

Health care Hygiene: Navigating Biomedical Waste Management Rules in Post Covid-19 India

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Abstract

Biomedical wastes refer to the refuse produced by healthcare establishments during the process of treating patients. These pollutants are very hazardous and detrimental, presenting substantial risks to both environmental cleanliness and human well-being. Therefore, it is imperative to provide the management and control of these wastes, which requires the establishment of a suitable institutional and legal structure. Although these countries generally adhere to established waste management legislation, they did not have any specific waste management regulations in effect during the COVID-19 pandemic. If the spread of COVID-19 beyond the acceptable threshold, there will be more deaths in the near future. Additionally, if the enormous amount of trash is not properly managed according to adequate regulations, it could pose an environmental hazard. Various legal restrictions have periodically been acknowledged on both a domestic and global scale in response to this imperative. This study will analyse the existing regulations on biomedical waste management in India in order to assess the necessary level of effectiveness for improved management of such wastes. The analysis will encompass the global legal frameworks pertaining to biological waste.

Keywords: Biomedical waste, Bio-Medical Waste Management Rule, Covid-19, Health

Introduction

The progress of a nation depends on the advancement of civilization, the use of technology, and resource consumption, but these factors have unanticipated detrimental effects on the urban environment. As science and technology have advanced, people have also created better healthcare facilities equipped with the most cutting-edge technologies possible to extend life expectancy rates globally. With fresh advancements being produced every day, India, a developing nation, has been able to support the expansion of medical technologies. However, all of these advancements in the medical field also cause a significant amount of biomedical waste to be produced while patients are being treated. These biomedical wastes are made up of both liquid and solid materials, such as bodily fluids from people and animals, tissues, animal excrement, needles, used medication, cotton, plaster kits, etc. In simple definition, biomedical wastes are any and all wastes produced during medical procedures. Such wastes could pose major environmental and health risks if they are not properly handled and disposed off (Manjoor & Sarman, 2019).

The World Health Organization (WHO) gives a more specific classification of BMW into five categories

es that emphasise the degree of BMW-related risks, ranging from low to high levels (WHO, 2014) as follows:

• Category A: Non-hazardous wastes (office wastes, packaging, leftover food);
• Category B: BMW requiring special attention including anatomical, sharps, pharmaceutical, blood, and fluid wastes;
• Category C: Infectious wastes from laboratories and microbiological cultures;
• Category D: Other hazardous wastes such as chemicals, gases, liquids or products with higher concentration of metals (e.g. mercury);
• Category E: Radioactive wastes (e.g. cobalt, technetium, iridium).

Source: WHO Report 2014

India has a number of garbage-related issues. Local and international environmental institutions have been affected by waste disposal technologies and practises. The CPCB's new standards for handling, treating, and disposing BMWs at COVID-19 treatment facilities have increased their production. BMW disposes of leftover patient food and disposable items such as surgical masks, gloves, bibs, rolls, linens, medicine/syringe wrappers, spent water bottles, food plates, and semisolid gels (Hasija et al., 2022; Sarkodie and Owusu, 2021). These extras result in massive BMWs during the pandemic (Chowdhury et al., 2022). Their daily generation rate increased from 500-750 g per bed to 2500-4000 g per bed during the pandemic. BMWs produce 609 tonnes per day, with COVID-19 BMWs adding 164 tonnes per day, including trash from quarantine facilities (Sharma et al., 2020). Waste management is a hotly debated topic in policy and legal development. Biomedical waste management in India must be based on scientific evidence. This article compares international and national legal frameworks governing biomedical waste management to determine their compliance with standards for efficiently managing hazardous wastes (Naz & Boruah, 2021).

Evolution of BMW laws

At the turn of the 19th century, New York City's garbage included human urine, dead animals, and horse manure. Squalor encouraged bacteria and other infectious organisms. Edwin Chatwick's research into the dangerous conditions in British hospitals and jails led to the 1848 Public Health Act. This was the first step toward better public health, but many more regulations and laws were needed (Brown, 2022). Before being regulated, medical waste was dumped in the United States. Until the 1980s, when medical waste began washing up on east coast beaches, people became aware of its health hazards (Brown, 2022).

