Relative Rates of Incidence of Total Coliform and *E. coli*—Preliminary Analysis for TCR

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This Meeting's Presentations

Objectives

Provisions

System compliance

Relative Rates of Incidence of Total Coliform and *E. coli*—Preliminary Analysis for TCR

Improvement

Research

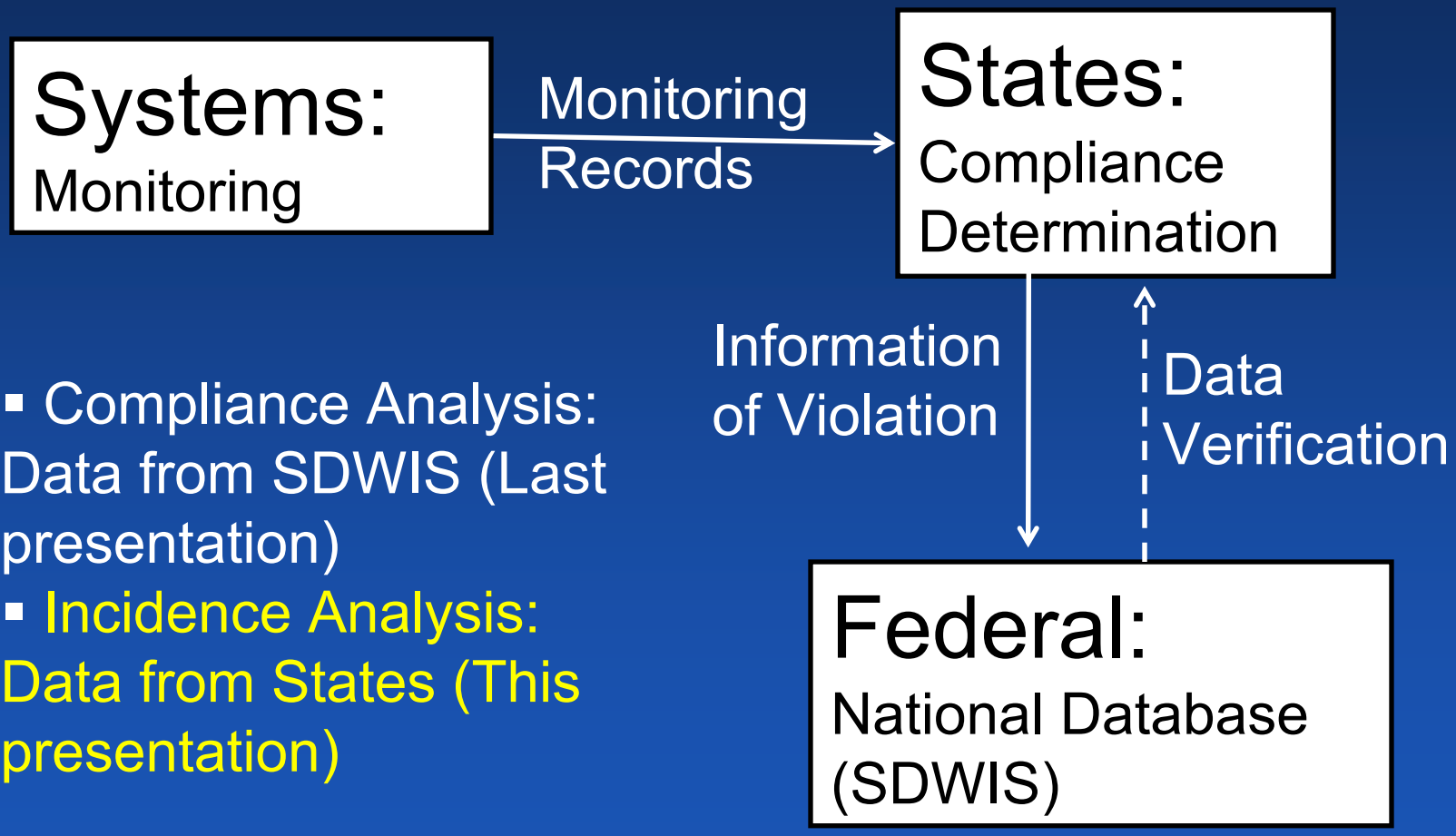
FAC Questions Addressed in Presentation

- What percent of overall samples are TC+, EC+?
- What are the differences in percent positives by system types and sizes?

