Bio-medical waste mangement –a review of practices adopted by hospitals in Pune city

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Abstract

The present paper is a review of practices adopted by hospitals in Pune with respect to the bio-medical waste management norms. The study was undertaken to check whether the bio-medical waste management rules are being followed or not in hospitals, Clinics and diagnostic centers in Pune.

This paper is an interesting insight on the awareness level of health organizations about waste management rules. Pune municipality has been strictly following provisions of bio-medical waste management. The research done for this paper clearly reveals that there is a lot of ignorance by hospitals, clinics with regards to waste management and the other important issue is that there is a lot of a cost involved in treating the waste.

The data has been collected from 10 health institutions like big hospitals, small hospitals, clinics etc.regarding their habits of treating the waste. And the results reveal that there is an urgent requirement of training for the staff of the hospitals as 50% (Primary sources) of staff is not clear about the standard waste management practices. Therefore, PMC should consider this issue and make sure that standard bio-medical waste management practices are being followed in all the hospitals/clinics of Pune.

The present paper also attempts to provide a solution followed by recommendations based on its observation. It demonstrates some good practices adopted by some of the hospitals under the study. The main purpose of this paper is to spread awareness about the rules (colour coding, handling of waste etc.) of handling of biomedical waste in hospitals which can be followed if a little care is taken by each hospital staff in separating the waste at starting level itself. Mainly highlighting the harmful effects of biomedical waste to the environment if not disposed of properly.

This paper also highlights the health hazards to the people handling this waste in the like laundry workers, nurses, medical personnel and other employees of the hospitals.

Keywords: Bio-Medical Waste Management, Hospitals, Best practices

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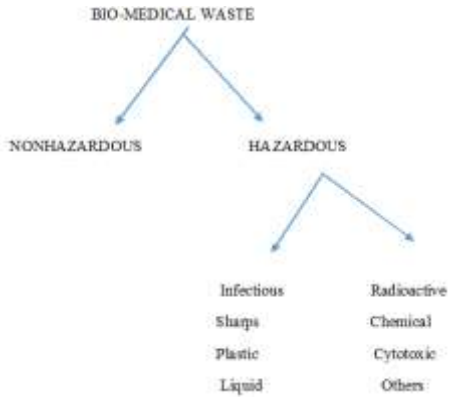
Introduction

According to Bio-Medical Waste Rules of 1988, India- Bio-medical waste is defined as "any waste which is generated during diagnosis, treatment of human beings and animals or any other waste produced during production or testing of biologicals".

In recent years, bio-medical waste treatment has mainly emerged as an important concern from an environment point of view. But the bio-medical wastegenerated from hospitals depends on various factors like availability of infrastructure and resources, types of health care units and reusable items used in hospitals etc. However, the impact of bio-medical waste on the environment, human beings, and flora fauna has raised concerns worldwide.

The main pollution that gets generated due to biomedical waste are air pollution, Indoor air pollution, outdoor air pollution, water pollution, radioactive emissions and land pollution mainly. So as the solution of all above problems there are some methods that hospitals can implement based on the budget of their waste generation because it is not only the legal necessity but social responsibility as well, So there is an urgent need fortraining to be given to the medical staff for handling the biomedical waste, then only the problem of improper disposal of waste from big and small hospitals will be solved. The need of an hour is to create a proper waste management system in order to provide quality assurance in hospitals.



