefore higher quality of life, access to healthcare. • Contamination of environment.

Formal actors have waged employment that brings them into contact with the healthcare waste stream; their jobs are relatively secure. Although healthcare waste workers are still considered among the lowest social groups, they are more likely to have their opinions considered than the informal actors and may be represented by trade unions. They may be provided with protective equipment and receive basic training, although in low-income countries this is frequently neglected. Healthcare workers will

have completed some medical training and have a higher level of general education. Their social status is much higher than waste workers and they have a greater influence on and knowledge of healthcare waste practices.

Table 5. Risks to the local community

	Group	Risk Level	Why
Local community	Low-income groups	Medium to High	<ul style="list-style-type: none"> • Residential areas likely to be near/on waste sites. • Closer contact with waste than higher income groups, e.g. through vectors, contact with waste pickers. • Little access to healthcare. • Likely to use unscrupulous doctors and be affected by the primary recycling of healthcare products. • Low level of education and low awareness of risks. • Often low resistance to disease and infections due to poor diet, poor living conditions etc. • Contamination of environment.
	Children	High	<ul style="list-style-type: none"> • Low awareness of dangers. • Attraction to parts of waste e.g. syringes as toys. • At more risk if from low-income families as likely to have greater access to waste due to location & lack of supervision. • Likely to have a lower resistance to disease and infection than adults. • Contamination of environment.
	Drug addicts	High	<ul style="list-style-type: none"> • Exposed to similar risks as waste pickers as they scavenge for used hypodermic needles and syringes to use to inject drugs. • May attempt to use (misuse) drugs found on healthcare waste sites. • If from low-income groups, also subject to the above risks.
	Health establishment visitors & patients	Medium	<ul style="list-style-type: none"> • Where healthcare waste management practices are poor, they may be exposed to waste. • Visitors less at risk than patients as shorter stay and have greater resistance to infection. • Contamination of environment.
	Middle-high Income groups	Low	<ul style="list-style-type: none"> • Little or no contact with waste or with waste workers. • Good living conditions and access to good healthcare. • Contamination of environment. • Greater political power to stop bad practices occurring near homes. • Higher level of education and greater awareness of risks.

Very low-income families, such as those who depend on waste picking, may live in squatter settlements or even within a waste dump. They are usually poorly educated and their opinions are often neglected. By comparison, higher income groups have a better quality of life, are more educated and have more influence.

This qualitative analysis indicates that waste pickers are most likely to be at serious risk from the hazards associated with healthcare waste. The informal, invisible nature of their activities means they have little access to healthcare support, education or awareness raising in relation to occupational health and have most to lose if their access to the waste is prevented. Whilst their livelihoods are the most vulnerable to changes in the healthcare waste management system, similar livelihood issues also affect actors further up the recycling industry chain. Boxes 3 and 4 tell two typical stories.

Box 3. Abul Hossain, healthcare waste picker, Dhaka, Bangladesh.

After a serious accident, Abul had to give up work as a building construction labourer as he could no longer do heavy physical work and started earning his living by picking the valuables from hospital waste. He chose this job because:

it is not physically demanding;

he is his own boss;

no financial investment is needed; and,

cash is obtained instantly.

He works both inside the Banga Bandhu Medical College (BMC), Dhaka and in the municipal bin provided outside the hospital where a large amount of clinical waste is dumped. He collects syringes, needles, saline and blood bags, drips and other valuables and earns between Tk.100 - 120 (US\$2.0-2.4) per day selling these items to small local traders. In order to support his family of five, he supplements this income by making brick chips for the building industry. He has a limited knowledge of the risks of handling clinical wastes but wears gloves and shoes and wraps a piece of cloth around his nose when handling waste. He and his family members suffer from skin diseases, colds and fevers several times a year; he attributes these to his job. He also believes that tetanus and septic infections are caused by handling hospital waste. However, other members of his family believe that disease is as a result of injustice, sin or curses and that God will protect them as they are poor. They also feel that many other people are in contact with the waste and are still healthy. Abul has never been discouraged from picking the waste, even within the hospital. He knows that the goods that he collects are often cleaned and sold back to local medicine shops and believes that if they are cleaned properly they present no risk of spreading disease.

