ozwater18

Brisbane, Queensland, Australia
May 9, 2018

AUTOMATED, RAPID MICROBIAL DETECTION SYSTEM FOR REMOTE TESTING OF *E.COLI*, COLIFORMS, AND ENTEROCOCCI BACTERIA

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Presented by: Douglas Wilton, P. Eng., President
www.tecta-pds.com

TECTA - PDS

TECTA - PDS

- Formed in 2003 based on water monitoring technology developed at a major Canadian University - Queen's University
- Direct response to Walkerton, Ontario *E. coli* contamination drinking water disaster
- Acquired by Veolia Water in 2009 and re-branded as ENDETEC
- Management led buyout in 2016
- Sales in over 25 countries

TECTA - PDS

- Our Mandate: To revolutionize the microbiological monitoring of water
- The Problem: Inadequate microbiological testing – ancient methods lead to water quality and human health problems
- We can and should do better.
- The Solution: Lab equivalent, Fully automated, Rapid, EPA approved, microbial detection system

Why a revolution?

E. coli Detected!

Boil water advisory issued for Picture Butte

Alberta Health Services says water should be boiled for at least a minute before consumed

CBC News Posted: Feb 20, 2014 12:50 PM MT | Last Updated: Feb 20, 2014 12:50 PM MT

Facebook 0 Twitter

People in Picture Butte are being told to boil their water.

1.3 million Montrealers face boil water advisory

Residents should expect advisory to last a minimum of 24 hours

CBC News Posted: May 22, 2013 10:46 AM ET | Last Updated: May 23, 2013 9:06 AM ET

98 cases
coli outb

Monday 22 October 2012 20.21

1 of 2

There are a further 175 probable cases

Doylestown - Water restrictions remained in place at Linden Elementary School in Doylestown Wednesday, a day after it was revealed that fecal coliform showed up in a water test at the school.

News › World news › E coli

Coroner calls for stricter controls after E coli death

to Opelika, Alabama Water Park

ark are investigating an E. coli O157:H7 outbreak linked to a water park in

Tap water warning in Copenhagen after E.coli found

Aug 21, 2011

TA-PDS

Why a revolution?

Walkerton Report – Causes:

- Lack of technology
- Centralized testing
- Storage and transport of samples
- Long overall test time
- Manual test method
- opportunity for human error / human negligence
- Regulatory shortcomings
- ***INADEQUATE TESTING***

7	2,300	46%
Dead	People Sick	Population

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The Solution

E. coli Detected!

- **Walkerton Report – Solution / Government checklist:**

- ☑ **Automated test**
- ☑ **Testing done on-site, on-line**
- ☑ **No storage or shipping**
- ☑ **Overall test turn-around at most one day**
- ☑ **No visual estimation or judgment**
- ☑ **Replace human sample manipulation/ intervention/decision making with Intelligent System using objective, pre-set criteria**

TECTA™ B16
Rapid, Automated Microbial Detection System

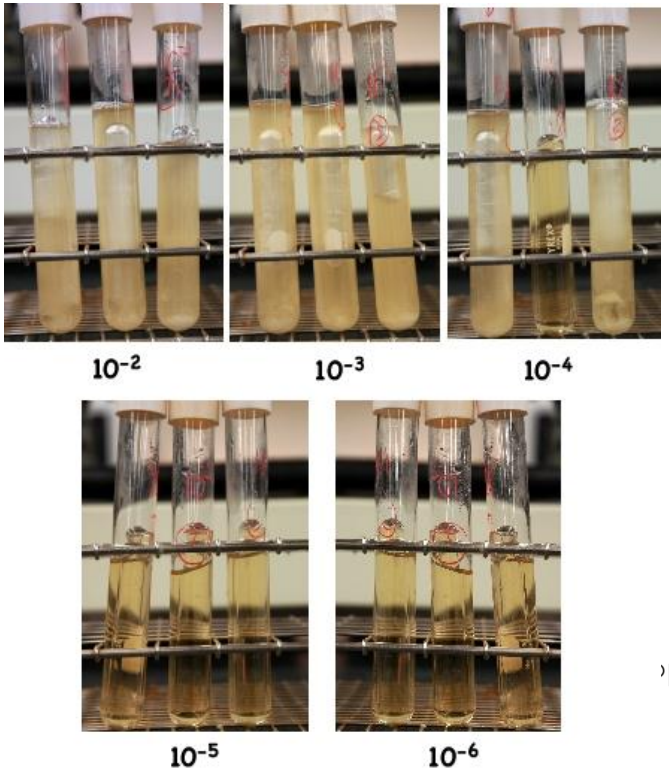
Conventional methods

Limitations of current methods

- Based on ancient technology
- Require a microbiology lab
- Take too long
- Visual interpretation required
- Prone to errors
- There are no better options
- Everyone accepts this as “state of the art”

