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Management of Healthcare Generated Waste: Ghanaian Urban and Rural Hospitals in Perspective

Ethel Yiranbon

Lecturer, Department of Emerging technologies of the Faculty of Computing and Information Systems, Ghana Technology University College, Ghana

Michelle Afrifah

Lecturer, Faculty of I. T. Business, Ghana Technology University College, Ghana

Dela Akpakli

Assistant Lecturer, Department of Social Science, Ghana Technology University College, Ghana

Yaa Essah Armah

Assistant Lecturer, Directorate of Quality Assurance and Promotion,
Ghana Technology University College, Ghana

Abstract:

Management of healthcare waste has not ceased to be an issue of public concern. This referent waste has the potency of risking the health of sundry. Unlike waste generated in other sectors, healthcare waste is more hazardous, having that it contains materials that are dangerous and potentially infectious. This characteristic of healthcare waste makes its management a need in recent times. Several papers have reported how that health facilities in many developing countries have found this waste management a great challenge and of course, a force to reckon with. However, considering Ghana as one of such countries, the present article juxtaposes healthcare waste management in public hospitals in the urban areas with those in rural communities. The study sampled four government hospitals, two each from cities and villages. The authors employed such measures as site-visits, interviews with health workers and people responsible for waste management in the hospitals, and waste quantification in the considered facilities in order to reach a concrete analysis. The study seeks to identify how location has bearing on the amount of hospital waste produced as well as its management practices and to be an eye-opener in the course of solving healthcare waste management issues in Ghana.

Keywords: Healthcare waste management, urban hospital, rural hospital, waste generation, infectious waste, waste segregation

1. Introduction

The importance of hospitals and healthcare facilities as social infrastructure in communities cannot be overemphasized (Treasurer, 2015). These facilities undertake the role of surveillance and provision of patient care services in societies. Inevitably, healthcare facilities generate waste in the process of delivering their services. Waste from healthcare centers is a categorized type produced from models where medical officers and professionals provide treatment (WHO, 2018). Such models include hospitals, tattoo and ear-piercing centers, clinics, imaging and radiology centers; nursing homes, laboratories, dialysis and birth centers, medical and animal research centers, blood banks, ambulatory surgical centers, dispensaries, mortuary and autopsy centers, veterinaries etc.

According to Cheng et al (2008) increase in number of hospitals and medical facilities as well as growth in population in developing countries like Ghana has resulted in increase in healthcare waste. A study conducted by Gilden, Scissors and Reuler (1992) confirms that the record of the recent increase in this waste also results from the budding use of disposable medical materials; hence the need for its management.

Per the definition of World Health Organization (WHO, 2018), healthcare waste management involves putting in place measures that will ensure the safety of individuals and the environment from the adverse impacts of healthcare waste. The organization asserts that generally, 85% of this type of waste is composed of materials likened to domestic waste which are not hazardous. 15% may be infectious, genotoxic, radioactive or chemical, pharmaceutical or pathological, thus, hazardous. The nature of this waste puts individuals, especially doctors, patients, nurses, hospital visitors etc. at risks – injury and contraction of acute or chronic diseases as they come into direct or indirect contact with the waste (Mastorakis et al, 2010). Aljabre (2002) outlined the profile involved in effective hospital waste management. According to the researcher, the profile includes first of all, the proper collection of the waste right from the point of generation and its segregation (hazardous from non-hazardous, almost certainly by the use of color-coded containers). The means of storing healthcare waste in utility rooms is also a point of consideration in the process of management; the treatment of especially hazardous waste, its transportation and safe disposal are approved ways to mitigate and minimize risks involved in

handling this medical waste (Chaerul et al, 2008). Although there have been some records of initiatives towards healthcare waste management awareness in Ghana, such as the United Nations Development Program's implementation of medical waste pilot project with the Ghana government in collaboration, there still remains a need for the training of hospital workers in this area as the issue cannot be overlooked (Olaifa, Goovenda, Ross, 2018). Having noted the neglect of research into medical waste management in the rurals of developing countries (Li and Huan,2016), the authors took up this study, comparing happenings in the urban areas and the rural communities, in order to throw light on the situation for the consideration of safety measures and more serious steps towards its address. The study considers government primary healthcare facilities in two cities of the country (Hospital A1 and A2) and in two villages (Hospital B1 and B2). This is to weigh the extent to which setting as a socio-demographic factor affects medical waste management and what causal factors determine the difference in management in the surveyed hospitals. The authors refer to urban or city hospitals as those located within a metropolitan area and the rural or village hospitals are those that are located outside a metropolitan area.

