World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(REVIEW ARTICLE)

Check for updates

Elimination of mercury thermometers in health facilities: Review of achievement data as of January–October 2023

Engrasia Widyadhana *

Department of Environmental Health, Faculty of Public Health, Airlangga University, Surabaya, Indonesia.

World Journal of Advanced Research and Reviews, 2024, 22(02), 498–503

Publication history: Received on 27 March 2024; revised on 05 May 2024; accepted on 07 May 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.22.2.1359

Abstract

The Minamata Convention as a form of international agreement in the prevention and reduction of mercury emissions globally moves the world in support of eliminating mercury in the environment. Indonesia is one of the countries that contributed to making the "National Action Plan for Mercury Reduction and Elimination" particularly within its health sector, focusing on the elimination of mercury thermometers. This study aims to analyze the achievement of the elimination of mercury medical devices in the form of thermometers at Indonesian health facilities as an evaluation material for improving performance in achieving the program target by 100%. The research method utilized is descriptive qualitative analysis. In this study, primary data processing was carried out online to eliminate mercury medical devices in health facilities in Indonesia. From the research findings, it can be concluded that the achievement of mercury thermometer removal in Indonesia still has not reached the target of the "National Action Plan for Mercury Reduction and Elimination"

Keywords: Minamata; Elimination; Thermometer; Mercury; Health Facilities

1. Introduction

Mercury (Hg) is a chemical element characterized by its atomic number of 80 and a relative molecular mass of 200.59. Classified among the heavy metals known in Latin as *Hydrargyrum*, mercury exhibits a unique characteristic wherein it transitions into a liquid state under normal room temperature conditions, hence its common designation as mercury[1]. However, the World Health Organization (WHO) identifies mercury as one of the top ten chemicals or chemical groups posing significant risks to public health and the environment. This designation is due to its toxic properties, environmental persistence, bioaccumulative nature, and capacity to disperse widely in the atmosphere over considerable distances[2].

Between 1932 and 1968, an unprecedented occurrence of mercury poisoning transpired in Minamata Bay due to the disposal of a toxic byproduct known as *methylmercury* into the local bay and sea by the Chisso chemical plant in Minamata [3]. The anticipated continuation of mercury (Hg) contamination in soil and water is expected to sustain its adverse effects on the future food chain, thereby presenting potential hazards to human health. Manifestations of mercury poisoning include muscular weakness, sensory impairment, paralysis, and, in severe cases, fatality [2, 4]. Subsequently, in 2013 the "Minamata Convention" was established as an international treaty ratified by the global community under the auspices of the United Nations Environment Programme (UNEP) to address the mercury issue. This treaty serves as a global pact aimed at protecting human health and environmental integrity from the adverse effects of mercury, particularly following the Minamata incident in Japan. Its primary objective is to mitigate such hazardous heavy metal emissions and human-induced releases [4, 5].

* Corresponding author: Engrasia Widyadhana

Indonesia ratified the Minamata Convention through Indonesian Government Regulation No. 11 of 2017 concerning the Minamata Convention related to Mercury and Presidential Regulation No. 21 of 2019 concerning the National Action Plan for Mercury Reduction and Elimination as a tangible form of the Government of Indonesia's commitment to safeguard human health and the environment from the threat of mercury pollution by focusing on four sectors including manufacturing, energy, Small-Scale Gold Mining (PESK), and health[6]. In following up on Government Regulation 47 of 2016 concerning Law of the Republic of Indonesia No. 11 of 2017, the Indonesian Ministry of Health and cross-sectoral agreed to remove all mercury-containing medical devices in Indonesian health facilities, including thermometers, table sphygmomanometers, standing sphygmomanometers, and dental amalgams. This study is a form of evaluation material for the progress of the withdrawal of mercury medical devices in Health Service Facilities in Indonesia in January-October 2023.

2. Material and methods

This article uses a descriptive qualitative method with data collection techniques in the form of secondary data on the number of mercury medical devices in health facilities in Indonesia obtained through a recapitulation of filling out online forms reporting the removal of mercury medical devices by registered/licensed health facilities throughout Indonesia in January—October 2023 informed by the Ministry of Health through the circular letter of the Director of Environmental Health Number KL.03. 01/4/3541/2020 concerning the submission of online forms (online forms) reporting the removal of mercury medical devices to local governments and registered/licensed health facilities throughout Indonesia.

