



Case Study: Mercury Reduction in Hospitals of Ecuador and Mexico 2009-2013

This case study describes a collaborative project to reduce mercury in hospitals in Ecuador and Mexico and at the same time, to train environmental health and safety specialists and hospital staff on a process for reducing occupational and environmental hazards. The ultimate goal was to increase expertise in pollution prevention among hospital workers and enable hospitals to advance mercury reduction efforts on their own. It is hoped that the study’s findings can be useful for hospital administrators, managers, and staff, as well as occupational health and safety practitioners.

Mercury in Healthcare: Useful But Hazardous

Historically, silvery elemental mercury liquid was widely used in medical products and equipment. Elemental mercury’s inherent properties made it attractive for medical thermometers, sphygmomanometers, dental amalgam, and electrical switches. Among these are:

- Cohesive fluid
- Sensitive to small temperature variations
- Favorable properties for measuring pressure
- Good electrical conductor
- Strong, durable amalgam when combined with metal powders

However mercury is a persistent, bioaccumulative and toxic material (PBT). Exposure to elemental mercury in hospitals from spills or broken equipment, such as mercury-containing fever thermometers and blood pressure cuffs, is a serious problem for employees, patients and visitors. Waste mercury is also a concern for the global environment, as it can easily escape through the air, water and solid waste streams. Exposure to mercury is preventable through the careful choice of non-mercury medical products and through the methodical control of equipment or devices in which mercury cannot be easily eliminated.

Persistent
Long lasting
Doesn’t break down easily
Difficult to clean up
Bioaccumulative
Accumulates in tissue of organisms
Toxic
Poisonous

In many countries and regions, mercury is regulated by occupational and environmental policies including national law, standards, rules, and norms. Even if some locations do not have rigorous mercury regulations at present, they are likely to in the future as international mercury reduction efforts expand further.

Overview of the Mercury Reduction Project

The case described here is a four-year collaborative project that provided training and conducted pilot projects to reduce mercury in hospitals in Ecuador and Mexico. Financial resources for carrying out the project were provided by the U.S. EPA under Cooperative Agreement No. 83415501. The ultimate goal was to increase the capacity of hospitals to practice pollution prevention and enable them to or advance mercury reduction efforts on their own. Collaborating partners were:

- A team from the University of Massachusetts Lowell, USA. This team led and managed the project.
- The Institute for the Development of Production and the Work Environment (IFA), Quito, Ecuador. IFA conducted pilot activities in four partner hospitals in Ecuador.
- The University of Sonora (UNISON), Hermosillo, Mexico. UNISON conducted pilot activities in three partner hospitals in Mexico.

Ultimately the project strengthened pollution prevention activities in Ecuador and Mexico in multiple ways: 1.) building hospital, government, community and academic networks in each country; 2.) training environmental health specialists and hospital staff; 3.) mentoring university students who can create a new generation of pollution prevention expertise in Latin America; and 4.) developing, piloting, and publishing a workbook to guide hospitals on conducting mercury reduction in their institutions.

The workbook developed by the project team, *Eliminating Mercury in Health Care: a workbook to identify safer alternatives* (“the workbook”; also available in Spanish, *Eliminación de Mercurio en el Sector Salud: un Manual para Identificar Alternativas más Seguras*), is a comprehensive guide for hospitals, with user-friendly guidance, tools, and sample templates for replacing mercury with safer products and practices.¹ It was designed to help hospitals undertake mercury reduction on their own or continue expanding existing mercury reduction efforts, based on pilot activities in Mexico and Ecuador.

Project Methodology

The project used a participatory strategy—that is, it engaged all groups affected by the changes to be made—for mercury reduction and assessment of alternative products and practices. It considered both *environmental* and *human* safety and health. The approach recognized that a successful mercury reduction program will consider how all the pieces come together: the hospital’s policies and practices, environmental characteristics of products, and how products are selected, used, maintained, and disposed of. The buyers and users of mercury devices are key players for ensuring that necessary functions and pertinent characteristics are satisfied with any replacement products.

Mercury reduction was carried out in the partner hospitals through a series of logical steps:

1. Establishing a working group to reduce mercury use in the hospital and training hospital staff
2. Conducting a baseline assessment of the institution’s mercury policies and practices
3. Quantifying the amounts and locations of mercury in the hospital
4. Prioritizing potential actions and developing plans to reduce the use of mercury in the hospital
5. Implementing projects to reduce mercury use
6. Monitoring progress of the mercury reduction program

The following sections provide an overview of the activities conducted in Ecuador and in Mexico. It is notable that at the start of this project in 2009, mercury reduction was considerably more advanced in Mexico than in Ecuador. As a result, the activities in Ecuador differed somewhat from the activities in Mexico.