Source : Field work by Dr Noor Kazi, Dhaka, Jan 2000

Box 4. Barkat Masih, sanitary worker, Karachi, Pakistan.

Barkat has been employed as a sanitary worker by the Karachi Municipal Corporation (KMC) for the last 15 years. His job is to collect waste from municipal bins in an upper middle class area in the south of the city. He and three others operate with one waste collection van. They cover an area of 194 acres which contains one private hospital and about 6 consulting clinics. Whilst in theory he should not be exposed to healthcare waste, many of these establishments dispose of their hazardous waste along with general municipal waste. Recently Barkat was infected by hypodermic needles whilst transferring waste to his basket for carrying to the refuse truck; as a result he had to spend one week undergoing costly treatment. He was not wearing protective equipment.

He is paid Rs 3000 per month (\approx US\$55) which includes allowances for medical treatment and purchase of equipment. However, with a family of five to support he cannot afford protective equipment and can barely afford a pair of shoes. His co-workers say that infection from healthcare waste is a common occurrence; waste is dumped indiscriminately by the various establishments. Their employers at KMC do not listen to their complaints as they say that healthcare waste is not the responsibility of the municipality, even though they recognise that healthcare waste management in the city is poor. Attempts are being made to address the problem. Previously, healthcare waste was the responsibility of the establishment that produced the waste. KMC has now started to develop a healthcare waste collection and disposal service with the installation of two incinerators each of which can handle 10 tons per day. This service has not yet reached Barkat's area.

Source: Field work by Sarah Siddiqui, Karachi, Jan 2000.

6. How risks can be reduced

In section five, we described how the hazards of healthcare waste could become risks to the population at large if pathways exist between the two. We can therefore consider direct actions to reduce or eliminate risks by addressing:

- hazard reduction;
- removing the pathway; and
- protecting the population directly.

6.1 Key actions to reduce hazards

Reduce the actual hazards, which result from the nature of the waste by:

- efficient separation from the waste stream at the point of generation and subsequent labelling of hazardous wastes; this reduces the total volume of hazardous waste and hence reduces the costs of the subsequent specialised disposal;
- disinfect before disposal, e.g. chemical treatment, steam/heat treatment;
- maximise safe and sanitary recycling / re-use (where appropriate);
- incineration to destroy the hazard; note that ineffective incineration may cause air pollution; and
- return outdated pharmaceuticals to the suppliers for disposal.

Table 6 gives an overview of the various technologies used for the treatment and final disposal of healthcare waste. Further information on each can be obtained from the sources given in the Bibliography.

6.2 Key actions to cut the pathway

Eliminate direct contact between people and hazardous waste by:

- providing personal protective equipment e.g. heavy duty gloves, safety glasses;
- designing systems to minimise contact e.g. good onsite storage, bagging of waste, use of boxes to store waste sharps, more effective transportation, no emptying of waste directly into municipal containers;
- providing special treatment for radioactive wastes;
- restricting access to healthcare waste landfill sites;
- improving education of dangers of healthcare waste.

Eliminate indirect contact between people and hazardous waste by:

- applying vector control methods e.g. covering waste;
- protecting water supplies from contamination;
- implementing good hygiene practices when dealing with waste e.g. hand washing; and
- implementing final disposal by effective sanitary landfill.

6.3 Key actions to protect the population

Introduce measures that offer increased protection to the populations most at risk by:

- improving education, training and awareness raising for those dealing with healthcare waste which targets safety and recognition of risks;
- immunising those in contact with healthcare waste against certain diseases e.g. Hepatitis B and tetanus;
- provide better access to healthcare for those in contact with waste e.g. in order to stop infections from deteriorating.

6.4 Concluding remarks

It is essential to develop an overall strategy for healthcare waste management that takes full account of these three approaches and reviews how the different actions described above can best be implemented. Frequently, the importance of effective final treatment and disposal is over-emphasised at the expense of more basic measures such as improved education, awareness raising and segregation of hazardous waste from non-hazardous waste. The important point is to consider appropriate actions at all stages in the healthcare waste stream, from generation at source to final disposal. Improvements in healthcare waste management involve a number of activities, which can be undertaken as a series of small steps on the road to improvement. There is no 'one stop' technical solution.