3. Results and discussion

3.1. Mercury Content, Elimination Achievements, and Total Mercury Thermometer Breakdown at Indonesian Health Facilities January—October 2023

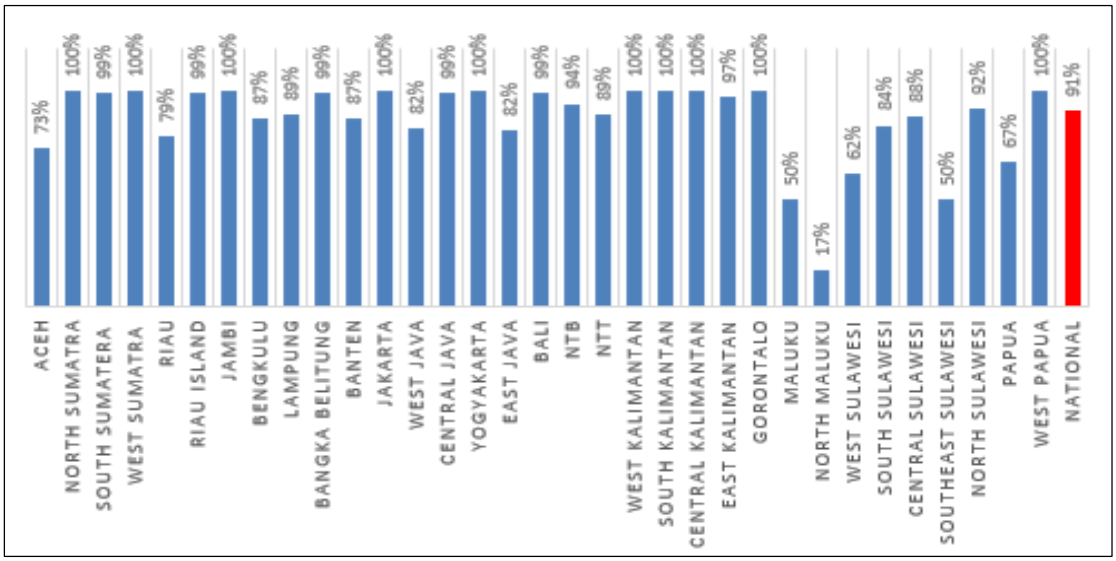
Based on the results of the recapitulation of the filling of the mercury medical device withdrawal form at health care, the brand and mercury content on the thermometer can be seen in the following table:

Table 1 Mercury Levels in Mercury Thermometers at Health Facilities

Thermometer Brand	Womb	Information
Riester	1 g	In general, the mercury content in thermometers is 0.5–1.5 grams (UNDP-GEF12 Guidelines)
General care	5 g	
GEA	0.2 g	
LOTUS	1.5 g	
Nesco	1 g	
Kris Chef	0.5 g	
Onemed	0.2 g	
Yenaco	1 g	
Corona	0.02 g	
Safety	0.5 g	

The table shows that as many as ten brands of mercury thermometers were recalled, with the highest mercury content being 5 g and the lowest mercury content being 0.02 g. In general, the mercury content in thermometers is 0.5–1.5 g (UNDP-GEF12 Guidelines).

Based on the results of the recapitulation of the filling of the mercury medical device withdrawal form at health facilities, the percentage of achievement of the elimination of mercury medical devices in the form of thermometers can be seen in the following figure:

