Quantity and quality of solid wastes produced in dental offices of babol city

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Abstract
Introduction: Dental wastes due to having bacterial disease-causing agents and toxic chemicals are categorized in hazardous wastes. The aim of this study was to evaluate the quantity and composition of dental waste produced by general and specialized dental offices in babol city.

Materials & Methods: From all dental offices (170 and 40 dental offices were related to general and specialized respectively) in babol city, 20 general and 5 specialized offices were randomly selected. Waste samples were collected three times a week (Sunday, Monday and Tuesday), 50 sub-groups were separated and weighted by a digital scale with accuracy of 0.01 gram. The data were presented by excel and word software in figures and tables.

Results: The total wastes of general and specialized offices were 11829 and 2831.5 kg/year, respectively. The percentages of domestic-type, infectious, pharmaceutical and toxic wastes in general dental offices were 52.5%, 42.5%, 4.7% and 0.3%; and in specialized offices were 42.5%, 50%, 7% and 0.5%, respectively. Most components in a variety of dental waste included plastic, paper, plaster molds, glass and metals.

Conclusion: Due to the large contents of plastic, paper, plaster molds, glass and metals in domestic-type and infectious wastes produced in the general and specialized dental offices, it is necessary to manage the wastes and their separation and recycling in source place.

Keywords: Solid waste, Dental offices, Separation, Recycling

Introduction

Medical wastes are being considerably attended due to the presence of many hazardous, toxic and pathogenic agents and have triggered major concerns on the human and environmental health. \[1, 2\] A large amount of medical waste production originates from dental offices. Dental solid wastes are classified into four categories including a: domestic-type wastes; b: potentially infectious wastes; c: chemical and pharmaceutical wastes; and d: toxic wastes. \[3, 4\] Dental domestic type wastes are those which have no adverse environmental and public health problems and can be collected, recycled and disposed with the ordinary municipal solid wastes. Examples of domestic type wastes are tissues, gauzes, dental rolls, packaging materials for syringe and needle, carbon steel, clothing and paper. \[5, 6\] Dental infectious and potentially infectious wastes cause disease and disease transmission due to the presence of pathogens which include materials contaminated with blood and saliva, nylon gloves, dental suction tips, sharps, extracted teeth and mirrors. \[7, 8\] Major chemical, pharmaceutical and toxic solid wastes include tissues and gauzes contaminated with amalgam, lead foil (coming from the radiography film covers), disinfectants and batteries. Dental amalgam is commonly used to fill the teeth in dental offices. It contains a mixture of metals such as mercury, silver, copper, zinc and tin, thus represents a serious environmental and health risk. \[9, 10\] Nabizadeh, et al.in 2009 reported that total amount of dental wastes production in Hamedan city was annually 14662.67 kg and showed that percentages of infectious, domestic-type, chemical-pharmaceutical and toxic wastes were 51.93 %, 38.16%, 9.47 % and 0.44 %, respectively. \[11\] Also, in another study conducted by Kulivand et al. in 2009, the composition of dental solid wastes included domestic-type wastes (91.14%), chemical and pharmaceutical wastes (6.7%), potentially infectious waste (2.14%) and toxic waste (0.02%). \[12\] Kizlary et al. in 2005, found that the number of infectious wastes, chemical wastes and domestic-type wastes produced in the dental centers was 2%, 3.3% and 7.94%, respectively. \[13\] Many studies have been performed in
Solid wastes produced in dental offices

field of dental solid wastes management by some researchers. [14-17] According to the limitations of database and the lack of data related to the composition and production rate of dental solid waste in northern Iran, this study was done to evaluate the composition and characteristics of solid wastes generation in general and specialized dental offices in Babol city.

Materials & Methods

Babol is the most important city in Mazandaran Province, Iran. This city has several universities and scientific centers. Babol has totally 210 dental offices including 170 and 40 offices related to general and specialized centers, respectively. For this study, 20 general dental offices and 5 specialized dental centers were selected based on random sampling, and the generation rate and composition of dental solid wastes were measured, too (Table 1).

