

Revolutionary Advances in Medical Waste Management. The Sanitec® System

Richard F. Edlich, MD, PhD,¹ Lise Borel, DMD,² H. Gordon Jensen, BSCE,³ Kathryn L. Winters,⁴ William B. Long III, MD,⁵ K. Dean Gubler, DO, MPH,⁶ Ralph M. Buschbacher, MD,⁷ Daniel G. Becker, MD,⁸ Dillon E. Chang, MD,⁹ Jonathan Korngold,¹⁰ W. Randolph Chitwood, Jr., MD,¹¹ Kant Y. Lin, MD,¹² Larry S. Nichter, MD, MS,¹³ Susan Berenson RN, MS, OCN,¹⁴ L. D. Britt, MD¹⁵ & John A. Tafel, MD¹⁶

¹Distinguished Professor of Plastic Surgery, Biomedical Engineering and Emergency Medicine, University of Virginia Health System, Charlottesville, Virginia, USA; Director of Trauma Prevention, Research and Education, Trauma Specialists, LLP, Legacy Emanuel Hospital, Portland, Oregon, USA, ²Sales and Pharmaceutical Representative, West Chester, Pennsylvania, USA; ³Life Member of the American Society of Civil Engineers, Life Senior Member of the Institute of Electrical and Electronic Engineers, Oregon City, Oregon, USA; ⁴Website Manager and Senior Research Associate, Vancouver, Washington, USA; ⁵Medical Director of Trauma Specialists, LLP, Legacy Emanuel Hospital, Portland, Oregon, USA; ⁶Surgical Critical Care Director, Trauma Specialist, LLP, Legacy Emanuel Hospital, Portland, Oregon, USA; ⁷Professor and Chair Dept. of Physical Medicine and Rehabilitation, Indiana University School of Medicine, Indianapolis, Indiana, USA; ⁸Associate Professor, Director of Facial Plastic Surgery Dept of Otolaryngology-Head and Neck Surgery, University of Pennsylvania Medical Center Founder, Becker Nose and Sinus Center, LLC Sewell, New Jersey, USA; ⁹Chairman, Department of Anesthesiology, Kapiolani Medical Center for Women and Children, Honolulu, Hawaii, USA; ¹⁰Pre-Medical Student, New York, New York, USA; ¹¹Professor of Surgery; Senior Associate Vice Chancellor Health Sciences (Cardiovascular Diseases); Chief, Division of Cardiothoracic and Vascular Surgery, Brody School of Medicine/East Carolina University, Greenville, North Carolina, USA; ¹²Associate Professor of Plastic Surgery, University of Virginia Health System, Charlottesville, Virginia, USA; ¹³Pacific Center for Plastic Surgery, Huntington Beach, California, USA; ¹⁴Clinical Nurse Specialist in Integrative Medicine Certified by the American Reflexology Certification Board, Certified for Reiki Level II, Memorial Sloan Kettering Cancer Center, New York, New York, USA; ¹⁵Chairman, Brickhouse Professor of Surgery, Eastern Virginia Medical School, Norfolk, Virginia, USA; ¹⁶Physical Medicine and Rehabilitation, Livermore, Colorado, USA

* Address all correspondence to Dr. Richard F. Edlich, 22500 NE 128th Circle, Brush Prairie, WA 98606; richardedlichmd@gmail.com.

ABSTRACT: It is the purpose of this collective review to provide a detailed outline of a revolutionary medical waste disposal system that should be used in all medical centers in the world to prevent pollution of our planet from medical waste. The Sanitec® medical waste disposal system consists of the following seven components: (1) an all-weather steel enclosure of

Received March 15 2005 / Accepted August 15 2005

the waste management system, allowing it to be used inside or outside of the hospital center; (2) an automatic mechanical lift-and-load system that protects the workers from devastating back injuries; (3) a sophisticated shredding system designed for medical waste; (4) a series of air filters including the High Efficiency Particulate Air (HEPA) filter; (5) microwave disinfection of the medical waste material; (6) a waste compactor or dumpster; and (7) an onboard microprocessor.