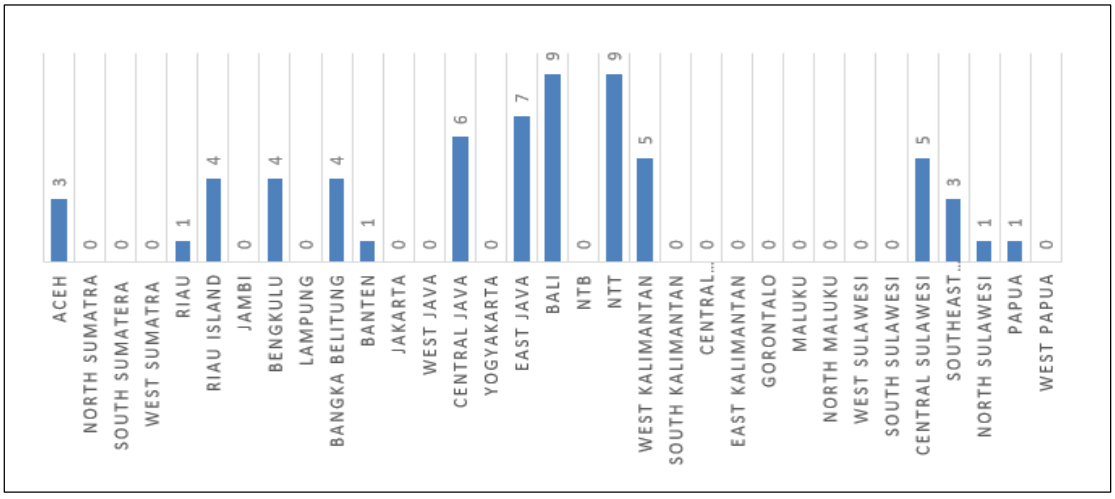


Data on the Achievement of Mercury Medical Equipment Elimination in Indonesian Health Facilities, January–October 2023

Figure 1 Achievement of Mercury Thermometer Elimination at Indonesian Health Facilities January–October 2023

Based on data from the "Data Report of Medical Devices Elimination in Health Facilities as of October 31, 2023" owned by the Ministry of Health of the Republic of Indonesia, national achievements in the elimination of mercury thermometers in Indonesian health facilities, including hospitals, community health centers, and clinics as of October 31, 2023 reached 91% of the target of 100% with a total withdrawal of mercury medical devices of 3,204 units and 9% or 331 units that health facilities still use. Chart analysis shows that 10 of Indonesia's 33 provinces, including North Sumatra, West Sumatra, Jambi, Jakarta, Yogyakarta, West Kalimantan, South Kalimantan, Central Kalimantan, Gorontalo, and West Papua, successfully achieved the target of eliminating mercury thermometers by that date. A total of 23 provinces achieved those that still have not reached the 100% target.

Based on the results of the recapitulation of the broken thermometer mercury withdrawal form at health facilities, the total rupture of mercury medical devices in the form of thermometers can be seen in the following figure:



Total Mercury Thermometer Fragments at Indonesian Health Facilities, January–October 2023

Figure 2 Mercury Thermometer Fragments at Indonesian Health Facilities January–October 2023

Based on data in the "Data Report of Medical Devices Elimination in Health Facilities as of October 31, 2023," owned by the Ministry of Health of the Republic of Indonesia, a total of 63 mercury thermometers were found to be broken in health facilities across the country. The highest number of broken thermometers in health facilities in East Nusa Tenggara and Bali Provinces totaled 9 units.

Based on data about the achievement percentage in eliminating mercury thermometers within health facilities from January to October 2023, it is evident that the elimination target still needs to be fully met. This circumstance is attributed to several factors, including the lack of replacement stock at health facilities, leading to a reliance on used products. Data concerning incidents of mercury thermometer breakage indicate that there are still numerous cases within health facilities, posing potential adverse effects on environmental health and individuals involved. The primary concern in mercury medical devices, particularly thermometers, is device breakage and subsequent spillage[7]. According to foundational information on mercury as presented by the EPA, instances of thermometer falls and ruptures can result in the dispersion of elemental mercury into droplets. Exposure to elemental mercury droplets at ambient temperature may lead to its evaporation into invisible and odorless vapor mercury [8].

The indoor presence of elemental mercury vapor exhibits varying levels of air resistance over a period ranging from 3 months to 3 years. Inhalation exposure to elemental mercury vapor represents a considerable source of toxicity, with steam inhalation serving as a critical pathway. Approximately 80% of inhaled mercury vapor is absorbed into the bloodstream via the human lungs, subsequently disseminating throughout the body [9]. Notably, this mercury persists within the body, potentially impacting the central nervous system by breaching the blood-brain, peripheral nervous system, and renal barriers [10, 11]. Unlike the ingestion pathway, elemental mercury intake through ingestion does not exert a significant effect due to its comparatively lower absorption rate from the digestive tract and limited ability to permeate the skin [12, 13].

