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FROM POLICY TABLE TO BIN-SIDE: AN URGENT NEED TO ADDRESS BIO-MEDICAL WASTE MANAGEMENT IN INDIA

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ABSTRACT

This paper attempts to document the status of Bio-medical Waste Management (BMWM) practices in different healthcare facilities in India and compare that with standard recommendations for Bio-medical Waste (Management and Handling) Rules 1998. Bio-medical waste management practices at King George's Medical University (KGMU), a 100 year-old, approximately 3000 bedded, tertiary care institute are described, as a concerted effort has been made over the preceding two years to streamline these practices as part of a special GEFUNDP/ MoEF project. Proper handling and disposal of bio-medical waste entails the sequential steps of handling, segregation at point of generation, storage, disinfection, mutilation, transportation and disposal. The ultimate objective of the bio-medical waste management is to prevent the transmission of infections to healthcare personnel, patient and attendants and the community at large.

KEYWORDS : Bio-medical Waste, Bio-medical Waste Management, Bio-medical Waste (Management and Handling) Rules, Segregation, disposal

Bio-medical waste (BMW) includes all the waste generated by healthcare establishments, research facilities, and laboratories. Bio-medical waste management (BMWM) has become an important issue as it poses potential health risks and damage to the environment. Currently, it has taken a central place in the national health policy and is attracting considerable international interest. The Government of India took cognisance of this menace and issued a notification through the Environmental (Protection) Act 1986, (Rule 29 of 1986) on Bio-medical Waste (Management and Handling), Rules 1998, indicating the rules for the management and handling of bio-medical solid waste. Despite this formal notification, BMWM has been consistently overlooked by healthcare facilities across India, possibly due to ignorance, poor infrastructure or because of the absence of a model facility that can be emulated. The problem of poor BMWM has assumed epidemic proportions in India. Healthcare facilities (HCF), whether government or private, have been found guilty of violating rules laid down for proper management of BMW. Very little thought is given to the hazards of the toxic garbage that lies strewn around the facility and its terminal disposal. Indiscriminate disposal and subsequent exposure to BMW poses serious threat to the environment and human health including the health care provider, waste handlers, the patients, and their visitors. The problem is further compounded by the reuse of syringes and other material in BMW, leading to spread of diseases such as HIV and Hepatitis B and C (Sreegiri, 2009). Primary level of segregation (segregation at source of generation), which is the basic requirement for good waste management, is almost non-existent in healthcare facilities in India. Most hospitals still have not evolved the basic mechanisms to segregate biomedical waste into the major waste categories. In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of healthcare facilities that do not use proper waste disposal methods range from 18% to 64% (WHO, 2005).

This can possibly be attributed to lack of knowledge, lack of planning and/or infrastructure, lack of role model healthcare facility, lack of motivation amongst the staff and employees, ignorance about existing rules and simple dishonesty.

Potential Hazards of Bio-Medical Waste

- **Hazards to Healthcare Personnel and Waste Handlers**

Improperly contained contaminated sharps pose the highest risk in all categories of BMW. WHO estimated that in the year 2000, as many as 16,000 Hepatitis C, 66,000 Hepatitis B, and 1,000 HIV infections may have occurred among healthcare personnel due to injuries caused by contaminated sharps (Pruss-Ustun, 2005). There is also a

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Table 1: Categories of Bio-medical Waste

Category	Waste Category	Treatment & Disposal
1	Human Anatomical Waste	Incineration/Deep burial
2	Animal Waste	Incineration/Deep burial
3	Microbiology & Biotechnology Waste	Local autoclaving/Microwaving/Incineration
4	Waste Sharp	Disinfection (chemical treatment / autoclaving/microwaving and mutilation/shredding)
5	Discarded Medicines and Cytotoxic drugs	Incineration/Destruction and drugs disposal in secured landfills
6	Soiled Waste	Incineration/Autoclaving/Microwaving
7	Solid Waste	Disinfection by chemical, Treatment/Autoclaving/ Microwaving and mutilation/ Shredding
8	Liquid Waste	Disinfection by chemical treatment and discharge into drains.
9	Ash from Incineration	Disposal in municipal landfill
10	Chemical Waste	Chemical treatment and discharge into drains for liquids and secured landfill for solids

The Gazette of India (1998)

theoretical health threat to medical waste handlers from blood borne pathogens due to sharps injuries and blood splatter, as well as pathogens that may be aerosolized during the compacting, grinding or shredding process associated with certain medical waste management or treatment practices. Physical injury and health hazards are also associated with the high operating temperatures of incinerators and steam sterilizers, toxic substances in incinerator ash, and with toxic gases vented into the atmosphere after waste treatment.

