In most hospitals, angioplasty can be used successfully in only a small and select group of patients. This includes patients with iliac-artery stenoses, superficial femoral-artery stenoses, or short occlusions with vessels open distally to allow a good blood flow. Dilation of distal vessels may not be equally successful. Arterial occlusion is a complication of angioplasty that may require vascular surgery. During the past two decades, simpler vascular procedures that do not involve major surgery have become more common. A subcutaneous femoral-femoral graft to supply a limb with an obstructed iliac artery or an axillofemoral-femoral graft to bypass an aortic obstruction avoids major abdominal surgery. In patients with total occlusion of one iliac artery and a stenosis of the contralateral iliac artery, angioplasty may be used to dilate the stenosed artery. Then a femoral-femoral bypass can be performed to supply the limb distal to the obstructed iliac artery. Some patients may therefore undergo both angioplasty and vascular surgery. More surgery is being performed with grafts to distal calf vessels and even pedal arteries in an attempt to save ischemic limbs. Such procedures can be performed with success in patients considered to be at high risk from major surgery and are one reason for the increase in vascular operations.

The surprising finding in the study by Tunis et al.¹ is that the rate of amputation has not decreased despite the increase in bypass surgery and the advent of angioplasty. Although other studies have shown a decrease in the rate of amputation, they have been criticized for their small size. Each study, of course, represents the experience of one institution with an obvious interest and expertise in vascular surgery. However, the impressive earlier study by Veith and coworkers¹¹ included 2829 procedures performed over a 15-year period. Angioplasty, bypass surgery, or a combination of the two were performed in an attempt to save limbs with critical ischemia. The rate of major amputations decreased from 41 to 5 percent, and that of total amputations from 49 to 14 percent — a remarkable result. There were many reoperations after failed procedures, but this fact could be one key to the overall success rate. Unfortunately, the indications for angioplasty and bypass surgery were not given in the Maryland study.¹ If the patients included those with mild-to-moderate disease, limbs would not have been saved. In fact, complications resulting from intervention in these patients could lead to amputations. Tunis et al. do not report the sites of the angioplasty procedures. If more procedures were being performed distal to the inguinal ligament, as suggested by the increased age of the patients in 1989, the rates of failure and amputation may have been higher than before. Perhaps, in many of the hospitals, interventions were not being performed after failed procedures, as they were in the study of Veith et al.¹¹ The Maryland study included many institutions, although half the angioplasty procedures were performed in hospitals with large numbers of such procedures. High volume does not always translate into skill, however.

The absence of any decrease in the rate of amputa-

tion despite a large increase in the rate of vascular procedures is an important revelation of the Maryland study. The most likely explanation is that angioplasty and vascular surgery were being performed in patients for whom these procedures were not appropriate and in too many hospitals, rather than only in centers where expertise was greater. When problems occur in most hospitals, staff with the technical proficiency to perform complicated corrective surgical procedures may not be available. The availability of an expert vascular team at the center being studied is probably the primary reason, in addition to the careful selection of patients, that the smaller studies found a decrease in the rate of amputation. Unless the rate of amputation can be shown to decrease in a hospital, it is possible that neither angioplasty nor vascular surgery should be performed.

The treatment of patients with intermittent claudication alone should be conservative, because the prognosis for the limb is favorable, because surgical mortality from cardiovascular events is high among such patients, and because the use of interventions has not decreased the rate of amputation in many hospitals. Invasive procedures are indicated only for the severely ischemic limb and should be performed in an institution and by a team with a good track record.

Boston University Medical Center
Boston, MA 02118

JAY D. COFFMAN, M.D.