Despite hospitals, medical institutions, labs, and dentists existing for more than a century, United states congress wasn't moved to act until the 1980s by beach debris. United state congress passed the Medical Waste Tracking Act (MWTa) of 1988 as a two-year federal initiative to develop rules for medical waste disposal. 1988's Medical Waste Tracking Act stated:

- Guidelines for the definition of medical waste
- Created a waste tracking system
- Established standards for the separation, packaging, storage and labeling of waste
- Imposed penalties for failure to track medical waste

Depending on the specific violation, penalties could include anything from \$25,000 daily fines to millions of dollars in imprisonment and fines.

The MWRTA required the EPA to monitor medical waste for two years, until June 21, 1991. The EPA analysed information gathered over two years and determined that medical waste has the most potential to spread disease at the time of generation and decreases thereafter. This highlighted the risk of medical waste-related illnesses to healthcare workers. Since the MWRTA expired in 1991, state environmental and health authorities regulate medical waste. CDC, FDA, DOT, and OSHA have released medical waste safety recommendations (Brown, 2022).

A INTERNATIONAL LEGAL FRAMEWORK ON BIOMEDICAL WASTE MANAGEMENT

The most significant international conventions and agreements that are relevant to the management of biomedical waste will be covered in this section. These conventions and agreements create a broad regulatory framework and global standards that support the development of national policies in the area.

The Basel Convention

The Convention aims to control the cross-border movement of hazardous wastes, and member states must ensure they are generated, transported, and disposed of environmentally. The Convention controlled biomedical wastes by adopting technical directives like collecting hazardous wastes in leak-proof or tear-resistant containers and incinerating or disinfecting infectious wastes before disposal (Basel convention > the convention>overview, n.d.).

Bamako Convention

Koko and Basel's failure prompted this convention. Developed countries could export hazardous waste to LDCs despite the Basel Convention. This convention was meant to improve Basel and included radioactive wastes that Basel had excluded. This convention, like Basel, covers radioactive wastes. It differs from Basel by limiting transboundary waste movement. This Convention considers hospital, medical, and pharmaceutical wastes hazardous.

The Stockholm Convention

Protecting the environment and human health from POPs led to 2001's Stockholm Convention. Most persistent organic pollutants (POPs) are carbon-based chemicals that persist in the environment for long periods, posing health risks to humans and animals. Birds and mammals ingest POPs and transport them to new locations, where they affect humans and other animals (Lallas, 2001).

Minamata Convention

The Convention was first held there, where many people died from drinking mercury-tainted water from a factory. This Convention made history as the first to prioritise environmental and public health by addressing toxic metals. Regarding biomedical wastes, Article 4(1) requires member states to stop manufacturing mercury-containing devices by 2020. 16 The Convention also requires Parties to replace dental mercury with safer alternatives (*Homepage / Minamata Convention on Mercury*, n.d.).

Internationally Agreed Guidelines

The following guidelines on Waste Management that were accepted globally in addition to the aforementioned Agreements are discussed:

A. Recommendations for the Ecologically Responsible Disposal of Medical Waste

The Basel Convention Secretariat drafted guidelines for the effective management of biomedical wastes in 2003, drawing on WHO and ECSS guidelines. The guidelines include collecting Biomedical wastes

separately from other wastes and placing them in airtight and leakproof containers; disposing of the wastes in isolated places accessible only to the authorities responsible for disposing of such wastes; and limiting the reuse of syringes and needles after their initial use.

B. The World Health Organization's Recommendations for the Secure Disposal of Healthcare Waste

The World Health Organization (WHO) and WHO European Center released guidelines for the safe management of wastes from healthcare activities in an effort to raise awareness of this issue globally. Some of the guidelines' key components include: brief summaries of the various types of healthcare wastes, their sources of generation, the risks they pose, and the methods needed for their proper disposal; for the disposal of liquid wastes, recommendations for a separate wastewater sewerage system (World Health Organization, 2014)

C. WHO Recommendations for COVID-19

On April 23, 2020, WHO issued interim guidelines for waste management, sanitation, water, and hygiene during the Covid-19 pandemic. The guidelines required all sanitation workers and health workers treating Covid-19 wastes or patients to wear PPE kits with heavy-duty gloves, goggles, boots, etc. and to maintain social distance while working (World Health Organization, 2014).

