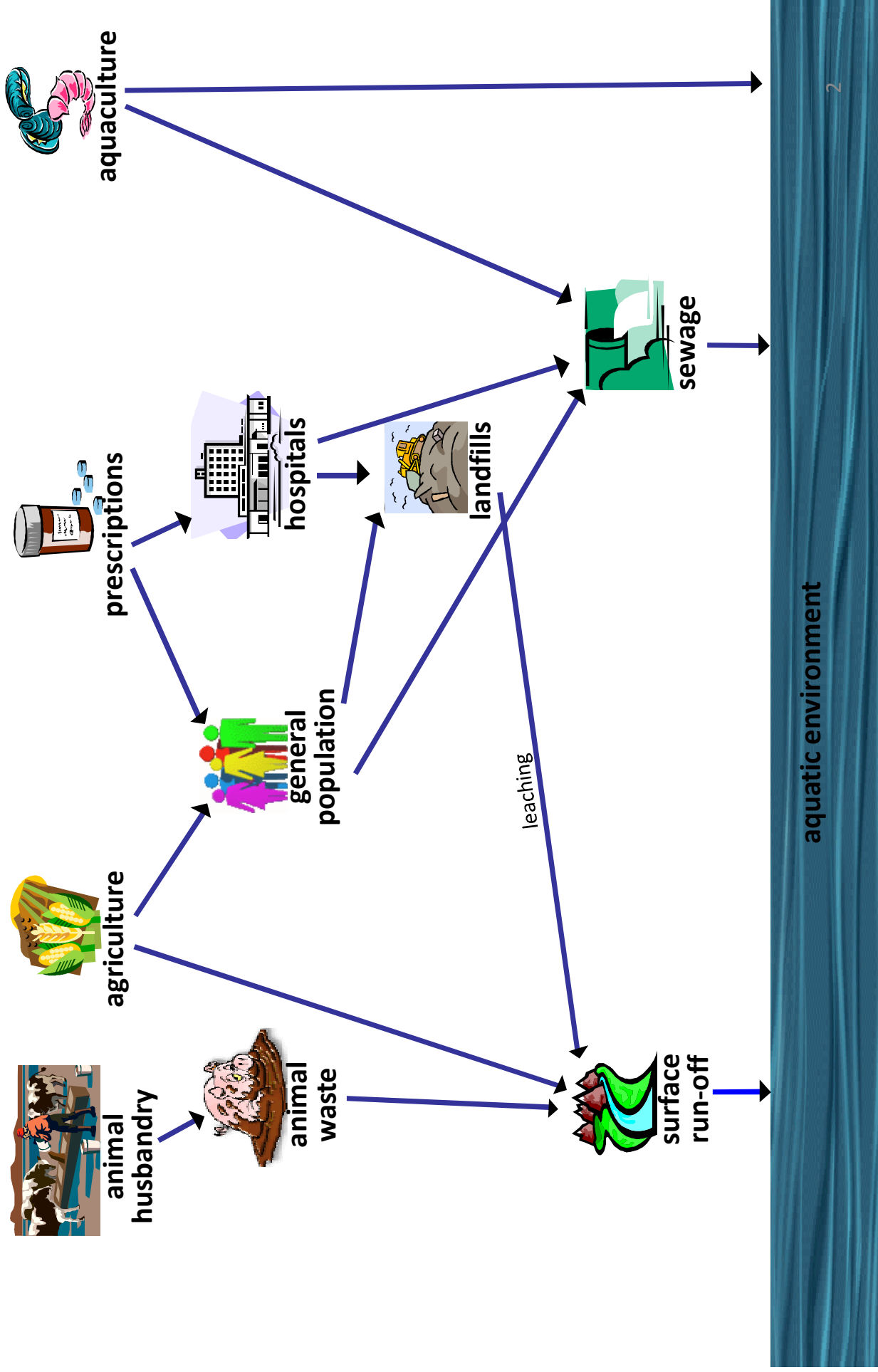


# Antibiotic Resistance in Massachusetts Bay

Karen Lachmayr, ScD

Harvard University, Microbial Sciences Initiative (MSI)

