Using MWON to Assess Private Well Water Quality and Management in Pennsylvania

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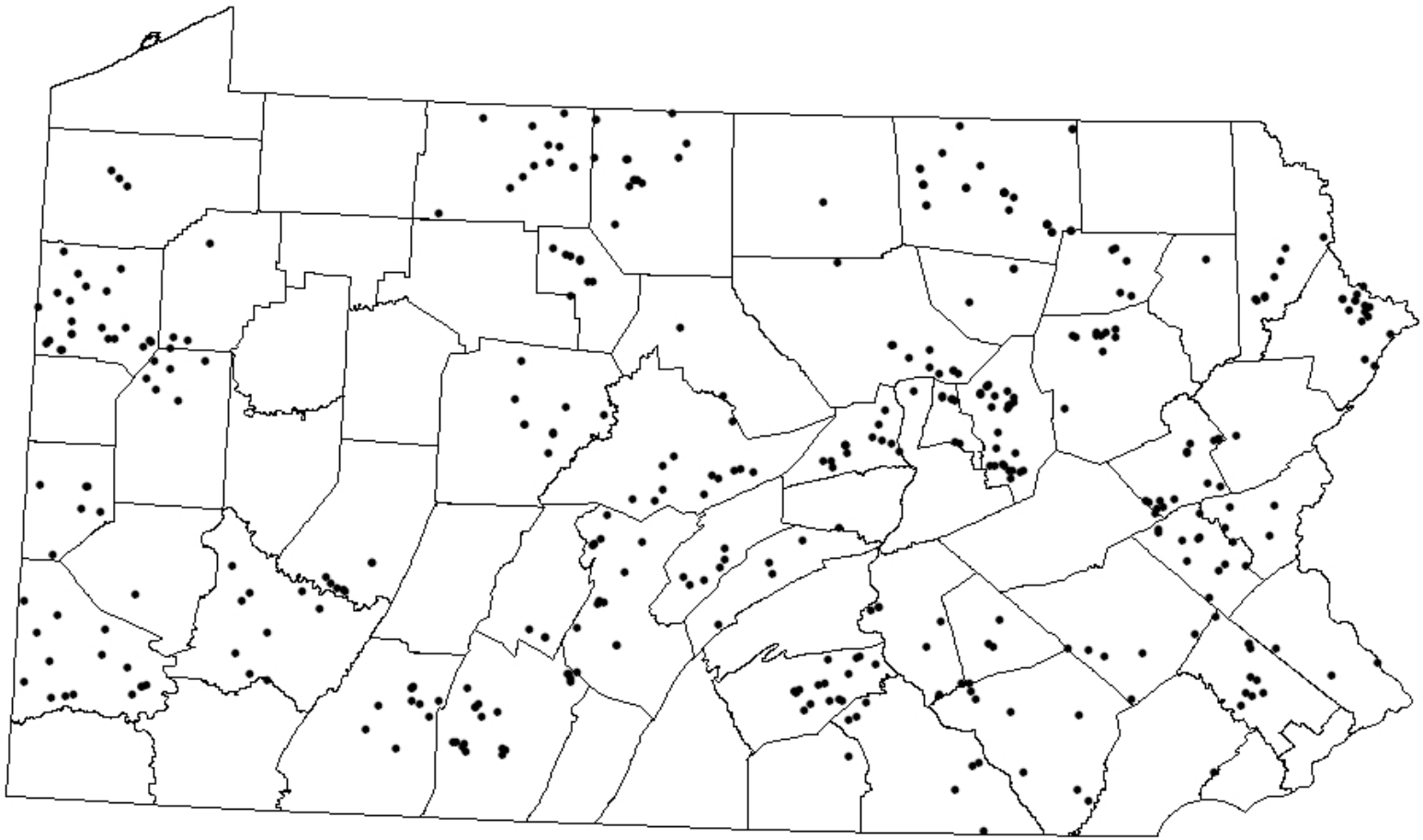
Research Questions

- How prevalent are health-related pollutants in private wells in comparison to past surveys?
- Does well construction influence water quality in private wells?
- What potential sources of contamination are correlated with well water quality?
- How effective is voluntary versus regulatory management of private wells in reducing health risks?