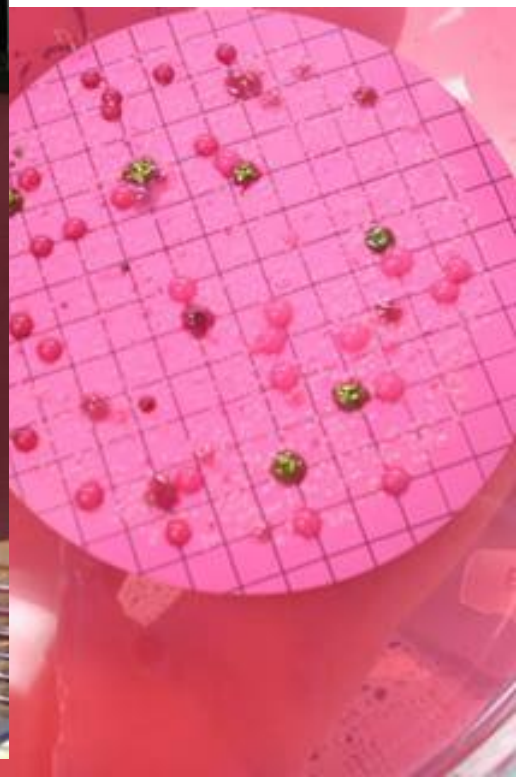
Conventional methods

- Test Tube Methods
  - Lactose fermenting bacteria
  - Presence of gas bubbles in positive tubes
  - P/A, or quantitative using multi-tubes & MPN
  - Originally developed: 1914
  - Still in use, though being replaced in most jurisdictions



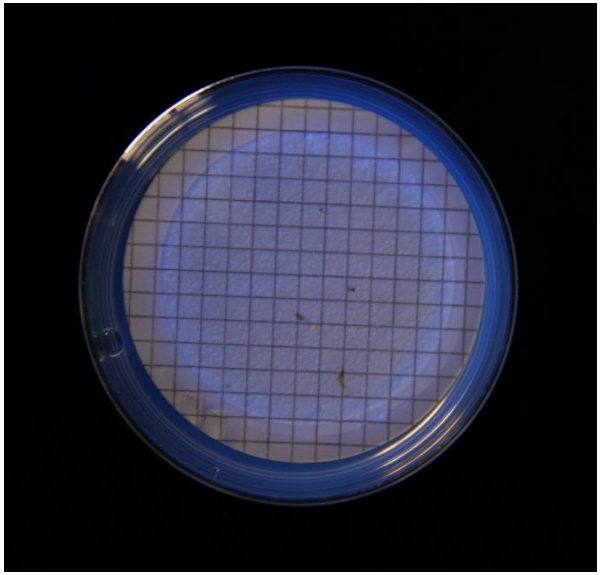
Conventional methods

- Membrane Filtration (traditional "plate" meth
  - Culture bact
  - Metabolism colonies
  - Lactose-fern pH change (
  - P/A or quant
  - Early versior



Membrane filtration

- **Limitations for Quantitation**



- dynamic range 0~80 CFU or sample dilutions required
- excess “general bacteria” can result in “over-grown” plate

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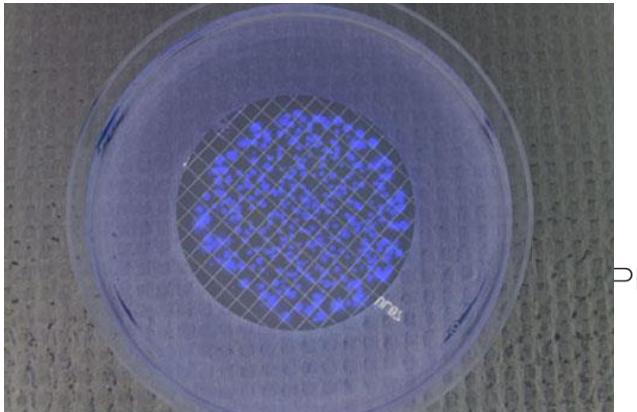
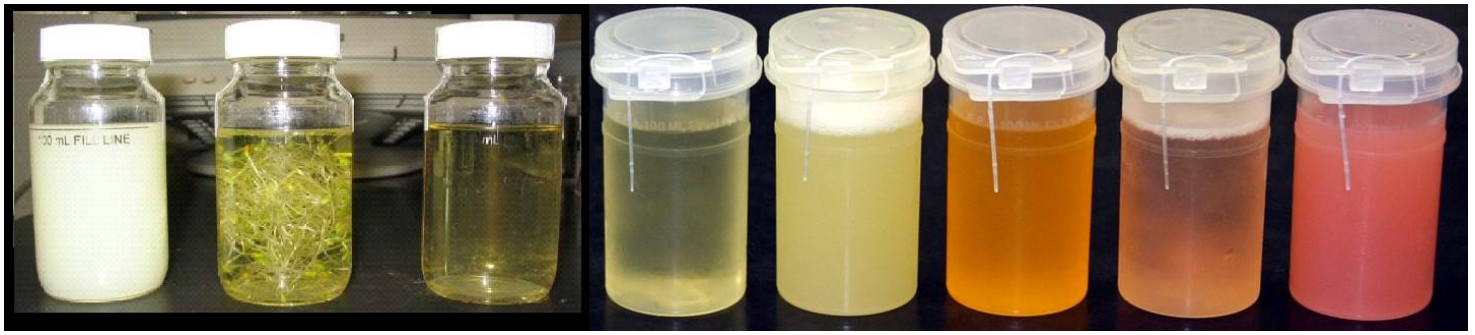
Enzyme methods

