Children's Environmental Health: One Year in a Pediatric Environmental Health Specialty Unit

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Background/Objective.—As a result of an increasing desire among physicians and parents for clinical centers that can evaluate children with known or suspected exposures to environmental toxicants, a network of federally funded ''pediatric environmental health specialty units'' has recently been created. This descriptive study profiles the children seen in one unit of this program.

Setting.—A New England, university-affiliated Pediatric Environmental Health Center (PEHC).

Methods.—Review and analysis of all children seen in the PEHC in calendar year 1999.

Results.—Over the course of the year, 281 children made 863 visits to the PEHC. Presenting complaints fell into 4 major categories: new visit for management of lead intoxication (n = 248), return visit for management of lead intoxication (n = 569), new visit for evaluation of exposure to an environmental toxicant other than lead (n = 33), and return visit for the management of exposure to a non-lead toxicant (n = 13). Among those children with new visits for a non-lead toxicant, the most common chief complaints were exposure to solvent-contaminated water (n = 7), pesticide exposure (n = 6), illness associated with proximity to a hazardous waste site (n = 6), autism from suspected mercury intoxication (n = 4), and evaluation of school-induced, building-related illness (''sick school syndrome'')(n = 4). Eleven children had autism or pervasive developmental delay. Families traveled distances as great as 450 kilometers for evaluation by a pediatric environmental health clinical specialist. Every child was evaluated by a pediatrician with subspecialty training in medical toxicology. Environmental investigation of air, water, paint, dust, or land was conducted for all except 4 children (all foreign-born adoptees). Therapeutic interventions included chelation therapy, relocation to a safe environment, removal from school, and termination of chelation therapy that had been initiated by another practitioner. Third-party payors provided full reimbursement for all visits.

Conclusions.—The chief complaints of the children brought to pediatric environmental health specialty units are diverse, involving exposures to a wide range of toxicants from all environmental media (air, water, soil, and food). Parents desiring such an evaluation must often travel extensive distances, suggesting the need for a broader network of such centers. Third-party payors and health maintenance organizations are willing to provide full reimbursement for these services.

KEY WORDS: pediatric environmental health; specialty units

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Over the last decade, pediatric environmental health has become a growing public health issue. This has been driven in part by two factors: increasing recognition of the environmental pollutants capable of producing adverse physiologic effects (eg, lead, mercury, pesticides, ozone, environmental tobacco smoke, and nitrogen oxides) coupled with growing evidence that children are more susceptible than adults to the effects of these toxicants.[1] Passage of the Executive Order of 1997, designed to protect children from environmental threats,[2] and inclusion of pediatric environmental health among the *Healthy People 2010* goals[3] have further brought this pediatric issue into public health prominence.

Greater public awareness about relationships between environmental toxicants and adverse effects has led to growing parental concerns about the potential health consequences to their children after known or suspected environmental exposures. Given the limited knowledge of how certain exposures may affect children, parents, physicians, and public health agency officials are often in need of clinical information from medical experts in pediatric environmental health. To address this need, in 1998 the Agency for Toxic Substances and Disease Registry, in conjunction with the Association of Occupational and Environmental Clinics and the US Environmental Protection Agency (EPA), began establishing a national network of ''pediatric environmental health specialty units'' (PEHSUs), with the goal of placing at least one PEHSU in every EPA Region (Table 1). This federal program joins established occupational and environmental health clinics with pediatric specialists to form a novel clinical center. In many cases the pediatric specialists are toxicologists who have affiliations with a regional Poison Control Center. The overarching goals of the PEHSUs are to reduce environmental health threats to children, improve access to experts in pediatric environmental medicine, and educate health providers about pediatric environmental health issues. To meet these goals the PEHSUs, in addition to providing direct patient care, offer direct toll-free telephone access to pediatric environmental health specialists,

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Current Pediatric Environmental Health Specialty Units

