SP.722 (D-Lab) Spring 2005
Session #9 notes

Lab #1: Water Testing

Chemical Tests

Chlorination is in theory available in many communities, but its effectiveness depends on frequent monitoring for chlorine levels. A typical test set uses a pair of test tubes that test for free chlorine and for residual chlorine. It comes with a color matching wheel or other scheme to measure the concentration. Some residual chlorine is a good thing, to treat post-treatment contamination.

With similar types of kids, you can test for many chemicals in the field – e.g. arsenic, nitrates – and a typical kit costs ~$80.

Coliform

Fecal coliform bacteria is used as "indicator" that water may make you ill. This bacteria may not necessarily be what causes the illness, but it's usually found with other sources water contamination.

Various tests have been developed. For instance, one system uses UV light to make fecal coliform fluoresce. The drawback is this test only gives you a yes/no answer, no indication of concentrations.

Q: What about viral testing?
A: Viral tests do exist but they're only suited for lab use today. Remember, the goal is to use indicator tests for overall water quality. Coliform is a generally accepted indicator.

Membrane Filtration

A standard sample (i.e. 100 ml) is cultured to indicate contamination levels. Draw the water sample through a piece of filter paper, then culture the paper in a Petri dish.

Several variations based on cost, lab vs. field suitability, ease of use and quality of results.

When you run a field test, use the 100ml WhirlPak® to collect each sample.

Some filtration systems are well suited for high volume lab work in the U.S. but too expensive for developing country field work. Example: Millipore Microfil S Filtration Device. This kit includes a measured container with pre-installed filter paper and fitting for tubing into a syringe. Unfortunately, once used the entire kit (~$6) has to be thrown away.

Next step down: a stainless steel fixture ($800!), in which you install filter paper. But this allows you to reuse the "container fitting" portion of the kit.

Both of these approaches are prohibitively expensive for development projects. This need is targeted by the low cost D-Lab solution with baby bottle inserts. Diameter of the bottle is about 2mm different than the filter paper, leading to 3 extra parts (metal washer, rubber washer, and a plastic insert to connect to the tube). But $13 fixed cost plus a few cents per sample is hard to beat.

Photos show students assembling the testing kit. The water sample is placed in the baby bottle insert. Filter paper is placed over the top of the baby bottle, and then washers and screen are sterilized in alcohol and flame. Finally, 100 ml of the water sample is pulled through the paper.

To incubate the sample, use Amy's phase change incubator. Setting the balls in the sun in the morning is often enough to melt the chemical.

Q: With the D-Lab water filtration and the phase change incubator, how "trusted" are the results? Will they stand up to peer-reviewed journal publication?
A: May not withstand the statistical expectations of journals, although it hasn't been verified. But it's certainly "within 10%" which is good enough for community-based water testing.

Turbidity

D-Lab has created a low-cost turbidy meter: a tube with marks, a disk with checkerboard pattern at the bottom. See the photo below. Fill the tube with the sample and stop filling when you can't make out the individual squares anymore. Note this tube stops at 4 NTU (turbitidy units), and most drinking water is closer to 1-2. A practical tube (measures to 0.25) would be ~10 ft tall, prohibits looking down to the end. Charles River was just tested at 3.2 and you'd never drink this.

A commercial optical turbidity meter measures using attenuation of reflected light.