Biomedical waste Rules in India

Constitutional Article

Article 21: No person shall be deprived of his life or personal liberty except according to procedure established by law

Article 21 is the most vibrant part of our constitution, and it has played a critical role in environmental protection. The court's judicial activism has established that the right to a clean and healthy environment falls under the umbrella of rights covered by Article 21 of the constitution and will be guaranteed and protected as a fundamental right.

Article 47: It is the responsibility of the State to improve public health and raise the level of nutrition and living standards.

Art.47 is a state policy directive. Raising the level of nutrition and the standard of living of its people and improving public health are among the state's primary duties. In particular, the state shall seek to prohibit, except for medicinal purposes, the consumption of intoxicating drinks and harmful drugs.

Article 48A: The State shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country

This article was added by the 42nd amendment in 1976 in response to the Stockholm conference on the environment. Article 48A requires the state to protect and improve the environment and wildlife. BMW pollutes the environment in various ways, such as by emitting harmful fumes and dumping waste into water, which leads to the extinction of wild animals.

Article 51A (g):To protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures

This article was added by the 42nd amendment in 1976. Since environmental protection is incomplete without citizen participation, this Article 51A (g) requires them to protect and improve the environment and have compassion for other living things.

Indian Legal Framework On Bio medical waste management

In India, scavengers sort open, unprotected healthcare waste without gloves, masks, or shoes for recycling, and syringes are reused without sterilization (Salkin & Kennedy, 2004). First BMW rules were notified by the Indian government in July 1998 (BMW,1998).

In 2002–2004, 82 percent of primary, 60 percent of secondary, and 54 percent of tertiary HCFs in India lacked a credible BMW system. 240 people in Gujarat, India contracted hepatitis B in 2009 from reused syringes (Seetharam, 2009). This and other studies show that despite India being among the first countries to initiate measures for safe BMW disposal, it is urgent to strengthen the existing system capacity, increase funding, and commit to safe disposal (IPEN, 2014)..

In 2000, 2003, and 2011, BMW 1998 rules were modified. BMW rules 2011 remained a draught due to a lack of categorization and standards. Ministry of Environment, Forest, and Climate Change amended BMW rules in March 2016. These new rules expand coverage, simplify categorization and authorization, and improve segregation, transportation, and disposal to reduce environmental pollution (BMW Rules, 2016)

In 1998, India's Ministry of Environment and Forests issued Bio-Medical Waste (Management and Handling) Rules. This authority was granted by EPA sections 6, 8, and 25. This required health care establishments to follow these rules, but they didn't work, so they were amended.

India has adopted several legal mechanisms for efficient waste management, including biomedical wastes, in accordance with international standards and local conditions. Biomedical waste treatment measures include:

Bio-Medical Waste Management Rules 1998

The Indian government enacted these Rules on July 20, 1998, using the 1986 Environment Act's Sections 5, 8, and 25. These Bio-Medical Waste Management Rules 1998 apply to those who collect, receive, store, etc. Biomedical Wastes. The Rules include-

- Occupants of healthcare facilities must handle biomedical wastes so they don't harm anyone's health. The Rules also require separating Biomedical wastes from other wastes in separate bags, containers, etc.
- Healthcare establishments are also responsible for maintaining waste treatment systems like incinerators, microwave systems, etc. for treating Biomedical wastes; and treatments of such wastes are to be made as per Schedule V of the Rules
- these Rules also provide for certain authorities who are made responsible for monitoring the enforcement of these Rules, and such authorities include- the State Pollution Control Boards (SPCB) and Pollutant Discharge Boards (PDB).

However, these Rules lacked penal provisions for noncompliance, lacking deterrence. These Rules also lacked safety measures for workers who collect, dispose, and transport Biomedical wastes. It also had no provisions for cleaning Biomedical waste storage devices or separating them from hospital functional units.

Biomedical Waste Management (Amendment) Rules, 2000

This Amendment introduced changes to the previously discussed Rules, which can be analyzed as follows in new Rule that is BMW (Amendment) Rule,2000 Some of the provision are as follows:

- Clause 6 was added to Rule 6 to require municipal bodies to collect non-Biomedical wastes and trea-

ted Biomedical wastes from nursing homes and dump them in municipal sites;

- Rule 8 of 1998 Rules was also amended to give authorising agencies the power to impose compliance conditions on Biomedical waste occupiers. 25; Occupants treating over 1000 patients per month and producing biomedical wastes must apply for authorization, etc.