- Defined substrate methods (or Enzyme methods)
  - Colour change and fluorescence
  - Two method styles
    - Broth Culture - media powder mixed into sample
    - MF Plates
  - IDEXX Colilert, Colitag; Colisure; ReadyCult; E*Colite
  - P/A or quant by MPN (Quantitray or tubes); plate counting
  - In use since 1980s, replacing older methods

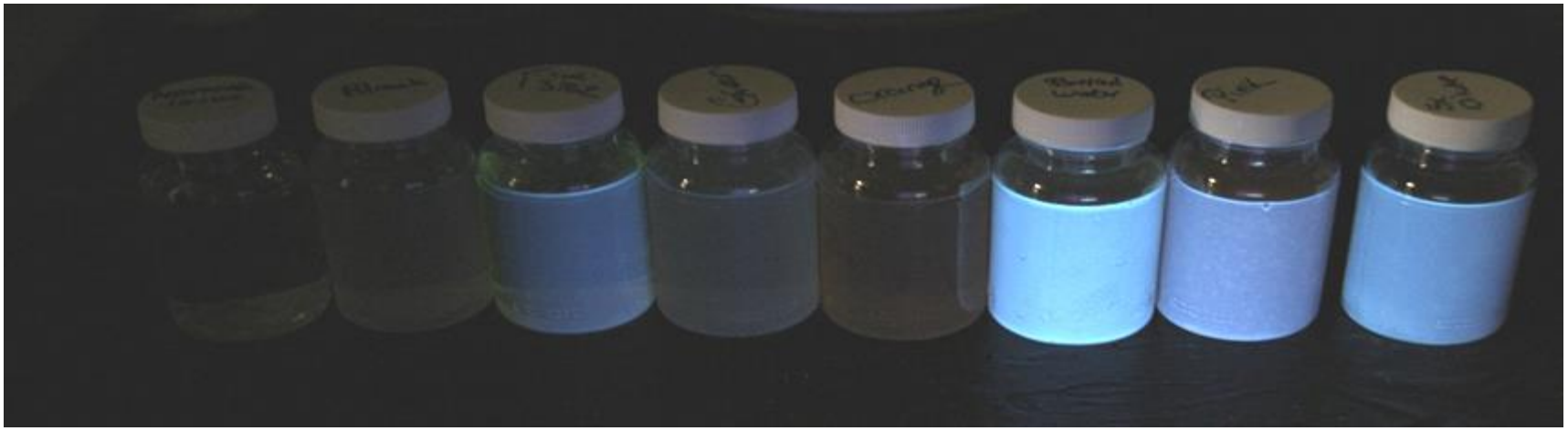


Enzyme methods

- **Limits for visual interpretation** – subjective



Milk | Sprouts | Apple Juice | Lake Water | Lemon-ade | Carrot Wash | Iced Tea | Pink Lemonade



Automated method

E. coli Detected!

- TECTA™ B16 Bench Top Testing System
- TECTAlert™ Consumable Test Cartridges

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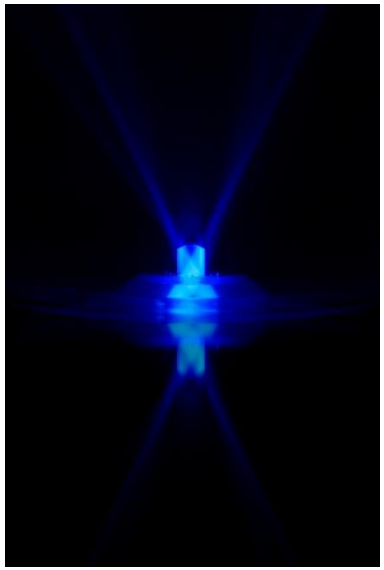
Automated method

- Selective broth culture with detection of enzymes identical to conventional tests:
  - glucoronidase for *E. coli*
  - galactosidase for coliforms
- Opto-chemical sensor extracts and automatically detects enzyme product
- Complete test and sensor in a single-use cartridge with pre-measured reagents
- Simple instrument that can be operated in the field
- Continuous automated interpretation and reporting of sample result