1.1. Problem Statement

Many researchers have asserted that management of healthcare waste in Ghana has been a bone of contention over the years (Okyere-Hayford, 2016; Abor, 2013). Poor management of this waste has resulted in the emission of furans, dioxins and other harmful substances which in turn have adverse health impacts on neighbors of hospitals, medical officers and workers more especially (Njagi et al, 2012). The issue of hospital waste management looks into the processes of waste handling in medical centers and how hospital workers contribute in solving the problem by means of hospital standards (WHO, 2018). Whereas a body of literature has dwelt on comparison between waste management in private and public hospitals, district and regional hospitals etc., this paper examines setting, thus, a hospital's location in the rural community or the urban area as a factor that accounts for poor medical waste management in Ghana. In comparison with urban health providers, (Kwikiriza et al, 2019) asserts that rural hospitals have been known for low level of direct and general supervision of work, from heads of departments and other authorities and lack of enforcement of instructions. Many village hospitals have also suffered the ordeal of weaker financial foundation. The study considers this base with the objective of finding how these and other factors affect the different waste management practices in the village hospitals and in the cities. The authors anchor the proposition that healthcare waste management in the rurals is poorer than in the urban area. Hence, the causal factors revealed in the findings give guidance in developing specific strategies towards the address of the problem in the village hospitals and in the city hospitals respectively. The work will also help in policy making towards improved hospital waste management in the country as well as any action geared towards that.

1.2. Objectives

The main objectives of the study are:

- To evaluate the profile of hospital waste management in the selected hospitals
- Analyze how their setting affect their management practices

2. Methodology

The work employed a descriptive and an analytic approach. It considers hospital waste management as the primary explanatory variable and two dependent variables – hospital waste management in the rural area and hospital waste management in the urban area. The study was conducted in four (4) government hospitals (primary healthcare providers). Two were selected from two cities in the southern part of Ghana, and the other two from two villages in the southern and northern parts of Ghana. The sampled healthcare providers render general health services to their catchment areas and beyond. Per the sampling strategy, the health facilities considered were based on purposeful sampling, factoring in comparable size; bed-capacity (about 50-bed) and number of departments.

The research considered four (4) healthcare students who were recruited as research assistants. The research assistants were trained for eight days. The objectives of research were explained to them and they were thoroughly taught the plan and research procedure. They were also taught how to make observations and how to gather data. They were made abreast with the interview questions and posted to a hospital each. The assistants distributed letters to the various hospitals for permission prior to the visiting day. The entire study lasted three months in order to reach the desired outcome. Interviews were run in English was each lasted fifteen to thirty minutes. All interviews were recorded and transcribed.

The paper based analysis on existing literature and the outcome of the structured interviews which included both open and close-ended questions, waste quantification and observation from site-visits by research assistants. These were done in the consent and permission of doctors and other relevant respondents such as waste collectors (porters), nurses, authorities in charge of waste management and neighbors of the hospitals. The strategy was to take note of workers' level awareness of and practices of medical waste management: waste collection, segregation, storage, transportation, treatment, and disposal in the various facilities.

In all, forty-eight (48) participants were interviewed in the four hospitals, including twelve (12) neighbors of the four hospitals: response was 100% as all interviewees answered all the research questions. Qualification of participants who are hospital workers were taken into consideration. The work ensured that such workers, who were interviewed, except waste collectors, have similar, if not the same qualifications and have been in service for not less than five (5) years and have been in their respective workplaces for not less than half a year. These research methods were adopted in order to rate how different the selected hospitals manage waste and to what end their locations play role, without effect from

difference in qualifications and experience. These methods also suit the World Health Organization measures for evaluating healthcare waste management in hospitals (WHO, 2015).

The authors developed a quantitative data from the interviews and analysis from site-visits, based on the quantity of waste production and methods of waste management in each of the hospitals visited in order to ease assessment and comparison. Interviews and questions were on topics such as seminar or training, supervision, segregation, awareness of duties etc.

