Pb

facts about lead and pediatrics

LEAD INDUSTRIES ASSOCIATION, INC.

Introduction

Great progress has been made in the past few decades to prevent and control the absorption of lead by both adults and children. Cases of lead intoxication, or plumbism, among adults are rare today, even in lead-processing and lead-using industries where the possibility of over-exposure seems greatest.

Such improvement is the result of broadly increasing knowledge about the physiological effects of lead, of the application of proper controls and safeguards to prevent over-exposure that can bring on illness and of better diagnosis and improved treatment of plumbism. Much of this increase in knowledge has come directly from scientific research encouraged or sponsored by the Lead Industries Association, Inc. (LIA) and its members.

One vexing problem area, however, remains a challenge. That is the absorption of lead by some children, particularly in city slum areas, as a result of eating leaded paint that was applied to the interior surfaces of buildings generally 30 years or more ago.

LIA's concern with lead poisoning problems is not new. The lead industry has for several decades supported research at leading universities and hospitals on the metabolism of lead and the diagnosis and treatment of lead poisoning in an effort to bring about better understanding of the problem. The information developed from such research has been disseminated in medical and public health journals and at various symposia. Basic research on lead intoxication was reported by Dr. Joseph C. Aub et al. of Harvard University in a monograph published in 1926. In 1933 the Kettering Laboratory of Applied Physiology at the University of Cincinnati, under the direction of Dr. Robert A. Kehoe, began publishing studies on lead absorption and excretion. LIA sponsored the early investigations of childhood lead poisoning by Dr. J. Julian Chisolm, Jr. et al. of Johns Hopkins University School of Medicine, as well as research on the treatment of lead absorption by chelation. Since 1937 a number of symposia on lead poisoning have been conducted by LIA, both alone and in cooperation with such organizations as the American Industrial Hygiene Association and the American Medical Association. These conferences have been held to make available to health professionals and interested laymen the facts concerning plumbism which underlie present-day concepts of its causation, prevention, and treatment. The lead industry today continues to support research in such areas as lead in the environment, the biological basis for lead intoxication, and the normal metabolism of lead, as part of its overall research program on all aspects of the use of lead.

Support for Legislation

For many years, representatives of LIA have met and consulted with public health officials concerning the problem of childhood lead intoxication. The industry has supported legislation designed to stop the use of leaded paints in interiors of residences and on furniture, toys and other items which children might chew.

Contents

Representatives of LIA have been members of the Sectional Committee on Prevention or Control of Hazards to children since it was organized in 1953 by the American Standards Association (now known as the USA Standards Institute) under the sponsorship of the American Academy of Pediatrics. This Committee developed a standard (Z66.1), in effect since 1955, which specifies that all paints for articles such as toys, furniture and the like, and for use in interiors of dwellings, should contain no harmful quantities of lead. (1)

Childhood lead intoxication, though relatively rare in the general population, still is a problem, particularly in the underprivileged areas of large cities. It is directly traceable to the fact that a number of children, many with pica (an unnatural craving for nonfood items), pick up and eat chips of paint flaking from walls or ceilings of old buildings erected when leaded paints were used in interiors (as they no longer are), or chew on lead-painted windowsills, baseboards or other surfaces.

Prevention Needs Cooperation

The knowledge and means are at hand for controlling this problem. But complete prevention calls for cooperative efforts among many groups, including parents, social and public health workers, doctors, landlords, city officials, and public-spirited citizens.

Lead intoxication is a man-made disease, and as such is subject to complete control. To help achieve this objective, LIA has prepared this booklet especially for distribution to physicians, public health authorities, social workers, city officials and others who can help eventually achieve a solution.

Much has been done; much more remains to be done. LIA hopes this booklet, "Lead and Pediatrics," will contribute to the success of efforts aimed at preventing lead absorption by children. For additional information and recommendations, we suggest a careful reading of "Lead Poisoning in Children," by Dr. Jane S. Lin-Fu, a pamphlet (No. 452) published by the Children's Bureau of the U.S. Department of Health, Education and Welfare in 1967 (see copy enclosed). (2)

Plumbism is Preventable

The seven steps to prevention and control outlined in the box have been the basis of campaigns against childhood plumbism in a number of cities. Some of these experiences will be discussed in detail.