The most common health effects of mercury exposure in health facilities are in groups of health workers, especially nurses and doctors [13]. Elemental mercury/Hg0 vapor inhaled through the inhalation pathway disrupts the work of the central nervous system if mercury exposure occurs in the long term. Symptoms include erethism, which includes irritability, heightened shyness, restlessness, insomnia, excessive saliva production, gingivitis, and tremors. In children, conditions such as acrodynia can occur, characterized by severe leg spasms, irritability, paresthesia, discoloration of fingers to redness and extreme pain, and peeling of the skin on the hands and feet [7].

3.2. Alternative Medical Devices Mercury Thermometer

To replace thermometer mercury in health facilities, the steps taken are to stop purchasing medical devices that contain mercury and look for alternatives that are free from these materials[14,15]. Mercury medical devices in the form of mercury thermometers must not be used after December 2020, and they could be replaced with nonmercury medical devices such as axillary digital thermometers, tympanic infrared thermometers, temporal artery infrared thermometers, and non-contact infrared thermometers [16, 17].

3.3. Mercury Medical Device Waste Management

Mercury behaves uniquely compared to other substances. When a mercury thermometer breaks, it forms tiny droplets that can merge into a larger ball, capable of rolling on flat surfaces. However, if the ball is disturbed or under pressure, it can break back into smaller droplets. Therefore, it is important to carefully handle mercury spills and thermometer fragments, avoiding using vacuum cleaners or brooms that can spread mercury further and break it into smaller droplets, speeding up evaporation[8]. For cleanup, specialized tools such as rubber or cardboard should be used instead. Additionally, for tiny and hard-to-see mercury droplets, spreading sulfur powder can help as it changes their color to brown, making them easier to detect [18].

The treatment of waste from healthcare facilities is carried out by third parties who have permission to be recycled[15]. In Indonesia, currently, there are no processing facilities for used medical devices containing mercury. Only a few facilities can disassemble and separate equipment from the mercury contained therein. The device will then be encapsulated before being sent to the Final Processing Site (TPA). However, until now, there's no special facility has been dedicated to mercury waste treatment.

Based on Indonesia Minister of Health Regulation No. 41 of 2019 concerning the elimination and withdrawal of mercury medical devices in Health Service Facilities, one of the follow-up efforts to manage mercury medical device waste in Health facilities is storage by being divided into two categories, namely mercury medical devices that are not damaged and damaged. Undamaged mercury thermometer waste (intact) is temporarily stored in a secure container and/or special room. Containers used to store mercury medical devices have several important characteristics, including containers that must be distinguished based on the type of device and labeled indicating the type of waste in it. In addition, the container must be impermeable so that there are no mercury leaks that can harm the environment. Containers are also placed in hard-to-reach places, such as large rooms, with adequate lighting and ventilation[6]. For mercury thermometer waste storage, the container measures 40 cm x 23 cm x 15 cm and can hold up to 50

thermometers wrapped in bubble wrap. Next, the container storage step will occur in the Mercury Interim Storage room [11].

Once collected, the Environment Agency or the authorities will withdraw Mercury thermometers that are intact and undamaged. The thermometer will be temporarily stored in a storage warehouse before being transported for export. Follow-up will be carried out by companies that can manage. Thermometers with mercury that have broken and mercury spilled from medical devices must be placed in the Temporary Storage of Hazardous and Toxic Waste (TPS B3) by applicable laws and regulations. Mercury thermometer waste that has broken and mercury that has been spilled must follow a special and safe final treatment process. In this process, combustion or incineration is not carried out so that mercury does not become harmful vapors. Handling damaged medical devices with mercury spilled from these devices is the same as handling hazardous and toxic waste by applicable laws and regulations. Mercury from broken and scattered mercury thermometers requires a special handling approach usually implemented in health facilities facilities. Hazardous and toxic waste handling protocols will ensure that the mercury is managed safely and by safety standards[6].

4. Conclusion

Based on the results of the previous presentation, it can be concluded that the achievement of the mercury medical device elimination program in the form of thermometers in Health facilities still needs to reach the target of RAN-PPM (National Action Plan for Mercury Withdrawal and Elimination) In the calculation results, the elimination of national-scale thermometers has only reached 91% of the targeted 100%. The non-achievement of the target is due to the absence of replacement stock, which depends on the product being used. There are still cases of mercury thermometer ruptures in some health facilities. Actions for handling rupture to thermometer waste management in Health facilities are carried out based on the recommendations in Indonesia Minister of Health Regulation No. 41 of 2019 concerning eliminating and withdrawing mercury medical devices in Health Facilities.

