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The Findings of the Agency for Toxic Substances and Disease Registry Medical Waste Tracking Act Report

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The Agency for Toxic Substances and Disease Registry (ATSDR) report "The Public Health Implications of Medical Waste: A Report to Congress" has been finalized and submitted to Congress. The report is a comprehensive review of all available data and information on the subject. Based on the data developed in the report, ATSDR concludes that the general public is not likely to be adversely affected by medical waste generated in the traditional health setting. However, the increase of in-home health care and other sources of nonregulated medical waste (e.g., intravenous drug users) provides opportunities for the general public to contact medical waste. In addition, ATSDR concludes that public health concerns exist for selected occupations involved with medical waste. These populations include janitorial and laundry workers, nurses, emergency medical personnel, and refuse workers. The ATSDR report also defines what material should be managed as medical waste and identifies research needs related to medical waste.

Introduction

The proper management and disposal of solid waste (hazardous, medical, and residential) in the United States is a concern to health and environmental authorities and citizens alike. Concern has developed over the years with revelations that hazardous and medical wastes have been improperly disposed of and has mounted with the growing realization that our residential solid waste is increasingly difficult to manage.

In the last decade, the public has become increasingly concerned about the proper disposal of medical waste. In response to the public outcry, state and local legislators have promulgated regulations and statutes governing the management of medical waste. These statutes rely on a variety of management systems to accomplish their goals and require the management and/or tracking of different types of medical waste. To assist in developing national policy on the management of medical waste, the U.S. Congress passed the Medical Waste Tracking Act of 1988 (MWTA), enacted into law on November 1, 1988, and codified at 42 U.S.C. 6992 et seq.

Section 11009 of the MWTA requires the Administrator of the Agency for Toxic Substances and Disease Registry (ATSDR) to prepare a report on the health effects of medical waste and mandates the report be submitted to Congress within 24 months after enactment. In addition, Section 11009 specifies that the report must include the following information:

(1) A description of the potential for infection or injury from the segregation, handling, storage, treatment, or disposal of medical wastes.

(2) An estimate of the number of people injured or infected annually by sharps, and the nature and seriousness of those injuries or infections.

(3) An estimate of the number of people infected annually by other means related to waste segregation, handling, storage, treatment, or disposal, and the nature and seriousness of those infections.

(4) For diseases possibly spread by medical waste, including acquired immune deficiency syndrome and hepatitis B, an estimate of what percentage of the total number of cases nationally may be traceable to medical wastes.

Development Methodology of the ATSDR Medical Waste Report

To prepare the required report, pertinent data sources were identified through several methods. Figure 1 depicts the data-gathering scheme used for the ATSDR report. An announcement was published in the *Federal Register* requesting any relevant data and information on infection and injury associated with the segregation, handling, storage, treatment, and disposal of medical waste (*1*). Data

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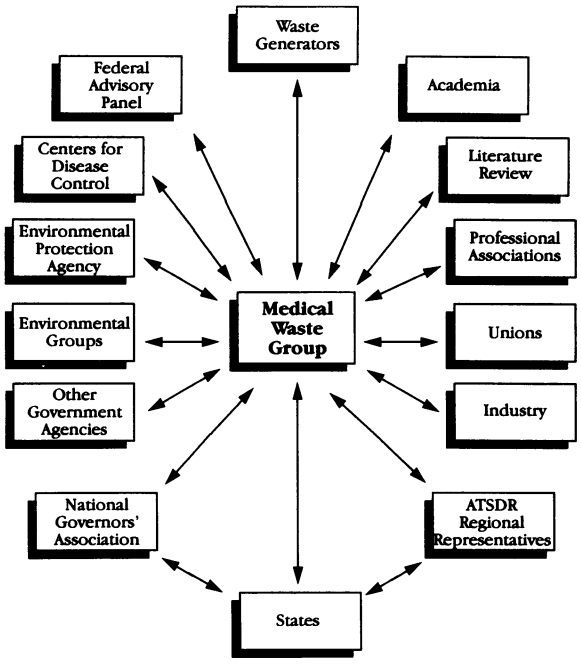

FIGURE 1. Data-gathering scheme for the ATSDR Medical Waste Report.

and information were also solicited from individual professional associations, unions, environmental groups, academia, and industry.

