Toxic Playpens

by Sasha Henriques

Pollution from lead and other heavy metals are agents of disease for many of the world's children. In Jamaica and other poor countries, the health risks associated with this kind of pollution are all too often seen as the inevitable price of economic development.

When a baby is born, mothers see the promise of infinite possibilities. But for Carol Allen, the promise turned to tears. Her first three children grew up devastated by the effects of lead poisoning caused by environmental contamination in Red Pond, on the Caribbean island of Jamaica.

In 1963 a privately owned battery supply company built a lead recovery plant in semi-rural Red Pond, 40km from the capital Kingston.

A community with hundreds of families sprang up around the factory as people came from surrounding areas looking for work. Twenty years later there were more than 2,000 residents.

Carol says, "Sometimes when they began smelting at the factory, the black cloud would cover every house in the community until you couldn't see."

Carol had three children in Red Pond. Her eldest, Gary, is now 22. When he was a boy he would play hide-and-seek in the factory yard. He's been having seizures since he was 17. And even with medication, he still has two seizures every month. Lately, his mother says, his jaw becomes dislocated every time he has a fit. The seizures are so frequent that he can't hold down a proper job.

Carol's second eldest, Nicola, is 20 this year. Nicola has seizures too. She hasn't spoken since she was three, and can no longer walk. She can't feed herself and can't control her bladder or bowel functions. She requires round-the-clock care from her mother.

Carol's second son Jovian would have been 16 this year. But he had a seizure when he was 12 on his way home from school one day. He fell into a gully by the roadside and drowned before help could arrive. "Many many children died because of lead poisoning in Red Pond. They were born with lead and died." says Carol.

During the lead recovery plant's 26 years of operation, people in the area and in other poor communities began operating their own backyard smelters.

"Progress gave us this problem," says Dr. Gerald Lalor, Director General of the International Centre for Environmental and Nuclear Sciences (ICENS) in Jamaica, whose work is supported by the IAEA and funded by the Environmental Foundation of Jamaica, the Jamaican Government, the Inter-American Development Bank, the CHASE Foundation and the University of the West Indies.

"When people realized that batteries could be recycled for profit, and how easy it was, they said 'I can do this too'," says Lalor.

Backyard smelting contaminated play areas and other places throughout the community. Children who ate the dirt, sucked their fingers, or played outside absorbed large amounts of the heavy metal.

The youngest suffer the most. "Exposure in the first two years of life plays hell with children's brains," says Lalor. Lead is a metal with no known biological benefit to humans. A direct link has been found between early exposure and extreme learning disability, hyperactivity, violence and lethargy. Too much lead in the body interferes with the normal

Nicola (centre) and Gary (right) are victims of lead poisoning, and still suffer serious health effects from exposure as young children. Their mother Carol (left) says many children have died from lead poisoning. (Photo: S.Henriques/IAEA)

Sherene Thompson (left) and her children Shane (centre) and Sasha-Gaye (right). The Thompson yard was once used for smelting lead from used car batteries. Today it's no longer a health hazard after the contaminated soil was covered. (Photo: S.Henriques/IAEA)

development of the brain, the central nervous system, the kidney and the heart.

Tip of a Lead Iceberg

Jamaica's lead exposure problems represent the tip of an iceberg, experts say. Worldwide, lead exposure is a major health hazard. The Blacksmith Institute, an environmental health group in the United States, ranks lead recycling from batteries among the world's top 10 pollution problems.

An estimated 120 million people worldwide are exposed to lead in the environment — in air, soil, water. Dangerous lead contamination is found in children in some 80 countries. In 2008, eighteen children died from lead poisoning in Dakar, Senegal.

The Blacksmith Institute estimates that over 12 million people are affected by lead contamination from processing of used lead acid batteries throughout the developing world. Battery recycling occurs in almost every city in the developing world, and even in some countries undergoing rapid transition.

The problem of unsafe unregulated recycling is exacerbated by high unemployment among the underprivileged, growing industrialisation, increasing wealth in the middle classes, which results in increased car ownership, and therefore more batteries being imported.

People are exposed to lead through informal and formal—but poorly regulated—smelting activities. Informal smelting involves breaking the batteries with an axe and disposing of the sulphuric acid. Often the battery acid, which contains some lead, is carelessly dumped on the ground, waste pile or into the nearest water body. Then the lead plates are removed from the plastic battery casing. The plates are boiled in a large metal container and impurities are siphoned off with a ladle.

World-wide, informal battery melting is done to recover and sell lead to larger processers. And despite the risks, overriding economic needs drive people to continue.

