

QUANTIFICATION OF THE PRODUCTION OF SOLID MEDICAL WASTE FROM THE PUBLIC HOSPITAL CENTER IN TANGIER - MOROCCO

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Abstract

Introduction. The evolution of demography, medical technology and the COVID-19 epidemic phenomenon increases the production of this waste which continues to increase.

Methods. This work determined the quantitative importance of the monthly production of solid medical waste at the level of 13 cares units of the public hospital center in Northern Morocco in period of two years 2019 and 2020.

Results. The results showed an average annual production of solid medical waste in 2019 was 108.66 kg/day with a quotidian production per occupied bed was 0.31 kg/day/bed. The average quantity produced in 2020 was 162.42 kg/day with quotidian production per occupied bed was 0.46 kg/day/bed. Infectious risk healthcare waste was the most produced (84.5%) during these two years. The study shows that in the majority of responses, the average amount of waste produced by the hospital during the month of May was more than 100kg/month.

Conclusion. The production of solid medical waste at the level of the various care units of the hospital has been variable during the month of May of each year. The large quantities were recorded in emergency services, intensive care units and maternity services. The low productions were observed at the laboratory level and the pediatric services.

Keywords: Medical waste, production; management; Public Hospital Center and COVID-19.

1. INTRODUCTION

Hospitals whose main function is to provide the population with comprehensive preventive and curative medical care produce a large and diversified quantity of waste. Indeed, population growth, industrial development and medical technology and the COVID-19 epidemic lead to an increase in the production of different types of waste responsible for a serious threat to humans and the environment [1]. Medical activities generate waste that must always be disposed of at the points of use by the healthcare provider structure. The amount of waste generated should always be minimized and care should be taken while handling it [2]. The interest of quantifying the daily production of waste in each healthcare establishment lies in knowing of the weight and volume of the waste produced daily [3]. As a general rule, the production of waste depends on several factors, in particular the management methods, the number of beds and the occupancy rate, the number of

patients treated daily, the degree of specialization of the care provided, the technical platform, the use of disposable materials [4]. The amount of waste produced in a hospital will depend on the level of national income and the type of structure [2].

A university hospital in a high-income country can produce up to 10 kg of waste per day per bed, all categories combined. In each structure, an estimate of the quantities of waste produced must be made. A hospital with a hundred beds will produce an average of 1.5 to 3 kg of waste per day and per patient depending on the context (all categories combined, with household waste) [5]. Infectious waste is that likely to generate infections represents less than 8% of all waste [6]. To be able to establish an effective program, the WHO recommends certain measures, among others, the need to carry out a study beforehand on the waste which is produced or which is likely to be, to determine its quantity and its type [7].

In Morocco, with a national bedding capacity (public and private sectors) of 33.300 beds and the national average occupancy rate is 56%, healthcare establishments produce more than 21,000 tons per year of solid medical waste [8] which 5.979 tons per year are hazardous medical waste or Infectious risk healthcare waste (about 28%) [3].

The public hospital in Northern Morocco suffers as a whole from a number of human, material, financial and organizational constraints. There are no detailed and official statistics on the exact quantities and composition of solid medical waste produced in hospitals. To carry out an inventory of solid medical waste close to reality, it would therefore be more reasonable to quantify the solid medical waste produced in this public hospital center in Northern Morocco.

2. MATERIALS AND METHODS

2.1. Strategy and design of the study

We adopted a descriptive and exploratory cross-sectional study design with a mixed approach and two levels of analysis: Health professionals and managers. The samples were taken every morning for a period of two years (2019 and 2020).

2.2. Study site

This study focused only on solid medical waste weighed daily using a scale from the public hospital center in Tangier city. Indeed, eight stations were investigated (emergency, surgery, resuscitation, pediatrics, operating room, laboratory, maternity and others). The solid medical waste used is two categories named according to the hospital system: Category I: Infectious risk healthcare waste (infectious waste and sharp waste) and category II: Unused chemical and biological products, incompletely used, damaged or expired blood derivatives for therapeutic use, unidentifiable human or animal anatomical parts and blood and its derivatives, example placenta. Questionnaires were distributed to health personnel and semi-structured interviews were carried out with certain persons of the management of solid medical waste.

2.3. Statistical analysis

The processing of the quantitative data collected was done by Excel, also the qualitative analysis was carried out by the manual processing and transcription of the interviews: the analysis of the content was made according to the method of "analysis theme of the content" by deciphering the verbatim from the interviews and by analyzing the decoding of the information provided by the interviews.