A Federal Advisory Panel was established to assure the ATSDR report is based on the best contemporary science. The panel advised ATSDR on the preparation of the report, reviewed drafts of the report, and assisted with questions of science related to data in the report. The Federal Advisory Panel consisted of representatives from the Centers for Disease Control (CDC), National Institutes of Health (NIH), Environmental Protection Agency, Food and Drug Administration, Health Resources and Services Administration, Indian Health Service, Alcohol, Drug Abuse, and Mental Health Administration, and Health Care Financing Administration. In addition to the agencies on the Federal Advisory Panel, the Department of Defense (DOD), Department of Veterans Affairs, and the Occupational Safety and Health Administration were requested to provide any pertinent information and data.

State health and environmental departments nationwide were contacted to obtain relevant data and information on the public health implications of medical waste. As part of a cooperative agreement between National Governors' Association (NGA) and ATSDR, NGA conducted a survey of every state health and environmental department. To supplement the NGA effort, ATSDR regional staff solicited information in their respective regions.

In addition, the state health departments of Arkansas, Connecticut, Delaware, Illinois, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Mexico, Ohio, Oklahoma, Rhode Island, Texas, and Wisconsin conducted an injury survey. The state health department survey's objective was to collect information concerning medical waste-related injuries from sharps in selected occupations (e.g., health care, janitorial, and refuse workers) and to provide baseline injury data for these occupational groups. The participation of a state in the survey was based upon obtaining a cross-sectional representation of the United States (e.g., rural and urban) and the willingness of the state to undertake this project.

During the summer of 1989, the 17 states mailed questionnaires to licensed hospitals, nursing homes, public health clinics, and solid waste facilities within their jurisdictions. The questionnaires requested information on medical waste-related sharp injuries that occurred in 1988. Two questionnaires were used. Based on the injury records maintained by the facilities, the number of total injuries and medical waste-related injuries from sharps were reported by job. In five states (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas), injuries were recorded for the generic categories of patient care providers, nonpatient care providers, solid waste collectors, and solid waste handlers. In the second survey of 12 other states (Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, Ohio, Rhode Island, and Wisconsin), more specific categories of patient care providers, laboratory workers, housekeepers, all other workers (health care facilities only), solid waste collectors, solid waste handlers, and solid waste collectors and handlers were used. For each facility, an employee was defined as any individual employed for at least 1 month at the facility during 1988.

Approximately 57% of all the questionnaires mailed by the 17 states were returned. The populations covered by the returned questionnaires are 1,050,792 health care providers and 88,844 refuse workers (232,961 health care providers and 8,082 refuse workers for the 5-state survey, and 817,831 health care provides and 80,762 refuse workers for the 12-state survey, respectively) (*2*).

A thorough literature review was conducted during the data collection phase of the report. The review began with a computer search of Medline (key words: medical, infectious, pathological, and hospital waste; hepatitis B; and AIDS). The pertinent journal articles were obtained and reviewed. The reference sections of each article reviewed were cross-referenced. Contacts with academia, professional associations, environmental groups, and other interested parties helped identify additional pertinent literature. More than 500 journal articles, reports, and books were reviewed.

The review process for the report consisted of an internal ATSDR review, a review by the Federal Advisory Panel, an external peer review by a panel composed of representatives from academia, professional associations, state health departments, and other relevant organizations, and a public comment period (January 30–April 2, 1990). During the public comment period, the U.S. Environmental Protection Agency reviewed the report. After the public comment period, the report was reviewed by the Public Health Service and U.S. Department of Health and Human Services.

Findings of the ATSDR Medical Waste Report

The ATSDR report has six major findings, covering the potential for injury and infection from medical waste, estimates of the annual number of medical waste-related injuries from sharps, estimates of the annual number of medical waste-related infections from sharps, medical waste-related infections by means other than sharps, the percentage of infectious diseases attributable to medical waste, and data limitations. For the purposes of the report, medical material was considered waste only after it has been discarded (*2*).