- **Hazards to the Community and the Environment**

Careless disposal of BMW is hazardous to the community and aesthetically improper. There may be increased risk of nosocomial infections in patients due to improper BMWM. Waste pickers at dumpsites are especially at risk from untreated BMW. Improper waste management can lead to change in microbial ecology and spread of antibiotic resistance.

Inappropriate functioning of incinerators or other medical waste treatment equipment also adversely impacts the environment. In particular, the WHO Policy Paper on Safe health-care waste management warns of the risks from toxic dioxins, furans and other pollutants emitted by incinerators (WHO, 2004).

- **Classification of Bio-Medical Waste**

An essential element of BMWM is the classification of waste. A typical breakdown of BMW and ten standard categories are shown in the table 1and figure 1.

Bio-Medical Waste Management Rules

India participated in the United Nations Conference on Human Environment held at Stockholm in June 1972, where decisions were taken to initiate appropriate steps for the protection and improvement of human environment. Subsequently, the Environmental (Protection) Act 1986 (EPA) was formed under the Ministry of Environment and Forest, which is the most comprehensive Act in the Indian Statutes Book relating to environment protection (Jaswal and Jaswal, 1998). It is a general legislation for the protection of environment, enacted under article 253 of the constitution, which came into force on 19th November 1986. In July 1998, the Government of India (Environmental (Protection) Act 1986, (Rule 29 of 1986)) issued a notification on Bio-medical Waste (Management and Handling), Rules 1998/2000, indicating the rules for the management and handling of bio-medical solid waste. In accordance with these rules, it is mandatory for the producer of bio-medical waste to ensure its safe disposal.

Despite these rules, a lack of enforcement coupled with a lack of awareness is responsible for the present poor status of BWM practices in healthcare facilities in India.