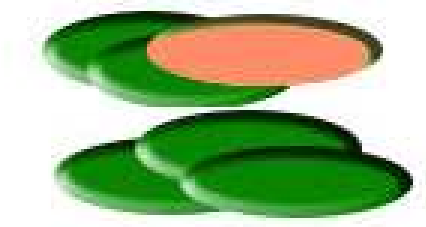
# Flow of Antibiotics into the Aquatic Environment



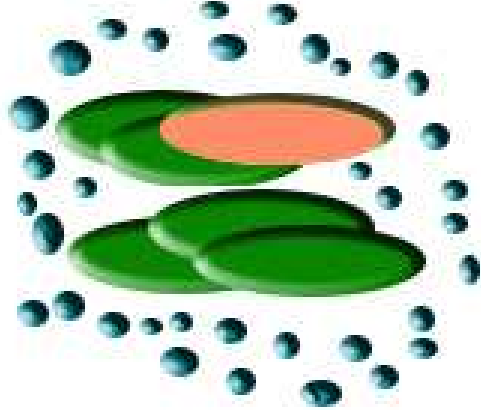
## 2 Conditions Ideal for Selecting for Resistance

- 1) Low concentration
- 2) Prolonged exposure

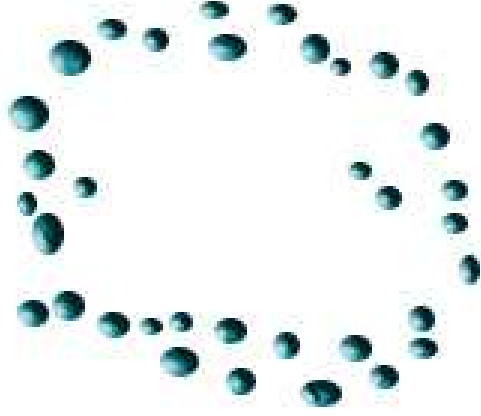
# Clinical Strategy



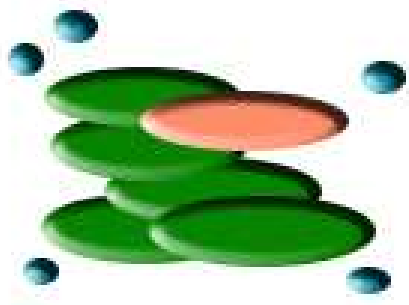
# Clinical Strategy



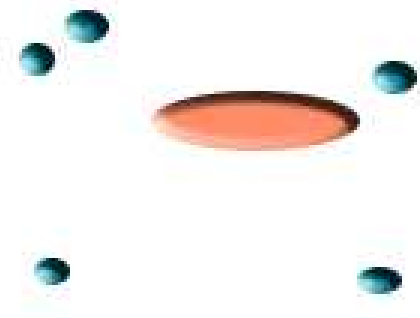
# Clinical Strategy



# Environmental Situation



# Environmental Situation

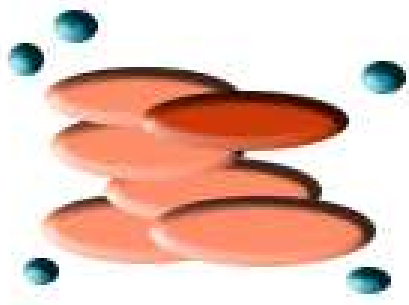