Potential for Injury and Infection from Medical Waste

The potential for injury and infection from medical waste segregation, handling, storage, treatment, or disposal can best be described as a chain of events. This chain of events is depicted in Figure 2. For infection to occur, each of these events must take place: an individual must come in contact with medical waste; an injury must occur following this contact, thereby creating an appropriate portal of entry, or a portal of entry must already exist; and a sufficient number of viable infectious agents must enter a susceptible individual via this portal of entry, then cause infection. Infection does not always result in disease.

Of these four requirements, an appropriate portal of entry is the most important determinant in the infectious disease transmission process. Medical sharps (hypodermic needles, broken glass, scalpel blades, etc.) are inherently capable of creating an appropriate portal of entry (cuts, scrapes, punctures, etc.) for viable infectious agents to enter the body. Therefore, injuries from sharps have the greatest potential to cause infection and disease. Infection or disease associated with nonsharp contact can occur only when a portal of entry already exists or when contaminated free-flowing blood or blood products enter the body via a mucous membrane. Because most medically related injuries from sharps occur during patient care, the greatest potential for infectious disease transmission from medical waste is in the health care setting.

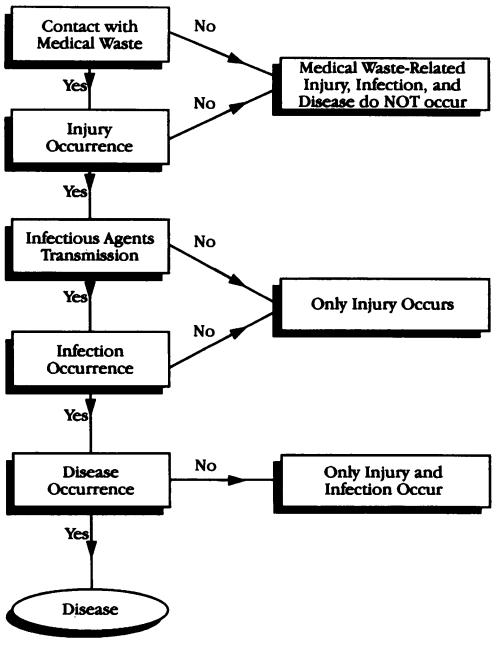

FIGURE 2. Chain of events required for medical waste-related injury, infection, and disease.

The potential for injury and infection related to medical waste varies with the type and extent of each occupational subgroup's involvement in medical waste management. Some occupational groups, such as janitors in the hospital setting, have a greater potential for medical waste-related injuries and infections than other occupational groups, such as chemical waste site clean-up workers, because they have a greater opportunity for contact with medical waste.

Estimates of the Annual Number of Medical Waste-related Injuries from Sharps

To determine the number of people injured annually from medical waste sharps (discarded sharps), four sources of data were used: the medical waste-related injury survey conducted by 17 state health departments, which specifically requested only medical waste-related injuries be reported; data provided to ATSDR by the solid waste industry and by the DOD, which also reported only medical waste-related injuries; and scientific literature. The scientific literature, however, reported the total number of needle-stick injuries (medical waste- and patient care-related) that occurred in hospital staff.

To use the data reported in the scientific literature, it was necessary to adjust the data to reflect only medical waste-related injuries. This adjustment was accomplished by identifying activities associated with medical waste-related injuries. Possible medical waste-related activities include cleaning, handling trash, and brushing up against the needle disposal box. A study conducted by Neuberger and co-workers (*3*) identified needle injuries by activity. Of the total number of needle-stick injuries reported by Neuberger et al. for each population, the following proportions were possibly attributable to medical waste: 4% for laboratory staff, 12.6% for registered nurses, 32% for licensed practical nurses, and 90% for janitorial and laundry (housekeeping) staff (*3*). This information was used to adjust the total number of needle-stick injuries presented in other scientific literature used in the report. All these scientific studies consisted of retrospective reviews of needle-stick injury records or surveys of past unreported needle sticks, were conducted in similar size hospitals, and covered periods of a year or more.

