



A study related to the management of medical and pharmaceutical wastes in Beni mellal-Khenifra region: Beni mellal city as a case of study

S. Msaad^{1*}, N. Abbadi², M. Mbarki³, S. Rabi³, N. Belkhouya¹, A. Gamouh¹

¹ Laboratory of Applied Spectro- Chemistry and Environment. Faculty of Sciences and Technologies, University of Sultan Moulay Slimane (BP) 592, Beni Mellal, Morocco. smsaadi@yahoo.fr

² Laboratory of Biological Engineering. Faculty of Sciences and Technologies, University of Sultan Moulay Slimane (BP), 592, Beni Mellal, Morocco.

³ Laboratory of Chemical Processing and Applied Materials. Multi-disciplinary Faculty, Sultan Moulay Slimane University (BP), 592, Beni-Mellal, Morocco

Received 22 Dec 2019,
Revised 09 Feb 2020,
Accepted 11 Feb 2020

Keywords

- ✓ Health centers,
- ✓ Investigation,
- ✓ Landfill,
- ✓ Medical,
- ✓ Pharmaceutical,
- ✓ Wastes

smsaadi@yahoo.fr ;
Phone: +212661902464;
Fax: +212523480048

Abstract

After having conducted an investigation about landfill in Beni Mellal city, Medical and Pharmaceutical Wastes (MPWs) are unloaded mixed with household and similar wastes. The objective of the present study aims primarily at determining the source of medical and pharmaceutical wastes, evaluating and analyzing their management at the level of Beni Mellal city, ameliorating the quality of collecting and consequently minimizing the management costs of these wastes. First of all, we have created database concerning the location of health centers (HC). After, we have conducted a survey with the help of a questionnaire distributed in different public and private health centers. Then we have carried out a research on MPWs in Dustbins existing around the health centers. We have also made an analysis of the management system of MPWs inside The Regional Hospital Center (RHC) in Beni Mellal. Afterwards, we have made a comparison between some hospital centers in Morocco when it comes to the management costs of MPWs. Based on the results obtained; we have suggested some solutions to master the management system of MPWs in addition to the scenarios for optimizing the costs linked with this service.

1. Introduction

Medical waste management is of major concern due to the potentially high risks to both human health and the environment caused by inadequate waste management practices [1] as the world accumulates more wastes which can be seen as any useless, unwanted or discarded substance or material, irrespective of whether or not such substance or material has any other or future use [2]. Hospitals and medical centers are not the exception. The development of medical technology has increased the production of different types of wastes, which can threaten the environment and Jeopardize human health [3]. Among these wastes, we have pharmaceutical wastes, which are seen as one of the hazardous wastes class in the hospital [4].

According to the International Health Organization, in its note in 2007, it is stipulated that there was not inexpensive options, which have no effect on the environment, for eliminating hospital wastes with safety.

In Morocco, the management of wastes is a priority for the Government to protect the environment and people's health without forgetting also that the mismanagement of health care waste poses risks to people and environment [5]. In keeping with this, Dr. Anjali along with other experts in their article claim that Improper management of health care waste can have both direct and indirect health consequences for health personnel and to the environment [6]. Since many years, the quantity of wastes produced continues to increase to the extent that it has created a challenge for the workers working in this domain; hence the quantity produced is estimated by 21 000 tons per year [7].

As part of its strategy to the problematic of MPWs, the Moroccan Government, through its ministry of health, encourages private sector to invest in private processing units.

The Moroccan Government has adopted a number of laws in the domain of MPWs management which are as follows:

- Law n° 28-00, November 22, 2006 related to the management of wastes and their elimination;
- Decree N° 2-07-253, July 18, 2008 classifying wastes and listing dangerous wastes;
- Decree N° 2-96-139, May 21, 2009 related to the management of pharmaceutical and medical wastes;
- Law N° 30-05, June 2, 2011 related to the transportation of dangerous goods by roads;
- Law N° 2-14-85, January 20, 2015 related to the management of dangerous wastes.

