



HEALTH and HAZARDOUS WASTE

A Practitioner's Guide to Patients' Environmental Exposures

Volume 1, Number 2

December 1995

ARSENIC and Your Patient

Arsenic is a metal-like element found in the earth's crust. It is nearly always bound to other elements to form various inorganic and organic compounds, at different valences, and with different resultant toxicities. Generally, inorganic arsenic is more toxic to humans than organic arsenic. Inorganic arsenic is often found as the pentavalent arsenate, or the trivalent arsenite. The organic forms usually exist as monomethyl arsonic acid (MMA) or dimethyl arsinic acid (DMA). Arsenobetaine and arsenocholine, or "fish arsenic," are non-toxic derivatives of organic arsenic found in fish and shellfish. These are readily absorbed by the human body, but are also rapidly excreted.

Human health effects of arsenic:

Exposure to arsenic can occur through ingestion, inhalation, or dermal contact. The route of exposure can affect the toxicity.

Ingestion: Inorganic arsenic is an ancient poison. The most immediate effects of ingestion of high doses of inorganic arsenic include vomiting, diarrhea, and gastrointestinal hemorrhage. Death may occur from fluid loss and circulatory collapse. In other cases, death may be delayed and caused by multiple tissue injuries.

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Focus on: VINELAND CHEMICAL

Wheat Road
Vineland, N.J.

Other impacted areas:

Blackwater Branch
Maurice River
Union Lake
Delaware Bay

The health impact of this site:

Past industrial practices at this site resulted in widespread arsenic contamination of groundwater (a former source of residential domestic water), surface water, soil and sediment. There are measurable levels of arsenic at area beaches, including Alliance Beach, West End Park, and Landis Avenue Beach, but these are below levels expected to result in health effects.

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Focus on: IMPERIAL OIL

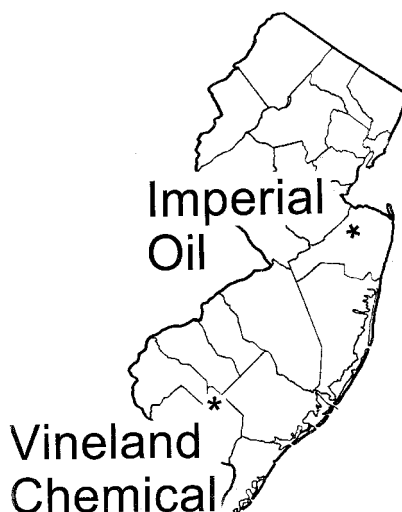
Orchard Place
Marlboro Twp.
Monmouth County, N.J.

Other impacted areas:

soils in off site areas behind the site
sediments associated with off-site surface water: Birch Swamp Brook to Lake Lefferts
soils of surrounding residential areas

The health impact of this site: Past industrial practices at this site resulted in contamination of on-site soils with petroleum hydrocarbons and other potentially hazardous substances. Years of surface water run-off has transported soils containing contamination, including arsenic, along low-lying drainage areas and the Birch Swamp Brook.

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ARSENIC and Your Patient continued

Arsenic ingestion may lead to cardiovascular effects, including altered myocardial depolarizations and cardiac arrhythmias. Long term, low-level exposure may also lead to damage of the vascular system. Arsenic contributes to Blackfoot disease, which is characterized by progressive loss of circulation in the hands and feet.

Anemia and leukopenia can occur after oral exposures to inorganic arsenic. Ingestion of inorganic arsenic can also lead to hepatic injury, resulting in a swollen and tender liver, and elevated levels of hepatic enzymes in the blood. Renal injury is usually not seen, although elevated serum levels of creatinine or bilirubin can occur.

A characteristic effect of arsenic ingestion is a pattern of skin effects, including hyperkeratosis and the formation of hyperkeratotic warts or corns on the palms and soles.

Ingestion of moderate levels of inorganic arsenic can lead to:

- **hyperkeratotic warts or corns**
- **"pins and needles" feelings in the extremities**
- **skin cancer**

Areas of hyperpigmentation and hypopigmentation on the face, neck and back are also seen.

Another commonly seen effect of inorganic arsenic ingestion is numbness in the hands and feet, which may progress to a painful "pins and needles" feeling. This occurs at intermediate and chronic exposures to low levels of arsenic. Higher levels of exposure can cause other injuries to the nervous system, including encephalopathy as evidenced by headache, lethargy, mental confusion, hallucinations, seizures and coma.

