

Potential Environmental Risks from Home Healthcare-Generated Municipal Solid Waste in Texas

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Abstract

Current hazardous waste disposal policies in the Home Health Care setting were evaluated as it related to the need for better regulation of hazardous materials entering residential waste streams. It was found that all waste materials from home care visits with the exception of "sharps," were placed directly into residential waste streams. Therefore, large volumes of potentially hazardous waste go undetected annually to municipal incinerators along with ordinary household refuse. Accordingly, the application of established TCEQ regulations to the home health environment is critical to protecting the public and the environment from possible harm. At the least, some home care waste should also be included in the list of household hazardous waste. The urgency for improved disposal methods is due to increasing the volumes of potentially hazardous materials and increased risks to public health and environment from toxic leachates and incinerator by-products.

Introduction

The Resource Conservation and Recovery Act (RCRA) is a United States law that provides much of the basic guidelines for the nation's waste management. The Hazardous Waste Management Program, under RCRA Subtitle C, establishes a system for controlling this hazardous waste from the time it is generated until its final disposal. This program regulates commercial businesses as well as federal, state, and local government facilities that generate, transport, treat, store, or dispose of hazardous waste. Hazardous waste is any waste that is harmful or has potential to cause harm to the public or the environment. While both the Federal Government and the states have the authority to regulated hazardous waste, the USEPA encourages states to regulate their own.

In the state of Texas, the Texas Commission on Environmental Quality (TCEQ) is the designated regulatory agency for hazardous waste (<http://www.epa.gov/wastes/laws-regs/regs-haz.htm>).

Appropriate guidelines for handling hazardous waste in Texas are provided by the Texas Regulations on Medical Waste. It covers rules for the proper handling, treatment, and transport of these wastes from health-care-related facilities. Types of waste include animals intentionally exposed to pathogens, bulk human blood and blood products, pathological waste, microbiological waste, and "sharps" of all types.

(<http://www.tceq.texas.gov/publications/rg/rg-001.html>).

Consequently medical waste is broadly defined as any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals in related research, biological production, or testing. There is a sizeable body of evidence that public health and environmental risks are associated with the improper management and disposal of medical waste (Alvim-Ferraz and Afonso, 2003, Graham et al., 2010, Howard and Muir, 2011, Abahussain and Ball, 2007, McDiarmid and Gehle, 2006). However, as stated before, medical waste streams may also include the dices used during the administration of services many of which increases the potential for pollutants entering the waste stream.

While health care facilities may have strict procedures for proper management and disposal of biomedical waste, private homes of patients receiving in-home medical care pose a greater challenge to conventional wisdom with regard to these established measures mainly because it is very difficult logistically to ensure complete compliance in a person's home. This is also where the imperceptible toxicological impacts may escape policy makers. For that reason, more research is required to avert further compounding the problem with weak or nonexistent regulations.

Home health care has become an integral part of patient care over the years, however, not much has been done to ensure uniform, effective environmental protection from hazardous waste it generates. Also, the industry has experienced such significant growth in recent years changes in policy is necessary for adequate environmental protection (Kendra, 2002). The United States Department of Health and Human Services Centers for Disease Control and Prevention National Center for Health Statistics conducted a study on national estimates of the organizational characteristics of home health and hospice in 2007. This report concluded that there were 14, 500 home health (HH) and hospice care agencies in the United States alone, an increase from 11, 400 in 2000, of which HH only agencies accounted for about 75% of this number (Park-Lee, E. Y. and Decker, F. H., 2010). It should be noted that patient numbers do vary from company to company and the needs of each patient does vary as well.

Increasing numbers of persons over age 65, decreased lengths of hospital stay, and the need for chronic (custodial) health care have increased the demand for such services. Typical providers of service are classified as *skilled*, example, nurses, social workers, physical therapists and occupational therapists and *non-skilled* for example the home health aide and attendants. The percentage of each provider group is very different for any number of reasons. However, the home health aide and attendants group of providers is quite large compared to the other provider groups. They are generally high school graduates or holders of GED diplomas. They perform the in-home, non-skilled, non-technical procedures with little or no supervision (Kendra, 2002). The educational level of these providers is only one aspect of the problem but still a very important one; any change in policy must also address training of service providers.