In the past, there has been a problem in law. Huge quantities of hospital wastes are eliminated without any prior processing, simply by landfill or burial method, which is viewed as one of the popular methods because all wastes after minimization or treatment need access to land or final disposal [8] as it is indicated in figure 1.

In reality, this method does not eliminate the harmfulness of wastes, but they have an effect, especially because improperly dispose of medications potentially pose environmental risk [9], and the disposal of pharmaceutical wastes depends on Multiple factors. For example, a particular pill, depending on its characteristics, could be hazardous waste [10]. These wastes constitute a reservoir of microorganisms which can cause some diseases, like SIDA, hepatitis A and B, Gastroenteritis, skin diseases, and the list is long [11]. According to the Article entitled “Medical Waste Management Community Health Centers” written Mohamad Saadati along with other researchers, Some hazardous agents such as HIV, Hepatitis B and hepatitis c, are transferrable through medical wastes [12].

Our study is the first study carried out in the domain of MPWs at the level of Beni Mellal region; it is about the problematic of managing medical and pharmaceutical wastes at the level of Beni Mellal and the objectives are to:

- Analyze and evaluate the management system of MPWs at the level of Beni Mellal city.
- Suggest some solutions and scenarios for optimizing the costs linked with this service .
- Ameliorate the quality of collecting and handling wastes. or develop an Efficient strategy for pharmaceutical wastes disposal [13], by providing good health care risk waste management practices [14].



Figure 1: Identification of MPWs at The Level of Landfill in Beni Mellal (year 2017)

We have visited the landfill of Beni Mellal two times a week during three months.

2. Material and Methods

We have created database concerning the location of health centers. After, we have conducted a survey with the help of a questionnaire (see annex1), and we have looked for MPWs in the dustbins existing around the health centers. We have analyzed and evaluated the management system of MPWs inside RHC in Beni Mellal. Then we

have made a comparison between the costs of eliminating wastes in Beni mellal with others in other cities in Morocco (sorting out, intermediate storage, final disposal and processing them according to their nature.(To carry this work, we have used the following materials:

- Excel ;
- Andlocalisation: Localisation ;
- ArcGis: Geolocation Information system (GIS);
- Sphinx: Elaboration of the questionnaire. Excel;

2.1. Presenting the area of study

Beni Mellal city is the biggest city and the capital city of Beni Mellal- khenifra region. It is located in the Centre of Morocco, 240 km away from Rabat, 200 Km away from Casablanca, and 190 km away from Marrakesh city (figure 2).