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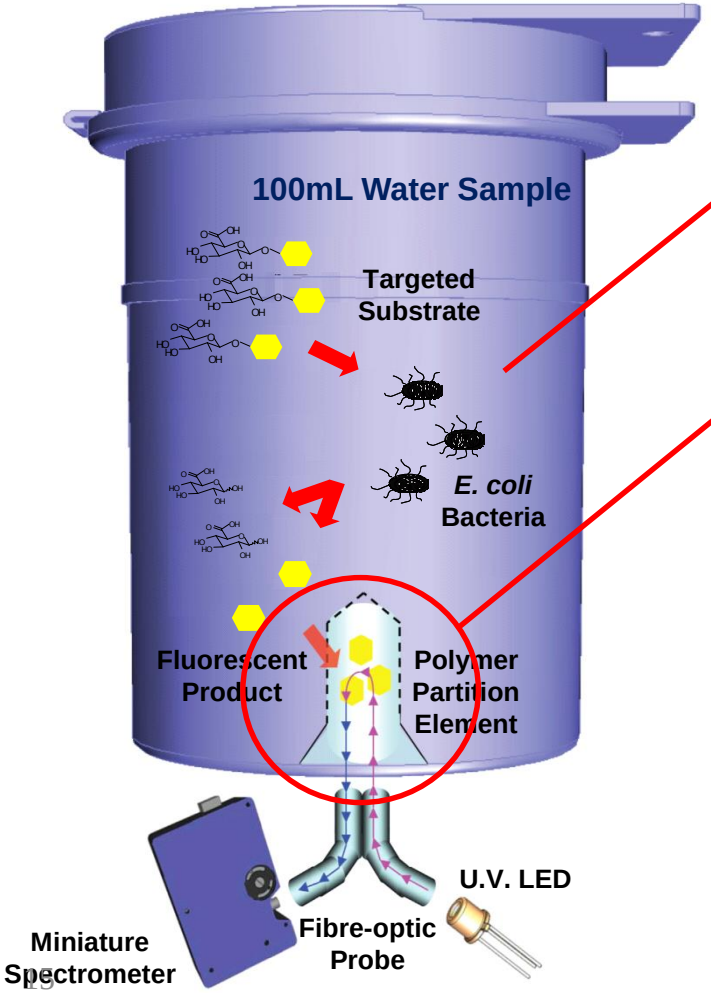
Tecta cartridge

E. coli Detected!

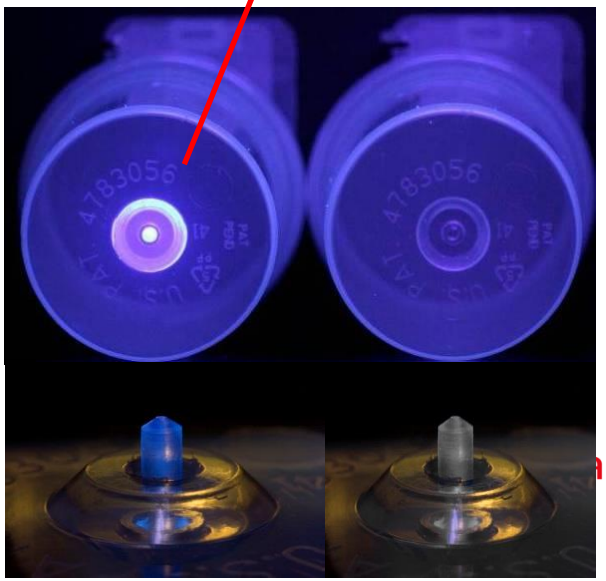
Enzyme-substrate / solution culture method



Detecting identical enzyme as conventional methods

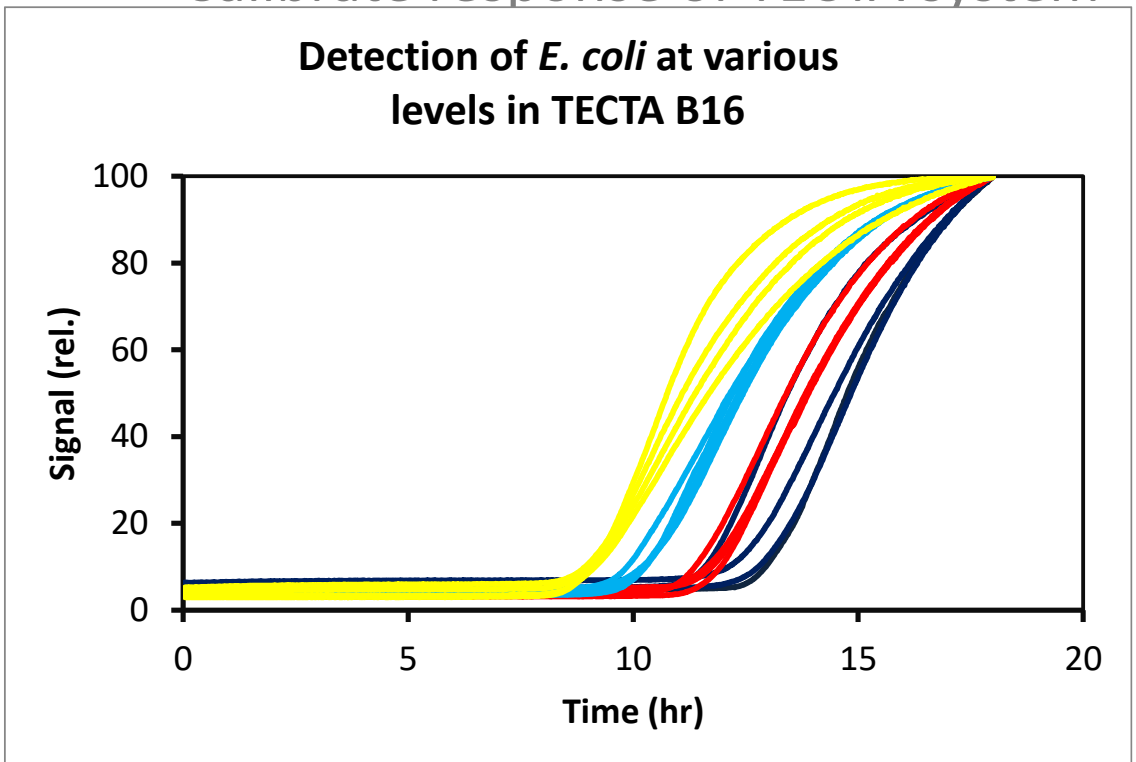
Extracting fluorescent markers outside of sample into polymer

