EXECUTIVE SUMMARY

THE CHILDREN'S ENVIRONMENTAL HEALTH INSTITUTE'S SECOND BIENNIAL SCIENTIFIC SYMPOSIUM ON CHILDREN'S HEALTH AS IMPACTED BY ENVIRONMENTAL CONTAMINANTS

November 1 and 2, 2002
Brooks Air Force Base and the
United States Air Force School of Aerospace Medicine,
San Antonio, Texas

The primary sponsors of the conference were:

Children's Environmental Health Institute
National Institute of Environmental Health Sciences
Physicians for Social Responsibility
Texas Medical Association
The Public Center for Environmental Health
U.S.A.F. School of Aerospace Medicine
Brooks City-Base
Air Force Real Property Agency (a.k.a. AFBCA)

The conference planners and directors wish to express special thanks to the conference host, the San Antonio City-Base Project, the conversion of what had been a major Air Force base to an official department and function within the City of San Antonio.

The welcome and introduction were given by Fernando Guerra, MD, MPH, FAAP, Director of the San Antonio Metropolitan Health District, who emphasized that even a partial list of environmental dangers would be long, from ozone to pesticides, from lead to mold, and now from chemical to biological agents of terrorism.

Rob Amler, MD, MS, Chief Medical Officer, U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry discussed the recognition and prevention of environmental triggers of disease in children. He reviewed the principles of (1) environmental pathways and prevention of toxic exposures in children, (2) recognition of environmental triggers in clinical settings, and (3) appropriate evaluation, treatment and clinical referral practices. Dr Amler explained three principles: (1) you can't make a diagnosis you don't think of, (2) the environment, it's not just about birds and bunnies, and (3) children are not just small adults.

He illustrated how to identify common environmental disease-triggers in commonly encountered illnesses such as asthma in children. He identified information sources and reference tools available to healthcare providers in recognizing, diagnosing, and managing environmentally-triggered illnesses in children. One such source is the toxic profile series published by the Agency for Toxic Substances and Disease Registry (ATSDR). This series covers almost 300 different chemicals and includes specialized toxicology for children, developmental toxicology, and a variety of other issues. Copies are available by contacting the ATSDR Information Center by phone at 1-888-422-8737 or email at atsdric.cdc.gov.

The need for more information in the area of children's environmental health was discussed by Claudia Miller, MD, Associate Professor of Environmental and Occupational Health, University of Texas Health Science Center at San Antonio. She highlighted the need for more data about which disorders are related to which environmental exposure? She noted that many issues such as sick-building syndrome and molds fall in the cracks between a number of different agencies, and there is oftentimes a deficit of funding for research in these areas.

Martin Lorin, MD, Professor of Pediatrics, Director of the Pediatric Residency Program, Baylor College of Medicine, presented an overview of environmental threats to children's health and examined these threats from the point of view of a primary care pediatrician. He pointed out how our environment is becoming more and more dangerous, why children are especially vulnerable to environmental toxins, how to respond to questions about environmental toxins, and how to advise parents about dealing with environmental toxins.

Because infants and children are growing, they consume more food and liquid in proportion to their weight than do adults. Consequently, they are exposed to relatively more toxins in those foods and liquids. Children play on the floor, where many toxins such as pesticide are applied and other allergens and toxins deposit and accumulate. Children are always putting nonfood items into their mouths. The brain and other organs of the child are developing, and the developmental process is especial vulnerable to toxins and other environmental hazards. Governmental agencies are only now beginning to take these factors into account in setting "acceptable limits" for environmental toxins.

Allen Dearry, Ph.D., Chief of the Chemical Exposures and Molecular Biology Branch, Division of Extramural Research and Training, National Institute of Environmental Health Sciences, National Institutes of Health Centers for Children's Environmental Health and Disease Prevention Research, spoke about the role of the Centers for Children's Environmental Health and Disease Prevention Research. The NIEHS and EPA are the two agencies co-funding these children's centers, as the result of an executive order issued in 1997 for the protection of children from environmental health and safety risks. Children have different metabolic, physiologic, biochemical and developmental processes compared to adults, but most of the standards and regulations that relate exposure to health risk have been predominantly based on research and assessment of risk to adults.