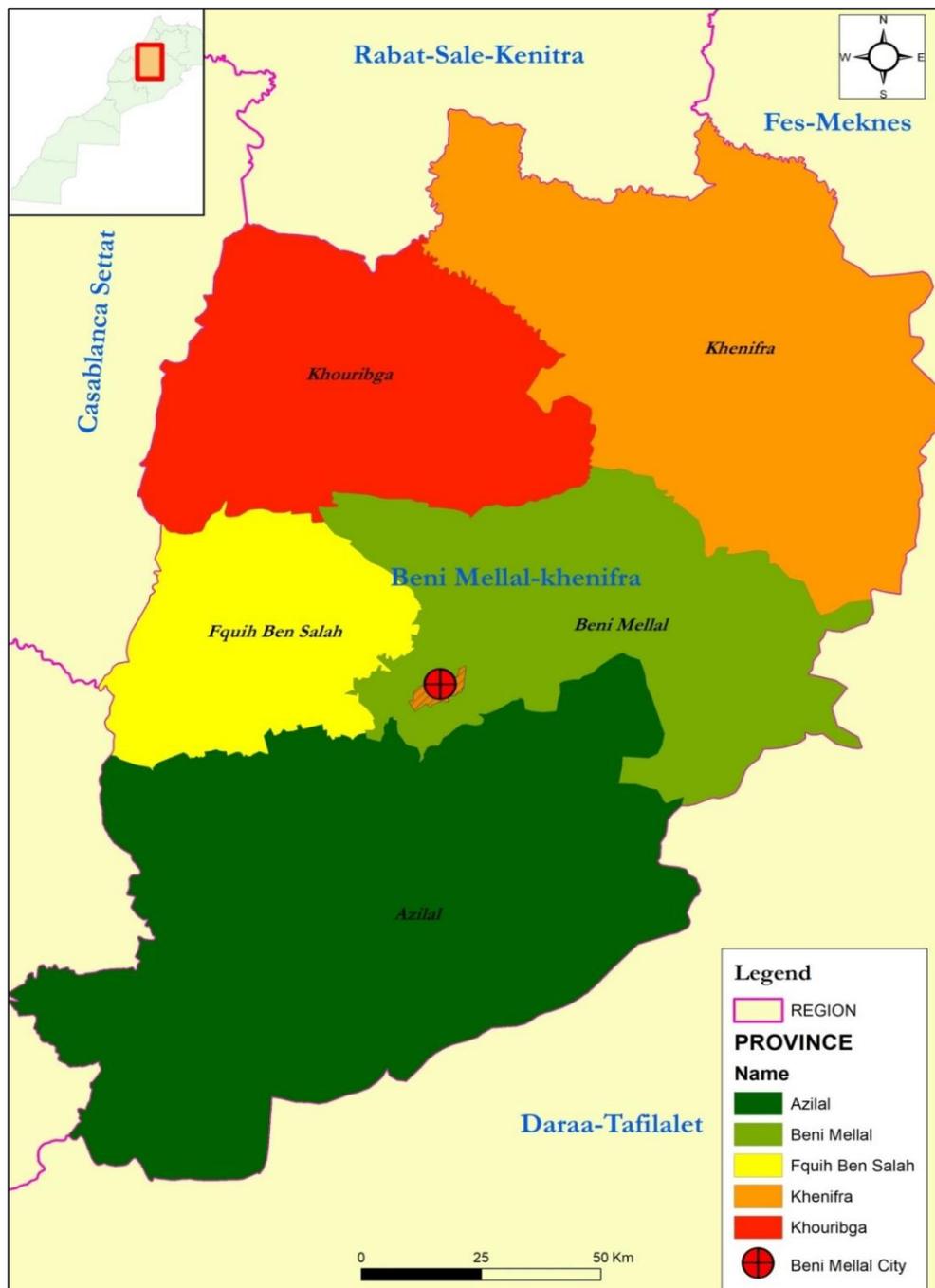


Figure 2: The location of Beni Mellal in Beni Mellal- Khenifra Region [15].

3. Results and discussion

3.1. Health Centers in Beni Mellal:

We have identified 29 health centers existing in different areas in Beni Mellal city, where its location is indicated in the map of annex 2.

The number of each type of health center is illustrated in the table 1 below:

Table 1: Number of each type of health center

Health Centers in Beni Mellal City		
– 1 (one) Regional Hospital	– 2 (two) Hemodialysis Centers	– 14 (fourteen) Private Clinics
– 7 (seven) Primary Health Centers	– 5 (five) Medical Analysis Laboratories	

Conducting a survey with the help of a questionnaire inside the health centers in Beni Mellal. We have conducted an investigation inside a number of health centers, and the results are the following:

- Given the sensitivity of the sector and for the confidential reasons, just 33% of health centers have answered the questionnaire.
- 60 % of the participants know about the legal framework of MPWs.
- 100% of the participants have confirmed that MPWs have hazardous effects on public health and environment.
- 50% of the participants investigated have benefited from a training in relation to the management of MPWs
- 100% the centers inquired have made some conventions with private operators about the management of MPWs.
- 100% of health centers inquired have appointed a person responsible for monitoring the management of MPWs.
- Sorting out and MPWs conditioning constitute 100% in the private health centers and less in the public ones.
- 100% of health centers investigated have a place for storing MPWs.