Ingestion of inorganic arsenic increases the risk of skin cancers, including multiple squamous cell carcinomas, and multiple basal cell carcinomas.

Inhalation: Inhalation of arsenic dusts can result in irritation to the mucous membranes of the nose and throat. Very high exposures can cause perforation of the nasal septum. Chronic inhalation exposure to inorganic arsenic can result in injuries to the heart or blood vessels. Inhalation of high levels of inorganic arsenic may cause nausea, vomiting and diarrhea. Peripheral neuropathy of sensory and motor neurons and frank encephalopathy can occur after inhalation of inorganic arsenic.

Dermal Exposure: The most commonly reported symptom of dermal exposure to inorganic arsenic is contact dermatitis.

There is evidence in animals that trace levels of arsenic

are necessary for health; however, this has not been reported in humans.

Potential sources of exposure: Low levels of arsenic are naturally found in all environmental media. For most people, diet is the largest source of exposure. Arsenic is found in seafood, meats and grains. Residents living near certain hazardous waste sites, metal smelters or power stations may have increased exposures to arsenic.

The largest current use of arsenic is as a wood preservative. Exposure can occur either in the manufacture or use of arsenic-treated wood, through sawing, sanding, or burning. Most of the remaining uses of arsenic are in agricultural pesticides.

Environmentally, arsenic tends to adsorb to soil or sediment. This is of special concern for children who may ingest soil containing high levels of arsenic during normal play activities.

Arsenic has been used in medicine in the treatment of syphilis, yaws, amoebic dysentery, and trypanosomiasis, as well as certain severe parasitic diseases. It is still used in some veterinary antiparasitic formulations.

Staff

Editor: Sharon Kubiak
Guest Contributor: James Pasquale, M.Ed.
Medical Reviewers: Marilyn V. Howarth, M.D.
Patricia Price, D.O.

Published quarterly by the New Jersey Department of Health, Environmental Health Services, CN 360, Trenton, NJ 08625-0360.
Telephone (609) 984-2193
FAX (609) 984-2192

Your comments, suggestions for future articles, and criticisms are welcome. Please address them to the Editor.

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ARSENIC and Your Patient continued

Toxicokinetics: Most ingested and inhaled arsenic is well absorbed into the bloodstream.

Dermal exposure can occur on contact. Absorption through this route is not well studied, but is believed to be very low.

Once absorbed, arsenic is rapidly cleared from the blood. It then accumulates in the liver, spleen, kidney, lungs, and gastrointestinal tract. Clearance from all these tissues is also rapid. Arsenic is also stored in the hair and nails, from which it is not cleared.

Most ingested or inhaled arsenic is readily absorbed into the blood. Inorganic arsenic is converted to less toxic organic forms, which are rapidly excreted.

In the blood, inorganic arsenates are converted to arsenites, and some arsenites to arsenates. Arsenites are methylated in the liver to form organic MMA and DMA. However, organic arsenic is not demethylated to form inorganic arsenic. As the arsenic dose increases, methylation becomes less efficient, with increasing retention in the soft tissues.

Arsenic is excreted in urine, generally within three days. Dimethylated arsenic is the principal metabolite, with inorganic (arsenate and arsenite) and monomethylated arsenic excreted in lesser amounts. Organic arsenicals, which undergo very little metabolism, are excreted more rapidly.

Laboratory tests:

Arsenic can be measured in the blood, urine, hair and nails. Because of its rapid elimination from the blood, blood arsenic indicates only very recent (within about 4 hours) exposure. Blood arsenic levels are useful in incidents of high exposure, but are not reliable indicators of chronic exposure to low levels.

The key test for arsenic exposure is urinary arsenic because urinary arsenic is accepted as the most reliable indicator of recent exposure. However, it is important to note that if total arsenic is measured, fish arsenic should be included. A dietary history for the past several days should be taken to ensure that fish arsenic is not a contributing factor to measured

arsenic levels. Ideally, arsenic can be speciated to distinguish arsenobetaine and arsenocholine from other organic and inorganic forms of arsenic excreted, but this is not a routine measurement.

Arsenic does accumulate in hair and nails, and can remain elevated for six to twelve months. Analysis of hair or nails requires that any arsenic adsorbed to the surface is removed by thorough washing before analysis.