Table 6. Technologies for treatment and final disposal

TECHNOLOGY	DESCRIPTION	ADVANTAGES	DISADVANTAGES	WHEN IS IT SUITABLE?
INCINERATE	A high temperature dry oxidation process that reduces organic and combustible waste to inorganic matter. Many different types of incinerator ranging from the sophisticated to the basic; however, basic incinerators often cause serious emissions problems.	<ul style="list-style-type: none"> Requires no pre-treatment. Good disinfection efficiency. 	<ul style="list-style-type: none"> If not operated effectively may pollute atmosphere High capital and operational costs. Low cost incineration is possible by using a drum or brick incinerator, however, these present large emission problems and are not as effective in the destruction of hazards. 	<ul style="list-style-type: none"> >60% combustible Moisture content < 30%. Not suitable for pressurised gas canisters, reactive chemical waste, PVC, wastes with high heavy metal content, photographic or radiography wastes.
CHEMICALLY DISINFECT	Chemicals added to the waste to kill/inactivate the pathogens. Shredding is usually necessary before disinfection, as only the surface of intact solid waste will be treated. The waste is then disposed of in a conventional way, e.g. landfill.	<ul style="list-style-type: none"> Efficient disinfection when operated well. Some chemical disinfectants are low cost. Shredding reduces volume of waste. 	<ul style="list-style-type: none"> Disinfectants may themselves be hazardous to operators & pose risks in the case of leakage and subsequent disposal. Needs highly trained operators. Shredder liable to mechanical failure. 	<ul style="list-style-type: none"> Best for liquid or sewage Inadequate for pharmaceutical, chemical and some types of infectious waste.
RENDER INERT	Mixing the waste with cement in order to prevent migration of toxic substances from waste into ground water etc.	<ul style="list-style-type: none"> Relatively low cost. Low-technology. 	<ul style="list-style-type: none"> Bulky and heavy final waste product to be disposed of. 	<ul style="list-style-type: none"> Especially suitable for pharmaceuticals. Not suitable for infectious waste.
WET THERMAL TREATMENT (inc. autoclaving)	Exposure of shredded waste to high temperature, high-pressure steam. If temperature and contact time is sufficient, most micro-organisms are inactivated. Waste can subsequently be disposed of as municipal waste.	<ul style="list-style-type: none"> Relatively low capital and operating costs. Low environmental impact. 	<ul style="list-style-type: none"> Shredder liable to mechanical failure. Efficiency of disinfection very sensitive to operational conditions. 	<ul style="list-style-type: none"> Not suitable for anatomical, pharmaceutical or chemical wastes.
MICROWAVE IRRADIATION	Waste shredded, humidified and then irradiated by microwaves. The heat generated destroys micro-organisms.	<ul style="list-style-type: none"> Very efficient disinfection when operated well. Environmentally sound. Reduction in volume of waste. 	<ul style="list-style-type: none"> Relatively high capital and operating costs. Potential operation and maintenance problems. 	<ul style="list-style-type: none"> Not suitable for pharmaceutical or chemical wastes Not suitable for large metal objects.
LANDFILL (Sanitary)	Landfill isolates waste from the environment; it requires appropriate engineering preparation, staff to control operations, organised deposition and covering of waste. Waste may be pre-treated (see above). Ideally, healthcare waste is separated from municipal waste.	<ul style="list-style-type: none"> Simple, low cost & safe when operated properly. 	<ul style="list-style-type: none"> If not operated properly scavengers may access the waste and it may cause pollution of environment etc. 	<ul style="list-style-type: none"> Generally suitable
(Encapsulate)	Pre-treatment involving filling containers with waste, adding an immobilising material and sealing the container e.g. bituminous sand, cement mortar.	<ul style="list-style-type: none"> Preventing access to HC waste by scavengers. Relatively simple, low cost & safe. 	<ul style="list-style-type: none"> Not recommended as sole method for non-sharp infectious waste. Bulky and heavy final waste product to be disposed of. 	<ul style="list-style-type: none"> Appropriate for establishments using minimal programmes for disposal of sharps, chemical or pharmaceutical residue.

7. Examples of good practice

The management of solid waste in low-income countries is generally very poor. The systems that exist normally cater only for municipal waste and treat hazardous wastes (including healthcare wastes) by the same methods. However, we have identified isolated cases of good practice from which we can draw lessons. The following case studies were difficult to find; however, they do offer practical examples of what can be done to address the problems of poor management of healthcare wastes. The key lessons are summarised in the Conclusions.

