Good Epidemiology Practice: The Time Has Come

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Today: Outline

• Epidemiology has been used in public health
• Guidelines and their uses
• Examples of improving relevancy of epidemiology studies for public health
• Discussion on challenges
Background

Fate and transport

Exposure measurements

Exposure models

Toxicology data: *in vitro, in vivo*

Epidemiology studies

Risk Assessment

Public Health Decision-Making
Epidemiology Goals

• What causes a disease?
• What factors impact our health?
  • Societal
  • Our behaviors
  • Our genetics
  • Pollutants and/or chemicals
• Rarely is epidemiology conducted for quantitative risk assessment
Epidemiology in Risk Assessment

- Increased reliance on epi for human health risk assessment
  - Target species is directly relevant - no inter-species extrapolations needed
  - Reduces need for high-to-low dose extrapolations
  - No/poor laboratory animal models for some health endpoints
  - Minimize the use of animals in chemical testing
Epidemiology & Regulations

• Dietary Guidelines
• Folic acid fortification
• Trans fats
• Fluoridation
• Ozone levels
• And... Pesticides
Risk Assessment

1. Hazard Identification
2. Dose-response Assessment
3. Exposure Assessment
4. Risk Characterization
Good Laboratory Practice

Covers

Planning  Recording
Performance  Reporting
Monitoring  Archiving

Ensures

Quality
Reliability
Integrity
Good Laboratory Practice

**Organization & Personnel**
- Sponsor
- Management
- Study Director
- Quality Assurance

**Test & Control Articles**
- Characterization
- Handling
- Storage

**Documents**
- Standard Operating Procedures
- Protocols
- Reports
- Archives

**Facility**
- Laboratory Operation
- Animal Care
- Equipment

- Reagents
- Materials
- Test Systems
- Storage
Toxicology and Epidemiology – who needs guidelines?
Epidemiology – Risk Assessment Gap

“Despite the considerable amount of epidemiological information available, the quality of much of this evidence was rather low and many limitations likely affect the results so firm conclusions cannot be drawn… Studies that do not meet the ‘recognised standards’… are thus not suited for risk assessment.”

EFSA 2017
Standard Operating Procedures

- Routine inspection, cleaning, maintenance, testing, and calibration of instruments
- Actions to be taken in response to equipment failure
- Analytical methods
- Definition of raw data
- Keeping records, reporting, storage, combining, and retrieval of data
Protocol

• Generally include description of and plans for
  • Study question, background, rationale
  • Study inclusion and exclusion criteria
  • Literature search strategy
  • Data extraction
  • Study quality assessment
  • Data synthesis
  • Plans for dissemination

• Specifying the methods \textit{a priori} reduces the risk of introducing bias
  • (\textit{e.g.}, can’t select studies based on results)

• If you must modify protocol
  • Amendments should be clearly justified and documented
Quality Assurance Team

Monitor
- Facilities
- Equipment
- Personnel
- Methods
- Practices
- Records
- Controls

Maintain
- Master Schedule
- Protocols
- Inspections

Verify Study Conducted in Accordance with
- Protocols
- Relevant SOPs
- GLP Regulations
Overview of GEP Guidelines

Prescriptive requirements in six different categories:

- Objectives and study plans
- Study design
- Exposure characterization
- Outcome assessment methods
- Study results
- Discussion
GEP Case Study: Exposure Assessment
Pesticide Exposure Assessment

- Biomonitoring
- Environmental samples
- Questionnaires/interviews/expert record review
- Residues in food & food consumption
Good Epidemiology Practice – Biological or Environmental Samples

• SOP and study protocol
• Validity and reliability of sampling
• Exposure window
• Time integration
• Sensitivity
• Specificity
• Validity and reliability of analytical methods
• Numbers of samples and replicates
• Consideration of matrix effects
• Sample storage and stability
• Reporting requirements
Good Epidemiology Practice – Questionnaires/Interviews/Expert Record Review

• SOP and study protocol
• Validity and reliability of sampling
• Exposure window
• Time integration
• Design of questionnaires
• Blinding
• Validation of exposure assessment methods
• Reporting requirements
Good Epidemiology Practice – Biological or Environmental Samples

Environmental Sampling
• SOP and study protocol
• Representative food sampling
• Validity and reliability of sampling
• Sensitivity
• Specificity
• Validity and reliability of analytical methods
• Numbers of samples and replicates
• Consideration of matrix effects
• Sample storage and stability
• Reporting requirements

Food Consumption
• SOP and study protocol
• Exposure window
• Time integration
• Study population
• Questionnaire design
• Blinding
• Validation of dietary assessment methods
• Reporting requirements
What If a Study Is Not Conducted in Accordance with GEP?

- Need to evaluate study quality
- Might be good for hypothesis generation
- Is it relevant for risk assessment?
- Key: Cannot take results at face value
Risk Assessment: How can epidemiology be more relevant?
Hazard ID – Confirm Exposure

Specific Exposure

Job
Farm
Urine

[Chemical Structure Image]
Dose-response: Use concordant doses across studies

Studies of pesticide “x” use per day

- **Cantar 1992**
  - Low: 5
  - Medium: 5
  - High: 5
  - Highest: 15

- **Hoar 1986**
  - Low: 5
  - Medium: 5
  - High: 5
  - Highest: 15

- **McDuffie 2001**
  - Low: 5
  - Medium: 5
  - High: 5
  - Highest: 20

- **Zahm 1990**
  - Low: 5
  - Medium: 10
  - High: 5
  - Highest: 10

At > 15 days per year, different study populations are labeled as medium, high, and highest.

Reporting similar cut-points would foster direct comparison.

Smith et al. 2017  Meta analysis of highest exposed groups
Exposure Assessment: Describe the data and its quality
Summary

• GEP draft guidelines (Julie talked about exposure today)
• Improve relevancy of epidemiology (Carol provided recommendations)
• The time is now.
GEP Challenges and Next Steps

• Complicated requirements
• Scientific advancements
• Buy-in
• Enforcement
Change study goals

• Will help ensure quality, reliability, & integrity
• Will improve relevancy of epidemiology data for policy
• Will help ensure risk assessments are based on sound science
Thank you.
Questions?