# Environmental Situation

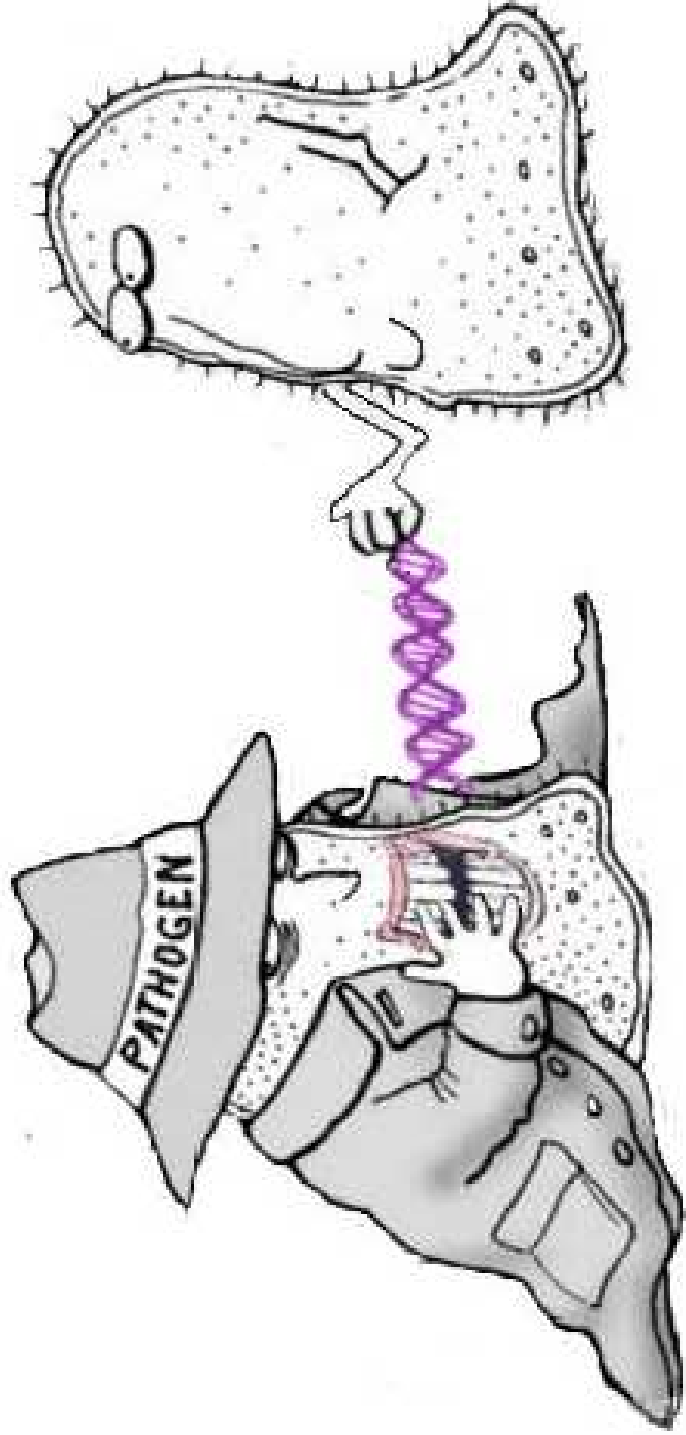


# Environmental Situation

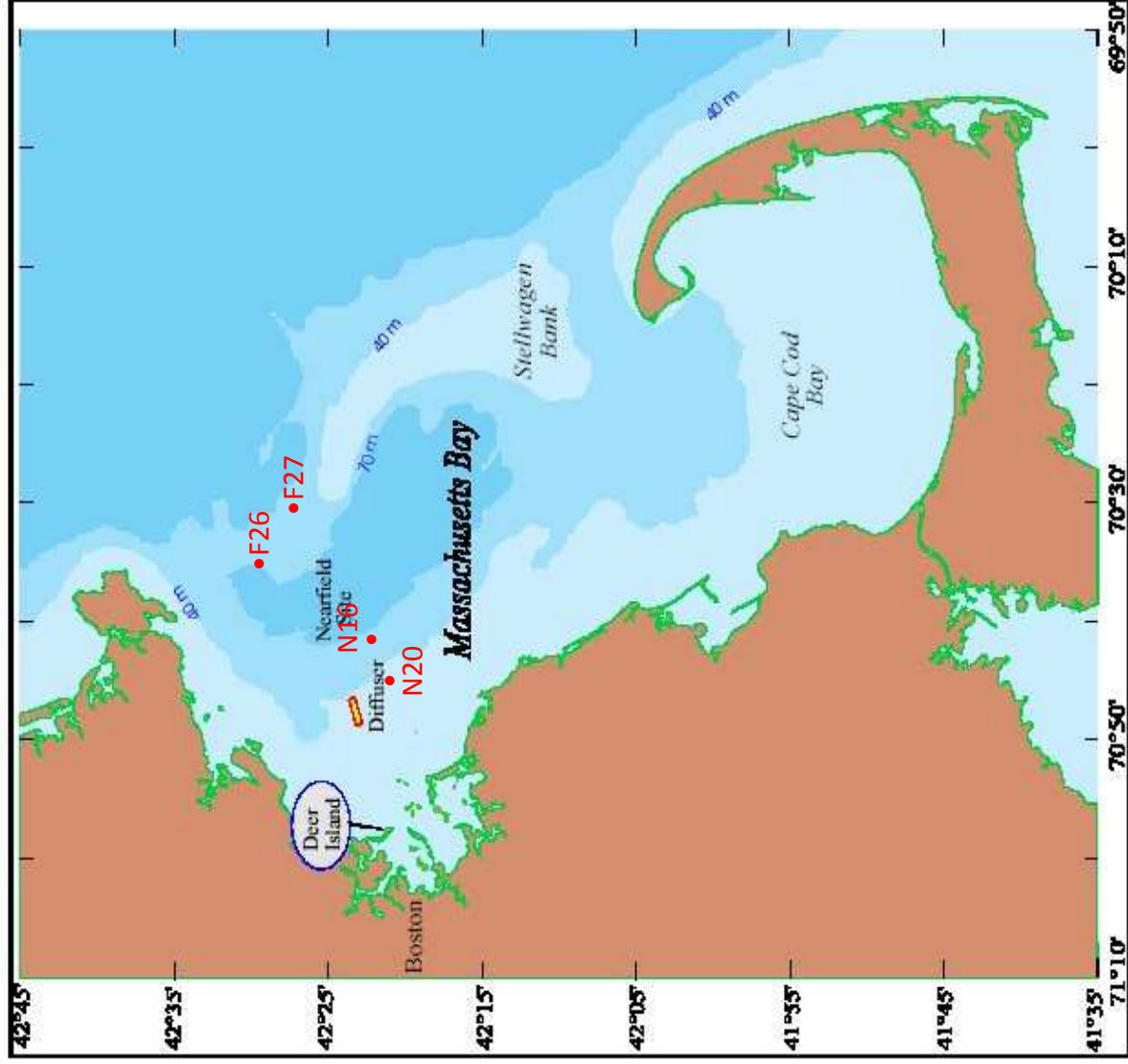


Why Should We Care if Nonpathogenic  
Environmental Microbes are Resistant to  
Antibiotics?