Source: Department of Environmental Science, MDS University, Ajmer

Literature Review

- The paper Management of Biomedical waste in India and other Countries: A Review by B. Ramesh Babu, A.K. Parande, R. Rajalakshmi, M.Volga and P.Suriyakala at Central electrochemical Research Institute, Tamil Nadu, India highlights the effects of biomedical waste in an environmentsuch as causing air, land and radioactive pollution. The paper highlights the importance of waste management with respect to both India and world and how over the years it has gained importance because of its harmful effects on the environment, human beings, animals, and flora & fauna. The paper discusses the quantity of waste produced in India per day and the contribution of hospitals, clinics and other diagnosis centers in that total waste.
- The paper Need of Biomedical Waste management in Hospitals –An emerging issue-A Review by Praveen Mathur, Sangita Patan, and Annand S. Shobhawat, Department of Environment Science, MDS University, Ajmer. This paper talks about the impact of waste generated by the medical activities and their straight way impact on mankind. The paper highlights that disposal of BMW waste or exposure to such waste possess a serious threat to the environment and hence requires specific treatment or management before disposal. Other than that, the paper deals with the problems relating to bio-medical waste and procedures for handling and disposal method and also create awareness among health personnel regarding the biomedical waste.
- The paper A study about Knowledge, attitude, practices, and technologies of Biomedical waste management techniques by Anurag Sharma, Ravish Garg, Anuj Srivastav and Neeraj Sharma. This paper gives a review about the awareness amongst people regarding the biomedical waste and the techniques adopted by households for their waste treatment. Also, this paper discusses various techniques majorly with the help of ultraviolet rays and ultrasonic rays which should be used to eliminate the risk of getting infected during the bio-medical treatment.

Bio-Medical Waste management in NEWS recently:

Infectious liquid waste is produced from every laboratory and hospital but only 40% of them has the proper plan of disposal rest all the waste water goes into the municipal waste system without taking care of the toxic gas that comes out from that hospital waste.

Record keeping of all the waste on the daily basis is very important as it keeps the estimation of all the waste quantity from all the hospitals.Most of the incinerators are not operational because of operational cost and if some hospitals are using it they are not using APC (air Pollution Control system). The waste generated from it buried in any waste area near the hospital without following any rules and regulations

No proper training is given to the people who are handling these waste.Pre-treatment should be done, separate septic tanks, soakaway systems should be present at every hospital.

The Pune Municipal Corporation (PMC) has reduced the annual subscription charges from Rs 2,900 to Rs 2,100 In July 2014. (*Source: TOI*)

The main issue of reluctance for subscription is Cost and door-to-door service is crucial among many issues that need to be addressed. While a large number of clinics/ hospitals have ignored the PMC's structure, some have not even sought the essential authorization needed from the pollution control board for generating biomedical waste, an MPCB official said.

The city's registered healthcare facilities generate around 2,800 kg to 3,000 kg bio-medical waste every day.The city has around 6,000 general practitioners. "Currently, less than half the clinics have subscribed to the facility. Only 2,162 clinics in the city have opted for the common biomedical waste treatment facility. This means a majority of the clinics are disposing of the waste in an unscientific and hazardous manner.

The irony is that today, those who have signed up for the service are penalized if they do not pay for the service, while those who never subscribed can go on disposing of the waste the way they like without any consequences. The system and said instead of collecting the waste from the clinic, the doctors are asked to ensure that the waste reaches the collection point at a particular time. "Neighbourhood clinics do not have many employees and it is not feasible for the doctor to rush out to dispose of the biomedical waste like that.

The solution could be: instead of charging small clinics and nursing homes a fixed rate, the authorities should charge them according to the amount of waste generated.

The calculation is made on the assumption that there is full occupancy throughout the year. But, unlike the bigger hospitals who get patients throughout the year, the case is not the same with smaller hospitals and nursing homes. The bigger hospitals generate a large amount of biomedical waste in the form of blood, surgical residues, placenta etc. most of the waste at a clinic is swabs of cotton and a few syringes.