These Rules seemed to have complicated the issue rather than solved it, since allowing municipal bodies to collect solid wastes from nursing homes has made it impractical to have 100% assurance that such solid wastes won't contain Biomedical wastes. Further, these Rules required only occupiers treating more than 1000 patients per month to apply for a grant of authorization. Any occupier treating less than 1000 patients is not required to have such a grant, but they can produce a significant amount of harmful Biomedical wastes that can contaminate the environment.

Bio-medical waste management Rules, 2016

The 2016 Bio-Medical waste management Rule regulates biomedical waste in the country. New rules:

1. Vaccination, blood donation, and surgical camp wastes are now included, expanding the rules.
2. Both occupiers (who have administrative control over biomedical waste-generating health care facilities) and operators (who control collection, reception, transportation, treatment, and disposal facilities) have clear responsibilities.
3. Barcode system for biomedical waste sent for treatment or disposal.
4. Operator or occupier must update the biomedical waste register daily and monthly on the website and keep all hydroclaving/incineration/autoclaving records for 5 years.
5. Biomedical waste segregation, packaging, transportation, and storage have been improved, and the waste has been classified into four categories instead of ten for effective management.
6. Common biomedical waste treatment facility and onsite treatment or disposal facility should be 75 km apart.
7. Stop using chlorinated gloves, bags, blood bags, etc.
8. Laboratory, microbiological waste, and blood bags must be pretreated on-site before disposal at a biomedical waste facility or on-site. Sterilization/disinfection should follow WHO/NACO guidelines (NACO).
9. Incinerator emissions are now more environmentally friendly.

The Ministry of Environment, Forests, and Climate Change will monitor rules annually. Each state will set up a district-level compliance committee under the District Collector, District Magistrate, or Additional District Magistrate.

Diferrence between BMW Rule 1998 and BMW Rule 2016

Criteria	BMW Rules 1998	BMW Rules 2016
1 Authorization	Only 1000-bed HCFs are authorised.	Every HCF needs authorization..
2 Duties of operator	Operators had no responsibilities.	Mandatory tasks are listed.
3 Division of waste	Waste was divided into 10 vague, tedious categories.	Only four specific categories remain.

4	Applicable	These rules applied to establishments with over 1000 beds.	These rules expanded the jurisdiction to include all biomedical waste facilities.
5	Examination/Review	No annual report makes policy review difficult.	Rules include a report format.
6	Duties of occupier	Laboratory waste, blood bags, etc. didn't need pretreatment. Chlorinated plastic bags, gloves, and blood bags were mentioned. Liquid waste isn't separated at the source, and ETP isn't required. Non-mandatory training and immunisation No barcodes existed	Laboratory, microbiological, blood sample, and blood bag pretreatment Remove chlorinated bags, gloves, and blood bags in 2 years. Pretreatment and ETP must separate liquid waste at source. Provide all HCWs with BMW rules and handling training and hepatitis B and tetanus vaccinations. Barcode bags or containers containing BMW for disposal.
7	Duties of the operator of a CBMWTF	No such recommendation No such records were maintained	BMW waste vehicle barcoding and GPS within 1 year Keep incinerator/autoclave/hydroclave records for 5 years. Keep a record of each treatment cycle.
8	CBMWTF	Every HCF must build a BMW treatment facility or use a CBMWT.	No occupier may build a BMW treatment and disposal plant if a CBMWTF is within 75 km of the HCF. If no CBMWTF is available, the occupier must establish a BMW treatment and disposal plant.

Bio-Medical Waste Management (Amendment) Rules, 2018 Rules

Biomedical waste rules, 2016 Rules have been changed to improve compliance and strengthen the management of biomedical waste in India.

Hospitals, nursing homes, clinics, and dispensaries cannot use chlorinated plastic bags and gloves after March 27, 2019 to save the environment. The 2018 BMW amendments exempt blood bags from phasing out.

Salient features of Bio-Medical Waste Management (Amendment) Rules, 2018 are as follows:

1. Hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, health care facilities, and clinical establishments must phase out chlorinated plastic bags and gloves.
2. Within two years, all healthcare facilities must post their annual report online.
3. Bio-medical waste treatment and disposal facilities must use bar coding and GPS.
4. State Pollution Control Boards/Pollution Control Committees must compile, review, and analyse received information and send it to the Central Pollution Control Board in a new Form seeking distri-

ct-wise bio-medical waste generation.