Automated detection of fluorescence in polymer triggers result



Quantitative analysis

- Signal onset gives Time-to-Detection (TTD)
  - TTD linearly related to log CFU bacteria
  - Indicates time for growth and enzyme expression
  - Calibrate response of TECTA system



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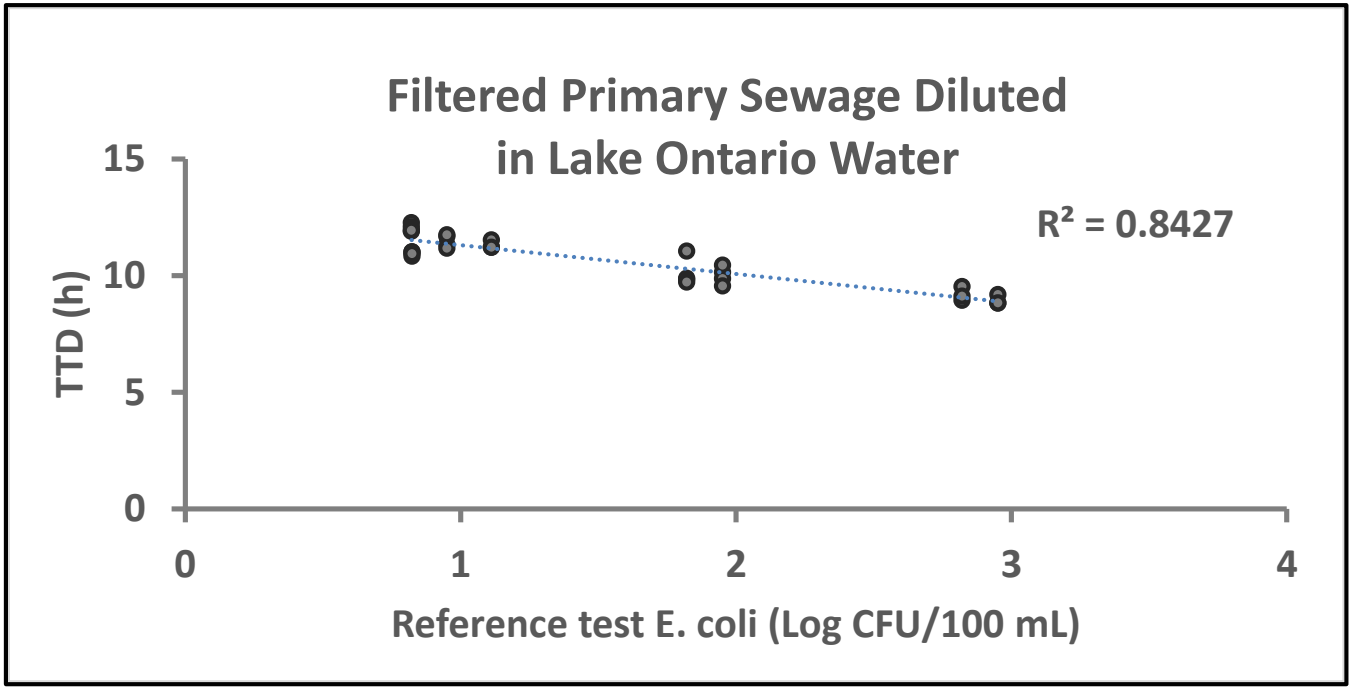
Quantitative analysis

E. coli Detected!

- Calibration using natural samples
  - Large sample carefully mixed and split into replicates
  - Also depends on reference method
    - various alternate methods give different results!