It must be emphasized that this waste management system can be used either inside or outside the hospital. From start to finish, the Sanitec[®] Microwave Disinfection system is designed to provide process and engineering controls that assure complete disinfection and destruction, while minimizing the operator's exposure to risk. There are numerous technologic benefits to the Sanitec[®] systems, including environmental, operational, physical, and disinfection efficiency as well as waste residue disinfection. Wastes treated through the Sanitec[®] system are thoroughly disinfected, unrecognizable, and reduced in volume by approximately 80% (saving valuable landfill space and reducing hauling requirements and costs). They are acceptable in any municipal solid waste program. Sanitec[®]'s Zero Pollution Advantage is augmented by a complete range of services, including installation, startup, testing, training, maintenance, and repair, over the life of this system. The Sanitec[®] waste management system has essentially been designed to provide the best overall solution to the customer, when that customer actually looks at the total cost of dealing with the medical waste issue. The Sanitec[®] system is the right choice for healthcare and medical waste professionals around the world.

KEY WORDS: medical waste management, Sanitec[®] Industries, Clean Air Act of 1990, Microwave Disinfection System, all-weather steel enclosure, automated mechanical lift-load system, medical waste shredding system, air-filtration system, waste compactor, microprocessor, OSHA Guide to Bloodborne Pathogens, universal precautions, packaging and shipping, autoclave

I. INTRODUCTION

In 2000, Valenti¹ provided a comprehensive review of medical waste management in the world. In his report, he emphasized that hospitals and clinics in the United States generate 600,000 to 1 million tons of waste each year, and as much as 15% of it poses a potential infection hazard. He then noted that most hospitals either incinerated contaminated syringes, needles, and tissues on-site or sent them to incinerators off their grounds to insure that all pathogens are destroyed.

He then discussed regulations for medical waste incinerator emissions that were required by the Clean Air Act of 1990.² After this act was passed in 1997, it changed the economics of medical waste management. US hospitals now had to retrofit their incinerators with costly scrubbers that removed or neutralized dioxins, furans, hydrogen chloride, sulfur dioxide,

nitrogen oxide, and the heavy metals lead, cadmium, and mercury to comply with these regulations.

Although the 1990 Clean Air Act is a federal law governing the entire country, the states do considerable work to carry out the Act. For example, a state air pollution agency holds a hearing on a permit application by a power or chemical plant or fines a company for violating air pollution limits.

Under this law, the Environmental Protection Agency sets limits on how much of a pollutant can be in the air anywhere in the United States. This act ensures that all Americans have the same basic health and environmental protections. This law allows individual states to have stronger pollution controls, but states are not allowed to have weaker pollution controls than those set up by the entire country. States have to develop state implementation plans that explain how each state will do its job under the Clean Air Act. A state implementation plan is a col-

lection of regulations that each state reviews to clean up polluted areas.

Valenti¹ emphasizes that many hospitals and medical centers have found it more economical to replace on-site incinerators with ultimate alternative waste treatment technologies, primarily microwave systems, or to send waste to treatment companies that are equipped with disinfectant technologies. He then emphasizes the revolutionary advances in medical waste technology that have been made by Sanitec® Industries (Sun Valley, California). It is the purpose of this collective review to provide a detailed outline of this revolutionary medical waste disposal system, which should be used in all medical centers in the world to prevent pollution of our planet from medical waste.

The Sanitec® medical waste disposal system consists of the following seven components: (1) an all-weather steel enclosure of the waste management system, allowing it to be used inside or outside of the hospital center; (2) an automatic mechanical lift-and-load system that protects workers from devastating back injuries; (3) a sophisticated shredding system designed for medical waste; (4) a series of air filters including the High Efficiency Particulate Air (HEPA) filter; (5) microwave disinfection of the medical waste material; (6) a waste compactor or dumpster; and (7) an onboard microprocessor. It must be emphasized that this waste management system can be used either inside or outside the hospital.

I.A. All-Weather Steel Enclosure of the Waste Management System

The Sanitec® system combines advanced shredding technology with conventional microwaves to provide both complete unrecognizability and a thorough disinfection. Sanitec® units are delivered housed in an all-weather steel enclosure (Fig. 1). Systems can be installed either inside or outside and require only a single electrical main connection rated at 150 amps/480 volts, three-phase, and one water hook-up. There is no drain required because there is no water emis-



FIGURE 1. An all-weather steel enclosure of the waste management system allows it to be used either inside or outside of the hospital center.

sion. Because there are no liquid discharges, a sewer connection is not necessary. Installation generally is complete within 2 days, and units can be easily relocated to accommodate changing space requirements.