5. Every occupier generating biomedical waste must disinfect or sterilise laboratory waste, microbiological waste, and blood samples on-site as prescribed by the WHO before sending them to the Common bio-medical waste treatment facility for final disposal.

Biomedical waste management rule during Covid -19

Most cases are in India. According to CPCB data, India produces 21000 tonnes/day of COVID-19 waste from January to June (CPCB, 2021). As COVID-19 cases rise, gloves, face masks, face shields, hair covers, goggles, and PPE will be in high demand. In this COVID-19 pandemic, the rising use of medical devices threatens the country's ability to manage biological waste. Since 2017, homes must separate dry, wet, and domestic hazardous waste (NDTV, 2021). Non-segregation is punishable by fines. Changing behaviour changes the game. CPCB assigns different colour codes to our nation's trash. Red and yellow bins are for biowaste. Biomedical Waste Management Rules 2016 (CPCB, 2019) provide explicit direction for handling gloves, PPE, and face masks during covid 19. The Central Pollution Control Board (CPCB) releases and revises guidelines for handling, treating, and disposing of COVID-19 waste (CPCB, 2020). The latest revised guideline, 5 (Guidelines for Handling, Treatment, and Disposal of Waste Generated During Treatment/Diagnosis/Quarantine of COVID-19 Patients), was issued on April 26, 2022. It supersedes Revision 4, which was uploaded to the CPCB website on July 17, 2020.

Revision 5 of guidelines for household disposal of used Rapid COVID-19 Antigen self-test kits. All stakeholders, including isolation wards, quarantine centres, sample collection centres, laboratories, ULBs, and common biomedical waste treatment and disposal facilities, must follow specific waste management guidelines for COVID-19 suspected/confirmed patients (CPCB, 2022).

Some of the guideline for different stakeholders are as follows:

Stakeholders	Guidelines
COVID-19 Isolation wards	<ul style="list-style-type: none"> • Collect and store biomedical waste in color-coded bins with double-layered bags before delivering to CBWTF with mandatory labelling. Separate COVID-19 isolation ward waste records. • COVID-19 patient faeces should be placed in a yellow bag/container as biomedical waste. Used mask, head cover/cap, shoe-cover, disposable linen, etc. Yellow-bagged gown, non-plastic or semi-plastic coverall • Wards/isolation rooms should separate biomedical waste and general solid waste to ensure occupational safety. • The hospital's nodal officer for biomedical waste management must train waste handlers with videos and demonstrations on infection prevention.
Sample Collection Centers and Laboratories	<ul style="list-style-type: none"> • Guidelines given for isolation wards should be applied suitably in in case of test centers and laboratories. • Pre-treat viral transport media, plastic vials, vacutainers, eppendorf tubes, plastic cryovials, pipette tips as per BMWM

	Rules, 2016 and collect in Red bags
Responsibilities of persons operating Quarantine Centers/Camps/Home Quarantine or HomeCare facilities	<ul style="list-style-type: none"> • General solid waste from quarantine centres or camps should be collected in bags, securely tied, and handed over to Urban Local Bodies for final disposal. • Quarantine centers/camps should collect biomedical waste in ULB-provided yellow bags. The Quarantine Centre/camp operator must designate a nodal person for waste management and record keeping. • Biomedical waste from these centres will be treated as "domestic hazardous waste" under Solid Waste Management Rules, 2016, and disposed of according to Biomedical Waste Management Rules, 2016..
Duties of Common Biomedical Waste Treatment Facility (CBWTF):	<ul style="list-style-type: none"> • Operator of CBWTF shall ensure Workers shall be provided with adequate PPEs including three layer masks, splash proof aprons/gowns, nitrile gloves, gum boots and safety goggles Regular sanitization of workers handling and collecting biomedical waste • Provide training to Waste handlers on infection prevention via videos and demonstrations etc. • Sanitation workers over 50 years old should manage non-COVID waste. • Do not allow sick workers to work at the facility. Such workers may get adequate leave and have their pay protected.
Duties of SPCBs/PCC	<ul style="list-style-type: none"> • Keep records of COVID-19 treatment wards/quarantine centers/quarantine homes in respective states. • Separate, collect, and dispose biomedical waste per BMW Rules, 2016 • In states without CBWTFs and rural or remote areas without access to CBWTFs, existing hospital captive facilities may be used to dispose of COVID19 waste per BMW Rules, 2016 and these guidelines. • Every SPCB/PCC must use CPCB's 'COVID19BWM' web-portal to track and verify COVID-19 biomedical waste and submit daily data through said portal.
Duties of Urban Local Bodies	<ul style="list-style-type: none"> • Urban Local Bodies are responsible for safe collection and disposal of biomedical waste from COVID-19 Quarantine Camps/ Homes/ Home Care. • Separate solid waste and biomedical waste from quarantine camps/homes/homecare. • Inform those in charge of isolation wards, quarantine centres,

