

# Long-term mortality patterns in a residential cohort exposed to inorganic selenium in drinking water

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## Background and aims



Selenium (Se) is a metalloid of considerable nutritional and toxicological importance in humans. To date, limited epidemiologic evidence exists about the health effects of exposure to this trace element in drinking water. We investigated the relationship between Se levels in water and mortality in the municipality of Reggio Emilia, Italy, where high levels of Se were previously observed in drinking water, constituting a natural experiment setting.

Figure 1. Map of Reggio Emilia municipality, Northern Italy.

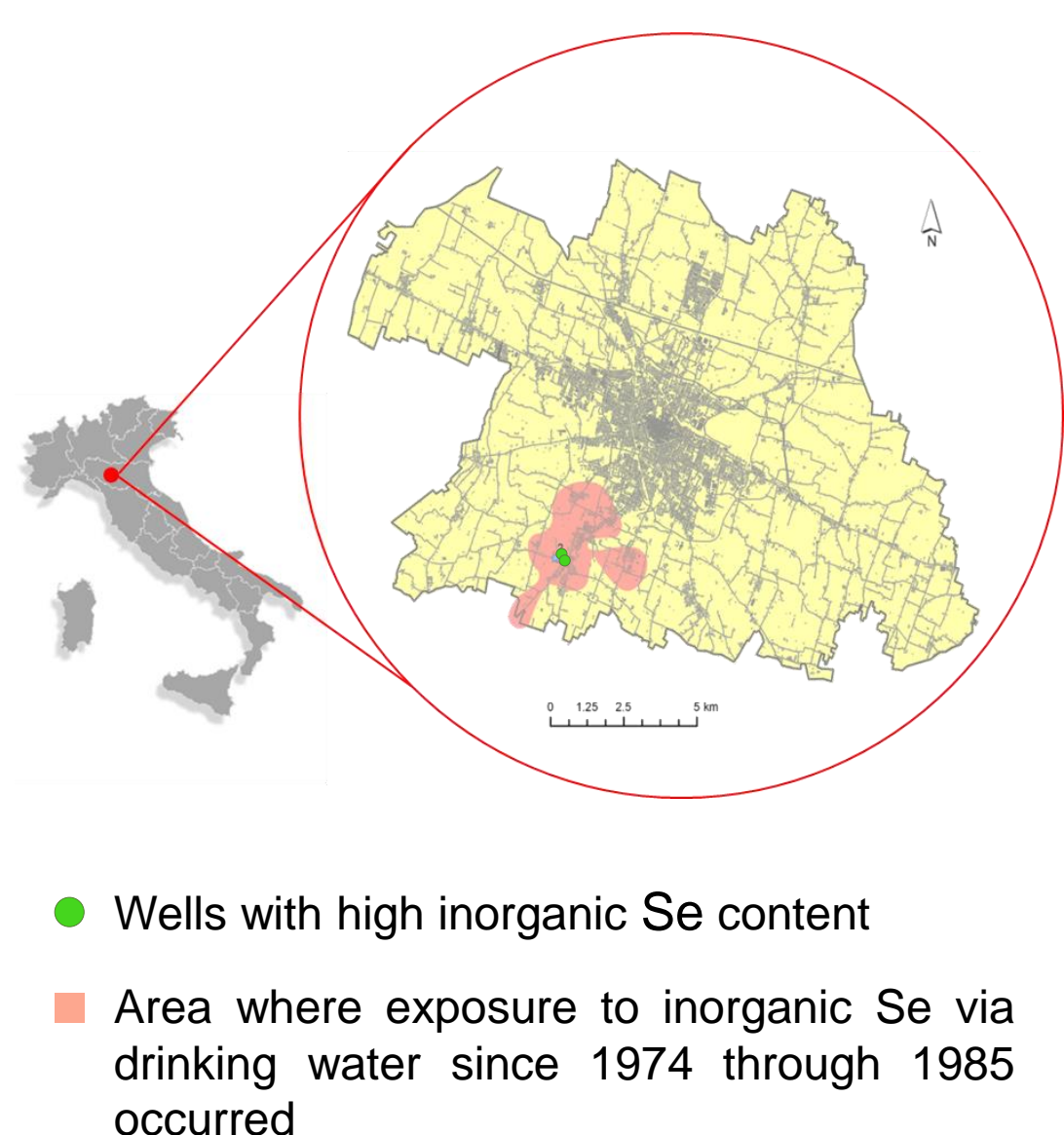
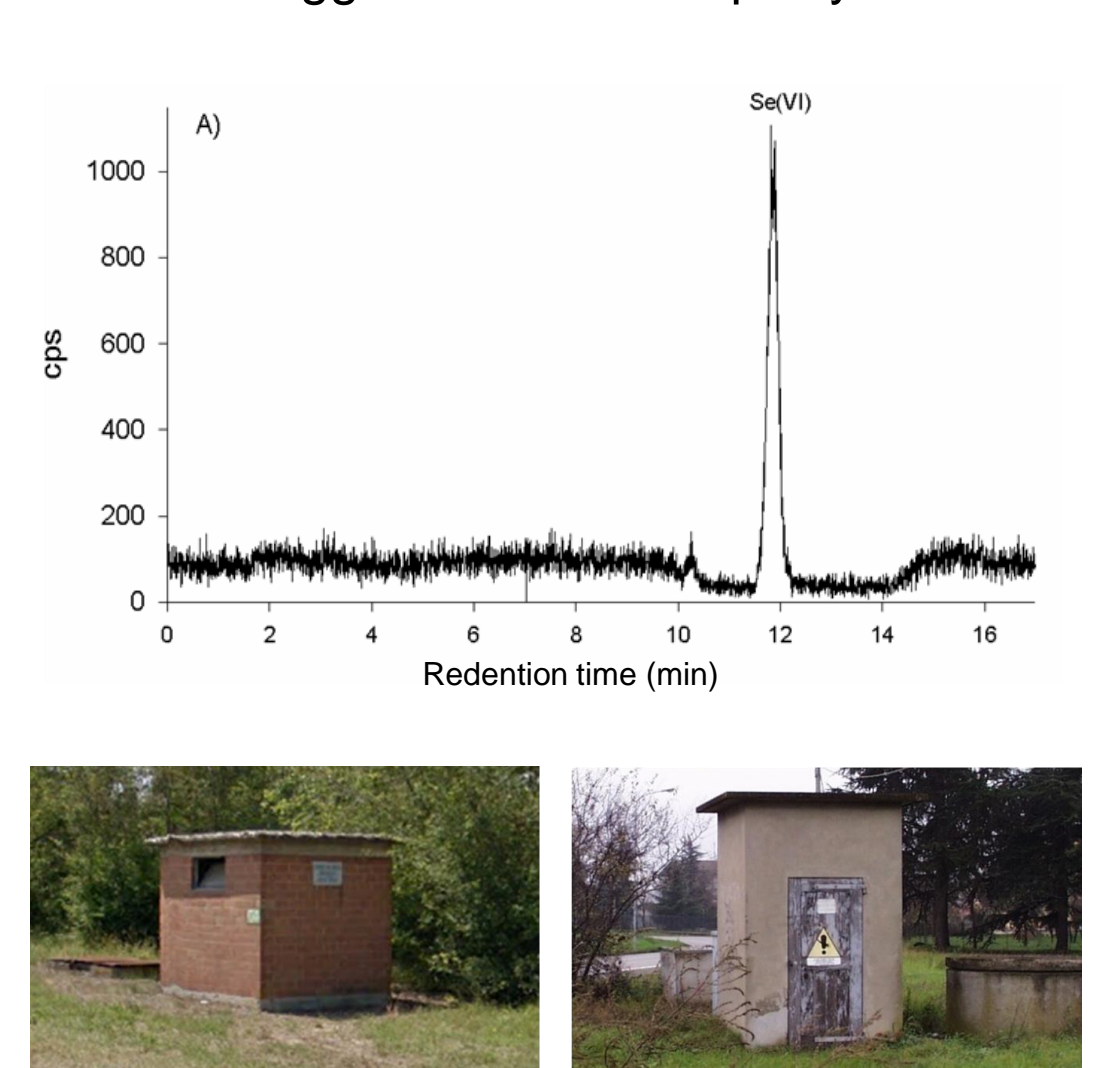


