



# A Sociological Appraisal of Biomedical Waste Management and Its Sanitation Implications for Private Clinics in Cotonou Town



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## Abstract

Medical activities generate an increasing volume of waste. The management of such produced waste heaps has become a really challenging phenomenon. This research article aims at analyzing the stakes going along with the management of those biomedical waste generated by the private health facilities in Cotonou town. To deliver this objective, qualitative and quantitative research method paradigms have been used for collecting the data, more specifically through desk review, interviews, questionnaires, and direct observation from a sampled population made up of 101 respondents. Following the data collection, processing, analysis, and disaggregation, the results reveal that the strategies used for biomedical waste management in some private health facilities induce some social behaviors responsible for, and causing various pathologies.

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## 1. Introduction

Health centers' biomedical waste management is a complex activity which requires a minimum of knowledge. An appropriate management of biomedical waste constitutes a preventive, security, and safety measure for all those people frequenting the hospital, the caregivers, as well as the social workers likely to be exposed to those wastes to be disposed of. Among those wastes, the biomedical and pharmaceutical types are the categories generated from health care activities performed in the various medical centers, mostly in the hospital facilities (Benabbess, 2014). African countries are known for their accelerated demographic growth which naturally induces an exponential increase of produced medical waste in line with the increase of health facilities. Nowadays, biomedical waste heaps production incessantly increases in all the countries (Billau, 2008). They represent a proportion of 10 to 25 % of hospital waste and constitute a serious source of hazard as 80% of them are infectious (Girout, 1996).

Monitoring their generation, management and elimination is part and parcel of the current ecological and sanitation preoccupations (Benabbess, 2014). Any inappropriate handling and management of those waste components at hospital

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facilities level increases risks of trauma, infections, toxicity, radioactivity, and psycho-emotions for both health professionals and hospital users (WHO, 2004). More importantly, the methods followed for their management could be a source of a health risk if the different steps of the management process are not appropriately handled (Ministry of Health, 2004). Several surveys have reported poor practices in biomedical waste management, in particular, in developing countries (Ministry of Health, Benin, 2006; Simonsen *et al.*, 1999). The World Health Organization estimated the volume of yearly injections to 12 billion; 10% of which are used as preventive measures, mainly immunization (Wittet *et al.*, 2004). Those data sound an appealing alert regarding the number of by-products emanating from those healthcare activities and mainly those wastes disposed of in the open. A survey conducted in Benin in 2005 reports that all the health facilities established in Cotonou town produce about 23,365 kg biomedical solid waste per week (Saizonou *et al.*, 2014).

The biomedical waste volume generated in public health facilities is estimated at about eight thousand seven hundred and fifty (8,750 kg) per day and three thousand one hundred and ninety-four (3,194) Metric Tons per year (Djibril, 2002). This production of biomedical waste is estimated at five thousand one hundred and fifty-six (5,156) Kg per day, or about one thousand eight hundred and eighty-two (1,882) Metric Tons per year in Abidjan city. In Congo, WHO (2008) estimates the biomedical waste production at 341 Metric Tons per year for hospitals with a minimum package of extended activity. People can be infected with the medical waste disposed of in wild, anarchic and poorly managed landfills. But that is a minor or secondary infection because dumping these wastes near the cities is highly-risky for the rag-dealers; garbage collectors and preschool children. In other words, ground and drinking waters as well as river waters are potentially contaminated by dumped or composted waste or the pouring of liquid waste (CREPA, 2001). The disposal of solid waste pollutes the environment. As for the air, it is polluted by the smoke emerging from incinerated waste. The metals or material incineration mainly those with a high content of heavy metals (lead, mercury furan) can induce the releases of these highly toxic metals in the air (Tinga: 1999, Alcivar, *et al.*: 2017).