Purpose of Presentation

- Show the relative rates of incidence of TC+ and EC+ in routine samples across system types and sizes
  - Based on 2002-2005 data
- Directions for future inquiry

Data Collection Process



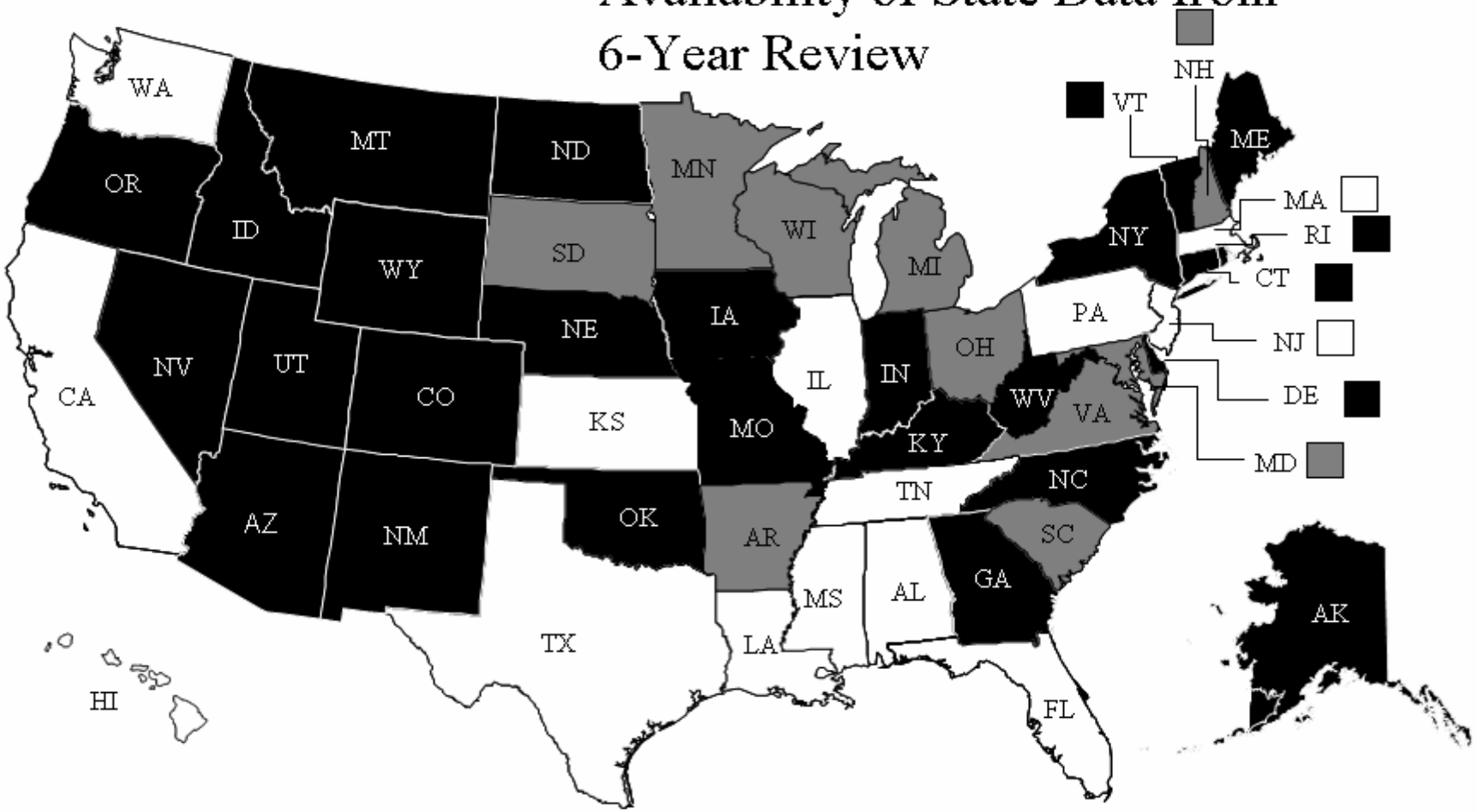
- Compliance Analysis: Data from SDWIS (Last presentation)
- Incidence Analysis: Data from States (This presentation)

Primacy Agencies Providing 6 Year Review Data

- This presentation includes data from 28 primacy agencies (see map) but does not include the following:
  - Available data from 11 other primacy agencies, and
  - 21 other primacy agencies either did not provide any data or have very limited data

- This presentation is based on the most recent 4 years, 2002-2005, of data (out of 8 years)

Availability of State Data from 6-Year Review



- Included
- Available, but not included
- Not Available

Plus Region 8 & 9 Tribal

System Information from States Included in Analysis (2005)

	Population	Systems					
		Total	Serving ≤1,000	Serving >1,000	CWS	NTNCWS	TNCWS
Inlcuded States (SDWIS data)	91,779,277	56,816	50,635	6,181	21,344	6,407	29,065
SDWIS Total	301,742,175	157,945	139,167	18,778	52,567	19,172	86,206
Percent	30%	36%	36%	33%	41%	33%	34%

Above percentages are overestimates:

- Data from states do not include all systems
  - Many systems serving over 100,000 are not in the state data.
  - There are also not 12 months of data for every system.
  - For some states, only ~50% of records are included.