	and homeware units to collect solid waste and biomedical waste in separate, securely tied bags for ULB waste collectors.
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Source: Revision 5 of guidelines CPCB 2022

India was one of the first countries to take biomedical waste seriously and create a legislative structure to curb it. The rules that were formulated in the background of the Stockholm conference on bio medical waste gave detailed rules considering every aspect according to the resources and technologies in India and the country's technological advances and contemporary needs. But we shouldn't forget that a policy that looks perfect on paper can become ineffective if it isn't monitored and checked properly. In such a situation, judicial bodies play an important role, as proven in various judgements. COVID-19's waste production has no specific guidelines.

Cases related to Biomedical waste management in India

ROLE OF JUDICIARY

India's courts have made environmental protection innovations. Article 21 of the Indian Constitution guarantees the right to a healthy environment, thanks to judicial activism. As for controlling pollution from biomedical wastes, the Judiciary has issued landmark decisions in many cases.

Dr. B L Wadhwa's vs Union of India and others

When a PIL was filed against improper disposal of Biomedical wastes in Delhi, the issue of improper management was raised before the Supreme Court of India in Dr. BL Wadhwa's vs. Union of India and others for the first time. The court ruled that Delhi residents have a statutory right to a clean environment and ordered municipal bodies to dispose of harmful wastes.

The defendants claimed the Danish company didn't provide proper cleaning logistics. The court said that lack of funds or machinery is no excuse for not meeting statutory obligations. Case is important because it lays out directives for bio medical waste collection, handling, and disposal. Third, it asks authorities to promote civic duties through the media.

Almitra Patel's Case

In Almitra Patel's case, the Supreme Court was petitioned about the mismanagement of solid waste in Mumbai, Chennai, and Delhi. The landmark court ruling forced the government to amend the 2000 Municipal Solid Waste Management Rules. Although this case was about solid waste management, the Court highlighted the role of local-self-governments in waste management, including biomedical wastes.

Suo Motu Petition of NGT (Applicants v State of Kerela and Others, 2019)35

In the Case Applicants v State of Kerela and Others, 2019 Huge amount of biomedical and slaughterhouse wastes polluted the Periyar river. The petitioner told the NGT that hospitals were illegally dumping biomedical wastes in the river and that pollution control authorities were doing nothing. The NGT immediately formed a joint committee with members from CPCB, Kerala SPCB, and District Pollution Control Boards to prepare an action plan to comply with Biodiversity wastes Rules and fined St. John's Hospital and Rajakkad Hospital 1,62,000 for illegally disposing of such wastes.

Haat Supreme Wastech Pvt. Ltd. & Ors. Vs State of Haryana & Ors

In this case Haat Supreme Wastech pvt. Ltd.& Ors. Vs State of Haryana & Ors, the appellant ran bio medical waste treatment units with permission from the Bio-Medical Waste (Management & Handling) rules, 1998. Before deciding on the validity of notices, the tribunal asked whether they need environmental clearance to run biomedical waste treatment plant. Nine government hospitals were cited

for mishandling biomedical waste.

Conclusion

In India laws address the treatment, management, and disposal of biomedical wastes however the lack of implementation of such laws is caused by a lack of infrastructure and in part by a lack of public awareness. Additionally, it has been observed that the Indian judiciary has been taking a very long time to rule in cases where the laws governing the management of such hazardous wastes have been broken. A further risk to the health of not only those health workers but also of those who come into contact with them is created by the lack of training programmes for both who are involved in the collection and transportation of such biomedical wastes as well as for those who work in the healthcare industry. A sophisticated mechanism for separating biomedical waste from other types of waste has not been included in the Rules.

