# The disposal pattern of domestic medical and pharmaceutical waste in Uyo metropolis, Southern Nigeria

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**ABSTRACT**

**Background**: Assessment of waste disposal practices is an important step in designing interventions to improve the health status of municipal communities.

**Objectives**: This study was aimed at assessing the domestic medical and pharmaceutical waste disposal practices by households in Uyo metropolis, Nigeria; and to provide informal education on appropriate practices for the community.

**Methods**: The town was demarcated into three zones A, B and C equivalent to high income, middle income and low income residential areas respectively. A total of one hundred and forty households were randomly selected from the zones (40 households each from zones A and B and 60 from zone C). The sampling unit was the head or representative of each household. A pretested self–administered questionnaire was used to assess the domestic medical and pharmaceutical waste disposal practices. Chi-square test was performed to assess differences in the disposal practices between the three zones. A p-value of less than 0.05 was regarded as significant.

**Results**: Majority of households disposed medical and pharmaceutical waste with garbage. The proportion of households involved in this practice ranged from 85% to 96.67% for medical waste and 73.34% to 82.5% for pharmaceutical waste. Only a small proportion disposed medical waste by burning or burying. Disposal by incineration was not practiced at all in the population surveyed. There was no significant difference in waste disposal practices between the three zones.

**Conclusion**: Waste was not sorted before disposal. Recommended methods were not followed in disposing the medical and pharmaceutical wastes. The disposal of domestic medical waste especially the sharps does not meet the international standard.

**Keywords**: Household, medical waste, pharmaceutical waste, disposal pattern.

# Le modèle de traitement des déchets médicaux et pharmaceutiques domestiques dans la métropole d'Uyo, au sud du Nigeria

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**RÉSUMÉ**

**Contexte**: L'évaluation des pratiques de traitement des déchets est une étape importante dans la conception d'interventions visant à améliorer l'état de santé des collectivités municipales.

**Objectifs**: Cette étude visait à évaluer les pratiques nationales en matière de traitement (élimination) des déchets médicaux et pharmaceutiques par les ménages de la métropole d'Uyo au Nigéria; et de fournir une éducation informelle sur les pratiques appropriées pour la communauté.

**Méthodes**: La ville a été délimitée en trois zones A, B et C équivalant respectivement à des quartiers résidentiels à revenu élevé, à revenu moyen et à faible revenu. Au total, cent quarante ménages ont été choisis au hasard dans les zones (40 ménages chacun des zones A et B et 60 de la zone C). L'unité d'échantillonnage était le chef ou le représentant de chaque ménage. Un questionnaire prétesté auto-administré a été utilisé pour évaluer les pratiques d'élimination des déchets médicaux et pharmaceutiques domestiques. Le test du chi carré a été effectué pour évaluer les différences dans les pratiques d'élimination entre les trois zones. Une valeur p inférieure à 0,05 a été considérée comme significative.

**Résultats**: La majorité des ménages ont disposé des déchets médicaux et pharmaceutiques avec des ordures. Le taux de ménages impliqués dans cette pratique variait de 85% à 96,67% pour les déchets médicaux et de 73,34% à 82,5% pour les déchets pharmaceutiques. Seule une petite proportion a éliminé les déchets médicaux en les brûlant ou en les enterrant. L'élimination par incinération n'a pas été pratiquée du tout dans la population étudiée. Il n'y avait pas de différence significative dans les pratiques d'élimination des déchets entre les trois zones.

**Conclusion**: Les déchets n'ont pas été triés avant leur élimination. Les méthodes recommandées n'ont pas été suivies pour l'élimination des déchets médicaux et pharmaceutiques. L'élimination des déchets médicaux domestiques, en particulier des objets tranchants, ne répond pas à la norme internationale.

**Mots-clés**: ménage, déchets médicaux, déchets pharmaceutiques, mode de disposition des déchets, Uyo.

## INTRODUCTION

Waste can be defined as any unwanted, defective, excess material, effluent or scrap resulting from production, domestic or other processes and intended for disposal.[1, 2] Wastes can be classified according to source, physical state or physicochemical properties. They can also be classified based on potential to cause harm to humans.[3, 4] A domestic waste is any waste that is generated at home.[(3)] Medical waste includes: cotton wool, swabs, gauze, blood, blood products, needles and other wastes resulting from biomedical procedures while pharmaceutical waste includes: unused and expired tablets, capsules, syrups, injectables and other drug products.[5] Therefore, domestic medical and pharmaceutical waste is the totality of medical and pharmaceutical wastes that are generated at home.