Table 1. Characterizations of the selected dental offices of Babol city

<table>
<thead>
<tr>
<th>Type of office</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>general</td>
<td>20</td>
</tr>
<tr>
<td>Specialized(restorative dentistry)</td>
<td>1</td>
</tr>
<tr>
<td>Specialized(orthodontics)</td>
<td>1</td>
</tr>
<tr>
<td>Specialized(periodontics)</td>
<td>1</td>
</tr>
<tr>
<td>Specialized(endodontics)</td>
<td>1</td>
</tr>
<tr>
<td>Specialized(oral radiology)</td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>25</td>
</tr>
</tbody>
</table>

Common services provided in specialized dental offices contain endodontics, restorative, oral radiology, orthodontics and periodontics. In this study, dental solid wastes were categorized into four classes including: 1. Domestic-type wastes; 2. Infectious and potentially infectious wastes; 3. Pharmaceutical and chemical wastes; and 4. Toxic wastes. [11, 18] Color coded plastic bags were used to collect and segregate of solid wastes in these offices. Domestic-type wastes were segregated to black colored bags. Orange and red colored bags were used to collect the infectious and initially infectious wastes. Used sharps, as infectious waste, were separately collected in safety boxes and chemical and pharmaceutical wastes were packaged in yellow colored bags. Waste samples were collected three times a week (Sunday, Monday and Tuesday) at the end of the working day and the selected dental solid wastes were manually sorted into 50 categories and weighted by a digital scale (Mettler PM4000) with accuracy of 0.01 gram. Each component was weighted in duplicate and the data were presented as average. In this study, the content of waste produced daily by each patient was determined in the general and specialized dental offices. The obtained data were presented by excel and word software in figures and tables.

Results

The percentages of domestic-type waste, infectious, pharmaceutical and toxic wastes in general offices were 52.5%, 42.5%, 4.7% and 0.3% and in specialized offices were 42.5%, 50%, 7% and 0.5%, respectively (Figures 1 and 2). The largest components of solid wastes in general dental offices were latex gloves (23.7%), infected syringes and needles (12.3%) and suction tips (11.5%). In specialized dental offices, the maximum quantity of solid waste components included latex gloves (34%), paper towels contaminated with saliva (10.5%), infected syringes and needles (9%).
In table 2, total types of solid wastes produced in the general and specialized dental offices were presented. In this table, total solid wastes generated were shown based on kg per day and gram per patient per day. Mean content of domestic-type, infectious and potentially infectious, pharmaceutical and chemical and toxic wastes production per person per day was more in the specialized dental centers than general dental offices (Table 2).

In table 3, the maximum content of the domestic-type waste components in the general offices was plastic (28.2%), gypsum (25.3%), and paper (18%) and in the specialized centers was belonged to plastic (27.3%) and paper (23.7%) respectively.

**Table 2. Dental solid waste generation in the dental offices of babol city**

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>General dental offices</th>
<th>Specialized dental offices</th>
<th>Total dental offices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generation rate (Kg/day)</td>
<td>Generation rate (gram/patient/day)</td>
<td>Generation rate (Kg/day)</td>
</tr>
<tr>
<td>Domestic-type waste</td>
<td>13.76</td>
<td>10.12</td>
<td>4.07</td>
</tr>
<tr>
<td>Infectious and potentially infectious waste</td>
<td>16.20</td>
<td>11.91</td>
<td>3.30</td>
</tr>
<tr>
<td>Pharmaceutical and chemical waste</td>
<td>2.28</td>
<td>1.68</td>
<td>0.36</td>
</tr>
<tr>
<td>Toxic waste</td>
<td>0.18</td>
<td>0.13</td>
<td>0.03</td>
</tr>
<tr>
<td>Total dental waste</td>
<td>32.42</td>
<td>23.84</td>
<td>7.76</td>
</tr>
</tbody>
</table>

**Table 3. Total dental solid waste generated (kg/year) in general and specialized offices**

<table>
<thead>
<tr>
<th>Waste type</th>
<th>Components</th>
<th>General dental offices</th>
<th>Specialized dental offices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliva contaminated tissue</td>
<td>512.4</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>Saliva soaked gauzes and cotton</td>
<td>383.4</td>
<td>87.3</td>
<td></td>
</tr>
<tr>
<td>Blood soaked gauzes and cotton</td>
<td>442.1</td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td>Nylon glove</td>
<td>445.2</td>
<td>118.5</td>
<td></td>
</tr>
<tr>
<td>latex glove</td>
<td>1400</td>
<td>410</td>
<td></td>
</tr>
<tr>
<td>Suction tips</td>
<td>680.3</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>Used ampoules</td>
<td>273.8</td>
<td>39.1</td>
<td></td>
</tr>
<tr>
<td>Abs lung</td>
<td>503</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Needles</td>
<td>512</td>
<td>61.4</td>
<td></td>
</tr>
<tr>
<td>Plastic syringes</td>
<td>216</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>541.9</td>
<td>116.8</td>
<td></td>
</tr>
<tr>
<td>Total (kg)</td>
<td>5909</td>
<td>1202.5</td>
<td></td>
</tr>
</tbody>
</table>