Bio-medical waste management rules comprise of

Schedule-I includes the ten categories of BMW as

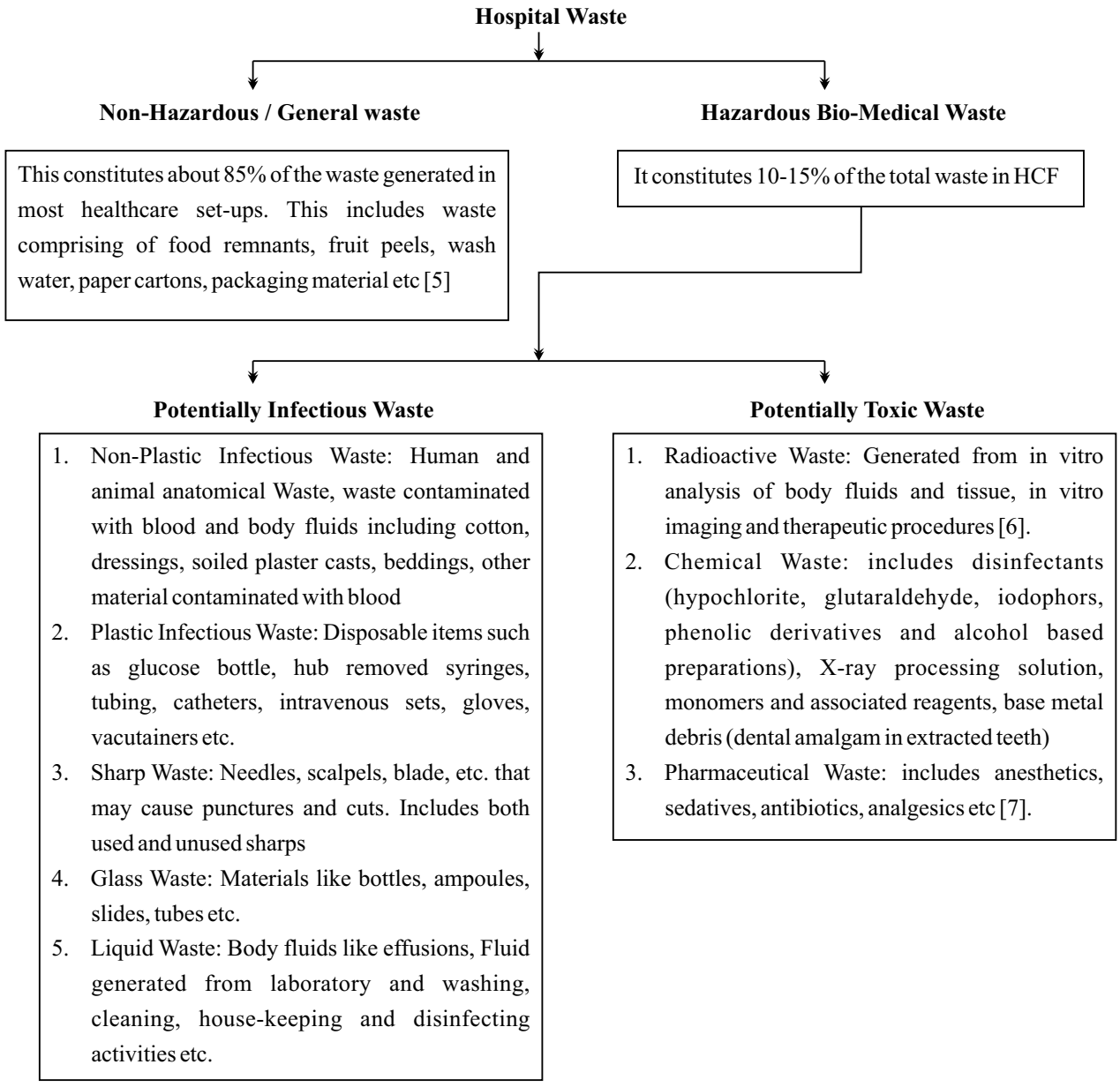


Figure 1

mentioned above.

Schedule - II Color coding & type of container for disposal of BMW.

Schedule - III Different labels for BMW containers & bags required for identification & safe handling of waste.

Schedule - IV Label for transport of BMW containers/bags.

Schedule - V Standards for treatment & disposal of BMW.

Schedule - VI Schedule for waste treatment facilities like Incinerator/Autoclave/ Microwave

Legal & Administrative Directives

The Bio-medical Waste (Management & Handling) Rules, 1998/2000 lays down the authorities, responsibilities, procedures and standards for health-care waste management. The Central Pollution Control Board Guidelines on Common Bio-medical Waste Treatment Facilities and Incineration add to the directives contained in the former. The BMW Rules direct that no biomedical waste is to be stored for more than 48 hours in untreated condition.

The Central Pollution Control Board Guidelines for Disposal of Bio-medical Waste generated during Universal Immunisation Programme (UIP), (2004) have made important additions over the instructions contained in the BMW Rules. First, it helps to reduce the quantity of sharp waste generated through immunisation programmes by advising cutting of the needles with hubs from the syringes. Second, it advises boiling of the waste sharps and used syringes and vials as a procedure for decontamination where autoclave is not available. Third, it prescribes sharp pits to dispose the waste sharps.

The Ideal Process for Waste Management

a. Facility-wide assessment to evaluate existing waste management practices and identify the various categories and quantities of waste, so that waste material can easily be segregated into different color-coded bags/bins at the point of generation itself (Schedule - I & II).

b. A simple but clear notice/poster describing which category of waste should be disposed in which bin, is to be pasted at an appropriate area nearest to the bins. The notice/poster should be in local language so that everybody can understand. There should be a pictorial depiction of waste material to be disposed, so that those who are not literate may also understand.

c. The placement of bins should be such that those being utilized for BMW (plastic, incinerable and sharp waste; red, yellow and sharp containers) are not in the direct access of the general public, yet be easily accessible to the hospital staff. This facilitates the process of segregation at point of generation. Black bins for general waste, on the other hand, should be placed at multiple access points within easy reach of patients and visitors.

d. The bags & bins carrying BMW should be labeled with the biohazard symbol & also bear the code of work station where the waste has been generated, to facilitate waste tracking. Bins should be cleaned daily after waste collection. (Schedule-III)

e. Tracking of waste from point of generation to central collection facility within the hospital allows for monitoring of segregation at point of generation and also restricts pilferage of plastic waste for resale and reuse.