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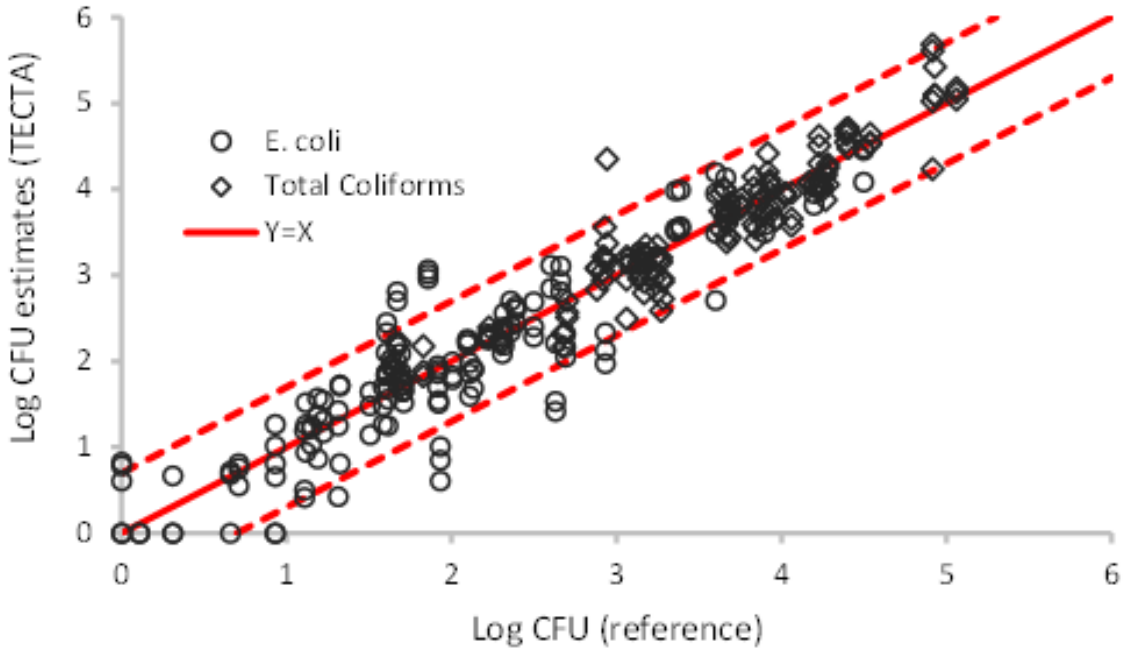
Quantitative analysis

E. coli Detected!

- Validation using separate sample set
  - *E. coli* and Total Coliforms tested simultaneously
  - 95% of results within 0.7 log of reference results
    - comparable to inter-lab studies using different methods



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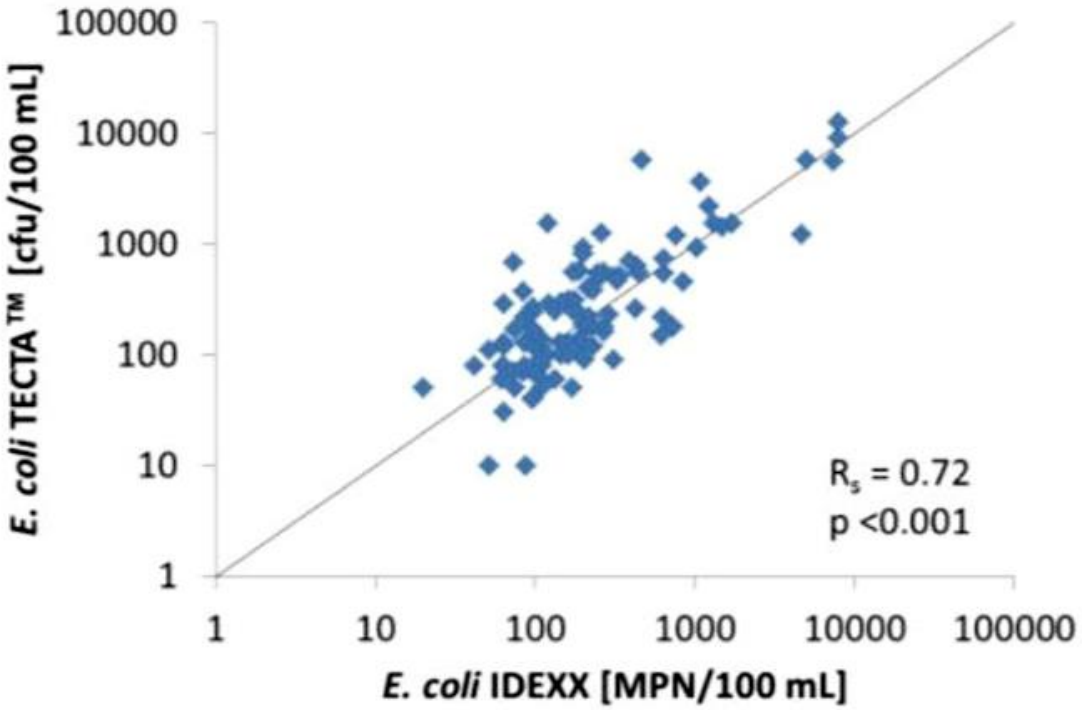
Quantitative analysis

E. coli Detected!

- Validation of calibration at alternate site
  - *McCarthy group, Monash U.*



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Schang *et al.* (2016). Evaluation of techniques for measuring microbial hazards in bathing waters: A comparative study. *PloS one*, *11*(5), e0155848.

