

# THE CHALLENGES OF EFFECTIVE BIOMEDICAL WASTE MANAGEMENT OF INDIAN HEALTH CARE FACILITIES

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## Abstract—

Biomedical waste management in India is currently in a state of transition. Approximately half of all generated biomedical waste is improperly disposed in public and natural areas creating serious public health and environmental hazards. Existing gaps in biomedical waste management result from ineffective management systems and an inadequate state of awareness and attitude. Challenges affected by attitudes and awareness that are currently preventing the success appropriate BMW treatment and disposal exist at all levels of management, beginning with the drafting of official rules by the Ministry of Environment and Forest and ending with the viewpoint of an individual sanitary worker. This project attempted to gain a broad understanding of what these challenges are and to analyze how employee awareness and attitudes can affect and be affected by them. The findings indicate that challenges exist on all levels of the system and that attitudes and awareness are a crucial factor in motivating the actions of both government authorities and health care facilities.

**Keywords:** Biomedical Waste, toxic, sharps, chemical wastes, categorization.

## I. INTRODUCTION

Over the past twenty years, waste management in India has become a topic of important concern. India accounts for 17.5% of the global population and is currently experiencing urban migration rates that are expected to increase another 60% by 2030.<sup>1,2</sup> These rates coupled with industrial development and the increased desire for higher standards of living work together to fuel current rates of waste production. These developments have drastically altered the relationship of millions of people and their local environments and we are only beginning to fully understand what consequences our current waste management methods will have on our future. As clearly visible by enormous landfills, overflowing garbage bins and widespread public acceptance of existing waste disposal methods, as a global community we are in need of a massive reexamination to perceive the waste we produce.

Waste can be divided into four categories: municipal solid, biomedical, hazardous and e-waste. Broadly defined, BMW consists of "Any solid and/or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals."<sup>3</sup> This means that BMW can come from any hospital, nursing home,

health clinic, pharmaceutical dispensary, veterinary institution, animal house, pathological laboratory, blood bank, other health care facility or clinical establishment. While the BMW produced by all the above institutions is considered potentially infectious and requires specialized management and disposal, approximately 85% of biomedical waste in India is produced by human health care facilities (HCFs) and primarily from hospitals, clinics and nursing homes.<sup>4</sup> Government response to BMW management issues has been slow to develop and largely unsuccessful in its attempts to govern and enforce the existing BMW management rules. According to a study conducted by the Indian Institute of Management (IIM) in Lucknow, "Presently 50 per cent - 55 per cent of bio-medical wastes is collected, segregated and treated as per Bio-medical Waste Management Rules."<sup>5</sup> So where is the rest of this waste going? It is dumped in hospital's backyards, thrown on the side of roads and mixed with municipal garbage.

It has been widely recognized that the first step towards improving biomedical waste management is simply to spread awareness and knowledge about the present situation. A greater and more widespread understanding of BMW's potential hazards will help us to reconsider how we perceive waste and further emphasize the importance of public health and environmental issues.

Until we, as a global community, begin to acknowledge the consequences of our behavior and actively begin changing it, the improper disposal of BMW will continue pollute the environment and threaten people's lives.

Biomedical waste management was selected as the topic of this study because of the serious potential hazards it poses to society and the environment when it is inappropriately managed and disposed. The purpose of this study was to gain a broad understanding of the current challenges preventing Indian health care facilities from effectively managing their biomedical waste and to learn about how the state of awareness and attitude affects and is affected by such challenges. Due to the complexity of the topic chosen and constraints of the given time period, the researcher attempted to a broader perspective of India's BMW management system by conducting field work within the major cities of Jaipur, Chennai and New Delhi. Primary research questions included: (1). What are the biggest challenges preventing the appropriate disposal of BMW by health care facilities? (2). At what points in the process of BMW management do these challenges cause the most problems? (3). How do the awareness and attitudes of involved persons affect the overall success of BMW management? (4) How are they in turn affected by such challenges?