With increasing numbers of medical treatments and procedures being carried out in private residences, a greater volume of medical and pharmaceutical wastes can be generated in households. Wastes resulting from health-care activities at home include needles, blades, cotton wool, swabs, gauze, diapers, blood, blood products, unused and expired drugs. These materials are all potentially hazardous.[5]

Medical wastes (sharps and non-sharps) are potential media for transmission of infectious diseases such as hepatitis and Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). Apart from being agents of transmission of deadly diseases, sharps can cause physical injuries. Children and pregnant women are at high risk at home. Also, scavengers are highly vulnerable at dump sites. Therefore, medical wastes have a higher potential for infection and injury than other types of wastes; and must be disposed off appropriately.[5]

There is colour coding for segregation of medical and pharmaceutical wastes. The container/bag colours for highly infectious, infectious and pharmaceutical wastes are red, yellow and brown respectively. In addition, sharps must be stored in puncture-proof containers. Most medical wastes generated in the household are infectious waste and sharps; and must be stored in yellow bags and puncture-proof containers respectively. Medical and pharmaceutical wastes are not to be mixed or disposed with domestic or municipal wastes.[6] After the collection of wastes from households, medical wastes should be disposed by incineration. Unwanted pharmaceutical products should be disposed off in the original containers after scratching out information on the container or making it indecipherable. The containers should be tightly closed and wrapped in multiple layers of masking tape if such products are to be put in garbage and then dumped as near pick-up time as possible.[6]

In our previous work in which Uyo was demarcated into three zones and same respondents were involved as this work [7] ,the proportion of respondents aged 20 to 40 years ranged from 80 to 95% for the three zones .The status of housing facility and water supply was found to be satisfactory in the three zones Zone A was found to be the least congested and it had the best facilities consistent with the high income status of the zone.

No reported work on assessment of domestic medical and pharmaceutical waste disposal pattern in Uyo was obtained from literature. This work was aimed at assessing the disposal pattern of sharp medical wastes, non-sharp medical wastes, unwanted solid drug products and unwanted liquid drug products in the metropolis.

## METHODS

### Setting

The setting of the study is Uyo located in the South-South geopolitical zone of Nigeria. Based on the 2006 census which put the population at 356,964 [8] and assuming an annual growth of 2.3 %, the current population has been estimated to be 428,183.[7] Receptacles are made available at numerous points in the city by the Waste Management Agency of the State Ministry of Environment for dumping of domestic solid wastes. The dumped wastes are then disposed off by the Agency.

### Study design and sampling method

A cross-sectional observational survey of households was used for the study. A pilot study was carried out before the final structured questionnaire was drawn. The city was demarcated into three zones: A (North-Eastern part), B (Southern part) and C (North-Western part) corresponding to high, medium and low-income residential areas respectively.[7]

Sample size was determined to be 400 using the formula described in a previous study.[7] The pilot study revealed the average family size to be 3.5. Therefore, minimum of 114 households would be surveyed to give a sample of 400. Sample sizes of 40 households from zone A, 40 households from zone B and 60 households from zone C were taken based on the proportion of wards in each zone. A total of 140 households were selected from the three zones.

**Data collection**

Data were collected using a structured pretested self-administered questionnaire. The sampling unit was the head or representative of each of the households as carried out in the previous study.[7] The questionnaire was divided into three sections. Section A dealt with disposal of domestic medical wastes, section B was made up of questions about disposal of unwanted drug products while section C was made up of questions about method of keeping the wastes and the frequency of disposal.

**Informal education on appropriate waste disposal practices**

At the point of collection of the completed questionnaire, each respondent was informally educated on the right manners of disposing medical and pharmaceutical wastes especially for the categories that were not appropriately disposed.

**Data analysis**

Data were presented as frequencies and percentages. Differences in waste disposal practices between zones were explored using the Chi-Square test.

*A p-value < 0.05* was considered significant .

**Ethical considerations**

Permission and approval for the study were obtained from the Ethics Committee of the Faculty of Pharmacy, University of Uyo, Uyo, Nigeria.

**RESULTS**

Disposal of medical wastes

The most frequent method of disposal of medical sharps and non-sharps in all the zones was along with garbage Disposing by incineration was not practised at all in the population surveyed (Table 1) .