REFERENCES

1. Tunis SR, Bass EB, Steinberg EP. The use of angioplasty, bypass surgery, and amputation in the management of peripheral vascular disease. *N Engl J Med* 1991; 325:556-62.
2. McDaniel MD, Cronenwett JL. Basic data related to the natural history of intermittent claudication. *Ann Vasc Surg* 1989; 3:273-7.
3. Criqui MH, Fronek A, Barrett-Connor E, Klauber MR, Gabriel S, Goodman D. The prevalence of peripheral arterial disease in a defined population. *Circulation* 1985; 71:510-5.
4. Kannel WB, Skinner JJ Jr, Schwartz MJ, Shurtleff D. Intermittent claudication: incidence in the Framingham Study. *Circulation* 1970; 41:875-83.
5. Greenhalgh RM, Rosengarten DS, Mervart I, Lewis B, Calnan JS, Martin P. Serum lipids and lipoproteins in peripheral vascular disease. *Lancet* 1971; 2:947-50.
6. Kannel WB, McGee DL. Diabetes and cardiovascular disease: the Framingham study. *JAMA* 1979; 241:2035-8.
7. Schadt DC, Hines EA Jr, Juergens JL, Barker NW. Chronic atherosclerotic occlusion of the femoral artery. *JAMA* 1961; 175:937-40.
8. Kannel WB, Shurtleff D. The Framingham Study: cigarettes and the development of intermittent claudication. *Geriatrics* 1973; 28(2):61-8.
9. Ekroth R, Dahlöf A-G, Gundeval B, Holm J, Scherstén T. Physical training of patients with intermittent claudication: indications, methods, and results. *Surgery* 1978; 84:640-3.
10. Barndt R Jr, Blankenhorn DH, Crawford DW, Brooks SH. Regression and progression of early femoral atherosclerosis in treated hyperlipoproteinemic patients. *Ann Intern Med* 1977; 86:139-46.
11. Veith FJ, Gupta SK, Wengerter KR, et al. Changing arteriosclerotic disease patterns and management strategies in lower-limb-threatening ischemia. *Ann Surg* 1990; 212:402-14.

SOUNDING BOARD

INFECTIOUS WASTE —

Mismatch between Science and Policy

DISPOSAL of medical waste has emerged as a major problem in the United States. The problem was brought to public attention by recent episodes of

medical waste washing ashore in some coastal states and the perceived threat of contracting the acquired immunodeficiency syndrome from it. This has led to restrictive rules governing the disposal of medical waste in most states and to more waste being defined as infectious. Coincidentally with the broadening of the definition of infectious waste, the options for the treatment and disposal of medical waste are diminishing because of lack of space and environmental concerns. In this article we define and characterize medical waste, assess its public health implications, evaluate current waste-management practices, and examine federal legislation in this area that could have an impact on health care providers.

MEDICAL WASTE

Despite the attention given the subject by the public and the media and at all levels of government, the terms "hospital waste," "medical waste," "regulated medical waste," and "infectious waste" are often taken to be synonymous. Hospital waste refers to all waste, biologic or nonbiologic, that is discarded and not intended for further use. Medical waste refers to material generated as a result of the diagnosis or treatment of a patient, such as soiled dressings or intravenous tubing. Infectious waste refers to the portion of medical waste that might potentially transmit an infectious disease.^{1,2} Congress and the Environmental Protection Agency (EPA) used the term "regulated medical waste" rather than "infectious waste" in the Medical Waste Tracking Act of 1988, because the possibility of transmission of disease by such waste was remote.² Thus, medical waste is a subcategory of hospital waste, and infectious waste, which is synonymous with regulated medical waste, is a subcategory of medical waste.

Guidelines produced by the Centers for Disease Control (CDC) have designated five types of hospital waste as infectious — microbiologic material, pathological material, contaminated animal carcasses, blood, and "sharps" (i.e., instruments such as needles or scalpels).^{3,4} The EPA guidelines also include all waste from patients who have communicable diseases and are isolated.⁵ In a survey of U.S. hospitals in July 1987 and January 1988, the overall rates of compliance with the CDC and EPA recommendations were 82 and 75 percent, respectively. Not only were the majority of hospitals in compliance, but they also frequently designated additional hospital waste as infectious, including contaminated laboratory waste (87 percent of hospitals), surgical waste (78 percent), waste from dialysis (69 percent), items contacting secretions (63 percent), waste from intensive care (37 percent), and emergency room waste (41 percent).¹

A key component in evaluating the effect of a medical-waste management program is the quantity of waste produced per patient. Hospitalized patients generate about 15 lb of hospital waste per day. Approximately 6700 tons are generated by U.S. hospitals daily, about 1 percent of the 158 million tons of municipal solid waste produced annually. U.S. hospitals designate at least 1000 tons of waste per day as infec-

tious (approximately 15 percent of total hospital waste according to weight).¹ Of course, the fraction of medical waste treated as if it were infectious increases with the number and types of medical waste classified as infectious.^{1,6} For example, about 6 percent of hospital waste will be treated as infectious if the CDC guidelines are followed,¹ but 45 percent of hospital waste could be considered infectious under the Medical Waste Tracking Act.⁷