The estimates derived from all four main data sources (the medical waste-related injury survey conducted by 17 state health departments, data provided to ATSDR by the solid waste industry and the DOD, and scientific literature) are subject to certain biases and inaccuracies. Underreporting of injuries is likely because of worker

concerns about expressions of blame, the time required to complete the reports, and a lack of concern by some employees. Additionally, data collected from multiple sources may not reflect identical degrees of involvement or encompass similar group definitions. Individual data sources' biases are compounded when sources are combined. To avoid as many biases and inaccuracies as possible, data sources were not combined. Whenever possible, a range of estimates was determined for each occupational work group. These ranges reflect worst- and best-case situations.

The method of calculating the estimated medical waste-related sharp injuries is presented in Figure 3. For each occupational subgroup, an annual range of injury was computed by using the worst- and best-case (high and low) injury rate obtained from the four sources. The annual number of employees in each occupational subgroup was obtained from a variety of sources, including the Department of Labor, State Licensing Boards, the American Hospital Association, the American Dental Association, and the National Safety Council. (*2*). Table 1 presents the estimated annual range of medical waste-related injuries from sharps for nonhospital and hospital employees.

Estimated number of medical waste-related injuries = (number of persons in each occupational subgroup) × medical waste-related injury rate

Estimated number of medical waste-related infections = (number of medical waste injuries) × (prevalence of contaminated material) × (seroconversion rate)

Estimated number of medical waste-related diseases = (number of medical waste related infections) × (clinical disease rate among seroconverted individuals.

FIGURE 3. Methods of calculating estimated medical waste-related injuries, infections, or disease. Each calculation must be made separately for each occupational subgroup and for each route of contact. Prevalence of contaminated material was based on the seroprevalence of infected individuals in the health care setting. Prevalence of infected individuals was based on seroprevalence surveys conducted in hospitalized populations. Seroconversion rates were obtained from case studies of exposed workers. Clinical disease rates among seroconverted individuals were obtained from case studies.

Estimates of the Annual Number of Medical Waste-related Infections from Sharps

Injuries from sharps (e.g., punctures, cuts, abrasions) disrupt the skin's integrity and may introduce infectious agents into the wound. Not all injuries from sharps result in infection. As discussed earlier, a sufficient number of viable infectious agents must be transported into the wound of a susceptible host before infection can occur.

Scientific literature has reported the transmission of infectious agents by contaminated sharps. However, almost all these transmissions occurred during patient care or laboratory procedures (before the sharp was discarded), and therefore are not associated with medical waste. At present, only one occurrence of infectious disease transmission possible associated with a medical waste sharp has been reported: a housekeeper in a hospital developed staphylococcal bacteremia and endocarditis after a needle injury (*4*).

To date, no information is present in the scientific literature on the potential of infectious agent transmission from discarded sharps other than this one reported case of infectious disease transmission from a needle. However, needle injury rates associated with medical waste have been reported for several health care worker populations. These needle injury rates can be used to calculate a theoretical infectious disease transmission rate (Fig. 3). Injury, infection, and disease can be described as steps in a chain of events. Each of these events has a unique probability of occurrence, which varies for each population potentially involved.

Table 1. Estimated annual range of injuries, the theoretical estimate of annual number of HBV and HIV infections, and the theoretical estimate of annual number of hepatitis B disease and AIDS in nonhospital and hospital employees as a result of medical waste-related injuries from sharps.

Subgroup	Sharps injury range	HBV infections	Hepatitis B cases	HIV infections	AIDS cases
Nonhospital employees					
Physicians	500–1,700	1–3	<1–2	<1	<1
Registered nurses	17,800–32,500	36–65	18–33	<1	<1
Licensed practical nurses	10,200–15,400	20–31	10–15	<1	<1
Emergency medical personnel[a]	12,000	24	12	<1	<1
Dentists	100–300	<1	<1	<1	<1
Dental assistants	2,600–3,900	5–8	3–4	<1	<1
Refuse workers	500–7,300	1–15	<1–7	<1	<1
Hospital employees					
Physicians/dentists/interns	100–400	<1	<1	<1	<1
Registered nurses	9,800–17,900	20–36	10–18	<1–1	<1–1
Licensed practical nurses	2,800–4,300	6–9	3–4	<1	<1
Laboratory workers	800–7,500	2–15	1–8	<1	<1
Janitorial/laundry workers	11,700–45,300	23–91	12–45	<1–3	<1–3
Hospital engineers[a]	12,200	24	12	<1	<1

Abbreviations: HBV, hepatitis B virus; HIV, human immunodeficiency virus; AIDS, acquired immune deficiency syndrome.
[a]Only one injury rate was available in order to calculate the injury range and infections.