3.2. Carrying a survey about MPWs in the garbage bins around the health centers.

This investigation is demonstrated in (Figure 3). We have looked for MPWs in every dustbin existing near the health centers. The result of this operation is negative. There are no MPWs in those dustbins.



Figure 3: Searching for Medical Wastes in Garbage bins existing around The Health Centers.

We have looked for medical wastes in garbage bins existing around the Health Centers three times a week in different places during four months.

3.3. Analyze and Evaluate the Management System of MPWs inside RHC in Beni Mellal

The objective of this stage in our study is to make an audit inside RHC in Beni Mellal so as to see the degree of respecting the procedure of managing MPWs inside every service.

The amount of hospital wastes, Household and similar wastes produced by RHC in Beni Mellal is indicated in the table below.

Table2: The Amount of Hospital Wastes Produced by RHC in Beni Mellal in 2018 [16].

Month	MPWs	Household and similar wastes
January	6 122	11 905
February	4 734	12 160
March	6 450	13 024
April	5 397	14 071
May	6 180	14 215
June	5 834	16 315
July	6 171	16 978
August	6 181	16 606
September	6 761	15 865
October	5 990	13 981
November	5 404	13 195
December	6 140	11 650
Total Quantity (Kg)	71 364	169 965
Average Quantity (Kg) /Month	5 947	14 164
Total Average Quantity (Kg) / Month	20 111	

After analyzing the quantity of MPWs produced by RHC in Beni Mellal, it is observable that the maternity section produces more MPWs (see the quantity produced in the graph below).

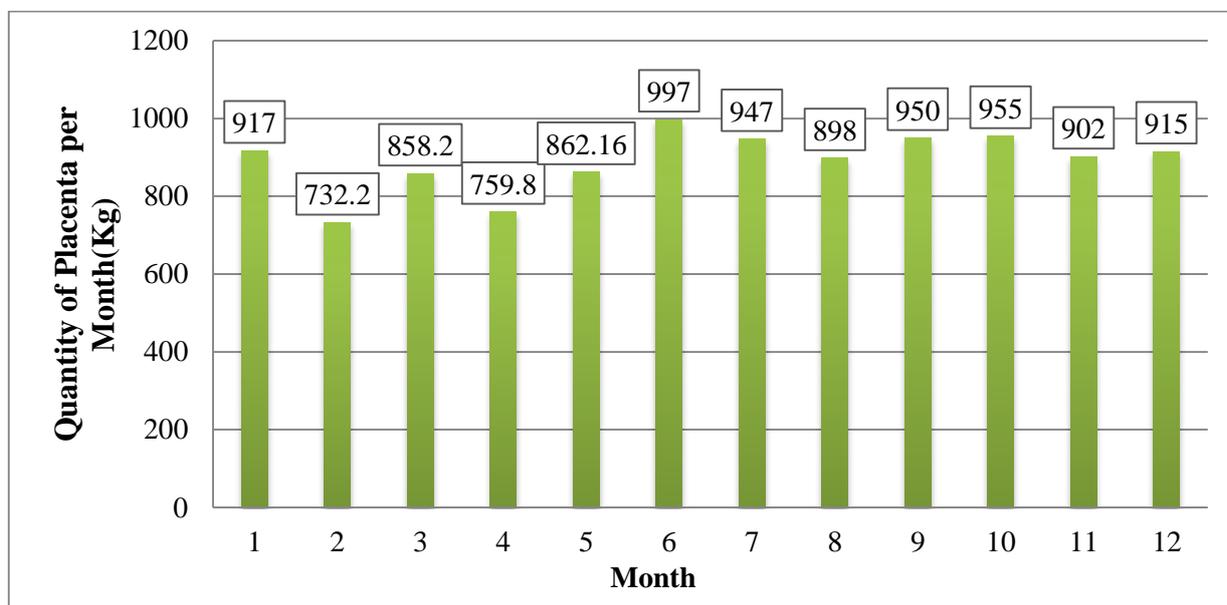


Figure 4: The Quantity of Placenta Produced by the Maternity Section inside RHC in Beni Mellal in 2018.