The current scientific data pertaining to the liquid biomedical waste's impact on health and environment are produced by some surveys conducted in developed countries. However, in developing countries where health facilities produce increasing volumes of liquid waste, there is a large number of health-related and environmental risks (Ngankem, 2014). According to this author, various social categories of players are exposed to those risks. Those are inter alia, the health workers, garbage collectors, the riparian population of the dumping sites and/or recycling facilities and whose water reserves have been polluted, the professional or casual waste garbage collectors. The risk run by this population as a result of biomedical waste is partly due to the waste composition, as it may contain infectious agents, toxic pharmaceutical or chemical substances, *genotoxic* and radioactive substances. Besides, untreated BMW disposed of in the sewerage network constitutes potential sources for soils, surface waters and groundwater pollution, thereby exposing the riparian population to serious hazards, in particular, those affecting the digestive and respiratory tracts.

Regarding the digestive tract associated with microorganisms of fecal contamination, this phenomenon is well known for coliforms and salmonella which, even after treatment still remain virulent as a result of their ability to hide and lock themselves up in pockets of resistance. The respiratory tract results from inhalation of organic dust, fungi, and thermo-tolerant bacteria or toxins. Over the years, new realities have emerged, including the expansion of practices such as tattooing and piercing, as well as increased accessibility to some treatments that require the use of syringes and needles at home referred to as self-care practice. According to a survey report published by the MSSS in 2005, there is an increasing number of accidental needle sticks due to the presence of syringes and needles in inappropriate locations (Courtois, 2010). These accidents particularly affect children and some categories of workers, such as street and park maintenance workers, janitors, garbage collectors, and sorting centers' employees.

According to the World Health Organization (WHO), the objective of biomedical waste management is to remove and treat them by ensuring as much as possible the hygienic, environmental, health and economic aspects through risk-lessening methods at all stages (Kone, 2006, WHO, 2006). The minimum regulations governing solid biomedical waste management (DBMS) stipulate that they must always follow appropriate and well-identified routes, from their point of production to their final treatment or dumping sites (Girout, 1996). In compliance with the legislation and regulations governing in Benin, neither must biomedical waste be managed in a way that compromises and jeopardizes the health of the actors involved nor shall it pollute the environment (Saizonou *et al.*, 2014). A health facility is therefore of paramount importance because these wastes pose a serious public health problem (Tinga, 1999).

Nevertheless, observations made among the clinics established in Cotonou town reveal the inappropriate behavior in biomedical waste management. Among other, those problems have to do with the protection of waste collection bins, and the waste disposal of or dumping in places widely opened and accessible to the riparian population. Considering the serious situation and the multiple risks faced by the various layers of the society, biomedical waste management calls for critical attention in Benin. Such attention should focus on the strategies to be implemented for

an appropriate management and the socio-health implications of biomedical waste generated by the private clinics in Cotonou town (De Calderero, *et al.*: 2018, Jurado: 2017).

## 2. Materials and Methods

The ongoing survey takes place within the territory of the Local of Government of Cotonou, one of the coastal towns in Benin. Located at the intersection of 6 ° 20 north parallel and 2 ° 20 meridian East, covers 10 km in the west where it is bordered by the municipality of Abomey-Calavi belonging to the Atlantique region, and 6 in the East along Sèmè-Kpodji Municipality in Ouémé region. Besides, the town under consideration is bordered in the South by the Atlantic Ocean and in the North by Nokoué Lake. Unlike the other cities, Cotonou is a municipality also making up Littoral Region. It covers a surface of 79 Km<sup>2</sup> and is divided into 13 districts, also subdivided into 140 town areas. This town which is the economic capital of Benin was settled by 678,874 inhabitants according to the February 2013 fourth General Population and Housing Census. This population which represented a proportion of 9.8% of Benin's total population in 2002 has dropped to 6.7% in 2013 In terms of scope in Cotonou town, there are many health facilities (more than 500). The private health sector is made up of the humanitarian and liberal private sector. The humanitarian sector includes faith-based and NGOs' health facilities. Nowadays, many private clinics provide medical care to a large proportion of the population of Cotonou town. The private medical providing centers are mainly spread in urban areas through the establishment of clinics and other health centers.