**Domestic-type waste**

- Dry tissue                           | 48.8                                     | 158.5                  |
- Paper and cardboard                   | 636.8                                    | 118.5                  |
- Tissue box                            | 217.8                                    | 75.3                   |
- Disposable cup                        | 109.5                                    | 105                    |
- Gypsum                                | 1269                                     | 96.8                   |
- Food residues                         | 51.5                                     | 78.8                   |
- Metals                                | 65.9                                     | 41.9                   |
- Nylon                                 | 642.6                                    | 289                    |
- Plastic                               | 771.4                                    | 115.7                  |
- Glass                                 | 496.4                                    | 120                    |
- others                                | 412                                      | 287.7                  |
- Total (kg)                            | 5021.5                                   | 1487                   |

**Pharmaceutical and chemical waste**

- Impression materials                  | 400                                      | 100.5                  |
- Other chemical materials              | 433.8                                    | 32.2                   |
- Total (kg)                            | 833.8                                    | 132.7                  |

**Toxic waste**

- Amalgam contaminated wastes           | 24.2                                     | 2.3                     |
- Radiography film                      | 4.7                                      | 1.4                     |
- Radiography film covers               | 35.7                                     | 5.6                     |
- Total (kg)                            | 64.6                                     | 9.3                     |
Discussion

The results of the present study showed that total solid wastes generated by total dental offices in Babol city were 14661 kg/year. Totally, 11829.5 kg (81%) and 2831.5 kg (19%) of these solid wastes belonged to general and specialized offices, respectively. In this study, the infectious wastes generated in specialized dental centers (50%) were more than general dental offices (42.5%) caused by great variety of activities and treatments in these places. Komilis et al. in 2009 reported that the domestic-type, infectious and potentially infectious waste, and non-infectious toxic waste comprised approximately 74%, 26%, and less than 0.5% of the total dental wastes weight produced, respectively. In another study, infectious and potentially infectious wastes were 24.3%, and domestic-type waste was 27.6%. Bazrafshan et al. in 2014 suggested that the generation rate of potentially infectious wastes in Sistan and Baluchestan province was 80.3%. In this study, the highest components of infectious wastes in general and specialized dental offices were latex gloves (about 30%). Therefore, more attention should be concentrated on the source reduction, separation and recycle of this component. Ozbek and Sanin in 2004 reported that used gloves were 35% in terms of the weight of total dental solid wastes. In this study, pharmaceutical and toxic wastes in the general dental offices were 4.7% and 0.3% and in the specialized centers were 7% and 0.5%, respectively. Bazrafshan et al. reported that the pharmaceutical and toxic wastes in dental centers of Sistan and Baluchestan were 6.3% and 1.7%, respectively. Their study is consistent with this current study.

Amouei et al. in 2013 determined that the pharmaceutical and chemical wastes contained 2.38% in terms of the weight of the total dental solid wastes. In this study, pharmaceutical and toxic wastes in general dental offices consist of radiography film covers (55.29%), amalgam contaminated wastes (37.39%) and radiography film (7.32%); and in specialized offices contain radiography film covers (60.22%), amalgam contaminated wastes (24.47%) and radiography film (15.31%) which comprise more than 50% of toxic wastes. Kulivand et al. in 2009 suggested that the dental impression materials had the highest percent (4.21%) in terms of weight among chemical and pharmaceutical wastes in all studied dental offices. This result agrees with the findings of the present study. In this study, nearly 50% of total dental solid wastes generated in general dental offices (42.5%) and specialized centers (52.5%) belonged to domestic-type waste.

Major components of domestic-type wastes in general dental offices were gypsum (25.27%), plastic items (19.5%), paper items (18%), glass (9.88%), and metals (1.3%); and in specialized dental offices were plastic items (38.60%), Paper items (14.5%), glass (8.07%), gypsum (6.51%), and metals (2.81%), which contained more than 70% of dental solid wastes produced by these centers. Therefore, the integrated management of dental solid wastes generated in general and specialized dental centers including source separation, source reduction and recovery of domestic-type waste components such as plastics, paper and cardboards, glass and metal items are necessary. Nabizadeh et al. in 2012 showed that there was no effective activity for waste minimization, separation, reuse, and recycling in dental offices and management of sharps, potentially infectious waste and other hazardous waste was poor.

Conclusion

Considering the high percentage of plastic, paper and glass items in the domestic-type and infectious solid wastes generated in general and specialized dental centers, the integrated management of domestic-type and infectious wastes including reduction source, separation and recovery of valuable items and environmental conservation should be considered.

Conflict of interest: The authors declare that they have no conflict of interest.

Authors’ Contributions

The study was designed by Abdoliman Amouei. The study data were collected by Hossein Faraji and the Literature search and manuscript were prepared by Amid Khosravi Samani. Analysis and interpretation of data and manuscript editing were conducted by Mahmood Khosravi Samani. Critical revision of the manuscript for important intellectual content and supervision of the study were performed by Abdoliman Amouei.
References