The average quantity of Placenta produced by the maternity section in RHC in Beni Mellal in 2018 is 891.11 kg/month. It represents 15 % of MPWs. Consequently, this section is given much importance, unlike the other sections because it requires more materials of waste collection than the others.

3.4. A Comparison between the Costs of Eliminating MPWs in Beni Mellal with Other Cities in Morocco (Sorting out, collecting, intermediate storage, final evacuation, and processing depending on their nature)

A comparative study about the costs of managing MPWs in different hospital centers in Morocco has been conducted, and the costs of this management are presented in the table 3.

Table 3: A Comparative Table about the Costs of Handling Medical Wastes in Different Hospital Centers in Morocco [17].

City	Quantity (Kg)	Amount (Dhs)	Costs (Dhs/Kg)
Prefectural hospital center- Agadir (PHC)	120 000	628 560	5.2
RHC Béni Mellal	120 000	864 000	7.2
PHC Essaouira	49 500	259 000	5.2
Hospital-university Mohammed VI center -Marrakech	288 000	1 900 800	6.6
PHC Al-Hoceima	56 452	623 073.60	11.03
PHC Tinghir	13 000	255 060	19.62

The analysis of MPWs management costs in different health centers shows that the costs are not fixed. Consequently, the costs vary depending on the requirements of each health center (The special conditions document).

The analysis of different previous results has led us to formulate the following remarks:

- The necessity of enhancing training and sensitization side of the staff working in those health centers for better understanding of the process of eliminating MPWs;
- Private health centers master well the management of MPWs better than the public ones;
- Periodic maintenance of materials of managing MPWs inside RHC is a factor determining the process of management;
- The cost of eliminating MPWs inside Beni Mellal city is slightly high, and it depends basically on how far are they from the processing sites and the quantity to be processed.

Conclusion and perspectives

Our work has brought up results which are the first in the domain of managing MPWs at the level of Beni Mellal region. These results have led us to diagnose the mode of managing MPWs at the level of the region and detect the defects that exist.

Improving the management system of MPWs at the level of each health center is necessary. This improvement focuses on sensitization and staff training, offering equipment for handling MPWs. There must be necessarily a control over these health centers by paying unexpected visits and suggesting some improvements every time if necessary.

Given its potentials and geographical vocation, Beni Mellal city has an important industrial zone, and installing a processing unit for MPWs with a great amount of capacity would allow to:

- Reduce the costs of transporting MPWs;
- Minimize the duration of MPWs storage; hence the energy consumed by the refrigerators will be reduced and the risk of infected wastes will be diminished as well;
- Encourage different private health centers to adhere to this unit with competitive prices, hence the probability of finding these wastes in the landfill decreases;
- Possibility of managing MPWs at the regional level;
- Offering more job opportunities at the level of the region.

Acknowledgements-The authors would like to thank the Regional Hospital Center, private clinics of Beni Mellal city and Municipality of Beni Mellal City, Morocco, for their assistance and support.