Name	Academic Affiliation	Location	EPA Region
Children's Hospital Boston/Cambridge Hospital	Harvard Medical School	Boston	I
Mt. Sinai Hospital/Selikoff Occupational Health Center	Mt. Sinai Medical School	New York	II
Mid-Atlantic Center for Children's Health & the Environment	George Washington Univ.	Washington	III
Southeast Pediatric Environmental Health Specialty Unit	Emory School of Medicine/Rollins School of Public Health	Atlanta	IV
Great Lakes Center for Children's Environmental Health	Univ. of Illinois–Chicago	Chicago	V
Southwest Center for Pediatric Environmental Health	Univ. of Texas	Tyler	VI
Midwestern Regional Pediatric Environmental Health Unit	Univ. of Iowa	Iowa City	VII
Rocky Mountain Regional Pediatric Environmental Health Specialty Unit	Univ. of Colorado	Denver	VIII
Univ. of San Francisco/Univ. of California–Irvine	Univ. of California	Irvine	IX
Children's Environmental Health Center	Univ. of Washington	Seattle	X
Misericordia Hospital*	Univ. of Alberta	Edmonton, Canada	

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who provide medical consultation and engage in a range of educational activities.

In 1998, Children's Hospital Boston and the Cambridge Hospital Occupational and Environmental Health Center collaborated to create a PEHSU. The Pediatric Environmental Health Center (PEHC) of Children's Hospital Boston was a successor to the hospital's Lead and Toxicology Clinic (created in 1971). Staffed by a multidisciplinary team of specialists, the PEHC has an extensive history of evaluating children with known or suspected exposures to environmental pollutants.[4] We conducted this descriptive study to analyze the spectrum of visits to a PEHSU, in an effort to predict the likely future needs of these centers.

METHODS

All visits to the PEHC over a calendar year (1999) were reviewed and analyzed. Every child was seen by one of the authors (M.S. or A.W.). The clinical staff of the PEHC includes pediatrician toxicologists, a nurse educator, a resource specialist (who has social work and health education training), and a clinic coordinator. Intake forms created by the PEHC are used to capture information from a range of complaints in an organized manner. Patient visits are preceded by telephone contact between one of the PEHC staff and the parent so that initial information can be obtained, clinical needs anticipated, and available environmental data brought with the child to the visit.

After review of medical test results, environmental data, and relevant medical literature, causal relationships or risk assessments are formulated. In cases in which additional environmental data are needed, the PEHC works with the family and local or state health departments to conduct the appropriate tests. Follow-up visits to the PEHC are made on an as-needed basis.

RESULTS

Over the study period 281 children made 863 visits to the PEHC. Mean age was 3.3 ± 2.4 years; 50% of children were less than 2.5 years of age, whereas 1% were adolescents. Among the 281 children, 133 (47%) were female. Thirteen children had a significant pre-existing illness, including 10 with autism, 1 with pervasive developmental delay, and 1 with Down syndrome. Four were foreign-born adoptees.

Presenting complaints to the PEHC fell into 4 categories: new visits for the management of lead poisoning (n = 248), return visits for the management of lead poisoning (n = 569), new visits for the evaluation of exposure to environmental toxicants other than lead (n = 33), and return visits for exposure to non-lead toxicants (n = 13).

Among the 248 children evaluated for lead poisoning, mean age was 3.0 ± 1.7 years (range 0.5–13.2 years). Mean lead level was 18 ± 8 μg/dL (range 2–77 μg/dL). In this group, all environmental assessments and interventions, including residential lead abatement, were supervised by the municipal or state Childhood Lead Poisoning Prevention Program. Sixty-six children underwent chelation therapy in accordance with PEHC treatment protocols.

Thirty-three children made 46 visits for evaluation of known or suspected exposure to toxicants other than lead. Presenting complaints involved one of 6 toxicants or exposure media: solvents (n = 7, mean age 8.4 years), pesticides (n = 6, mean age 9.1 years), indoor air pollutants (n = 10 [mean age 11.2 years], 5 of which were assessments for ''sick school syndrome''), mercury (n = 4, mean age 6 years, all of whom had autism), contaminated land sites (n = 4, mean age 8.1 years), and ambient air pollutants (n = 2, mean age 3.3 years). Mean age of these 33 children was 8.7 ± 4.7 years, which was significantly older than those referred for lead poisoning (mean age 3.0 ± 1.7 years, $P = .001$). Two children presented with the specific complaint of possible multiple chemical sensitivities.

Diagnoses fell into one of 3 ICD-9 categories: 984.0

(exposure to organic lead compounds), 984.9 (exposure to unspecified lead compounds), and 987.8 (exposure to other specified gas, fume, or vapor).