Methods

- Private well study
  - 450 private wells (no springs, cisterns) sampled (April - October 2006)
  - Raw water samples collected by trained Master Well Owner volunteers
  - Analyzed for coliform bacteria, *E. coli*, pH, lead, arsenic, nitrate, triazine pesticides, hardness, and total dissolved solids
  - Source tracking of *E. coli* bacteria
  - Homeowner survey and volunteer survey to collect information about the well and management

Location of 450 Private Wells Tested During 2006



71 MWON Volunteer Wells
379 Homeowner Wells

Results
Well Construction

- Well log
  - Only 9% have their well log

- Well Construction
  - 14% had buried wells
  - 16% had a sanitary well cap
  - 16% were reported to be grouted
  - 4% had both grout and sanitary well cap

Results
Wastewater Characteristics

- 91% have on-lot wastewater systems
  - 71% traditional septic system
  - 17% sand mound
  - 2% alternative system
  - 1% don't know what happens to their wastewater !

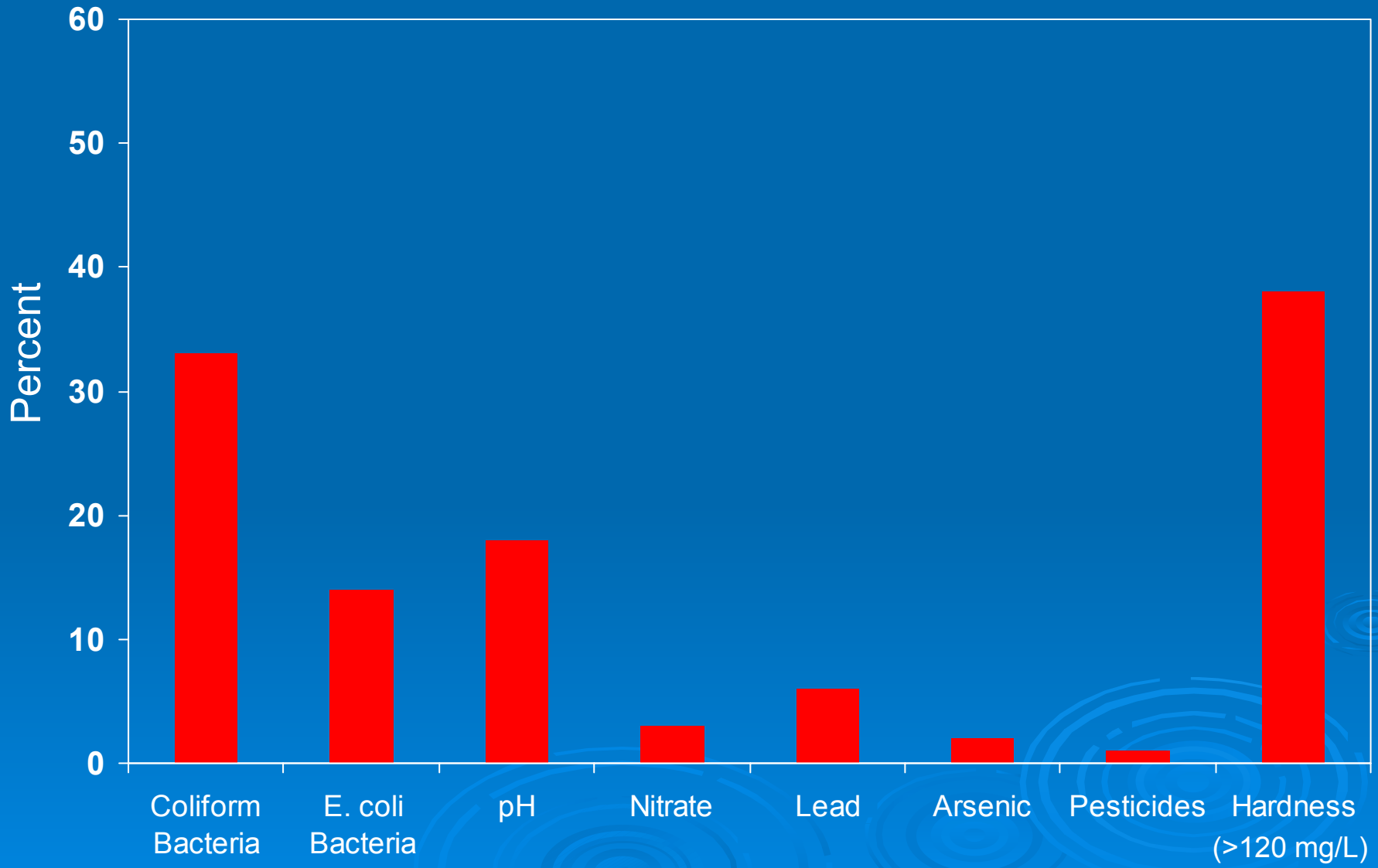
- Septic tank pumping
  - 29% never pumped !
  - 34% pumped > every four years
  - 37% at least every three years