To deliver the objective of this research, both qualitative and quantitative methods have been used, focusing on a target population made up of private clinics medical agents operating in Cotonou town (nurses, medical doctors, caregivers, midwives), Health and Sanitation Police agents, and the users of those medical facilities as well as the riparian populations. The sampling techniques used to conduct this research work are the purposive sampling, accidental and randomized techniques. These techniques made it possible to select 101 respondents for this research following data saturation. For data collection purposes, this research has used some techniques and tools such as desk review with its reading grid, the interview with its guide, the administration of questionnaires, and the observation checklist. To process the so collected data, it has been necessary to proceed with carrying out a structural and systematic analysis which emphasized the statements released by the respondents. This culminates with some verbatim which better illustrates the analysis. The data triangulation has enabled to loop the validation process. The other leg here has been to process the collected data by using Word and Excel word software for the realization of graphs and tables.



Picture 1. Waste piled up in a corner of the Clinic



Picture 2. Waste gathered on the floor



Picture 3. Incinerators used for destroying biomedical waste

Source: [Cliché Nangbe\\_2016](#)

### 3. Results and Discussions

#### 3.1 Biomedical Waste Management Modalities in the Private Health Facilities in Cotonou

The various modes of biomedical waste management are observed all along the stages of their route. From the waste generation until final processing, the players involved adopt different and various behaviors. At this junction, the study reveals the biomedical waste handling and management strategies both in the health centers where they are produced, during their transport and in the final treatment phase

##### a) Waste Management Strategies in the Private Health Facilities

Nurses are the main stakeholders generating biomedical waste in the health facilities. This is due to their permanent involvement in the performance of health care prescribed by medical doctors. In addition to the nurses, there are midwives, general practitioners, and specialists. Nevertheless, one should not overlook the active contribution of patients, care attendants and other health centers users in the household as well as biomedical waste generation. Regarding the situation of the players described so far, one should recall that biomedical waste management strategies are not the only outcome of administrative policies implemented in the health facilities but also the result of health workers and other users' behavior. Therefore, one of the administrative standards pertaining to waste management in health centers premises is the provision of waste bins or containers. Moreover, the waste bins and containers' varied shapes and colors also contribute significantly to a better orientation of agents and users. As far a waste bins or containers installation is concerned, L. A. a private clinic manager states:

« [...] At home, there are two major categories of places where waste containers are installed. There are positioned everywhere in the waiting room and in the hospital wards. There are also in the consultation rooms where special waste sorting measures are taken. [...] As for the waste bins put outside the consultation rooms, they mostly contain household waste disposed of therein [...] » [Extract from the interview granted by L. A., a private clinic manager in Cotonou].

On analyzing the statement by this informant, it can be inferred that his main concern is the appropriate management of the waste generated in his clinic. In his capacity as a private clinic manager, he has his own strategies stemming from his beliefs that waste sorting strategies are better respected inside consultation rooms. Out there and in the treatment rooms, people do not always follow the waste bins typologies though these containers are available in the health facilities. In those clinics which have been investigated, the policies adopted in terms of good disposal of bins, quite vary from rigorous to leeway which could be detrimental to the stakeholders. The investigation reveals that several private clinics put their waste bins in strategic areas of their health facilities, but the maintenance of those bins is often defaulting. Though they do exist, there is, however, a default of rigor around their handling and management. According to another informant, this neglect can be explained by the users' attitude as they do not comply with the instructions on the use of garbage cans. The words of the latter provide more clarification in that regard:

« [...] Despite all the effort made to keep the waste well contained and tidy, the desired results are not delivered. Unfortunately, users do not respect the instructions regarding the use of waste containers. But due to the failure of pedagogical measures taken by leading them through examples, we end up dropping that way of doing, to think about another method. But in the meantime, we remain watchful. No damage is recorded at that level up to now. [Extract from the interview granted by E. L., a private clinic agent in Cotonou].