Mercury Reduction: The Experience in Ecuador

The project in Ecuador started with two hospitals in the city of Quito, each of which agreed to develop a mercury reduction pilot program. Later, a third hospital in Quito and a fourth hospital in the city of Guayaquil joined the mercury reduction effort. The mercury reduction programs had committed participation of hospital managers and staff. The project also received significant endorsement from the Ministry of Public Health and the Ministry of Environment of Ecuador. All four hospitals shared their experiences and contributed to the development of useful tools that are included in *Eliminating Mercury in Health Care: A workbook to identify safer alternatives*.

In the original two hospitals in Quito, programs were developed for a mercury reduction pilot using the six-step methodology described above. Experiences and discussions during the project refined the methodology, raised new perspectives and awareness about the risks of mercury, identified common sources of mercury, and found viable alternatives and solutions. The project especially highlighted the power of staff to implement change and protect the health of employees, patients and the environment in general.

¹ English and Spanish versions of the workbook are available online at:
<http://www.sustainableproduction.org/MercuryProject.resources.php>

Each pilot project was launched and followed a stepwise procedure under the guidance of representatives of the Institute for the Development of Production and the Work Environment (IFA) and the University of Massachusetts Lowell. In each hospital, the project began with a training session about mercury and the formation of a mercury reduction team. These hospital teams were instrumental for overseeing the identification of mercury in the hospital, prioritizing reduction efforts and evaluating alternative products and processes.

A walk-through assessment in each hospital and its departments was important for understanding the work processes, staff involvement and interactions, and opportunities for finding solutions. It should be noted that during the visits and interviews with health personnel, it became apparent that mercury thermometers were used in most of the hospitals' services and departments. Thermometer breakage was an ongoing problem that posed a threat to the health of hospital staff and patients. Although mercury spills frequently occurred, there were no policies or established protocols for spill cleanup or to prevent exposure to mercury vapors. Findings of the walk-through assessment were discussed in subsequent training sessions.

During visits to one hospital, the mercury project team found non-mercury digital thermometers on site. Although several hundred digital thermometers were stored in a hospital warehouse, they were not in use and the clinical staff was unaware of their availability. This is important in two important ways: First, the existence of digital thermometers shows that it is possible to have alternatives to mercury thermometers, regardless of cost (which is still very high). Second, it shows that the purchase of mercury-free devices alone does not insure they will be used. For successful adoption of new products and practices, health personnel (supervisors, medical assistants and nurses) must participate in the careful evaluation of alternatives. These clinicians understand the conditions under which the devices are used and must be confident that the devices are reliable and can uphold the hospital's delivery of high quality health services. Use of a participatory methodology with its ongoing evaluation of alternatives was instrumental for mercury reduction.

In the case of blood pressure cuffs, mercury sphygmomanometers (typically called "tensiometers" in Ecuador) were still mounted on the walls in some areas, but newer non-mercury tensiometers were also in use. This reflected in part that non-mercury tensiometers are comparable in cost and easy to maintain. Mercury tensiometer maintenance poses risks to health and the environment, as it includes refilling the glass column with liquid mercury. This activity is unacceptable; it not only exposes maintenance workers to mercury, but it also requires the purchase of liquid mercury despite knowing that there is no mechanism for safe handling or disposal of mercury waste. Since the mercury project began, the re-filling of mercury tensiometers has stopped.

Walk-through assessments revealed that mercury amalgams are still used in the dental clinics, either through mixing of bulk liquid mercury and metal powders or as single-use mercury-containing amalgam capsules. The use of resins as a restorative material, an alternative to mercury, was also observed in the clinics.

In storage areas, it was surprising to find large quantities of liquid mercury which were reported to be donations from private foundations for use in the dental clinic. No one knew the identity of the foundations. A review of the product labels revealed that the origin was unclear. The company and address on the labels did not appear to exist and could not be verified, which also prevented return of the mercury. The assessment revealed that large quantities of mercury stored in warehouses are a significant problem for hospitals. Likewise, the transfer of toxic substances to the hospital under the guise of humanitarian donations raises concerns.

