Volunteer Monitoring of *E. coli* in Upper Midwest Streams: A Comparison of Methods and Preferences
Project Partners
Project Goals

- Build the capacity of volunteer monitoring programs to monitor *E. coli* using the most effective and “volunteer-friendly” home lab testing methods
- Develop a comprehensive training program for volunteers to monitor *E. coli* in surface waters across six states
- Develop & disseminate educational materials about *E. coli* and its associated health risks, sources and reasons for monitoring
Projects Goals

- Increase awareness and acceptance of the use of volunteer collected data
- Share results with other volunteer monitoring programs

http://www.usawaterquality.org/volunteer/Ecoli
Project Overview

■ Year 1
  ■ Pilot test 5 home lab methods in 2 states (IA and IN) → recommendation
  ■ Develop training materials

■ Year 2
  ■ Four states monitor using home lab methods selected from Iowa & Indiana year 1 results
  ■ Iowa and Indiana continue to test 5 (plus 1) home lab methods
  ■ Evaluate data and training methods

■ Year 3
  ■ Adapt monitoring plan based on year 1 and 2 results
  ■ Continue monitoring with existing and new volunteers
  ■ Share results and materials
Why research *E. coli*?

- Many U.S. surface waters impaired by bacteria
- Fecal bacteria can be used as an indicator of pathogens in water
  - Are easy to culture
  - Are generally harmless
- Current EPA standards use *E. coli* as indicator bacteria for beach closings
Why research *E. coli* home lab methods?

- Cost of lab analyses high
- Many economical home lab methods available
- No comparative, independent study of how well these methods work vs. traditional lab methods – nor how well they work for use by volunteers
Body contact standard

- Indicator of potential health risks from primary contact (swimming, kayaking, water skiing) or partial contact (boating, fishing)
- Used for recreational waters, TMDLs, beach closings
- 235 cfu per 100ml (primary contact 1 sample)
2004 Testing – Iowa & Indiana

- **Home lab methods:**
  - Coliscan® Easygel (incubated)
  - Coliscan® Easygel (not incubated)
  - 3M™ Petrifilm™
  - Coliscan® MF Method Kit *(IN only)*
  - Colisure® Method with IDEXX Quanti-Tray/2000™ *(IA only)*
2004 Testing – Iowa & Indiana

- Testing spring, summer and fall 2004
- Water samples sent to lab for analysis
- Recommended the ‘best’ method for volunteers
Identifying Impairments After 2004

- Four methods were statistically significant for predicting above or below regulatory cutoffs
  - Only Coliscan® MF was insignificant

- Methods with best results (1-4)
  - IDEXX Colisure®
  - 3M™ Petrifilm™
  - Coliscan® Easygel – Incubated
  - Coliscan® Easygel – Non Incubated
Results:

**Cost of Kits**

<table>
<thead>
<tr>
<th>Method</th>
<th>Cost/Sample</th>
<th>Cost Includes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliscan® Easygel</td>
<td><strong>$1.85</strong></td>
<td>Incubator (varies)</td>
</tr>
<tr>
<td><strong>3M™ Petrifilm™</strong></td>
<td><strong>$1.06</strong></td>
<td>Incubator (varies)</td>
</tr>
<tr>
<td>Coliscan® Membrane Filtration Method</td>
<td><strong>$1.70</strong></td>
<td>Incubator (varies)</td>
</tr>
<tr>
<td>Colisure™ Method with the IDEXX Quanti-Tray®/2000</td>
<td><strong>$5.45</strong>*</td>
<td>Incubator ($400) Sealer ($3,000) UV light &amp; box ($240)</td>
</tr>
</tbody>
</table>

*Value would be much lower if ordered in greater bulk.
2005 Testing

- **All states**
  - Coliscan® Easygel (incubated)
  - 3M™ Petrifilm™
  - Water samples sent to lab for analysis

- **Indiana & Iowa**
  - Continued to test all other methods (and one more) too
2005 Data - What did it show?