To calculate a theoretical infectious disease transmission rate, it is necessary to determine the probability that any sharp instrument will be contaminated with an infective dose (a sufficient number of infectious agents), that infection will occur following an injury with that sharp, and that this infection will result in disease.

Estimates of the prevalence of sharp contamination are not available, but a surrogate of this rate can be based on the prevalence of persons with an infectious disease entering the health care setting. (This assumes the use of medical sharps is equal among all patients.) Information on the prevalence of persons with human immunodeficiency virus (HIV) and hepatitis B virus (HBV) in the health care setting is available.

The Centers for Disease Control has developed a network of hospitals to monitor HIV-antibody prevalence. Survey data are anonymous and are not linked to identifiable individuals, but they include patients of all ages being treated for conditions not known to be related to HIV. From January 1987 to March 1989, 32 sentinel hospitals submitted a total of 129,929 blood specimens for HIV testing. The crude median HIV seroprevalence was 0.8%. Ranking all sentinel hospitals according to their measured seroprevalence indicates 25% of the hospitals have seroprevalence values of less than 0.3% (25th percentile) and 25% have seroprevalence values of greater than 2.0% (75th percentile) (staff of the Surveillance Branch, Division HIV/AIDS, Center for Infectious Diseases, CDC, personal communication). The use of these data to calculate annual estimates of HIV infections related to medical waste injuries should be guided by the following considerations.

a) Sentinel hospitals are not a representative sample of all hospitals in the United States. These hospitals are primarily university affiliated, and all are urban. Therefore, these prevalence in sentinel hospitals is likely to be higher than among all U.S. hospitals.

b) Sentinel hospital patients eligible to participate in this study are not a cross-section of all patients in sentinel hospitals. Specifically, patients who are known to have HIV-related disease or risk factors for HIV infection are excluded from the sample. This would, in effect, underestimate the true seroprevalence in these institutions.

c) Sentinel hospital data are standardized by age and gender to the U.S. population. Because patients in hospitals are older than the average U.S. population, the overall seroprevalence in sentinel hospitals and all other hospitals is likely to be lower than the standardized rates.

d) Sentinel hospital patients are sampled only once per year. It is possible HIV-infected patients have multiple blood draws during the course of their hospitalization. Therefore, the prevalence of HIV-contaminated needles or other medical waste could be higher than that measured in the sentinel hospital study.

Given the limitations of the sentinel hospital data, a range was used to represent the probability a random sharp inside a hospital is contaminated with HIV. The seroprevalence values to determine the probability are the 25th and 75th percentile values (0.3–2.0%) and the crude median (0.8%).

The most appropriate data on HIV seroprevalence in outpatients are available from an ongoing laboratory-based survey of primary care outpatients. This survey uses leftover blood specimens submitted to a national clinical laboratory for complete blood count or hematocrit (the most commonly ordered diagnostic tests) by approximately 15,000 pediatricians, general internists, and family practitioners. These specimens include all primary care outpatients, and unlike the sentinel hospital study, this survey does not exclude patients seen for reasons related to HIV clinical syndromes or risk behaviors. From January to August 1989, the seroprevalence from 49,565 specimens was 0.65% (staff of the Surveillance Branch, Division HIV/AIDS, Center for Infectious Diseases, CDC, personal communication) The use of these data to calculate annual estimates of HIV infections related to nonhospital-based generated medical waste should be guided by the following considerations:

a) Data from this study include only specimens received from primary care physicians. Infectious disease specialists are likely to have patient populations with seroprevalences considerably higher than those included in the report.

b) Although the laboratory is national, a disproportionate number of specimens are submitted from urban areas. This bias cannot yet be fully assessed, but is likely to overestimate true nationwide HIV seroprevalence.

c) Primary care outpatients are sampled only once per year. It is likely many HIV-infected patients have multiple blood draws during the course of a year. Therefore, the prevalence of HIV-contaminated needles or other medical waste may be higher than that measured in the study. Preliminary data suggest the overall prevalence of HIV infection in all specimens (including all specimens from those patients who had multiple blood samples drawn in a single year) is at least 20% higher than the observed seroprevalence in the primary care study.