Treatment and management:

Rapid stabilization with fluid and electrolyte replacement is required for patients with acute arsenic poisoning. Gastric lavage may be useful soon after an acute ingestion to prevent further absorption. Dimercaprol (BAL) is a frequently recommended chelating agent. In cases of chronic exposure, removal of the patient from the source of exposure and supportive measures are recommended. Recovery from peripheral neuropathy may take months, and is not always complete.

Biological testing for arsenic exposure includes:

- **blood for very recent exposure;**
- **urine for exposure within several days;**
- **hair and nails for exposure within six to twelve months**

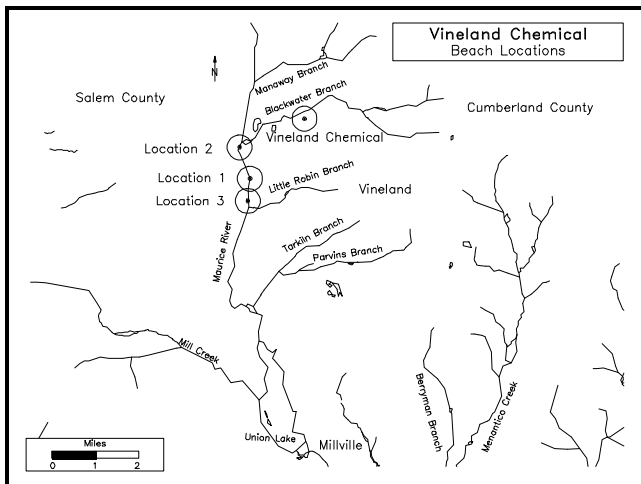
Public health significance of arsenic: Arsenic is a potent toxicant and a known human carcinogen. It has been found at numerous hazardous waste sites in New Jersey, including those highlighted in this newsletter. Exposures to arsenic at hazardous sites can include inhalation of arsenic dusts in air, ingestion of arsenic in water, food or soil, or dermal contact with contaminated water and soil.

This article is based in part on the Agency for Toxic Substances and Disease Registry's Case Study in Environmental Medicine - Arsenic Toxicity. Additional case studies include 25 individual chemicals or classes of chemicals and ionizing radiation, as well as topics such as taking an exposure history, skin lesions, and reproductive and developmental hazards. For your copies, please contact the Editor.

Focus on VINELAND CHEMICAL continued

When the site was used for pesticide manufacturing, rental housing there was available and in use by individuals and families. Area children were also permitted to access the site. It is possible that health impacts to those children, who are now adults, have occurred.

Site history: Vineland Chemical Company manufactured organic arsenic-based herbicides, pesticides and fungicides from 1950 until the early 1990's. Prior to 1977, arsenic salts were stored in open piles and in several chicken coops on the site. Water contacting the salts carried arsenic into groundwater, soil and area waterways.



Location 1: West End Park
Location 2: Alliance Beach
Location 3: Landis Avenue Beach

The company's process wastewater began undergoing treatment in 1982; however, only 35,000 gallons of water was treated per day. An additional 115,000 gallons per day were released untreated into the Blackwater Branch.

Groundwater remains contaminated to the present day. The Blackwater Branch and its sediment are highly contaminated with arsenic, and the Maurice River, Union Lake, and Delaware Bay have measurable levels of arsenic from Vineland Chemical. Clean-up plans for the next several years include:

- *decontamination of on-site soil;*
- *treatment and cleanup of groundwater;*
- *diversion of the Blackwater Branch, water treatment and sediment decontamination.*

If, after a period of several years, the Maurice River has not recovered, it, too, will require remediation.

Is your patient at risk from this site?

Your patient may be at risk if he or she:

- worked at or lived on the site during its production years
- had frequent contact with the site and its contaminants
- used contaminated well water for domestic purposes

Frequent recreational use of the Maurice River below the Blackwater Branch, or of Union Lake, may put your patient at low-level, chronic risk. Risk from usage of these beaches will continue to be evaluated annually.

Presently exposed population: The Vineland Chemical Company site is well secured, and incidental access is unlikely. It is also unlikely that there is recreational use of this portion of the Blackwater Branch. There is some arsenic exposure to people using the Maurice River and its beaches, however, including the West End Park Beach, Alliance Beach, and Landis Avenue Beach (known locally as "BA Beach"), but not at levels expected to be harmful to most residents. Additionally, there is some low-level arsenic exposure for people using the Union Lake, particularly those coming in contact with sediments. Consumption of fish may result in exposure not only to arsenic, but to mercury in much of the state.