- Evaluation of
  - Ability to make distinctions on impaired waters (235 cfu/100ml)
  - Regression models
  - Cost of kits
  - User friendliness (volunteer preferences)
Indiana and Iowa
2005 Results
Ranking of the % of time the home lab & laboratory values were both either above or below the 235 cfu/100 mL value

<table>
<thead>
<tr>
<th>Test</th>
<th>Incubation Time (h)</th>
<th>n</th>
<th>Agree</th>
<th>Disagree</th>
<th>% Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colisure (IDEXX)</td>
<td>24</td>
<td>171</td>
<td>151</td>
<td>20</td>
<td>88.3%</td>
</tr>
<tr>
<td>Petrifilm (3M)</td>
<td>24</td>
<td>268</td>
<td>229</td>
<td>39</td>
<td>85.4%</td>
</tr>
<tr>
<td>Colilert (IDEXX)</td>
<td>24</td>
<td>161</td>
<td>136</td>
<td>25</td>
<td>84.5%</td>
</tr>
<tr>
<td>Easygel - 35°C</td>
<td>24</td>
<td>245</td>
<td>196</td>
<td>49</td>
<td>80.0%</td>
</tr>
<tr>
<td>Coliscan MF</td>
<td>24</td>
<td>94</td>
<td>75</td>
<td>19</td>
<td>79.8%</td>
</tr>
<tr>
<td>Easygel - Room Temp</td>
<td>24</td>
<td>241</td>
<td>143</td>
<td>98</td>
<td>59.3%</td>
</tr>
</tbody>
</table>
Ohio, Michigan, Wisconsin & Minnesota

2005 Results

Ranking of the % of time the home lab & laboratory values were both either above or below the 235 cfu/100 mL value

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<th>n</th>
<th>Agree</th>
<th>Disagree</th>
<th>% Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrifilm (3M)</td>
<td>24</td>
<td>291</td>
<td>254</td>
<td>37</td>
<td>87.29</td>
</tr>
<tr>
<td>Easygel-35 °C</td>
<td>24</td>
<td>289</td>
<td>240</td>
<td>49</td>
<td>83.04</td>
</tr>
</tbody>
</table>
Lab results vs. IDEXX Colilert
2005 (Iowa)

$y = 1.052x - 24.976$

$R^2 = 0.9021$

Incubation = 24

$n = 135$
$y = 0.9719x + 35.928$

$R^2 = 0.9005$

Incubation = 24

n = 149
Lab results vs. 3M Petrifilm
2005 (IA & IN)

$y = 0.9223x + 5.1283$

$R^2 = 0.8978$

Incubation = 24

$n = 241$
Lab results vs. Coliscan Easygel (incubated) 2005 (IA & IN)

\[ y = 0.9788x - 47.204 \]

\[ R^2 = 0.7952 \]

Incubation = 24

\[ n = 223 \]
Lab results vs. Coliscan MF
2005 (Indiana)

$y = 0.894x + 85.047$
$R^2 = 0.7548$
Incubation = 24
n = 84
Lab results vs. 3M Petrifilm
2005 (all states)
n=498

$y = 0.7306x + 85.618$

$R^2 = 0.6606$
Lab results vs. Coliscan Easygel
2005 (all states)
n=478

\[ y = 0.5557x + 68.038 \]
\[ R^2 = 0.5304 \]
Volunteer Perceptions

- Indiana and Iowa volunteers ranked their confidence in methods used in 2005

- Indiana volunteers chose (Used Coliscan Easygel, 3M Petrifilm, Coliscan MF, but did not use IDEXX methods)
  (1) Coliscan Easygel® - Incubated
  (2) 3M™ Petrifilm™

- Iowa volunteers chose (Used Coliscan Easygel, 3M Petrifilm, two IDEXX methods)
  (1) Colisure® with IDEXX Quanti-Tray /2000
  (2) 3M™ Petrifilm™
  (3) Colilert® with IDEXX Quanti-Tray /2000
Volunteer Perceptions (cont.)

- Minnesota, Michigan, Ohio and Wisconsin volunteers’ end of season confidence rankings showed a nearly equal split
- 13 chose Coliscan Easygel® - Incubated
- 16 chose 3M™ Petrifilm™
Conclusions

- IDEXX, Coliscan Easygel ® (incubated) and 3M™ Petrifilm™ perform well in describing when bacteria counts are above and below 235 cfu/100 mL standard.
- These also have strongest correlations with lab results.
- Volunteers nearly equally split in their assessment of two methods.
- Cost of IDEXX methods might be prohibitive for volunteer groups.
- We need more data! Season 3 results will:
  - Help clarify trends and reliability.
  - Provide additional volunteer opinions about using the methods.
Acknowledgements

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“I adore the beauty and tranquillity of these raw-sewage days.”
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