In Jamaica, some battery smelters have also resisted efforts to change their behaviour.

Head of ICENS' nuclear labs and Chief Reactor Operator, Charles Grant, says "It's purely economic; because you're explaining to them that they're doing things that are harming their children, or in one case we saw, their grandchildren. And in the other breath he'll tell you, 'That's how I make my money. This is how I put food on the table.' For them it's sometimes a case of having their children die now from starvation or die later from lead poisoning."

Retarded Development

Sasha-Gaye and Shane Thompson live in Maverly, a rundown community on the outskirts of Jamaica's bustling capital city, Kingston. When she was two years old Sasha-Gaye was admitted to the Bustamante Hospital for Children after vomiting non-stop. Three weeks later came the seizures. Then, doctors unravelled the mystery - Sasha-Gaye was poisoned by lead from a backyard smelter operated by her father.

Sasha-Gaye's mother Sherene was perplexed by the illness. "The doctors gave her medication and sent her home. But she was still having behaviour problems, acting as if she was retarded. She would just do stuff and you didn't understand why she was doing it."

During an ICENS survey of the area, the case came to researchers' attention. "That's how Sasha-Gaye started getting treatment and stopped having the problems," says Sherene.

Lead poisoning is determined by measuring the ratio of lead to blood in the human body. When Sasha-Gaye was first admitted to hospital in 1998 her blood lead level (BLL) was 130 micro grams per decilitre of blood (µg/dL), thirteen times the accepted limit, which is 10 µg/dL.

Treatment involves introducing a substance, often calcium disodium EDTA, into the body that essentially latches onto the lead in the blood. From there, the now soluble metal is passed out in urine and faeces. This process is called chelation. With regular treatment, the child's condition can improve signif-

icantly, granted there is no re-exposure to the lead source.

But five years after she was first admitted to hospital, Sasha-Gaye was back, along with Shane, her 2-year-old brother. Sasha-Gaye's BLL was 62 µg/kg, and Shane's was 135 µg/dL. Three years later in 2006, both children's readings were no better than in 2003.

"You take the lead out of the blood and the child recovers to a large extent and people used to think it was cured," says Lalor. "But we are finding several examples where two years later the blood lead is high again and the child just keeps turning up ill at hospital. That's either because the parents have not told us the truth that they have stopped working with batteries, or because the lead is leaking out of their bones and going back into their blood."

Lalor and his team have been on the environmental trail of lead and other heavy metals for more than a decade. The IAEA provides advanced testing equipment and training for these scientists.

"Monetarily our role is small," says Rick Kastens, Head of one of the two Latin America Sections in the IAEA Department of Technical Cooperation. "But the impact has been significant. It means that children like Sasha-Gaye can get treated much quicker if they are exposed to lead. Doctors know test results in a matter of hours rather than weeks because of the equipment and training we've provided."

The IAEA has provided a total reflection x-ray fluorescence unit and germanium photon detectors which are used to test for the presence of heavy metals like lead in humans and the environment.

No Quick Fix

The threat posed by lead pollution is not fully captured by its death toll or the number of those who are hospitalised. Grant says, "Lead poisoning doesn't allow children to reach their full potential as adults."

Yvonne Turner is the Principal of a preschool in a squatter settlement called Mona Commons, where lead smelting was widespread. She says her teachers noticed hyperactivity and learning difficulties in pupils who were later found to be suffering from lead poisoning.

"About four years ago my teachers and I had been noticing problems with the students who came from that area. But we didn't know what the problem was. Some of them had great difficulty learning, especially two children who lived very near to the main smelting area. You would tell them something now, and in the next few minutes they would forget what you said. When ICENS tested our students, they found that the blood lead levels of those two were higher than all the rest," says Turner.

A Problem to Remediate

More needs to be done by government and other agencies worldwide to eliminate the threat lead poses to vulnerable populations, in the view of experts at the IAEA and in the field.

"First of all, lead needs to be taken seriously. There need to be properly enforced environmental controls for factories and mines, comprehensive remediation plans for sites that are already contaminated, as well as ongoing and thorough public education," says Kastens.

Blacksmith Institute advocates that implementing the necessary interventions first require the international community to take on the responsibility of identifying all polluted places where human health is at risk, and provide resources to support the remediation of these sites because even a small smelter can contaminate a significant area. And as the market for reclaiming secondary lead grows, many developing countries have entered the business of buying used batteries in bulk in order to recycle them.