Benefits of BMW

- The common biomedical waste treatment facility located at Kailas crematorium scientifically treats and incinerates hazardous bio-medical waste generated at hospitals and clinics in Pune and charges a certain amount to doctors for the service.
- Subscribing to the facility is mandatory for all clinical establishments under the Bio-Medical Waste (management and handling) Rules, 1998 and amendment thereof

- PASSCO Environment Solution Pvt Ltd, a service providing company, runs this facility on behalf of the Pune Municipal Corporation

The norms

- Biomedical waste shall not be mixed with other waste
- It should be segregated into containers/bags at the point of thegeneration prior to its storage, transportation, treatment, and disposal. The containers shall be labelled
- No untreated biomedical waste shall be stored for more than 48 hours
- If necessary to store for more than 48 hours, the authorized person must take permission of the prescribed authority and ensure that the waste does not affect human health and environment

(Source: Maharashtra Pollution Control Board)

Methodology

- The researchers followed asystematic approach towards the problem of Bio-Medical Waste in the Pune city.
- 10 hospitals have been visited by the researchers that include 2 clinics, 4 small hospitals, and 4 big multispecialty hospitals.
- Researchers have approached the staff of hospitals to get the actual observation of Bio-Medical waste practices.
- The identity of hospitals has been masked for the discussion under this paper.

Bio-medical Waste Management: Peek into theexisting literature

There was a pilot study conducted to find out how many hospitals(Gaza StripPalestine) are following the rules of handling the biomedical waste in that particular area. After the study it was found that not even half of the hospitals(public and private) know exactly where their biomedical waste goes and to what extent it is spoiling the environment and people staying near that locality.

After more investigation it was found that only in few hospitals the segregation of sharp waste only is separated. No colour coding was followed in the hospitals and rest waste is simply disposed of with domestic waste that is abig risk with the people who handles the domestic waste and medical waste without knowing the harmful effects of handling biomedical waste. In last they found that putting fine is not the only solution the Govt. should also emphasise on giving training to the staff of the hospitals.

A survey was conducted in different hospitals of Pune with different capacity of beds and found that there is urgent need of training that needs to be given to the hospital staff to handle the biomedical waste with is currently disposed of with domestic waste generally by small nursing homes.

Hospitals must utilize central incineration facility that will reduce the operating cost per Kg to all hospitals and the air pollution will also be in a controlled manner.

The Govt. should emphasise small hospitals to get registered with them so that all the biomedical handling process could be handled by one central authority and systematic manner. Small hospitals should come together in handling the transportation system of biomedical waste so that they would not be fully dependent on PMC and they can also conduct this activity at night hours so that there will be fewer traffic problems and whole procedure can be conducted in afaster manner and in less time.

Another study was conducted in the city hospitals of Davangere city of Karnataka. Most of the hospitals are not bothered about the disposal of waste with precautions. Even the people handling the waste does not wear proper equipment and gloves. Most of the hospitals are not interested in spending money in waste disposal and no training is also not provided to the staff.

At least the segregation of waste should be done at the hospital level so that the disposal becomes easy. Lesser the amount of waste from the hospital more beneficial for the hospital as it will reduce the expenditure on biomedical waste. So cost saving and effective waste management system are very much required in the city hospitals to avoid any effects on the environment and blood borne virus infections to people.

According to biomedical waste management rules 1998, the waste is classified in different 8 categories and most dangerous waste is radioactive, chemical, sharps etc. There are several benefits of following the standards of waste management reduction in chances of infection, reduction in thecost of disposal and improved image of health care. So after the survey, it was concluded that every hospital, lab, nursing homes should follow these norms. The biggest challenge is people are not aware of these things and not even bothered about it as disposing of the waste with domestic waste is much cheaper and convenient than giving to PMC. The govt. should also take some steps to strictly implement these practices among all health institutions.

Another study was conducted for big hospitals having many departments and located in the middle of thecity. They have found many flaws in handling the hospital waste by the hospital staff and the company that is responsible for final disposal of the waste coming from the hospitals.

The points that they have found out are as follow:

- The temporary storage area hospital for temporary storage before the onsite disposal is not sanitised properly so there are chances that the person who is handling can get infected.