Although hospitals are considered to be the primary generators of medical waste and the focus of most regulations,^{2,8,9} they are only a part of the health care facilities that generate medical waste, including 180,000 physicians' offices, 98,400 dentists' offices, 38,000 veterinarians' offices, 15,500 medical clinics, 12,700 long-term health care facilities, 4300 laboratories, and 900 free-standing blood banks.¹⁰ Reliable data are not available on the amount of medical waste produced from these nonhospital health care sites. In addition, there are 2 million diabetics and 1.2 million intravenous drug abusers nationwide who use more than 1 billion insulin-type syringes annually, which are not regulated.¹¹

PUBLIC HEALTH EFFECTS

Most proponents of state and federal medical-waste legislation have claimed that medical waste poses a threat to human health and must therefore be strictly regulated. However, the alleged health hazards of our current medical-waste disposal practices have not been demonstrated. The potential for infection from contact with medical waste other than sharps is virtually nonexistent.¹¹ Contaminated sharps are the only form of medical waste that has been associated with the transmission of infectious disease. This is not surprising, given the intrinsic capability of sharps to disrupt the integrity of the skin and introduce infectious agents into the wound. All the reports describing the transmission of infectious agents by contaminated sharps have occurred in settings of occupational health care, however, and none have been associated with environmental injuries occurring after the disposal of the waste outside the hospital.¹¹ There is no epidemiologic evidence that hospital waste-disposal practices have caused disease in the community.^{1,11,12}

MEDICAL WASTE MANAGEMENT IN THE UNITED STATES

The vast majority of U.S. hospitals designate and treat waste, including microbiologic agents, pathological specimens, material from patients in isolation, blood, and sharps, as infectious.¹ At U.S. hospitals, infectious waste is most commonly incinerated — 64 to 93 percent of it, depending on the type of waste. About one third of U.S. hospitals sterilize their microbiologic waste with steam, and about one fourth pour blood down a drain connected to a sanitary sewer (unpublished data). Most states have rules for medical waste that are overly restrictive, and thereby increase the volume of infectious waste that must be treated^{8,9}; at the same time, they have restricted the use of certain treatment methods, such as the disposal of regu-

lated medical waste in sanitary landfills.⁹ The evidence suggests that untreated medical waste can be disposed of safely in such landfills provided that procedures are used to prevent it from coming in contact with workers during disposal.¹¹ Studies demonstrate that pathogenic bacteria and viruses are significantly reduced in number in properly operated sanitary landfills because of such processes as thermal inactivation, antimicrobial characteristics of the leachate, and adsorption to organic material in solid waste.¹³⁻¹⁷ Although on average municipal solid waste contains more microorganisms with pathogenic potential for humans than does medical waste,¹⁸⁻²² there are no restrictions on the placement of municipal wastes into landfills. In any event, the use of sanitary landfills for medical-waste disposal is not a satisfactory long-term alternative, since one third of the remaining landfills will reach their capacity within the next five years.²³ Clearly, proper hospital-waste management must include methods to reduce the total output of waste and to recycle or reuse medical materials when feasible.

Paradoxically, although strict waste-tracking laws encourage on-site incineration,² tough emission restrictions are discouraging the use of this form of waste disposal,⁸ even though there are no known infectious health hazards associated with properly operated incinerators. Incineration produces a sterile ash,^{24,25} there is no difference between bacteria in stack emissions and those in ambient air,²⁶ and when *Bacillus subtilis*, for example, is mixed with waste, it is inactivated.²⁷

Although hospital and municipal waste incinerators generate a variety of chemicals, such as carbon monoxide, metals, dioxins, and furans,²⁸⁻³⁰ no health risks from their generation in this way have been demonstrated. Nonetheless, public health anxieties about the chemical emissions from incinerators mandate further investigation and the subsequent development of scientifically based emission standards. Currently, statewide moratoriums, stringent rules, and requirements for permits restrict hospitals from using incinerators even if they have already been installed. As a consequence, regulated medical wastes are sometimes transported long distances to regional incinerators, increasing the costs of disposal.

THE MEDICAL WASTE TRACKING ACT OF 1988

The beach wash-ups and resultant beach closings brought pressure on state and federal legislators to prevent future closings, and several states issued strict emergency regulations. The Medical Waste Tracking Act was pushed rapidly through Congress in October 1988 and signed into law on November 1. It directed the EPA to begin a two-year pilot program on the disposal of infectious waste. Although the act expired on June 22, 1991, and affected only four states (New York, New Jersey, Connecticut, and Rhode Island) and the commonwealth of Puerto Rico, it is likely that it or similar legislation will be included in the reauthorization of the Resource Conservation and Recovery Act in 1992 and will be extended to all the states.