f. Bags should be collected from different work stations & then are sent to central collection facility. Standard or custom made collection trolleys may be used for this purpose. Smaller ward collection trolleys, larger wheeled trolleys and rickshaw trolleys used in collection and transportation should be leak proof, covered & bear biohazard symbol. Waste collection and transportation trolleys should be washed with disinfectant solution after each shift. The corridors or ramps used for waste collection should ideally be completely isolated from public use. Schedules of waste collection, replacement of new bags, waste transport and interim storage should be set to ensure that waste is not stored beyond the 48-hour limit under section 6 of the BMW Rules.

g. The healthcare facility should have a dedicated isolated building for BMW collection and short-term storage. In the storage area, infectious & non-infectious waste should be kept in different rooms, so that general household waste does not get contaminated.

h. The BMW handler should wear all the protective gears i.e., mask, glove, boot, apron, etc. while handling of waste. He or she should be fully vaccinated for hepatitis B virus.

i. Safe disposal of the various categories of waste is the final step of BMW management. The BMW should be disposed of according to Schedule-II as mentioned above.

j. Steps should be taken to minimize various occupational hazards inherent in the careless, non-ideal collection, transport and storage of BMW, e.g., cut/punctures from sharps, contact with infected material, aerosols, etc. Examples include refresher training, monitoring & corrective action, and ensuring the availability of proper containers and protective gear. Both medical/paramedical and non-medical staff and workers may be exposed to the hazards.

k. Establishment of adequate and ideal BMWM practices in any healthcare facility is a labor intensive, time consuming continuous process of awareness and education and needs perseverance. The hospital management needs to organize awareness/education programs, especially for the auxiliary staff. Games, debates, drama, movie, essay competition etc. Are good tools for this purpose. Eliciting the participation of staff in developing implementation plans helps build ownership and commitment to BMWM. Identifying staff

who would champion the cause of BMWM is very important in establishing role models for the hospital community. Regular monitoring rounds are an integral part of an effective system for BMWM, which identify compliant and defaulter sites and staff, identify locally relevant problems and promote a two-way dialogue. The monitoring rounds should specifically take note of the following:

- Segregation of waste and any attempt to secondarily segregate
- Placement of poster and bins and their maintenance
- Record keeping
- Requirements on-site and any local problems
- Knowledge of personnel with regards BMWM practices
- New and existing health care professionals requiring re/training in BMWM
- New suggestions

Bio-Medical Waste Management in India: A Review

Most of the studies conducted in various states of India have described a poor state of BMWM. A study conducted by Singh et al. (2011) in Jhansi, Uttar Pradesh revealed that most of the private as well as Govt. hospitals were not disposing off their BMW properly as per BMWM rules. These healthcare facilities were not segregating the BMW on a daily basis in accordance with the various waste categories and were also not collecting waste in the appropriate types of containers with specified colour coded bags and plastic drums. In another study done in Chennai, BMW management practices were found unsatisfactory. Waste segregation was absent in almost all hospitals, colour coding was not followed, storage of bio-medical waste was not being done in an isolated area, personal protective equipment and accessories were not provided and most of the hospitals did not have proper waste treatment and disposal facilities(Radha et al., 2009).

A survey performed on the characteristics of hospital waste and the present practice of hospital waste management in 38 hospitals and clinics in Dhaka, Mymensingh and Dinajpur revealed that the present waste disposal system was unhygienic and unsafe. The knowledge level of hospital staff on the harmful impacts of improper waste disposal was also very low (Akter et al., 1999).

Some studies reported a partially evolved system with a disconnect between knowledge and practice. Mathew et al., 2011 reported the status of disposal of BMWM in Ludhiana, Punjab, which showed that the doctors working in the healthcare facilities were sound in theoretical knowledge than the more practical aspects of BMW management. In the case of nurses and paramedical staff, the reverse was true, i.e. their theoretical knowledge lagged behind that of doctors while their practical knowledge regarding BMW segregation and management was better. The doctors attitude towards BMW management was casual, while nurses and paramedical staff were more meticulous and careful. The BMW management practices in the hospital were satisfactory, except for a deficiency in supply of needle-cutters in a few wards.

