

*Letter to Editor*

# “Mercury Eradication in Healthcare Services” – a Health Promotion Programme

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## Abstract

The programme of the State Provincial Sanitary Inspector of Białystok was aimed at gradual elimination of mercury from healthcare facilities, spread out over the years 2003-08. Participation in the programme was voluntary.

The programme outlined the preliminary actions to be taken and their realization at each governing level, including technical possibilities for substitution or recycling. It included information on harmful effects of mercury and its compounds on people and the environment, instructions concerning implementation, monitoring and training, information about alternative products, costs and effects of implementing non-mercury devices, and how to collect, store and utilize this metal.

The programme of mercury eradication in the Podlasie region was mainly concerned with the withdrawal of Hg-based medical thermometers and sphygmomanometers. Already in 2003, when the programme was commenced, one of the largest hospitals delivered several dozen kilograms of stored mercury for recycling, thus eliminating the risk of staff exposure to this deleterious metal.

**Keywords:** mercury, mercury eradication, utilization, recycling

## Introduction

Over 100 years have passed since the sphygmomanometer was invented by Scipione-Riva Rocci. However, its practical application in medicine initiated the common use of mercury [1].

The volume of mercury spilled in hospitals, outpatient departments and other healthcare facilities cannot be precisely estimated. No data are available on how much mercury has been collected into recycling bins. We can assume that the older the hospital, the higher the mercury contamination in its rooms. Hospital renovations have failed to remove all mercury exposure from the building. That is why the risk is especially high for hospital employees, patients and visitors, especially for staff members spending 30% of their lifetime in a healthcare institution. Mercury is

known to exert a harmful effect on humans [2-5], its vapours posing a major threat [6].

In the world, mercury elimination in healthcare facilities has at least a 10-year history, resulting in a reduced number of mercury devices used by medical staff [7]. However, our habits and trust in reliability of mercury-based devices that have been used for such a long time seems to be an obstacle. Fortunately, thanks to technical advances, new validated thermometers, sphygmomanometers, etc., are more accurate, and have been approved and recommended by scientific societies [8].

The study objective was to present the programme of the State Provincial Sanitary Inspector of Białystok in the years 2003-08 concerning mercury elimination from healthcare facilities.

## Material and Methods

The programme was designed by the Provincial Sanitary Inspectorate in Białystok and then its implementation was launched in 2003. The Provincial Sanitary Inspectorate in Białystok and 15 Poviats Sanitary Inspectorates in Podlasie province were involved in its realization. Participation was voluntary. Each hospital and each outpatient centre, after getting acquainted with the principles of the programme, could participate.

Having implemented the programme, training sessions were begun in hospitals and medical centres. Up to the end of 2006, there were 47 trainings organized for 259 workers. The main training issues were:

- aims and tasks of the programme of mercury elimination from medical centres,
- physical and chemical mercury characteristics,
- mercury application,
- harmful effects of mercury on humans,
- mercury metabolism – absorption and excretion,
- measures to be taken in case of metallic mercury contamination,
- mercury – benefit or ecological bomb of the 21st century,
- mercury in nature,
- safe mercury use,
- economic and health benefits of mercury eradication from hospital environment,
- mercury utilization and recycling.

A brochure edited by the Provincial Sanitary Inspectorate in Białystok, titled “Mercury” was used for training. It describes the measures to be taken in the case of mercury spillage, the use of protective equipment by an employee and environmental protection.

During the three-year period (2003-06) the Provincial Sanitary Inspectorate in Białystok and all the Poviats Sanitary Inspectorates were cooperating with healthcare facilities, systematically monitoring mercury elimination and providing some auxiliary materials. During routine visits at these facilities, training on the programme and individual instruction were performed.

## Results

Among 28 hospitals in Podlasie province, 21 were involved in the programme. Total withdrawal was completed in 10 hospitals, including the three largest hospitals in the region and seven smaller ones. Before the programme commenced, there were 6,548 mercury-based medical thermometers in these 21 hospitals. Within the study period, 7,081 new mercury-based devices were bought whereas 11,134 were eliminated from use and substituted with 1,937 electronic thermometers. Since the beginning of the programme, 7 hospitals were not buying mercury-based thermometers, and another three hospitals bought such devices in 2003, but soon got rid of them. Out of 11 hospitals still participating in the programme and still using mercury-based devices, three did not buy this type of thermometer but the alternative ones (a total of 632 electronic thermometers were introduced).

The situation in outpatient centres appears promising, as 32 centres joined the programme and as many as 50% (16) completely eliminated mercury thermometers from use. In the remaining outpatient facilities, of 443 mercury thermometers used prior to implementation of the programme, 211 were withdrawn, and then only 6 new mercury thermometers and as many as 94 electronic ones were bought. In total, in 32 healthcare centres 339 mercury thermometers were used, and 6 new mercury thermometers and 152 electronic ones were bought. Before the programme, in these centres there were 571 mercury thermometers.

A total of 20 hospitals participated in the mercury sphygmomanometer eradication program. Six hospitals totally eliminated mercury sphygmomanometers, and in 14 hospitals the programme is continued. Since the beginning of the programme, new mercury sphygmomanometers were bought only in 2 hospitals out of those 14. Of 733 mercury devices used before the programme in 14 hospitals, 279 were eliminated and only 25 new mercury sphygmomanometers and 457 electronic or analogue sphygmomanometers were bought. In total, in 20 public and non-public hospitals, there were 798 mercury sphygmomanometers prior to implementation of the programme, then 344 were removed and new 25 mercury sphygmomanometers and 694 electronic or analogue devices were bought.