Under the tracking plan, health care providers (physicians, dentists, veterinarians, small clinics, laboratories, and hospitals) that generate more than 50 lb of regulated medical waste per month are required to maintain detailed records that track such wastes from point of origin to final disposal. At present, the EPA has exempted providers that generate less than 50 lb per month from the full tracking requirements of the act, but not from other requirements for disposal and treatment. Those that do not comply are subject to civil penalties of up to \$25,000 per day and criminal penalties of up to \$50,000 per day for each violation and a maximal penalty of five years in prison.²

The passage of this law was opposed by the CDC, the Association for Practitioners of Infection Control, and the National Institutes of Health, all of which testified that medical waste generated in traditional health care settings posed no hazard to the general public, although it was an occupational health concern.³¹ The same conclusion was reached by the Agency for Toxic Substances and Disease Registry of the Department of Health and Human Services, which presented a report to Congress in September 1990.¹¹

If regulatory control were based on epidemiologic and microbiologic data, only two types of medical waste would require special handling and treatment — sharps and microbiologic waste.³² Such an approach should be the basis for a uniform definition of regulated medical waste, which could be monitored by appropriate accrediting agencies, such as the Joint Commission for the Accreditation of Health Care Organizations or the State Division of Facility Services, during their periodic reviews.

THE DISCREPANCY BETWEEN SCIENCE AND POLICY

Governmental regulations are intended to protect the public health and limit the degradation of the environment by medical waste. It is extremely unlikely, however, that the Medical Waste Tracking Act will have any effect on the public health or prevent medical debris from washing up on public beaches, for several reasons.

First, three detailed reports of beach wash-ups found that about 99 percent of the waste on beaches was debris such as wood, plastics, and paper, not medical waste.³³⁻³⁵ Despite extensive investigations, the washed-up materials could not be traced to illegal dumping or to a specific source, such as a hospital, but were related more directly to malfunctioning sewage-treatment systems and prevailing winds and currents.^{2,33} EPA officials acknowledged that some 65 percent of the medical waste that washed ashore in the summer of 1988 was related to syringes and was from use in home health care or intravenous drug abuse. Chemical analysis identified insulin or cocaine in three of five syringes collected during the EPA Harbor Studies Program.^{2,34,36} Even though a single syringe on a beach is one too many, the Medical Waste Tracking Act will not prevent an occasional appearance, because waste from home health care and intravenous drug users is not regulated. Thus, the amount

of medical waste deposited on beaches may not be reduced by the requirements of the act — its principal purpose.

Second, studies have shown that U.S. hospitals are generally in compliance with the CDC infectious-waste guidelines. In fact, most hospitals consider more types of medical waste infectious than the CDC recommends.³ Possible explanations for this overly broad definition of infectious waste include a misinterpretation of universal precautions (i.e., the incorrect belief that all patient-contacted waste must be treated as infectious),³⁷ overly restrictive state regulations, and fear that the hospital may be identified as a mismanager of medical waste by state or federal surveyors who might choose to include items among the regulated waste for aesthetic reasons or perceived health risks. In addition, in certain locations used for patient care (e.g., operating rooms and emergency rooms) it might be difficult to maintain separate waste containers for regulated and nonregulated medical waste in a manner that ensures no confusion. In such situations, some facilities have decided to designate all waste as regulated medical waste.

Third, household waste contains on average 100 times more microorganisms with pathogenic potential for humans than medical waste.¹⁸⁻²⁰ From our daily experience with household waste and decades of waste removal and burial in landfills, we can deduce that the incremental health risks from the less microbially contaminated medical waste are nominal.

Finally, with the exception of sharps, which have caused disease only in occupational settings, there is no scientific evidence that medical waste has led to disease in the hospital or the community.^{11,12} Although the public is concerned that blood-borne pathogens, such as hepatitis B virus and human immunodeficiency virus (HIV), could be contracted through accidental exposure to infectious waste in the environment, the probability, on theoretical grounds, that the events necessary for infection to occur and that a person will acquire HIV infection from a needle on a beach is vanishingly small (1 in 15 billion to 1 in 390 trillion).^{11,38-42} Although sharps are the only medical waste known to be involved in disease transmission, there are several medical wastes that are regulated because of aesthetic considerations and the perceived rather than proved risk of disease transmission. Except in the case of pathological specimens, the use of aesthetic criteria for the regulation of waste is subjective and establishes a controversial precedent.