Surface waters for example, routinely receive large quantities of wastewater from medical, agricultural, industrial and domestic sources including municipal sewage treatment plants (Ohe et al, 2004 and B. I. Escher et al., 2011). Moreover, solid waste generated from healthcare activities also adds to the list of sources of chemicals that pollute waterways (Ohe et al, 2004). This is due to the fact that much of this waste is incinerated thus giving rise to fly ash and bottom ash production (Zhao et al, 2010, Chen et al, 2009, Zhu et al, 2008, Xie, et al, 2009, Alvim-Ferraz and Afonso, 2003, Leem et al, 2006). Many toxic metals also volatilize during combustion in cement kilns and thus adding to concerns with organics, dioxins and furans (Wendt, 1994).

Furthermore, many organic pollutants that persist through (or are formed during) wastewater treatment and which are associated with potential human health effects. One such class of pollutants in question is pharmaceutically active compounds (PhACs) and personal care products, antimicrobials have been also been identified in water samples (Kimura et al, 2003). So, it becomes necessary to be aware of fact that this field is quickly emerging as a significant point source of large quantities of potentially hazardous waste.

Furthermore, many home healthcare agencies also utilize a number of items that could add to the growing problem of hazardous waste disposal. One such group is that of antimicrobial agents used in the treatment of chronic wounds. Among these are gentamicin, dimethyl sulphoxide, silver sulfadiazine, benzoyl peroxide, oxyquinoline and chlorhexidine. The latter can be embedded in central venous catheters as a method of reducing catheter-related bloodstream infection (Omeara et al., 2001, Osma et al., 2006). Another group of compounds with silver as the active metal (silver sulfadiazine, silver nitrate, silver calcium phosphate and metallic silver film) have been used for many years in burn treatments.

Silver has been known to be effective against a broad spectrum of aerobic, anaerobic, gram negative and gram positive bacteria, yeast, filamentous fungi and viruses (Ülkür et al., 2005). Despite their role in disease control, the silver containing compounds do pose a serious risk to the environment if not disposed of cautiously. Again coupled with a lack of awareness about environmental issues the problem becomes even more complex.

Research has also indicated that the volume of plastic containers widely used in medical items, such as solution containers, transfer tubing and devices are on the rise. The nature and composition of these materials provide medical products their desirable performance characteristics. These plastics provide chemical inertness; the interaction between plastics and a contact pharmaceutical product are well documented. Such interactions include leaching, the release of plastic material components to the product, thus exposing the patient to possibly harmful levels of contaminants (Jenke, 2006).

One component of plastics of concern is the plasticizer. Phthalate esters are one of the largest groups of plasticizing agents, in terms of production volume and sales volume. Their toxicity is beyond question: they have an extremely wide sphere of activity and may be considered as polytrophic toxins. They are hepatotoxic, cause gastrointestinal tract damage and are also carcinogens (Di Bella et al., 1999). For this reason recent research into plasticizers have focused more on leaching, migration, evaporation and degradation, which all lead to deterioration of the thermo-mechanical properties of in plastics. Human exposure to these substances has gotten much attention because di-(2-ethylhexyl) phthalate, used in medical plastics have been detected in measurable amounts in the blood supply. So, protecting patients and the environment from contamination by these compounds become absolutely important (Rahman, 2004).

