"EPIDEMIOLOGY OF HAZARDS OF DISEASES TRANSMISSION RISKS WITH BIO-MEDICAL WASTE IN COMPARISON WITH MUNICIPAL SOLID WASTE, AND THE RELATED UNIVERSAL PRECAUTIONS.'

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OBJECTIVE

Whilst 'awareness' of Infectious waste handling, treatment and disposal is being vigorously pursued, the knowledge of how the diseases get transmitted and the scientific risks involved is not known to the managers and workers of waste generators and waste handlers. The contents of this paper will bring awareness of weighing the risk analysis for Hospital Waste as well as for the Municipal Solid Waste, and the public health and environmental hazards associated with the disposal of waste. Knowledge about the 'Universal Precautions' related with infectious waste and its implementation will be of great benefit to the community at large.

BACKGROUND

The momentum on hospital waste management gained public opinion in USA, when medical waste washing up on resort beaches was noticed. In India, the momentum of medical waste management took place with public concern on risk of medical waste transmitting the human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other associated with blood borne diseases. Furthermore, recycling of medical disposable back to the health treatment facilities through the waste handling industry, became a greater concern. Soon the Bio-medical waste (Management & Handling) Rules, 1998 was promulgated in India.

On the other hand, based on the principles of disease transmission, it is extremely unlikely that infectious agents from medical waste will be introduced into a host by the respiratory tract, urinary tract, gastrointestinal tract, or mucous membranes of the mouth, eyes, or nose so long as standard health measures and proper personal hygiene practices are adhered to (e.g., no ingestion, no injection). There is no evidence that a member of the public or a waste industry worker has ever acquired infection from medical waste. The only medical waste that has been associated with infectious disease transmission is contaminated sharps. All reports of transmission of infectious agents by contaminated sharps describe occurrences in the healthcare setting during patient care, laboratory procedures, or sharp disposal, and not associated with environmental injuries that occurred after extramural disposal. This aspect has been well covered by William A. Rutala and Glen Mayhall, The Society for Hospital Epidemiology of America, in their paper 'Medical Waste'. Rutala and Mayhall in this article further bring out the findings that the household waste contains more microorganisms

with pathogenic potential for humans on average than medical waste. Several investigators have demonstrated that household waste contains, on the average, 100 time more microorganisms with pathogenic potential for humans than hospital waste. The concentration of gram-negative rods was on an average 10,000 times higher than waste from the operating room. Selected findings are tabulated in this paper.

Modes of Disease Transmission and Universal Precaution, covered in this paper, will further re-emphasise the contents of the background note. This paper would provide further thinking to legislative authority, general public and media about the Bio-medical and household waste.

DISEASE TRANSMISSION

Disease agents must have access to the body if they are to have an opportunity to cause illness; therefore, the agent and the victim must have a direct or indirect environmental association. Direct contact can occur in the handling of waste materials. Indirect contact can occur through transportation of disease agents to the victim by means of a biological vector, such as fly, mosquito, flea, or rodent.
Any living agent who transports, directly or indirectly, a disease agent (bacteria, viruses, rickettsia, nematodes, protozoa, etc.) is termed a vector. The carrier (vector) may either be a true "host" of the disease or serve only in its transportation. Domestic, commensal, or wild animals that produce infectious solid wastes serve as links in a chain of infection, ultimately ending in a man.

INDIRECT MODE OF DISEASE TRANSMISSION

Flies have been shown to transport many diseases that can infect man. When a accumulation of fly breeding media is permitted, the potential for human infection via fly-borne pathogen is great. Flies breed in large numbers in human and animal excreta as well as in food waste and sewage sludge. It has been that flies can enter a garbage container through opening as small as one-eighth of an inch in diameter and deposit their eggs. Many of these eggs are carted away when the refuse is collected, but during warm weather large numbers of larvae migrate from the can before collection. One of the most important reasons for burying garbage and mixed refuse is to control fly breeding. Flies will emerge from as much as five feet of uncompacted cover over refuse. Yet, only six inches of compacted cover is sufficient to prevent their eventual emergence. You will understand, one of the reasons as to why the Deep Burial standards are included in Bio-medical waste Rule, 1998. Studies have also shown that Flies will travel up to 20 miles (32 Km) between food sources and therefore are capable of functioning as vectors of human disease.

Landfilling: Some pathogenic fungi occur normally in the soil and will multiply through the nutritive effect of some wastes. Disturbance of infested soils in preparation of solid waste disposal provides the possibility of the fungi causing respiratory and other diseases in man. This can be done by releasing of spores and dust for inhalation or by their contact with minor wounds. Therefore, sanitary landfill roads should be kept from drying up in warm weather, and landfill machine operators should wear masks and be environmentally protected.
Rodents are carriers of dreaded diseases such as leptopirosis, Plague, Salmonllosis, Rabies. It is reported that rats outnumber human beings in Mumbai by approximately 10:1.
Sea Water: The presence of microbiological pathogens in the sea arise largely from the dumping of untreated sewage at sea That has been noted by the UN that pathogenic viruses may live up to seventeen months in the sea. Therefore all sewage be treated before discharge into the sea.
Syringe Needles. When needle cutters are used, the infective needle will liberate pathogenic aerosols, putting both, the patient and the health worker at risk. When needle burner are used, the residual metal oxide ash poses a serious toxic hazard.