The Medical Waste Tracking Act also requires all regulated medical waste to be not only treated (i.e., processed to reduce or eliminate its potential for causing disease) but also destroyed, so that it is no longer recognizable. This environmental standard could halt the development of new forms of technology that would provide "treatment" without "destruction" and would render previously available methods of treatment (e.g., steam sterilization without subsequent destruction) illegal. In addition, the terminology associated with some categories is nebulous, such as "items saturated and/or dripping with human

blood."² Such an approach would result in an enormous increase in the volume of regulated medical waste and in the costs of hospital-waste disposal, well beyond the EPA estimate of \$3,757 per hospital per year.² To illustrate, a New York academic center reported that to comply with the act, it increased the amount of regulated medical waste by 315 percent from 1984 (443,000 lb) to 1989 (1,837,000 lb). The total cost increased nearly 700 percent, from \$106,000 to \$835,000 per year, resulting in a rise in the daily cost for regulated medical waste per patient from \$1.04 to \$5.19.⁷ This effect was largely the result of considering a larger portion of medical waste as regulated medical waste and of the difference in cost between the disposal of nonregulated (i.e., \$0.02 to \$0.05 per pound) and regulated (i.e., \$0.20 to \$0.60 per pound) medical waste. On the basis of these data and patient-census data from the American Hospital Association, it would cost U.S. hospitals about \$1.3 billion a year to comply with the Medical Waste Tracking Act — approximately seven times the amount (\$182 million) allotted by the federal government in 1991 for all childhood immunizations. Ultimately, this additional cost will be passed on to the public in the form of higher medical fees, insurance rates, or taxes.

Nonetheless, because of intense and often misleading media coverage of this issue and a lack of understanding of disease transmission, the states and the federal government created strict regulations, which aggravated the problem by defining more waste as infectious. To complicate matters further, some waste-treatment options such as landfilling have been eliminated, and others such as incineration may be eliminated. The result is an extraordinary increase in cost with no environmental or public health benefit. The medical-waste policies that have evolved from perceived risks over the past few years should be supplanted by rules based on scientific considerations.

University of
North Carolina
Chapel Hill, NC 27599

WILLIAM A. RUTALA, PH.D., M.P.H.
DAVID J. WEBER, M.D., M.P.H.

REFERENCES

1. Rutala WA, Odette RL, Samsa GP. Management of infectious waste by US hospitals. *JAMA* 1989; 262:1635-40.
2. Environmental Protection Agency. Standards for the tracking and management of medical waste. *Fed Regist* 1989; 54:12326-95.
3. Garner JS, Favero MS. Section 4, Infective waste. Guideline for handwashing and hospital environmental control, 1985. Atlanta: Centers for Disease Control, 1985.
4. Richardson JH, Barkley WE, eds. Biosafety in microbiological and biomedical laboratories. Washington, D.C.: Department of Health and Human Services, 1988. (HHS publication no. (NIH) 88-8395.)
5. Environmental Protection Agency. Guide for infectious waste management. Washington, D.C.: Government Printing Office, 1986. (Report EPA/530-SW-86-014.)
6. Rutala WA, Sarubbi FA Jr. Management of infectious waste from hospitals. *Infect Control* 1983; 4:198-204.
7. Marchese JT, Marshall GB, Lavalle RF, Greene WH. Regulated medical waste disposal at a university and university hospital: future implications. Presented at the Third International Conference on Nosocomial Infections, Atlanta, August 1990. abstract.
8. Karpiak J, Pugliese G. Medical waste — declining options in the 90s. *Am J Infect Control* 1991; 19:8-15.
9. State infectious waste regulatory program. Lexington, Ky.: Council of State Governments, 1988.
10. Environmental Protection Agency. Medical waste management in the United States: first interim report to Congress. Washington, D.C.: Government Printing Office, 1990. (EPA/530-SW-90-051A.)