3. Results and Discussion

3.1. Findings on Waste Quantification

From the study, the quantity of waste produced in each of the sampled hospitals differed. First of all, hospital A1 produced 0.94kg/bed/day, hospital A2 produced 0.97kg/bed/day. For the village hospitals, B1 produced 0.65kg/bed/day and B2 produced 0.72kg/bed/day. What accounts for the difference in waste production in the hospitals may be a subject of research. However, it was found out that the hospitals in the rural areas did not have as much hospital supplies as those in the cities. This result confirms the findings of Freeman et al (2010) who point out that “the percent of all supplies that were available in the rural hospitals sampled was 5.1 percentage points less than the percent available in the urban hospitals”. This may contribute as a reason why their waste quantity seems less than their comparatives. Moreover, it was also observed that there was a huge difference in the sum of waste generated daily in the various hospitals. Hospital A1 generated between 90 and 140kg/day, hospital A2 generated between 100 and 150kg/day. Hospitals B1 and B2 generated about 52kg and 65kg respectively. The finding presupposes that more people visit urban hospitals than rural hospitals (Drislane, Akpalu and Wegdam, 2014), thus the difference in waste generation cannot be associated with difference in number of beds and departments (all the sampled hospitals were comparatively similar in terms of number of beds and departments). The reasons for the less record of rural hospital visit may differ: for instance, Yaya, Bishwajit and Udenigwe (2017) confirm in their study that people are not satisfied with health service in the rural hospitals. Although people who live therein are more susceptible to health risks as a result of lack of several social amenities, described by Amalba et al (2018), many would choose other health providers over government ones. Sulemana and Dinye (2014) also agree that people in the rural communities prefer to seek medical attention at mission hospitals in the area rather than government or public hospitals due to lack of equipment and limited service in the latter.

3.2. Findings on Waste Segregation

In the aspect of waste segregation, 100% of respondents attested to the need for segregation of waste in hospitals. According to one of the respondents:

“There is need for the waste produced in the hospital to be segregated, because segregation will help to separate the dangerous and hazardous waste from the no-hazardous one. Some of the waste can be recycled. But when we mix them, they may be soiled or stained with other substances and so, they cannot be used or recycled again. So, I know that segregation is very good and it will help us save some resources. Just that many times, we are not able to follow the rule. Sometimes it is not intentional, out of haste or something. So, segregation is actually good and helpful in waste management”.

In addition, 94.7% of the respondents identified two major types of medical waste (hazardous and non-hazardous) which need to be segregated. Researchers like Sahiledengle (2019) noted that the process of segregation, which pertains to sorting and separating waste according to their various classifications and types (sharps - razors, needles, trocars etc.; radioactive waste –radiotherapy liquid etc.; infectious waste – swabs, excreta etc.; pharmaceuticals - contaminated vaccines and drugs etc.; pathological – human fluids, blood etc.; chemical – disinfectants batteries etc.; genotoxic waste – cytotoxic drugs etc. and non-hazardous waste)(WHO, 2015), is key to the effective management of waste generated in hospitals. Managements of hospitals and authorities in charge of waste management in hospitals are to see to the segregation of waste in the hospitals (Aljabre, 2002). 97.2% agreed that the responsibility of managing and specifically segregating waste is the responsibility of health workers. 2.77% of the respondents said segregation is the sole responsibility of those who dispose the waste.

The study records that hospital A1 and A2 practice satisfactory segregation, although all four hospitals did not fully adhere to segregation principles. In hospital A1, hospital workers use color-coded bins (medium-sized bins and bigger ones with wheels) in segregating waste. The hospital layered the inner part of the bins with black plastic bags. The medium-sized bins were found in the wards and units, while a few (7) bigger ones with wheels were sited outside on the hospital compound. Yellow coded bins had syringes and used cottons in them and some catheters. Blue bins had general waste in them and black bins were used to collect body tissues etc. In hospital A2, the same situation was noticed, only that the bins were old and had no black rubber layers in them. Yellow, black and blue bins were used the same way as in hospital A1, but sharps were segregated in one of the bins. In hospital B1, there were color-coded bins as well. There were blue and black in all the units and wards. However, waste was not segregated. Infectious, hazardous and general waste was mixed together, and there was no label on any bin, neither was there any rubber to layer the bins. In hospital B2, there were a few bins. They were insufficient for all the units and wards. Some wards shared bins. The bins were not necessarily color-coded. There were black and blue bins. Waste was dumped without segregation. There were plastic baskets also available in hospital B2. They were used to gather wastes that are not liquid. Moreover, there were wheelbarrows which were also used to collect waste (both hazardous and non-hazardous). In all the sampled hospitals, there was no waste container or receptacle on which a biohazard sign was inscribed. Also, in all the hospitals, waste managers empty the bins

and containers at the end of each day. In the hospitals where plastic bags were layered in bins, they were replaced each time the bins are emptied.