- Lack of training and clear plans and policies of hospital waste management to the hospital staff.
- There is no program to avoid usage of mercury contained product.
- There is no initiative to reduce the use of plastic packaging and container
- While transferring the waste by hospital staff to the corporation van if the waste spills on thegroundno body attend that and this increases the risk of infection to thecommon public.

Basically the non-infectious waste and infectious waste which can be handled with adifferent level of care at different hospital institutes like big hospitals till small clinic and labs. There issome safe solution for disposal of infectious waste that can be adapted by city clinics/ PMC on a centralized level to avoid more operation cost.

The infectious waste mainly includes Blood saturated waste, Contaminated Animal Carcasses, Body Parts, and Bedding, Isolation Waste(from communicable disease), Cultures and Stocks of Infectious Agents, Sharps etc.

The issue with incinerator is that the operation cost is high and it should also be under the limitation of air quality rules. So at the hospital level, they can do is, go for sterilization, chemical disinfection, thermal inactivation, irradiation and gas/vapour sterilization for infectious waste management. The involvement of private players in this to increase the level of precautions in handling the infectious waste. The container should be moisture resistant, leakage proof, puncture resistant. The rigid containers for sharp waste should be labelled separately to avoid any accident.

The vehicles that are used in thetransportation of medical waste should such that, there should not be any infection or pollution to the environment and the people involved in this process should receive training in waste management and spill clean-up methods.

These practiceshave shown the output that how a proper health care waste management practices by thehospital can reduce the waste quantity as well as the expenditure for that. The proper training to the hospital staff can be done and that can increase the awareness among the staff to handle the infectious waste in thehospital. I also want to highlight the lack of rules and regulation in various countries and government authorities.

Improper waste management causes environmental pollution and many decrease transmission to the staff handling that waste. Hospital waste management can reduce the chances of these type of problems significantly in the hospitals. The people who get affected by biomedical waste are waste handlers, common public, local people near that area. The environment also gets affected badly by disposing of biomedical waste in the open area.

The bad effects of the biomedical waste have been seen in the big countries like the UK where in the year 1996-2004 around 2140 people were killed due to blood borne viruses. Thereis some common chemical waste that comes out almost from all the hospitals are Formaldehyde, Photographic chemicals, Solvents.

As mentioned above, there are many things that are being ignored in all the hospitals like mercury contained waste, flammable waste, Improper storage of perchloric acid that might result in an explosion etc. all that can lead to abig accident that can be easily avoided by some precautions.

Pune being the 8th largest metropolis half of the clinics are operating without any adequate arrangement of handling the biomedical waste and many nursing homes are not following norms of disposing hazardous waste from their hospital.Considering the amount of waste that Pune city is producing the government should take strict action against the heath institution to make sure that they follow the standard procedure in disposing of biomedical waste.

There is various biomedical waste that comes out from various hospitals. Some hospitals knowingly avoid safe procedure and some avoid because there is a lot of cost involved operation in theincinerator. So there should be acommon system of disposing of biomedical waste with safe transport and suitable technology in every big city.

The city health institution should take this as asocial responsibility not only the legal responsibility of the government. The only reason for that is alack of concern, awareness, motivation and cost involved in it. The authority should also work towards the reduction of waste by conducting proper training to hospital staff and avoid any extra wastage and chemicals that are affecting the environment.

The laws are also not strict enough so people tends to ignore these practices to save their money and time in segregation of waste at thehospital level. The Govt. should also conduct arandom inspection in hospitals to make sure that these practices should be followed in all the hospitals without any ignorance.

Bio-Medical waste management practicesin Pune

Following are the few hospital of Pune explaining the practices of bio-medical waste management that have been followed in their hospital/Clinics.

