Aging, Risk and Communication around Pesticides
Outline

I. What is Risk?

II. Effects of Chronic, Low-level Exposure

III. The Implications for Aging and Risk

IV. How do we Communicate Risks
Is it safe?

The risk is low, but tell me about your specific concerns…
Safe is a SUBJECTIVE term. It’s not one size-fits all. It can imply many things including:

- Health and well-being
- Peace of Mind
- Financial security
- Quality of life
- Predictability

“Is it safe?”
The Essence of Toxicology

“All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.”

Theophrastus Phillipus Aureolus Bombastus von Hohenheim (Paracelsus, 1493-1541)
Safety vs. Risk

Safety
- Yes or No
- No/All precautions necessary
- Safe is safe for everyone
- Easy to explain

Risk
- More risky---Less risky
- Precautions reduce risk
- Risk is higher for certain people
- Harder to explain

The impression of safety can...

Careless behaviors, lack of vigilance

Increased risk
The Risk Equation

Risk = Toxicity of the Chemical \times Probability of Exposure
The Risk Equation

Risk = Toxicity of the Chemical & Probability of Exposure

- Toxicology of active ingredient
- Product signal word
- Effects (signs & symptoms) reported in the literature

- High/moderate/low; chronic effects; inerts; concentration
- DANGER, WARNING, CAUTION
- The chemical’s mode of action; poisoning case reports; toxicology literature
The Risk Equation

Risk = Toxicity of the Chemical & Probability of Exposure

- Formulations
- Person Being Exposed
- Ways to minimize exposure

- Dust, liquid, baits, EC, etc.
- Sensitive populations, pregnant/nursing, young, elderly, pets
- Discuss the location of the application, and options for keeping exposure low
Acute vs. Chronic

• Acute poisoning – High dose & immediate health effects
  – With one class of insecticides (organophosphates), there can be long-term health effects from a single high-dose poisoning: OPIDN (nerve death)

• Chronic poisoning – Low dose & long-term exposure & slow-to-develop health effects
Effects from chronic low-level exposure

- Less well understood
  - chronic arsenic exposure effects well documented

- Based on epidemiological or animal studies
  - diseases with low incidence difficult to evaluate
  - statistical association ≠ causation
  - often good for hypothesis generation
  - most common shortcoming is reliability of the exposure assessment

- Conditions that support a potential cause/effect relationship
  - temporal relationship, strength of effect, dose-response, consistency, bio. plausibility, experimental support
Pesticide Exposure and Depression among Male Private Pesticide Applicators in the Agricultural Health Study

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BACKGROUND: Pesticide exposure may be positively associated with depression. Few previous studies have considered the episodic nature of depression or examined individual pesticides.

OBJECTIVE: We evaluated associations between pesticide exposure and depression among male private pesticide applicators in the Agricultural Health Study.

METHODS: We analyzed data for 10 pesticide classes and 50 specific pesticides used by 21,208 applicators enrolled in 1993–1997 who completed a follow-up telephone interview in 2005–2010. We divided applicators who reported a physician diagnosis of depression (n = 1,702; 8%) into those who reported a previous diagnosis of depression at enrollment but not follow-up (n = 474; 28%), at both enrollment and follow-up (n = 540; 32%), and at follow-up but not enrollment (n = 688; 40%) and used polytomous logistic regression to estimate odds ratios (ORs) and 95% CIs. We used inverse probability weighting to adjust for potential confounders and to account for the exclusion of 3,315 applicators with missing covariate data and 24,619 who did not complete the follow-up interview.

RESULTS: After weighting for potential confounders, missing covariate data, and dropout, ever-use of two pesticide classes—fungicides and organochlorine insecticides—and seven individual pesticides—the fungicides aluminum phosphide and ethylene dibromide; the phenoxy herbicide 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); the organochlorine insecticide dieldrin; and the organophosphate insecticides diazinon, malathion, and parathion—were all positively associated with depression in each case group, with ORs between 1.1 and 1.9.

CONCLUSIONS: Our study supports a positive association between pesticide exposure and depression, including associations with several specific pesticides.

Chronic Effects: Insecticides

- Neurodevelopmental effects
  - most studies focus on OPs and OCs
  - far fewer studies on other pesticides
- Preschool Children
  - Adverse behavioral effects from prenatal exposure to OPs
  - prenatal chlorpyrifos exposure ↓ both motor and mental function @ 3 yrs
Chronic Effects: Insecticides

• School-Age Children
  – Organochlorines
    • consistent association between ADHD and Autism Spectrum Disorders with maternal proximity to applications during a critical period of pregnancy
    • ADHD consistent association with PCBs and DDE
  – Organophosphates
    • association between ADHD and OP exposure
    • Poor nutrition may increases the adverse effects on neurodevelopment
Chronic Effects: *Insecticides*

• Adults

  – Cross-sectional study of PCOs and OPs
    • decreased vibration sense and neuromuscular function
    • More pronounced the longer someone worked with OPs

  – Pesticide applicators in agriculture
    • Overall ‘pesticide exposure’ was association with symptoms of headache, depression, fatigue, numbness in hands & feet, etc.
    • strongest association with fumigants, OPs and OCs
    • physician-diagnosed depression was associated with single, high-exposure events and high cumulative exposures
Chronic Effects: Insecticides, fungicides herbicides

• Adults
  – Parkinson’s Disease
    • several studies
      – temporal association
      – positive association with dieldrin tissue levels
      – biological plausibility warrants further studies
    • animal studies support an association
      – dose dependent with certain fungicides (mancozeb and maneb)
      – other pesticides associated with Parkinson’s Disease include 2,4-D, paraquat, diquat, permethrin, dieldrin and rotenone
Chronic Effects: Cancer