3.3. Findings on Waste Transportation, Storage and Disposal

In hospital A1, waste collectors empty waste in bigger waste bins with wheels on-site. Waste is transported to internal storage close to the hospital before taken to final disposal sites. Transportation was done by the use of wheeled containers and wheelbarrow. To off-sites, external waste collectors (those who do not work in the hospitals) carry them with vehicles. Workers in hospital A1 indicated that both hazardous and non-hazardous waste is transported off-site together. The same case was recorded in hospital in hospital A2. However, it was observed that in hospital A2, sometimes, waste collectors carried waste with their hands, sometimes with gloves, other times without gloves from the generation points to the storage area. For off-site disposal, the two urban hospitals have liaising with waste disposal companies which carry the waste away. 91.6% of respondents reported that infectious waste is treated in their respective hospitals before finally taken off-site. In hospitals B1 and B2, waste is transported by waste collectors using their hands to carry bins to the internal storage. The collectors also use wheelbarrows when they are available. Internal storages in both hospitals were a large container and dug/ landfill pits. According to 38.8% of respondents from hospital B1 and B2, waste collectors often burn the waste a few miles away from the hospitals. In their view, the hospitals have to contact external waste collectors to come for the waste that cannot be burnt, or they deem "too hazardous". Combustion or open burning is practiced in all the hospitals as a means of handling waste. All four hospitals have incinerators, and ashes and residues from incineration are dumped into the dug pits. This result confirms the study of Diaz, Savage and Eggerth (2005) who noted that developing countries like Ghana resort to auto claves and retorts; microwave disinfection systems; chemical disinfection; combustions; and disposal on land as waste handling method.

3.4. Other Relevant Variables

It was also observed that 83.3% of respondents had no idea of certain existing policies that are to regulate hospital waste management in the country. For instance the same percentage of participants did not show knowledge of the Environmental Protection Agency (EPA) Act 490 (1994) and the National Sanitation Policy (1999) that assign some responsibilities and function to district assemblies and the EPA in the regard of waste management (MOH policy, 2006).

In order to find out why the practices differ in the various hospitals, it was revealed through the interview that in hospitals A1 and A2 there were a supervisor each who is put in charge of waste management in the hospital. The supervisor directs the waste collectors and they are accountable to him. On occasions, the supervisor goes round to check what needs to be done concerning waste handling. Although the duties of the supervisor are formalized, it was narrated in the interview that in hospital A2, he does not do much supervision because "the waste collectors know their responsibilities and are experienced". The supervisor in hospital A1 was observed to be a bit more active in his duties. He upon being interviewed stated that he does his best to ensure that the hospital is clean. According to him, they organize seminars but not often at all. He also said that

"if I don't ensure that the hospital is neat and clean; people will come here and be sicker. They will come with malaria and go home with typhoid and even HIV/AIDS, so I think that we need to give attention to how we dispose waste in the hospital. If we leave waste anywhere, anything can happen to anybody. I also think the government should help us to do this. They should provide some of our needs in time and as for us, we will do our possible best."

Nevertheless, there were no supervisors in the rural hospitals B1 and B2. One of the waste collectors said that they only do their job and they do it very well. He mentioned that everyone knows his responsibilities and nobody needs to be told. Agreeing that there is the need for waste manager or supervisor, he also said that there is a lot that needs to be done in terms of this management in the hospital, B2. He also said they are trying their best to help and "serve their country". When one of the directors in hospital B1 was asked the reason for the absence of waste supervisor, he said that one was posted to their hospital from Accra but he did not come. She confirmed that not only doctors, but other hospital workers do not want to be posted to the villages, even if it is their own village. She however confirmed that it has been a subject of consideration and they were going to get a supervisor for their waste management. She also saw the need to hold training sessions on waste management for the betterment of the hospital. Her concerns about village posting endorses Amalba et al (2018)'s research on how and why medical doctors and other hospital workers would not accept posting to the rurals in the future.

In addition, in all the hospitals, it was noted that hospital workers somewhat expect government to come to their aid in the matter of waste management. In hospital B2, one respondent said that sometimes people from Non-governmental organizations and churches come to donate bins to them, and they think that that has been helpful in improving management of waste. A respondent in hospital B1 mentioned that they need a government official to come witness the state of the hospital because that will convince them to come and help quickly. Hospitals A1 and A2 also showed need for government support, however, per observation; the hospitals in the rurals need more of such support. The authors analyze of some key factors in the four hospitals in table 1 and FIGURE 1.