Because of these data limitations, a probability of 0.8% was chosen as the prevalence of HIV sharp contamination outside a hospital. This prevalence is about 20% higher than the observed seroprevalence in the primary care outpatient survey (0.65%) to compensate for the fact that the primary care outpatient survey samples individuals only once per year.

The probability that any injury from an HIV-contaminated sharp will result in seroconversion of the individual injured has been reported in several case studies of health care workers. To date, all reported cases are related to patient care and are not associated with medical waste. CDC reported a seroconversion rate of 0.42% among 1201 health care workers (*5,6*). In 1987, Gerberding reported that only 1 occupational transmission could be documented following 224 needle-stick blood exposures in 180 health care workers. The corresponding seroconversion rate in that study was 0.45% (*7*). In 1990, Henderson summarized all cases related to HIV seroconversion following injury from a sharp or significant blood contact. In that review, he summarized 1389 reports of percutaneous exposures of 1320 persons of which 5, or 0.36% have experienced HIV seroconversion (*8*). A principal characteristic of those

cases is that they represent persons injured with a needle containing freshly drawn blood or other body fluids contaminated with a sufficient number of viable HIV. These seroconversion rates are better representative of patient-care activities than of medical waste-related injuries and may overrepresent the potential for infections occurring several hours to days later, because HIV is a very fragile virus that quickly becomes nonviable once removed from an infected individual.

At present, all individuals infected with HIV are likely to develop clinical AIDS. Therefore, for the purpose of the calculations presented in the ATSDR Report, it is assumed 100% of the infected individuals will ultimately manifest disease.

The potential for hepatitis B virus infection following an injury with an HBV-contaminated needle in the health care setting is greater than for HIV because more people in that setting are HBV infected and HBV is transmitted more efficiently than is HIV (*9*). The prevalence of persons with HBV entering the health care setting is approximately 1% (seroprevalence). The potential for developing infection when injury occurs from a sharp known to be contaminated with HBV is 20% (seroconversion). Upon HBV infection, 50% of infected individuals will manifest disease (*9*).

Both the HBV seroprevalence and seroconversion rates (1 and 20%, respectively) used to estimate medical waste-related HBV infections and disease cases represent median values. In contrast with the limited data available on HIV, substantial information related to HBV seroprevalence and seroconversion is available to justify the use of median values rather than a range, as if the case for HIV (sentinel hospital survey).

The information needed to calculate a theoretical transmission rate for infectious diseases other than HIV and HBV is not available. Table 1 presents the theoretical estimate of the annual number of HBV and HIV infections and hepatitis B and AIDS cases in nonhospital and hospital employees as a result of medical waste-related injuries from sharps.

These estimates are upper-limit theoretical estimates because the probability of infection is based on case studies of persons who came in contact with freshly drawn blood or other body fluids—an event more likely to occur during patient care than during medical-waste handling. In addition, some persons may be immune to HBV infection because of prior exposure or immunization (*10*). The estimates did not take into account the rapid decline of viable HIV outside a living host (*11*). Because data were not available to determine how many janitorial and laundry workers, laboratory workers, and building engineers are employed at nonhospital facilities that generate medical waste, estimates could not be derived for these workers in those settings.

Medical Waste-related Infections by Means Other Than Sharps

No documented information was available on infections resulting from contact with medical waste by means other than sharps. Based on data obtained from the scientific literature, serological evidence of hepatitis B infection was associated with involvement with blood and blood products and with occupational categories frequently contacting blood and blood products (nurses, laboratory workers, and janitorial staff), but not with direct patient contact. None of the HIV infections attributed to dermal contact or mucous membrane contamination was associated with medical waste (*2*).

