The global water crisis, marked by scarcity, pollution, and mismanagement, severely threatens human health, food security, ecosystems, and economic development. Over 3.6 billion people lack access to clean water and sanitation. Heavy metal contamination, from sources like aging water pipes (Pb(II)), is a significant concern, causing various health issues. Electrochemical sensors, particularly those incorporating nanomaterials (NMs), offer a promising solution for detecting trace amounts of toxic metals (Pb(II), Hg(II), As(III), Cu(II), Cd(II), and Ag(I)) in water. These sensors leverage their high sensitivity, accuracy, and cost-effectiveness. Various electrochemical techniques (CV, LSV, DPV, SWV, CA, CP, EIS, PEC, and ECL) and NM-based modifications (metal nanoparticles, metal oxide NMs, carbon NMs, polymers, and biomaterials) enhance sensor performance. Advances in nanotechnology, such as molecular imprinting and the use of porous organic frameworks (POFs) and carbon nanodots (CNDs) from recycled materials, further improve sensitivity, selectivity, and stability. The development of portable and cost-effective sensors using these techniques is crucial for real-time water quality monitoring and pollution control.