The Solution

TECTA™ B16

Rapid, Automated Microbial Detection System

- Fully automated bacterial test – *E. coli* and Total Coliform
- Lab-in-a-box - On-site analysis; zero transport, zero storage; zero prep, sample on-test with no delay
- No visual estimation or judgment
- No human sample manipulation or intervention
- Fully automated test monitoring, interpretation and reporting via email; networkable
- Major approvals in place including USEPA

The Solution

TECTA™ B16
Rapid, Automated Microbial Detection System

- Not affected by turbidity or sample color
  - Applicable to a wide range of matrices
- High dynamic range: <1 CFU - 10^8 CFU / 100mL
- Installed & operated anywhere, by anyone, at any time
- Single-cell sensitivity
- Ready-to-use, pre-sterilized test cartridge
- Fastest test on market
  - only method available with early alerting
  - results in 2-18 hours depending on contamination level

Detection Times

CFU / 100mL v TTD value

< 1 (absent).....18 hours

1 CFU.....10h 40m

100 CFU.....8h 40m

1000 CFU.....7h 30m

10,000 CFU.....6h 30m

10^6 CFU.....4h 20m

****default calibration – E. coli-only test*

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The Solution

TECTA™ B16

Rapid, Automated Microbial Detection System

- Secure storage of test reports for QA/QC protection
- Networkable
- Automated reporting via email

TECTA-B16 (1.2.5) Report

Sample ID:
Collection Time: 2013-11-12 14:50:08
Stored: Unknown
Target Temperature (C): 35.63 | Actual Temperature (C): 35.46
Data File: XPDS00046.2013-11-12_14.50.08_Chamber1_TIME.pds

Test Result

E. coli Result: Present
EC Detect Time: 10h4m6s || Quantity: 140 CFU/100 ml
[EC-35.5 Default Calibration rev. 1.0]

Total Coliform Result: Present
Total Coliform Detect Time: 10h17m23s || Quantity: 3000 CFU/100 ml
[TC-35.5 Default Calibration rev. 2.0]

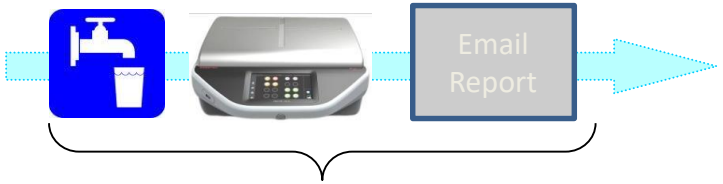
The Opportunities

E. coli Detected!

Conventional Methods / labs:

36 – 72 hours plus….

TECTA B-16:



2 – 18 hours

What opportunities exist for your operation if you had a rapid, on-site, easy to use micro system?

- Drinking water
  - Distribution compliance samples
  - Raw, pre/post filtration, pre/post chlorination, post clear well
  - Customer hand off
  - Broken/replacement pipe
- Waste / Reuse water
  - Raw, pre/post MBR, pre/post RO, pre/post UV
- Remote/challenging locations
- Recreational water

Approvals & Validations

E. coli Detected!

- **US EPA Approved** *(drinking water)*
  - Only EPA approved method with "early-alerting"
  - Better recovery of stressed cells

- **Ministry of Environment, Ontario, Canada** *(published in Journal of Microbiological Methods, 2009)*
  - 100% detection by non-micro operator under field conditions
  - Better accuracy than reference method

	Actual samples	PDS	MF-DC	Actual Samples	PDS	MF-DC
True positives	43	43	42	58	58	56[a]
False positives	0	0	0	0	0	0
True negatives	23	23	23	8	8	8
False negatives	0	0	1	0	0	2
Sensitivity (%)[a]		100	97.6		100	96.6
Specificity (%)[b]		100	100		100	100

PDS

Approvals & Validations

E. coli Detected!

- **New Zealand Ministry of Health Approval**
  - Received March 2016
  - *"MOH is satisfied that TECTA-B16 can be used for bacterial compliance monitoring"*

MINISTRY OF HEALTH

- **National Institute of Environmental Research (NIER), South Korea**

National Institute of Environmental Research

- **AOAC Certified**
  - *"Performance identical to reference methods at detection limit of one viable organism in 100mL sample"*


AOAC RESEARCH INSTITUTE

CERTIFICATION

AOAC® *Performance Tested*℠

Certificate No.