Box 5. Good practice at the Aga Khan University Hospital, Karachi, Pakistan

The Aga Khan University Hospital is a large health care institution of medical research, education and both private and public treatment. It admits an average of 2500 in-patients a month and many times this number of out patients.

Waste handling is the responsibility of the Housekeeping Section of the Maintenance Department, which has a staff of 223: of these, 13 are managers and the rest 'housekeepers' who handle waste directly. All new personnel must attend a 15-20 day training course prior to starting work. House keepers and incinerator operatives are required to wear a uniform, including protective gloves and a face mask. The annual budget for waste management is Rs. 18.4 million (≈US\$0.35 million) - Rs 4 million (≈US\$77,000) on consumable items, Rs 14.4 million (≈US\$273,00) on wages for the housekeeping section).

The waste is separated at the point of generation into different coloured bags. Infectious, pharmaceutical and chemical waste is placed in double red bags; general solid waste in green bags; kitchen waste in blue bags; and disposable surgical items such as used syringes, sharps etc. are placed in puncture proof containers clearly marked 'danger'. Note that 'red' bags and 'danger' bags are hazardous.

The red bags are placed in closed containers in the utility rooms on each floor. Once full, the containers are wheeled to the incinerator located on the hospital premises; residual ash is transported by a private contractor to the municipal landfill site. The incinerator has a capacity of 3500kg of waste per day; it currently processes about 1200kg, at an approximate running cost of Rs. 22.50 (US\$0.43) per kg. On those days when the incinerator is not working, infectious waste is stored in walk-in freezers located in each ward.

Green and blue bags are carried in open containers to a storage site where the recyclable material (e.g. paper, plastics) is separated and sold to private contractors. Kitchen waste (e.g. organic waste) is ground and disposed of in the municipal sewer system. The remaining waste from these bags (approximately 1800kg per day) is transported by the Karachi Metropolitan Corporation to the municipal landfill site.

Liquid waste such as blood and urine from the laboratories is flushed into the municipal sewers via underground neutralising tanks containing calcium carbonate and other disinfectants. Chemical waste is first de-activated within research laboratories before going through the neutralising tanks. Human waste, such as blood and urine, from treatment rooms and wards is disinfected before reaching the municipal sewers.

Source: Field work by Sarah Siddiqui Jan 2000

Box 6. Good practice at the Enam Clinic & Diagnostic Centre, Savar, Bangladesh

The Enam Clinic is a small, private healthcare facility, which provides general healthcare, emergency, surgical and maternity facilities; it incorporates 65 beds, a pharmacy and an operating theatre. In 1998, practical training was given with financial help from the Asia Foundation to clinic staff on how to improve their waste management system. All healthcare workers involved in waste management are now trained in operational aspects and undergo awareness-raising on the consequences of poor healthcare waste management. This has resulted in major improvements to waste management practices.

Non-hazardous wastes such as discarded food, paper and packaging materials are placed in a small waste bin by each bed in the clinic. These are emptied into a plastic bucket by a 'ward boy', and carried to a fixed concrete bin within the clinic's premises. This waste is then transferred to the nearest municipal bin by hospital cleaners using shovels and handcarts, from where it mixes with the municipal waste and is carried to the landfill site by municipal staff.

Hazardous waste such as needles and infected materials are collected at the time of generation by the nurse-in-charge of the bed, using a small stainless steel container. The sharps are subsequently placed in a separate plastic container whilst other wastes are deposited in a plastic bin which is lined with a removable polythene bag. The bin is fitted with a lid to reduce problems with insects. When two-thirds full, the bag and the sharps containers are carried to a burial point on the premises. Access to the waste by waste pickers and possible vectors is further minimised by covering the waste with a layer of soil every day.

The hospital managers understand that the final disposal of their hazardous waste is not ideal. However, they are attempting to improve their waste management incrementally over a period of time.

Source: Fieldwork by Dr Noor Kazi, Jan 2000.

8. Conclusions: lessons learned

Poor healthcare waste management is widespread in low income countries; many people come into direct contact with the waste and are thereby exposed to health risks. Important contributory factors include a lack of awareness of the potential health risks, a consequent lack of motivation to improve the situation and inadequate resources with which to improve practices.