Primary fieldwork methods included conducting site visits to hospitals, nursing homes, and common biomedical waste treatment facilities (CBWTFs). During these visits, interviews were conducted with hospital administrative staff, doctors, nurses, sanitary staff, a CBWTF manager and their employees. The researcher also attended the National Workshop on Issues and Challenges in Managing Biomedical Waste in India organized by the New Delhi based NGO Toxics Link and from there conducted additional interviews with Toxics Link employees and associated BMW management professionals. The studies findings indicate that major challenges exist at all levels of management and disposal processes and that awareness and attitudes surrounding these challenges are both shaped by them and play a significant role in overcoming them.

## II. BMW CATEGORIZATION AND SYSTEM IMPLEMENTATION

As outlined in Schedule I of the Ministry of

Environment and Forest's (MoEF) 2011 biomedical waste Draft Rules, all varieties of BMW are separated into 8 categories and determined according to how a particular type of waste is to be handled, treated and disposed. Simply stated, these categories are 1) Human Anatomical Waste; 2) Animal Waste; 3) Microbiology and Biotechnology Waste and other laboratory waste; 4) Waste sharps; 5) Discarded Medicines and Cytotoxic drugs; 6) Soiled Wastes; 7) Infectious Solid Wastes, and 8) Chemical Waste.<sup>6</sup> For a complete view of Schedule I, please see Appendix A.

As per Schedule II of the new Draft Rules, all HCFs are required to segregate their BMW at the source of its production. This means each producer of BMW must take appropriate measures to ensure the safe containment and transport of all biomedical wastes within its site of origin and then to the site of its disposal. To do this, all employees must follow a four color-coded bin disposal system. Each color is designated for indicated categories of waste. Yellow bins are allocated for human anatomical wastes, discarded medicines and cytotoxic drugs and soiled waste. Red bins are for microbiology and biotechnology wastes and other laboratory wastes and also need to be accompanied by a red puncture proof container designated for waste sharps. Blue bins are allocated for chemical wastes and black bins for any simultaneously produced municipal solid wastes.<sup>7</sup> To view Schedule II, please see Appendix B. Each container is required to have a matching non-chlorinated plastic bag. Each bag is to be collected at least once a day and taken to a designated common collection area when approximately three fourths full. Each HCF's common collection area needs to have separate areas to temporarily house each kind of waste according to its color and be located with easy access to the street where the waste can then be picked up by a CBWTF employee.

From here the Ministry of Environment and Forests prescribes two options for a HCF's BMW collection and disposal. First, under certain conditions such as if the hospital has five hundred or more beds or is located in an inaccessible area, an HCF can install its own on-site BMW treatment facility, thus making the HCF responsible for disposing of the waste according to MoEF rules. Second, an HCF can choose to make an agreement for collection and treatment of their BMW by an authorized CBWTF. Because on-site installation of treatment

facilities is financially impractical for most HCFs, the majority of registered HCF's currently employ the services of CBWTFs.<sup>8</sup> The role of a CBWTF is to transport, treat and dispose of BMW using MoEF specified equipment. Because BMW consists of a variety of materials, it is crucial that each type is decontaminated and treated using the appropriate technology. CBWTFs disposal technologies should include both high-heat and low-heat methods to treat BMW accordingly. High-heat methods destroy and decontaminate through incineration and hydroclaving while low-heat systems disinfect by using autoclaves and microwaves. Yellow bags, those that hold all contaminated non metal and plastic materials and anatomical parts, are to be burned into ash using a double chamber incinerator that operates with 99% combustion efficiency, a primary chamber operating temperature of 800 degrees Celsius and a secondary chamber operating temperature of 1050 degrees Celsius. All incinerators should have an air pollution control device installed or be retrofitted to meet emission limits. All red and blue bags, (those containing contaminated plastics, biotechnology and microbiology wastes, sharps, and chemical wastes) are to be disinfected by autoclave and/or microwave technology. Black bags are to be disposed with other generated municipal solid waste. After disinfected, all sharps are to be disposed in concrete waste sharp pits.<sup>9</sup>