Figure 2. Chromatograms of Se speciation analysis for water samples with high inorganic Se content of two wells in the North of Reggio Emilia municipality.

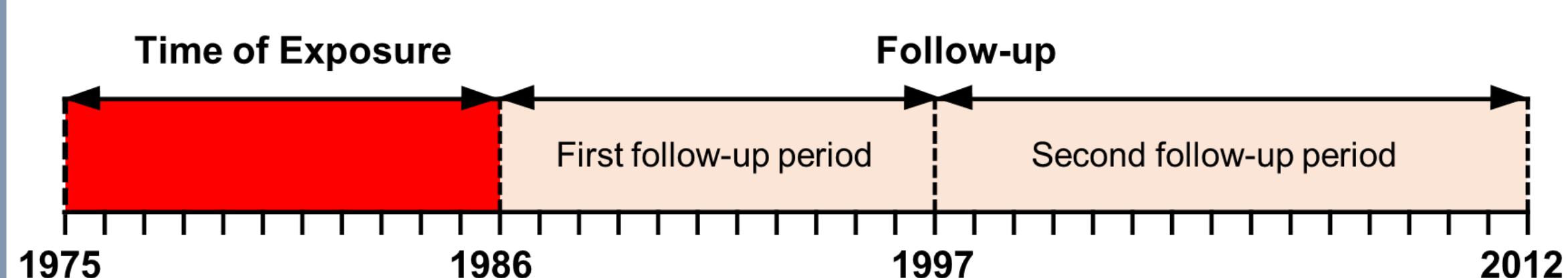


## Methods



From 1974 to 1985, 2,065 residents of Reggio Emilia municipality consumed drinking water with selenium levels close to the European standard of 10 µg/l standard, in its inorganic hexavalent form (selenate). Follow-up was conducted for the years 1986-2012, with the remaining 100,000 municipal residents, with comparable sociodemographic characteristics, as the comparison group.

Figure 3. Design of the retrospective cohort study, which involved residents of Reggio Emilia municipality exposed to hexavalent inorganic selenium through drinking water