Another study by Joseph and Ajith Krishnan, 2003-2004 from Pondicherry reported that more than 52% of the respondents were not aware of the existence of legislation for BMWM and majority (72%) were not aware that authorisation was required by healthcare facilities.

Burning was the most widely prevalent (42%) practice followed by incineration (39%), burial (28%), segregation (24%), autoclaving (24%) and deep burial (23%). Vast majority (74%) did not use any colour coding and only a very small percentage (15%) used the biohazard symbol.

On the other hand, some studies have reported satisfactory BMWM. A study conducted by Sarojini et al. (2007) in Chettipalayam, Coimbatore found that the hospital/healthcare waste was being collected and sent to Common Biomedical Waste Treatment Facility (CBWTF) for treatment. In CBWTF, waste was being properly treated according to the rules.

According to Uttar Pradesh Pollution Control Board (UPPCB), among 5510 hospitals of U.P., only 3631 (65.9%) hospitals have authorized Bio-Medical waste management systems in place and a total of twelve Central Bio-Medical Waste Treatment Facility (CBWTF) plants have been established and are functioning smoothly. Apart from this, seventeen hospitals have their own incinerator (UPPCB Report, 2011).

Bio-Medical Waste Management at KG Medical University, Lucknow

King Georges Medical University, Lucknow is a 100-year old tertiary-care 3000 bedded hospital with about 40 departments and catering to 510,000 OPD and 51,000 Indoor patients per year. This tremendous footfall is over a widely scattered sprawling campus and is also contributed to by undergraduate medical students and a huge number of patient relatives and attendants.

The status of BMWM practices at KGMU were almost dismally the same as has been described for most places in India till about two years back. In the last two years, we have managed to establish a model facility for BMWM in the University, based very much on the ideal process of BMWM described in the preceding paragraphs.

The University was selected to be a priority site for Global Environment Facility (GEF)/Ministry of Environment and Forest (MoEF)/United Nations Development Program (UNDP) project which was initiated in May 2010. The GEF-financed MoEF project, supported by UNDP, seeks to demonstrate best practices and non-incineration technologies for BMWM to avoid environmental releases of dioxins and mercury. A lot of what has been achieved is as a consequence of the guidance, supervision and financial support from this project.

At the beginning of the UNDP-GEF-MoEF project, there was hardly any segregation at the point of generation and all the categories of waste were being mixed together. This was attributable to lack of infrastructure, lack of knowledge and a sheer lack of commitment.

Whatever segregation was being done was being done secondarily by the authorized waste collector at the terminal disposal site. The University was paying a waste disposal company for terminal disposal and the University was not getting any revenue for the waste it was producing. There was also a significant risk to the health care workers, waste sorters, community at large, besides significantly contributing to an increased burden of incinerable waste. As the figures in table 2 simply suggest, the magnitude of incinerable waste has significantly decreased and has become largely plastic-free, thereby reducing dioxin and furan emissions as required by the Stockholm Convention on Persistent Organic Pollutants of which India is a signatory. Moreover, the University, by virtue of segregation at point of generation and further segregation and recycling of autoclaved plastic waste, has started generating revenue, which offsets the costs incurred for disposal of biomedical waste. As a consequence, finances generated as a result of recycling plastic biomedical waste offset the cost of BMW disposal by approximately 25% as of now.

