Public Perceptions of Risk

Presentation to the Manure Irrigation Workgroup,
November 22, 2013

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The Heart of the Debate

Luxembourg WHO/EC Workshop, 2003:

"*There are (…) important reasons to invoke the Precautionary Principle within a public health policy:*

- *To be more anticipatory in terms of health and dealing with unknowns,*
- *To address public concern, which may be more directed at ensuring a potential problem is not ignored, in contrast to scientists who are often reluctant to give credibility to unproven possibilities."*

Precautionary Principle

"When an activity raises threats of harm to human health or the environment, precautionary measures should be take even if some cause and effect relationships are not fully established scientifically."

Wingspread Conference, 1998.

Central components

- Taking preventive action in the face of uncertainty
- Shifting the burden of proof/responsibility to the proponents of an activity
- Exploring a wide range of alternatives to possibly harmful actions
- Increasing public participation in decision making (environmental justice)

Wingspread Conference, 1998.

Purpose/Objectives

- Improve decision making
- Promote integrated assessments
- Promote transparency
- Promote sharing of information
- Examine alternatives
- Examine uncertainties
- Encourage discussion among stake holders

Risk Management

- Uncertainty
- Perception
- Comparison
- Education
- Regulation

Comparing Risks

- By probability
- By expected value
- By outrage
- By exposure
- By experts

Annual Risk Of Death In The U.S.

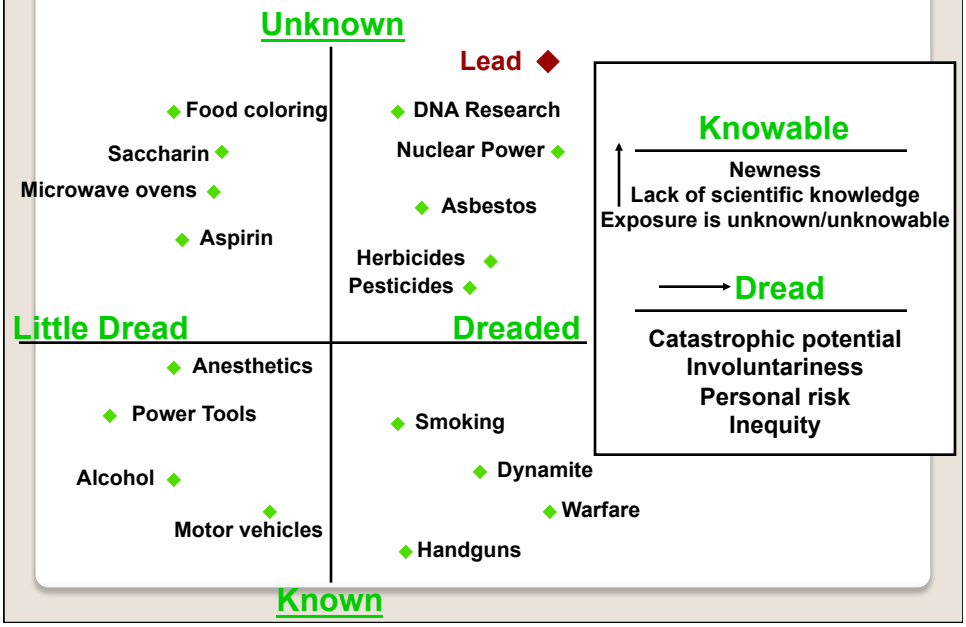
HAZARD	RISK PER MILLION
All causes	9,000.0
Motor vehicle accidents	210.0
Work accidents	150.0
Homicides	93.0
Drowning	37.0
Poisoning, Solids/liquids	17.0
Railroads	0.9
Civil aviation	0.8
Bits and stings	0.2

Characteristics of Risk

Characteristic	Level	Examples
Knowledge	Little known	Food additives
	Much known	Alcoholic drinks
Newness	Old	Guns
	New	Space travel
Voluntariness	Not voluntary	Crime
	Voluntary	Rock climbing
Control	Not controllable	Natural disasters
	Controllable	Smoking
Dreadedness	Little dread	Vaccination
	Great dread	Nerve gas
Catastrophic potential	Not likely	Sunbathing
	Likely	War
Equity	Distributed	Skiing
	Undistributed	Hazardous dump

Adapted from Kraus and Slovic (1988), Risk Anal., 8: 435.

Risk Perceptions



Differences in Risk Perception

Activity/Agent	Rank by Risk Analyst	Rank by non-Risk Analyst
Motor Vehicles	1	2
Smoking	2	4
Alcohol	3	6
Handguns	4	3
Surgery	5	10
Motorcycles	6	5
X-rays	7	22
Pesticides	8	9
Electric Power	9	18
Swimming	10	19
Nuclear Power	20	1

Adapted from Slovic et al. (1979), Environ., 21: 14.