Physicians and public health authorities agree that lead intoxication in children is preventable. The source is known: old leaded paint in poor housing associated with poverty. There is no disputing that slum area dwellings painted many years ago with lead-bearing paint are the setting for virtually all cases of plumbism in children.

But many years of urban renewal and rehabilitation will be required before these sources of lead are eradicated. Lead problems can continue to occur in children whose parents neither keep their home free of lead paint sources nor seek medical attention until severe damage has been incurred.

Clean-up and constant alertness can prevent children getting at old paint and plaster chips. Parents can be urged into action. Peeling paint can be removed and chips cleaned up and removed from areas in which the child crawls or plays. Crumbling painted plaster and painted woodwork can be cleaned up, repaired and painted with modern interior-type paint. Parents and baby sitters must be alerted to the dangers of children chewing on lead painted surfaces.

Alertness to Symptoms

Diagnosis of lead intoxication will depend to a large degree on how hard physicians look for it. They must be alert for vague and early symptoms in children and should investigate quickly and thoroughly the child's environment and history. They should not be lulled by the fact that modern interior paints are safe; the problem results mostly from underlying paints applied indoors years ago, frequently in once fine buildings that now lie within economically deprived areas of many cities.

Seven Steps to Prevention

The problem of childhood plumbism is so clearly understood that it would seem prevention should be simple. It is not. This is because the problem is rooted in social, educational, economic, medical, technical and political factors.

Even so, a formula for prevention and control is offered; making it work will take time, patient effort, and perhaps new ideas and approaches. Some suggestions may be termed "impractical." Nonetheless, they pose a challenge to find a "practical" way of doing them.

The booklet will discuss in detail the components of this basic preventive formula which physicians, social workers, public health workers, parents and others should be aware of. The following steps are essential.

1. Alert and warn parents and others who live in dwellings which have leaded paint in interiors. As with other accidents involving children, parents (and other child caretakers) can do much to keep children from eating paint and chewing painted surfaces and can keep chips off floors and out of reach of infants. (Almost all cases occur in children 5 years old or under.)

2. Remove sources of lead that children can eat. This source is almost invariably old leaded paint on interior walls, ceilings and trim. This leaded paint must be removed or effectively covered. One city (Baltimore) reports good results from covering walls to a height of four feet with wallboard. Lead paint on woodwork should be removed. Peeling paint and old plaster should be swept from floors and scraped from walls and ceilings.

3. Take steps to keep any child suspected of eating lead from further exposure. Remove the source of lead or keep the child from the source. "From three to six months of steady lead ingestion" precedes overt symptoms in almost all cases, according to the enclosed Children's Bureau pamphlet. (2)

4. Physicians, public health nurses and others should watch for early symptoms of lead absorption—vague, nonspecific symptoms of lethargy, irritability, and stomach pains and vomiting—and proceed at once to see that appropriate tests are made.

5. Quick and accurate diagnosis prevents serious consequences. This should be done by the most modern methods to be sure whether lead ingestion has taken place, and should be based on clinical findings and supported by biochemical evidence of excessive lead absorption. Blood lead tests are considered the most reliable and accurate. Iron deficiency anemia is quite common in lead-poisoned children but not all children with this ailment turn out to have plumbism. Careful diagnosis of an ailing child's problem is essential. Lead frequently is not the cause and, if such proves true, a quite different treatment may be required.

6. Proper and careful treatment should start immediately after diagnosis of lead intoxication.

7. When a case is found, check other children in the home immediately for possible signs of lead absorption.

Some Campaign Histories

Experience shows that when well organized programs are pursued in a city the incidence of childhood plumbism can be reduced, usually after an initial rise in reported cases, and that fatalities and crippling illnesses can be greatly curtailed.