I.B. Automated Mechanical Lift-Load System

The medical waste should be placed in plastic bags whose strength shall meet or exceed the American Society for Testing Materials 165 gm drop dart strength test.³ The bags should contain some percent of recycled plastic scrap content. An automated lift-load mechanism eliminates the need to lift heavy bags (Fig. 2). Waste is brought to the unit in carts, which are then attached to the Sanitec® unit and emptied into the infeed hopper. The loading mechanism can be designed to accept a wide variety of standard cart systems.

I.C. Sophisticated Medical Waste Shredding System

The infeed hopper is sealed, and waste is ground into tiny particles by a sophisticated shredding system designed specifically for medical waste (Fig. 3).



FIGURE 2. An automatic lift-and-load system protects workers from devastating back injuries.

Grinding creates a more even waste stream that can be effectively treated at lower temperatures than used in competing systems, thereby eliminating the potentially harmful air emissions associated with other units. Shredding reduces the waste volume by 80% and renders it unrecognizable.

I.D. Air Filtration System

Air from the infeed hopper is drawn by a fan through a series of filters including a High Efficiency Particulate Air (HEPA) filter and a carbon filter to control odors (Fig. 4). Air tests performed on the system



FIGURE 4. All air is purified by a series of air filters, including the High Efficiency Particulate Air (HEPA) filter.

confirm that no harmful air emissions are released during waste processing.

I.E. Microwave Disinfection System

Waste is then picked up by a stainless steel screw conveyor, moistened with steam, and passed by a series of microwave units (Fig. 5). Microwave energy is extremely efficient at thermally treating each individual waste particle from the inside out, assuring thorough disinfection. Treatment is verified on a regular basis by challenge testing using spores of *Bacillus subtilis*.



FIGURE 3. The Sanitec® system has a sophisticated shredding system designed for medical waste.



FIGURE 5. All medical waste is subjected to microwave disinfection.

I.F. Waste Compactor or Dumpster

Treated waste is then transported outside the unit by a secondary screw conveyor and is deposited into a waste compactor or dumpster (Fig. 6). At this point, waste is considered safe for disposal in any municipal solid waste program. An optional granulator is available for further waste reduction, if desired.



I.G. Onboard Microprocessor

The entire process is controlled by an onboard microprocessor (Figs.7-8). A highly sophisticated computer program monitors the waste treatment cycle, assuring that all time and temperature parameters required for treatment are met before any waste is discharged. Continuous digital monitoring and a built-in strip chart are included to do real-time recording of the disinfection process. From start to finish, the Sanitec® Microwave Disinfection system is designed to provide process and engineering controls that assure complete disinfection and destruction while minimizing the operator's exposure to risk (Fig. 9).



FIGURES 7-8. Each Sanitec® system has an onboard microprocessor.

There are numerous technological benefits to the Sanitec® systems, including environmental, operational, physical, and disinfection efficiency and waste residue disinfection. Sanitec® systems are recognized worldwide for their environmental compatibility. Because waste is processed at relatively low

temperatures (203–212 °F), Sanitec® does not create the volatile organic compound or substance emissions commonly associated with other treatment methods (e.g., incineration, autoclaving). There are no chemicals used in any part of the process, and there are no



FIGURE 6. The Sanitec® system has a waste compactor or dumpster.



FIGURE 9. The Sanitec® system is designed to protect the operator from injury.

liquid discharges of any kind. Sanitec®'s completely automated lift-load and material handling capabilities and process and engineering controls virtually eliminate occupational exposures such as spill, lifting, and needlestick injuries associated with medical waste handling (Fig. 10). Waste can be collected and stored at the point of generation, transported, and treated using a one-container system. All treatment functions are microprocessor controlled and digitally recorded. Noise and odor are minimized through engineering control features built into the system. Sanitec® units have demonstrated an outstanding record for reliability and serviceability, with availability rates of up to 97%.

The Sanitec® system is housed in an attractive, all-weather steel enclosure and requires only standard electrical and water hook-ups to install and operate. No sewer hook-ups or boiler lines are required. Installation is generally complete within a 24–48 hour period. The footprint is a very compact 10 ft × 22 ft and is compatible with a hospital's image of cleanliness. All waste is contained within the system during



FIGURE 10. Sanitec®'s automated lift-load and handling capabilities.

processing and not subject to blowing or scattering about the treatment area. Sanitec® units treat wastes to a verifiable $6^{\log_{10}}$ reduction of bacterial spores. Sanitec®'s level of treatment exceeds all regulatory standards, including recommendations contained in the State and Territorial Association on Alternate Treatment Technologies (STA2T2) Report.