Quantifying baseline inventories of mercury in the hospitals allowed prioritizing targets for mercury reduction. Thermometers and liquid mercury (purchased and donated) were identified as two major sources of mercury warranting attention. Alternatives for mercury thermometers were identified, evaluated, and implemented in clinical areas. Health personnel strongly supported the effort to introduce mercury-free products because they saw it as a means to protect their own health and provide better care to patients. Many of the products evaluated are now routinely used in the hospitals.

These methods used here have provided a framework for systematically reducing mercury in hospitals in Ecuador. This protects the health of hospital personnel and patients and the environment as a whole. The methodology was demonstrated to be successful in the two initial pilot projects in Quito hospitals, as judged by the hospitals' success in

introducing products and practices that significantly reduced the use of mercury throughout their institutions. Two additional hospitals, in Quito and Guayaquil, also successfully launched mercury reduction projects with the assistance of IFA and the University of Massachusetts Lowell, using the workbook and leveraging the success of the first two hospitals. The Ministry of Public Health and the Pan American Health Organization (PAHO) have initiated a national program to reduce mercury in public hospitals throughout Ecuador, using the workbook. This is an important demonstration that the methodology used here is a valid one for hospitals and other organizations to advance their own mercury reduction programs.

Much effort is needed to achieve mercury-free hospitals in Ecuador. No doubt this has been a powerful starting point for hospitals to take action and for encouraging others to identify and adopt safer alternatives to toxic mercury. At the start of the project, no one in the hospitals was aware of the problem with mercury. Once the program was initiated, mercury became a routine topic of conversation and one would even hear discussions about reducing mercury in the corridors. This seemingly small detail reflects a larger cultural change in progress.

Mercury Reduction: The Experience in Mexico

The mercury reduction program in Hermosillo, Mexico began with two hospitals in and was later joined by a third hospital. The three institutions are public tertiary health hospitals, with 206 beds, 215 beds and 145 beds respectively, and serve as teaching hospitals. From the outset, the project received strong support from the Ministry of Health of the State of Sonora and the Ministry of Environment and Natural Resources (SEMARNAT). The achievements and success were made possible thanks to the interest, support and work of managers and staff of the pilot hospitals. The activities took place under the auspices of cooperative agreements between the participating institutions and the University of Sonora (UNISON).

An important factor in the project was collaboration and international support, through technical assistance and exchange of experiences from hospitals in the United States and Ecuador, as well as the involvement of higher education institutions. Engaging UNISON undergraduate and graduate students as social service providers offered the dual benefit of training the next generation of occupational health professionals while simultaneously providing in-kind resources for the project.

The methodology described earlier (see page 2) was applied in the three hospitals. It is noteworthy that the hospitals had previously begun to reduce mercury in their facilities and had made some progress. Our project offered the opportunity to help identify what mercury products were still being purchased and used, such as thermometers, sphygmomanometers, and other mercury-containing products, and to assist with the evaluation and implementation of alternatives. Therefore this project was presented as an opportunity to strengthen and unify efforts to achieve further progress by using a systematic methodology. The following is a brief overview of the findings, challenges, and major accomplishments.

Developing Capacity in the Organization

An early step for each hospital was the formation of working groups, as a means of developing capacity for mercury reduction and dividing up the work. The working groups included the head of each work area that used or was integral to the use or handling of mercury in the hospitals, as well as a person appointed by the hospital director to serve as liaison between the working group and the UNISON research team. Liaisons for different working groups included the director of education, the medical director, and a hospital assistant.

The project was launched with an official ceremony. The presence of executives from the SEMARNAT, the State of Sonora, the Ministry of Labor and Social Welfare, the University of Sonora, the participating hospitals, as well as leading environmentalists gave evidence of the relevance and support for this project. This formal and well-attended ceremony was instrumental to the hospitals' commitment and respect for the project. Working groups saw firsthand the importance of their mission, not only within the hospitals but for the larger environment as well.

Annual staff training sessions within each hospital were an important means of communicating progress and reinforcing commitment to mercury reduction. These meetings included updates on SEMARNAT policy, regulatory trends, and

progress in mercury reduction. Including environmental authorities in these sessions provided a further show of support for the project and its objectives.

In the future, the Federal Commission for Protection against Health Risks (COFEPRIS) of the State of Sonora will be invited to participate in the training sessions. In 2011, COFEPRIS initiated a project to reduce occupational exposure to mercury in dental practices and it conducted awareness talks aimed at professionals in the industry. The presence and potential exposure to mercury in dental services was an important finding from the mercury reduction team's inspection tours in hospitals.

