Nitrate: Risk Assessment and Health Effects

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A little bit about who I am
• Introduction to Risk Assessment
• ‘Blue Baby’ syndrome (methemoglobinemia)
• Epidemiology studies of long term effects
• Co-occurring contaminants
• Final thoughts and questions
• Dose makes the poison
• How much for how long
• One chemical paradigm
  • Additive or synergistic
  • Cumulative assessment
• Ultimately: What concentration of a chemical has little or no risk, even for those highly exposed and for sensitive populations?
CONDUCTING A HUMAN HEALTH RISK ASSESSMENT

- Hazard ID
- Dose-Response
- Exposure Assessment
- Risk Characterization
• Can an exposure cause a health effect?
• Does it happen in humans?
• What is already known?
DOSE-RESPONSE

- Describes how likely an adverse effect is after a certain amount of exposure
- What is the lowest dose where these health effects are seen?
- What is the highest dose where these effects are not seen
- Uncertainty factors
The process of measuring or estimating the magnitude, frequency, and duration of human exposure to an agent in the environment.
Summarize/integrate information from steps 1-3
Nitrate Risk Assessment for Methemoglobinemia
• Step one Hazard ID: Methemoglobinemia diagnosed in infants drinking well water/formula
  • Hunter (1949)
  • Bosch (1950) and Walton (1951)
  • 20 other documents
STEP TWO: DOSE RESPONSE

Distribution of Blue Baby Cases in the 1950/51 Studies

- Percent of Blue Baby cases
- mg/L nitrate in well water

0 to 10
11 to 20
21 to 50
50+

1950
1951
EXPOSURE ASSESSMENT

- Who
- What
- For how long
- How exposed
- Other exposures - ???
STEP FOUR - RISK CHARACTERIZATION

- Infants exposed through well water
- Exposure could be one-time or short term
- When nitrate was removed, the methemoglobinemia often spontaneously resolved
- More cases at higher nitrate concentrations
- No cases at 10 mg/L and below
- Nitrate alone was sufficient to cause methemoglobinemia
Nitrate and Chronic Health Risks
Colon cancer
Thyroid disease
Neural Tube Defects
Nonhodgkins Lymphoma
Breast Cancer
• There are *potential* links to cancer, neural tube defects at or below 10 mg/L

• Potential thyroid disease from drinking water at or above 10 mg/L nitrate.

• The studies need better exposure assessments.
CONFOUNDERS IN THE CASE OF NITRATE STUDIES

Other exposures—Very important

Red meat
Pesticides
Disinfection byproducts (city water)
Smoking
Drinking alcohol
Sedentary lifestyle
OTHER CONTAMINANTS FOUND WITH NITRATES

- Dakota County
- MN Dept. of Ag
  Nitrate
  Coliform bacteria
  Pesticides
- EDC (WI)
Thank you

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Drinking Water Nitrate and Human Health: An Updated Review.

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