Wastes treated through the Sanitec® system are thoroughly disinfected, unrecognizable, and reduced in volume by approximately 80% (saving valuable landfill space and reducing hauling requirements and costs) (Fig. 11). They are acceptable in any municipal solid waste program. Sanitec®'s Zero Pollution Advantage is augmented by a complete range of services, including installation, startup, testing, training, maintenance, and repair, over the life of this system. The Sanitec® system is the right choice for healthcare and medical waste professionals around the world.

II. MOBILE SANITEC® TRANSPORT SYSTEM

Although many hospitals prefer to have the above Sanitec® system for medical waste disposal at the hospital, Valenti¹ emphasized that this same Sanitec® system can be placed on a truck-mounted mobile



FIGURE 11. Sanitec® treatment of medical waste disposal reduces the volume of disposable waste by 80%.

unit. SafeWaste Inc. (Charlotte, North Carolina) brings the Sanitec® process to hospitals in their home states as well as Virginia on four truck-mounted mobile units. SafeWaste's Sanitec® trucks pick up waste from almost 40 hospitals, including Carolina Medical Center in Charlotte, and even the comprehensive Fairfax Hospital (Fairfax, Virginia), and treat it on-site using each hospital's water and power connections. The company uses smaller vans to treat waste from more than 400 smaller medical facilities, including doctors' offices, rural clinics, laboratories, and veterinary clinics. SafeWaste processes nearly 10 million pounds of potentially hazardous material annually. Realizing the enormous potential of SafeWaste, with its over 700 customers and operations in Virginia, the Carolinas, and Georgia, Sanitec® completed in 2005 its acquisition of SafeWaste, to become the world's largest processor of medical waste using microwave technology. Sanitec® Industries' mobile and on-site Microwave Healthcare Waste Disinfection System™ now serves more than 1000 healthcare facilities!

III. INTELLECTUAL PROPERTY

Sanitec® Industries has two new patents pending at the US Patent Office. One is for processing medical waste while simultaneously safeguarding private patient information under the Health Insurance Information Privacy Act. The second patent involves the tracking of medical waste using radio frequency. Currently, Sanitec® uses a barcode to determine the waste's origin and weight, charging the customer by the pound for processing the waste materials.

The radio frequency identification system will be fully automated. Each waste container will have a small radio frequency identification chip attached to it with the receiver and PC mounted within the Sanitec® unit. This new system will allow its computer system to collect its information and charge the customer's account accordingly, resulting in added simplicity, tighter chain of custody, fewer man hours, and lower unit costs.

IV. DISCUSSION

On February 2, 2005, Darice G. Bailey, Chief, Waste Management Section of the State of California Health and Human Services Agency, provided a report on steam sterilization of suction canisters in all medical waste generators and off-site treatment facilities.⁴ The Department of Health Services has recently been involved in an evaluation of the efficacy of the treatment of suction canister waste by steam sterilization. The results of that evaluation suggest that in certain circumstances, the Medical Waste Management Act, Chapter 8, Section 118215 (a)(2)(D) treatment of waste must be demonstrated using a biological indicator. The law states that the indicator must be placed in the center of the waste load due to the density of the filled canister surrounded by waste if such containers are routinely part of waste loads.

Based on the preliminary testing performed on surrogate suction canister waste, it appears that the addition of solidifiers to the liquid waste present in the suction canister prevents or inhibits the resulting solidified waste from reaching optimum temperatures that ensure adequate sterilization. Therefore, it is inappropriate for solidified suction canisters to be treated by steam sterilization. The options for this waste stream would include treatment by incineration, extreme heat treatment systems such as pyrolysis and plasma arc technologies, or systems that include grinding of the waste as part of the treatment technology.

In addition, Bailey indicates that any entity performing treatment of medical waste must submit proof that the waste is being properly treated. For on-site treatment facilities, this demonstration may include testing using proper spore media or putting procedures into place such as removing the canisters from autoclaving, using canisters that do not withstand autoclave temperature conditions, or installing an engineered system that eliminates the need to dispose of filled canisters in the medical waste system. For off-site treatment facilities using steam sterilization without a grinding function, testing using proper spore media will be required unless

procedural changes are put into place to eliminate all suction canisters from the autoclave waste system. This new test requirement will obviously make it very difficult for hospital waste management systems using autoclave waste stream to gain approval by the Department of Health in the State of California as well as in other states.