The over-arching objectives of this center program are to provide for multidisciplinary interactions among basic clinical and behavioral scientists, to support a coordinated program of research and prevention, to develop programs that incorporate exposure assessment and health effects research as well as the development and validation of risk management of disease prevention strategies, and finally, to develop a national network that fosters communication and innovation and research excellence. For more information on the Children's Centers or on children's environmental health in general, check the website, www.niehs.nih.gov/translat/children.htm.

A discussion of the epidemiology of childhood cancer was presented by Melissa Bondy, PhD, Professor of Epidemiology, MD Anderson Cancer Center. Each year, about 9,000 children in the United States (about 163 per million) are diagnosed with cancer. While that doesn't seem like a lot, cancer is the second leading cause of death in children, and the number of cases of cancer in children is increasing over time. The median age for diagnosis for children is six years. Unfortunately, children are frequently diagnosed with more advanced stages of disease. Only about one in 100 adults show evidence of disease spread at diagnosis, while 80 percent of the children have evidence of metastasizes at presentation. Despite this, the good news is that the survival rate for children is outstanding; about 75 percent of children diagnosed with cancer survive their illness.

Etiology involves a gene-environment interaction, but we do not know the proportion that each plays and we do not know all the genes or all the environmental factors involved. Ionizing radiation clearly increases the cancer risk. The data for electr omagnetic fields are controversial, and I think that most of the current studies, with better exposure assessment, are showing that it doesn't seem to be a major risk factor for childhood cancers. Studies looking at parental pesticide exposures found an association with an increased risk of non-Hodgkin's lymphoma. There have been some studies suggesting that breast feeding reduces the risk of childhood leukemias, ALL and AML. It seems to, so we're talking about another reason that lactation is important. Glutathione S-transferase is a family of metabolic enzymes that can repair damage from different types of exposures, including reactive oxygen species damage related to radiation. There seems to be an association with certain alleles for this gene and an increased risk of leukemia. There are plans for a national registry for childhood cancers; each child with cancer in the United States would be entered into this registry and would be available for studies. This population-based registry would provide many research opportunities as well as more precise estimates of incidence and trends.

Lovell A. Jones, Ph.D., Professor, Gynecologic Oncology, Biochemistry and Molecular Biology; Director, Experimental Gynecology and Endocrinology; Head, Cancer Nutrition Research Group; Director, Center for Research on Minority Health, U.T. M.D. Anderson Cancer Center, presented on endocrine disruption. Dr Jones defined endocrine disruptors (ED) as substances that alter normal development or function by confusing the body's systems when they occupy an endocrine receptor, either stimulating or blocking that receptor.

While the initial concern was about estrogens, this has now been expanded to a number of other hormones, including androgens.

Dr Jones pointed out that males have female hormones and vice versa and that endocrine disruption during fetal or early infantile development can have profound and far reaching effects, including the development of cancer. He also emphasized that there are critical times in gestation when the fetus is especially vulnerable to certain EDs even in minute doses.

The Role of Air Pollutants and Environmental Factors in Childhood Asthma was reviewed by Pamela R. Wood, MD, Professor, Division of General Pediatrics, Department of Pediatrics, The University of Texas Health Science Center at San Antonio. Dr Wood reviewed the effects of ozone, nitrogen dioxide, sulfur dioxide, and suspended particular matter but focused on the role of indoor air pollutants, irritants, and allergens on respiratory diseases, particularly on asthma.

Between 1980 and 1996 we saw a tremendous increase in the prevalence of asthma. In 1997 the epidemiologic definition of asthma used by the National Health Survey changed, so it's difficult to compare data from 1997 and later with earlier data. Beginning in 1997, we separated asthma data into lifetime prevalence and symptoms within the previous year. What we do know is that since 1995 we have seen a continued increase in the number of acute care visits and clinic visits for asthma, but it seems that the rates for hospitalization and for death from asthma have stabilized. There are some particularly high risk groups including African-Americans and Puerto Rican-Americans living in large urban centers, and children less than four years of age.