Potential for future exposures: As site clean-up progresses, the present contamination levels in off-site waterways should decrease. Future exposures are expected to be less than present ones.

Community health concerns: Most current community health concerns relate to the presence of arsenic in recreational waterways and beaches, and consumption of fish from Union Lake and the Maurice River. Present arsenic levels in the Maurice River, Union Lake and the beaches are not likely to result in health effects to most people. Fish consumption from these waters is not recommended because of mercury levels, however. Adherence to state guidance on fishing will protect against arsenic exposure, as well.

Prevention strategies for your patient: Your patients should be encouraged to avoid excess exposure to contaminated sediments in the Maurice River, Union Lake, and their beaches. By limiting eating, drinking or smoking in these areas, your patients will have less contact with contaminants. In addition, they should not eat fish caught in these waterways.

Focus on VINELAND CHEMICAL continued

Recreational boaters in Union Lake are advised to keep speeds below 10 mph to avoid disturbing and resuspending lake sediments.

Although arsenic levels are decreasing, patients should be encouraged to avoid excessive exposure to contaminated sediments.

Other area Superfund sites: Nearby Superfund sites include: Sheildalloy Corporation, Newfield Borough, Gloucester County; Vineland State School, Vineland, Cumberland County (no longer listed as a Superfund site); South Jersey Clothing Company and Garden State Cleaners, both in Buena, Atlantic County; and Nascolite Corporation, Millville, Cumberland County.

For further information on this site: Contact the Vineland Department of Health, (609) 794-4131; the Cumberland County Health Department, 453-2150; or the New Jersey Department of Health, Environmental Health Services, at (609) 984-2193.

Additional information available from the New Jersey Department of Health on the Vineland Chemical site:

The Health Consultation for the Maurice River and Union Lake beaches is available from the Environmental Health Services Health Assessment Project at (609) 984-2193.

Each year, prior to swimming season, the Health Assessment Project will review environmental data relative to these beaches and determine the health risk to swimmers.

A fact sheet on the site is available.

Additional information available from the New Jersey Department of Health on the Imperial Oil site:

State and federal agencies will delineate the contaminants found off-site to determine the source(s) of contamination. When environmental sampling is completed, the Health Assessment Project will conduct a Health Consultation on residential exposure. It is expected that this will occur in the spring or summer of 1996.

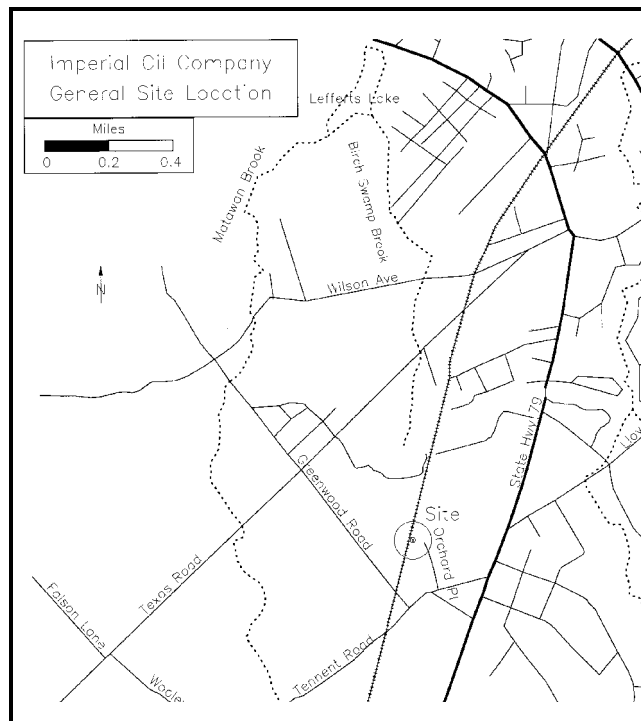
A fact sheet on the site is available.

Focus on IMPERIAL OIL continued

Although they are below levels expected to result in adverse health effects, levels of arsenic in surface water sediments along the Brook, and flood prone areas as far as Lake Lefferts in Matawan Borough (1.5 miles downstream) are measureable. Some residential soils in the area of the site have exhibited low-level arsenic contamination, although it is presently unclear whether this is associated with the site or past agricultural activities.

