

Evaluation of household microbial water quality testing in a Pilot Peruvian Demographic and Health Survey using the portable compartment bag test (CBT) for *E. coli*

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Introduction

- Most drinking waters in the developing world are never tested for microbial safety
- Water quality tests are not accessible, too complicated and costly
- “Improved” does not always mean “safe” water
- Compartment Bag Test (CBT) overcomes problems facing microbial water quality testing in the field

Hypothesis: Microbial water quality results at household level in the field can be obtained by the CBT, comparable to a standard laboratory method

The Compartment Bag Test (CBT)

- Clear plastic bag with 5 compartments totaling a sample volume of 100mL (1, 3, 10, 30, 56mL)
- Uses the Most Probable Number Method (MPN) to detect WHO *E.coli*/100mL low to high risk ranges (0, 1-9, 10-99, 100+)
- Easily read color with chromogenic medium for *E.coli*
- No need for a cold chain, simple to perform, portable, low-cost



Bag Combo	Compartment Volume, mL					MPN/100 mL	95% CI
	1	3	10	30	56		
1	-	+	+	+	+	48.3	[7, 352]
2	-	-	+	+	+	13.6	[2.2, 83.1]
3	-	-	-	+	+	4.7	[0.9, 22.8]
4	-	-	-	-	+	1.5	[0.2, 7.8.0]

All positive: >48.3 MPN/100 mL
No positive: <1.5 MPN/100 mL

32 possible combinations
Common results shown here

Methods

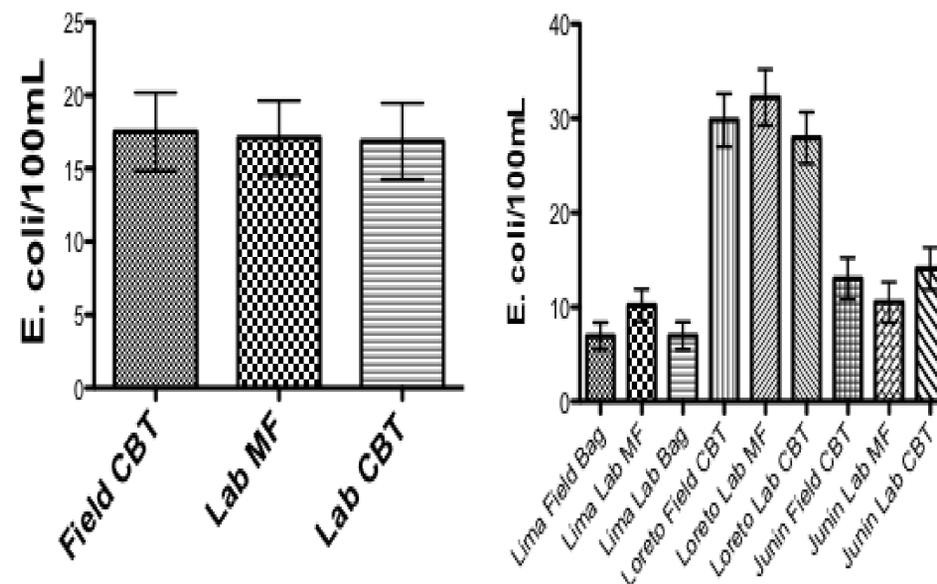
- 3 geographically diverse regions were chosen for the pilot (coastal/Lima, mountainous/Junín, jungle/Loreto)
- A member of the Peru National Institute of Statistics and Information (INEI) survey team used the CBT to analyze one of the 100mL samples in the field
 - Incubated inoculated sample overnight (18-28 hours) at 37°C or ambient temperatures (25-32°C) in modified electric incubator with alcohol burner
 - Decontaminated the CBT bag and contents with chlorine (134 mg NaDCC) for safe disposal after performing the test and reading the results
- Other two 100mL aliquots of each collected water sample were submitted to a regional reference lab for analysis
- One volume analyzed for *E. coli* by CBT (same as INEI survey staff)
- One volume analyzed for *E. coli* by membrane filtration
- Reference lab samples incubated overnight (20-28 hours) at 37° C

Results

Statistical Summary of the Results: Field CBT, Lab MF and Lab CBT

	Field CBT (<i>E. coli</i> in MPN/100mL)	Lab Membrane Filtration (<i>E. coli</i> /100mL)	Lab CBT (<i>E. coli</i> in MPN/100mL)
Number of Households	665	665	665
Mean	17.46	17.22	16.84
Median	0.0	0.0	0.0
Maximum	101.0	101.0	101.0
Lower 95% CI	14.79	14.68	14.25
Upper 95% CI	20.12	19.76	19.44

Comparison of *E.coli* detection in household water between CBT field, CBT lab and MF lab at 3 regional locations in Peru



Means and 95% CI for each test

Means and 95% CI by location

Statistical Comparisons of the Results in all Locations and by Site

Comparison	p-value for Friedman's Test Non- Parametric Repeated Measures ANOVA ^a and Wilcoxon matched-pairs signed-ranks tests ^b	Spearman's Rank Correlation(R)*
All Locations	0.25 ^a	0.88
Field CBT vs. Lab CBT	0.50 ^b	0.80
Field CBT vs. Lab MF	0.84 ^b	0.76
Lab CBT vs. Lab MF	0.43 ^b	0.88
Lima		
Field CBT vs. Lab CBT	0.68 ^b	0.81
Field CBT vs. Lab MF	0.07 ^b	0.60
Lab CBT vs. Lab MF	0.14 ^b	0.62
Loreto		
Field CBT vs. Lab CBT	0.29 ^b	0.90
Field CBT vs. Lab MF	0.37 ^b	0.88
Lab CBT vs. Lab MF	0.03^b	0.95
Junin		
Field CBT vs. Lab CBT	0.76 ^b	0.61
Field CBT vs. Lab MF	0.16 ^b	0.60
Lab CBT vs. Lab MF	0.08 ^b	0.88

Conclusions

- Samples incubated at ambient (25-33°C) or standard temperature in the field gave equivalent results to those of reference labs using standard incubation temperature
- No significant differences between CBT test in the field, the CBT in the laboratory and the membrane filtration method in the laboratory for *E.coli* detection in household drinking waters in geographically diverse areas
- Previously untrained survey staff are able to obtain statistically comparable results to laboratory technicians and ranked the CBT a 9.3 out of 10 for overall use
- Use of the CBT within this pilot demonstrates that microbial water quality testing within household health surveys is feasible
- The CBT is an effective tool that can be used to directly measure the microbial quality and safety of household drinking water and monitor progress towards the Millennium Development Goals water target in DHS, MICS and other surveys

Acknowledgements

- United States Agency for International Development
- El Instituto Nacional de Estadística e Informática (INEI)
- Instituto de Investigación Nutricional (IIN)
- Asociación Civil Selva Amazonica
- Dirección Regional de Salud Junín y Laboratorio



Presented at the Annual Meeting of the American Society For Tropical Medicine and Hygiene, December, 2011, Philadelphia, PA. USA