**Table 1:Methods of disposal of sharp and non-sharp medical wastes**

| Method of disposal | Zone A n=40 | | Zone B n=40 | | Zone C n=60 | | |
|---|---|---|---|---|---|---|---|
| | Freq. | % | Freq. | % | Freq. | % | *p-value* |
| **Sharp wastes** | | | | | | | |
| Incineration | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | > 0.05 |
| With garbage | 37 | 92.50 | 34 | 85.00 | 58 | 96.67 | < 0.05 |
| Others | 3 | 7.50 | 6 | 15.00 | 2 | 3.33 | < 0.05 |
| **Non sharp wastes** | | | | | | | |
| Incineration | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 | > 0.05 |
| Wrapped, dispose with garbage | 30 | 75.00 | 24 | 60.00 | 47 | 78.30 | < 0.05 |
| Not wrapped, dispose with garbage | 3 | 7.50 | 5 | 12.50 | 6 | 10.00 | > 0.05 |
| Burning | 3 | 7.50 | 7 | 17.50 | 3 | 5.00 | < 0.05 |
| Burying | 4 | 10.00 | 4 | 10.00 | 4 | 6.70 | > 0.05 |

**Disposal of unwanted pharmaceutical products**

The methods used for the disposal of unused and expired liquid and solid drug products are shown in Table 2. Disposal with garbage constituted the highest proportion for the three zones for liquid drug products while most households disposed solid drug products by dumping and covering with domestic garbage inside receptacles. There were no significant differences in the proportion of households using these methods in the three zones.

**Table 2:Methods of disposal of unused and expired liquid and solid drug products**

| Method of disposal | Zone A n=40 | | Zone B n=40 | | Zone C n=60 | | |
|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | *p-value* |
| **Liquid products** | | | | | | | |
| Dilute and flush down sewer | 5 | 12.5 | 7 | 17.50 | 12 | 20.00 | > 0.05 |
| Dispose with garbage | 33 | 82.50 | 31 | 77.50 | 44 | 73.34 | > 0.05 |
| Keep at home indefinitely | 0 | 0.00 | 0 | 0.00 | 1 | 1.66 | > 0.05 |
| Burning | 2 | 5.00 | 2 | 5.00 | 3 | 5.00 | > 0.05 |
| **Solid products** | | | | | | | |
| Cover with garbage | 37 | 92.50 | 35 | 87.50 | 48 | 80.00 | > 0.05 |
| On top of garbage | 2 | 5.00 | 4 | 10.00 | 5 | 8.33 | > 0.05 |
| Keep at home indefinitely | 0 | 0.00 | 0 | 0.00 | 1 | 1.67 | > 0.05 |
| Burning | 1 | 2.50 | 1 | 2.50 | 6 | 10.00 | > 0.05 |

Storage materials and rate of waste disposal Zone A had the highest proportion of households using bag for keeping wastes while the use of container with lid was the most predominant mode in zone B. Residents in zone C used an equal mix of the two types of containers. The use of open containers constituted the lowest proportion in all the zones. No colour segregation of containers for different wastes was observed in any of the zones .Most residents disposed waste 2-3 times a week while monthly disposal rate constituted the lowest proportion in all the zones (Table 3) .

**Table 3:Storage materials and rate of waste disposal**

| | Zone A n=40 | | Zone B n=40 | | Zone C n=60 | | |
|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | *p-value* |
| **Storage materials** | | | | | | | |
| Bag | 28 | 70.00 | 16 | 40.00 | 26 | 43.34 | < 0.001 |
| Container with lid | 10 | 25.00 | 17 | 42.50 | 26 | 43.34 | < 0.05 |
| Open container | 2 | 5.00 | 7 | 17.50 | 8 | 13.33 | < 0.05 |
| **Rate of disposal** | | | | | | | |
| Daily | 4 | 10.00 | 13 | 32.50 | 15 | 25.00 | < 0.001 |
| 2-3 times a week | 19 | 47.50 | 15 | 37.50 | 29 | 48.34 | > 0.05 |
| Weekly | 17 | 42.50 | 10 | 25.00 | 15 | 25.00 | < 0.05 |
| Every 2 weeks | 0 | 0.00 | 1 | 2.50 | 1 | 1.66 | > 0.05 |
| Monthly | 0 | 0.00 | 1 | 2.50 | 0 | 0.00 | > 0.05 |

**Methods of waste collection/removal from households**

Dumping in receptacles for onward disposal by truck constituted the highest proportion in all the zones with the proportion being highest in zone A and lowest in zone C. Disposal in landfill constituted the lowest proportion in all the zones (Table 4).