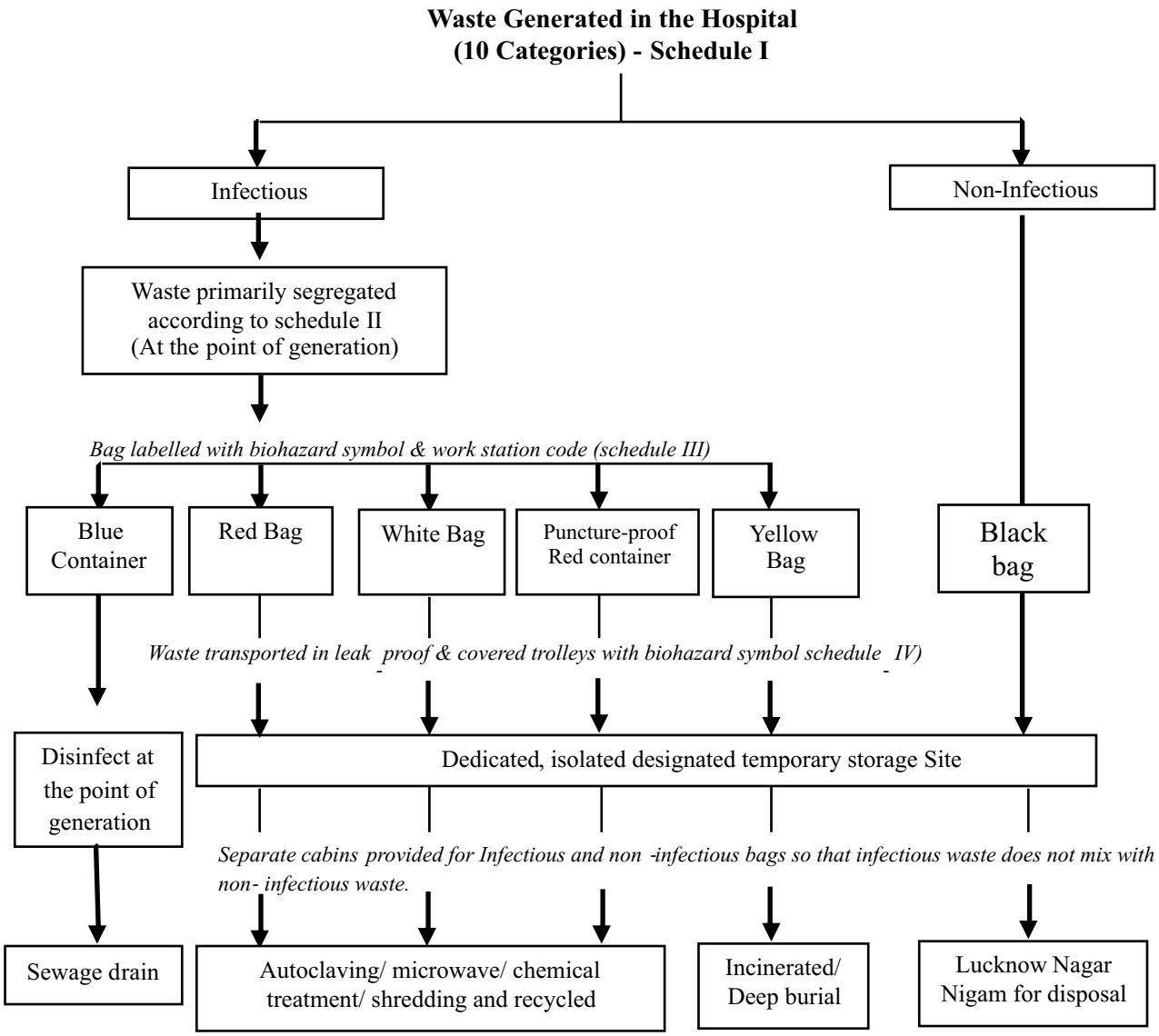
As a first step, the University administration was sensitized towards the issue of poor BMWM and was then motivated to form a dedicated Waste Management Committee along with the establishment of a BMWM Cell. A member secretary for BMWM was formally appointed and faculty members/staff were selected and designated as nodal officers for the individual departments. A centralized policy for segregation at point of generation into various categories of waste based on colour codes was formulated. A strategy was formulated for the regular and clean collection and transport of BMW from the various departments of the University. A dedicated and isolated place for terminal collection and temporary storage of BMW was identified and constructed. This facility also houses the Autoclave and shredder for on-site disinfection

Table 2 : Comparison of Waste Generation Data Before & After the Development of BMWM System

Type of waste	Previous status Wt Kg/day (% total)	Current status Wt Kg/day (% total)
General Household Waste	807 (33.2)	2239 (80.1)
Infectious Plastic waste (Autoclavable)	770 (31.7)	355 (12.7)
Infectious Non-Plastic waste (Incinerable)	850 (35.0)	108 (3.8)
Sharps	-	5.6 (0.2)
Glass	-	88 (3.1)
Status of segregation	Very poor	Good

Bio-medical Waste Management in CSMMU/KGMU

(According to Gazette of India (1998))



Every person who handles BMW wears complete protective gear i.e. glove, mask, boot, apron, etc.