Site History: The Imperial Oil site has been used for industrial purposes since 1912. From 1917 to 1944, the site was occupied by the Stratford Chemical Company which manufactured calcium arsenate, considered to be the source of on-site and off-site arsenic contamination. Later occupants of the site included Champion Chemicals (1950-1969), and Imperial Oil. The activities of both companies produced waste oils, sludges and oily filter clay. As a result, on-site soils and groundwater were contaminated with hydrocarbons, metals, and polychlorinated biphenyls (PCBs).

The environmental investigation of the Imperial oil site began in 1987, and in 1991, approximately 3,700 cubic yards of contaminated soils were removed. While on-site contaminants have been characterized and remediation is underway, the New Jersey Department of Environmental Protection (NJDEP) is presently delineating low-level off-site soil contamination.



Is your patient at risk from this site?

Your patient may be at risk if he or she:

- worked at the site during its production years;
- had frequent contact with the site and its contaminants;
- had occasion to contact surface water sediments down stream of the site (children may be prone to playing in the Birch Swamp Brook); or if
- soils surrounding his or her residence are contaminated

Presently exposed population: The Imperial Oil facility and off-site contaminated areas are well secured, and incidental access is unlikely. However, the Birch Swamp Brook is not secured and access, especially by children, is possible. In addition, residential soils downstream of the site contain low levels of arsenic which could constitute a health threat under conditions of long-term exposure.

Potential for future exposures: As site clean up progresses, and off-site arsenic contamination of soils is fully characterized, the potential for future exposures will decrease. Elevated levels of arsenic are being remediated immediately to minimize human exposure.

Community health concerns: Community health concerns expressed to the New Jersey Department of Health (NJDOH) are related to the likelihood of adverse health outcomes resulting from exposure to arsenic in soils. In May 1995, the NJDOH, together with county and federal health officials, sampled the hair and urine of residents for evidence of arsenic exposure. Results of this screening indicated that exposure was not occurring at levels of public health significance.

Prevention strategies for your patients: Your patients should be encouraged to avoid contact with sediments of the Birch Swamp Brook. In addition, residents concerned about possible exposure through residential soils should limit the possibility of incidental ingestion of soils until the presence of arsenic can be verified or discounted. Arsenic is not readily absorbed through dermal contact; inhalation or ingestion of contaminated soils/dusts is the primary exposure pathway at this site. This is especially important for young children exhibiting pica behavior.

Other area superfund sites: The Burnt Fly Bog Superfund site is also located in Marlboro Township. For information regarding this site please contact the NJDOH.

For further information on this site: For further information regarding the Imperial Oil Superfund site, contact the Monmouth County Health Department at 908-431-7466, or the NJDOH, Environmental Health Services at (609) 984-2193.

For Your Reference:

The Agency for Toxic Substances and Disease Registry (ATSDR)

1600 Clifton Road, N.E., Mailstop E28
Atlanta, Georgia 30333
(404) 639-0700

Regional Office:
290 Broadway Floor 18
New York, N.Y. 10007
(212) 637-4305

This article is repeated from Volume 1, Number 1 of "Health and Hazardous Waste."

The Agency for Toxic Substances and Disease Registry (ATSDR) is one of the eight federal public health agencies which constitute the Public Health Service. ATSDR's mission is to prevent exposure, adverse human health effects and diminished quality of life associated with exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution in the environment.

To carry out its mission and to serve the needs of the public, ATSDR conducts activities in several areas.

- **Public Health Assessments:** ATSDR evaluates data on the health impacts from the release of hazardous substances into the environment; develops health advisories; and identifies actions needed to evaluate, mitigate or prevent human health effects.
- **Health Consultations** address specific requests for health risks related to a particular site, release or material.
- **Health Investigations** study the relationships between toxic substances and human health effects.

Case Studies in Environmental Medicine are a series of self-instructional monographs designed to increase the primary care provider's knowledge of hazardous substances in the environment and aid in the evaluation of potentially exposed patients. Written by physicians as case histories, they cover topics ranging from specific chemicals found at hazardous waste sites to taking an environmental exposure history.

providers materials on the effects of toxic substances on human health.