General Caveats for Interpretation of Monitoring Data

- Data represents 28 Primacy Agencies (a little over a third of the systems & population)
- Data don’t account for possible sampling and measurement bias
- These results are limited to routine compliance monitoring data

Context—TC+ Computation

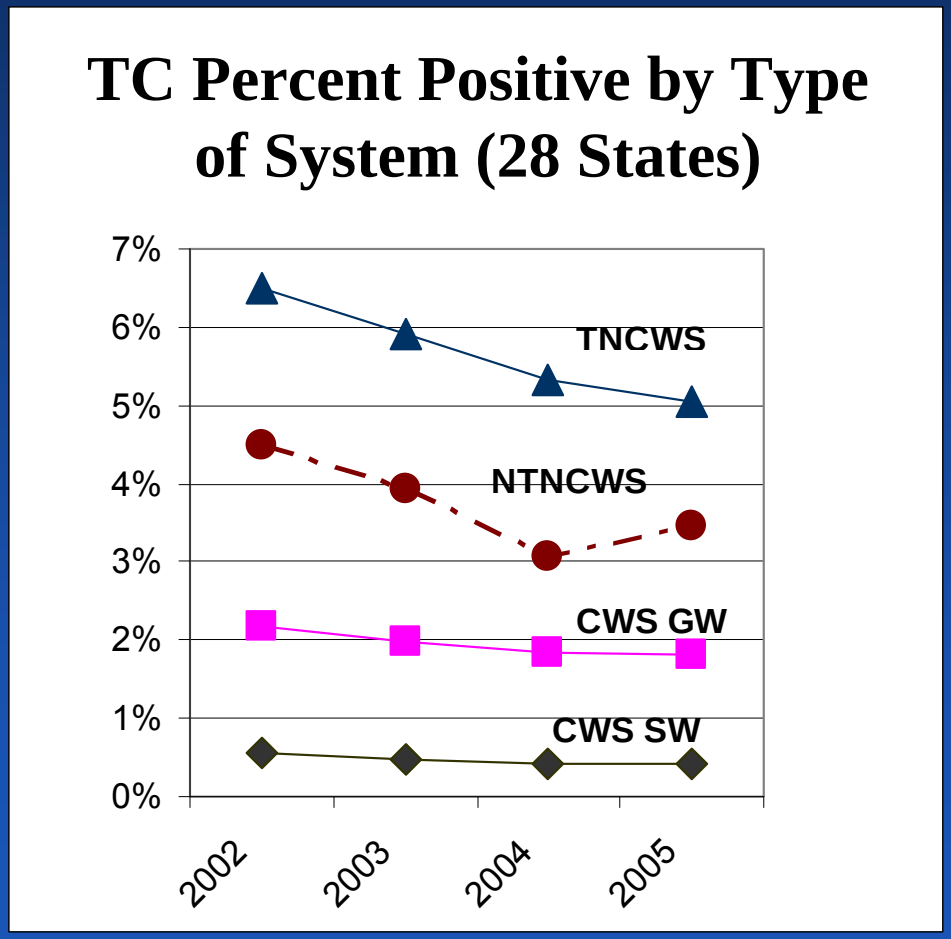
Question to be addressed: What percent of overall samples are TC+?

$$\text{TC Percent Positive} = \frac{\text{\# Routine TC+ samples}}{\text{all Routine TC samples}}$$

Note: For smaller systems, includes additional routine samples in the month following a TC+

Preliminary Observations— Percent TC+ by Type of System

- *Roughly an order of magnitude difference exists for TC+ rate between TNCWS and CWS SW*
- *An approximately 4-fold TC+ rate difference between CWS GW and CWS SW*