A significant challenge during the course of this work was the constant turnover of staff and administration in the hospitals. Because personnel changes occur frequently, it is essential that all training sessions include basic information for new employees on the toxic effects of mercury, the importance of recognizing sources of mercury, and the importance of managing waste in an environmentally appropriate manner. Training sessions at the end of the first and second years of the project included a progress report on mercury-reduction policies and practices, the inventory of mercury, and evaluation of mercury-free alternative products and processes. This showed the progress being made by the working groups and reinforced the support of senior management. An important strategy in describing the findings of the inspections was to present them as opportunities for improving mercury management within the facility.

One limitation encountered at the outset of the project was finding the time for hospital staff to attend training sessions. The workload in the hospitals is large and some staff members hold more than one job, limiting their availability. For the future, holding several training sessions at different times may be the best way to reach all the staff.

Baseline Assessment of Mercury Inventory, Policies and Practices

Walk-through assessments and taking inventory of mercury-containing products were key for knowing and communicating the presence of mercury throughout the hospital. The systematic manner in which this was done revealed the sources of mercury; hospital purchasing practices; use, storage, and disposal of mercury; staff training; and spill control measures. This also established a baseline for measuring progress of mercury reduction and elimination in these workplaces. The participation of staff in the mercury reduction work teams gave them first-hand knowledge and real insight into the problem of mercury in their departments.

A visible gap in the mercury inventory is the potential for mercury to be hidden in laboratory products. This reflects the wide variety of substances and chemicals used and the lack of information about their composition and ingredients. Laboratory chemicals warrant further examination and consultation with suppliers and manufacturers.

In addition to looking for mercury itself, one of the working groups was assigned to search for existing mercury reduction/elimination policies in the hospital and to develop new policies where none existed. To insure they knew what to look for, the team was given examples of policies implemented in other hospitals. The examples were an important source of support for their activities and served as models for drafting new policies.

Prioritization of Efforts to Reduce Mercury and Development and Implementation of Action Plans

Sources of mercury were ranked in terms of mercury content, potential impact on health and the environment, ease of replacement, and cost. This led to prioritizing replacement of mercury thermometers, followed by sphygmomanometers. In addition, two areas became newly evident for attention in the future: 1.) reducing exposure to mercury in dental clinics and 2.) implementation of a state management plan for the environmentally sound management of mercury waste.

Digital fever thermometers and aneroid sphygmomanometers were commercially available in the region as alternatives to the mercury-containing devices. The replacement process has taken place gradually. Most of the mercury fever thermometers have been eliminated and aneroid sphygmomanometers are systematically being phased in to replace the mercury sphygmomanometers.

Both digital thermometers and aneroid sphygmomanometers were well received by the hospital staff. For the initial evaluation of the new devices, the alternatives assessment tools in the workbook were used to obtain user feedback.

Results of the initial evaluation were favorable. However, late in the second year, there were reports of aneroid sphygmomanometer pedestals breaking. (The pedestal is the wheeled base on which the device is mounted.) This was particularly evident in the emergency area where activities require the use of more robust products. As a result, the recommendation was made to switch to another brand of aneroid sphygmomanometer with a more durable base.

Monitoring progress

A mercury inventory conducted one year after the project began revealed significant progress in the reduction of mercury associated with thermometers and sphygmomanometers. Purchasing records also showed clear evidence of progress. The only fever thermometers entering the hospital via purchasing were digital thermometers.

At this time, mercury elimination in hospitals is constrained by economic resources and the lack of an official federal government policy for mercury. The federal government's leadership is critical. Government support for eliminating the use of mercury in the health sector should address purchasing criteria to prevent the acquisition of mercury, allocation of resources for procurement of mercury-free alternatives, and assistance with the handling of waste mercury. With this support, hospitals will move forward more quickly and may even become mercury free.

Moving forward

This project was strategic for building expertise and fostering mercury reduction in the hospitals of Hermosillo, Mexico. The partnership of UNISON and three hospitals, with the endorsement of the ministries of health and environment, resulted in reduced mercury in the hospitals and a culture of protecting occupational and environmental safety and health. The project also revealed that an important consideration is the environmentally sound management of waste mercury. The implementation of a state management plan for mercury, in accordance with the provisions of the General Law on the Prevention and Waste Management, is in process and will be essential to mercury reduction efforts.