From the table and chart, hospitals A1 and A2 practice some appreciable method of segregation, engage in some seminar or training of staff on waste management and there is a sort of supervision. The hospitals also employ a satisfactory means of transportation and disposal. In hospitals B1 and B2, there is no supervision and there is no engagement in seminar or training on waste management. Practices of segregation, transportation and disposal are not satisfactory.

Through the results and discussion, it was noted that although all the hospitals are government / public hospitals, there was vast difference in the management of waste in each. Having certified that all the workers interviewed are well-trained in their specific fields except for waste collectors in all the hospitals, who happened to be porters, the results prove that the location of a hospital has effect on how waste is managed therein. The work revealed that much attention to waste management is not given to hospitals in the village. In terms of all the profile of waste management as defined by WHO (2018), thus, collection, segregation, treatment, transportation and disposal, hospitals located in the cities employed better mechanisms. This may result from the existence of supervisors in those hospitals who make sure waste is handled properly according to their ability. More so, there was record of the organization of training of staff in the area of waste management, which seem to be absent in the rural areas. The location of the hospitals, which have bearing on the absence of these variable is found out in this work to be the causal factor of poorer management of waste in the rural hospitals selected. Quantification of results of relevant close-ended interview questions is as follows in table 2. The table summarizes what has been earlier discussed. It elaborates lack of finance as a major hindrance to proper hospital waste management, the need for government intervention to address this confronting issue of waste management.

3.5. Response from Hospital Neighbors

Finally, from the response of hospital neighbors, it was asserted that air pollution has been their major problem. Neighbors of hospitals A1 and A2 mentioned that sometimes they smell smoke even in their rooms as a result of burning taking place at the hospitals. 91.6% of them complained about the danger of this to their health and one raised the alarm that "the hospital is causing us to be sick so that we will come there for medical attention". Contrastively, in the hospitals in the villages, neighbors did not complain about air pollution because they lived a distance away from the hospitals. Their concern was that the hospital should cover the dug pits when they are not ready to burn because it is unsightly to see the waste in the pits. They narrated how negligent workers in the hospital are as pertaining to leaving waste on the bare ground. 75% of the neighbors pointed out that they see waste around many times they visited the hospital. Most of this waste they referred to was general waste. They appealed that hospital managers saw to the correction of that. In the view of these neighbors, hospital staffs are negligent in the aspect of managing waste. Neighbors of the rural hospitals also complained about the health implications of not covering the pits for a long time until hospital workers are ready to burn. 33.3% mentioned that such a situation is one of the reasons why they suffer malaria and other diseases in the village. All the neighbors somewhat sought that the government of Ghana steps in to help solve the problem of waste management in the hospitals.

3.6. Research Recommendations

This research thus, proposes that the institution under the government of Ghana, which is responsible for posting hospital workers, should consider special remuneration for staffs that are posted to rural areas. This is to serve as an encouragement to such workers to accept the posting. In such a case, supervisors as part of hospital workers will accept to be taken to the rural hospitals to monitor and enforce instructions on waste management.

Also training must be organized in rural hospitals to create awareness of modern waste management practices and to practical enforce them. More so, government should consider equal distribution of hospital supplies and equal financial allocations to the rural hospitals and the urban hospitals. Supplies that pertain to instruments useful for waste management will be of benefit to rural hospitals in quest to improve their waste management practices. This will help counter the reason of low financial budgetary in the rural hospitals.

Finally, there should be enforced policies which will permit district assemblies or relevant institutions to supervise waste management in hospitals, and who supervisors of waste management in the hospitals will be accountable to.