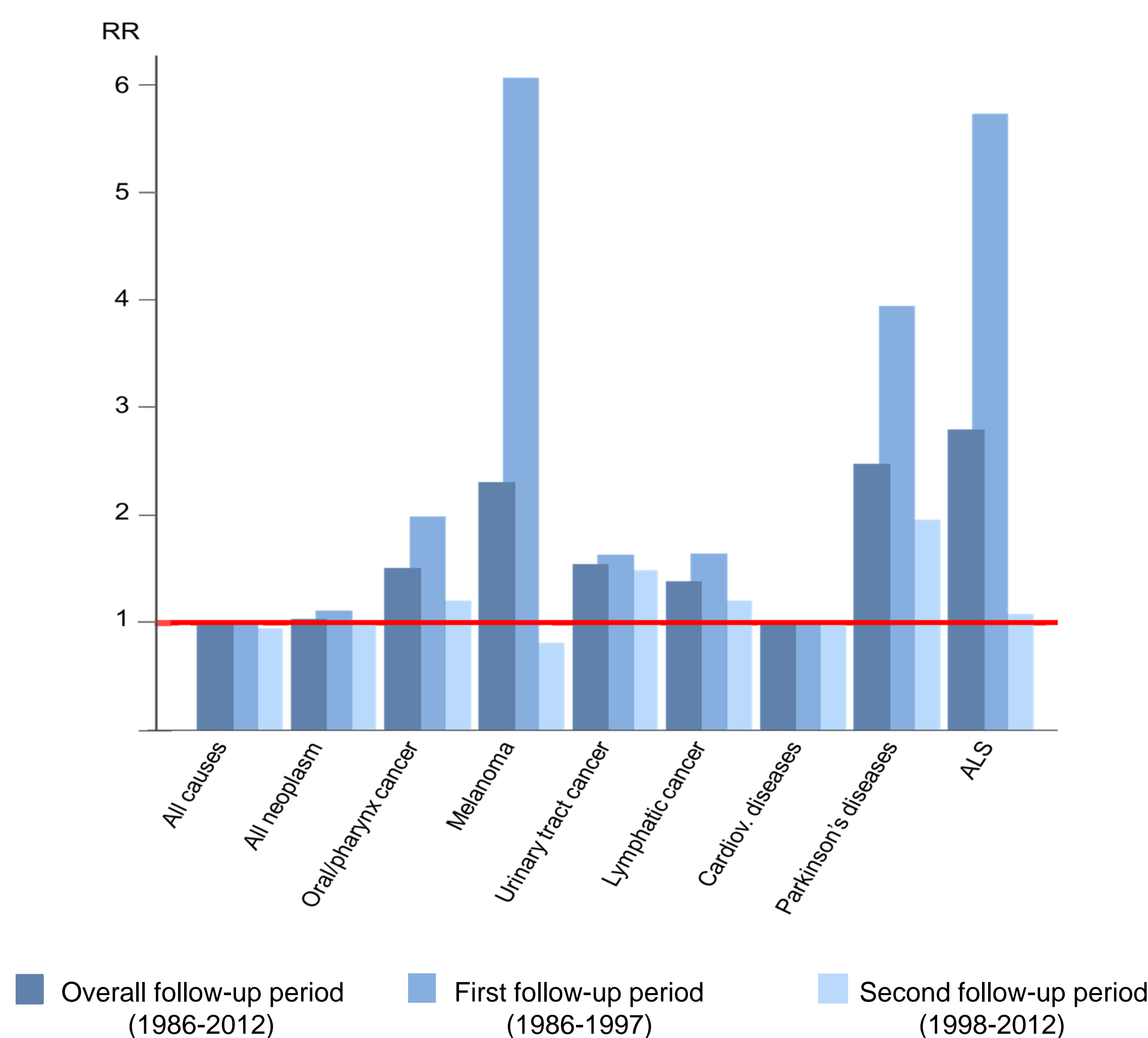


## Results



Overall mortality from all causes, cardiovascular disease and cancer showed little evidence of differences. However, we observed excess rate ratios for some site-specific cancers such as neoplasms of buccal cavity and pharynx, urinary tract, lymphohematopoietic tissue, melanoma, and two neurodegenerative diseases, Parkinson's disease and amyotrophic lateral sclerosis. Excess mortality in the exposed cohort for specific outcomes was concentrated in the first period of follow-up (1986-1997), and waned starting 10 years after the high exposure ended. We also found lower mortality from breast cancer in females during the first period of follow-up. When we extended the analysis to include residents who had been consuming the high-selenium drinking water for a shorter period, mortality rate ratios were also increased, but to a lesser extent. Overall, we found that the mortality patterns related to long-term exposure to inorganic hexavalent selenium through drinking water were elevated for several site-specific cancers and neurodegenerative disease.

Figure 4. Relative Risk of cancer and neurologic diseases in the population exposed to inorganic selenium through drinking water. Overall period 1986-2012 and two time windows (1986-1997 and 1998-2012) were considered.



## Conclusions



Overall, the mortality patterns related to long-term exposure to inorganic hexavalent selenium through drinking water were unfavorable, consistent with adverse effects on risk of some site-specific cancers and neurodegenerative disease, thus suggesting the need to reassess current drinking water selenium standard.