### III. POTENTIAL HAZARDS

The principle risk of inappropriate segregation primarily affects people who physically handle the waste. If the waste is not segregated at its source, which means if the appropriate measures are not taken to ensure its safe containment and transport immediately after procurement, the risk of the waste infecting its handlers significantly increases. Handlers include those involved in the production, transport and disposal processes such as doctors, nurses, patients, laboratory technicians, housekeeping and sanitary staff and common treatment facility employees. The health hazards created by improper segregation and lack of precautionary measures include injuries from infectious sharps, exposure to materials like bloody bandages and anatomical wastes and exposure to harmful chemical and radioactive waste. Infections caused by such exposures are commonly termed Hospital Acquired Infections and include the

accidental acquisition of diseases such as HIV/AIDS, Hepatitis A, B and C, Cholera, Typhoid, Dysentery, Staphylococcal infections, Tuberculosis and Candida infections.<sup>10</sup> Additional serious public health risks are created by inappropriate disposal practices. These include mixing biomedical waste with municipal solid wastes and/or leaving these waste materials in open public areas and/or natural habitats. The act of mixing biomedical waste with municipal solid waste automatically renders all of the general waste material as potentially infectious.<sup>11</sup> This practice can immeasurably increase the amount of waste that requires biomedical waste treatment and disposal. It also imposes particularly acute risks upon people commonly known as rag pickers. Rag pickers often sift through discarded piles of waste or landfills in search of recyclable items. When biomedical waste has been mixed with municipal solid wastes, rag pickers, who often manually sort through the waste without any form of hand or facial protection, are exposed to the risk of physical sharp injuries and transmission of infections as outlined above. If the occupier neglects to provide appropriate management of biomedical wastes and simply dumps waste materials in public spaces or natural habitats, these same risks as mentioned above are magnified and imposed on not only those directly involved, but also upon the general public, any roaming and hungry animal and on the ecological habitat of the environment in which it has been left.<sup>12</sup>

The improper management and disposal of biomedical waste also creates significant environmental hazards when then turn into additional public health risk. Currently many CBWTFs use incineration processes that are meant to destroy only yellow and infectious red color-coded biomedical wastes. Environmental and public hazards arise when segregation and/or incinerator maintenance protocols are not followed correctly. The incineration of plastics and metals commonly found in biomedical waste create toxic pollutants that if released into the atmosphere can travel thousands of miles and endanger the health of people living in surrounding communities. A few of these pollutants include dioxins, furans, acid gasses such as hydrogen chloride and sulfur dioxide, carbon monoxide, nitrogen oxide, traces of toxic metals and suspended particulate matter. Mercury is a known neurotoxin that can cause brain, kidney and lung damage. Dioxins have been linked to birth defects,

immune system disorders and other harmful health effects. Incineration processes, according to the US Environmental Protection Agency, are the third largest known source of dioxin air emissions and contribute about 10% of known mercury emissions into the atmosphere.<sup>13</sup>

To prevent such emissions, the MoEF requires that every incinerator be equipped with air pollution control device<sup>14</sup> to remove toxic incineration byproducts and prevent their release into the environment. The reality is that these rules are extremely difficult to manage on a practical level and many older incinerators continue to operate without CPCB required air pollution control device improvements in overall compliance of BMW rules and guidelines. While they include many updated explanations of BMW categorization and required color-coding systems and are a significant improvement when compared with previous regulations, they are not perfect. Current controversies surrounding this new draft illustrate how the process has developed into a system inextricably linked with contemporary issues like the lack of basic infrastructure and education and indicates that while general awareness and attitudes are certainly important factors in determining success, outcomes can also easily be affected by random circumstances.

Additionally, a person's attitude towards a particular matter is highly subjective and how they think about the issue, what decisions they make and what they actually do can be influenced by any number of unrelated conditions. Maybe a CBWTF doesn't exist near enough to a hospital or an SPCB official is just having a bad month and hasn't gotten around to signing all of those authorization papers. There are an infinite number of factors in play, yet it is the assurance of every individual's ability to adapt and find ways to overcome such challenges that is currently needed to ensure the successful management of BMW. Everyone, from the MoEF officials who are writing and revising the 2011 Draft Rules to the ward boy of even a ten bedded HCF have to be aware of the impact their actions will have and be motivated to and take the necessary precautions.