There has been little quantitative research into the actual impacts (as opposed to perceived impacts) of the risks posed by poor healthcare waste management. Solutions and best practices based on perceived risk rather than assessment of actual risk could result in the adoption of very high standards, using expensive and inappropriate technology, which is unsustainable. There is a resulting lack of guidance and emphasis on small intermediary steps, which can be carried out at low cost; additional work is needed to ensure that solutions are appropriate, affordable and suitable for implementation in an incremental way.

For the same reasons, it is difficult to address the dilemma of the impact on the livelihoods of waste pickers who are most at risk from the adverse health impacts of handling healthcare waste. Restricting access to waste has important occupational health benefits but serious negative impacts on the incomes of waste workers and waste pickers who are drawn from the urban poor. There is scope for holistic approaches to be developed, for example through raising awareness and providing basic protection measures whilst still permitting access to non-hazardous wastes under more carefully controlled conditions.

The following lessons have been learned on how to improve healthcare waste management from the two case studies of good practice in Karachi and Dhaka:

- improve practices at all stages of the waste stream and do not focus on one component only, for example final treatment;
- separate the different types of waste at source: in particular sort infectious waste, pathological waste, sharps and chemical waste from non-hazardous material;
- separation and sale of reusable but non-hazardous materials such as paper, plastic and glass can successfully take place under controlled conditions if the waste is separated at source;
- be prepared to improve the systems incrementally rather than look to 'once and for all' solutions such as incineration of all waste from the outset; small steps can have significant impacts;
- establish a distinct management function for dealing with the waste generated;
- create a dedicated budget line for waste management;
- provide all staff with training on handling waste; and
- work out detailed procedures for storage, handling, transfer and disposals of waste according to its characteristics and potential risks.

9. Select bibliography

Ahmed, R. (1997) **'Hospital Waste Management in Pakistan'** Urban Waste Expertise Programme (UWEP) Case Study report

This document outlines the results of a detailed study into the current practices of healthcare waste management in Karachi, Pakistan. It discusses, in detail, the various formal and informal actors involved in healthcare waste and how they must all be considered when making changes to current practices. An environmental impact of current practices is carried out and specific recommendations made which may also be relevant to other cities in similar situations.

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Association for Rural Development and Studies (1999) **'Medical Waste Disposal in Bangladesh with Special Reference to Dhaka City and its Environmental Evaluation.'** BRAC Research and Evaluation Division, Dhaka.

This document reports on the existing practices of healthcare waste management in Dhaka. It includes an assessment of the impact of these practices on health and the environment. It contains personal interviews with those involved in healthcare waste and investigates the incidents of occupational injury of these groups. Finally, it provides recommendations for improving existing practices.

For further details and availability contact –

Association for Rural Development and Studies,
196/3 Shantibagh,
Dhaka - 1217,
GPO Box: 644,
Dhaka - 1000,
Bangladesh

Bangladesh Centre for Advanced Studies (1997) '**Final report on “Hospital Environmental Management Project”**' and associated '**Training Manual on Hospital Waste Management for Hospital Staffs**' BCAS.

The 'Hospital Environmental Management Project' studied the procedures in place for the management of healthcare waste in a small hospital in Dhaka. This survey concluded that procedures carried out were not sufficient. Suggestions for improvements were made and the staff underwent training in these new procedures using the training manual. The impact of training was then monitored and it was concluded that such improvements can easily be made.

For further details and availability contact -

Bangladesh Centre for Advanced Studies,
House 23 (New) 620 (Old),
Road 10A (New),
Dhanmondi,
GPO Box 3971,
Dhaka- 1209,
Bangladesh.

e-mail bcas@pradeshta.net

Bostoen, K. (1997) '**Landfilling Healthcare Waste. Sustainable method of disposal or threat to public health?**' MSc report, WEDC.

This report analyses the risks involved with healthcare waste management: perceived, biological and chemical. It includes introductions into transmission of infectious diseases, toxicology and an overview of landfill practices. It concludes that, on the basis of available information, it is not possible to answer the question posed in the title. However, it suggests that the formal landfilling of healthcare wastes in low-income countries may offer a significant benefit to public health compared to current practices.

