An Evaluation of Simplifying Modifications to the SenSafe Quick™ Arsenic II as a Method of Widespread Well Water Monitoring in North Carolina

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Background

- Arsenic is a known neurotoxin which affects children, an especially vulnerable population.[1]
- Regular monitoring may not be feasible in historically disadvantaged areas, often due to budget constraints.[2]
- Approximately one third of NC residents rely on well water and are responsible for the monitoring of their own wells.[3]
- More innovative, novel, and cost-saving approaches may be needed to monitor water safety in the areas, such as using low-cost field kits.
- Preliminary data shows that these field kits may be difficult for civilian use (Fig. 1.)
- The SenSafe Quick™ Arsenic II Test Kit was found to be a cost effective and reliable arsenic contaminant field kit.
- However, ease of use showed to be a limit in usability.
- Reagent 2, potassium peroxymonosulfate accounts for a hydrogen sulfide interference in the production of arsine gas, the analyte of the test method.
- Uncommonly found in drinking water, accounted for by smell.
- How might the SenSafe Quick™ Arsenic II Test Kit test procedure be simplified without compromising accuracy?

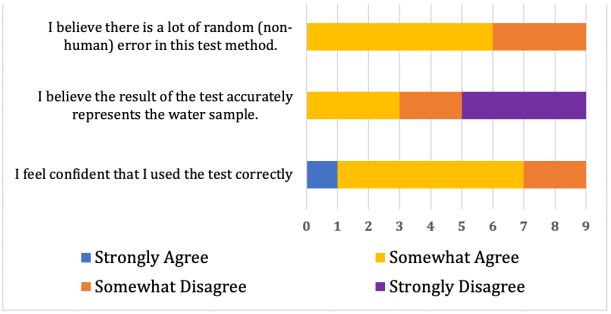

Fig. 1. Survey data collected regarding the ease of use of the vanilla Procedure. Users were generally unconfident in the test method.

Methods

- The SenSafe Quick™ Arsenic II Test Kit was used in all trials.
- Three test methods were investigated:
  - Vanilla (V): Original test procedure
  - Without reagent 2 (-2): Removed potassium peroxymonsulfate from the procedure.
  - Without reagent 2, combined steps 1 and 3 (-2, 1+3): Removed reagent 2, added reagents 1 and 3 in the same step.
- Each method was tested at 5, 10, and 15 ppb, in triplicate.
- Three group ANOVA was conducted to examine differences. $\alpha = 0.05$

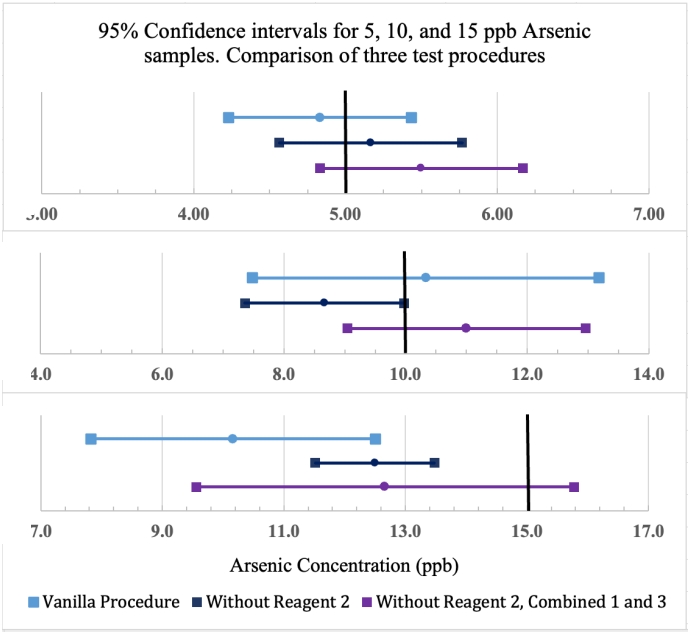

Fig. 2. 95% confidence intervals of 5, 10, and 15 ppb Arsenic (top to bottom). All intervals within each concentration overlap.

Results

- The p-values from each concentration are greater than the alpha of 0.05.
- We fail to reject the null hypothesis that there is a not difference in arsenic response between the test methods.

Table 1. Three-way ANOVA: Arsenic response of three different test methods at 5, 10, and 15 ppb As^{3+}

Test Method and Conc.		Sample mean (ppb)	n	Std. Dev	F	F-Crit	p-value
5 ppb	V	4.8	6	0.75	1.09	3.68	0.36
	-2	5.2	6	0.75			
	-2, 1+3	5.5	6	0.84			
10 ppb	V	10.3	3	2.5	1.22	5.13	0.36
	-2	8.7	3	1.2			
	-2, 1+3	11.0	3	1.7			
15 ppb	V	10.2	6	2.9	1.40	3.68	0.28
	-2	12.5	6	1.2			
	-2, 1+3	12.7	6	3.9			

Conclusion

- Significant simplifying modifications to the SenSafe Quick™ Arsenic II Test Kit were found to have no significant difference in test results among the three modifications.
- Removing reagent 2, as well as combining reagents 1 and 3 may be a viable method of increasing accessibility and usability of the SenSafe Quick™ Arsenic II Test Kit by untrained civilians while maintaining acceptable accuracy.

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