The Governor of Illinois, Rod Blagojevich, has ordered the state's 11 incinerators to be shut down or he will follow through on a plan to have legislation introduced that would force them to close. With this announcement, Sanitec® Industries has plans to open a large commercial processing center in Chicago, Illinois. In preparation for the Chicago operations, Sanitec® Industries has obtained an Illinois EPA permit to transport medical waste throughout the State.

House Bill 4658R.RDS has recently passed the House of Representatives and is now pending in the US Senate. This bill recognizes that the disposal of medical waste from Veterans Administration hospitals must be environment friendly. The bill requires the Veterans Administration to make an assessment or evaluation of the methods of disposing of medical waste and an identification of which of those methods are more desirable from an environmental perspective, in that they would be least likely to result in contamination of air or water or otherwise cause future cleanup problems.

Mr. James Harkess, President of Sanitec® Industries, sees bright prospects for Sanitec® Industries outside of the United States as well. He believes that their biggest sales growth should be in off-shore markets including China, Brazil, Japan, Korea, Saudi Arabia, the United Kingdom, and the Philippines. The problem of treating of hospital wastes knows no borders.

Some 3400 French hospitals and clinics generate 700,000 metric tons of medical waste each year.¹ Approximately 140,000 metric tons of contaminated hospital waste is incinerated and, as in the United States, there are environmental concerns that the ambient metal particles this generates pose a medical hazard in their own right. Incinerating biomedical waste is further complicated at French hospitals because the incineration facilities are often remote.

In the entire country, only about 50 hospitals operate incineration plants on-site, and an additional 24 do so off-site. Facilities are authorized to burn potentially infectious waste. For these reasons, French companies are developing specific non-incineration techniques for treating biomedical wastes.

Fortunately, there have been dramatic changes in waste management in the United States since 1987 and 1988. At that time, beaches up and down the East Coast were closed due to wash-ups of needles, syringes, and other medical wastes that had not been disposed of properly. Today, we have universal precautions,⁵ OSHA blood-borne pathogen standards,⁶ new ways for packaging and shipping restrictions,⁷ and state and city regulations. Although many other countries have just come to grips with the problem, the US healthcare and commercial medical waste industries have been effectively dealing with the 600,000 tons of infectious waste generated annually. Healthcare providers have responded by training staff to identify and segregate infectious waste carefully and by moving to reusable rather than disposable products, where appropriate. The commercial market has responded by building a number of regional treatment centers to meet the needs of almost every waste generator, no matter the size or location.

Since 1990, one company has become the recognized leader in providing safe, clean, reliable waste processing systems to both the healthcare and the commercial medical waste treatment industries. Sanitec® Microwave Disinfection is now the technology of choice for mid-size and large-size healthcare hospitals and regional waste treatment facilities around the world, and this time-tested and proven system now stands ready to provide each facility with the most cost-efficient, environment-compatible solution to medical waste treatment currently available. One has to evaluate every aspect of waste generation, collection, and then ultimately treatment when choosing the device they will use. After this detailed analysis of waste management, one comes to the following conclusion. The Sanitec® waste management system has essentially been designed to provide the best overall solution to the customer, when that customer actually

looks at his/her total cost in dealing with the medical waste issue. Designed originally by an international team of experts in the field of process engineering and control, Sanitec® systems have been manufactured in West Caldwell, New Jersey, since 1990, and from that time until today, Sanitec® Industries has listened to its customers and has been responsive to many of their very specific needs by demonstrating a commitment to a clean environment, promoting worker safety, reducing liability, transforming medical waste into municipal solid waste, and significantly decreasing costs.

Sanitec® users have been awarded a number of organizational and governmental awards, including two Governor's Awards in Arizona and Illinois, for their commitment to a clean environment displayed by using microwave disinfection technology. Efficacy testing was done for the Department of Health in New York, the state with the most stringent and comprehensive evaluation standards in the US. The Sanitec® System was the first alternative technology approved for use in the state and is now approved or accepted for use in over 40 states. Most states require a separate license for alternative medical waste disposal devices. By far the most stringent is the validation process published by New York State, which requires that medical waste disposal devices be evaluated microbiologically. Researchers at Stanford University use the duck-hepatitis virus model to evaluate the instrument. They put these viruses, as well as bacteria, into small tubes, put the tubes in a bag, and then put the bags in the medical waste disposal device; at the end of the process they determine whether the viruses are alive or dead. All of the viruses and bacteria were dead using the Sanitec® technology. Consequently, the device was certified by the State of New York.