Results
Water Treatment

- Water Treatment
  - 53% have some water treatment
  - Most common = softeners, sediment filters, oxidizing filters, UV lights, carbon filters
  - Average cost to install = $1,147, maximum = $7,000

- About 10% of homes had treatment equipment that did not APPEAR to be necessary based on water testing and information from homeowner. Agrees with similar study in central PA in 2005.

% Wells Failing Drinking Water Standards



Comparison of Results to Past Studies

- Bacteria and pH contamination similar to that reported by Sharpe et al. (1985).
- Nitrate and lead contamination lower than those reported by Swistock et al. (1993).
  - Lead = 19% in 1993, 6% in 2006 (1991 Lead Ban effect?)
  - Homes with high lead had wells drilled prior to 1991
  - Nitrate = 14% in 1985, 9% in 1993, 3% in 2006.
- Arsenic results were nearly identical to USGS results from 2000.

Logistic Regression

- Allows for inclusion of many factors that might explain contamination including:
  - Well construction characteristics
  - Nearby land uses
  - Septic system construction, location and maintenance

- Preliminary results for analysis of coliform bacteria contamination indicates the following parameters are important:
  - Well Depth – wells less than 80' deep nearly twice as likely to have bacteria than those greater than 80'
  - Extended well casing – buried wells more likely to have bacteria
  - Distance to pasture – of all the nearby land uses, the distance to a pasture was most correlated to bacterial contamination
  - Septic system maintenance – while distance to septic system was not significant, the maintenance interval was important.
  - Ground slope – wells in depressions more likely to have bacteria