For further details and availability contact -

WEDC
Loughborough University,
Loughborough,
Leicestershire.
LE11 3TU
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email: WEDC@lboro.ac.uk

Chary, V.S. (1998) '**Medical Waste Management Practices in Bidar City and Strategies for Safe Disposal**' Centre for Energy, Environment and Technology, ASCI, India.

This report presents a study on current practices in medical waste management in Bidar, a small urbanising Indian city. It attempts to identify an appropriate strategy for the safe management of this waste integrating technical, financial, institutional, managerial, social and environmental issues.

Available from

Centre for Energy, Environment and Technology,
Administrative Staff College of India,
Bella Vista,
Hyderabad - 500 082

e-mail schary@asci.globemail1.com

Coad, A., (1992), '**Managing Medical Wastes in Developing Countries**' Report on a Consultation on Medical Wastes Management in Developing Countries, WHO, Geneva, Sept 1992. WHO.

The aim of this report is to promote procedures and facilities that will reduce the risk of the spread of disease and the occurrence of accidents associated with healthcare wastes. It first outlines hazards and risks associated with healthcare waste. A selection of current practices in developing countries are then discussed and evaluated, before detailed, practical advice on appropriate treatment and disposal practices is given.

Available from WHO stockists or WHO directly (see address below)-

WHO,
DSA,
CH-1211,
Geneva 27.

e-mail publications@who.ch

Coad, A. (1997) '**Lessons from India in Solid Waste Management**' WEDC, Loughborough, UK.

This book provides a detailed assessment of the lessons learned through a series of training courses and case studies in India. It covers most aspects of solid waste management including a relevant chapter on the management of hospital wastes. It outlines current practices in Mumbai and offers appropriate suggestions for improving these practices.

For further details and availability contact

WEDC (see address given previously).

Coad, A. & Christen, J. (1999) **'How Are We Managing Our Healthcare Wastes?'** SKAT, Switzerland.

This publication offers a guide to the investigation of waste management practices in healthcare establishments. It is based on the work done on case studies in Ghana, India, Nepal, the Palestinian Territories, Senegal and Tanzania. It includes a general introduction to healthcare wastes and offers conclusions on the lessons learned from the case studies.

For further details and availability contact -

Intermediate Technology Publications Ltd.,
103-105 Southampton Row,
London.
WC1B 4HH
UK

e-mail orders@itpubs.org.uk

Collins, C.H. & Kennedy, D.A. (1993) **'The Treatment and Disposal of Clinical Waste'** H & H Scientific Consultants Handbook No. 13.

This is a small handbook mainly directed at decision makers involved in the disposal of hospital waste in developed countries although it will also be useful for those involved in such decisions in low-income countries. It is a valuable guide, which reviews past literature including information on the relationship between perceived and actual hazards of clinical waste. It details recommendations for all stages of the waste management system including descriptions of a large range of final disposal technologies.

For further details and availability contact -

H and H Scientific Consultants Ltd,
P.O. Box MT27,
Leeds.
LS17 8QP

Hornsby, M.J., Sunga, I. & Kochhar, R. (1998) **'Demand Survey for Medical Waste Incineration Equipment'** Intermediate Technology Consultants Ltd. (Innovative Technology Centre, De Montfort University).

This report studies the demand for low cost incinerators for the disposal of hospital waste in Nepal, Zimbabwe and India. It investigates the main barriers to the introduction of such incinerators, namely, lack of ownership, compliance with legislation, ability to pay and market awareness. Conclusions are reached which state that incinerators are only useful as part of a holistic waste management programme and a plan of action to achieve this is suggested.

For further details and availability contact –

Innovative Technology Centre,
De Montfort University,
School of Agriculture,
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Caythorpe,
Lincolnshire.
NG32 3EP

http://www.dmu.ac.uk/Schools/Agriculture_and_Horticulture/Research/Innovative_Technology_Group/Inc.htm

http://www.dmu.ac.uk/Schools/Agriculture_and_Horticulture/Research/Innovative_Technology_Group/Inc2.htm

Lampis, A. (1997) **'Hospital Waste Management in Colombia'** UWEP Case Study Report.

This report details practices in healthcare waste management in Columbia, based largely on both examination by the author and interviews with actors in the process. It includes information into the development of micro-enterprises and larger organisations in the recycling of hospital waste.