Baltimore: The long-term, intensive campaign in Baltimore is a prime example of what can be done through intelligent cooperation by all concerned. (3)

The hazard to children from old paint was first recognized by the Baltimore Health Department in 1931, and since 1935, the Health Department's Bureau of Laboratories has provided free blood lead determinations to physicians and hospitals. In 1949 a public health nurse was assigned to investigate reported instances of abnormal lead ingestion by children and to make sure that the old paint, or other source, was removed.

In 1951 the city adopted a regulation barring the use of heavily leaded paints in interiors of dwellings. A Baltimore ordinance requires a warning label on paint that contains more than 1 percent lead. The label must state that the paint contains lead, is harmful if eaten, and should not be used for interiors or for toys, cribs or other accessible, potentially hazardous surfaces.

Throughout the years the Baltimore Health Department has continued to maintain awareness of the problem through all available media. It has prepared pamphlets used by public health nurses and sanitarians in clinics and in home visits; in addition, information on lead hazards in paint has been mailed periodically to hospitals and physicians. Exhibits and other visual aids have been shown at meetings and in public buildings. Newspapers, radio and television stations, medical and public health publications, and other media have been used to inform the public of the hazards of ingestion of leaded paint by children.

Prevention Committee Organized

In order to pinpoint sources of lead paint, Baltimore's City Health Commissioner in 1957 organized a prevention committee of staff personnel directly concerned with the problem. The committee surveyed 100 blocks of dwellings and found more than 1 percent lead in paint in 70 percent of 667 dwelling units. Public health nurses collected paint scrapings from 300 homes of indigent persons and positive tests for lead were found in scrapings from 58 percent of the houses. Then action was taken to see that such paint was removed.

Five years later the committee began a pilot, "hard sell" educational program aimed at parents and others responsible for the care of children under 4 years of age living in selected areas where a high potential existed for lead intoxication from paint ingestion. The three-year program encompassed a person-to-person approach.

Painted surfaces accessible to children were inspected in the presence of the persons charged with their care. These people were instructed by the visiting sanitarian in the hazards of lead in paint and a leaflet was discussed and left for further study. When this leaflet was found to be above the educational level in the study area, a simpler version was prepared. In all, the sanitarian made five visits to each home to remind the parents of the hazards.

Morbidity-Mortality Data

The results may be seen in a 1968 pamphlet on the subject prepared by the Baltimore City Health Department which illustrates dramatically

*Official Baltimore Figures**

Child Lead Paint Poisoning 1931-1967

	CASES			DEATHS		
YEAR	TOTAL	WHITE	NONWHITE	TOTAL	WHITE	NONWHITE
TOTAL	1,111	203	908	136	46	90
1967	15	4	11	1	1	0
1966	32	2	30	1	0	1
1965	32	4	28	0	0	0
1964	45	3	42	1	0	1
1963	42	7	35	3	0	3
1962	44	3	41	1	0	1
1961	48	4	44	1	0	1
1960	53	9	44	4	1	3
1959	66	2	64	2	1	1
1958	133	17	116	10	3	7
1957	56	4	52	3	2	1
1956	48	8	40	3	1	2
1955	35	5	30	1	–	1
1954	34	8	26	3	1	2
1953	49	10	39	6	3	3
1952	29	6	23	5	2	3
1951	77	20	57	9	3	6
1950	31	2	29	2	–	2
1949	34	11	23	4	1	3
1948	31	4	27	4	1	3
1947	11	1	10	3	1	2
1946	13	7	6	4	2	2
1945	8	4	4	2	1	1
1944	9	5	4	1	–	1
1943	10	3	7	5	2	3
1942	13	1	12	5	–	5
1941	15	4	11	3	2	1
1940	12	3	9	7	–	7
1939	11	6	5	4	3	1
1938	13	9	4	6	4	2
1937	10	7	3	2	1	1
1936	19	12	7	8	4	4
1935	17	2	15	10	2	8
1934	10	4	6	6	2	4
1933	2	1	1	2	1	1
1932	2	1	1	2	1	1
1931	2	–	2	2	–	2

*"Lead Paint Poisoning in Children," pamphlet issued in 1968 by Baltimore City Health Department.

the results of a well-organized, intensive program. (4) Reproduced on the opposite page is a table from this pamphlet summarizing child lead poisoning cases in Baltimore from 1931 through 1967.