From the analysis of the statement by this informant, it can be inferred that the fact that waste bins are left in an undesirable situation inside the clinics is due to the managing team's disappointment. According to E. L., many times, users have reminded the appropriate use of waste bins without any convincing results. The managers of these health facilities have eventually made the option of a transient solution meanwhile they succeed in improving their strategy. On the other side, care providers, including nurses, midwives, and medical doctors show different behaviors towards the waste generated according to the means available and according to their individual situations. As such, in those clinics where there are not enough waste bins, several agents report that they keep the waste long in temporary container meanwhile they move them into the definite waste bins. Those are generally cartons, plastic bags or sometimes under the trolley meant for keeping treatment instruments. Some among the informants tell us how they proceed in their respective units. Among them, C. B. believes that the lack of bin in the treatment wards does not facilitate the immediate protection of biomedical waste generated during the activities:

*"[...]In my Unit, needles, bottles of medicated products, gloves, cotton swabs and many other wastes are regularly produced. There is no waste bin in the treatment ward. I am obliged to accumulate and keep those generated waste for a long time before taking them into the container intended to receive it and which is located on the other side of the premises. When I say a long time, I mean the whole morning or the whole day, it depends. In fact, I cannot be going to the container after every treatment. It's not possible. [...]"* [Extract from the interview granted by C. B., a private clinic agent in Cotonou].

In another clinic, an informant explains that he has assigned that work to the waiters and waitresses. They are those taking care of biomedical waste disposal into the containers His words:

*"[...] As soon as the treatment is over, the nursing auxiliary present in the ward knows that she/he must spontaneously rid the room of this waste before I wash my hands. They know that I do not need to remind them that. Otherwise, it is a war between us. So, I was able to find an alternative, meanwhile, we were sent a trash for the room [...]"* [Interview granted by U. Z., a health worker in a private clinic in Cotonou].

Through the statement of this informant, it can be understood that despite the lack of waste bins in the care unit, he knew how to prompt his human resources to make good use for better waste management. From one actor to another, from one health facility to another, multiple reasons are put forth to justify the poor practices; and people who understand more and more the importance of good biomedical waste management try to find alternatives.

Other authors have, in similar studies investigated and addressed the thematic of biomedical waste management in health facilities. As such, [Ndiaye et al. \(2012\)](#) in their study have come up with the conclusion that BMW carriage and handling within the services were done manually in 55.8% of services. In 22.1% of services, they use trolleys as transport means to carry waste to the central storage area. While 67.4% of services use medical trolleys to carry biomedical waste, 33.7% rather make use of wheelbarrows to carry those biomedical wastes. According to the same authors, sorting out BMW is unsuitable in the majority of the services of the hospitals surveyed. The findings of another survey reveal that out of 38 sites visited, 92.1% were not safe as the waste storage period exceeds 48 hours; health caregivers do not comply with the color codes for storage containers and do not use protective equipment. Containers were covered only in 34.0% of cases ([Saizonou, 2014](#)). It can, therefore, be inferred (except for some few nuances) that our results converge with, and corroborate those of Saizonou, Ndiaye and his collaborators. In a study conducted in Mali, the sorting based on the separation of waste into two categories, with red bins for DBM and black for waste, had significantly contributed to enhancing BMW management ([Sanogo et al., 2007](#)). An Indian study rather suggests a sorting mechanism in three categories with separation of domestic waste, sharps waste, and infectious waste ([Gayathri and Pokhrel, 2005](#)).

#### *b) Practices Adopted by the Players Involved in Waste Carriage and Treatment*

A good waste management requires its appropriate carriage to the final treatment sites. Specialized players in this procedure do it and only work with the clinics that accept them and respect the terms of their contract. Some clinics do not use their services and treat waste in their own way. The carriage of biomedical waste in Cotonou is done under poor conditions. In fact, some of the actors involved in waste management are not trained at all for this job. They do not respect any of the various standards governing this delicate activity. As such, none of the stakeholders really complies with the measures and precautions that normally govern waste carriage. Those players also point out the many difficulties they face in the waste carriage. It is on this aspect that the findings of the ongoing research work corroborate those of other authors like [Adon \(2011\)](#) who consider that waste handlers and carriers incur high risks and threats while performing their work with heavy containers (back pain, lumbago, etc.) or unmanageable carriages. Other studies have highlighted that 41.9 % respondents noticed the compliance of waste carriage and transport equipment through either motorcycle or supervision vehicle for those centers that are not equipped with the incinerator. [Saizonou \(2014\)](#) observes that there are spills over in 35.5 % of cases during the transport of solid biomedical waste. Many respondents in this study have also reported the occurrence of spillage as follows:

*"[...] the containers in which the waste is carried towards the treatment sites are so rusted and riddled with holes beneath. This means that waste is often poured along the way. Apart from one of our executive who insists that we should always stop to pick those spill-over, we never deem it necessary to stop. When the executive is not on duty with us, we do not stop. We only continue on our way. Those also are wastes! Moreover, the country itself is already polluted. They told us that things would change very soon, but still, it is the status quo as nothing has changed [...]"* [Interview granted by R. S., Biomedical Waste Manager]

The interview granted by this respondent shows that biomedical wastes are carried with some rolling materials fit with rusted and old containers. One should recall that many respondents mentioned the obsolete or inappropriate nature of

the means of transportation availed to them for transportation. At this level, our results partially diverge from those obtained in Côte d'Ivoire in 2011 by Adon (2011) who concludes that the handling and protection materials are used for this purpose. Thus, the transportation of biomedical waste out of the health facilities is done with dump trucks or packer trucks used by formal private operators as it is the case in Cocody Teaching Hospital. Carriage means in good condition is a guarantee of protection for the users of the private health facilities as well as for the riparian population. Moreover, the waste transportation should follow a routing circuit far away from areas frequented by patients and visitors; it should also be done with maximum safety measures by using adjustable sanitary trolleys. This type of trolley must be easily *manipulable* in terms of loading, unloading, servicing and be manufactured by local craft industry so as to ensure its affordability (Ndiaye *et al.*, 2012). For them, waste collection and carriage require specific equipment which is unavailable in the surveyed health facilities. This point of view is also adapted, given the situation observed in Cotonou.

### c) *Modalities of Treatment of Biomedical Waste Generated by the Private Health Facilities*

This study reveals that different modes are used for BMW removal at the level of the investigated centers. Eventually, the private clinics, health facilities, and health service providers treat in three ways the waste generated in their premises. According to their statements, there are incineration operations, dumping and burning in a pit in the open air. Some health centers do not convey their waste to the central incinerator; they rather make the option of incinerating their waste with the means at hand. A similar remark is made by Adon (2011), who reports that most of the visited health centers use methods such as small-scale incinerators or incineration pits. They practice burning in the open air. Modern incinerators are still functional and allow efficient and effective disposal of biomedical waste. For this author, external elimination enables a safe disposal of biomedical waste that could not have been completely eliminated within the health center. The disposal procedures to be prioritized are landfilling, incineration, use of transfer center and municipal scavenging services (Adon, 2011). The health facilities that are not equipped with incinerators rather burn the waste or dump it inside two meters deep holes. Gloves and bandages are not incinerated; rather, they are packed in bags and disposed of into garbage bins which are later collected by NGOs which carry them to the dumping sites. At the level of treatment sites surveyed, agents do not use any protective equipment. Most of the incinerators and treatment sites are poorly maintained. However, in a similar study conducted by Nianga (2002), he reports that incineration is used in 30.48% of cases as the most secure means of waste disposal measure. This method of waste elimination does not require highly qualified operators. It is fitted with appropriate disinfection efficiency, a reduction of waste volume, but a major emitter of air pollutants (WHO, 2005a).