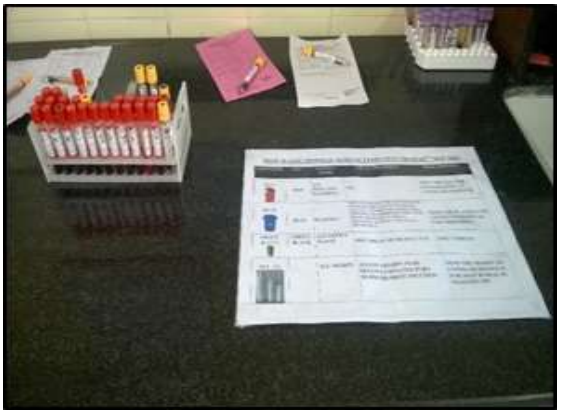
PASSCO for thebio-medical waste treatment process.

AB eye clinic: Photos

- This hospital disposes on aweekly basis. Only minor operations are done here so thequantity of waste is not much. This clinic is registered in

Public Sector Hospital

- Dispose waste to command hospital and command hospital has all the facility to dispose of bio-medical waste like incinerator etc. there are mainly laboratories present and the SOP for biomedical waste is very clear here.
- The facility for UV rays waste disposal is also present. So there should not be much harm from the functioning of this health institution.



Private orthopedic Hospital

- The maintenance is very poor. The staff is not even aware of colour code for thebio-medical waste they only know that all the waste is being disposed of in ayellow bag.
- The extra waste is kept under the bed.
- No Colour Code is followed.

CG multispeciality hospital

- The waste is disposed of daily basis.
- White bag is used instead of black to ensure quality.
- The waste is disposed once in a month and this includes waste from the eye and dental clinic. This is very dangerous practice as keeping the waste for so long time increases the chances of infection to the people staying near to it.
- Waste is disposed of monthly basis.

MN multispeciality hospital

- Follow the rules better than another hospital. Have separate service lift for taking thebio-medical waste.
- Bacillocid is used to clean all the infected used items of the patient.

ABC Multispeciality hospital

- No separate lift for carrying bio-medical waste.
- Colour code is followed.

Nursing Home

- Maintenance is very poor. The storage area of waste is also not clean. Plus this hospital is situated in aresidential area where chances of spreading infection are very high. No color code is followed.

Observations based on survey: Clinics

- The researcher found that generally clinics dispose their waste weekly basis and few clinics dispose of monthly basis which takes to a question whether keeping /storing the waste for more than a week is safe or not?
- They also found that staff members are not aware of these rules of keeping the waste for more than a week in the clinic or store room are safe or not. They only consider the weight of waste whenever the volume of waste crosses a limit then only they dispose of the waste.

- Clinical staff is not even trained and aware of the infectious harm that they can get in handling the contaminated waste normally without using any special germ killer (anti-germ spray).
- As most of theclinics are not aware of consequences of storing the waste so they were very open about the practices they follow. As all the clinics in their locality does not take care of contamination of waste and its infection to the people who are handling that, so they think this is the standard practice that should be followed.
- Most of the clinics under the study were in residence area i.e. the stairs or lift they use is same that the other people use. No separate passage for taking the waste in the buildings. This is one of the biggest carelessness that even big hospitalsdo not give importance too.
- It has been noticed by researchers that the staff who handles waste in clinics is actually not clear about the color code. They just have arough idea of color coding.