References

1. A. Mbarki, B. Kabbachi, A. Ezaidi, M. Benssaou, Medical Waste Management: A Case Study of the Souss-Massa-Drâa Region, Morocco. *Journal of Environmental Protection*; 4 (2013) 914-919. <http://dx.doi.org/10.4236/jep.2013.49105>
2. R. Renju, T.R. Delvin, M. Vandaranani, Biomedical waste management in Ayurveda hospitals-current practices and future prospectives. *Journal of Ayurveda and Integrative Medicine*, 10 (2019) 214-221. <https://doi.org/10.1016/j.jaim.2017.07.011>
3. M.H. Dehghani, H.D. Ahramia, R. Nabizadeha, Z. Heidarinejadd, A. Zareif. Medical waste generation and management in medical clinics in South of Iran. *Methods X*, 6 (2019) 727-733. <https://doi.org/10.1016/j.mex.2019.03.029>
4. S. Sasu, K. Kümmerer, M. Kranert. Assessment of pharmaceutical waste management at selected hospitals and homes in Ghana. *Waste Management & Research*, 30 (2012) 625-630. <https://doi.org/10.1177/0734242X11423286>
5. L.M. Johannessen, M. Dijkman, C. Bartone, D. Hanrahan, M. G. Boyer, C. Chandra. Health Care Waste Management Guidance Note. (2000) p 1-74 <https://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/Johannssen-HealthCare-whole.pdf>
6. A. Acharya, V.A. Gokhale, D. Joshi. Impact of Biomedical Waste on City Environment: Case Study of Pune. India. *IOSR Journal of Applied Chemistry*, 6 (2014) 21-27. <http://www.iosrjournals.org/iosr-jac/papers/vol6-issue6/D0662127.pdf>
7. Faiza Rhoul. Management of medical wastes: "We must follow hospitals and clinics". (2018). www.yabiladi.com/articles/details/69034/gestion-dechets-medicaux-faut-poursuivre.html
8. M. Ansaria, M.H. Ehrampousha, M. Farzadkia, E. Ahmadi. Dynamic assessment of economic and environmental performance index and generation, composition, environmental and human health risks of hospital solid waste in developing countries; A state of the art of review. *Environment International*, 132 (2019) 1-18. <https://doi.org/10.1016/j.envint.2019.105073>
9. A. Azad, R.H. Ansary, A. Akhter, S.M.M. Al-Mamun, M. Uddin and M.M. Rahman. Disposal Practice for Unused Medications among the Students of the International Islamic University Malaysia. *Journal of Applied Pharmaceutical Science* 02 (2012) 101-106. https://www.japsonline.com/admin/php/uploads/553_pdf.pdf
10. Bryan W. Shaw, Buddy Garcia, Carlos Rubinstein, Mark R. Vickery, Study of the Methods for Disposing of Unused Pharmaceuticals. Texas commission on environment quality (2010) 1-278. https://www.tceq.texas.gov/assets/public/comm_exec/pubs/sfr/098.pdf
11. T. AJZOUL, A. El bouardi, J. Bullejos, M. Bahri. Alternative option for handling hospital waste in Morocco: The choice between burial, incineration and autoclaving. In: First National Conference on medical Wastes: Management and its impact on Health and Environment. Premier colloque national sur les déchets d'activités de soins: gestion et impact sur la santé et l'environnement. Faculty of Sciences, Meknes, Morocco (2007). http://dmp.uae.ma/articles_auteurs/communications_sc/Colloque_Meknes_Alternatives_traitement.pdf
12. J.S Tabrizi, R. Rezapour, M. Saadati, S. Seifi, B. Amini, F. Varmazyar. Medical Waste Management in Community Health Centers. *Iran J Public Health* 47 (2018) 286-291. <https://www.ncbi.nlm.nih.gov/pubmed/29445640>
13. S. Bungau, D. Mirela Tit, K. Fodor, G. Cioca, M. Agop, C. Iovan, D.C.N. Cseppento, A. Bumbu, C. Bustea. Aspects Regarding the Pharmaceutical Waste Management in Romania, *Sustainability*, 10 (2018) 1-14. <https://ideas.repec.org/a/gam/jsusta/v10y2018i8p2788-d162292.html>
14. W.D. Khanyile. Health Kwazulu-Natal. Policy for Kwazulu-natal: Health care risk waste management. Reference 16/1/P, (2008) 1-37. <http://www.kznhealth.gov.za/eh1.2008.pdf>
15. The General Directorate of Local Government, Morocco. Monograph about Beni Mellal - Khénifra region, p.3.
16. Beni Mellal Regional Hospital Center. Waste tonnage documents
17. Public Procurement Platform. Medical and pharmaceutical waste management. <https://www.marchespublics.gov.ma>