Thus, based on the above analysis, the following recommendations are suggested : First, training programmes for the management of biomedical wastes should be organized , and the rules should be amended so that attending such training facilities is a requirement for obtaining a job in the medical sector, regardless of the position sought; an implementation mechanism should be established at all district levels, with members who are experts in the field.

References

1. Agrawal, P., Kaur, G., & Kolekar, S. S. (2021). Investigation on biomedical waste management of hospitals using cohort intelligence algorithm. *Soft Computing Letters*, 3, 100008.
2. *Almitra H Patel v Union of India*, AIR 1998 2 SCC 416
3. Ara, L., Billah, W., Bashar, F., Mahmud, S., Amin, A., Iqbal, R., ... & Sarker, S. A. (2022). Effectiveness of a multi-modal capacity-building initiative for upgrading biomedical waste management practices at healthcare facilities in Bangladesh: a 21st century challenge for developing countries. *Journal of Hospital Infection*, 121, 49-56.
4. *Basel Convention > The Convention > Overview*. (n.d.). <http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx>
5. Bio-Medical Waste Management (Amendment) Rules, 2000, Ministry of Environment & Forests, available at: https://jspcb.nic.in/upload/uploadfiles/files/BMW_Notification_1998.pdf , (Last seen on March 20. 2020
6. Bio-Medical Waste Management Rules, 2016. Published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-Section (i), Government of India Ministry of Environment, Forest and Climate Change. Notification; New Delhi, the 28th March, 2016.
7. Brown, B. (2022, April 14). *The History of Medical Waste*. Solutions Inc. <https://a-solutionsinc.com/the-history-of-medical-waste/>
8. Case no O.A No. 200/2014.
9. case no O.A. No. 585/2018.
10. Choudhary, M., Balappanavar, A. Y., Gupta, S., Ghosh, S., & Verma, M. (2022). Knowledge, Attitude and Practice of Dental Health Care Professional Toward Biomedical Waste Management During COVID-19. *Journal of South Asian Association of Pediatric Dentistry*, 5(1), 3-10.
11. CPCB, 2019. Bio-medical Waste Management Rules(Amended).
12. CPCB, 2020. Guidelines for Handling, Treatment and Disposal of Waste Generated during Treatme-

- nt/Diagnosis/Quarantine of COVID-19 Patients.
13. CPCB, 2021. Generation of COVID-19 related Biomedical Waste in States/UTs.
 14. CPCB, 2022. Guidelines for Handling, Treatment and Disposal of Waste Generated during Treatment/Diagnosis/ Quarantine of COVID-19 Patients
 15. Datta P, Mohi GK, Chander J. Biomedical waste management in India: Critical appraisal. *J Lab Physicians* 2018;10:6-14
 16. Dehal, A., Vaidya, A. N., & Kumar, A. R. (2022). Biomedical waste generation and management during COVID-19 pandemic in India: challenges and possible management strategies. *Environmental Science and Pollution Research*, 29(10), 14830-14845.
 17. *Dr.B.L Wadhera v Union of India*, AIR 1996 SC 2969.
 18. Faye, M.M., [2007](#). *Plan de Gestion des déchets Biomédicaux, rapport république du tchad, deuxième projet population et Lutte contre le Sida (PPLS2)*. N'Djamena, Tchad: Ministère de l'Economie et du Plan, 51.
 19. Hasija, V., Patial, S., Raizada, P., Thakur, S., Singh, P., & Hussain, C. M. (2022). The environmental impact of mass coronavirus vaccinations: A point of view on huge COVID-19 vaccine waste across the globe during ongoing vaccine campaigns. *Science of The Total Environment*, 813, 151881.
 20. *Homepage / Minamata Convention on Mercury*. (n.d.). <https://www.mercuryconvention.org/en>
 21. INCLEN Program Evaluation Network (IPEN) Study Group, New Delhi, India. Bio-medical waste management: Situational analysis & predictors of performances in 25 districts across 20 Indian states. *Indian J Med Res* 2014;139:141-53.
 22. Indian Constitution. Art.21.
 23. Indian Constitution. Art.47
 24. Indian Constitution. Art.51A(g)
 25. Indian Constitution. Art48A
 26. Javid Manjoor and Manoj Sarman, Impact of Biomedical Wastes on Environment and Health Hazards, 31 (4) *Environmental Claims Journal* (2019), available at <https://doi.org/10.1080/10406026.2019.1619265>. (Last seen on August 07, 2020).
 27. Lallas, P. L. (2001). The Stockholm Convention on Persistent Organic Pollutants. *American Journal of International Law*, 95(3), 692–708. <https://doi.org/10.2307/2668517>
 28. Ministry of Environment and Forests Notification. Bio-Medical Waste (Management and Handling, 1998) Rules. New Delhi: Government of India Publications; 1998. p. 276-84.
 29. Mohan, H. T., Jayanarayanan, K., & Mini, K. M. (2022). A sustainable approach for the utilization of PPE biomedical waste in the construction sector. *Engineering Science and Technology, an International Journal*, 32, 101060.
 30. Naz, F., & Boruah, J. (2021). Biomedical Waste Management System Under Indian Legal Framework. *Journal of Comperative Legal Studies*.
 31. NDTV, 2021. Coronavirus Pandemic Exposes Broken System Of Bio-medical Waste
 32. Ramesh Kumar, A., Vaidya, A. N., Singh, I., Ambekar, K., Gurjar, S., Prajapati, A., ... & Bodkhe, S. (2021). Leaching characteristics and hazard evaluation of bottom ash generated from common biomedical waste incinerators. *Journal of Environmental Science and Health, Part A*, 56(10), 1069-1079.
 33. Richter, A., Ng, K. T. W., Vu, H. L., & Kabir, G. (2021). Waste disposal characteristics and data variability in a mid-sized Canadian city during COVID-19. *Waste Management*, 122, 49-54.