Briefly, the table shows that in 1931 two cases of lead poisoning in children were reported and both were fatal. No deaths occurred from childhood lead poisoning in 1965, which was the first year of record in which there were no deaths from this illness in Baltimore; furthermore, childhood lead poisoning cases totaled 32, the lowest since 1952.

The slight decline in case-findings from 1941 to 1945 reflects a wartime shortage of physicians. On the other hand, the sudden peak in 1958 resulted from the entry into the program of a large university hospital, plus the organization of the city prevention staff and the two lead-in-housing surveys of the previous year. Furthermore, it should be noted that the 10 deaths among 1958's 133 cases—or 7 percent of the total—were equalled only in 1935 when there were only 17 cases and the 10 deaths were over half of the total.

The experience recorded in the table shows that fatalities from lead can be reduced or prevented. It also demonstrates that in such a campaign, deaths decline as the number of cases rise, indicating improvement in speed and efficacy of treatment; and that thereafter, cases also tend to decline as prevention becomes more efficient.

Chicago: This city has been giving increasing attention to childhood plumbism in recent years. The City Board of Health has a preventive program under way and various citizens' groups also are actively involved in efforts to find and control the disease. The problem is a serious one in Chicago because of its large areas of old, rundown housing.

In the summer of 1965 residents of the East Garfield Park district organized a Citizens Committee to End Lead Poisoning (CCELP). This was done after the occurrence of several cases of lead intoxication in that area.

With the help of the American Friends Service Committee, CCELP began an educational and case-finding campaign. The City Board of Health, and later the Medical Committee for Human Rights, helped CCELP in testing urine samples obtained by high school students. Four plumbism cases were reported in the district from September through November.

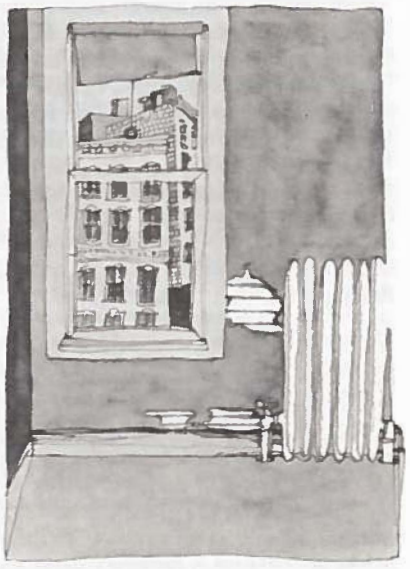
The Board of Health undertook a widespread and continuing testing program; addresses of apartments where cases were found were turned over to the City Building Commission for corrective action.

From the start of the program in 1965 through September 1966, the Board of Health tested 30,000 urine samples. The city switched to a blood lead test in October. (In February 1963, the Board had begun a urinary coproporphyrin screening program in its clinics.)

As a result of the Board's expanded screening program, there was an increase in total cases being reported, from 24 in 1957 to 304 in 1966. At the same time, there was a significant drop in the fatality rate among reported cases, from 29.2 percent in 1957 to 1.6 percent in 1966. The Health Commissioner of Chicago, Dr. Morgan J. O'Connell, reported that the number of deaths among Chicago children from lead poisoning fell to 10 in 1968 from 14 in 1967. (5)

Mass Screening Program

In August 1966 the Chicago Board of Health began a mass screening program using a blood lead test. The children screened were from 10 high-risk Urban Progress Center areas. By April 1969 approximately 90,000 children had been tested.



During 1967 a total of 27,959 children had a blood test, and of these 8.5 percent (2,379) had lead values above 50 micrograms per 100 milliliters of blood. These children were referred to a special clinic established by the Board for the diagnosis and treatment of plumbism.

Of these children, 582 (24.6 percent of the suspects) were promptly treated with chelates. Three percent of those treated were 5 years of age, 8 percent were 4 years old, and the remaining 89 percent were 1-3 years old.