#### **IV. GOVERNANCE AND ENFORCEMENT**

One of the biggest challenges facing the effective governance and enforcement of BMW management is

the ability of the Central Pollution Control Board (CPCB) and all State Pollution Control Boards (SPCB)/Pollution Control Committees (PPC) to efficiently compile accurate annual inventories of BMW statistics such as the quantity of waste generated per day, the quantity of BMW treated per day, the total number of HCFs and CBWTFs within a particular state and the number of HCF's using CBWTFs services.<sup>16</sup> These statistics are crucial in developing a comprehensive understanding of India's BMW management progress and to thus make major administrative decisions accordingly. They are the evidence that the CPCB uses to determine which states are doing well and which are lagging behind and enable decisions about where and what kind of administrative changes need to be made.

The problem lies within the amount of inaccurate data that is being submitted to the CPCB by many SPCBs and PPCs. The CPCB's 2010 BMW inventory data, as compiled by SPCBs and PPCs, shows that many states are submitting total BMW quantity estimates that are illogical when compared with the state's total population and number of operating HCFs and CBWTFs. For example, compare the reported data from Delhi and Uttar Pradesh using the assumptions that one hospital bed produces approximately 600 grams of BMW per day and the number of beds per 1000 people is 1.5. Delhi, with a population of 1.67 Crore and 1,848 HCFs reported to have produced 10,125.03 kilograms of BMW per day. Uttar Pradesh, with a 19.96 Crore, and apparently only 4,990 HCFs reported that they generate only 23,390

kilograms of BMW per day.<sup>17</sup> That's only 13,264.97 kilograms per day more than what Delhi produces with approximately 19 times the population. Additionally the CPCB official who presented this information at the National Workshop on "Issues and Challenges of Managing Biomedical Waste in India" this past month openly admitted to the inaccuracy the CPCB's estimates of total national BMW quantity and quantity treated. He argued that the CPCB is overworked with only 8 people directly addressing BMW issues and that they have a hard time doing their jobs when SPCBs submit false data.<sup>18</sup> This argument seems legitimate when one considers that according to the same evaluation of the CPCB presented by the Indian Institute of Management, Lucknow as mentioned above, 550 more people are needed to fill both head and zonal office posts, 308 of

them immediately.<sup>19</sup> However, as of the 2010 India's unemployment rate is estimated to be around 9.4% so there should be more than enough qualified people looking for jobs.<sup>20</sup>

Additionally, in the recent article "A trail of infection. From hospital to junkyard." published by Tehelka Magazine, many other inconsistencies have been found in SPCB annual reports. According to the article, Kerala's SPCB reported to the CPCB that more than 1.65 lakh kg were generated per day during 2007. When Tehelka asked, they reported only have produced less than half of that day in 2009. The SPCB's response to this sudden drop was that it "may be due to the improvement of proper segregation of bio-medical waste."<sup>21</sup> However according to the CPCB's "State-wise status of Common Biomedical Waste Treatment Facilities for 2008", Kerala was reported to have only one CBWTF.<sup>22</sup> Tehelka also wrote that Rajasthan was reported to have generated 31,399 kg in 2007, 32,779 kg in 2008 and 19,591 kg per day in 2009 however their inquiries from the RPCB brought back quantities of only 15,872 kg for 2007 and 9,782 kg for 2009.<sup>23</sup> Such inaccuracies indicate the impact of casual and even indifferent attitudes toward BMW management of employees in the administrative offices of many SPCBs.

Such apathy towards government rules and morality of environmental policy, especially when conducted by people within managerial positions, can potentially prevent the implementation and enforcement of BMW treatment and disposal of an entire state. A NGO employee and key proponent of BMW legislation and implementation experienced such a situation. After having spent 2 years pleading with and then finally convincing the commissioner of a district in Karnataka to begin implementing BMW management, bad luck hit and before any progress was made, the commissioner was transferred to a different department. This instance illustrates how a single person's attitude can be an immense impediment towards BMW management implementation. On the other hand, the attitudes and actions of a single

person can also be the determining factor for statewide improvement. Months later after no progress had been made the commissioner's replacement was finally instated. The NGO employee brought the issue to

the new commissioner's attention and he signed the agreement immediately.<sup>24</sup> Additionally, according to an official within the Rajasthan Pollution Control Board (RPCB), 330 show cause notices were issued to HCFs across the state last year and because of the meticulous work of RPCB inspections and regulation enforcement, all pending hospitals were successfully authorized.<sup>25</sup> Efforts such as those of the RPCB, exemplify some of the significant achievements made by SPCBs.