Children have more difficulty because their smaller airways have less room for mucosal swelling and bronchospasm and are more easily obstructed. Children also breathe more rapidly, so for any given exposure they inhale more than an adult would on the basis of body weight, and they crawl on the floor where there are a lot of allergens and irritants that are found in carpeting and flooring.

There are basically two different types of indoor air exposures that are important -- biological and chemical exposures. Most of the biological exposures are allergens, with the exception of a few infectious agents. Regarding causation of asthma, we have strong evidence incriminating dust mite antigen and environmental tobacco smoke. There is some limited and evidence for cockroach antigen and for respiratory syncytial virus infection. In regard to exacerbations we have evidence for pet dander, for cockroach antigens, for house dust mites, and for environmental tobacco smoke in younger children. There is an association, not quite as strong, for dog, for molds, and for rhinovirus. We know that we can eliminate or significantly reduce dust mite with resultant improvement in symptomatology. For cockroach antigen, we don't have a lot of evidence either for successfully eliminating the roach or for reducing symptoms if we do eliminate it.

Laura Mitchell, PhD, Associate Professor, Institute of Biosciences and Technology; Texas A&M University Health Science Center, talked about the role of the environment and genes in the etiology of birth defects. The March of Dimes defines a birth defect as any abnormality of form or function, inherited or acquired, that is present in the prenatal or perinatal period. Birth defects occur in about 3 percent of live births in the United States, which translates into about 120,000 affected individuals born each year. Dr. Mitchell focused on structural malformations which develop early in gestation.

For the past 20 years or so, birth defects have actually been the leading cause of infant mortality in this country, accounting for more than 5,000 infant deaths each year, or about 20 percent of all the infant deaths in the country. We know that about 20 percent of all birth defects can be attributed to chromosome abnormalities. Another 5 percent can be attributed to single gene or Mendelian disorders. About 10 percent of birth defects can be attributed to specific environmental exposures, including maternal medications, substance abuse, and nutritional factors. That leaves 65 percent of cases for which we really have no clue as to the cause of the disorder.

Cleft lip, with or without cleft palate, is a relatively common birth defect, occurring in about 1 to 2 per thousand live births. About 9 percent are due to known chromosome abnormalities. Slightly less than 2 percent due to recognized syndromes, including syndromes due to known teratogens, syndromes due to known single gene disorders, and syndromes for which we don't understand the cause. About 20 percent are due to unrecognized syndromes -- individuals who have cleft lip in association with other malformations so that there's probably some underlying cause but we don't know what is. For fully 70 percent the condition is isolated, and we have no clue as to the underlying cause.

There are two known teratogenic drugs that increase the risk of cleft lip -- anti-epileptic drugs and high doses of Vitamin A or compounds like Accutane. There is emerging evidence that maternal cigarette smoking and high level maternal use of alcohol at a critical point in development can increase the risk of cleft lip. The evidence is weaker for maternal use of steroids and exposure to organic solvents and agricultural chemicals. Agents and factors on the radar screen for an association with increased risk of birth defects include pesticides, drinking water disinfection byproducts, the mycotoxin fumonisin B (found in infected corn), and proximity to hazardous waste sites. In addition to, or interacting with these environmental exposures, are several genes which have been associated with increased risk for clefting.

Jim Wild, PhD, Professor of Biochemistry, Genetics, and Toxicology, Department of Biochemistry & Biophysics, Texas A&M University, delivered the ethics session, Why not have a perfect child live a perfect life for 125 years? As we develop new genetic and other biotechnologies, how are we going to get to use these in a responsible and ethically correct manner? Are we looking at a tomorrow full of promise, or are we looking at one that's full of promises? Whom shall we trust -- the scientists, the government, the universities?

Who should set the guidelines for gene therapy in humans, genetic modification of foods and animals, use of embryonic stem cells, control of the information in the human genome project? We need to find a bioethic perspective. One of the most attractive is the Land Ethic, which basically says that a thing is right if it serves to enhance the biotic community, if it serves to improve the Earth's life at all different levels.