As a result of this program and its educational impact in these slum areas, the average blood lead level in the same population in 1968 was markedly lower.

According to Drs. Lorry A. Blanksma, Henrietta K. Sachs and Edward F. Murray, all of the Chicago Board of Health, "Mass screening programs of blood lead determination can discover incipient intoxication weeks and probably months before the onset of encephalopathy, thus reducing the case fatality rate." (6)

Recently the Chicago Board of Health made a film on the subject of lead poisoning in children. This film, titled "To Save a Life," provides a description of the steps taken, and the specialists involved, in combatting the problem and is being used especially in neighborhoods where lead poisoning may be a problem. (7)

Other Cities: Physicians in New York are encouraged to send blood specimens on all suspected cases to city health department laboratories where there are technicians specially trained to do blood lead level analyses quickly and accurately. As a result, the number of cases reported increased from 80 in 1954 to 725 in 1968. During the same period the fatalities among reported cases declined from 15 percent (12 deaths) to less than 1 percent (five deaths) in 1968.

New York's program on lead poisoning is being enlarged under the direction of a special task force within the city health department. The de-

partment holds sessions on the problem for physicians, social workers and nurses. Literature is distributed to the public, particularly to parents in "high risk" areas, by public health nurses and sanitarians. The city also uses people who live in the high risk areas to help identify possible cases of lead intoxicated children and to provide families with firsthand information about the dangers of eating lead paint.

Reported cases of childhood lead intoxication are followed up by a public health nurse to ensure treatment and necessary follow-up. Public health sanitarians inspect premises for sources of lead, effect necessary repair and repainting, sample and analyze peeling paint for lead content, and check other places where the child may regularly spend time. (8)

The Philadelphia Department of Public Health's program has been under way since 1956, with the cooperation of realtors, landlords, various industries (including a member company of LIA) and the Society of Friends. It includes systematic investigation of all reported cases. The Department issues a checklist of possible sources of lead for use in field investigations when the source of lead ingestion isn't readily apparent. It also issues specifications and safety standards for the removal of lead paint from interiors. The Department sponsored a two-day seminar on lead poisoning in June 1967 in which representatives of the lead industry participated.

Cause and Incidence of Childhood Plumbism

Although plumbism in children is a distinct and specific problem, its control must be viewed as one aspect of protecting infants and children from other home hazards.

The National Clearinghouse, Poison Control Branch, Division of Direct Health Services, of the U.S. Public Health Service, finds that 90 percent of all reported poisoning cases involve children under the age of 5 who have eaten or drunk substances found around the house. (9) In about half the cases, these substances are medicines of one kind or another. In the other half, household products such as cleaning and polishing agents, pesticides, turpentine, petroleum products and cosmetics are involved. In 1967, for example, among all substances "most frequently ingested" by such children, paint (leaded and nonleaded) ranks 26th, and involved 1 percent of the total reported from 395 centers in 43 states. However, many lead poisoning cases are not reported to these centers, so that such figures indicate the extent of acute poisoning cases from other substances but not from lead ingestion.

Studies have shown that almost every case of childhood plumbism is related to old lead paint in old buildings, a situation found mostly in large cities, mainly those east of the Mississippi River. In Baltimore, for example, where childhood plumbism has been brought under control, early studies showed that from 50 to 70 percent of old houses in some slum sections had flaking paint that contained lead.

Housing-Plumbism Relation

The relation of housing to plumbism was shown in a home survey of preschool children in Cleveland, which has had a study and control program for years. Of 801 children living in old houses, 216 (27 percent) had abnormal lead concentrations in their urine, and 38 (4.7 percent) were already afflicted with plumbism. Of 105 children in a new housing project, only three (2.85 percent) were found to have abnormal lead concentrations in their urine and there were no cases of plumbism. (10)

In some instances, a child may ingest lead from objects such as windowsills or repainted cribs when care has not been taken to avoid lead paints. Other possible sources are rarely reported and even more rarely established. Some epidemiological studies have indicated that symptomatic lead intoxication, particularly encephalopathy, is more common in the June-September period. However, lead intoxication may occur at any time of the year, and there is no season in which physicians and other public health workers should be less alert. (11)

Plumbism also shows close family relationships. If one member of a family is found to have plumbism, all the children between 1 and 5 years of age should be carefully checked, since there is a 33 percent incidence among children living in the same household.

