Under the High Patronage of His Majesty King Mohammed VI

International Water Resources Association
IWRA

XIX WORLD WATER CONGRESS
International Water Resources Association (IWRA)
Marrakech, Morocco| 1-5 December 2025

Kingdom of Morocco
Ministry of Equipment and Water

PlomBOX: A Cutting-Edge Biosensor for Tackling Lead Contamination in Drinking Water

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Marrakech, December 4, 2025

Lead pollution

- **Pb is one of 10 chemicals identified of major public health concern - WHO**
- **Contaminates soil, water, and air, harm ecosystems and disrupt food chains**
- **Children - irreversible neurological damage, reduced IQ, behavioral problems, and impaired cognitive development,**
- **Adults - cardiovascular disease, hypertension, kidney and reproductive issues, anemia and impaired brain and nervous system functions**
- **Middle and Low-income countries more affected**
- **Globally, lead exposure contributes to millions of deaths and disability-adjusted life years lost annually (**Institute for Health Metrics and Evaluation (IHME) estimates that 1.5 million deaths)

Lead: A silent pollutant

Lead pollution in drinking water

WHO, Pb **in drinking water is <10 ppb**, though no level has been shown to be safe for human

Water access in **informal settlements**

https://www.epa.gov/ground-water-and-drinking-water/infographic-lead-drinking-water

The PlomBOX Project

https://plombox.org/index-old.phpl - PHASE I

International + Multidisciplinary + Multi-institutional

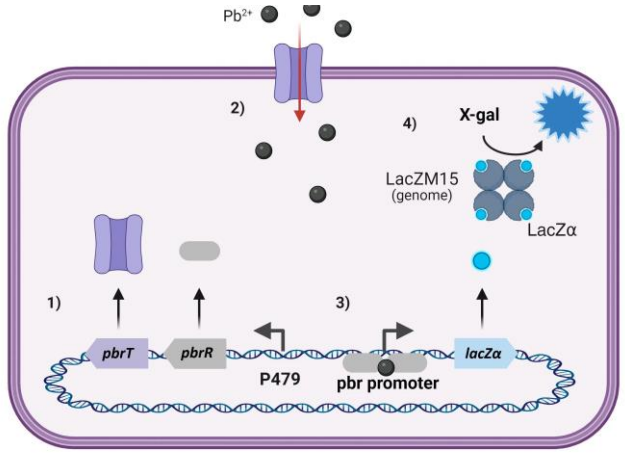
The TRACE Collaboration - Tools and Research to Assay Contamination in the Environment.

PlomBOX is an innovative biosensor designed to facilitate lead detection in drinking water at the point of use, helping to reduce lead intake through contaminated water.

Plombox consists of…

The PlomBOX Project

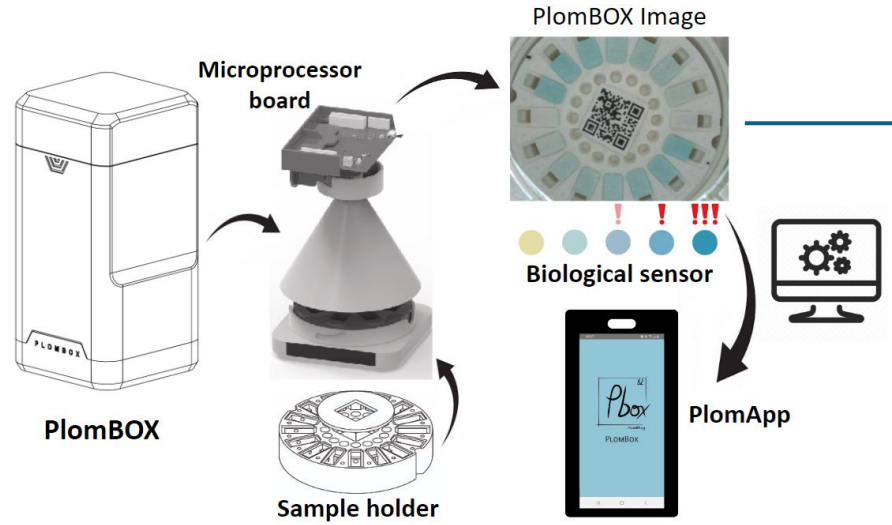
LEAD-SENSING BACTERIA



-The PlomBOX uses a bacteria sensitive to lead is an *E. coli* DH5α strain bearing the lead-sensing genetic construction

- 0 – 500 ppb Pb Calibration curve. Optimum response to 100 ppb PB

OPTICAL METROLOGY COMPONENTS



- Acquiring image data via Bluetooth and collecting metadata from the smartphone's geo-location sensors.
- Image and metadata are sent to a remote server via Message Queuing Telemetry Transport (MQTT) protocol.
- The server analyses the data and returns the lead result per sample to the PlomApp via MQTT.
- Plombox developed in Android Studio using Java.

MOBILE PHONE DATA ACQUISITION

The sample holder for 16 samples

20 USD for the reusable case

The PlomBOX Project

Calibration, validation and tap water monitoring design

Water samples from 44 homes in the City of Buenos Aires and its suburbs (2020-2022) were extracted for Lead (Pb) detection.

Total of 100 samples.

Sampling design consisted of 4 samples per site:

- **Outside the building**
- **Inside the building - kitchen faucet (immediately opened; a minute (1'); 5 minutes (5') after the faucet is opened**

Atomic Absorption Spectrophotometry for Pb quantification (INA) and compared to results obtained from the Plombox biosensor.

Concentrations up to 3.55 mg Pb/L were found, a value 70 times higher than the limit established by the Argentina regulation (0.05 mg Pb/L) and 350 times above the limit established by the WHO (0.01 mg Pb/L).

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74 % samples

83 % correlation with lead measured by AAS

Conclusion and Future Perspectives

The PlomBOX biosensor represent…

Innovation	• Use a genetically modified *E. coli* strain plus an imaging system using low-cost, off-the-shelf components.
Sensitivity	• PlomBOX detects lead in drinking water above the WHO upper limit of 10 ppb
Limitation	• Not designed for effective use at concentrations >10× WHO limit, dilutions could be applied.
Ease of use for non-experts	• PlomBOX is envisioned to work with simple disposable devise. • Biosensor can be loaded and measured directly during water sampling campaigns.
Expected impact	• Supports environmental management and regulatory decision-making. • A reliable point-of-use tool, especially valuable in developing countries.
Next step PlomBOX PHASE II	• Developing an internal growth control and lyophilization optimization. • Biosensor improvements

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Thank you!

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https://plombox.org/

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