11. Agency for Toxic Substances and Disease Registry. The public health implications of medical waste: a report to Congress. Washington, D.C.: Department of Health and Human Services, 1990.
12. Rutala WA. Infectious waste — a growing problem for infection control. *Asepsis* 1987; 9:2-6.
13. Engelbrecht RS, Weber MJ, Amirhor P, Foster DH, LaRossa D. Biological properties of sanitary landfill leachate. In: Malina JF Jr, Sagik BP, eds. *Virus survival in water and wastewater systems*. Austin: University of Texas, 1974:201-17.
14. Cooper RC, Potter JL, Leong C. Virus survival in solid waste leachates. *Water Res* 1975; 9:733-9.
15. Pahren HR. Microorganisms in municipal solid waste and public health implications. *CRC Crit Rev Environ Control* 1987; 17:187-228.
16. Sobsey MD, Wallis C, Melnick JL. Studies on the survival and fate of enteroviruses in an experimental model of a municipal solid waste landfill and leachate. *Appl Microbiol* 1975; 30:565-74.
17. Sobsey MD. Field survey of enteric viruses in solid waste landfill leachates. *Am J Public Health* 1978; 68:858-64.
18. Althaus H, Sauerwald M, Schrammeck E. Hygienische Aspekte bei der Abfallbeseitigung. *Zentralbl Bakteriell Mikrobiol Hyg [B]* 1983; 178:1-29.
19. Kalnowski G, Wiegand H, Rüdén H. Über die mikrobielle Kontamination von Abfällen aus dem Krankenhaus. *Zentralbl Bakteriell Mikrobiol Hyg [B]* 1983; 178:364-79.
20. Jager E, Xander L, Ruden H. Hospital wastes. I. Communication: microbiological investigations of hospital wastes from various wards of a big and of a smaller hospital in comparison to household refuse. *Zentralbl Hyg Umweltmed* 1989; 188:343-64.
21. Möse JR, Reinthaler F. Mikrobiologische Untersuchungen zur Kontamination von Krankenhausabfällen und Haushaltsmüll. *Zentralbl Bakteriell Mikrobiol Hyg [B]* 1985; 181:98-110.
22. Donnelly JA, Scarpino PV. Isolation, characterization and identification of microorganisms from laboratory and full-scale landfills. Cincinnati: Environmental Protection Agency, Municipal Environmental Research Laboratory, Office of Research and Development, 1984. (Publication no. (EPA) 600/2-84-119.)
23. Beck M. Buried alive. *Newsweek*. November 27, 1989:66-71, 75-6.
24. Blenkham JJ, Oakland D. Emission of viable bacteria in the exhaust flue gases from a hospital incinerator. *J Hosp Infect* 1989; 14:73-8.
25. Barba PD. Test results from bacterial sample burns from nine infectious waste incinerators. In: Mid-Atlantic Air Pollution Control Association Meeting, November 1987, Atlantic City, N.J.
26. Environmental Protection Agency. Summary of potential risk from hospital waste incineration: pathogens in air emissions and residues. Washington, D.C.: Government Printing Office, 1989.
27. Allen RJ, Brennum GR, Logue RR, Strand VA. Emission of airborne bacteria from a hospital incinerator. *J Air Pollut Control Assoc* 1989; 39:164-8.
28. Slavik N. The dilemma of medical waste incineration. *Health Facilities Management*. September 1988:22-9.
29. U.S. Congress, Office of Technology Assessment. Finding the Rx for managing medical wastes. Washington, D.C.: Government Printing Office, 1990. (OTA-0-459.)
30. Driver JH, Rogers HW, Claxton LD. Mutagenicity of combustion emissions from a biomedical waste incinerator. In: Proceedings of the 1989 Incineration Conference of the University of California, Irvine, Knoxville, Tenn., May 1-5, 1989:5.5.1-5.5.11.
31. House of Representatives, Committee on Energy and Commerce. Regulation of medical waste. Washington, D.C.: Government Printing Office, 1988. (Serial no. 100-187.)
32. Rutala WA, Weber DJ. Environmental issues and nosocomial infections. In: Farber BF, ed. *Infection control in intensive care. Clinics in critical care medicine*. Vol. 12. New York: Churchill Livingstone, 1987:131-71.
33. New York State Department of Environmental Conservation. Investigation: sources of beach washups in 1988. Albany, N.Y.: State Department of Environmental Conservation, December 1988.
34. Environmental Protection Agency. Inventory of medical waste beach washups — June–October 1988. Fairfax, Va.: ICF, March 1989.
35. O'Hara KJ. Trash on America's beaches: a national assessment. Washington, D.C.: Center for Marine Conservation, 1989.
36. Environmental Protection Agency. Medical waste management in the United States: second interim report to Congress. Washington, D.C.: Government Printing Office, 1990. (EPA/530-SW-90-087A.)
37. Recommendations for prevention of HIV transmission in health-care settings. *MMWR* 1987; 36:Suppl 2S:3-18.
38. St. Louis ME, Rauch KJ, Petersen LR, et al. Seroprevalence rates of human immunodeficiency virus infection at sentinel hospitals in the United States. *N Engl J Med* 1990; 323:213-8.
39. Lee HH, Weiss SH, Brown LS, et al. Patterns of HIV-1 and HTLV-I/II in intravenous drug abusers from the middle atlantic and central regions of the USA. *J Infect Dis* 1990; 162:347-52.
40. Slade JS, Pike EB, Eglin RP, Colbourne JS, Kurtz JB. The survival of human immunodeficiency virus in water, sewage and sea water. *Water Sci Technol* 1989; 21:55-9.
41. Resnick L, Veren K, Salahuddin SZ, Tondreau S, Markham PD. Stability and inactivation of HTLV-III/LAV under clinical and laboratory environments. *JAMA* 1986; 255:1887-91.
42. Henderson DK, Fahey BJ, Willy M, et al. Risk for occupational transmission of human immunodeficiency virus type 1 (HIV-1) associated with clinical exposures; a prospective evaluation. *Ann Intern Med* 1990; 113:740-6.