Most victims are between 1 and 6 years of age, with 85 percent in the 1-3 year old group, as noted on page 5 of the Children's Bureau pamphlet. (2) These toddlers often crawl about without supervision. Either as an aspect of pica, or of the oral exploration usual to children of this age, they may pick up and eat paint chips found on the floors, or chew on cribs or windowsills that were long ago covered with lead-bearing paint. Certain lead compounds are known to have a somewhat sweet taste which may accentuate the appeal to children's palates. As pointed out on page 6 of the Children's Bureau booklet (2), "from three to six months of fairly steady lead ingestion" precedes the appearance of overt symptoms in almost all patients.

The Factor of Pica

Pica, a very common precondition, is the medical term for an unnatural craving for dirt or other nonfood items. Some studies found that from 70 to 90 percent of children suffering from plumbism had a history of pica. In a New York City study, more than 30 percent of children with a diagnosis of pica were found to have lead poisoning. (11) A study of 784 Baltimore

children from underprivileged areas disclosed that nearly 22 percent had pica. (12) In most cases, pica was established as a habit by the second year but had disappeared by the fourth or fifth year.

The causes of pica are unknown despite various theories. In the present state of knowledge, it should be recognized that pica is widespread, occurs particularly often in poor families, and is a potential source of metal and other poisoning, as well as of intestinal parasites.

Dr. Chisolm of Johns Hopkins, a long-time investigator in the field of childhood plumbism, notes that historically, pica "seems to be related mainly to the relative availability of a diet adequate both in quantity and quality to the social group as a whole. Women (especially pregnant women) and young children are the members of the group most vulnerable to pica." (13)

The Emotional Environment

Dr. Chisolm also points out that the symptom of pica is most likely to occur in children with a high level of mouth activity whose oral relief of anxiety "is reinforced by cultural patterns and to whom the mothering necessary to stop it is unavailable for a variety of reasons. When such a child is exposed to hazardous environmental lead sources, the likelihood of plumbism is indeed great." (13)

Medical Aspects of Childhood Plumbism

It is not the function of this booklet to give specific medical advice, but a brief review is given of the extensive literature on plumbism which the physician may consult in the usual manner.

The diagnosis and treatment of lead intoxication in children are complex and must be placed in the hands of experienced physicians. The enclosed pamphlet by the Children's Bureau offers 37 authoritative references. (2) In addition, a bibliography of references to some works in these fields by experts is printed at the end of this booklet.

However, everyone concerned with the problem should be aware of certain findings which should arouse suspicion at once. To physicians not actively engaged in pediatrics, symptoms and signs often are so commonplace and nonspecific that initially they may be overlooked. Cases may occur without being suspected; on the other hand, there are instances of illnesses erroneously diagnosed as lead poisoning.

It is important that all physicians, public health workers and others realize there is a childhood plumbism problem in urban slum areas. Being aware of this fact should make physicians more inclined to recognize and investigate symptoms they ordinarily would not associate with lead intoxication.

Check on Chewing and Pica

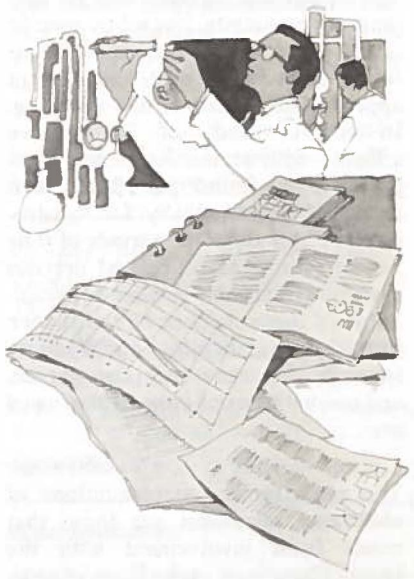
The presence of pica should especially arouse a physician's suspicions. Though most children pass through a stage of chewing on almost anything in reach, this habit should be gone by the age of 15 months and should never be of great intensity. Though the presence and history of pica is important, diagnosis should not rest on these alone. Many lead intoxicated patients have been found to have no history of pica when first examined.