Compliance with ethical standards

Acknowledgments

This article did not receive assistance from the government, private companies, or non-profit organizations.

References

[1] Manpreetkaur K. Gaur, & Kalpana R. Chavhan. A comprehensive and detailed review on Mercury Toxicity. Journal of Ayurveda and Integrated Medical Sciences, 2023. 8(11), 82–86.

[2] Jiang L, Zhang R, Zhang L, Zheng R, Zhong M. Improving the regulatory health risk assessment of mercury-contaminated sites. J Hazard Mater. 2021; 402:123493

[3] Yuki Miyamoto. A World Otherwise: Environmental Praxis in Minamata. Lanham, MD: Lexington Books. 2021.

[4] Gworek, B., Dmuchowski, W., &; Baczewska-Dąbrowska, A. H. Mercury in the terrestrial environment: a review. In Environmental Sciences Europe. 2020; 32(1).

[5] Sodeno, R. Analysis of the Minamata Convention on Mercury in the Context of Sustainable Development Goals (SDGs). Global Environmental Research, 2020; 065–070.

[6] Ministry of Health of the Republic of Indonesia. (2019). Minister of Health Regulation Number 41 of 2019 concerning the Elimination and Withdrawal of Mercury Medical Devices in Health Service Facilities.

[7] Kusuma, D., Tubagus Tsani Risqi Aji, A., Murtono, A., Ilham Ramadhani, A., &; Marine and Fisheries Pangandaran, P. Design a training workshop temperature recording using Arduino. 24th Indonesian National Fisheries Seminar. 2023; 95–101.

[8] Martin, J. A., Epstein, E. S., &; Reid, M. Safety Highlights. ACS Chemical Health & Safety, 2020; 27(2), 86–87.

[9] Rao, G. S. Assessment of internet addiction and violent behavior in children and adolescents before and after COVID-19 lockdown. Curr Pediatr Res, 2023; 27(09), 9.

[10] Basu, N., Bastiansz, A., Dórea, J. G., Fujimura, M., Horvat, M., Shroff, E., Weihe, P., &; Zastenskaya, I. Our evolved understanding of the human health risks of mercury. In Ambio. 2023, 52(5), 877–896.

[11] Princess Natari Ratna, &; Sri Lusiani. Design of Mercury Interim Storage for Medical Devices Containing Mercury. JST (Journal of Science and Technology). 2023; 12(1).

[12] Erfantalab, P., Zamani, N., &; Hassanian-Moghaddam, H. Broken thermometer in foot: a source of mercury poisoning. Tropical Doctor, 2020; 50(1), 83–84.

[13] Sukhshant, K. All that glitters is not gold: Mercury poisoning in a family mimicking an infectious illness, Current Problems in Pediatric and Adolescent Health facilities. Elsevier, 2020; 50(2), 1–6.

[14] Tresnadi, H. PRELIMINARY REVIEW OF THE PROGRESS OF THE ELIMINATION OF MERCURY MEDICAL DEVICES. Journal of Mining Engineering (JRP). 2021; 1(1)

[15] Muthia Septanti, E., Joko, T., &; Nurjazuli, N. Implementation of the Mercury Medical Device Recall Program at the Sukmajaya District Health Center. JOURNAL OF ENVIRONMENTAL HEALTH: Journal and Applications of Environmental Health Engineering, 2022; 19(2), 261–268.

[16] Pecoraro, V., Petri, D., Costantino, G., Squizzato, A., Moja, L., Virgili, G., &; Lucenteforte, E. The diagnostic accuracy of digital, infrared and mercury-in-glass thermometers in measuring body temperature: a systematic review and network meta-analysis. In Internal and Emergency Medicine. 2021; 16(4), pp: 1071–1083.

[17] Saturday, A. Journal of Environment and Health Science Mercury and its Associated Impacts on Environment and Human Health: A Review Citation: Saturday, A. Mercury and its Associated Impacts on Environment and Human Health: A Review. J Environ Health Sci. 2018; 4(2), 37–43.

[18] Dante, A., Gaxhja, E., Masotta, V., la Cerra, C., Caponnetto, V., Petrucci, C., &; Lancia, L. Evaluating the interchangeability of infrared and digital devices with the traditional mercury thermometer in hospitalized pediatric patients: an observational study. Scientific Reports, 2021; 11(1).