4. Conclusion

Healthcare waste management has been long indicated as a problem, not only in Ghana, but in several other developing countries. Much research has focused on this area. However, comparison of management in hospitals in the rurals and the urban areas has not received much attention. Healthcare waste if not properly manage pose health risks to health workers especially, patients and even the environment. In the present study, where management of waste is referred to as the plan or strategy of handling all waste generated in the hospital, it is realized that this management includes the process of waste generation, segregation, treatment, transportation and disposal. The study compared the various ways by which the considered hospitals A1, A2, B1 and B2 followed the waste management profile. Whereas urban hospitals were found to somewhat satisfactorily conform to these processes, the rural hospital practices did not conform to this waste management plan. There were varied indications that segregation principles were not so much adhered to in all the hospitals. In the urban hospitals there were certain factors such as training sessions (although not frequently) held for hospital staff on waste management and there were supervisors or managers in charge of waste handling. These were not found in the village hospitals. The study was deliberate in the choice of hospitals so as to have several factors that may affect the outcome of the research, comparatively the same. Hospital staff selected for interview had similar qualifications and experience, except for waste collectors. The hospitals had approximately the same number of beds and hospital units. However, the only factor that was revealed as what made difference in their practices of waste management was the difference in their locations, the city and the village. The location has had bearing on how the various hospitals go about the profile of waste management, as the same reason was found out to have effect on the lack of waste supervisors and consequently training. This is because qualified workers refuse posting to the rural areas. Setting of hospitals definitely

has effect on its waste management practices. The findings of this research is geared at helping to make achievable policies and effective efforts towards waste management, with consideration of what is applicable in the various hospitals and according to their locations.

Variables	Hospital A1	Hospital A2	Hospital B1	Hospital B2
Supervision	3.0	2.0	0.0	0.0
Seminar/training	2.0	2.0	0.0	0.0
Segregation	2.5	2.0	0.5	1.0
Transportation	3.0	2.5	2.0	2.0
Disposal	3.0	3.0	2.0	2.0

Table 1: Analysis of Key Factors on a Scale of 5 (In the Four Hospitals)

The table analysis is reflected in the chart below.

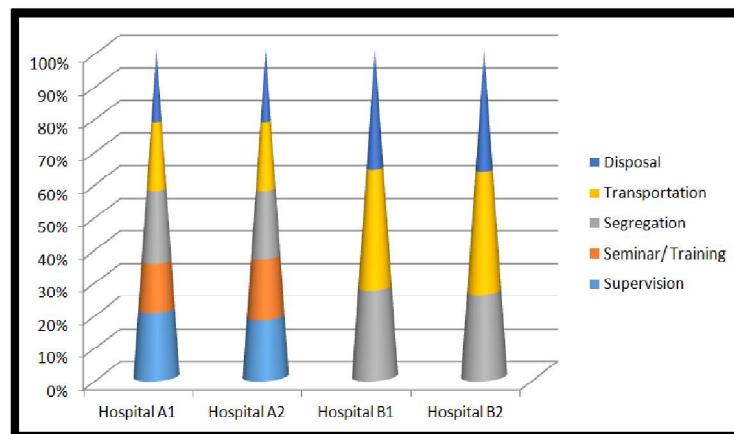


Figure 1: Analysis of Rate of Key Practices in the Hospitals

Close-Ended Interview Questions		Response from Urban Hospitals		Response from Rural Hospitals	
		Yes	No	Yes	No
1.	Do you the need for effective segregation?	100 %	-	100 %	-
2.	Are your transportation and disposal methods satisfactory to you?	0.83%	99.17%	-	100%
3.	Do you have regular supervision?	5.50%	94.5%	-	100%
4.	In your view, is there a need for appointment and posting of waste supervisors?	100%	-	100%	-
5.	Do you mostly have sufficient hospital supplies?	11.1%	88.9%	-	100%
6.	Can you say lack of finance is a problem to the issue of waste management?	16.6	83.4%	5.5%	94.5%
7.	Do you think there is need for government support in the area of waste management?	100%	-	100%	-

Table 2: Quantification of Pertinent Interview Results

5. References

- i. Abor, P.A. (2003). Managing healthcare waste in Ghana: a comparative study of public and private hospitals. *International journal of health care quality assurance*, 26(4), 375-386. <https://doi.org/10.1108/095268613113195> [12.01.2020].
- ii. Aljabre, S. H.M. (2002). Hospital generated waste: A plan for its proper management. *Journal of Family Community Medicine*, 61-65.
- iii. Amalba, A., Abantanga, F. A., Scherpbier, A.J.J.A., van Mook, W.N.K.A., et al. (2018). Working among the rural communities in Ghana – why doctors choose to engage in rural practice. *BMC Medicine Education*, 133 (18) <https://doi.org/10.1186/s12909-0184-y> [15.01.2020].
- iv. Chaerul, M., Tanaka, M., Shekdar, A.V. (2008). A system dynamic approach for hospital waste management. *Waste management, New York*, 28(2), 442-449. doi:10.1016/j.wasman.2007.01.007 [01.02.2020]
- v. Cheng, Y.W., Sung, F-C., Yang, Y., Lo, Y.H., Chung, Y.T., Li.K-C. (2008). Medical waste and production at hospitals and associated factors. *Waste management: New York*, 29.doi-10.1016/j.wasman.2008.01.014. [15.01.2020].
- vi. Diaz, L.F., Savage, G.M., Eggerth, L.L, (2005). Alternatives for the treatment and disposal of healthcare wastes in developing countries. *Waste management*, 25, 626-637.