Donald Dudley, MD, Professor of Maternal-Fetal Medicine, University of Texas Health Science Center at San Antonio, Member, Federal Advisory Committee for the National Children's Study, spoke about the National Children's Study. The Children's Health Act of 2000 authorized the National Institute of Child Health and Human Development and a consortium of federal agencies to conduct a national longitudinal study of environmental influences on children's health and development.

This study will investigate the interaction of biologic, genetic, social, and environmental factors in disease etiology. It will be the most comprehensive study ever undertaken to examine the effects of the environment on children. With a longitudinal study design and a life stage approach, this study will include approximately 100,000 children across the U.S., identified early in pregnancy and followed through birth, childhood, and into adulthood.

The successful completion of a study of this magnitude will require well-defined scientific questions, careful integration and communication with community groups and health care providers, and a state-of-the-art data collection and management system. The planning process will emphasize strong partnerships with federal and nonfederal scientists and with community, parent, advocacy, and industry groups. This study will provide a rich national resource for study and evaluation of a wide array of child health questions and form the basis of child environmental health guidance and policy over the next generation. The goal for the working groups is to come up with eight to ten key hypotheses that could be answered by following 100,000 children over 30 years. The study hopes to start enrolling patients in 2005.

Ronald Blanck, DO, President, University of North Texas Health Science Center at Fort Worth, presented an update on bioterrorism preparedness. We need to see bioterrorism and biologic weapons in the context of weapons of mass destruction, the others being nuclear, chemical, incendiary, and conventional explosives. Bioterrorism is the intentional use of organisms or toxins against humans, animals or plants to harm, disrupt and create panic. Biologic weapons are relatively easy to get, fairly inexpensive, and can be disseminated. They're invisible and early detection is difficult. A few of the organisms that might be used include anthrax, smallpox, and pneumonic plague. The Federal Bureau of Investigation and the Federal Emergency Management Agency were charged with crisis management and with consequence management, crisis being measures to anticipate, prevent, or resolve a threat, and consequence management being measures to take care of a lot of casualties, transportation issues, food and water, etc. Subsequent to 9/11, Governor Ridge was placed in a homeland security role to provide coordination.

The first responders to a physical event are the firefighters, police officers, and emergency medical technicians. The first responders to a biological event may well be healthcare workers -- people in public health, physicians, veterinarians, and hospital microbiologists, anybody with health training who might see something unusual.

Sophie J. Balk, MD, Pediatric Academic Associates, Montefiore Medical Center, Albert Einstein College of Medicine, New York, NY, and Chair of the Committee on Environmental Health of the American Academy of Pediatrics, gave a presentation on the impact of chemical and biological terrorism on children and the role of the pediatrician in this area.

What are some of the agents that are felt to be good candidates for weaponization? Chemical agents include nerve gases such as sarin, irritants and corrosives such as chlorine, choking agents, cyanogens (including hydrogen cyanide), and CNS depressants. Biologic agents include bacterial agents such as anthrax, plague, brucella, and tularemia. Viral agents include smallpox, Ebola, and other hemorrhagic viruses. Biological toxins include Botulism toxin.

Biological weapons are called the poor man's nuclear bomb, because they can kill or injure hundreds of thousands, and they also don't require sophisticated delivery systems. Pediatricians may be the first to encounter the victims of a covert biologic attack.

Children are especially vulnerable to some of these agents. Children have an increased respiratory rate, so with aerosolized agents, such as Sarin, chlorine, and anthrax, children will receive a relatively greater dose. Children are short, so their breathing is closer to the ground, where toxicants such as Sarin tend to accumulate. They also play on the ground, possibly resulting in more exposure. Infants have a larger surface to weight ratio than adults, which can increase cutaneous exposure. For the same reason, kids lose heat more rapidly and may become hypothermic more rapidly when showered as part of contamination efforts. The skin of young infants also is thinner and possibly more permeable to some of these agents. Finally, children have unique psychological issues in regards to a real or threatened act of terrorism.