Among public and non-public outpatient facilities, elimination of sphygmomanometers was conducted in 26 institutions. Up to the end of 2006, 15 of them got rid of all mercury-based devices. In the remaining 11 centres, of 154 sphygmomanometers before the programme, 64 were removed and none was bought; 45 mercury-free alternatives were purchased.

## Discussion

The global demand for mercury accounts for 3,600t annually, with 300t in the EU countries, where this metal is used mainly in electrophoresis of alkaline metal chlorides and also as dental amalgamate. In EU countries, 25-30t of mercury are used for the annual production of medical thermometers. Emission of mercury to the air due to annual production of measuring devices and from old unused appliances and other instruments in the EU amounts to approximately 8 tons [10].

However, 85% of mercury released to the environment originates from the burning of various materials, e.g. mineral sources of energy and waste. In the USA, 185 tons of mercury are emitted to the atmosphere each year. Most of it is released in the form of gas that moves long distances in the wind. Certain amounts of mercury contained in the air are transformed into oxidized mercury to form aerosol, which subsequently passes to soil and water. The bacteria-induced conversion of mercury deposits into methyl mercury that accumulates in the food chain, with the human being at its end, is a threatening phenomenon [11-15]. That is, burning plants, factories and power stations can be considered a major source of pollution. Harmful mercury compounds

may accumulate in the human body, which remains asymptomatic for a long time. They are especially hazardous for pregnant women and fetuses [12, 15].

According to the Ordinance of the Minister of Health of 2007 [16], mercury content in drinking water cannot exceed 0.001 mg/l. Mercury content in food in Poland ranged within the following values: potatoes 0.12 ng/g, carrots 4.0 ng/g, cucumbers 8.1 ng/g, milk 0.06 ng/g, Edamski cheese 8.1 ng/g, bacon 8.8 ng/g, Zwyczajna sausage 1.4 ng/g, powder milk 9.6 ng/g [17-20]. The above values are very low and are not a direct threat to human health.

A Committee Directive (WE) determines the highest acceptable mercury levels in food products within the European Union [10]. Threats to health can include some fish species, including angler fish, wolf fish, Atlantic bonito, eel, orange roughy, rattail, Atlantic halibut, Atlantic blue marlin, *Lepidorhombus whiffiagonis*, red mullet, pike, *Orcynopsis unicolor*, poor cod, *Centroscyms coelolepis*, raja, redfish, sailfish, frost-fish, common sea bream, shark, oilfish, sturgeon, swordfish and tuna, in which the highest acceptable mercury level cannot exceed 1.0 mg/kg of fresh mass. But, in other fishery products, such as crustaceans (with the exception of brown meat of crab or head and corpus meat of lobster) the acceptable mercury concentration is 0.5 mg/kg of fresh mass [21].

For over 100 years sphygmomanometers have been used in clinical practice, as well as mercury-based thermometers and other devices which can emit deleterious mercury vapours [7, 8, 22]. Each mercury sphygmomanometer contains from 70 to 90 grams of mercury and its use poses the risk of environment contamination.

In addition to mercury thermometers and sphygmomanometers, many other sources of mercury can be found in healthcare facilities: barometers (800g of mercury; they can be substituted with aneroid barometers or weather data can be obtained from the media), manometers, oesophageal dilators, fluorescent lamps, laboratory reagents, dental amalgamate or detergents [6, 22-26]. According to an American study, the greatest amount of mercury gets to the hospital environment from thermometers (over 55%) and then from sphygmomanometers (approximately 17%) [27].

It was estimated that a factory in Kodaikanal in India, producing from 100,000 to 150,000 mercury thermometers a year, caused evaporation of 539 kg of mercury into the surrounding environment [22]. It has been reported that medical wastes contain 50 times more mercury than non-hospital wastes [27]. Hospital sewage contains up to 5% of the mercury released to the environment, and mercury-based thermometers alone provide approximately 17 tons of mercury to the environment in the USA yearly [26, 27].

Some European countries, including Sweden, Norway, Denmark and France, have followed the Directive of the European Parliament and Council that introduces a ban on the use of mercury-based medical thermometers, barometers, manometers and sphygmomanometers. The prohibition refers only to new devices; the use of those produced earlier remain legal. This regulations will take effect on April 3, 2009 [10].

Occupational risk of exposure to this metal is an important aspect of its presence in healthcare facilities. Among healthcare workers, the most highly exposed are nurses and laboratory workers, as well as their family members (due to such factors as contact with clothes) [7, 13].

The use of mercury-containing devices carries a lot of additional disadvantages due to their exploitation and extra costs associated with cleaning, drying, disinfection, zeroing (zero adjustment by shaking), storing in a frame, the possibility of transmitting hospital infections, mercury recycling, editing and getting acquainted with the manual, purchase of chemicals for neutralization, protection of staff members (vinyl or rubber gloves, masks), costs of the personnel engaged – mainly nurses [1, 6, 8, 28].

Alternative devices seem to have undoubted advantages over the mercury ones: higher measurement accuracy, convenience (shorter measuring time), no risk of mercury evaporation [1, 8, 28].

Mercury reduction in the environment also brings economic benefits [1,28]. The cost of non-mercury sphygmomanometers is limited to a single purchase of a device and the exchange of pads, which additionally prevents transmission of hospital infections [1].

## Conclusions

The programme of eliminating mercury-based thermometers and sphygmomanometers run in the years 2003-06 has resulted in a substantial reduction in mercury occurrence in healthcare facilities in the Podlasie region.

Although participation in the programme was voluntary, a large number of hospitals and outpatient centres were involved, which indicates the high level of responsibility of the medical staff for health. Active engagement of managers of these institutions in the eradication of the harmful effects of mercury on human being should be emphasized.

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