Medical Waste

While passing by a hospital you must have noticed blood soaked bandages, needles, syringes, cotton, etc., dumped in a nearby municipal dump where a ragpicker might be rummaging through the waste, trying to sort and collect recyclables from this waste, or a cow moving around for food. If all these have not been able to catch your attention then the stench might have.

Hospitals are meant to ensure community health. But, with the increasing load of hospital waste, especially owing to the increased use of disposables, it is becoming a major source for transmitting various diseases and putting those who handle it and live in its proximity, at risk.

What is medical waste?
Medical waste includes all types of wastes produced by health care units, clinics, doctor’s offices and other medical and research facilities.

The general belief about medical waste is that all the waste produced is infectious. However, it is only a small percentage (10-15%) of the hospital waste that is infectious, while another 5% is non-infectious but hazardous. 80-85% of the waste, i.e. the major chunk, is general, household type waste.

The most commonly used technology for dealing with medical waste, till recently was an incinerator. Incinerator, when introduced was supposed to be a wonder technology. A technology that would get rid of loads of waste by burning it and would leave behind some ash, that could be dumped. However, instead of solving the problem of waste, it aggravated it. It only changed the biological problem into a chemical one. When burnt in the incinerator, the solid and liquid toxic wastes get transformed into gaseous emissions dispersing pollutants over land and water systems and into the atmosphere. These include toxic chemicals and metals like mercury, lead and cadmium. In addition, potent carcinogens like dioxins and furans are created when chlorinated products like syringes, catheters, PVC tubing, blood bags, bleached paper etc. are incinerated.

Further, incinerator ash is highly toxic as it contains heavy metals whose concentration in the ash increases if the air pollution control equipment is installed. The heavy metals in the ash might leach and pollute the ground water, if it is dumped into a landfill.

It was then realized that solving the problem of medical waste lies in managing waste by segregation. Infact, the Bio-Medical (Management and Handling) Rules 1998, have made it mandatory for hospitals to segregate their waste and treat it according to its type in addition to a complete ban on incineration of chlorinated plastics and recognition of alternative technologies such as microwave and autoclave.
Segregation is the key to any waste management scheme. Segregation comprises of sorting waste into different streams, and placing it into different containers and bags at the point of generation. If the waste is not segregated at source and all type of waste is mixed, all 100% waste becomes infectious, and the hospital has a huge chunk of waste to deal with. Unable to handle this huge quantum of waste, the hospital ends up throwing most of it in near by dumps, where ragpickers come in contact with the infectious waste while sorting through the waste. Further, absence of segregation also leads to the incineration of many types of waste which are particularly unsuitable for this, increasing the toxicity of the emissions and ash.

Segregation at the point of generation ensures that the general waste does not become infectious. Hence with segregation, a hospital can -- reduce total treatment costs, reduce the impacts of this waste on the community, and reduce the chances of infecting workers.

Hospital waste is categorised into infectious, disposables, general, liquid, non-infectious or hazardous and sharps. Let us examine each type separately.

**Infectious waste:**
Microbiological waste, body parts, pathological tissues, soiled cotton and dressings come under the category of infectious waste. Infectious waste should be kept separately and under no circumstance should it mix with the non-infectious waste. While the pathological waste should be either incinerated or deep buried (deep burial option should be practiced in rural areas or towns with population less than 5 lacs. For specification of the pit, please refer to the rules), the rest can be microwaved, autoclaved or hydroclaved.

**Liquid waste:**
All body fluids (blood, urine, suctions of body fluids like lungs aspirations etc.) come under the category of liquid wastes. Hospitals generate liquid wastes, which are considered infectious in nature. These should be treated with 1 - 10% bleach (a concentrated sodium hypochlorite solution mixed with the liquid so that the percentage of bleach in the final solution is 1 - 10%) for an hour and then flushed into the sewer system.

**Non-infectious Waste:**
Non-infectious waste is like normal household waste and therefore does not require any special treatment. While the general office waste comprising of the waste papers can be sent for recycling, kitchen waste can be utilized in many different ways according to the quantity of the waste. In large hospitals, technologies like bio-digests can be installed. Such conversion uses the waste as a resource producing both compost as well as gas. The gas can be piped for cooking etc. In smaller establishments kitchen waste can be composted, for use as manure.

**Chemical hazardous waste:**
Hospitals also generate a wide range of chemical hazardous waste, which must be stored separately and properly managed. They should be neutralized before flushing them down the drain. These include – solvents, chemotherapy waste, photographic chemicals, formaldehyde waste, radioactive waste, heavy metals like mercury used in instruments, other toxics and corrosives, waste anaesthetic gases etc. Most of the X-ray films and the photographic chemicals are taken by contractors and the hospital can earn from this waste.
Radioactive waste is to be handled in accordance with the Atomic Energy (Safe Disposal of Radioactive Waste Rules) 1995.

**Plastics**

There has been a major shift towards plastics (particularly PVC), within hospitals be it syringes, blood and urine bags, IV bottles, tubings etc. This is because, plastics are disposed off after single use, which reduces interpatient transfer of pathogens via equipment. However, there are problems related to its use and disposal. A major problem is their resale, which can spread infection to the patient on whom it is used and also injure rag pickers who collect waste. As for disposal, incinerating PVC leads to the formation of dioxin and furans, which are carcinogenic and have endocrine disrupting properties. These are toxic at levels as low as 0.006 picograms per kg of body weight. Further, if disposed in a dump, the toxins in it can leach, thereby contaminating the surrounding soil and water bodies.