Adam Antwine, Chief, Air Force Base Conversion Agency and senior representative for the Air Force Base Conversion Agency at what was formerly Kelly Air Force Base in San Antonio, talked about the conversion of a military base to civilian use.

Kelly is the oldest Air Force base in the country, so one can imagine the kinds of activities that have occurred over that period of time. A major environmental cleanup was required in order to covert to civilian use. A jet fuel plume beneath the base was discovered in 1988, and these contaminants had migrated off the base. The primary chemicals of concern were not the jet fuel itself, but rather perchloroethylene and tetrachloroethylene, solvents that were used industrial parts cleaning.

Disease monitoring in the military was the topic presented by Kenneth L. Cox, Lt Col, USAF, MC, SFS, Brooks Air Force Base. Systems designed to monitor symptoms and diseases as a warning of bioterrorism could have a connection to chronic issues, and many of the new techniques developed in response to terrorism-related issues have helped move traditional public health surveillance forward. The Air Force Institute for Environmental Safety and Occupational Health Risk Analysis (AFIERA), an institute that is in the process of changing its name to the Air Force Institute for Operational Medicine, is concerned about the health not only of individuals but also of the environment. Being a military institute, the first focus is on war-fighting individuals, but it extends the same systems to the family members of those individuals and to the communities that surround military installations. Analyzing data is as important, and as difficult, as obtaining data.

We think of the data in terms of signals, and a lot of the mathematics in identifying meaningful blips in disease frequency is based on the techniques used in submarine warfare for distinguishing a submarine from a whale. We need to learn to sort out the noise and find the signal of interest. We need multiple data streams of data, including data from the community clinics and physician offices. These systems should be able to cover both bioterrorism and public health issues at the same time, thereby conserving our resources and getting the most for the dollar.

Sam Sanchez, R.S., Environmental Health Administrator, San Antonio Metropolitan Health District, spoke about the Public Health Center for Environmental Health, an Air Force and community partnership. The Center learned a great deal from the military about public health, in a cooperative manner with Kelly Air Force Base. The goal of the Center is to protect and enhance community health through the development of scientifically sound recommendations for environmental improvement. It is a cooperative agreement to act as consultants to our elected officials and generate solutions that would benefit the community around Kelly Air Force Base.

One issue addressed was the contamination of the shallow groundwater aquifer around the Base. The approach involved over 100 community forums, sampling the drinking water to make sure that the chemicals from the Base were not leaching into the drinking water, and testing of some of the food being produced around the Base. The goal is to offer evidence-based solutions to the community.

Laura Rasar King, MPH, CHES, Outreach Director, Environment and Health Program, Physicians for Social Responsibility, presented a vision and a plan for a nationwide health tracking network. There are tremendous gaps in our public health data. We know that more than 40 million people live within four miles of a Superfund site, twenty-five percent of community water systems don't meet EPA standards for biologic and chemical contaminants, and more than 50 percent of citizens reside where outdoor air exceeds EPA standards for airborne contaminants, and only 632 of the 80,000 chemicals used by industry must be reported to the Toxic Releases Inventory. We know that seventy percent of deaths in the United States are attributable to chronic disease.

We know that there have been increases in the rates of asthma, autism and Parkinson's disease.

Only four states report tracking autoimmune conditions. Only six states track learning disabilities. Most states don't track developmental disabilities like autism, and less than half of the nation's population is covered by a birth defects registry. Most states don't track endocrine, metabolic, or neurological disorders. We know from the National Health Interview Survey, however, that there has been an increase in the self-reporting of many of these conditions dramatically from 1986 to 1995. There are gaps in infrastructure and systems. Even when we do have systems to track chronic disease, they are not consistent. Different states track different things and are often funded by different agencies.

In 1999 the Pew Environmental Health Commission brought together scientists, doctors, business leaders, policy-makers, and others and produced a landmark report with recommendations for a nationwide tracking system. They produced a landmark report which can be downloaded from www.healthyamericans.org. Their recommendations were for the national baseline tracking of priority diseases and exposures that would use existing networks of hospitals, poison centers and public health agencies to monitor acute environmental health crises. There are basically three different types of environmental health tracking: hazard tracking measures whether or not the hazard or chemical is present in the environment, exposure tracking measures whether or not that contaminant or chemical is actually present in the body, and the third component is health outcomes tracking. These three types of data need to be linked, overlaid, and correlated.