Some of the items that may be generated and may enter the residential/ municipal waste from home health visits are:

1. Contaminated medicine cups (cytotoxic and genotoxic medications for cancer for example)
2. Cotton swabs and plugs
3. Diabetic syringes and test strips only (needles and lancets not listed because they are regulated waste and are required to be collected in approved biohazard containers)
4. Disposable adult diapers
5. Disposable adult wipes/wash cloths
6. Disposable bed covers
7. Incontinent supplies
8. Latex gloves
9. Nasal-gastric tubes
10. Ostomy care supplies (feeding tubes)
11. Tongue depressors
12. Wound care supplies
13. Disposable thermometer sheaths
14. Empty medication vials (vaccines and liquids)
15. Plastic medical tubing
16. Expired, unused or discontinued medication

Currently, the final resting places of many of the items listed above are landfills and/or incinerators. Landfilling is a very common solid waste disposal method used in many small and medium-sized municipalities. Leachates (water that percolates through the solid waste and enroute picks up dissolved and/or particulate material) produced in landfills can contaminate groundwater (Radi et al., 1987). The Toxicity Characteristic Leaching number is set by the USEPA and is a measure of the potential for exposure to the public or harm to the environment.

Incinerator fly ash generated from solid waste incineration is also known to contain many inorganic pollutants, especially heavy metals and can also be a source of soil and water pollution. There are instances however where recycling of some items does occur at the disposal facility. Once more the issue in this case becomes contamination with hazardous waste put in the residential waste at the point source, the patients' home. Persons ultimately responsible for waste disposal may include caregivers, family members (including children), sanitation workers and the community as a whole.

Patients residing in rural communities also pose another unique challenge to this proper waste disposal since the method used may vary significantly from one living in a more urban setting. There are still some rural communities, which burn waste in open backyard fires. Yet again, this is another area worth further exploration due to the dangers posed by ash produced from such burnings. It is well documented in the literature that combustion of hazardous waste (1) produces and releases air emissions of organic compounds; (2) releases dioxins and furans into the environment; and (3) toxic heavy metals, which are often present in medical wastes (Wendt, 1994, Kougemitrou et al, 2011).

Observations

A preliminary investigation of hazardous waste practices in the home health industry in Texas showed that the industry sets its guidelines on acceptable waste handling and disposal procedures according to the current policies set by of the Department of Health and Human Services (DHHS). Secondly, the current DHHS regulations only stipulate that sharps generated during the administration of care are to be stored in approved biohazard containers and the agency rendering care must make provision for proper waste collection and management through a licensed hauler. Additionally, many home healthcare workers are untrained in even basic environmental issues. In a recent editorial in the Journal of Public Nursing, Mary Salazar commented that nurses are in a prime position to address environmental health concerns of individuals and communities; by and large, they as well as other workers in the field are inadequately prepared to address and prevent adverse health risks resulting from environmental exposures (Salazar, 2000).

This inadequacy is a contributing factor in the improper disposal of medical waste generated at the point of care, in this case the patients' home. Recipients of home healthcare treatment have been thoroughly screened by the appropriate agencies prior to acceptance into a government sponsored home health program based on severe disability and other debilitating illnesses. Many persons who receive home healthcare benefits are extremely ill and advanced in age. In other words, a large number of these patients have impaired mobility due to age and/or disease and are sometimes bedridden. They are therefore unable for the most part to properly dispose of waste generated. They often rely on a second or third party for assistance. Second and third party handlers can be family members or other personal care givers with the responsibility of disposing of used supplies, which eventually end up in the ordinary residential trash receptacles. Very often patients and caregivers alike are unaware of the danger this practice can pose to the environment. Caregivers also contribute a substantial amount of contaminated waste to the residential compilation of potentially hazardous point of care products.

Medicare and Medicaid programs have established admissions criteria for a person to be admitted into such programs. There are also criteria for the types of patients to be admitted:

1. Patients/clients with acute, non-chronic, episodic type disease or disability who will return to a pre-illness level of functioning.
2. Patients/clients with chronic disease or disability who are experiencing acute episodes of illness but have the potential for returning to a pre-episodic level of functioning.
3. Patients/clients with chronic disease or disability who, even though a return to pre-illness level of functioning is not possible, do have potential for increasing their level of functioning and will eventually function without agency services.
4. Patients/clients with end stage disease.

Many home health patients live on very modest incomes and many do not have much formal education. In some cases there may even be a language barrier that can be a further hindrance unless the caregiver is bilingual. So there are a variety of circumstances, which can further complicate the situation. This is why special training should be given to care givers in the area of proper waste disposal in order to protect their health as well as that of their patients and subsequent handlers of the waste they generate. Current issues of air and water quality have forced changes in institutional (hospital) waste disposal practices (Larsson et al., 2002). Now a similar approach may be necessary for the home health setting.