DIRECT MODE OF DISEASE TRANSMISSION
Sharps. Injuries due to infected sharp at the work place are an established fact. A policy of sharps handling at each work place treating infective patients or handling infective laboratory samples should be displayed at each workstation. This paper does not cover universal precaution related to handling of sharps. Syringe needles can act as reservoirs of pathogens in which the pathogens may survive for a long time, up to 8 days, because of the blood that is present.

Microbiological quality of Hospital Waste Versus Household Waste
Several studies have quantitatively and qualitatively evaluated microbiological content of hospital waste and household waste. Household wastes that may contribute to large number of microorganisms include tissues, dog and cat faeces, soiled diapers, and putrescible foods. Kalnowski et al examined the microbial contamination and species pattern of hospital waste from surgical department (operating unit, intensive care unit, nursing station) and household waste. Using a gentle homogenisation technique, these investigators found household waste to be 10 to 10,000 times more microbially contaminated than hospital waste. In addition, common nosocomial pathogens (i.e., Pseudomonas aeruginosa, Klebsiella species, Enterobacter species, Proteus species, and group D streptococci) were detected more frequently from household waste than from hospital waste.

BACTERIAL CONCENTRATIONS (ARITHMETIC MEAN /G) IN HOSPITAL WASTES AND HOUSEHOLD REFUSE

Althaus et al, 1983

Group of Bacteria	Private Household	Operating Unit	Intensive Care Unit	Surgical Ward	Internal Medicine
Aerobic bacteria	7.2×10^6	8.8×10^3	1.57×10^5	2.8×10^5	2.6×10^6
Coliform bacteria	8.4×10^5	1.1×10^2	3.7×10^5	1.9×10^4	9.4×10^4
E coli	1.3×10^5	1.2×10^1	3.5×10^4	2.4×10^4	5.6×10^4

Kalnowski et al, 1983

Group of Bacteria	Private Household	Operating Unit	Intensive Care Unit	Surgical Ward	Internal Medicine
Aerobic bacteria	6.1×10^9	2.3×10^4	2.2×10^6	3.4×10^8	Not done
Gram-negative bacteria	6.0×10^7	5.8×10^3	7.2×10^4	2.8×10^7	Not done
Streptococci Group D	1.0×10^7	0	2.9×10^5	1.2×10^6	Not done
Facultative anaerobes	9.6×10^6	1.7×10^3	2.1×10^6	2.6×10^7	Not done

Jager et al, 1989

Group of Bacteria	Private Household	Operating Unit	Intensive Care Unit	Surgical Ward	Internal Medicine
Total bacteria	2.5×10^8	5.0×10^5	3.5×10^5	1.1×10^7	2.8×10^6
Streptococci Group D	1.1×10^7	4.0×10^1	2.0×10^3	6.3×10^5	7.9×10^4
Gram-negative rods	7.9×10^7	2.5×10^3	2.5×10^4	2.0×10^6	1.3×10^6
Obligate Facultative anaerobes	2.0×10^3	1.0×10^1	5.0×10^2	1.6×10^2	2.5×10^2

FIVE FACTORS FOR DISEASE TRANSMISSION

For any disease to be transmitted to individual, FIVE conditions must exist. All of these conditions must exist at the same time, and take place sequentially.

1. **Presence of disease producing Pathogen**. First, an organism capable of producing illness must be present.
2. **Virulence**. The Second condition that needs to exist is a sufficient quantity of this disease-producing organism to actually cause a disease.
3. **Suitable receptor**. The Third condition is the availability of a suitable receptor or "host" for the infectious organism to attack. Many persons are resistant to a variety of pathogens and therefore may not be susceptible to the given pathogen and the resultant disease.

4. **Disease transmission**. The Fourth condition is a means for the organism to be transferred from the waste material to an individual. This is called a "mode" or "method" of transmission.
5. **Pathway**. The Fifth condition that must be present is a pathway into the host's body. This is referred to as a "portal of entry".

As all the FIVE steps have to take place at the same time in sequence, the chain can be broken and the risk minimised by maintaining simple hygiene, immunisation, placing waste in bags or boxes, protective gear and the like steps.

CONCLUSION

The prospects of the climatic warming, urbanisation and vegetation changes have the potential to materially effect global patterns of vector-borne diseases. Global warming will enable the geographical distribution of vectors. Equal and perhaps greater emphasis should be laid in management and handling of household waste compared to Bio-medical waste. The urgency required is in to education and practice of better hygiene and safer sanitation rather than state of the art technologies and high environmental standards. There should not be any lack of understanding of the modes of transmission of agents associated with bloodborne diseases, which may mislead media coverage and result in intense public pressure on the legislative authorities. Universal Precautions related to breaking the sequential chain of the Five-factors of disease transmission, is the order of the day, for everyday.

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