Big hospitals/multispeciality hospitals

- The carelessness in waste management is observed by researchers in the big multispecialty hospitals where the volume of waste is more
- The color code that should be followed is not clear among the employees of hospitals. Researchers have observed that few hospital staff mentioned different rules of separation of waste in different color bags.
- Hospital nurses and themedical assistant may know the correct color code that should be followed but this color codeshould also be known to housekeeping staff as well as people who handle these bags because different precautions need to be taken care for handling different waste.
- **Infrastructure issues:** It has been observed by researchers that due to infrastructure issues even in the big hospitals there is no separate lift or stairs to carry the waste bags.
- Some nurses and staff of some big hospital also mentioned that there should be aseparate lift, but they are bound to follow the wrong practice as there can't be new lift constructed due to lack of space in the hospital.
- **Congested passages:** it has been observed in many hospitals that the passages that patients or the staff use are very congested. In thecase of any spill or leak of any type of waste on the ground during handling of this waste, it would be very dangerous for the patients who passes through that passage during that time.
- **In some hospitals, the corridors were so congested that there were much higher chances that any other person could get in contact with the infectious waste bag while carrying them through these corridors.**
- Hospitals have kept the stretchers also in that small corridors. Hospital staff has also accepted the problem that they face problems during rush hours. Any person who passes near to the waste bag can get infected as there is hardly any space left in thecorridor after putting so many things in such a small area.
- **NO particular time:** after knowing that the same lift is used by both patients as well as for carrying waste there is no particular time in a day to dispose of the waste.
- The one adjustable solution to infrastructure problem can be that if there is particular time to carry the waste through the lift so that the usage of lift by patients can be avoided or restricted for that particular time to avoid any spreading of infection to patients or visitors in the hospitals.
- **The dustbins in the ward of patients were broken:** Researchers have observed that the dustbins in the patient wards were broken and at some place dustbins are not coded properly, researchers have tried to take apicture of that but the staff did not allow.
- The big hospital staff is well aware of these loopholes in waste management but they were quiet about this matter like a government hospitals staff.
- **Lack of training to contract staff:**The housekeeping staff gets changed in few months depending on the contract so there were many staff members who have not got proper training in handling in hospital waste. The hospital does not take any authority to train these people and these people do their work only according to their knowledge.
- **Givenmetal waste to scrap collector:** researchers have found one hospital in which the house keeping supervisor has accepted that the needles that have been used in thehospitalareburned and given to the scrap collectors, not to PMC. This is averydangerous practice that is being followed. The needles are not infection free even after burning.
- **PMC** has the proper way to dispose of the burnedneedles and the scrap collector obviously does not follow these processes, in fact, they used to mix this waste with the normal metal waste which is absolutely not safe even for the scrap collector and the person that comes in contact with this infectious material.
- **Avoidance in providing information:** after visiting 10 hospitals there were only 2 hospitals, who have corporate with us in providing the information, rest all hospitals were very reluctant to even speak to researchers.

- It was very difficult for researchers to click a single photo. Researchers also went to ahigher authority to take permission with our authorized letter, after that also they were not ready to allow theteam to click any photo.
- It was observed by researchers that in some cases housekeeping supervisors were also confused about the separation of waste at theinitial level. They just take care that the waste that comes out from each floor is packed and disposed of in PMC van that comes to their hospital.

Observation

- Few hospital authorities were reluctant to give information and to interact with their staff.
- No proper training was given to the staff who handles the bio-medical waste.

Commendable work by few hospitals

- **MN Multispecialty and PublicHospital**

These are the 2 hospitals who have cooperated with theteam and given each detail that researchers have asked. The reason could be that these hospitals are following all the rules that government has mentioned.

They even have aseparate lift to carry all the waste from each floor and staff is also aware that there could be chances of infection if the waste bags are carried from thesame lift.

The color code that these hospitals follow is also according to the standards and the area they have i.e. infrastructure is also well planned so that there is no problem during rush hours or any emergency.

The staff who handles the waste bags and the medical staff at each floor are trained sufficiently to handle all the infectious waste.

The cleanliness is maintained and usage of disinfectant to clear the area after the usage by patient shows the awareness that the hospital authority has to avoid any further infection to other patient and people because of ignorance of small things.

Proper inspection is done by higher authority to make sure that the practices are being flowed properly by every staff of thehospital.

- The team also found that of the one hospital (CG Multispecialty Hospital) uses high-qualitypolyethylene (white in color) to carry dry waste in the hospital which is also a better step by the hospitals towards the waste management.