**Table 4 : Methods of waste collection/removal from households**

| Method | Zone A n=40 | | Zone B n=40 | | Zone C n=60 | | |
|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | p-value |
| Open dumping | 3 | 7.50 | 3 | 7.50 | 4 | 6.66 | > 0.05 |
| In receptacle for truck | 37 | 92.50 | 34 | 85.00 | 45 | 75.00 | < 0.05 |
| As landfill | 0 | 0.00 | 1 | 2.50 | 3 | 5.00 | > 0.05 |
| Burning | 0 | 0.00 | 2 | 5.00 | 8 | 13.34 | < 0.005 |

## DISCUSSION

The commonest method of disposal of medical wastes in all the zones is along with garbage Domestic medical wastes are not expected to be disposed with garbage because of their hazardous nature . They are to be differentiated into sharps and non -sharps to ease the process of disposal.[6] They must also be stored temporarily in yellow bags (for non -sharps ) or puncture-proof containers (for sharps) until they are collected by authorized agencies for final disposal.[9]

Disposal by incineration is the recommended method for disposing sharps.[6] This work revealed that residents of Uyo do not dispose sharps as recommended. Disposal with other domestic wastes (garbage) is the major practice in the three zones. This is contrary to the recommendation of Inter-governmental Panel on Climate Change, Paris, France.[6] Sharps apart from being agents of transmission of deadly diseases like HIV and hepatitis B ,may also cause physical injuries.

Incineration is also recommended by IPCC [6] for disposal of the non-sharps. This practice is not obtainable in Uyo as majority of the residents dispose the non-sharps with garbage. Wrapping in nylon before disposal with garbage is the commonest practice in the three zones. This practice is fairly acceptable as human contact and disease transmission potential is reduced. Less than 30% of households in all the zones dispose non-sharps by burning and burying. Disposal by burning or burying is better than open dumping although potential for air pollution is a major disadvantage.[10]

The recommended method of disposing unwanted drug products depends on the type of formulation the quantity involved and the class of the active drug.[11] For example, liquid preparations ought to be disposed by dilution and flushing down sewer cement encapsulation or high temperature incineration. This precludes antibiotics and anti-infectives since they affect sewage flora. If tablets capsules and other solid products are in small quantities they can be disposed directly in landfill and covered with municipal waste.[12] If they are in large quantities, they are disposed by high temperature incineration.[11]

The proportion of households disposing unwanted liquid drug products by the recommended method was quite small. For majority of households, unused liquid medicines were disposed with household garbage. This method is also acceptable provided the liquid products are kept sealed in their containers and their labels are removed.[11] An even smaller proportion of households dispose medicines by burning. The major advantage of direct burning over disposing with garbage is that it eliminates the chance of the drug getting to scavengers.

Disposal of unused and expired solid drug products with other domestic wastes (garbage) is the common practice for majority of households in the three zones. It is recommended that unwanted pharmaceutical products generated in large quantities be disposed by incineration [11]. However, because unwanted domestic drug products are in small quantities, they can be disposed directly in landfills and covered by municipal wastes. Burning at low temperature is also allowed. However, it is associated with release of toxic pollutants.[11]

Keeping wastes inside bags and containers with lid prevents offensive odour and minimizes disease transmission. Zone A with the smallest proportion of households keeping wastes in open container has the best waste disposal practice. Waste disposal practice in Zones B and C did not differ significantly. Waste disposal at the rate of 2-3 times a week is the most common disposal rate in the three zones. This is quite commendable as it ensures minimum hazard from stored wastes. Our finding contradicts an earlier study which reported daily disposal as the commonest rate of solid waste disposal for residents of Uyo.[8] Majority of households did not separate medical and pharmaceutical wastes from household garbage.

Open dumping is a rare practice among the residents of Uyo with less than 10% of the residents engaging in this practice .Avoidance of open dumping ensures minimal contamination of surface water by dumped waste .

Dumping of waste into receptacles for disposal by truck is the commonest practice in the three zones ,even though a minority of residents in all the zones was engaged in disposal by burning. Open burning should be discouraged as it results in air pollution [10].

Domestic wastes not being segregated before dumping have serious environmental and health implications. Wastes dumped in receptacles for truck should be sorted out before final disposal as they contain different classes of wastes including garbage, medical wastes and pharmaceutical wastes .Each class of waste should be disposed off according to standard recommendations. Despite availability of waste bins (receptacles )and willingness of residents to use them , a major challenge is the delay in emptying the receptacles [8]. When emptying is delayed ,humans are exposed to hazards from the waste . Therefore , appropriate authorities should ensure regular and predictable pick up times.