(2020) ; <http://www.jmaterenviromsci.com>

Annex 1

A Study Related to the Management of Medical and Pharmaceutical Wastes in Beni Mellal-Khenifra Region: Beni Mellal City as a Case of Study

May, 2017 – Faculty of Sciences and Technologies in Beni Mellal

Hello! Sir/Madam

within the framework of preparing my doctoral thesis in the Faculty of Sciences and Technologies in Beni-Mellal and within this objective of analyzing and evaluating the management system of medical and pharmaceutical wastes at the level of Beni-Mellal city in order to ameliorate the quality of collecting and handling these wastes and consequently minimizing the costs of management, we have designed this questionnaire, and we would appreciate your collaboration by responding to the questions below.

1. Name of the Center

2. Address

3. Occupation/Job

1. Doctor 2. Engineer 3. Nurse 4. Technician 5. Others

4. Gender

1. Female 2. Male

5. Years of Experience

1. Less than 5 years 2. 5-10 years 3. More than 10 years

6. What do medical and pharmaceutical wastes mean for you?

7. Do you know national, legislative and regulatory references related to the management of medical and pharmaceutical wastes?

1. Yes 2. No

8. If yes, state one at least.

9. Do you think that medical and pharmaceutical wastes provoke hazardous effects on public health and environment?

1. Yes 2. No

10. If yes, from these suggestions, what are they?

1. Infectious risks 2. Biological risks 3. Radio active risks 4. Others :.....

11. Does the center ensure a training about the theme of medical and pharmaceutical wastes?

1. Yes 2. No

12. Has the center appointed someone responsible for medical and pharmaceutical wastes?

1. Yes 2. No

13. Is There any plan about the management of medical and pharmaceutical wastes at the level of your center

1. Yes 2. No

14. If yes, is it documented? Can you give us a general idea?

15. If no, what are the methods used?

16. Is sorting out used as a technique for managing medical and pharmaceutical wastes in your center?

1. Yes 2. No

17. If yes, what are the services that are concerned with this? What are the means used ?

--

18. Do you think that their separation is going to be utile for their management?

1. Yes 2. No

19. Does the center manage and collect this type of medical and pharmaceutical wastes by a private operator?

1. Yes 2. No

20. If yes, what are the agreed conditions set up by the center and this operator?

1. Management and collection unit 2. Transportation towards the location of the processing unit 3. Others:.....

21. In case transportation is offered by a private operator, the transportation is done by :

1. The Center itself 2. Another specialized company 3. Others:.....

22. Have you made conventions with private operators to ameliorate the management of wastes?

1. Yes 2. No

23. Is a qualitative estimation of the management of medical and pharmaceutical wastes already done by your center?

1. Yes 2. No

24. Can you give us a daily average quantity of medical and pharmaceutical wastes that your center generates?

1. Dangerous wastes..... 2. Harmless wastes

25. At the level of your center, do you have a place for storing medical and pharmaceutical wastes?

1. Yes 2. No

26. If yes, what are the means used for storage?

1. Plastic bags 2. Freezers 3. Solvent 4. Others:.....

27. For how long do you store medical and pharmaceutical wastes before evacuation?

1. 24 hours 2. 48 hours 3. 72 hours 4. more than 72hours

28. What is the cost of managing medical and pharmaceutical wastes (kg/tons)?

--

29. Generally, are you satisfied with the management of wastes in your center?

1. Yes 2. No

30. What are the problems encountered in your center when it comes to the collection of medical and pharmaceutical wastes?