Unlike some other contaminants, lead never disappears on its own. "If it's in the blood it has to be medically removed. And if it's in the soil, the dirt has to either be dug up and dumped in a safe place or you have to concrete the entire polluted area," says Lalor.

Such basic and practical intervention is often prohibitively expensive for the very poor.

♦ ♦ ♦

In Jamaica, ICENS has been spearheading remediation of contaminated sites for the last five years. But the scientists describe it as an uphill task that requires the full force of state machinery behind it.

The communities of Hope Flats and Kintyre sprang up on the site of an old abandoned lead mine, and the local preschool was unknowingly built on top of pure mine waste. All 60 students at the school were found to be lead poisoned in 2004. Lalor says, "In certain areas like the Kintyre Basic School we simply pour concrete over sidewalks and play areas to con-

The IAEA's Role

Over the last 20 years, the IAEA has operated 32 projects in 51 countries dealing with various aspects of heavy metal pollution and the effects on humans and the environment. There are now eight projects ongoing in 25 countries.

In Kenya and seven other African countries for example, the Agency is training scientists to better use nuclear techniques to assess contamination of the marine environment around the continent.

And in Argentina, the IAEA is involved in conservation and management of natural resources by finding the source of methyl-mercury and identifying the main bioaccumulation pathways in significant lakes of Nahuel Huapi National Park.

The Agency contributes to the study of elements such as arsenic, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, tin, titanium and zinc in a variety of ways. For some Member States the IAEA provides testing equipment and training for scientists. For others, the Agency's reference materials are basic tools in quality control when new soil, plant and water samples are tested.

Testing for lead and other heavy metals in the environment and in the human body involves using the complementary techniques of neutron activation analysis (NAA), anodic stripping voltametry (ASV) and total reflection x-ray fluorescence (TXRF). The assay methods are used to determine the heavy metal composition of soils, food, water, body tissue and blood.

With NAA the material to be studied is exposed to neutrons in the core of the reactor. This causes nuclear transformations of elements in the sample, followed by radioactive decay. Each element forms radioactive nuclides which emit radiation of characteristic energy, like a "gamma fingerprint". In this way many elements, including heavy metals, can be identified and measured in the sample at the same time.

For XRF, instead of using neutrons to excite the elements in the sample, X-rays are used. Each element then de-excites by the emission of a characteristic X-ray. However, unlike NAA the samples do not remain radioactive after the process is complete.

In Jamaica, the IAEA provided a TXRF unit which is used for XRF analysis, as well as high-purity germanium photon detectors (a.k.a. gamma ray detectors) which detect the different "gamma fingerprints" being emitted by the samples under analysis.

tain the contaminating source (dirt) and protect those who interact with this environment."

But some scientists say they're being forced to become social workers, a role they're ill-equipped to handle. "In Kintyre the migration rate due to violence is just far too high. So by the time you educate persons on lead exposure, they've moved away and you have to educate another set," says researcher Kameaka Duncan.

"We really need the government to stand up and pay attention to the research that has been done because when our funding runs out there will still be children who need consistent medical attention and nutritional support," she says.

Hope Flats and Kintyre were built on top of pure toxic waste. "You can probably see why the political directorate would not want to touch it," says Blossom Anglin-Brown, Head of the University of the West Indies Health Centre, "where are they going to relocate the people to? And that's really what needs to be done."

Finding a Durable Solution

State governments aren't the only ones challenged by the prospect of handling environmental pollution problems. Only a fraction of international aid is set aside for remediation of critically polluted sites, despite the significant threat posed to human health, and despite the proven effectiveness of such intervention.

But there are steps being taken by private sector entities and international non-governmental organisations.

In Jamaica for instance, the Caribbean Recycling Company will next year begin collecting used lead acid batteries for export to Israel where both the plastic and the lead will be recycled. Co-owner Geoffrey Ziadie anticipates that 100 tonnes of batteries will be exported each month when operations begin.

Internationally, the Blacksmith Institute is working in seven countries to mitigate against lead pollution from improper recycling through education and remediation of legacy contaminated soils. The project also involves developing responsible policies for managing these batteries, and either formalizing used battery collection or providing other sources of income for the informal operators.

There are also plans for a $400 million fund dedicated to combating toxic pollution in developing countries that has resulted from industrial, mining, and military operations.

Despite increases in international aid however, the havoc wreaked by heavy metal pollution on vulnerable populations will persist in developing countries unless poverty and alternate sources of employment are addressed.

Sasha Henriques is a staff writer in the IAEA Division of Public Information. E-mail: S.Henriques@iaea.org

To hear podcast and view the photoessay of this article, visit www.iaea.org