Percentage of Infectious Diseases Attributable to Medical Waste

According to theoretical calculations, a maximum of approximately 162–321 HBV infections related to medical waste sharps could occur annually. The CDC estimates that approximately 300,000 HBV infections occur in the United States yearly (*12*). The 162–321 HBV infections estimated to occur as a result of contact with medical waste sharps would account for 0.05–0.1% of the total number of HBV infections occurring annually in the United States.

Theoretically, a maximum of approximately 81–160 hepatitis B disease cases related to medical waste sharps are estimated to occur annually. According to CDC, approximately 150,000 acute cases of hepatitis B occur in the United States annually (*12*). Based on this information, the maximum theoretical percentage of hepatitis B disease cases occurring annually that may be related to medical waste sharps is 0.05–0.1% of the total number of HBV clinical disease cases occurring annually in the United States.

Based on the data developed in this report, there is a theoretical possibility that a maximum of less than one to four cases of AIDS per year could occur as a result of contact with medical waste sharps. As of December 31, 1989, a total of 117,781 AIDS cases had been reported to the CDC (*13*). For 1989, the total number of AIDS cases reported to CDC was 35,238 (*13*). Consequently, contact with medical waste sharps may account for <0.003–0.01% of all the 1989 AIDS cases in the United States. Contact with nonsharp medical waste may make an unknown contribution to the total number of HBV and HIV infections and cases. However, this contribution would be considerably less, based on the principles of infectious disease transmission.

Data Limitations

Estimates of the health impact of medical waste were developed by defining the chain of events necessary to result in medical waste-related injury and infection and then estimating the probability of each of these events through the use of data from reported surveys or studies or by using surrogate measurements. No objective evaluation of the number of injuries or infections resulting from contact with medical waste has previously been performed. Measuring injuries and infections is difficult and subject to many biases.

Estimates of the population size for any worker group may be biased because the degree of organization and skill level may vary. Numbers of professional health care providers, who are well organized and typically require more licensing for employment, may be easier to estimate than those of unskilled labor forces such as janitorial or refuse workers. In addition, the accuracy of data sources may vary. For example, physicians licensed to practice in more than one state may contribute to higher-than-actual estimates because of multiple counting.

The injury rates developed in the report are based on four studies found in the scientific literature (*3,14–16*). One of those studies used active data collection as injuries occurred, and the other three used retrospective surveys or case-report analyses. The major bias in all the studies is underreporting of injuries. Without active, nonpunitive encouragement of case reports, many injuries may go unreported. The underreporting rate may vary with the occupational group. Unskilled workers, who may not be able to assess the need for treatment, may be more likely to report an injury in an encouraging environment than busy physicians or nurses would be. The accuracy of relating the injury to medical waste may be a bias of unpredictable influence on the injury rates. Because most data were not collected with medical waste as a primary part of the project, recording this information may not have occurred to the fullest possible extent.

The 17 state health department medical waste injury survey may suffer similar biases. The case reports were completed by company management representatives who may have difficulty in relating past injury case reports to medical waste. It is unknown whether nonparticipants would have relied similarly to the participants; however, it is unlikely they would.

Conclusions of the ATSDR Medical Waste Report

The 15 major conclusions of the report as are follows. The general public's health is not likely to be adversely affected by medical waste generated in the traditional health care setting. Outside the health care setting, the potential for HBV or HIV infection in the general public following medical waste-related injuries is not likely to be a health concern. However, needle-stick injuries may cause local or systemic secondary infections, similar to injuries from nails.

The increase of in-home health care provides opportunities for the general public to contact medical waste. In addition, other sources of nonregulated medical waste may also present opportunities for medical waste contact. Based on estimates of the number of medical waste-related HIV and HBV infections and disease cases, occupational health concerns exist for selected occupations involved with medical waste. Those populations include janitorial and laundry workers, nurses, emergency medical personnel, and refuse workers.

When in effect, the recently proposed regulations by the Department of Labor's Occupational Safety and Health Administration (OSHA) (*17*) should decrease workplace medical waste-related injuries and infections nationwide. This disease should be achieved through increased awareness, regulatory control, and immunization.

From a public health standpoint, medical waste should include the following categories of waste material: cultures and stocks, pathological wastes, blood and blood products, sharps, animal waste, selected isolation waste, and unused, discarded sharps.