**Horizontal Gene Transfer**



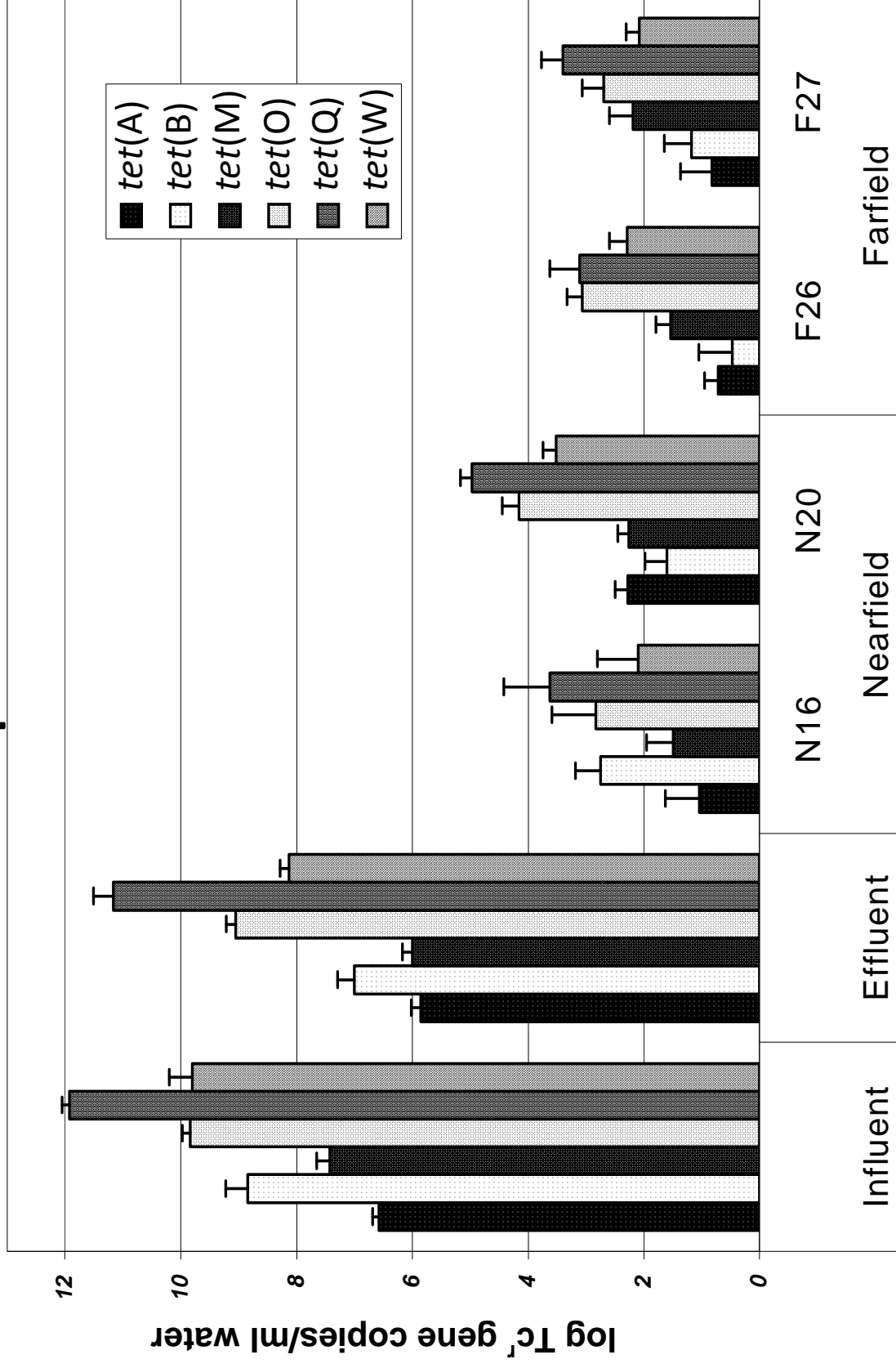
# Massachusetts Bay



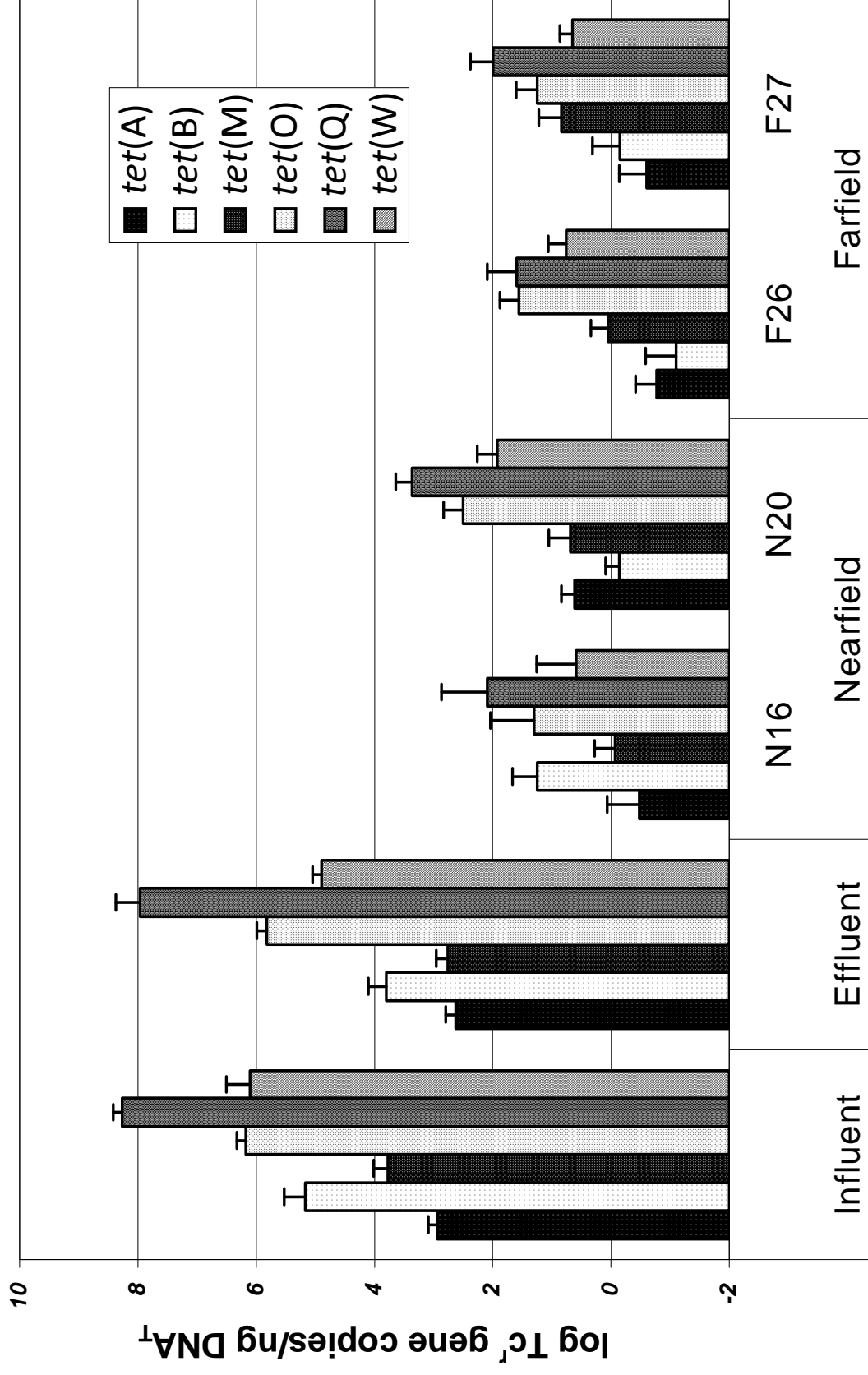
# Sample Analysis

- DNA extracted
- Real Time PCR

# *tet* Genes per ml of Water

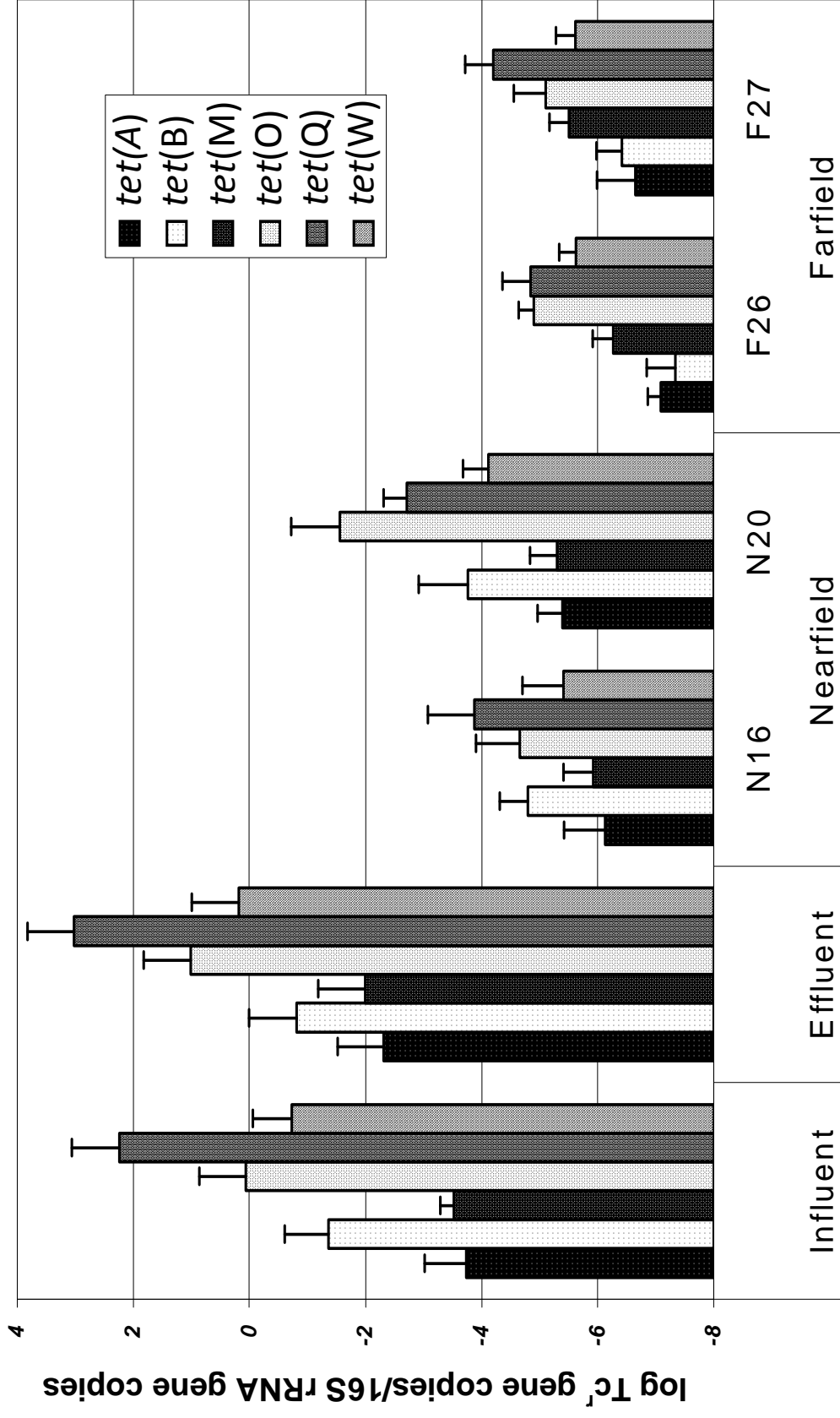


# *tet* Genes Relative to Biomass





# *tet* Genes Relative to Bacterial Count

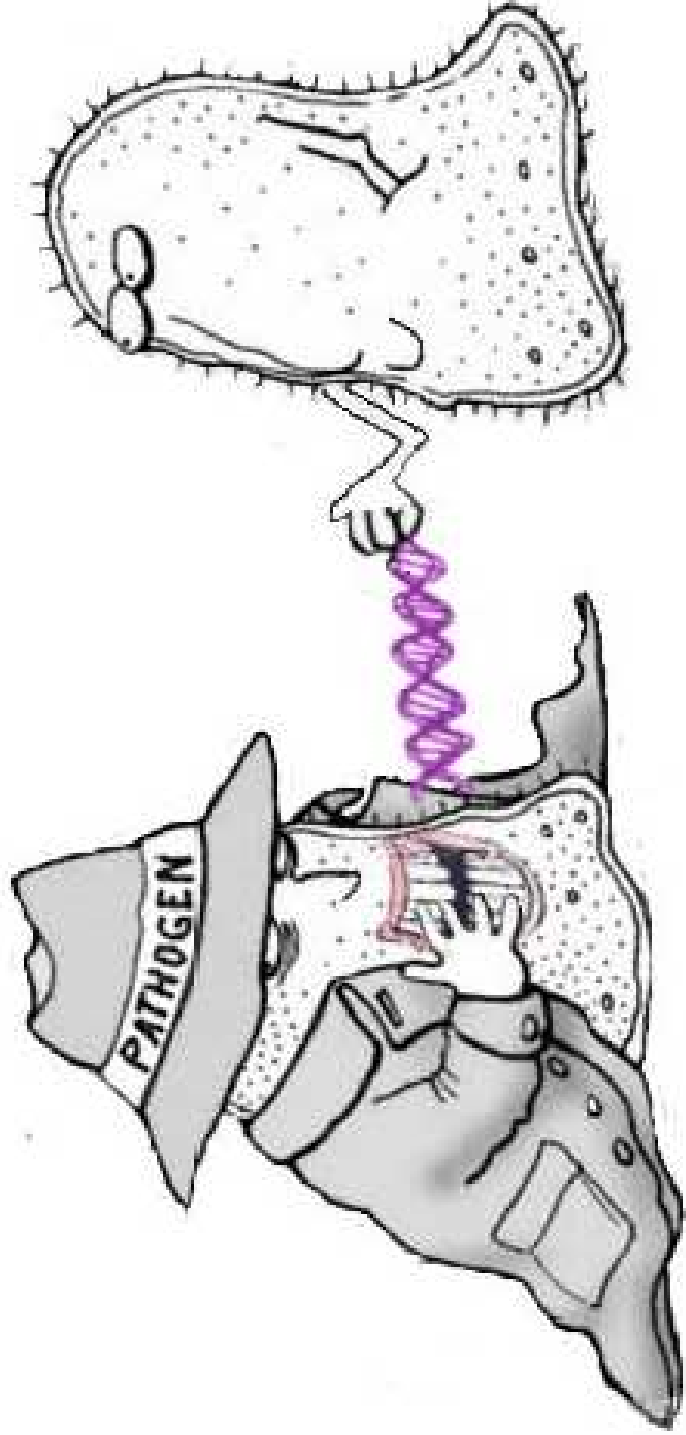


# Conclusions

- Sewage treatment decreases concentrations of antibiotic resistance genes