- vii. Drislane, W.F, Akpalu A., Wegdam, H.H.J. (2014). The medical system in Ghana. *The Yale journal of biology and medicine*.
- viii. Freeman, V., Randolph, R., Poley, S., Friedman, S., Slifkin, R. (2010). Pediatric care in Rural hospital emergency department. *Rural health research and Policy analysis center, UNC-Chapel Hill, North Carolina*.
- ix. Gilden, D.J., Scissors, K.N., Rueler, J.B. (1992). Disposable products in the hospital waste stream. *Western journal of medicine*, 156 (3,) 269-272.
- x. Kwikiriza, S., Stewart, A.G., Mutahunga, B., Dobson, A.E., Wilkinson, E. (2019). A whole system approach to hospital waste management in rural Uganda. *Frontiers of public health*. <https://doi.org/10.3389/fpubbh.2019.00136>. [07.01.2020].
- xi. Li, N., Hual, W. (2016). Investigation and analysis of rural medical waste management. *Journal of environmental protection*, doi:10.42.36/jep.2016.71009 [04.01.2020].
- xii. Mastorakis, N., Bulucea, C.A., Oprea, T., Dondon, P. (2010). Environmental health risks associated with biomedical waste management. *International conference on development, energy, environment, economic – proceedings*, 287-294.
- xiii. MOH Policy and Guidelines for Health Institutions. (2006). Health Care Waste Management Policy.
- xiv. Njagi, N.A., Oloo, M.A., Kithinji, J., &Kithinji, M.J. (2012). Health-care waste incineration and related dangers to public health: case study of the two teaching and referral hospitals in Kenya. *Journal of Community health*, 37(6), 1168-1171. <https://doi.org/10.1007/s10900-012->. [14.01.2020].
- xv. Okyere-Hayford F. (2016). Solid waste management practices at the university hospital, KNUST, Kumasi. *Diane publishing*, Thesis.
- xvi. Olaifa, A., Govender, D. R., Ross, J.A. (2018). Knowledge, attitudes and practices of healthcare workers about healthcare waste management at a district hospital in KwaZulu- Natal. *South African Family Practice*, 60(6), 137-145. doi: 10.1080/20786190.2018.1432137 [04.01.2020].
- xvii. Sahiledengle, B. (2019). Self-reported healthcare waste segregation practice and its correlate among healthcare workers in hospitals of Southeast Ethiopia. *BMC Health Services Research*, 19, 591. <https://doi.org/10.1186/s12913-019-4439-9> [03.01.2020].
- xviii. Sulemana, A., & Dinye, R. D. (2014). Access to healthcare in rural communities in Ghana: A study of some selected communities in the Pru district. *European Journal of Research in Social Sciences, Progressive Academic Publishing, UK*, 1(4), 122-131.
- xix. Treasurer, L. L. (2015). Infrastructure, - key to healthcare improvement. *Future Healthcare Journal* 2(1), 4-7. doi:10.7861/futurehosp.2-4 [05.01.2020].
- xx. UNDP Ghana implements medical waste project. (2016). <https://www.gh.undp.org/content/ghana/en/home/presscenter/articles/2016/02/29/ghana-implements-medical-waste-project.html>. [11.01.2020].
- xxi. WHO/UNICEF. (2015). Water, Sanitation and hygiene in health care facilities: status in low and middle-income countries. World Health Organization, Geneva.
- xxii. World Health Organization India. Medical Waste. (2018). http://www.searo.who.int/india/topics/medical_waste/en/ [05.01.2020].
- xxiii. Yaya, S., Bishwajit, G., Ekholuenetale, M.et al. (2017). Urban-rural difference in satisfaction with primary healthcare services in Ghana. *BMC Health Service Res*, 17, 776 <https://doi.org/10.1186/s12913-01702745-7> [19.01.2020]