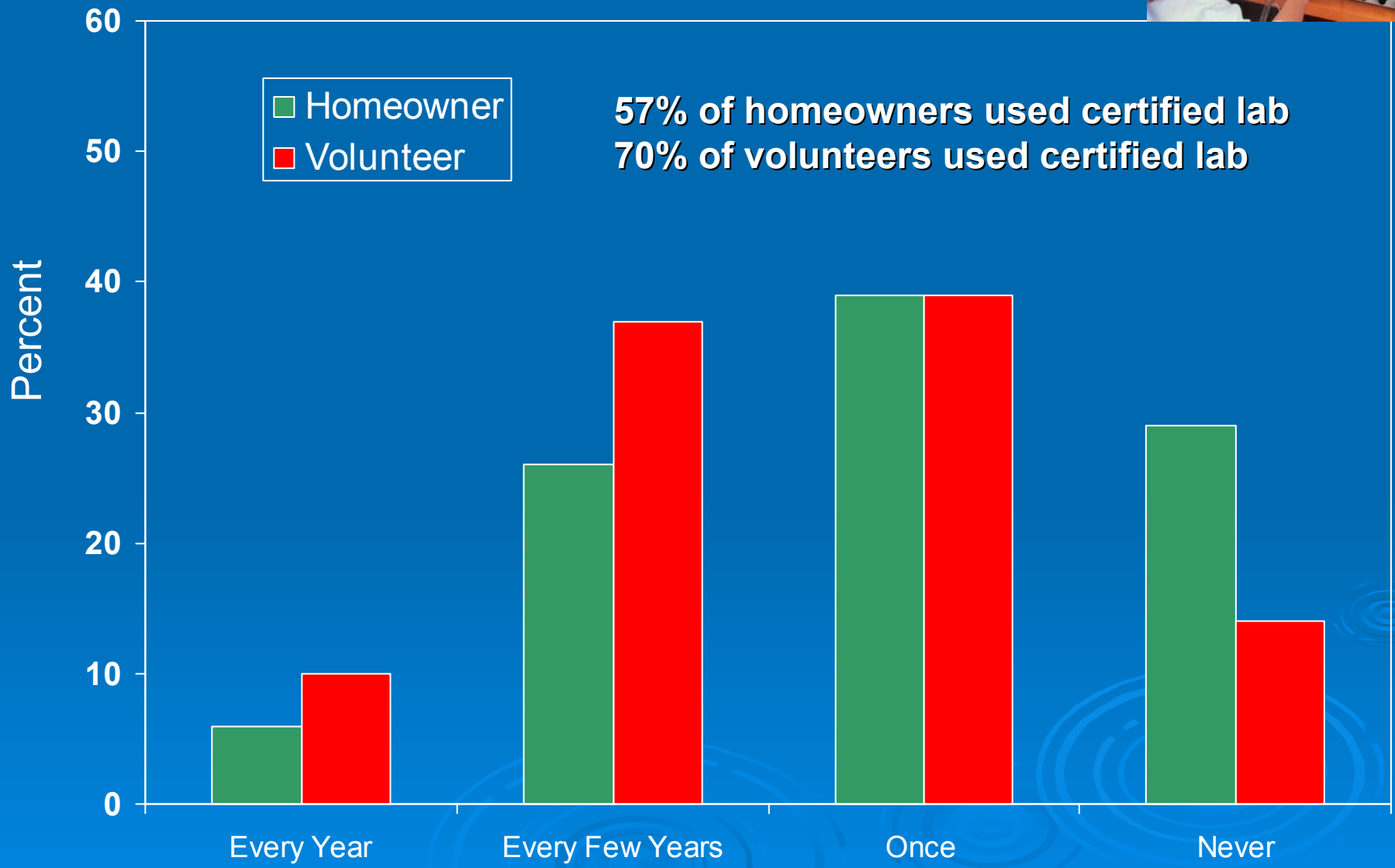
- Additional factors may become important with more samples and greater information (i.e. geology).