Conclusion and recommendations

- **Rule of particular time slot to carry waste bags in case of no separate lift:** it is known that the management of separate lift and stairs is not possible due to infrastructure lack in few hospitals, so to tackle this problem hospitals can follow the rule of particular timing for carrying the waste bag from different floor to the store room. Preferably it should be at night time when there are fewer chances of usage of lift by normal public or patients.
- **Rooms are very congested:** the rooms in some hospitals are so much congested that the dustbin in that room is kept just below the bed which can increase the chances of infection to thepatient.
- There should be some initiative taken to reduce the usage of plastic/PVC products in waste handling.
- There should be aninitiative taken to reduce the usage of mercury contained product by the hospitals.
- If the waste gets spilled while transferring it from hospital location to PMC van, does the PMC staff or hospital staff bothers to take responsibility of that and make sure the waste gets cleaned to avoid any infection to common public?
- Audit of these practices should be done on daily basis to maintain the standards.

Limitation

- Only 10 hospitals were covered by researchers.
- The time given was few months for visiting hospitals.
- Researchers have taken the inputs from hospital staff only.
- Many hospitals did not entertain their employees to interact with the researchers.

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References

1. B. Ramesh Babu*, A.K. Parande, R. Rajalakshmi, P. Suriyakala, M. Volga(2009). Management of Biomedical Waste in India and Other Countries: A ReviewVol.4(1):65-78.
2. Sarsour Amal, Ayoub Aaeid, LubbadIhab, Omran Abdelnaser, Shahrour Isam (2014). Assessment of Medical Waste Management within Selected Hospitals in Gaza Strip Palestine: A Pilot Study, ISSN:2322-4983.
3. Lt Col SKM Rao*, Wg Cdr RK Ranyal+, Lt Col SS Bhatia#, Lt Col VR Sharma (2004), Biomedical Waste Management: An Infrastructural Survey of Hospitals.
4. Thirumala. S (2013), Study of Bio-Medical Waste Generation And Management In Various Hospitals In Davangere City Of Karnataka, India, ISSN 2249-7110.
5. Mathur Praveen, Patan Sangeeta and Shobhawat S.Anand (2012), Need of Biomedical Waste Management System in Hospitals - An Emerging issue - A Review, ISSN: 0973-4929.
6. Abor Aseweh, 2007 September, Medical Waste Management Practices in a Southern African Hospital, JASEM, ISSN: 1119-8362.
7. N. Hilton Medical Waste Best Management Practices.

8. Binaya Sapkota, Gupta Kumar Gopal and Dhiraj Mainali, 2013 October, Impact of intervention on healthcare waste management practices in a tertiary care governmental hospital of Nepal, DOI- 10.1186/1471-2458-14-1005.
9. Dr. Acharya1 Anjali, Dr. Gokhale2 Ashutosh Vasudha, Joshi Deepa, 2014 Januaray.
10. Impact of Biomedical Waste on City Environment: Case Study of Pune, India,ISSN: 2278-5736.
11. Rastogi Vishal, Rastogi Pooja and Bhatia Shalini,2011 June, Bacteriological Profile of Biomedical Waste: Management Guidelines, ISSN: 0971-0973.
12. Arora Mamta, (2013 November), Hospital waste: Management and Handling, international Journal of Advancemnets in Research and Technology, ISSN 2278,7763.
13. K.V Radha, K. Kalaivani and R.Lavanya, 2009 April, A case study of Biomedicalwaste management in Hospitals, Vol(1).
14. http://timesofindia.indiatimes.com/city/pune/Medical-waste-disposal-charges-slashed/articleshow/38762782.cms.
15. http://timesofindia.indiatimes.com/city/pune/Small-clinics-oppose-PMCs-biomed-waste-disposal-policy/articleshow/20707743.cms.
16. http://www.dnaindia.com/pune/report-pmc-hospitals-asked-to-register-with-biomedical-waste-department-in-pune-2001568.