Extensions of the View

- People's assessments of acceptable and unacceptable risks.
  - Controllable v. not controllable
  - Merely injurious v. fatal
  - Equitable v. not equitable
  - Low v. high risk to future generations
  - Easily v. not easily reduced
  - Voluntary v. involuntary
  - Affects v. does not affect me
  - Dreaded v. not dreaded

Risk Assessment

Philip Handler said about balancing risks and benefits:

"A sensible guide would surely be to reduce exposure to hazard whenever possible, to accept substantial hazard only for great benefit, minor hazard for modest benefit, and no hazard at all when the benefit seems relatively trivial." (Handler, 1979).

Handler P. 1979. Some comments on risk. In: The National Research Council in 1979; Current Issues and Studies. Washington, DC: National Academy of Sciences, 3-24.

Risk Communication: Key Concepts

When people are stressed, concerned, or worried, they typically:

(1)…want to know that you care before they care what you know

(2)…have difficulty hearing, understanding, and remembering information

(3)…seek out credible information and make rapid decisions that are difficult to change

Risk Communication: Key Concepts – continued

When people are stressed or concerned,

- …they focus most on what they hear first and last
- …they focus much more on negative information than positive information
- …they process information at well below their education level

Risk Assessment

"We should remember that risk assessment data can be like the captured spy: If you torture it long enough, it will tell you anything you want to know."

(William Ruckelshaus -1st administrator of U.S. EPA 1984.)

Quantitative Microbial Risk Assessment Planning and Scoping

Manure Irrigation Workgroup Meeting

November 22nd, 2013

Mark Borchardt
USDA – Agricultural Research Service
USGS – Wisconsin Water Science Center

This is the first of many opportunities for input
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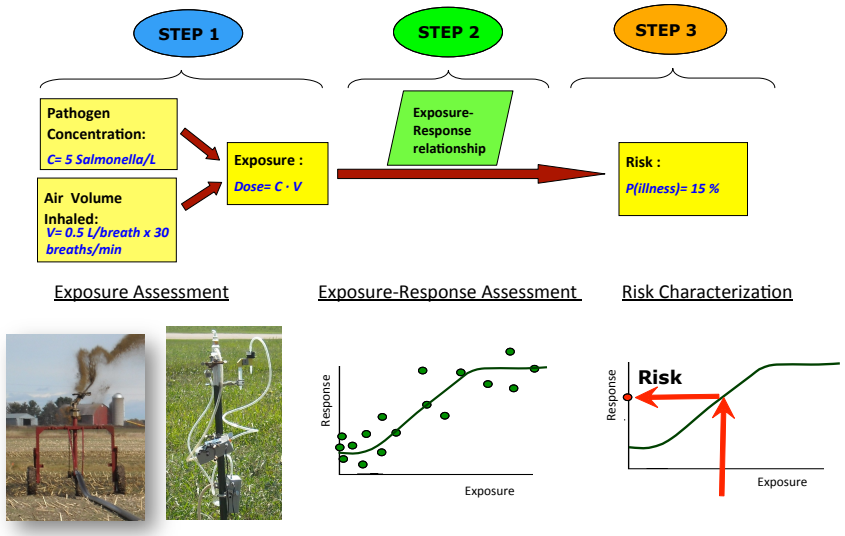
QMRA Definition

- QMRA is a process using risk assessment principles for quantifying at the population-level the adverse health effects that result from exposure to pathogenic microorganisms

QMRA Process Steps



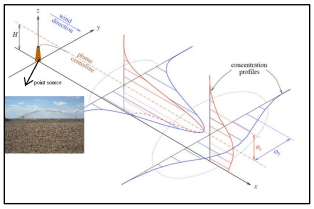
Study Objectives

- Define the setback distance at which the risk of illness from airborne pathogens from manure irrigation is acceptable
- Perform sensitivity analyses to identify those variables driving the pathogen transmission process from source (irrigation) to receptor (people) that contribute the greatest uncertainty to the defined setback (e.g. manure pathogen concentration, wind speed, pathogen inactivation rates, etc.)