This study assessed the mode of disposal of the different classes of domestic medical and pharmaceutical wastes. It showed the proportion of households in each zone utilizing the different disposal methods for the different classes of medical and pharmaceutical wastes .The storage materials and rate of disposal were equally studied .The methods of collection /removal of the entire household wastes from households were studied because the pilot study showed that the home-generated medical and pharmaceutical wastes were usually disposed with garbage .There was capacity building (in respect of appropriate ways of disposing household medical and pharmaceutical waste) for the respondents at the point of collection of the completed questionnaire .Also ,a letter detailing the findings and recommendations was sent to the Permanent Secretary ,Akwa Ibom State Ministry of Environment after the research .

The study did not determine the percent composition of the home -generated wastes ;that is ,it did not show the proportion of the household waste that is medical, the proportion that is pharmaceutical and the proportion that is garbage. This is a limitation of the study and it can be investigated in future work. Similar study as this can be carried out after some time to check the impact of the informal training provided and the interventions suggested as recommendations to the State Ministry of Environment .

**CONCLUSION**

The mode of disposal of the medical wastes especially the sharps does not meet the international standard. Similarly, unused and expired drug products (liquids and solids) are mainly disposed with garbage. Residents should be enlightened about the appropriate way of handling medical and pharmaceutical wastes. Also, appropriate measures should be put in place to prevent scavengers from excavating pharmaceutical products from dump sites .The informal training on appropriate waste disposal practices given at the point of collection of completed questionnaire ; and advocacy by the recommendations sent to the State Ministry of Environment at the end of the research are the contributions of this work .

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**REFERENCES**

1. Madu IA. (2001). Urban solid waste problems in Nigeria. In: Ezeani EO, Elekwa NN. (Eds.), Issues in Urbanization and Urban Administration in Nigeria. Enugu, Nigeria: Jamoi Enterprises (Nig.), pp. 100-126.
2. Oyediran AS. (1997). Waste generation and disposal in Nigeria. In: Ezeani EO, Elekwa NN. (Eds.), Issues in Urbanization and Urban Administration in Nigeria. Enugu, Nigeria: Jamoi Enterprises (Nig.), pp. 10-21.
3. Daniel EE, Ibok E. (2013). Solid wastes disposal habits of students in Nigerian universities: A case of University of Uyo, Nigeria. IOSR Journal of *Environmental Science, Toxicology and Food Technology 5(6): 46-50.*
4. Fellman HJ, Getis A, Getis J. (1995). Human *Geography: Landscapes of Human Activities.* Chicago, U.S.A.: WMC Brown Publishers.
5. Ngouakam H, Atanga MBS, Onojeta AF, Aniekan EJ, Konlak GD. (2012). Generation and disposal of solid clinical wastes in General Hospital and Infectious disease Hospital, Ikot Ekpene, Akwa Ibom State, Nigeria: Characterization and management strategies. *Journal of Emerging Trends in Engineering and Applied Sciences 3*(1): 165 – 169.

6. Houghton JT, Meira-Filho LG, Lim B, Tréanton K, Mamaty I, Bonduki Y, Griggs DJ, Callander BA. (1997). *Guidelines for National Greenhouse Inventories.* Intergovernmental Panel on Climate Change. IPCC/OECD/IEA, Paris, France.
7. Olorunsola EO, Adje DU. (2016). Health implications of housing, human waste disposal practices and water supply in Uyo, Southern Nigeria. *Ethiopian Journal of Environmental Studies and Management* 9(Suppl 1): 876-885.
8. Ukpong IE, Udofia EP. (2011). Domestic solid waste management in a rapidly growing Nigerian city of Uyo. *Journal of Human Ecology* 36(3): 229-235.
9. UOO (University of Ottawa). Biomedical wastes disposal procedure 2007. Available at: *http://www.uottawa.ca/service/ehss/biosafety*. m. Accessed August 18, 2014.
10. Guendehou GHS. (2004). Open-burning of waste. Discussion Paper, Fifth Authors/Experts Meeting in the Preparation of the 2006 IPCC National greenhouse Gas Inventories Guidelines. Ottawa, Canada.
11. Frontieres MS. (1999). Guidelines for safe disposal of unwanted pharmaceuticals. Available at: *www.who.int/water_sanitation_health/medical waste*. Accessed July 14, 2014.
12. Food and Drug Administration. Consumer health information 2011. Available at: www.fda.gov. Accessed August 3, 2014.