We need the data, but we also need analysis, evaluation, and dissemination, which lead to public health action, with the goal of the improvement of the public's health. Another resource is the website at www.environhealthaction.org.

W. Randolph Daley, DVM, MPH, Centers for Disease Control and Prevention, National Center for Environmental Health, Environmental Health Tracking Branch talked about developing the nationwide environmental health-tracking network.

Surveillance is more than just collecting data. There needs to be basic research and epidemiologic studies to help us analyze the data. A tornado is an example of an environmental hazard, if a strong tornado occurs in an unpopulated desert, it is not a problem. Likewise, if a chemical exists but if it doesn't get to anyone, then we don't have exposure and we shouldn't have a health effect. Exposure can be looked at in a variety of ways, but one of the areas that we are excited about, is biomonitoring -- the measuring of constituents in blood, urine, or other biologic samples to determine the exposure level. Finally, we need to measure the health effect. Mortality is one of the easier health effects to quantify and monitor; morbidity is more difficult.

We have a lot of data sources. Vital statistics is one of the easiest to get. There's a lot of information about hospital discharge, but it's a very small part of the puzzle. We have cancer registries and birth defects registries, as well as national surveys. Outpatient surveillance is one area that is going to become more and more important. Our vision involves developing an environmental public health tracking network that looks at hazards, exposures, and health effects, integrates the data, and disseminates the knowledge. This is not going to be easy and not going to be quick. Collaboration is essential. See the website, ww.cdc.gov/nceh/gov.

The special lecture, "Dedicated to the health of children? Then call yourself an environmentalist" was given by Michael L. Fischer with the William and Flora Hewlett Foundation. Environmental health is the coming human rights challenge, and today's children are on the front line of that challenge. It is their future that we are designing for them today. They are powerless today to establish the pattern and the health of their future.

Within 40 years, the snow and ice cap on Mount Kilimanjaro, which has been there for millennia, will be gone, and the snow and ice cap on the top of the Himalayas will be reduced by more than 50 percent of where it is now. These snow and ice caps serve as the headwaters for every one of the major rivers that serves, today, half of the people on the planet, in all of Asia and South Asia, and 40 years is not a very long time from now. Life depends on water, and more than one billion people today, mostly in rural areas but also in the large urban cities of India and Pakistan, lack access to safe water. We need to be concerned with environmental justice and we need to recognize environmental racism. We need to focus on five topics: population growth, poverty, water quality, food quality, and air quality. We can tinker with everything else in the environment, but if we don't address poverty and population growth, everything else is rearranging the deck chairs on the Titanic.

Vince Torres, PE, Texas Institute for the Indoor Environment, The University of Texas at Austin, spoke about Mold Contamination in Buildings, putting the causes, pathways and health effects into perspective. Indoor mold has been making the news a lot recently, but we need to think about it from the standpoint of mold contamination. Contamination, in the context that I want to use it today, deals with a substance in a quantity or a location that causes an undesirable effect. We're never going to get rid of all mold in all buildings, but we can certainly get rid of mold contamination that is causing health effects.

When we went through our energy crisis a number of years ago, we started making buildings tight, with highly effective insulation in the walls. Putting insulation in the walls reduced the drying capability of the walls, so when these walls got wet they don’t have the ability to dry as readily as the older ones. We no longer design buildings to shed water. New construction materials do not absorb water. Brick absorbs quite a bit of water and acts as a buffer when the wall dries out.

Steel doesn't absorb water, so if you get water in a steel wall it can't go outward into the brick; it's going to soak into the chalk and paper on the inside of walls, the so-called gypsum wallboard. Now there is a place for the water to accumulate and for mold to grow. Then there's the use of HVAC (Heating Ventilation, Air Conditioning) systems in buildings. HVAC systems in buildings create cold spots. If hot, humid air makes its way into the building, and if vapor barrier aren't in the right spots, condensation will occur on those cold spots, and that provides a source of water for mold to grow. As we find new building materials or treated materials that will resist mold, we will have to deal with the chemical issues raised by these new materials. We have to deal with ventilation issues, and if we aren't able to improve the outside air, we're going to have to deal with how do we clean the air up before we bring into the buildings?