Another practice which has been observed and reported above is that of landfilling. Some private clinics still continue to use it despite its many contamination risks, especially during rainy season. Used waters flow into the pipes which drain them into municipal gutters and catchment basins. All these go along with contamination risks both for the riparian population and the neighboring environment. Previous studies have already highlighted this aspect, in particular, Bertin *et al.*, (2015) whose findings corroborate those of Ndiaye *et al.*, (2003 and 2005) which reveal similar remarks at the Ziguinchor Hospital. Eventually, it has also been revealed that in some health facilities, wastes are regularly disposed of into uninhabited houses either in the open air or in unsealed containers which are most of the time barrels.

### 3.2 *The Population' Social Conducts regarding the Biomedical Waste Generated by the Private Health Facilities in Cotonou*

Biomedical waste management is a true challenge not only for the health personnel but also for the population as a whole. Investigations in this regard have revealed that the way private clinics proceed to do biomedical waste management does not comply with the governing measures. The sociological perception of this situation enables to understand how the neighboring populations of the private health facilities experience such disastrous biomedical waste management. Indeed, the research questions are focused on several healthy and social indicators. The neighboring populations have different experiences regarding the waste generated in and by the private hospitals. While on the ground, it has been realized that most of the inhabitants correlate the waste with anything that pollutes their environment, anything that does not help or smells bad, but also all garbage, used water or food, rotten food or left-over, plastic bags and even dust. Thus, it can be inferred that the first impression and perception of the respondents about the waste simply refer to household waste. Others can come after. This is what Graindorge (2000) has also tried to demonstrate by claiming that waste is defined as: "any residue of a production, processing, or process, any substance or material produced or, more generally, any movable property or building abandoned or destined for abandonment."

Since the areas covered in this study are those in which there is at least one private health facility, it has been found that some hospitals or private health facilities are older than others. 70% of the private clinics were established five to ten years ago and the others more than ten years ago.

The number of private health facilities has probably tripled in less than ten years. It is only after having drawn the populations' attention on waste generation by the private health facilities in their district that they (85% of the respondents) confess that waste are generated as the residue of any human activity. While some think that if waste collection agencies often go round these private health facilities to empty their generated waste several times per week, others rather report that they are not health workers to say whether or not these agencies generating waste. What also attracts attention more is that the respondents were able to highlight differences between ordinary and biomedical waste generated in private health facilities. The following is the statement made by a respondent living near a private health center:

*"[...] In the house, I think waste is emanated from everything we eat, wear, do and our shopping. In the same vein the waste generated in a health center will be related to everything they do, for instance, like serum bottles, syringes, drugs, cottons and worn strips, plasters, blades (maybe), waters [...]"* [Interview granted by Q.L., a housewife, living near a private healthcare center.

From the analysis of this extract, one understands that the respondent regards as biomedical waste everything including, but not exclusively serum bottles, syringes, drugs, cotton, and worn strips, etc ... As part of this study, most of the respondents reveal that in their respective neighborhoods, these wastes are mostly identifiable in "uninhabited areas close to the health centers, on the waste dumps, in the lowlands, water drainage gutters", while waste collection agencies come to remove others. In Cotonou, the rate of biomedical waste generation is more or less high and very critical. In 2014, Saizonou asserted that a study done in Benin in 2005 has shown that all the health facilities established in Cotonou town were generating about 23,365 kg Solid BMW per week while those agencies happen to collect only a part of it. This exposes the populations to various infectious risks. Despite this, people cohabit with biomedical waste every day and their children and others use to go to pick bottles from biomedical waste dumps. That is what Djibril insinuated in 2004 by saying that "biomedical waste are wildly disposed of in heaps where collectors and children go to pick some materials. This is what H.M. tries to explain in the following statement:

*«One of those days, I did surprise some children fully engaged in a discussion: did you see human finger last time when we were sorting the waste to pick bottles for sale? [...]»* [Extract from the interview granted by H.M., Civil Servant, living in the vicinity of a private health center]

Sometimes, due to those traumatic risks, parents ban their children from going to the dumping sites, but "very poor families whose children must indulge in bottles or other objects collection before earning their livelihood, or abandoned children, and waste recyclers are fully exposed to serious risks. According to Fall (2005), in Senegal, waste recovery and recycling are significant incomes generating sources and employment for a large part of the population. From this, one can conclude that there are general and coercing risks associated with those various behaviors.