The grant supporting the PEHSU does not provide reimbursement for patient visits or diagnostic testing; each PEHSU is responsible for establishing its own payment mechanism. As one of the Children's Hospital Boston specialty clinics, the PEHC followed the same administrative and payment structure of all clinics, with the generation of both administrative and physician bills. In 1999, 100% of visits were reimbursed by third-party payors, including Medicaid and out-of-state insurers.

Among the 33 children with the question of injury or illness from a non-lead toxicant, the determination that causal health effects were either present or anticipated were probable in 9, possible in 12, and unlikely in 12 patients.

DISCUSSION

PEHSUs were created with 5 main objectives: 1) to provide a clinical site for evaluation and management of children with environmental health issues, 2) to train the next generation of leaders in pediatric environmental health, 3) to educate health care providers about the impact of environmental exposure in children, 4) to assist federal, state, and local governments in evaluating the pubic health risks and possible outcomes of environmental disasters, and 5) to work with the Agency for Toxic Substances and Disease Registry to determine the best feasible data-collection and reporting system possible. In order to meet these goals the PEHSUs have formulated several guiding strategies: a) to create mechanisms for teaching clinicians how to take and use a pediatric environmental health history, b) to form partnerships with occupational/environmental medicine and medical toxicology training programs, providing clinical experiences in pediatric environmental health, c) to collect referral data in order to begin the process of systematic epidemiologic survey, d) to develop a series of pediatric environmental medicine teaching materials for physicians in practice as well as for physician trainees, and e) to develop the infrastructure and capacity of existing medical resources in a way that will provide clinical pediatric environmental health specialists for every child in need of such a service.

In our experience, the most common patients were those with lead poisoning. This finding undoubtedly reflects the high prevalence of lead-containing homes in New England. PEHSUs in other EPA regions are likely to have fewer children with this diagnosis. The children referred for evaluation of toxicants other than lead made up the most diverse cohort. These children had a wide range of complaints, although 60% of their visits were for one of 4 complaints: exposure to solvent-contaminated water, exposure to pesticides, autism of suspected environmental origin, and building-related illness. In both 1998 and 2000, the years before and after this analysis, the same visit pattern was present (data not shown). It is also notable that parental concerns focused on developmental delays that were either already present or could appear as a consequence of the exposure. Such prevalence parallels the increasing concern about the number of developmental neurotoxins to which children are exposed.[5] In many cases, the environmental data brought by parents was voluminous, requiring many hours of review by the PEHC team; in other cases, environmental data were inadequate, making firm conclusions difficult.

Clinical activity by PEHSUs has been supported by the provision of a toll-free telephone contact number for use by health care providers, government agencies, and parents within the region. Through these lines' callers have 24-hour access to a pediatric environmental health specialist. The Children's Hospital PEHC telephone consultation service has also been active, receiving 1160 calls in 1999 (data not shown).

The data from this descriptive analysis provide a glimpse of the spectrum of complaints that might be seen at a PEHSU. Complaints and exposures are likely to differ by geographic region. Currently the PEHSUs appear to be providing a service that primary care providers and government agencies are unable to offer, including enrollment of lead-poisoned children into chelation protocols, interpretation of abnormal laboratory tests, performance of a risk assessment based on results of environmental analyses, and investigation of childhood illnesses in which an environmental agent is suspected. With PEHSUs now established across the country, 2 clinical issues remain unresolved. First, it is unclear whether 10 centers will be sufficient to accommodate the needs of all US children. It is conceivable, if not likely, that as concerns about environmental toxicants grows and as there is greater recognition of the PEHSUs, the capacity of the centers will be exceeded. Close tracking of clinical activities will be necessary in order to determine whether additional centers are needed. A second issue is the lack of formalized training in pediatric environmental health. To address this issue, 3 clinical fellowships, funded in part by the Ambulatory Pediatric Association, have recently been established to begin a ''pipeline'' of pediatric environmental health specialists for the future.[6] A PEHSU will be the main clinical training ground for these individuals. However, a long-term plan for the creation of pediatric environmental health fellowships is urgently needed in order to assure that the clinicians likely to be needed by children in the next century are available.

In summary, pediatric environmental health issues are increasingly being recognized as important and widespread problems. Referral centers in pediatric environmental health, as exemplified by PEHSUs, can make important contributions to addressing clinical and toxicological concerns, educating practitioners, and helping to train a new generation of pediatric environmental health physicians.

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