2.4. Ethical considerations

In order to preserve the anonymity of the persons surveyed and to protect the confidentiality of the information obtained within the framework of this study, all the participants were informed of the objective of this research in order to obtain their consent on the one hand and the other hand guarantee them the confidentiality of the information to be received with respect for anonymity and voluntary service.

The confidentiality of the information was ensured before starting the interview. Also consent was taken before starting note taking and using a recording device. The maximum time was 15 minutes for each interview.

3. RESULTS

3.1. Annual production of solid medical waste in 2019.

The public hospital in Northern Morocco, during the year 2019, the quantity produced of total solid medical waste was 39661.84 kg/year (average=108.66 kg/d). The quantity of waste produced for category I was 32948.7 kg/year (average=90.27 kg/day) and represents 83% of total solid medical waste. But for category II, the waste represented a production of 6713.14 kg/year (average=18.39 kg/day) representing more than 17% of total solid medical waste (Table 1).

Table 1: Annual production of solid medical waste in 2019.

	Category I	Category II	Solid Medical Waste
January	2905.88	468.81	3374.69
February	2175.56	418.51	2594.07
March	2914.29	544.09	3458.38
April	2909.46	606.32	3515.78
May	3136.16	545.8	3681.96
June	2640.32	706.11	3346.43
July	2648.97	536.34	3185.31
August	3243.43	629.84	3873.27
September	2258.33	584.15	2842.48
October	2687.18	547.43	3234.61
November	2683.42	566.74	3250.16
December	2745.7	559	3304.7
Total kg/year	32948.7	6713.14	39661.84
Average kg/day	90.27	18.39	108.66

3.2. Annual production of solid medical waste in 2020.

In 2020 the quantity produced of total solid medical waste was 59283.70 kg/year (average = 162.42 kg/day). The quantity of category I waste produced was 51184.45 kg (average=140.23 kg/day) and represents 86% of total solid medical waste. For category II, waste represented a production of 8099.25 kg/year (average=22.19 kg/day) representing more than 14% of total solid medical waste (Table 2).

Table 2: Annual production of solid medical waste in 2020.

	Category I	Category II	Solid Medical Waste
January	3003.03	609.24	3612.27
February	4485.25	465.5	4950.75
March	2589.27	621.89	3211.16
April	6625.53	581.8	7207.33
May	6807.99	803.14	7611.13
June	4027.83	757.9	4785.73
July	4740.38	765.17	5505.55
August	3168.65	654.35	3 823,00
September	4247.97	683.94	4931.91
October	4410.5	594	5004.5
November	3422.5	700.67	4123.17
December	3655.55	861.65	4517.2
Total kg/year	51184.45	8099.25	59283.70
Average kg/day	140.23	22.19	162.42

3.3. Evolution of the production of the solid medical waste

in 2019, we notice that the maximum production is 3873.27 unity at the level of August. While lower production of the waste (2005.04 kg) was obtained in the same month. This result could be explained by the fact that this month (August) saw an increase in patients at the emergency department (more than 303.496 cases). But in 2020, the increase of the production of the solid medical waste is mainly observed in April and May in connection with the confirmation of increased patient demand during COVID-19 because it was the only hospital that received COVID-19 patients approximately 887 cases. In 2020, from the end of May to December, we saw a decrease of the waste production as the hospital stopped receiving COVID-19 patients (Figure 1).

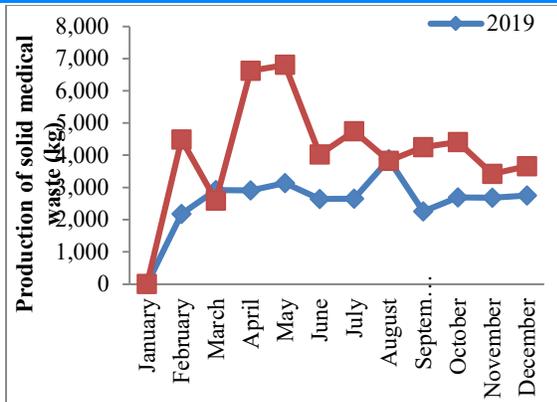


Figure 1: Evolution of the production of the solid medical waste.

3.4. Litter capacity and average occupancy rate

The average occupancy rate serves as a crucial indicator of hospital performance, efficiency, and effectiveness. Table 3 provides details on the bed capacity and average occupancy rate of the public hospital center in Tangier city. Notably, we observe that the average occupancy rate exceeds the standard (set at 80%) during these two years.

Table 3: Litter capacity and occupancy rate.