A recently completed report published by the Canadian Electrical Association notes that with operating costs in the range of 3–6 cents per pound including utilities, labor, and maintenance, Sanitec®'s cost of operation is among the lowest of all available treatment technologies and up to 24% lower than some of the leading autoclave systems.

Mobile units are also available for implementing a multifacility, shared cost solution. Sanitec® System's advanced shredding and microwaving technology has been used successfully in hospitals and commercial waste facilities since 1990. Since that time, over 200 million pounds of infectious waste have been processed through Sanitec® systems worldwide. Every month, Sanitec® users save our environment from the emissions of literally thousands of tons of hydrochloric acid, carbon monoxide, nitrous oxide, mercury, dioxin, and other pollutants that can come from medical waste incinerators.

With incineration, one has to worry about the toxic constituents that go up the smokestack, through the flying ash and bottom ash. It is very expensive equipment that needs to be controlled and maintained. When autoclaves are used, they present many of the same problems as incineration, especially when waste suction canisters are used.

V. CONCLUSION

It is the purpose of this collective review to provide a detailed outline of a revolutionary medical waste disposal system that should be used in all medical centers in the world to prevent pollution of our planet from medical waste. The Sanitec® medical waste disposal system consists of the following seven components: (1) an all-weather steel enclosure of the waste management system, allowing it to be used inside or outside of the hospital center; (2) an automatic mechanical lift-and-load system that protects workers from devastating back injuries; (3) a sophisticated shredding system designed for medical waste; (4) a series of air filters including the High Efficiency Particulate Air (HEPA) filter; (5) microwave disinfection of the medical waste material; (6) a waste compactor or dumpster; and (7) an onboard microprocessor. It must be emphasized that this waste management system can be used either inside or outside the hospital. From start to finish, the Sanitec® Microwave Disinfection system is designed to provide process and engineering controls that assure complete

disinfection and destruction while minimizing the operator's exposure to risk.

There are numerous technological benefits to the Sanitec® systems, including environmental, operational, physical, and disinfection efficiency as well as waste residue disinfection. Wastes treated through the Sanitec® system are thoroughly disinfected, unrecognizable, and reduced in volume by approximately 80% (saving valuable landfill space and reducing hauling requirements and costs). They are acceptable in any municipal solid waste program. Sanitec®'s Zero Pollution Advantage is augmented by a complete range of services, including installation, startup, testing,

training, maintenance, and repair, over the life of this system.

The Sanitec® waste management system has essentially been designed to provide the best overall solution to the customer, when that customer actually looks at the total cost of dealing with the medical waste issue. The Sanitec® system is the right choice for healthcare and medical waste professionals around the world. The Sanitec® system has been proven to be far superior to those of other hospital waste management systems, such as autoclave and incineration, protecting the healthcare facility as well as making our planet a safer place.

REFERENCES

1. Valenti N. Rx for medical waste. Microwaves, steam, hot air, and scrubbers clean up the treatment of biomedical refuse. *Mech Eng Mag* 2000, www.memagazine.org.
2. Features of the 1990 Clean Air Act. The role of the Federal Government and the role of states. US Environmental Protection Agency. Washington DC. http://www.epa.gov/oar/oaqps/peg_caa/pegcaa02.html#topic2
3. ASTM D 1709-04 Standard test methods for impact resistance of plastic film by the free-falling dart method. American Society of Testing Materials. West Conshohocken, PA.
4. Bailey DG. Steam sterilization of suction canisters. State of California Health and Human Service Agency Department of Health Services, Feb 2, 2005.
5. Centers for Disease Control and Prevention. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for post-exposure prophylaxis. *MMWR* 2001; 50 (RR11); 1-42.
6. OSHA Instruction CPL2-269 Enforcement procedure for occupational exposure to bloodborne pathogens, Standard 29CFR1910.1030, Nov 27th, 2001.
7. Environmental Protection Agency. Managing wastes: regulation, cleanup, and enforcement. <http://www.epa.gov/region4/waste/rcra/index.htm>