Another challenge that has plagued government authorities is the MoEF's failure to specifically define the responsibilities of national, state and regional authorities. Ashish Chaturvedi, an industry expert believes "What is needed... is greater focus on fixing responsibility on every agency involved so conflicts between ministries and departments are minimized and compliance improved."<sup>26</sup> While in response to these issues, the MoEF has clearly defined the role of each governing authority within the 2011 Draft Rules, it is apparent that confusion still pervades the system today. During Toxics Link's national workshop, the same CPCB official was asked who is responsible for taking action when an SPCB has failed to enforce BMW management. The official reluctantly stated that all the CPCB can do is put pressure on the SPCB and that taking direct control of the situation had previously proven ineffective.

And finally what is the penalty for future malaise? Currently there is no provision specifying what punitive action should be taken for SPCB and CPCB mismanagement. HCFs and CBWTFs risk being fined and then shut down for noncompliance issues however what should be done when the states pollution control board is responsible for allowing mismanagement? A participant in the workshop addressed this issue when citing an instance of SPCB neglect to address BMW dumping in Derhedun and asked the CPCB official whose responsibility it was to step in and begin managing the situation. The CPCB official responded that it was the SPCB's, and then began pointing out that the logistics of a mismanaged CBWTF are incredibly complicated. An alternate treatment facility would have to be designated to take over BMW disposal and those can be hard to come across.<sup>27</sup> It also didn't instill much confidence that the CPCB official left half way through the workshop.

## V. IMPLEMENTATION AND COMPLIANCE

The official CPCB statistics as reported by SPCBs and PCCs report that out of a total 137,487 HCFs, 98,758 are utilizing CBWTFs.<sup>28</sup> This states that HCF compliance is approximately 72%. However as previously discussed, these numbers could simply be the compiled result of more inaccurate data reporting and therefore are inappropriate to use when assessing the current state of HCF compliance. HCF management of BMW has developed very much like its administration's methods of implementation and enforcement. It is successful in some instances and completely fails in others. 5-10 out of every 100 HCFs currently ignore regulations and do not use CBWTF services.<sup>29</sup> While it is clear that whether or not an HCF complies is largely dependent on the SPCBs ability to do its job, awareness and attitudes are again a huge factor in overcoming the challenges that exist at all levels of an HCF's BMW system implementation and maintenance.

One of the biggest challenge HCFs have faced so far is the lack of system transparency. One of the most important factors that will determine an HCF's management success is the awareness of everyone involved about exactly what to do and what they are responsible for.<sup>30</sup> As of now, the MoEF and/or CPCB have yet to create a clear and user-friendly set of national guidelines that explain exactly how all HCFs are supposed to implement and maintain their BMW management system. All existing explanations and guidelines have been created through the initiative SPCBs, NGOs and/or private companies. As a result of this lack of transparency, wide disparities between HCF methods of implementation and therefore overall success exist throughout India. 200+bedded government hospitals who are successfully operating according to BMW rules are can be found ten within ten minutes of 10- bedded private nursing homes who are completely unaware of such regulations. Conclusions based on whether or not an HCF's implementation is controlled by the governing SPCB, CPP or hospitals own administration are inappropriate to make because all types of HCFs public, private, big, medium and small, exhibit measures of success and failure. Thus to effectively explain how challenges both affect and are affected by HCF personnel, it is necessary to also understand how BMW management should ideally be implemented within any kind HCF.

The first step in implementing BMW management within a hospital is to get authorized by the SPCB. The Biomedical Waste (Management and Handling) Amendment of 2003 requires that all HCFs be authorized by their SPCB/PPC before beginning operation.<sup>31</sup> This regulation came into effect rather late and many HCFs continue to operate today without authorization. Authorization means getting permission granted for the generation, collection, reception, storage, transportation, treatment, disposal, and/or any other form of handling of biomedical waste in accordance with the rules and guidelines issued by the Central Pollution Control Board, Ministry of Environment and Forests, Ministry of Health and Family Welfare, Government of India.<sup>32</sup> The HCFs occupier is whoever has administrative control over the HCF for example the Director or Medical Superintendent. To get authorized, the occupier must submit their application form to the SPCB once they have implemented the required management system and been inspected by the prescribed authority. When assessing the compliance of particular HCF, the acquisition of authorization should be an indicator of the HCF's state of awareness and attitudes.