• Adults
  – Non-Hodgkin lymphoma and other blood cancers
    • lack of sufficient exposure information is a limitation
    • one well-designed study listed risks for mecoprop (chlorophenoxy herbicide)
    • Other studies listed 2,4-D, MCPA and glyphosate as risk factors
Chronic Effects: Cancer

• Adults

  – Prostate cancer
    • may be related to hormonally active pesticides
    • carbofuran, permethrin, aldrin, and DDT
    • higher risk estimates found for methyl bromide
    • other meta studies found no association w prostate cancer

  – Kidney cancer – four studies w/ positive associations
Chronic Effects: Endocrine Disruption

• Breast cancer – unclear associations
• Female fertility – limited evidence – no specific pesticide
• Semen quality
  – evidence of reduced quality with atrazine, diazinon, chlorpyrifos, carbaryl
• Thyroid function – female spouses of farmworkers
  – benomyl and paraquat – hypothryroidism
  – mancozeb and maneb – hypo- and hyperthyroidism
Chronic Effects – Associated with Age
Aging and Risk

“Elderly people can be vulnerable to environmental challenges due to their age-altered physiological processes and exposure patterns. In addition, the presence of age-associated diseases or conditions may increase susceptibility to the harmful effects of specific agents. Therefore, special consideration of the elderly population is needed in assessing risk from exposure to environmental agents.”

SOURCE: AGING AND TOXIC RESPONSE: ISSUES RELEVANT TO RISK ASSESSMENT
U.S. Environmental Protection Agency , 2005
Age as a Risk Factor

Aging is as much biological as chronological
Aging is both chronological and biological.
Pesticide Absorption

As we age, the skin begins to thin, particularly the epidermis and the subcutaneous fat. These changes can result in:

- More rapid absorption of chemical
- More severe damage after chemical contact
- Slower to show signs of irritation (inflammation)
Pesticide Metabolism, Excretion

Reduced cardiac function
- decreases blood flow to liver and kidneys

Reduced size and blood flow of liver and kidneys
- lower metabolism
- proportionally more susceptible to injury
- aging liver and kidneys are slower to eliminate chemicals

The time that chemicals remain in the body may be 50-70% longer in those older than 65 years.
Other Factors

Increased use of pharmaceuticals
  – May alter pesticide absorption, metabolism and excretion
    • e.g. heart meds, diuretics, skin creams, steroids
  – Drug/pesticide interactions???

Diseases of aging
  – Can further alter effects of pesticides
  – Diabetes, hypertension, liver impairment, etc.

Older adults may experience health problems from pesticide exposures that would not cause problems for younger adults
What does this mean for risk?

Nervous system changes such as diminished smell, taste and touch sensations lead to a reduced ability to detect and avoid chemicals.

More rapid absorption across the skin combined with a potential increase in the time of contact adds up to a larger dose.

Pre-existing disease, pharmaceuticals and slower metabolism can lead to larger retention times and more opportunity for chemicals to exert negative effects.
How Do we Discuss Risk with the Public?

The expert:

• Need to build trust/rapport
• Need to convey critical information
• Need to respond to specific concerns

Interactive

The inquirer:

• Need to build trust/rapport
• Need to capture relevant information
• Need to archive, organize, retrieve & report information
Psychology of Risk: Key Points

- Trust is critical: hard won, easily lost
- Risk and risk assessment are subjective and value-laden
- Most risk perception is determined by fast, intuitive feelings
- There is no such thing as “true risk” or “objective risk.”
- If you define risk one way, the best solution might be (this).
  If you define it another way, the best solution might be (that).

Defining risk is an exercise of power.

Paul Slovic, Decision Research and University of Oregon
November 13, 2014
Things that affect risk perception

Voluntary ---------------------- Imposed
Fairly distributed risk -------------- Unfairly distributed risk
Natural ------------------ Man-made
Familiar ------------------ Exotic
Affects only adults ------------------ Affects children
Trusted entity ---------- Untrusted entity

Lower risk percieved

Higher risk perceived
Why Do Pesticides Elicit Fear?

Because for many people, pesticides are:

- One giant class of similarly toxic compounds
- “BIG” corporate & “BIG” Ag
- Something my neighbor uses
- Mysterious and unknown

And sometimes they are used incorrectly or without due caution & care.
Communication Tools

- Actively listen to concerns
- Do not interrupt
- Acknowledge their feelings
- Address the core concerns
- Politely correct misinformation (not emotions)
- Acknowledge when you don’t know something
- Offer third-party informational resources
Resources:

National Pesticide Information Center

1-800-858-7378

www.npic.orst.edu
www.npic.orst.edu/es

npic@ace.orst.edu
Address Expectations

Often, a major contributor to conflict is a misunderstanding of expectations.

- Explain your role
- Discuss limitations
- Discuss decision-making process
- Provide background
What to avoid...

Undefined technical terms & lots of acronyms

Repeating negative allegations from the public or media

Inflating your sense of certainty

Promising unrealistic outcomes or timelines

Not involving the public/clients as a real partner
Tell Your Story

You maintain certification and attend trainings
You use modern, calibrated spray equipment
You are judicious with use - pesticides cost $$$
You are also a member of the community

Offer objective, third-party resources
In summary:

I. What is Risk?

II. Effects of Chronic, Low-level Exposure

III. The Implications for Aging and Risk

IV. How do we Communicate Risks?
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