Plastics should be treated by non-burn technologies. They should be disinfected and mutilated as it prevents reuse. Waste should be mutilated using shredders. However, in smaller settings simple techniques can be used -- the fingers of the gloves can be cut, syringe tips can be cut using needle cutters/ destroyers, IV bottles can be punctured and the same can be done to other disposable items. Technologies like microwaves, autoclaves, hydroclaves and chemical disinfection are the most suited methods for the treatment of plastics.

Plastic medical waste after being properly disinfected and mutilated can be sold as plastic scrap. This waste has a lot of value because medical disposables are made of virgin high-grade plastic. However different types of plastic have to be separated before it can be recycled because of different melting points, different viscosity etc.

In addition to the disposal problems of PVC, there is concern of PVC in use, especially with blood bags. Plasticiser content and lead and cadmium additives which are loosely bound to PVC, can easily leach out in the blood. The patients needing frequent blood transfusions and sensitive patients are at very high risk. A number of hospitals in Austria and Germany have substituted PVC products by non-PVC products such as - glass, metal, rubber, certain types of plastics like ethylene inyl acetate copolymers, polypropylene, polyethylene and silicon.

**Sharps** consist of needles, syringes, scalpels, blades, glass etc., which have the capability to injure by piercing the skin. There is a danger of needle stick injuries and transmission of infection to hospital personnel and those who collect waste both municipal sweepers and ragpickers.

Improper disposal of sharps spells another risk -- the risk of reuse. Syringes to lancelets have been said to enter the market. Once these sharps are used and disposed, they are picked up, washed, repacked and sold. They are sold at cheaper prices and therefore have a ready market. This once again raises the specter of transmission of infection through its reuse.

The problems associated with sharps can be handled by treating them before disposal. A needle cutter/ destroyer can be used to cut the nozzle of the syringe and destroy the needle. The cut needle should then be disinfected by putting in a liquid disinfectant.
Glass shards should be collected with spatula. Sharps should be placed in a puncture resistant container immediately after use, which should be sealed before sending for final disposal.

**Mercury**

Mercury is a heavy metal which freely changes from liquid to gaseous form in the nature. It is used in various medical instruments like, thermometers, sphygmomanometers, dental amalgams etc. It can enter the body through skin or by inhalation. Mercury has the potential to pass through the blood brain barrier, the placental barrier and can also affect the sensitive organs like kidney, liver and the central nervous system. Alternatives to most of the mercury applications are available now. Switching on to these alternatives would be a good option for hospitals or if working with mercury instruments they should train all the staff to contain any spills. Mercury spills can be managed easily by gathering all the mercury using two hard sheets, then sucking the big droplet formed with the help of a syringe. The mercury can be emptied into a bottle with some water. Mercury being heavier than water settles down and this minimises its chances of escaping. This can be sold to anyone who deals with mercury instruments.

**Technology**

There are a growing number of efficient, economical, viable and environmentally friendly alternatives to medical waste incineration

**Autoclaving or steam sterilization** has been practiced for years and is typically used for reusable items such as syringes and other medical equipment. It encourages the reuse or recycle of medical equipment. For example, an estimated 45% of infectious medical equipment is reused through autoclaving in western hospitals.

Autoclaving involves heating medical waste at 120 deg C at 15 psi for 60 minutes (other temperature and time combinations are mentioned in the Rules). The steam penetration ensures destruction of bacteria and pathogenic microorganisms. Waste is reduced by an estimated 75% of its volume and can either be landfilled directly or compacted further.

However, it is not suitable for certain types of medical waste including low-level radioactive waste, organic solvents, laboratory chemicals, chemotherapy waste and pathological or anatomical remnants.

**Microwave Disinfection:** Microwave disinfection relies on treating medical waste with moist heat and conventional microwaves. High frequency waves cause the molecules within the waste material to vibrate. This generates heat from within the matter itself. The heat generated is high enough to ensure that all microbes are killed.

Microwaving is economically competitive and versatile. Since the internal microwave heat system is closed, studies in Europe have shown that there are no emissions at all. Consequently, there is no need for pollution control devices. However, it is not suitable for pathological waste, hazardous chemical compounds and metals.

**Hydroclave:** In a hydroclave, steam is introduced in the vessel jacket; which transmits heat to the wet, fragmented waste, which, in turn, produces steam of its own. It sterilizes the waste by high temperature and pressure steam, similar to an autoclave. It reduces the volume upto 85% and reduces weight upto 60%.
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**Chemical Disinfection:** Chemical disinfection is cost effective and does not require large investments. In this form of disinfection a chemical is used to destroy the pathogens. Chemical disinfectant generally used is sodium hypochloride or bleach.

**Shredder:** The shredder mutilates waste and reduces it into small unrecognizable pieces. The shredder is economical for large hospitals or for shared facilities. The waste should be shredded after disinfection.

**Combined facility:** Smaller health care units with low funding, space constraint and high cost of establishment of the facilities are unable to afford an individual facility. Such health care institutions can solve their problem of waste treatment by joining hands with one another and establishing a common waste treatment plant running by common funding from all the health care institutions sending their waste to the plant. Hyderabad, Mumbai and Delhi are a few places working towards establishing a centralized facility.

To conclude, we can say that no single disposal technology can be used to treat medical waste. It requires a combination of technologies along with segregation, disinfection, recycling. For example, contaminated plastics need to be shredded and disinfected, while pathological waste may need to be incinerated. If a medical facility does not have the resources to treat its waste should make sure that the infected waste generated from their premises is disinfected using bleach.

Thus solving the problem of medical waste requires a combination of technologies and the concepts of minimisation and segregation of wastes.

**Source:**
1. Managing Hospital Waste: A guide for health care facilities, Kela et.al. 1998
2. Plastics in healthcare A factsheet, Srishti, 1999
3. Factsheet on mercury, Srishti
4. Sharps Handling and Disposal: A Fact sheet, Srishti

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