Figure 2

and mutilation of recyclable BMW. Incinerable waste is outsourced to a company for terminal incineration. The recyclable, autoclaved and shredded, non-infectious.

BMW is sold to generate revenue for the University. Attempt to segregate at the point of generation in the highlighting feature of BMWM at KGMU, which we try to strictly enforce based on the recommended color coding of the bins. Proper signage has been put at every collection site. Collection, transportation, storage and record keeping and use of proper protective gear is being done as per the norms. Regular training and monitoring is being done by the faculty members of the University who have received training in BMWM under the Training of Trainers (TOT) program conducted by IGNOU (Indira Gandhi National Open University). The University has also been made a centre for doing a six-month certificate course of Healthcare Waste Management conducted by IGNOU. The categorization of waste, colour coding and terminal disposal adopted at KG Medical University is in Table 3.

CONCLUSION

Bio-medical waste is the natural by-product of increasing and improving medical care and the increase in healthcare facilities in India. On the one hand, medical advancements have led to increased longevity and increased life expectancy in India; on the other, BMW generated by these healthcare facilities are adversely impacting human community health as a consequence of poor BMWM practices.

Despite a formal notification by the Government of India with regards BMWM as far back as 1998, the state of BMW management in most states of India is dismal, exemplifying the dismal gap between policy and implementation, between administrative resolve and ground reality. Poor BMWM has assumed epidemic proportions in India, possibly as a consequence of ignorance, indifference, poor infrastructure, administrative apathy or because of the absence of a model facility that can be emulated. It is beginning to adversely impact human

Table 3: Segregation and Color Coding Followed in KGMU

No.	Category	Waste items	Color Coding	Terminal Disposal
1.	**General waste (Non-infectious)**	Paper, Wrappers, Peels of fruits & vegetables, Remains of food & edibles etc. (General household waste)	**Black**	Land Fill Collected by Lucknow Municipal authorities
Bio-Medical Waste				
2.	**Non-Plastic Infectious Waste**	Human and Animal anatomical waste, waste contaminated with blood and body fluids including cotton, dressings, soiled plaster casts, linen beddings, other material contaminated with blood	**Yellow**	Incineration Outsourced to company authorised by UP Pollution Control Board
3.	**Plastic Infectious Waste**	Disposable items such as glucose bottle, hub removed syringes, tubing, catheters, intravenous sets, gloves etc.)	**Red**	Autoclaving and shredding and recycled (On-site at CSMMU)
4.	**Sharp Waste**	Needles, scalpels, blades, broken ampoules, stilletes of intravenous devices etc. (both used and unused.	**Puncture-proof Red Container**	Disinfection by chemical treatment/ autoclaving and shredding and recycled
5.	**Glass Waste**	Glass bottle, ampoules, slides, tubes etc.	**White**	Disinfection by chemical treatment/ autoclaving & recycled
6.	**Liquid Waste**	Waste generated from laboratory and washing, cleaning, house-keeping and disinfecting activities. chemicals used in production of biological, chemicals used in disinfection, as insecticides etc., some body fluids	**Blue**	Chemical treatment and discharge into drains for liquids*

* No formal ETF (Effluent Treatment Facility is currently available in the University)

health. Development of sound waste management policies, legislation with implementation, resolve of the healthcare facility, ensuring careful waste segregation at point of generation, on-going training and awareness programs, and safe and effective terminal disposal are strong pillars on which an effective BMWM program is based. Good BMWM will lessen the environmental and health impact of the healthcare industry. Further, as evidenced by the results in KGMU, segregation at point of generation and further segregation of autoclaved plastic waste helps in reducing the quantity of incinerable waste, generates revenue for the healthcare facility and helps reducing the emission of dioxins, as plastics are not inadvertently sent for incineration.

The success story for BMWM at KG Medical University/CSMMU, a large 3000 bed tertiary care healthcare facility within a short span of 2 years exemplifies what may easily be achieved with administrative resolve, dedicated budget, baseline assessment, motivated BMWM team, regular training, employee cooperation and perseverance. The lack of a model training facility for BMWM which can be emulated by others may soon be a thing of the past. It is also ample proof of the fact the good BMWM is neither difficult to do nor impossible to achieve..

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