The amount of medical waste generated by in-home health care and hospice care is underappreciated and is expected to increase, because treating individuals in those settings is becoming more and more common. As a result, refuse workers may experience an increase in needle-stick injuries caused by medical waste discarded with residential waste, resulting in an increased opportunity for infection and disease in this occupational subgroup.

Illicit intravenous drug users (IVDUs), who have high rates of HIV and HBV infection, are a significant source of discarded sharps. (It is thought there are approximately 1.1 million–1.3 million illegal IVDUs nationwide.) The general public could come in contact with these discarded sharps and thus have an increased opportunity for injury and infection. A lack of data prevents estimating the potential HIV and HBV infection rates from IVDU-related waste.

Scientific studies indicate that, outside a living host, numbers of the human immunodeficiency virion rapidly decline, and the virus does not remain viable after a few days. Thus, persons coming in contact with medical waste outside the health care setting have a very low potential for HIV infection. HBV, however, does remain viable for an extended time outside a host. Consequently, the potential for HBV infection following contact with medical waste is likely to be higher than that associated with HIV.

The number of persons infected with the human immunodeficiency virus is anticipated to increase in the future. Based on the data analyzed and the methods of calculating the estimates for medical waste-related injuries, infections, and disease developed in this report, a maximum of less than one to four cases of AIDS per year (<0.003–0.01% of all the 1989 AIDS cases in the United States) are estimated to occur in health care workers as a result of contact with medical waste sharps. However, the increase in the number of persons infected with HIV is expected to increase the potential for medical waste-related HIV transmission in the health care setting. Based on the data analyzed and the methods of calculating the estimates for medical waste-related injuries, infections, and disease developed in this report, a maximum of approximately 162–321 HBV infections and 81–160 hepatitis B disease cases related to medical waste sharps could occur annually. The 162–321 HBV infections and 81–160 hepatitis B disease cases estimated to occur as a result of contact with medical waste would account, respectively, for 0.05–0.1% of the total number of HBV infections and 0.05–0.1% of hepatitis B clinical disease cases occurring annually in the United States.

Communicable diseases spread within medical facilities are usually the result of community-acquired (preexisting) or nosocomial (hospital-acquired) infections. Although,

theoretically, communicable diseases may be transmitted by medical waste, the probability of such transmission is generally considered to be remote. Appropriate preventive health measures and personal hygiene practices have controlled and should continue to successfully control the incidence of medical waste-related disease transmission within medical faciliteis.

Medical waste can be effectively treated by chemical, physical, or biological means, such as chemical decontamination, autoclaving, incineration, irradiation, and sanitary sewage treatment. Research indicates medical waste does not contain any greater quantity or different types of microbiological agents than residential waste, and viruses present in solid waste tend to absorb to organic matter and deactivate. Additionally, properly operated sanitary landfills provide microbiological environments hostile to most pathogenic agents. Therefore, untreated medical waste can be disposed of in sanitary landfills, provided procedures to prevent worker contact with this waste during handling and disposal operations are strictly employed. It is worth noting, however, that 158 million tons of municipal solid waste are created yearly nationwide. Medical waste is a part, albeit a small one at 0.3%, of the overall problem of solid waste management. Clearly, the most effective way to deal with this issue is to strive to reduce the amount of waste created, on a small scale in homes or on a large scale in industrial operations. Simultaneously, the impetus to recycle, reuse, and reclaim products is paramount to adequately manage solid waste, including medical waste, now and in the future.

Based on the principles of infectious disease transmission, the potential for infection resulting from contact with nonsharp medical waste is likely to be significantly less than that related to contasct with medical waste sharps. The primary reason for the reduced potential is, in contrast to sharps, a portal of entry must exist before contact with nonsharps for infection or disease to occur.

Medical waste adversely affects the environment. In general, this waste stream contributes to the overall environmental problem of solid waste disposal in the United States. Specifically, beach wash-ups and products of incomplete combustion are among the adverse environmental effects of inadequate medical waste management. Most environmental concerns related to beach wash-ups are associated with medical waste primarily generated by nonregulated sources.

Copies of the ATSDR report (document number PB 91-100271) can be obtained through the National Technical Information Service, Springfield, Virginia.

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