010801

The AOAC Research Institute hereby certifies that the performance of the test kit known as:

TECTA Combined *E. coli* and Total Coliform Test

- **US EPA ETV Study and Report**
  - *"Method very user friendly and eliminates need for technician"*

Approvals & Validations

- **Monash University Research Project, Australia**

TECTA Results

Test prep-time T-1st

Results interpretation time 1st

Incubation time 2nd

Cost per test 1st

Method	Organism	Pre-processing operator time [min/sample]	Post-result operator time [min/sample]	Average turnaround time [hours]	Cost $ vs $standard method
"standard method"	Total coliform	5	2	24	1
	E. coli	5	2	24	1
	enterococci	5	2	24	1
TECTA-B16	Total coliform	5	0	12.5	0.8
	E. coli	5	0	11.75	0.8
	enterococci	6	0	12	0.7
qPCR	enterococci	20	5	6	3.3
HTS		60[1]	30[2]	60[3]	30

*** Was run inside lab with samples ready to test

*** Does not consider:

1. Cost / time for transportation to lab
2. Cost for trained lab tech or microbiologist

TECTA - PDS

Schang *et al.* (2016). Evaluation of techniques for measuring microbial hazards in bathing waters: A comparative study. *PloS one*, *11*(5), e0155848.

Remote locations- Indigenous Communities

E. coli Detected!

- Challenges
  - Significant delays transporting samples from highly remote sites; not well served by existing lab infrastructure
  - High overall cost due to transportation
  - Loss of validity of samples (estimated at 25%)
- Chosen solution
  - Install Tecta on-site in remote communities for all DW samples
  - Capability of expanding use to other water types
- Outcomes
  - Faster results – increased public safety within First Nations communities
  - Reduced costs
  - Still maintain 100% integrity of results
  - Self management combined with Health Canada support for networking; automated reporting

"The biggest benefit for us is the shorter timespan for bacteria results. It is also an advantage to be able to receive emails confirming results from the TECTA™ B16, which helps eliminate any human error," says Jacobs. "In addition to using the machine for testing our distribution network, we hope to eventually use the TECTA™ B16 for all our water samples, including well water and recreational water."

Larry Jacobs, Environmental Health Technician, Kahnawake Shakotila'takenhas Community Services

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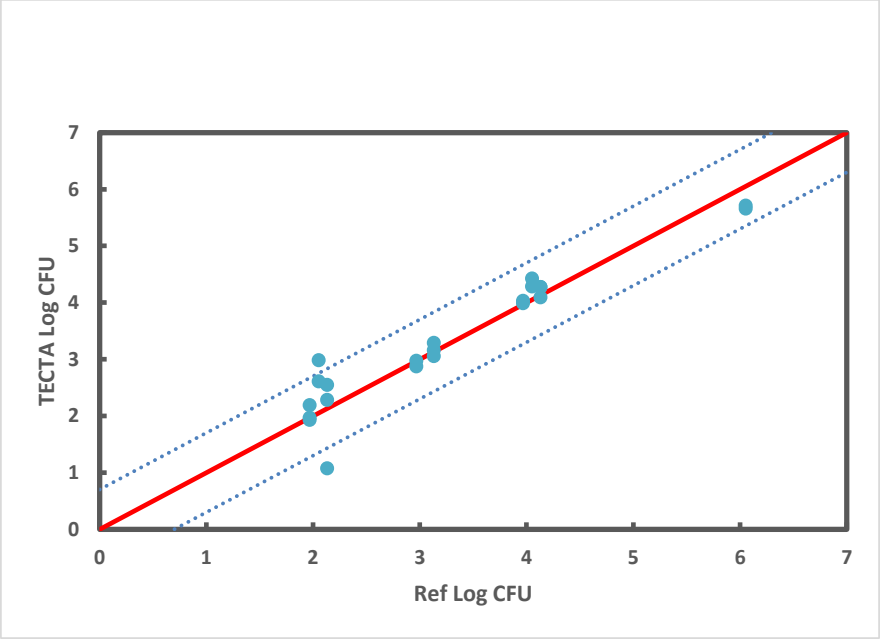
Enterococcus - New Test

- Enterococcus test
  - Enzyme based
  - Selectivity with ISO Method 7899 (Slanetz & Bartley)
  - Calibration procedure identical to *E. coli*
  - Initial validation shows similar performance
  - External validation partners in US, Australia and Singapore



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In Summary…

- Rapid, automated TECTA™ B16 system for *E. coli,* Total Coliform, Fecal Coliform
- Simple and robust for use in remote locations outside a laboratory
- Rapid detection (most positive samples in 2 h to 12 h)
- Approved for drinking water at <1 CFU/100 mL level
- Comparison with other methods shows good agreement for enumeration
- New test for Enterococcus bacteria now available

Acknowledgements

- Funding for this work:

NSERC CRSNG

Natural Sciences and Engineering Research Council Canada
CRD, I2I programs

Ontario

Province of Ontario
OCE, MRIS, MOECC

SOUTHERN ONTARIO WATER CONSORTIUM
LE CONSORTIUM POUR L'EAU DU SUD DE L'ONTARIO

- More information:

See TECTA-PDS at Booth M23 in Exhibition

Questions?

For more information

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