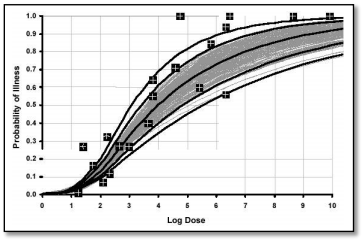
Study Plan Overview

1) Empirical measurements of pathogen transport during irrigation

2) Air dispersion modeling of pathogen transport



3) QMRA



Study Resources

- One FTE for one year, January 1 – December 31st, 2014

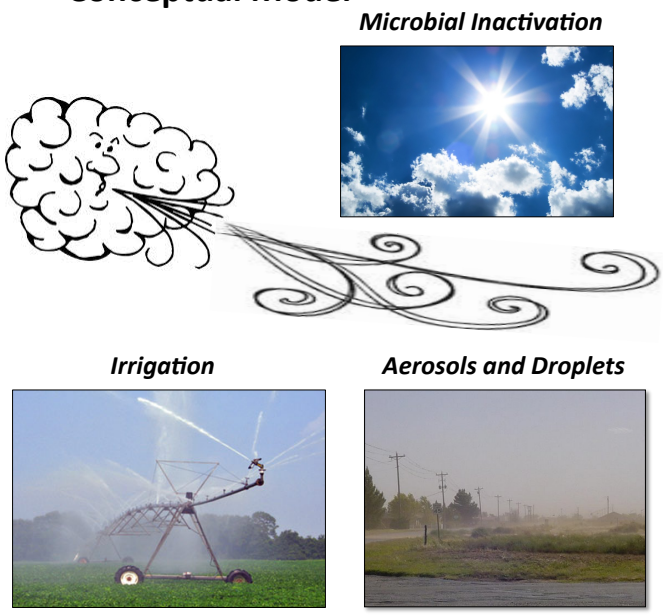
QMRA Study Context

- The current setback distance is 500 feet.
- What studies and data were used to establish this distance?

Scoping Overview

- Define exposure pathways
- Define pathogen hazards
- Define population at risk
- Define health outcome
- Define acceptable level of risk
- Define exposure scenarios

Conceptual Model



Hazard Characterization

Pathogen	Occurrence (% of positive manure samples)*			Infective Doses	Human Diseases and Symptoms
	Cattle	Poultry	Swine		
Bacteria					
Salmonella spp.	0.5 - 18	0 - 95	7.2 - 100	100 - 1,000 cells	Salmonella enteritis, Typhoid Fever, Paratyphoid fever (diarrhea, dysentery, systemic infections that spread from the intestinal tract to other parts of the body, abdominal pain, vomiting, dehydration, septicemia arthritis and other rheumatological syndromes)
E. coli 0157:H7	3.3 - 28	0	0.1 - 70	5 -10 cells	Enteric colibacillosis (diarrhea with or without bleeding), abdominal pain, fever, dysentery, renal failure, hemolytic-uremic syndrome , arthritis and other rheumatological syndromes
Campylobacter spp.	5 - 38	57 - 69	14 - 98	< 500 cells	Campylobacter enteritis (diarrhea, dysentery, abdominal pain, malaise, fever, nausea, vomiting, septicemia, meningitis,, Guillain-Barré syndrome (neuromuscular paralysis), arthritis and other rheumatological syndromes
Yersinia enterocolitica	-	-	0 - 65	10,000,000 cells	Yersiniosis (Intestinal infection mimicking appendicitis, diarrhea, fever, headache, anorexia, vomiting, pharyngitis, arthritis and other rheumatological syndromes)
Listeria spp.	0-100	8**	5.9 - 20	<10,000 cells	Listeriosis (diarrhea, systemic infections, meningitis headache, stiff neck, confusion, loss of balance convulsions miscarriage or stillbirth)
Protozoa					
Cryptosporidium spp.	0.6 - 23	6 - 27	0 - 45	10 -1,000 oocysts	Cryptosporidiosis (infection that can be asymptomatic, cause acute but short-lived diarrheal illness, cause chronic diarrheal illness, or be quite severe and cholera-like, with cramping, abdominal pain, weight loss, nausea, vomiting, fever, pneumonia, biliary system obstruction and pain)
Giardia	0.2 - 46	-	3.3 - 18	10-25 cysts	Giardiasis (diarrhea, abdominal cramps, bloating, fatigue, hypothyroidism, lactose intolerance, chronic joint pain)

- Focus on cattle manure only?

Source: EPA 820-R-13-002, July 2013

Hazard Characterization (cont)

Infrequent zoonotic pathogens in cattle manure

Microsporidia	Leptospira species
Brucella species	Listeria monocytogenes
Bacillus anthracis	Mycobacterium bovis
Clostridium perfringens	Apthovirus (foot and mouth disease)
Coxiella burneti	

Sources
Dungan, RS. 2010. J. Anim. Sci. 88:3693-3706
Atwill, ER. Et al. 2012 . NRCS Technical Note No. 9

Population at Risk

- General population
- Children (Age groups)
- Elderly
- Immunocompromised and immunosupressed
- Pregnant women
- Populations to be excluded (e.g. farm workers)

Health Outcome

- Illness versus infection
- If illness, which system? Gastrointestinal, respiratory, neurological etc.(Data gaps likely)
- Death

Acceptable Level of Risk

- Probabilistic USA standard for waterborne infectious disease is 1 infection per 10,000 people per year (i.e. 0.0001 infection/person-year)
- Probabilistic World Health Organization standard is 1 Disability Adjusted Life Year (DALY) per 1,000,000 people per year
- Define limits based on exposures currently tolerated
- Define by disease burden (e.g., 5% of illness from irrigation OK)
- Cost benefit analysis where risk reduction costs are weighed against illness costs
- Defined by public health professionals, bureaucrats, or politicians

Adapted from Hunter and Fewtrell, Water Quality: Guidelines, Standards, and Health; World Health Organization, 2001

Exposure scenarios

- Meteorological conditions during irrigation
- Day versus night time irrigation
- Worst case, “mid” case, or best case scenarios
- Others?

Next Steps for QMRA Planning

- Organized literature review
- Inventory of available data
- Revisit QMRA scope