A careful check should be made to determine the child's physical environment. A child with lead intoxication has almost always chewed lead painted materials, such as woodwork, plaster, wallpaper or putty, for at least three months before clinical signs appear. Though these materials themselves do not contain lead, they were often coated with leaded paint many years ago.

When a suspected case of childhood plumbism is seen, a check should be made to learn if the child lives in or frequently visits a house built before World War II. A list of "high-risk" addresses could be posted in all pediatric clinics to help physicians unfamiliar with the city. Most cities with the problem do have such areas of high risk.

Signs and Symptoms

A diagnosis of lead poisoning should be based on clinical findings and supported by biochemical evidence of excessive lead absorption, and, if possible, by evidence of unusual exposure.



There are a number of signs and symptoms which should arouse the suspicion of physicians and others, particularly if the patient lives in a slum area. They are not diagnostic by themselves, but are indications that emergency laboratory tests are required. The signs and symptoms listed below are not intended to be either definitive or exhaustive. For a thorough consideration of these sub-

jects, the physician should consult the medical literature.

The signs and symptoms of lead accumulation in children chiefly involve three organ systems: the gastrointestinal system, the central nervous system, and the hematologic system. (14)

The *gastrointestinal* symptoms are those which are most likely to be noticed first by parents and other laymen. They consist of vomiting, complaints of vague abdominal pain and constipation.

These are fairly common complaints among children, but the examining physician should be aware that plumbism may be the true underlying cause. He should also be aware that parents often are not of much help in his efforts to obtain definitive information. A survey of 300 children with confirmed cases of plumbism showed that 76 percent of them had no presenting complaints, but when specific and detailed inquiry was made, it was found that 58 percent had loss of appetite and 9 percent had vomiting. In another study of 22 children afflicted with severe lead encephalopathy, it was found that 18 had been treated symptomatically for "gastroenteritis" for different periods of time before symptoms of central nervous system involvement became apparent. Some of these children had also been treated for anemia, constipation, sugar in the urine, gait disturbance, and sudden onset of crossed or skewed eyes.

Central nervous system involvement: The most serious manifestations of childhood plumbism are those that result from involvement with the brain. These may range from drowsiness to deep unconsciousness (coma), or repeated fits (*grand mal* seizures). In some cases the first clues to the intoxication are repeated falling, clumsiness or loss of coordination. In other cases, convulsions may bring the child to medical attention. There also may be reading or behavior problems.

From the physician's point of view, there is nothing especially characteristic about the convulsions, for they may occur without fever and may be focal or generalized. However, if in the course of a few hours, the pattern of the seizures switches back and forth between right-sided, left-sided and generalized, the possibility of plumbism should be investigated. The physical examination in such cases may reveal inflammation of the optic nerve, ataxia (lack of muscular coordination), lethargy or seizures—with or without local paralysis and with or without reflex changes—and as such serves to confirm the involvement of the central nervous system but does not provide exact evidence of cause.

Hematological findings: Parents will be unable to detect changes in the blood of a possibly affected child. The physician may wish to check for anemia before asking for specific blood lead tests. Iron deficiency anemia is common in toddlers, and does not necessarily mean that the child has absorbed potentially toxic amounts of lead.

According to Dr. Chisolm, there are two groups of children involved: those with asymptomatic increased lead absorption, and those with lead poisoning. The first group, which probably contains the largest number, are children who show evidence of increased body lead burden without evidence of toxicity. The diagnosis of lead poisoning, Dr. Chisolm says, should be reserved for those children who, in addition to evidence of an increased body lead burden, also show biochemical evidence of toxicity. This latter evidence includes increased output of coproporphyrin and/or delta-aminolevulinic acid in urine.