	Litter capacity	Average Occupancy Rate (%)
2019	343	91.51
2020	350	86.49

3.5. Daily production of category I

We chose the month of May during these two years (2019 and 2020) to know the daily production of solid medical waste at the level of the various care units of the hospital. Indeed in 2019, we observed that the high quantities were recorded in the emergency department (average=55.87 kg/day), the surgery department (average=13.39 kg/day) and the pediatric department (average=6.87 kg/d). But, the large quantities were recorded during the year 2020 manifested in the emergency department (average=68.66 kg/day), the resuscitation department (average=65.63 kg/day) and the operating department (average=33.37 kg/day). The low productions were observed at the level of maternity service and laboratory (Figure 2).

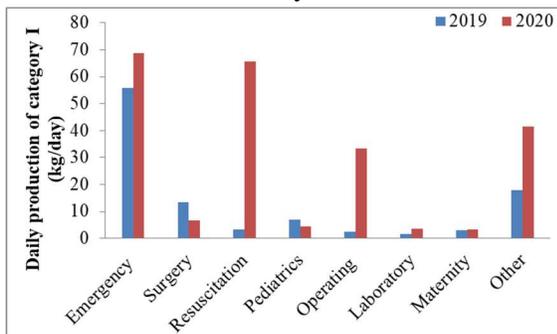


Fig 2: Daily production of category I (Infectious risk healthcare waste) at the level of public hospital care units.

3.6. Daily production of category II

In 2019, we note that the high quantities were recorded in the maternity department (average=3.62 kg/day), the pediatric department (average=2.99 kg/day) and the emergency department (average=3.22 kg/day).

In 2020, high quantities were recorded in the maternity department (average=7.44 kg/day), the operating theater department (average=2.66 kg/day) and the emergency department (average=1.85kg/day). More, low productions were observed at the laboratory level during these two years (Figure 3).

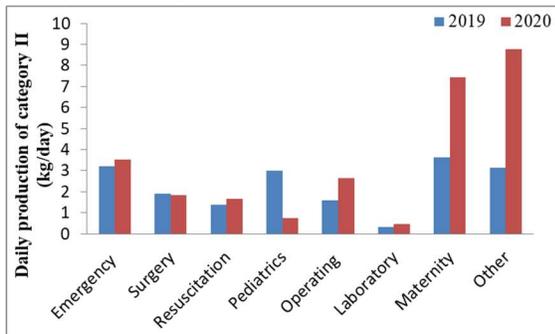


Fig 3: Daily production of category II at the level of public hospital care units.

3.7. Quantity of service waste generated in 2020

Higher quantity of waste generated by services in May was observed for category I and II >100 kg. While lower quantity of the waste generated by services in the same month was noticed for category I and II (Figure 4). The mean quantity of waste produced by the hospital during the month of May is more than 100kg.

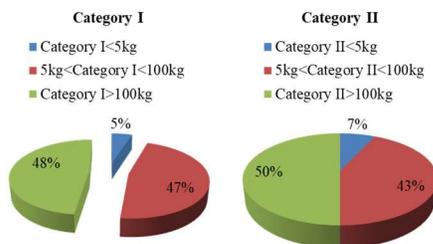


Fig 4: Quantity of waste generated by services in May.

4. DISCUSSION

According to our study and our investigation with the public hospital establishment, we can note that the public hospital in Northern of Morocco, generates significant quantities of waste which highlights a major infectious risk for health personnel and for the environment. .

The daily quantity of solid medical waste produced in 2020 was 162.42 kg/day, of which category I (Infectious risk healthcare waste) represents 140.23 kg/day, and 22.20 kg/day for category II. These quantities could be explained by the general specificity of this hospital which provides important care services and activities. Indeed, this hospital is the largest health facility in the North

region of Morocco. This is observed by a high litter occupancy rate (average occupancy rate =86.49%) which exceeds that recorded in several Moroccan regional hospitals. A study done at the Send we hospital in Lubumbashi suggested that the bed occupancy rate is an essential indicator of the performance, efficiency and effectiveness of hospitals [3].

A study conducted at the Children's Hospital in Rabat showed that the daily production of hospital waste was 3594 kg/day. At the same time, we chose the Moulay Ismail Military Hospital in Meknes; at its level, the estimate of the quantity of waste produced each day was 1075 kg/day [9]. In our study, the daily production of Infectious risk healthcare waste largely exceeds that observed at the regional hospital of Meknes where the Infectious risk healthcare waste produced were 0.24 kg/d [2], and less than that observed at the regional hospital of Tetouan or the Infectious risk healthcare waste were 172.79 kg/day [3].

The average production at the national level is estimated at 3 kg/bed/day, with variations, depending on the hospital discipline, ranging from 1.5 to 4.5 kg/bed/day [4]. The production of category I (Infectious risk healthcare waste) during the year 2020 is significant at the level of emergency services which is recognized by their intense activity and is considered as a hospital service with a high and regular admission rate. This study is also observed at the Tetouan regional hospital center which showed that this service generated an average of 36 kg/d [3].