- **Exposure Registries** are established for persons exposed to particular hazardous substances in the environment.
- **Toxicological Profiles** contain data on the health effects of over 200 individual hazardous substances.
- **Applied Research:** ATSDR conducts or sponsors research on the effects of hazardous substances on human health.
- **Emergency Response:** ATSDR provides health-related support to health care providers, states and local agencies in public health emergencies involving exposure to hazardous substances.

The ATSDR, located in Atlanta, Georgia, funds activities at the New Jersey Department of Health, including health professional and community education, health assessments, and health investigations on human exposure to hazardous waste sites in New Jersey.

EVALUATION

Please circle the appropriate response and mail or fax your evaluation of this newsletter to the NJDOH. Thank you.

I found the articles useful and informative. Yes No

I will be requesting additional materials in the near future. Yes No

I will be requesting a seminar on environmental health within the year. Yes No

I would read newsletters on sites outside of my county. Yes No

Please include the following in a future issue:

ORDER FORMS FOR ENVIRONMENTAL HEALTH MATERIALS

The following is a partial list of materials available from the New Jersey Department of Health Environmental Health Services for you or your patients. You may fax (609-984-2192) or mail your request to: NJDOH, Environmental Health Services, CN 360, Trenton, N.J. 08625-0360. Please include your name and address.

___ Complete order form for EHS materials

___ A Guide to Asbestos in the Home for N.J. Residents

___ Facts on Chlorinated Solvents in Drinking Water

___ Facts on Lead in Drinking Water

___ Facts on Mercury in Drinking Water

___ Facts on Nitrate and Nitrite in Drinking Water

___ Am I Exposed to Hazardous Waste?

___ Environmental Exposures and Your Health

___ Resource Guide for Health Professionals in:

___ Cumberland County ___ Salem County
 ___ Gloucester County ___ Middlesex County
 ___ Monmouth County

ATSDR Case Studies in Environmental Medicine:

___ Taking an Exposure History
 ___ Arsenic
 ___ Complete listing of available case studies

ATSDR Fact sheets:

___ Arsenic
 ___ Complete list of available fact sheets

ATSDR Public Health Statements:

___ Arsenic
 ___ Complete list of statements

ATSDR Managing Hazardous Waste Materials Incidents:
 Medical Management Guidelines for Acute Chemical Exposures

___ Introduction
 ___ Complete list of materials covered

___ Health and Hazardous Waste newsletter Issue 1

From the New Jersey Department of Health Environmental Health Services

The N.J. Department of Health is scheduling one-hour seminars for physicians, nurses, and health care providers on hazardous waste site exposures and patient health. These seminars are approved for CME and CEU credits, and are provided at no cost. Please call the Physician Education Project at (609) 984-2193 for additional information and scheduling.

The following materials are available to health care providers from the New Jersey Department of Health Physician and Community Education Project. Please call (609) 984-2193 for copies.

For Care Providers:

Environmental Resource Guide for Health Care Professionals: A county-specific manual containing information on hazardous waste sites and resources for health professionals. These guides are presently available for Bergen, Burlington, Cumberland, Essex, Hudson, Middlesex, Passaic, and Union Counties; Camden, Monmouth and Morris are scheduled for publication in early 1996.

For Patient Education:

"Am I Exposed to Hazardous Waste?" - fact sheet assisting your patients in determining if they live near a hazardous waste site.

"Environmental Exposures and Your Health" - booklet guiding patients through the issues relating to exposures to hazardous materials in the environment and their links to illness.

"Hazardous Waste Sites and Reproductive Health" - booklet on the effects of hazardous waste site contaminants and reproductive health (available in Spring, 1996).

There is no cost, but we request your evaluation of these materials.

***Health and Hazardous Waste* is published quarterly and sent to physicians in or contiguous to the county containing the highlighted Superfund site. If you would like to receive previous or future issues, please contact the editor.**

Contents of Vol.1 No. 1: Dioxin and Your Patient; Diamond Alkali (Newark, NJ); the Agency for Toxic Substances and Disease Registry.

Volume 1 No. 3 (Spring, 1996): Ionizing Radiation; US Radium (Orange), and Welsbach and General Gas Mantle site (Camden); the Association of Occupational and Environmental Clinics

Volume 1 No. 4 (Summer, 1996): Volatile Organic Compounds (VOCs); Chemsol/Tang Realty (Piscataway)