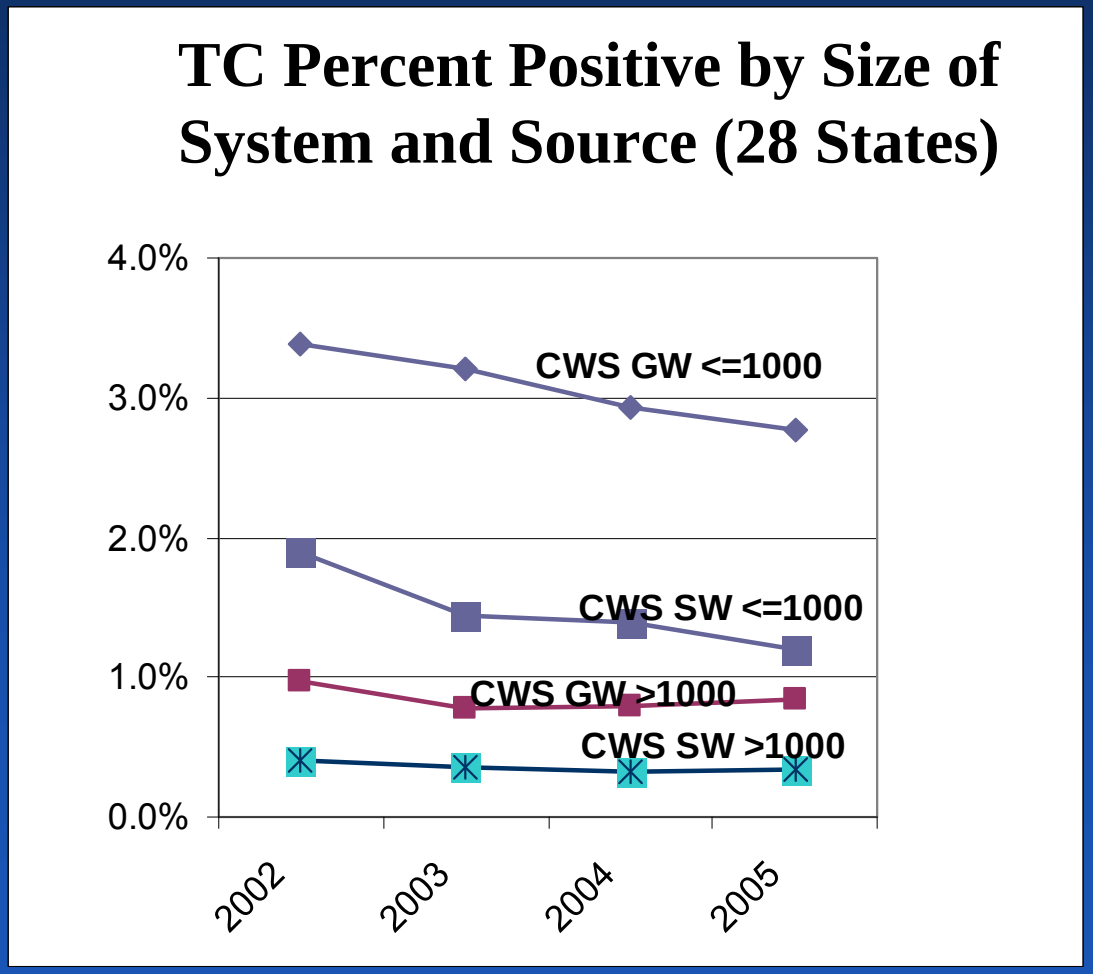


Preliminary Observations— Percent TC+ by Type of System

TC+		Positive Samples	Total Samples	Percent Positive
TNCWS	2002	6,899	106,089	6.5%
	2003	6,846	116,042	5.9%
	2004	6,656	125,265	5.3%
	2005	6,697	132,486	5.1%
NTNCWS	2002	1,980	44,027	4.5%
	2003	1,855	47,335	3.9%
	2004	1,483	48,334	3.1%
	2005	1,798	52,182	3.4%
CWS GW	2002	5,457	251,960	2.2%
	2003	5,291	267,975	2.0%
	2004	5,169	279,035	1.9%
	2005	5,551	304,686	1.8%
CWS SW	2002	932	168,903	0.6%
	2003	917	199,248	0.5%
	2004	984	231,825	0.4%
	2005	1,063	258,188	0.4%

Preliminary Observations— Percent TC+ by Size of System and Source (CWS Only)

- *GW systems serving <= 1,000 have a 3-fold higher TC+ rate than larger GW systems*
- *SW systems serving <= 1,000 have 4-fold higher TC+ rate than larger SW systems*



Preliminary Observations—
Percent TC+ by Size of System and Source
(CWS Only)

TC+		Positive Samples	Total Samples	Percent Positive
GW <=1000	2002	4,231	124,902	3.4%
	2003	4,224	131,836	3.2%
	2004	4,053	137,933	2.9%
	2005	4,293	154,616	2.8%
SW <=1000	2002	329	17,372	1.9%
	2003	286	19,794	1.4%
	2004	294	21,047	1.4%
	2005	278	23,304	1.2%
GW >1000	2002	1,226	127,058	1.0%
	2003	1,067	136,139	0.8%
	2004	1,116	141,102	0.8%
	2005	1,258	150,070	0.8%
SW >1000	2002	603	151,531	0.4%
	2003	631	179,454	0.4%
	2004	690	210,778	0.3%
	2005	785	234,884	0.3%

Context—EC+ Computation

Computation of EC Percent Positive for All Routine Samples—

- Assumption: All TC- (negative) samples are EC -
- Region 9 Tribal, Utah, and North Carolina reported only FC (thermotolerant) (no EC assays) – therefore those states were excluded from the following analysis
- About 20% of TC positives were followed by Fecal Coliform, therefore calculated EC+ rates included neither counts of samples assayed for FC nor counts of samples found positive for FC.

Context—EC+ Computation

Question to be addressed: What percent of overall samples are EC+?

EC Percent Positive =

$$\frac{\text{\# EC+ samples}}{\text{\# samples analyzed for EC*}}$$

* Samples analyzed for EC

Include:

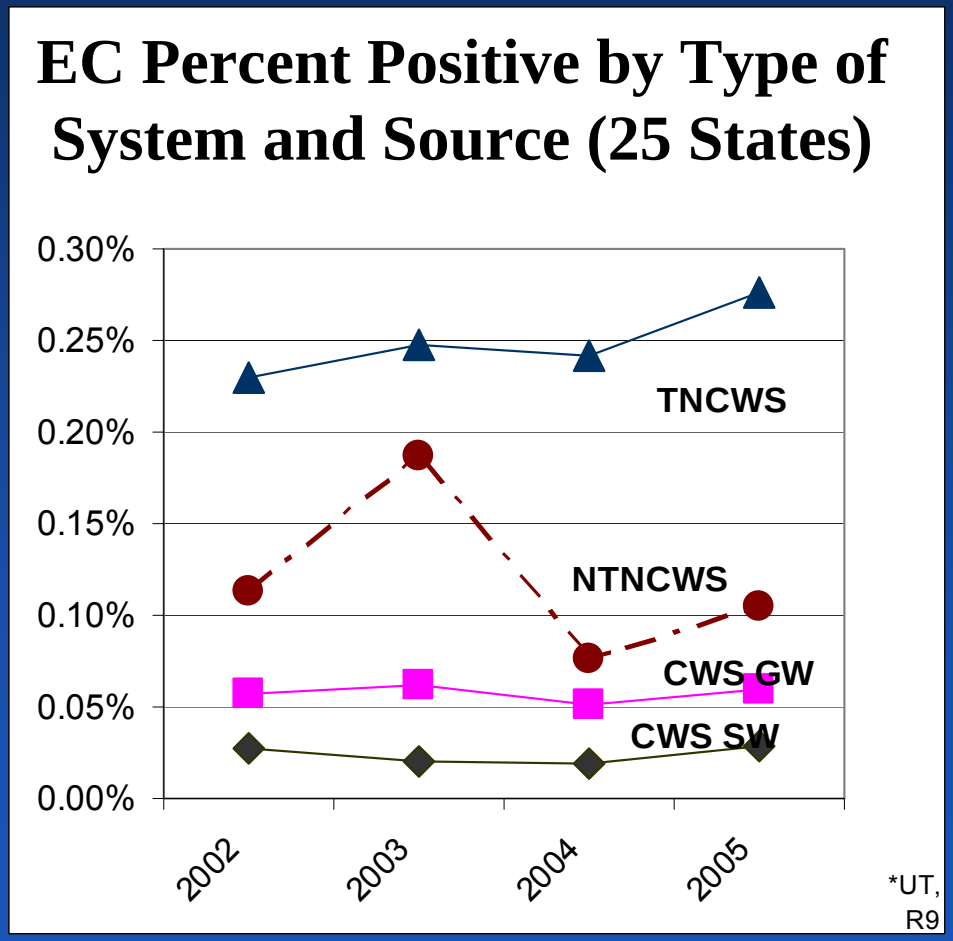
- TC- samples
- TC+ samples tested for EC

Exclude:

- TC+ samples tested for FC
- TC+ samples with no follow-on test reported

Preliminary Observations— Percent EC+ by Type of System

- *Roughly an order of magnitude difference exists for EC+ rate between TNCWS and CWS SW*