Additional Observations

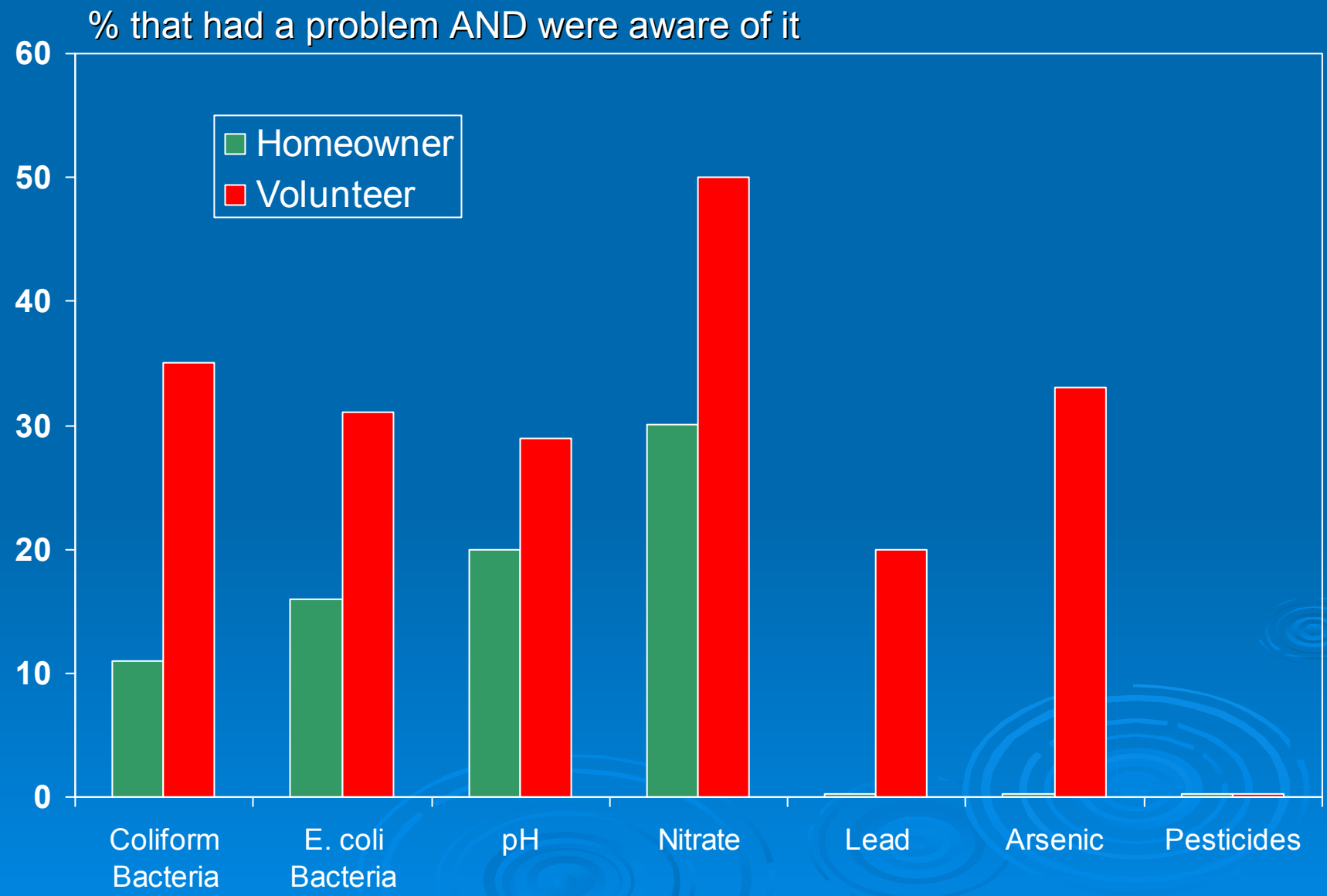
- Homes with a septic system were more likely to have bacterial contamination than those on centralized wastewater systems. This trend was more pronounced for *E. coli* bacteria.
- Wells at homes with septic systems that had malfunctioned were more than twice as likely to have bacteria contamination.
- Wells that had a history of turbidity problems were more likely to have bacteria (64%)
- Source tracking of *E. coli* will provide more useful information on the causes of bacterial contamination.


Voluntary Well Management
(How Good to Homeowners Do?)

Water Testing



Education Increases Awareness of Health-Related Problems



Does Awareness Translate to Action?

- Only 33% of MWON volunteers had installed their sanitary well cap
- Well owners that were aware of health-related problems in their water were likely to take action to avoid it
  - 61% of those that knew of coliform contamination had installed disinfection treatment or only drink bottled water
  - 83% of those that knew of E. coli took the same actions
- For aesthetic pollutants like hardness and iron, the percentage that chose to avoid the problem was near 50%

Activities in 2007

- Additional Wells
  - 250 additional wells focused on areas poorly represented in 2006 for a total of 700 wells
  - Same protocol as 2006
- Follow-up evaluation of 2006 participants to determine voluntary actions taken
- Additional sampling of a subset of 2006 participants (action versus non-action)

Master Well Owner Network

http://mwon.cas.psu.edu