34. Salkin, I. F., & Kennedy, M. E. (2004). Review of health impacts from microbiological hazards in health-care wastes. *Geneva: WHO*.
35. Sarkodie, S. A., & Owusu, P. A. (2021). Impact of COVID-19 pandemic on waste management. *Environment, development and sustainability*, 23(5), 7951-7960.
36. Saxena, S., & Srivastava, R. K. (2011). Assessment and disposal issues of biomedical waste-case study Allahabad city. *International Journal of Biomedical Engineering and Technology*, 7(1), 97-104.
37. Seetharam S. Hepatitis B outbreak in Gujarat: A wake-up call. *Indian J Med Ethics* 2009;6:120-1.
38. Shammi, M., Rahman, M. M., Ali, M. L., Khan, A. S. M., Siddique, M. A. B., Ashadudzaman, M., ... & Tareq, S. M. (2022). Application of short and rapid strategic environmental assessment (SEA) for biomedical waste management in Bangladesh. *Case Studies in Chemical and Environmental Engineering*, 5, 100177.
39. Sharma, H. B., Vanapalli, K. R., Cheela, V. S., Ranjan, V. P., Jaglan, A. K., Dubey, B., ... & Bhattacharya, J. (2020). Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. *Resources, conservation and recycling*, 162, 105052.
40. The Bio-medical Waste (Management and Handling) Rules, 1998, Ministry of Environment & Forests, available at: https://jspcb.nic.in/upload/uploadfiles/files/BMW_Notification_1998.pdf , (Last seen on March 20. 2020)
41. The Bio-medical Waste (Management and Handling) Rules, 1998, Ministry of Environment & Forests, available at: https://jspcb.nic.in/upload/uploadfiles/files/BMW_Notification_1998.pdf , (Last seen on March 20. 2020).
42. The Bio-medical Waste Management (Amendment) Rules, 2018, Ministry of Environment, Forests and Climate Change, available at: https://cpcb.nic.in/uploads/Projects/Bio-Medical-Waste/BMW_Amended_10.05.2019.pdf changes in 2019, (Last seen on March 20. 2020).
43. The Gazette of India Biomedical Wastes(Management and Handling) Rules, India: Ministry of Environment and Forests, Government of India. Notification Dated; 20th July, 1998.
44. World Health Organization (WHO), [2014](#). *Safe management of waste from healthcare activities*. 2nd ed. Geneva, Switzerland: WHO Press.
45. World Health Organization. (2014). *Safe Management of Wastes from Health-Care Activities* (2nd ed.).
46. World Health Organization. (2020). *Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 23 April 2020* (No. WHO/2019-nCoV/IPC_WASH/2020.3). World Health Organization.