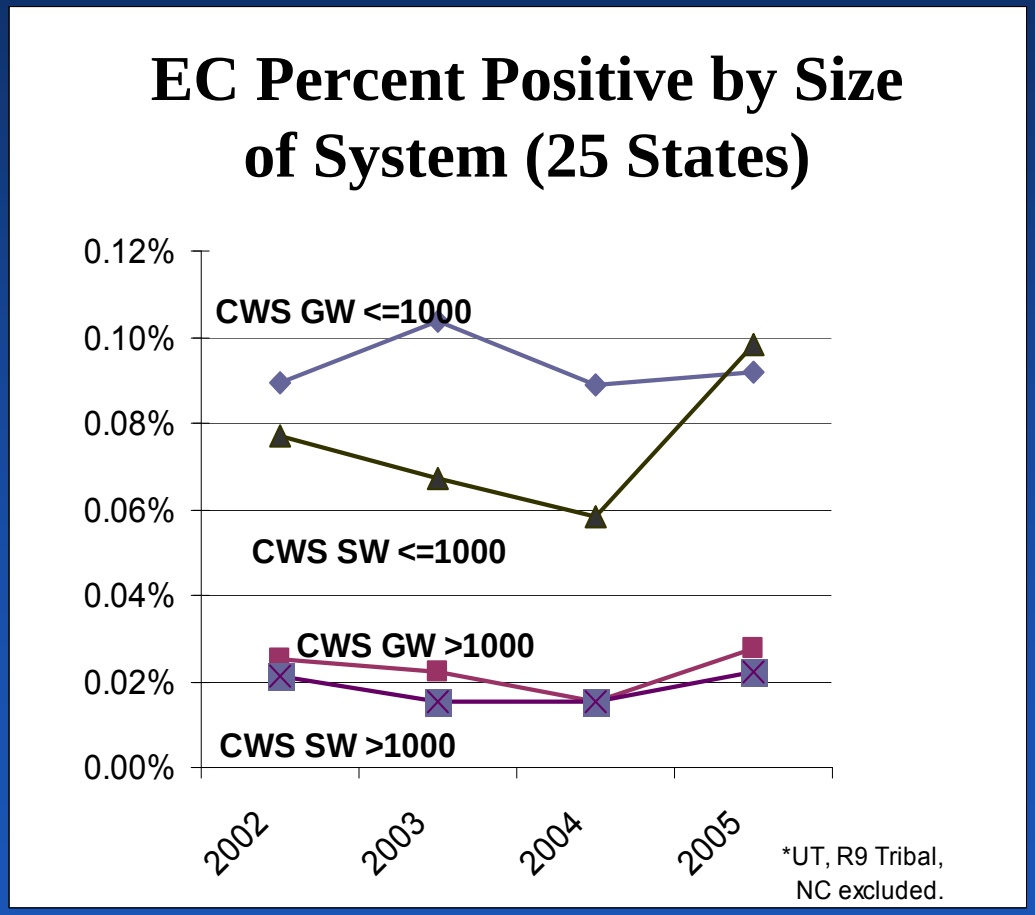


Preliminary Observations— Percent EC+ by Type of System

EC+		Positive Samples	Total Samples	Percent Positive
TNCWS	2002	234	101,873	0.230%
	2003	277	111,878	0.248%
	2004	293	121,360	0.241%
	2005	356	128,894	0.276%
NTNCWS	2002	47	41,436	0.113%
	2003	84	44,803	0.187%
	2004	35	46,053	0.076%
	2005	52	49,909	0.104%
CWS GW	2002	136	239,669	0.057%
	2003	158	256,001	0.062%
	2004	137	266,939	0.051%
	2005	170	284,217	0.060%
CWS SW	2002	45	167,388	0.027%
	2003	40	197,951	0.020%
	2004	44	230,695	0.019%
	2005	73	253,460	0.029%

Preliminary Observations— Percent EC+ by Size of System & Source (CWS Only)

- *Systems serving <= 1,000 have a greater than 3-fold higher EC+ rate than larger systems*
- *Not much difference in EC+ rate between GW vs. SW systems*



Preliminary Observations—
Percent EC+ by Size of System & Source
(CWS Only)

EC+		Positive Samples	Total Samples	Percent Positive
GW <=1000	2002	105	117,264	0.09%
	2003	129	124,689	0.10%
	2004	116	130,812	0.09%
	2005	131	142,356	0.09%
SW <=1000	2002	13	16,857	0.08%
	2003	13	19,347	0.07%
	2004	12	20,617	0.06%
	2005	22	22,343	0.10%
GW >1000	2002	31	122,405	0.03%
	2003	29	131,312	0.02%
	2004	21	136,127	0.02%
	2005	39	141,861	0.03%
SW >1000	2002	32	150,531	0.02%
	2003	27	178,604	0.02%
	2004	32	210,078	0.02%
	2005	51	231,117	0.02%

Summary of Findings – TC+

Type of System	Annual Percent TC Positive
TNCWS	5.1 – 6.5
NTNCWS	3.4 – 4.5
CWS GW	1.8 – 2.2
CWS SW	0.4 – 0.6
Size of System (CWS)	
GW ≤ 1000	2.8 – 3.4
SW ≤ 1000	1.2 – 1.9
GW > 1000	0.8 – 1.0
SW > 1000	0.3 – 0.4

Comparison of TC Positives to Violation Data is Not Straightforward

Type of System	Annual Percent TC Positive	Percent of Systems with At Least One Nonacute Violation (2005)
TNCWS	5.1 – 6.5	3.33
NTNCWS	3.4 – 4.5	3.65
CWS GW	1.8 – 2.2	5.23
CWS SW	0.4 – 0.6	2.42
Size of System (CWS)		
GW ≤ 1000	2.8 – 3.4	5.18
SW ≤ 1000	1.2 – 1.9	1.87
GW > 1000	0.8 – 1.0	4.99
SW > 1000	0.3 – 0.4	2.74

Summary of Findings – EC+

Type of System	Annual Percent EC Positive
TNCWS	0.230 – 0.276
NTNCWS	0.076 – 0.187
CWS GW	0.051 – 0.062
CWS SW	0.019 – 0.029
Size of System (CWS)	
GW ≤ 1000	0.09 – 0.10
SW ≤ 1000	0.06 – 0.10
GW > 1000	0.02 – 0.03
SW > 1000	0.02 – 0.02

Comparison of EC Positives to Violation Data is Not Straightforward

Type of System	Annual Percent EC Positive	Percent of Systems with At Least One Acute Violation (2005)
TNCWS	0.230 – 0.276	0.45
NTNCWS	0.076 – 0.187	0.39
CWS GW	0.051 – 0.062	0.32
CWS SW	0.019 – 0.029	0.30
Size of System (CWS)		
GW ≤ 1000	0.09 – 0.10	0.32
SW ≤ 1000	0.06 – 0.10	0.34
GW > 1000	0.02 – 0.03	0.29
SW > 1000	0.02 – 0.02	0.27

Potential Directions for Future Inquiry

- Evaluation of value of including additional state data
- Analysis of Repeat samples (inform relevance of repeat sampling for different system types and size categories in revised rule)
- Analysis of additional routine samples the following month (inform relevance of provision for small systems)
- FC samples and results (inform implications of excluding methods that measure FC vs E.coli in revised rule)
- Evaluate frequency and trend of method use (to inform potential bias from differences in method performance)

