Evaluating at-home E-Coli testing solutions to improve water quality testing in Eastern North Carolina

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E. coli testing in Water Quality Monitoring

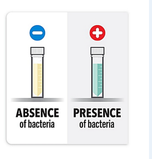
E. Coli is a significant drinking and recreational water contaminant that indicates the likely presence of other harmful microbes that can result in water-borne illness with contact[5].

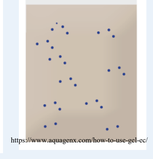
Current methods of E. coli testing

E. coli testing typically requires a lab procedure called membrane filtration that can be costly and time consuming. However alternate methods of E. coli culturing is being explored[3].

- **The Aquagenx GEL EC CFU Test allows for successful E. coli culturing in ambient air temperatures above 25℃ (77°F) [6]. The SafeHome DIY BACTERIA test kit provides a twostep presence- absence testing option. [7]**

https://www.amazon.com/Safe-Home-BACTERIA-Drinking-Water/dp/B0897VF4B7?th=1





https://www.aquagenx.com/how-to-use-gel-ec/

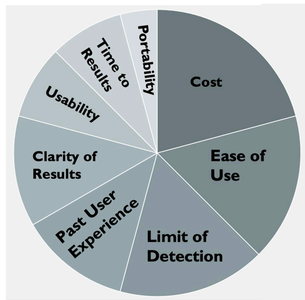
NC Water Quality Monitoring Accessibility

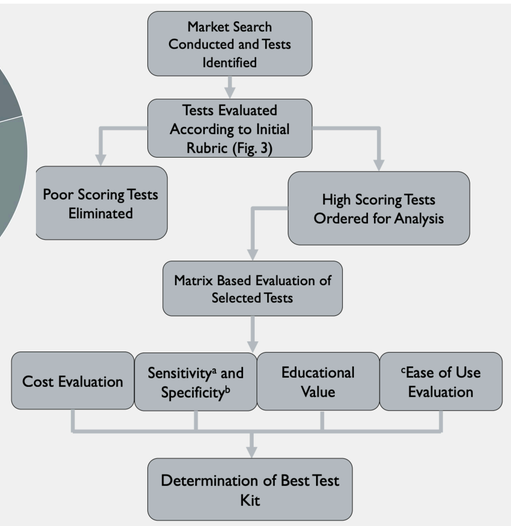
- **33% of the NC population rely on well water that is not regularly tested for contamination[8].**
- **Membrane Filtration lab testing for E. coli is not always accessible for households relying on private well water.**
- **Determining cost efficient, accurate E. coli test would increase at-home testing and accessibility to water quality monitoring in NC.**

Research Focus and General Methods

- **Immediate goal was to find an affordable, specific, sensitive, and easy-to-use at home E Coli test**
- **Incorporate findings into a testing kit that can be used in high schools in rural areas, potentially being implemented into curriculum as both an educational opportunity and assessment of students' water quality.**
- **Select tests based upon ease of use and cost first, then experimentally evaluate sensitivity and specificity of E. coli tests by comparing performance to membrane filtration.**

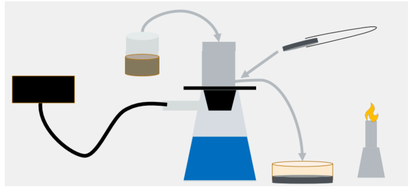
Test Evaluation Process





This figure depicts relative weighting of criteria for determination of initial test kits, with scores for selected tests. a. Sensitivity refers to the ability of the test to detect true positives. b. Specificity refers to the ability of the test to detect true negatives. c. Ease of use evaluation pending IRB approval.

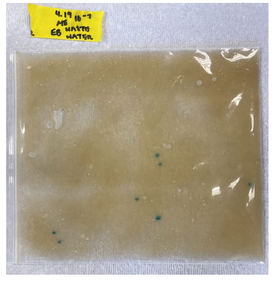
Membrane Filtration Apparatus

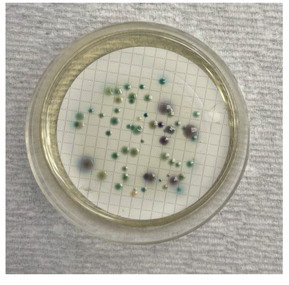


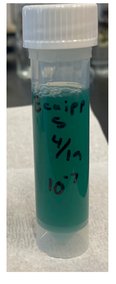
OWASA wastewater was used at different dilutions for membrane filtration, Aquagenx GEL, and SafeHome DIY. Below are images of one set of results all at the same wastewater dilution:

A membrane filtration apparatus was constructed using a vacuum Erlenmeyer flask connected to a vacuum line. Flame sterilized forceps were used to transfer filter paper to the apparatus and sample water was pulled through via vacuum. Filter paper was then transferred to agar to be stored and counted. Membrane filtration was performed in triplicate and used as gold standard.[9]

Experimental Evaluation







Specificity and Sensitivity Evaluation Raw Data

Wastewater Concentration	Membrane Filtration	Aquagenx GEL	SafeHome DIY
blank	• 0 CFU • 0 CFU • 0 CFU	0 CFU	Negative
10^-9	• 1 non-E.coli coliform • 0 CFU • 0 CFU	0 CFU	Negative
10^-8	• 0 CFU • 1 non-E.coli coliform • 0 CFU	0 CFU	Negative
10^-7	• 2 non-E.coli coliform • 0 CFU • 0 CFU	0 CFU	Negative
10^-6	• 5 E. coli coliforms/ 20 non-E.coli coliform • 5 E. coli coliforms/ 37 non-E.coli coliform • 4 E. coli coliforms/ 38 non-E.coli coliform	3 CFU	Positive
10^-5	• 25 E. coli coliforms/ 130 non-E.coli coliform • 31 E. coli coliforms/ 88 non-E.coli coliform • 41 E. coli coliforms/ 150 non-E.coli coliform	19 CFU	Positive
10^-3	TNTC TNTC TNTC	TNTC	Positive

Experimental Design and Next steps

Next steps include:

- **Statistical analysis of the Aquagenx GEL, Membrane Filtration, and SafeHome specificity and sensitivity results.**
- **Further testing to obtain a greater amount of data to be used for specificity and sensitivity evaluation.**
- **Incorporation of previous data with data from this semester to use findings in an educational or household setting.**

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