CORRESPONDENCE

UNTOWARD EFFECTS OF GAS MASKS DURING PERSIAN GULF WAR

To the Editor: During the recent Persian Gulf war, there were 18 missile attacks from western Iraq on scattered areas in Israel. The fear of chemical warheads resulted in the preventive use of gas masks by the Israeli population for variable periods after each alarm. We would like to report some of the medical complications that were associated with the wearing of gas masks.

Seven people were reported to have died of asphyxia because of their failure to remove the protective plastic seal on the gas-mask filter. Lesser degrees of transient hypoxia were noted, especially in persons with cardiopulmonary disorders. In some cases, the initial symptoms of hypoxia were erroneously interpreted by the victims as manifestations of gas poisoning and resulted in self-injections of atropine.

An 84-year-old man was admitted because of syncope that occurred repeatedly several minutes after he put on the gas mask. An extensive workup disclosed a severe stenosis (more than 85 percent) of both internal carotid arteries. Recurrent transient cerebral hypoxia in this patient resulted from compression of the stenotic carotid arteries by the lower pair of rubber straps of the gas mask.

A purpuric rash developed over the chin of a healthy 60-year-old physician 10 minutes after the removal of the gas mask, gradually disappearing within 48 hours. This "suction purpura" probably resulted from the vacuum induced by the well-sealed mask, causing extravasation of erythrocytes into the skin. Additional dermatologic complications noted in other people included recurrent facial contact urticaria and dermatographism.

The medical community should be aware of the possible side effects of the use of gas masks, ranging from minor and transient to severe and sometimes even fatal.

DAVID HUMINER, M.D., SILVIO D. PITLIK, M.D.,
ABRAHAM KATZ, M.D., ARYEH METZKER, M.D.,
AND MICHAEL DAVID, M.D.

Petah Tikvah 49 100, Israel

Beilinson Medical Center

To the Editor: An eight-year-old girl with adult-type Gaucher's disease presented at our clinic with facial purpura of acute onset. There was no history of viral illness, exposure to drugs, or similar

Letters to the Editor are considered for publication (subject to editing and abridgment), provided that they are submitted in duplicate, signed by all authors, typewritten in double spacing, and do not exceed 40 typewritten lines of manuscript text (excluding references). Submission of a letter constitutes permission for the Massachusetts Medical Society, its licensees, and its assignees to use it in the *Journal's* various editions (print, data base, and optical disk) in anthologies, revisions, and any other form or medium. Letters should not duplicate similar material being submitted or published elsewhere, and they should not contain abbreviations. Financial associations or other possible conflicts of interest should always be disclosed.

Letters referring to a recent *Journal* article must be received within six weeks of the article's publication. We are unable to provide pre-publication proofs, and unpublished material will not be returned to authors unless a stamped, self-addressed envelope is enclosed. Receipt of letters is not acknowledged, but correspondents will be notified when a decision is made.