Appendix

Context—TC+ Computation

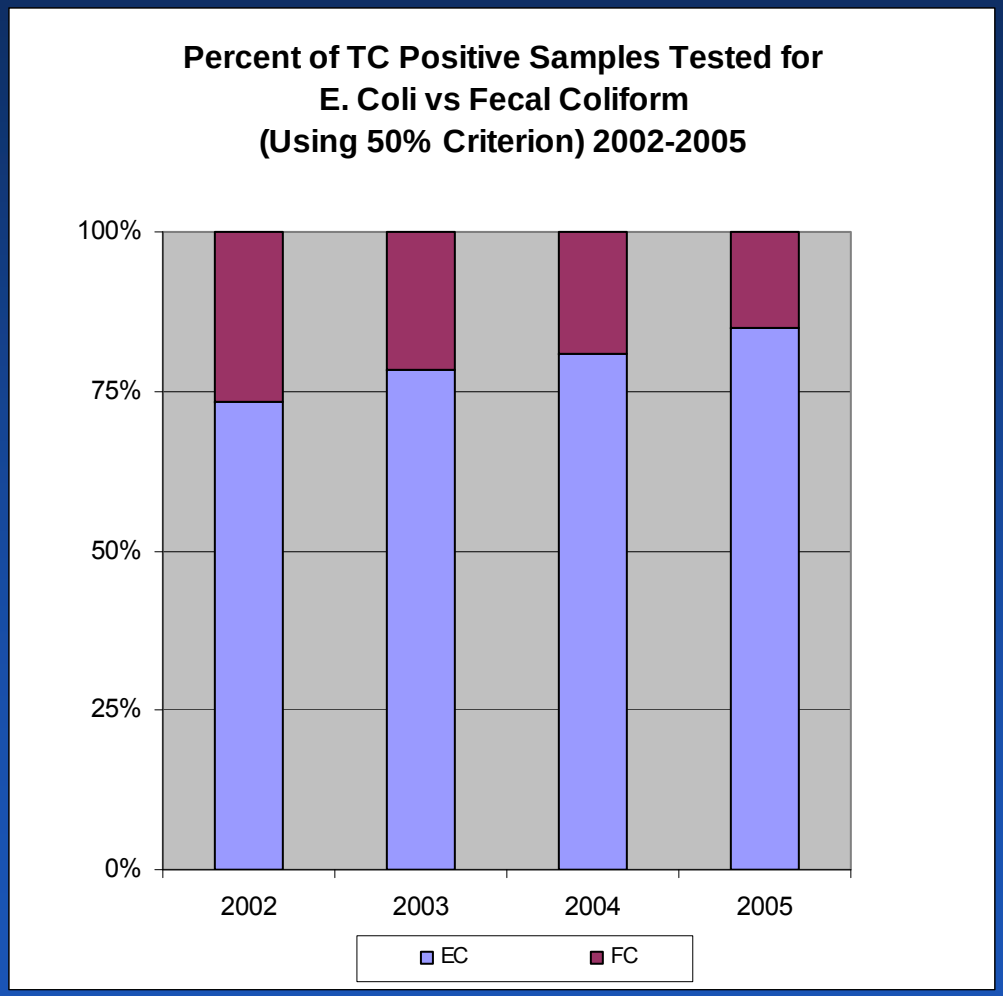
Preliminary criterion for complete month of data for a system:

$$\frac{\text{\# Samples Taken}}{\text{\# of Samples Required}} \sim >= \mathbf{50\%}$$

- 50% —
  - Excludes months that are not representative of a system (too few samples, e.g., may have reported TC- in summary form)
  - Acknowledges that population data may be incorrectly high (using 2006 population data for earlier time periods)
  - 0,10,80,90,and 95 percent completeness levels were also considered.
- "# of Samples Required" determined by TCR, based only on size of population served in 2006
  - Does not consider additional routine samples the following month

Preliminary Observations (cont'd)

- *For all years more than 70 percent of TC+ samples are tested for E. coli.*
- *Less than 30 percent tested for FC (Thermotolerant)*