--

31. What are your suggestions for management well medical and pharmaceutical wastes in your center?

--

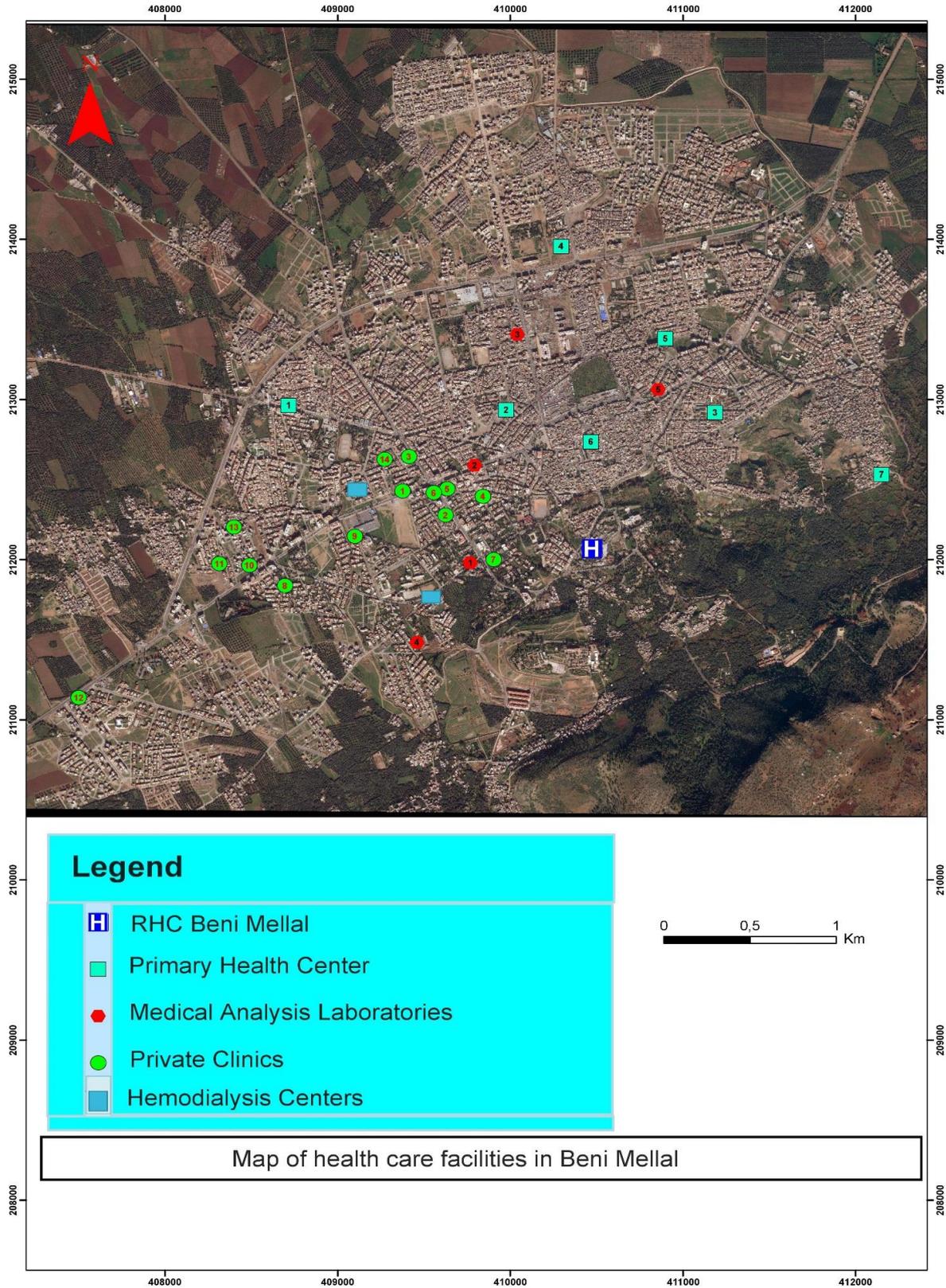
32. Has your center already benefited from a visit by a team responsible for the protection of environment?

1. Yes 2. No

33. If yes, what is the frequency?

1. 1/month 2. 1/3months 3. 1/6 months 4. 1/year

Annex 2



(2020) ; <http://www.jmaterenvirosnci.com>