- Through sewage effluent, antibiotic resistance genes are introduced into the environment in substantially higher concentrations than occur naturally
- This creates reservoirs of increased resistance potential

# Acknowledgements

- The organizers of the 2010 International Symposium on Safe Medicine
- Tim Ford
- Lee Kerkhof
- Colleen Cavanaugh
- Greg DiRienzo



# Biomass and Bacteria Estimates

	DNA <sub>T</sub> -ng/ml water	Copies 16S rRNA genes/ml water	Copies 16S rRNA genes/ng DNA <sub>T</sub>
<b>Influent</b>	4750.9 ±1323.7	9.2x10 <sup>10</sup> ±4.1x10 <sup>10</sup>	2.1x10 <sup>7</sup> ±1.0x10 <sup>7</sup>
<b>Effluent</b>	1714.6 ±497.9	8.1x10 <sup>9</sup> ±1.1x10 <sup>10</sup>	4.8x10 <sup>6</sup> ±6.9x10 <sup>6</sup>
<b>Nearfield</b>	46.2 ±28.4	5.6x10 <sup>7</sup> ±3.5x10 <sup>7</sup>	1.6x10 <sup>6</sup> ±1.7x10 <sup>6</sup>
N16	36.1 ±18.6	3.5x10 <sup>7</sup> ±2.0x10 <sup>7</sup>	1.3x10 <sup>6</sup> ±9.3x10 <sup>5</sup>
N20	56.4 ±32.8	7.8x10 <sup>7</sup> ±3.5x10 <sup>7</sup>	2.0x10 <sup>6</sup> ±2.2x10 <sup>6</sup>
<b>Farfield</b>	35.7 ±23.1	8.5x10 <sup>7</sup> ±4.8x10 <sup>7</sup>	3.0x10 <sup>6</sup> ±2.1x10 <sup>6</sup>
F26	43.3 ±27.4	9.0x10 <sup>7</sup> ±4.6x10 <sup>7</sup>	2.8x10 <sup>6</sup> ±2.1x10 <sup>6</sup>
F27	27.7 ±13.9	7.9x10 <sup>7</sup> ±5.1x10 <sup>7</sup>	3.1x10 <sup>6</sup> ±2.2x10 <sup>6</sup>

# Antibiotic Use All Applications