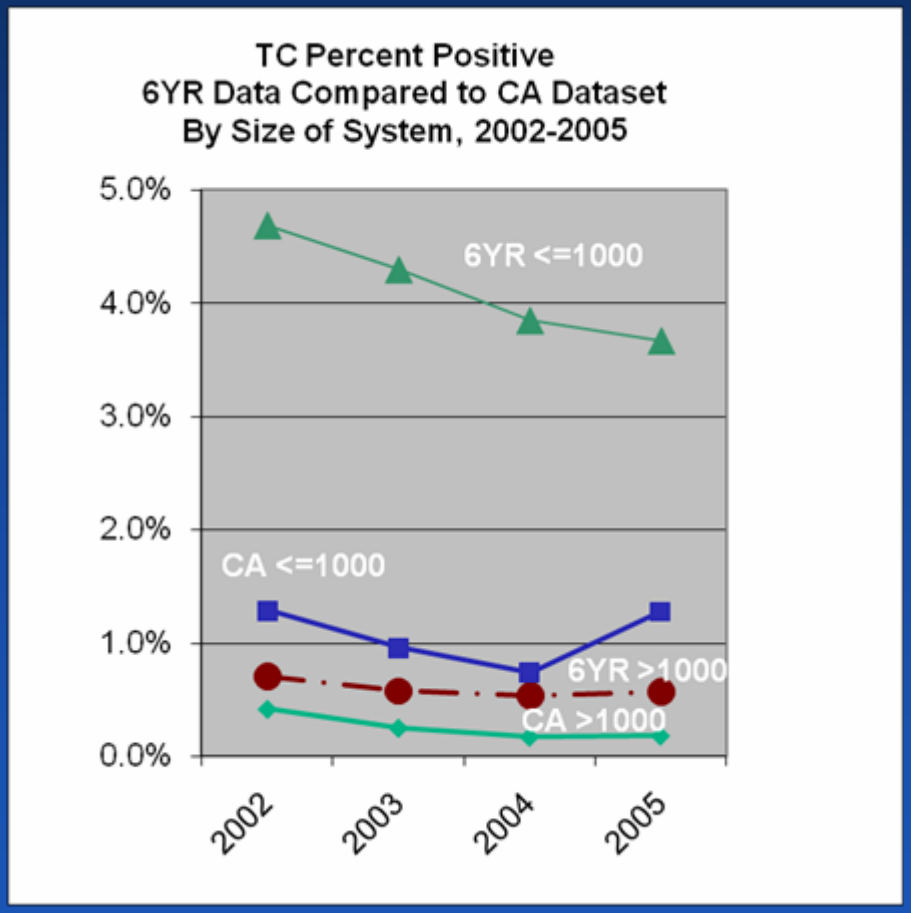


Compare Preliminary 6-Year Review Data to CA Data

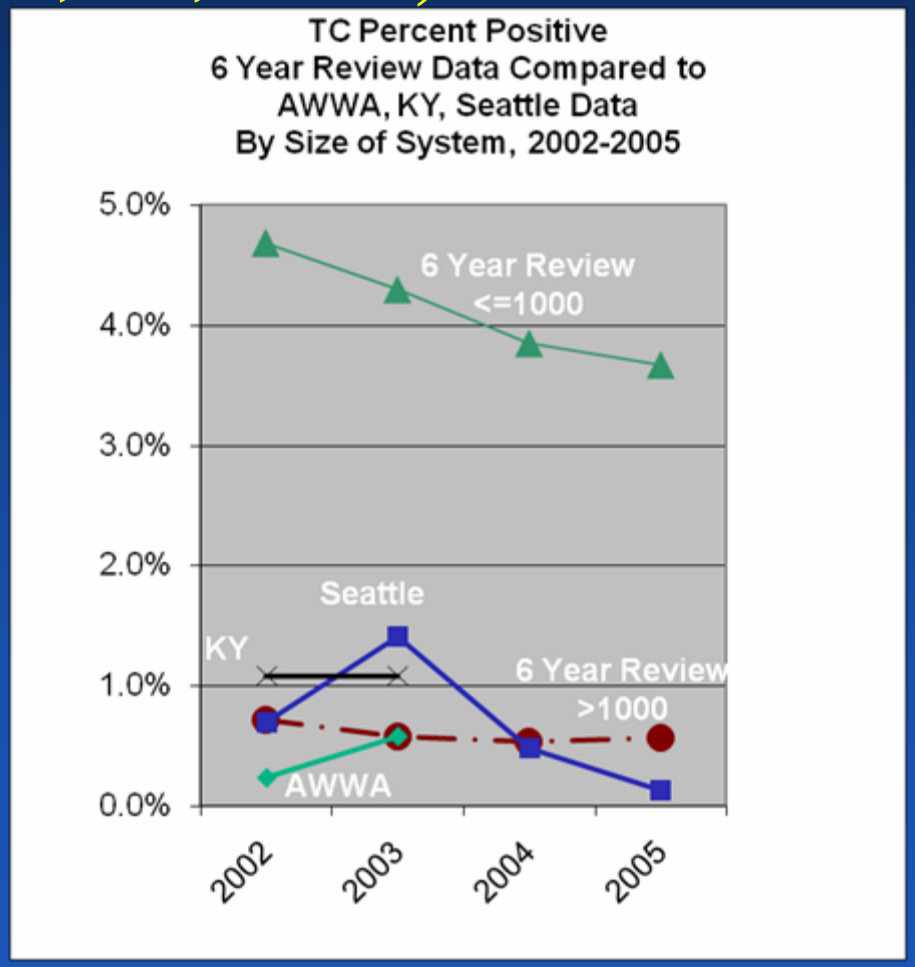
- Compiled from 631,998 samples for 1,489 water systems
- The data represented utilities of all sizes and included a variety of classifications including CWS, NTNCWS, and TNCWS

Compare Preliminary 6-Year Review Data to CA Data

- *Small systems in CA dataset had much lower frequency of TC Positives than those in 6 Year Review Data.*



Compare Preliminary 6-Year Review Data to Other Data

(AWWA, KY, Seattle)

- *Limited data points from these sources; data track within range of 6 Year Review data for Large Systems.*