The heavy metals mercury, lead, and arsenic, was the topic of Claudia Miller, MD, MS, University of Texas Health Science Center at San Antonio. Blood levels of lead in the general population has declined significantly over the past few decades. Leaded gasoline is gone, but other sources remain. Lead can impair a child's neurological development. In dealing with a population with lead exposure, a downward shift in I.Q. of 4 points would be obvious, but if an individual lost four I.Q. points you would never know it. So it's important to think about this in public health terms.

The form of the metal makes a difference. Methyl mercury, for example, is very soluble in lipids, so it's very neurotoxic, and methyl mercury is the form of mercury that has been used in gasoline. There are major difficulties in sorting out which metals are carcinogens. For example, arsenic causes skin cancer in humans but not in animals. In animal models, lead taken orally can produce cancer, but this has never been shown in humans. There are a number of other metals, like cadmium and nickel, which we know can cause cancer. There's no known safe level for lead. They're still debating whether arsenic is a necessary nutrient, but lead definitely is not. The bottom line is that lead, arsenic, and mercury, while they're all heavy metals, all act differently and have different effects when in inorganic or organic form.

Kirby C. Donnelly, PhD, Professor and Head, Department of Environmental and Occupational Health, School of Rural Public Health, Texas A&M University System Health Science Center, College Station, Texas, spoke about the sources and pathways pf childhood exposure to pesticides. Children put soil in their mouths and are willing to handle contaminated and dangerous materials. Not only are a child's behavioral activities very different from an adult, but also the child's metabolic capabilities and immunological capabilities are very different.

In the early 1900s, we developed the organochlorines, agents like DDT and Chlordane. Most of these are now banned in the United States, but they're still in use in developing countries. Categories of organochlorines include the dichlorodiphenyl ethanes, such as DDT; the cyclodienes, such as chlordane; and the chlorinated benzenes such as hexachlorobenzene and lindane. These are used primarily to control houseflies and mosquitoes, but they have also been used on field crops and fruits and livestock.

Aldrin is used for corn pests and timber preservation, as well as for termite-proofing. Termite-proofing, incidentally, is one situation where as physicians you may see patients who were exposed in their houses.

From the organochlorines we evolved to the organophosphates and the carbamates. These were developed from nerve gases, and so they are very toxic. There are over 200 different organophosphates in use today and about 25 different carbamate insecticides. These are the primary insecticides used for agriculture and include diazinon, methyl parathion, parathion, and chlorpyrifos. The carbamates include aldicarb, carbofurans, and merthiocarb.

The most recent pesticides to see widespread use in the United States are the pyrethroids, which are naturally occurring chemicals. They entered the marketplace in 1980. By 1982 they accounted for about 30 percent of the worldwide usage, and because they are derived from botanical insecticides, people consider them to be much safer. The new botanical insecticides include nicotine and the rotenoids.
Sources of exposure include ingestion of contaminated foods, drift from agricultural fields, contact with animals, and household and garden use and misuse.

Fernando Guerra, MD, MPH, Director, San Antonio Metropolitan Health District, discussed what local public health can offer the clinician in regard to children's environmental health. Monitoring the health status of the community and investigating health problems are major responsibilities for local public health.

The surveillance process begins with the collection of data, which then needs to be analyzed, interpreted, and finally disseminated. One such system in San Antonio tracks the immunizations of all children in the city. The system is connected to schools, clinics and physicians' offices. Another essential function of public health is leading people to appropriate health resources. Data collected can also drive the allocation of resources. Another function has to do with long-term health data collection for future preparedness. Local health departments handle vital statistics, but birth and death records are managed by the state.

A final reminder was provided that physicians and clinicians have to think about all of these contaminants from the very beginning, from conception and development of the fetus, with the critical stages of development that have ultimately some very long-term consequences.