For further details and availability contact

WASTE (see address above).

Layne, P., Westbrook, W., Hendry, K. & Pierson, T. (1988) **'Review and Evaluation of Existing Literature on Generation, Management, and Potential Health Effects of Medical Waste.'** Research Triangle Institute, USEPA.

This report offers a concise consolidation of the literature on medical waste available in 1988. It focuses mainly on the situation in the United States. It contains detailed information on the effectiveness of treatment and disposal processes and discusses the known occurrences of infection from medical waste.

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North Carolina 27709-2194,
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e-mail - listen@rti.org

Soncuya, R.T., Matais, L.B. & Lapid, D.G. (1997) **'Hospital Waste Management in the Philippines - Two Case studies in Metro Manila'** UWEP Case Study Report.

This study documents the waste management practices in two hospitals, from in-house management to collection and disposal. It outlines official practices and laws and compares them to actual practices. Recommendations are given on how to improve healthcare waste management with specific reference to the minimisation of human and environmental contamination and the promotion of small and micro-enterprises in the reuse and recycling of hospital waste.

For further details and availability contact

WASTE (see address above).

Soncuya, R.T., Matais, L.B. & Lapid, D.G. (1997) **'Hospital Waste Management in the Philippines - Minor Health Care Institutions and Funeral Establishments in Metro Manila'** UWEP Case Study Report.

This study investigates the healthcare waste disposal practices of minor healthcare institutions and funeral parlours. It identifies operational and legislative gaps in the existing solid waste management system and seeks to identify future research activities.

For further details and availability contact

WASTE (see address above).

Pescod, M.B. & Saw, C.B. (1998) **'Hospital Waste Management In Four Major Cities - A Synthesis Report'** UWEP working document 8.

This document contains a useful synthesis of the material gathered in case studies carried out in: Karachi, Pakistan; Hanoi, Vietnam; Bogota, Columbia; and Manila, Philippines. It outlines in detail current practices and the various stakeholders involved in hospital waste management. It concludes with an evaluation of current practices and recommendations of how these can be improved.

For further details and availability contact

WASTE (see address above).

Prüss, A., Giroult, E.& Rushbrook, P. (1999) **'Safe Management of Wastes from Healthcare Activities.'** WHO, Geneva.

ISBN 92 4 154525 9

This publication is directed at public health professionals, regulators, hospital managers and administrators. It recommends safe, efficient and sustainable methods for the handling, treatment and disposal of healthcare waste. It provides approaches, of many different degrees of sophistication, to healthcare waste management. It also addresses the organisational and policy issues that should be considered in this realm.

For further details and availability contact

WHO suppliers or WHO directly, (see address previously given).

Prüss, A. & Townend, W.K. (1998) '**Teachers Guide - Management of Wastes from Health-Care Activities.**' WHO, Geneva.

This accompanies the WHO publication Management of wastes from health-care activities (Geneva, 1999). It provides teaching materials (suggested overheads, handouts, exercises and course evaluation forms) and recommendations for a three-day training course, designed mainly for managers of healthcare establishments, public health professionals and policy makers.

For further details and availability contact

WHO suppliers or WHO directly, (see address above).

Also available on the following web site.

http://www.who.int/environmental_information/Information_resources/worddocs/HCteachguid/health_care_wastes_teacher.htm

WHO (1985) '**Management Of Waste From Hospitals**' EURO Reports and Studies 97. Report on WHO meeting, June 1983. pp61.

ISBN 92 890 1263 3

This publication provides a useful overview of the management of hospital waste. It includes a discussion of the impact of poor hospital waste management and provides brief outlines of how to improve current practices. It includes sections on the practical issues of handling, storage, transport and disposal as well touching on the legislative, administrative and economic aspects of improving hospital waste management.

For further details and availability contact

WHO suppliers or WHO directly, (see address above).

WHO, (1999), '**Guidelines For Safe Disposal Of Unwanted Pharmaceuticals In And After Emergencies**' Geneva.

This publication offers practical advice on the disposal of drugs in difficult situations. It outlines relatively simple low cost measures and is addressed to local authorities, healthcare personnel and other professionals confronted with this type of problem.

For further details and availability contact

WHO suppliers or WHO directly, (see address above).