Caring for someone who is bedridden for instance is far different from caring for a patient who is mobile. The treatments offered by the agency are solely dependent upon the patients/clients condition and so will in the end determine the type of waste generated. Treatment regimen may involve several of the items in the previous paragraph.

For example, if a patient is suffering from an extremely infectious disease (TB, influenza, hepatitis C), has an infected wound, takes a psychiatric medication, takes a cytotoxic or genotoxic medication during cancer treatment etc. the handler(s) of these wastes may be exposed to any number of hazards (WHO).

Conclusion

Owing to issues of privacy, which surrounds the very personal information to be derived in a home healthcare visit, this study was restricted to basic information from caregivers with direct access to patients. Basically all waste generated during a typical visit was essentially put in the residential waste stream. Only sharps as previously mentioned were put in biohazard receptacles. Disposable items like adult diapers, wound care waste, tongue depressors, plastic thermometer sheaths, urine bags, ostomy bags, medicine vials, plastic syringe plungers, wipes and wash cloths are only a few of the items placed in ordinary household trash. Any person handling this trash could be at risk of infection or even exposure to toxic substances, which may be in that waste. More over, waste entering landfills and incinerators may quite possibly be a source of ground and surface water pollution. The contaminants in leachates may vary in concentration from the point source due to filtration, dispersion, and attenuation within the soil matrix. Although leachability of many individual pollutants may be known the combined presence of these pollutants will further encumber accurate predictions of toxicity (Radi et al., 1987) and proper risk assessment.

It must also be noted that there are certain factors that must also be carefully analyzed in order to stave off the imminent dangers posed by improper waste disposal and current regulatory standards pertaining to medical waste generated in the home. The emission of dioxins for example, is dependent upon the type, composition and mode of separation of waste generated generally speaking (Alvim-Ferraz and Afonso, 2003). This is where community education relative to environmental issues should be part of any effective waste management solution. Recognizing the fact that the home healthcare field is a growing one, it would be safe to say that this area is foreseen to grow even more with a rapidly aging “baby boomer” population. It also stands to reason that the amount and types of waste generated will increase as well. So, as mentioned previously, education may be a vital tool in curbing pollution and effecting positive changes in waste handling in this industry.

There is already a body of literature dedicated to institutional waste management practices and the effectiveness of these practices (Soliman and Ahmed, 2007, Verma et al., 2008 and Coker et al., 2009). Medical and healthcare wastes, as stated earlier, have seen a sharp increase in the last few years since many more seniors are living much longer than before. Healthcare waste management policies have normally been set with institutions like hospitals and nursing homes in mind and very little, if any, consideration has been given to waste generated at the point of care facility, which is typically the patients’ home. Although not often considered as a major source of groundwater pollution, these facilities do generate a sizeable amount of potentially dangerous waste, which should be labeled as hazardous waste. It is for this reason why proper sorting of potentially hazardous home healthcare waste becomes necessary. As a consequence, hazardous waste management now becomes an integral part of the effort to prevent ground and surface water as well as soil pollution.

Finally, the effectiveness and success of any improved environmental management scheme in home health hinges on commitment and participation by all parties concerned in home health care. Caregivers, particularly nurses, must possess a basic understanding of the principles of science in order to explain basic mechanisms of exposure to environmental health hazards, prevention and control strategies (Larsson et al., 2002). If these teachings become routine at this level then patients and family members may eventually see how their input can reduce the amount of hazardous materials, which enter residential waste streams, thus minimizing pollution risks. In conjunction with the growing need for such services comes the potential negative environmental impact of hazardous waste generated during patient service as the number of new persons admitted to home health services increases. Consequently, as landfill space become more limited and the “not in my back yard voices become louder”, our society will face an even bigger test in the area of environmental protection if we do not address this area now while risks can still be mitigated.

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