Opportunities for Research to Enhance Microbial Risk Assessment

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QMRA Framework Used for Drinking Water

<u>Hazard Identification</u>

- Health endpoint - waterborne illness and mortality

<u>Dose-Response Assessments</u>

Relationships for probability of:

- Infection given exposure
- Illness given infection
- Premature death given illness

<u>Exposure Assessment</u>

- Number of people exposed to pathogens in finished drinking water
- Distribution of average daily *pathogen* ingestion levels across the exposed population

<u>Risk Characterization</u>

- Estimated cases of illness and death in the affected population
- Distribution of individual risk levels of illness and mortality
- Secondary spread

QMRA Supports Drinking Water Standard Development

- Supports risk assessment and benefit cost analysis required under SDWA
  - Informs numbers of illnesses (including severity distribution) and deaths avoided for regulatory options being considered
  - Considers sub-populations to extent feasible
- Informs structure of rule
  - Minimum treatment technique levels
  - Development of criteria that can be used to identify high versus low risk systems

Dose Response Issues

- Can we better characterize the uncertainty in estimating infection from ingestion of one pathogen?
  - Recognizing uncertainty within (parameter uncertainty) and across functional form (model uncertainty)
- What is the uncertainty in applying dose-response studies to environmental measurement data to inform risk assessment?
  - determine how to best reconcile the differences in environmental measurements vs laboratory/clinical pathogen dose-response measurements
- Can we better characterize range of morbidity resulting from infection for different sub-populations
  - Severity is a huge driver in benefit analysis

Secondary Spread

- How can we better characterize the effects of secondary spread?
  - What are the implications of using population dynamic risk modeling?
    - Due to data limitations, we primarily use a single value adjustment factor
    - What research can be conducted to better inform our assumption in using such analysis
    - May have largest implications for estimating risk from transient non-community water systems and distribution system exposure events

Estimating Risk from Distribution System (DS) Vulnerabilities

- What models can be developed or refined to inform potential exposure from different DS contaminant events?
  - Cross connections
  - Intrusions from transient pressures (e.g., from power outages, main breaks)
  - What is the magnitude of potential risks from these events and how frequently do they occur?
- What criteria can be developed to identify high risk systems and what risk management control strategies are available to mitigate concerns?
- Can we develop models to predict potential disease incidence associated with decaying infrastructure?

Treatment Issues

- How can we better consider episodic events pertaining to source water occurrence and treatment of pathogens?
  - Currently we rely on averaging techniques and this may significantly overestimate efficiencies assumed for treatment
- Can we improve upon our assumptions for estimating viral inactivation by disinfection?
  - Currently we mostly use HAV as target virus to estimate disinfection inactivation efficiencies; is this still appropriate since some viruses (Coxsackie) appear more resistant to disinfection?
  - How can we best account for differences between estimates derived from laboratory versus those applied to environmental conditions?