### *3.3 Social and Health-related Implications of Biomedical Waste Management Strategies adopted by the Private Health Facilities in Cotonou*

The biomedical waste generation and management stakeholders have different perceptions of the concept of biomedical waste management. Sometimes these people show a different level of knowledge, but they tend to converge when it comes to ethics. Many people do not apply the knowledge they have acquired for rational and ecological management of biomedical waste. This exposes the populations to various health and social risks. However, in compliance with the governing legislation and regulations in Benin, biomedical waste must be managed in such a way that does neither compromise and jeopardize the involved players' health in the process of their handling and management nor pollute the environment (Saizonou *et al.*, 2014). The management of biomedical waste in a health facility is of paramount importance as this waste poses a real public health problem (Tinga, 1999). This is not the case in all private health facilities in Cotonou. These investigations have enabled to discover and collect much data on the issue at stake. The respondents have given enough information which significantly contributed to broadening the researcher's view of an accurate sociological analysis of the findings. Among the many methods and techniques used for data collection, this research has found an appropriate window in direct observation. The various visits to the private clinics have enabled to find put that waste bins are positioned s in almost all the compartments of those visited private health facilities. The observance of the rule of discretion and confidentiality has enabled the research team members

to infiltrate and enter all the various reserved areas within some private health facilities where solid biomedical waste including bottles of medical and pharmaceutical products (Pictures 1 and 2) are disposed of. Still, on these premises, it has been noticed that there are some objects that are burned periodically. Some private health facilities do have incinerators but in very poor states to the extent that one still wonders if they are functional or meet the required standards (Picture 3).

Pictures 1 and 2 show reserved areas, in some private health facilities, where solid biomedical waste are disposed of, including the medical and pharmaceutical products containers. The respondents state that it is "late in the night that the smoke comes out of the private clinics established in their respective areas."

Looking at Picture 3, the impression coming to mind is that even though some of those health facilities do have incinerators for handling their biomedical waste management, these instruments are in faulty states, and are a source of several other risks such as respiratory diseases, and, therefore are also infections-bearing for the neighboring populations. This is what [Tinga \(1999\)](#) tries to show highlight that the gas emerging from the incineration of biomedical waste is as polluted as the smoke emanating from incinerated waste. Incineration of metals waste or material with a high content of heavy metals (lead, mercury furan) can release some highly toxic metals into the environment ([Tinga, 1999](#)). By reading Tinga, one realizes that those waste components can cause a lot of environmental damages. The definitional perception people have about everything regarded as biomedical waste, that is, inter alia everything containing bottles of serum, syringes, drugs, cotton, and worn strips, flows along and converges with the [Ngankem \(2014\)](#)'s explanations. Indeed, he also points out that the riparian population of the health facilities are at risk of infection as follows:

*"the risk incurred by the population related to biomedical waste resides partly in the composition of this waste, because it contains infectious agents, toxic pharmaceutical or chemical substances, genotoxic substances, and sometimes also radioactive substances. On the other hand, the fact that untreated DBM discharged into the sewerage network is a potential source of pollution for soils, surface water and groundwater exposes the population to hazards. "*

Considering the riparian population's assertion that "the so-defined biomedical waste components are mostly found in their respective neighborhoods, in uninhabited houses or plots of land and on refuse dumps", one can say that these strategies adopted by some private health facilities represent real "dangers " for the population. This comes to corroborate [Courtois' study \(2010\)](#) which concludes an increasing number of accidental stings due to the disposal of syringes and needles in inappropriate places ([Courtois, 2010](#)).