Being SPCB authorized however, does not necessarily mean a hospital is completely successful in managing their BMW. During an interview with the dean of Jeppiar Hospital, in Chennai Tamil Nadu, the dean adamantly expressed the importance of appropriate BMW waste management and spoke directly of the pre-operation rule, yet five minutes earlier while sitting in a ward next door, two nurses stumbled through an confused explanation of how red bins were allocated for blood products and anatomical parts while yellow bins were for plastics, syringes and IV tubes. They did however know that black bins were for general waste. Blue containers were no-where to be seen. Additionally, neither was able to recall what CBWTF comes to pick up Jeppiars BMW, described their common collection area as "just outside the main doors" and admitted that Jeppiar does not keep track of how much waste it produces<sup>33</sup>

The next step, after applying for authorization, is to conduct a HCF-wide survey of the current waste management practices. The survey's goal is to effectively ascertain the extent of system revision needed. All required supplies including the appropriately color-coded waste bins, bags, trolleys and such should be bought and

placed strategically in each ward to facilitate maximum segregation compliance.<sup>34</sup>

The location of a common collection site and the appropriate waste transfer routes from each ward to the collection site should be designated and adequately equipped to facilitate the safest possible collection and transfer of waste from the HCF to the treatment site.

The success of a HCF's capacity to acquire the needed facilities and equipments can be credited by the amount of personal investment a HCF is willing to put into its BMW implementation. Also in Chennai, Dr. Metha's Multi-Speciality Hospital exemplifies the ability of 200+bedded private hospital to go above and beyond required government rules. Their BMW segregation system is comprised of five (instead of the required 4) color-coded bins including two different kinds of red – one that is single-bagged and one that is double-bagged. Dr. Metha has allocated double-bagged bins for all infectious plastics and red single-bagged bins are for all non-infectious plastics. By taking the additional steps to separate infectious and non-infectious plastics at source, Dr. Metha's system exhibits a more than comprehensive understanding and care for the ultimate treatment and disposal of their BMW. Because their non-infectious plastic waste remains uncontaminated, it is collected by directly from the hospital by an authorized recycler instead of going to a CBWTF where its treatment would use more resources to treat waste whose contamination was completely avoidable. Dr. Metha's system also allocates black bins for cytotoxic wastes and expired drugs and green bins for general waste. Yellow and blue containers are for anatomical wastes and sharps respectively.<sup>35</sup>

Once the survey has been conducted, a waste management committee should be formed that will be responsible for training all hospital staff. Who exactly should be on the waste management committee is undefined however to effectively manage all hospital departments, it should include members from all hierarchical levels including hospital administrative staff, doctors, nurses and housekeeping staff. Training sessions should be held in groups according to respective departments and given by members of the committee. In the beginning, sessions should be held frequently for all staff and then less frequently as

everyone adjusts. During these training sessions, all staff needs to be taught about exactly what their responsibilities are and why taking them seriously is important.

One instance of a strictly regimented and highly successful awareness and training program is implemented by Mazidia Hospital in New Delhi. Mazidia is technically labeled a private institution however it also receives government funding and therefore is a good example of how both private and public administration can work together to effectively ensure that employee awareness and attitudes facilitate the hospitals BMW management. As explained by the head nurse, Mazidia ensures that no untrained staff will be employed in any department. Appropriate registration and educational background are from all staff before they begin working. To fill in whatever gaps remain, Mazidia also holds weekly training sessions to ensure the complete awareness and understanding of all staff members. Supervision is strict with 4 full time housekeeping supervisors to monitor the sanitary staff. Everyone wears gloves, masks and caps when handling BMW waste. While occasionally management problems arise, their frequency is low and an established series of punishments are enforced to prevent any persisting employee issues. Punishment protocol is as follows. A first incidence will result in the cancellation of the employee's free days and assignment of double shifts. A second incidence will result in the problem being noted and examined in official reports and a third incidence will result in the termination of their employment.<sup>35</sup>

Ensuring the future maintenance of the system is the final step towards effective and sustainable implementation. The existence of rules is not enough and an effective strategy of enforcement is key. Because most of the time a HCF's nurses and sanitary staff are the primary handlers BMW, the heads of nursing and housekeeping departments should be responsible for the practices of people within their departments. Constant monitoring and reminding about the importance of maintaining appropriate management practices is crucial. Keeping up with positional transfers and emphasizing the importance of induction training for new staff is also important when adapting hospital structural changes.