A study conducted in Algeria, at the Mohammed Boudiaf hospital, showed that the production of waste from healthcare activities was 70.78 kg/day, made up of 42% category I waste (Infectious risk healthcare waste) and 14% category II of waste [1]. This study is also observed at the regional hospital center of Daloa which showed that category I represents 41.5% on the other hand category II represents 19.4% [4].

The average amount of waste produced by the hospital during the month of May is more than 100kg. While, for category I, we can say that the Mohamed V hospital in Meknes released a quantity of 981 kg/month. The average weekly quantities are 245 kg, i.e. a daily average of 49.05 kg [2].

We found results comparable to those found in France following a survey within the Paul Brousse hospital, 18% of practitioners produce more than 5kg per month of infectious risk healthcare waste [10].

Our study is the first in Morocco describing the preparation, response and effects of the COVID-19 pandemic on the delivery of professional health care. It is made at the level of the entire Tangier city. Also our study has tried to dig to answer the research question at the same central or strategic, tactical and operational level in order to make an inventory of the situation on the preparation and the response.

Thus our study met the objectives set from the start of the work, as it allowed healthcare providers and managers to express their opinions and expectations to improve the quality of services during this crisis and the next pandemics.

This work, in its conception as in its realization, could have certain limits that are difficult to foresee. It should be noted that our study has some obstacles and biases that we have tried to neutralize.

- Time constraints.
- The unavailability of the target population and the difficulty of collecting responses on the work sites.
- The complexity of the interest of the study which included several dimensions.
- The subject was new and the information was not very available at the time of the literature search.

5. CONCLUSION

The production of solid medical waste constitutes a real danger to the public hospital in Northern of Morocco and to its environment. The daily production of solid medical waste increases over time. The recorded values exceed the average value recorded at the national level. This production is very important in terms of emergency, resuscitation and maternity services.

REFERENCES

- [1] K. N'Guessan, K. A. J. YÉO, K. Kouassi, and Y. S. S. Barima, "Gestion Des Dechets Solides Du Centre Hospitalier Regional De Daloa (Centre-Ouest De La Cote D'Ivoire) Et Des Risques Associes," *Environnement, Ingénierie & Développement*, vol. Unlabeled, pp. 26–32, 2021.
- [2] J. Bouzid, A. CHahlaoui, A. S. Jaouhar, Bouhlal, and K. Ouarrak, "Quantification de la production de déchets médicaux solides de l'hôpital Mohamed V de Meknès (Maroc)," *Int. J. Innov. Appl. Stud.*, vol. 18, no. 1, p. 9324, 2016.
- [3] S. M. Raoui, Y. Bougatouch, B. Chadli, F. Errachidi, and N. Chadli, "The Quantitative Importance of DASRI in the Regional Hospital Center of Tetouan City , Morocco," *World J. Res. Rev.*, no. 1, pp. 15–18, 2018.
- [4] Ministère de la santé, "Guide de gestion des dechets des etablissements de soins," 2004. [Online]. Available: <http://docum.o.d.f.unblog.fr/files/2011/04/guidegestiondechetsmpmaroc.pdf>.
- [5] Comité international de la Croix-Rouge (CICR)., "Manuel de gestion des déchets médicaux," 2011. [Online]. Available: www.cicr.org.
- [6] G. Sabeh, "Les Déchets Médicaux Connaissances et Traitements," *Hum. Heal.*, vol. 5 Oct, pp. 33–39, 2008.
- [7] Y. EL Maaroufi and A. EL Ouardi, "Gestion écologique des déchets solides médicaux et pharmaceutiques : Cas de l'hôpital Avicenne de Rabat," *Cent. Strat. Int. la Gouv. Glob.*, p. 25.
- [8] S. Arif and F. Doumani, "Coût de la dégradation de l'environnement due aux pratiques de gestion des déchets solides dans le Grand Rabat. Programme SWEEP-Net financé par la GiZ. Tunis.," 2014.
- [9] Y. Bouhtouri, "Management of hospital waste in Morocco. Case of CHU Rabat-Salé and Military Hospital Moulay Ismail in Meknes.," 2013.
- [10] S. Roux, V. Migliore, J.-C. Cêtre, and D. Peyramond, "R-04 L'élimination des déchets d'activités de soins à risques infectieux (DASRI) par les médecins généralistes du département de l'Ain," *Médecine Mal. Infect.*, vol. 39, pp. S70–S71, 2009.