Besides, Senegal also experiences the same phenomenon with the disposal and recycling of waste which generates the important volume of income and employment to a large group among the population. But this search in the waste exposes the scavengers to some risks including coming across hazardous and sharp biomedical waste. Toxic waste is often mixed with other household waste. As such a huge volume of wastes have become dangerous as a result of their mixture and merging with other contaminated waste during collection operations without prior sorting. Having visited many waste management units, [Fall \(2005\)](#) realizes that there are real difficulties in biomedical waste management". In the same vein, [Djibril \(2004\)](#) also demonstrates that the selective sorting and segregation of infectious waste is scarce, as a result, hazardous objects such as needles end up in getting into the same circuit with other unsorted waste. Those wastes are wildly disposed of in heaps where scavengers, collectors, and children collect used materials. This contributes, to some extent, to the rise of infectious diseases such as HIV / AIDS pandemic. [CREPA \(2001\)](#) also shows that populations including scavengers, collectors and pre-school children are exposed to multiple risks as they could be infected by this medical waste in wild, anarchical and poorly managed dumps.

They further affirm that "sometimes waste bins and containers are filled; flies and insects can be persistently crowding in the vicinity balmy with stench" (interview granted by some users of private health facilities). In fact, those are a virus and microbe-born insects. It should be pointed out that those health facilities use to subscribe waste collection and removal contract with some agencies not specialized in biomedical waste management, exposing, therefore, agents to a number of risks. Similarly, used water from those private health facilities is poured into a pit dug inside the premise of the clinics or sometimes dumped in the gutters. [CREPA \(2001\)](#) explains that this kind of waste management strategy can pollute groundwater. In the same vein, he continues that groundwater, drinking water and river water are potentially contaminated by buried or composted waste or by liquid waste dumping" ([CREPA, 2001](#)). [Ngankem \(2014\)](#) also demonstrated that several players are potentially exposed to risks through those improper practices of some health facilities. The author concludes that the categories exposed to such risks range from hospital workers, garbage collectors, the riparian or neighboring population of the dumping sites or health facilities, those population whose water reserves have been polluted, the professional permanent or casual scavengers and waste

removers. In a nutshell, such inappropriate management of biomedical waste generated by the private health centers constitutes a potential source of traumatic, infectious, toxic, radioactive and psycho-emotional risks to the health centers' professionals and users (WHO, 2004). All the same, the methods adopted for the biomedical waste management can jeopardize people's health if the various stages of the management process are not properly followed and observed (Ministry of Health, 2004). Several studies have reported persistent poor practices in waste management, in particular, in developing countries (Benin Ministry of Health, 2006, Simonsen *et al.*, 1999).

#### 4. Conclusion

Combining environmental and public hygiene and health management in society requires a collective effort in order to prevent any epidemiological risks or outbreak as a result of unsanitary environment prevailing in the private health facilities. The ongoing study was aimed at analyzing the biomedical waste management problems inherent to and posed by the various practices rampant in the private health facilities in Cotonou town. In this regard, the main hypothesis considers that biomedical waste management strategies used by some private health centers in Cotonou, lead to social behaviors culminating with various pathologies.

The mixed research method adopted has enabled to critically consider and apprehend the situation through appropriate desk review, interviews, administration of a questionnaire and direct observation. The sampling of the respondents' population has focused on 101 subjects. This study has revealed that the various modes of biomedical waste management, from their generation, gathering, handling, removal, transportation, disposal, and final treatment. The stakeholders involved along the chain adopt different and varied behaviors. A proper waste management requires its carriage to the final treatment sites. There are specialized actors in this domain who do this in collaboration with clinics that accept and abide by the terms of their contracts. Some private health facilities do not use the professional biomedical waste removers' services; rather, they handle them in their own way. The study has pointed out that biomedical waste carriage is poorly performed in Cotonou. This research has also shown that various modes are used by the investigated centers to remove their biomedical waste. The private clinics use three ways to treat their waste: incineration, burial, and burning in a pit in the open air. Some private health facilities do not carry their waste into the central incinerators; rather they make the option of incineration by any means available in the facility. Thus, biomedical waste management represents a real and topical challenge not only for health personnel but also for populations as a whole.

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The author declared that he has no competing interest. This study was financed by his own equity funds.

#### *Statement of authorship*

The author has a responsibility for the conception and design of the study. The author has approved the final article.

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