Arpan nursing home, a 10-bedded HCF in the

outskirts of New Delhi exhibits a failure of both BMW system implementation and maintenance on almost all accounts. According to one of the two employed nurses who have been working there for the past 20 years, Arpan's system of BMW management consists of collecting all infectious sharps and plastics into one bag, which is then collected by a company. All other wastes are thrown away with the hospital's municipal garbage. The nurse was unaware of which company comes to pick up the waste, and what was very apathetic when asked what if she knew what happens to it after leaving the hospital. Arpan serves approximately 50-60 outpatients and 5-6 inpatients per day and generates one to two bags of BMW. Two employed ward boys who the nurses are responsible for overseeing are in charge of keeping up the general cleanliness of the hospital and transporting the BMW outside when collected. Government officials or inspectors never come.

How can Arpan be allowed to continue such obvious BMW mismanagement when Mazidia hospital, just ten minutes away is being inspected every couple of months by Delhi Pollution Control Board Officials? Arpan's failure to implement, let alone maintain a successful BMW management system reflects how the lack of thorough and effective SPCB management of BMW systems can perpetuate the casual attitudes many nurses and sanitary staff exhibit when disposing of their biomedical waste. Without a serious risk of Arpan being shut down, of the nurse losing her job and while considering her level of education and past experience working at Arpan and complacent attitude, it is highly unlikely that she would decide to take initiative to learn about the appropriate BMW management and begin to implement it within Arpan.

## VI. CONCLUSIONS AND WAY FORWARD

The initial purpose of this study was gain a broad understanding of India's BMW management by identifying and learning about the current challenges that face the BMW management of health care facilities. Its primary focus was to then use this gained understanding to begin assessing how the state of awareness and attitude affect and are in turn affected by these challenges. New legislation to address the gaps caused by such challenges is currently in the process of being reviewed and finalized and is expected to be published in 2012.

The conclusion of the study found that the state of BMW management in India is currently in a state of flux. Major challenges that prevent 50% of India's BMW from being managed and treated exist on all levels of the system including governance, enforcement, implementation and compliance. The attitudes and awareness of people at all levels both play their parts in helping to create and overcome such challenges. The Ministry of Environment and Forests, Central Pollution Control Board and all State Pollution Control Boards and Pollution Control Committees all experience difficulties in coordinating accurate data, respective responsibilities and effective punishments for mismanagement. Health care facilities also experience challenges that are affected by the attitudes and awareness of employees. A few of these include obtaining authorization and providing and maintaining effective training for all HCF employees. While the relative success of an HCF's management is certainly dependent upon its surrounding circumstances, employee awareness and attitudes are crucial in effectively overcoming these challenges.

Fortunately a large majority of the individuals interviewed for this study noted that they believe public attitude and awareness of BMW issues are changing and will continue to develop in the future. New people, information and subsequent motivation continue to fuel systematic improvement and the contribution of every person indeed makes a difference. While the job is only half done, the improvements already made indeed reflect the genuine efforts that have brought BMW management from inexistence to where it is today. At some point, India *will* be able to effectively implement and enforce nation-wide BMW management yet the question that remains is whether the necessary changes will happen fast enough to effectively prevent an epidemic from taking place.

## VII. Recommendations for Future Study

There are plenty of opportunities for expanding knowledge and understanding about employee attitudes and awareness regarding biomedical waste issues. Due to the limitations of this study and gaining an in depth understanding all factors that could motivate a hospital to comply with biomedical regulations proved impractical to attempt. Further understanding in this regard could be conducted through in depth comparative study of two similar situated health care facilities that are exhibiting



differing levels of management success. Alternatively, many past studies have conducted broad based surveys to effectively assess HCF compliance yet many regions in India continue to remain unexplored. Locating and assessing the compliance of one of these areas could illuminate new challenges and even possibly new strategies to overcome them.

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