"Some of these will show no clinical signs," Dr. Chisolm says. "Because of the nebulous nature of the clinical signs and symptoms, we should demand that patients with signs and symptoms suggestive of lead intoxication also have biochemical evidence of intoxication." (15)

Tests for Plumbism

As noted above, the presence of one or more hematological, intestinal or neurological signs or symptoms is not in itself diagnostic of pediatric lead intoxication. Laboratory tests are necessary for the physician to determine whether his patient has absorbed lead in quantities sufficient to induce illness.

By far the most reliable test for lead absorption is the quantitative determination of the lead content of the blood. Since speed is often extremely important in diagnosis of childhood plumbism so that proper treatment can be undertaken, such a test ought to be ordered immediately upon the first suspicion.

Blood lead concentrations should be interpreted with caution as these values can be affected by a number of factors such as competence and experience of laboratories and laboratory technicians, methods used in the collection and storing of samples, and possible recent administration of chelating agents.

Blood-lead concentrations of 40 to 60 micrograms per 100 milliliters of blood have been used by various agencies as the upper limit of the normal range for children. For example, the Chicago Board of Health refers all children with lead values above 50 micrograms to a special clinic for the diagnosis and treatment of lead poisoning, whereas other agencies have suggested 60 micrograms as the upper normal limit of blood lead concentrations. (11, 16, 17) There appears to be general agreement that blood-lead concentrations between 60-80 micrograms are indicative of abnormal absorption of lead, but often not of a degree of absorption which is capable of inducing symptoms of intoxication. Blood concentrations of 80 micrograms and above are considered to be potentially capable of inducing intoxication, requiring immediate action including both referral for treatment and removal of the child from the source of exposure.

Blood lead determinations are the most reliable method currently available to communities with active programs aimed at controlling childhood plumbism. According to Dr. Chisolm, a test recently developed for estimating delta-aminolevulinic acid (ALA) in urine is simple, rapid and inexpensive and may be suited for most screening if it can be shown that the concentration of ALA in random samples of urine provide sufficient discrimination between normal and lead-exposed children. However, further evaluation is necessary before it can be accepted. (Chicago Health Commissioner O'Connell says a 1967 study in that city, which is to be published, found ALA does not correlate with blood lead in screening for asymptomatic lead intoxication.)

Urine lead analyses are generally limited to usefulness in clinical research and in management of hospitalized cases because they require 24-hour collections of urine to yield useful data, says Dr. Chisolm. The edathamil calcium disodium (EDTA) mobilization test for lead also requires quantitative collection of urine and seems to be mostly useful in the study of older children suspected of having chronic plumbism, he notes. (13) (Dr. O'Connell says the EDTA mobilization test is used in all age groups in Chicago's lead clinic with urine collected for eight hours after intramuscular injection of EDTA. The test is very useful, he says.)

A recent major discussion of medical aspects is "Childhood Lead Poisoning – Comprehensive Management and Prevention," by Drs. J. Julian Chisolm and Eugene Kaplan, both of Johns Hopkins Medical School in Baltimore. Published in the December 1968 *Journal of Pediatrics* (Vol. 73, No. 6, pp. 942-950), this sums up the views and contributions of the authors and six other experts in the field who participated in a symposium held at Happy Hills Hospital in Baltimore on April 24, 1967. The symposium was held "to call attention to the need for a cooperative community approach to the social, environmental, and psychological aspects of the problem of children with lead intoxication."

Other major contributions include: "The Use of Chelating Agents in the Treatment of Acute and Chronic Lead Intoxication in Childhood," J. Julian Chisolm, Jr. in *Journal of Pediatrics* (Vol. 73, 1968); "Lead Poisoning in Childhood: Signs, Symptoms, Current Therapy, Clinical Expressions," Joseph Greengard, in *Clinical Pediatrics,* May 1966; and "Pediatric Lead Poisoning," Hugo Dunlop Smith, in *Archives of Environmental Health,* February 1964.

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For other reading on lead and pediatrics see next page.

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