Dioxin: Toxicity and Health Effects

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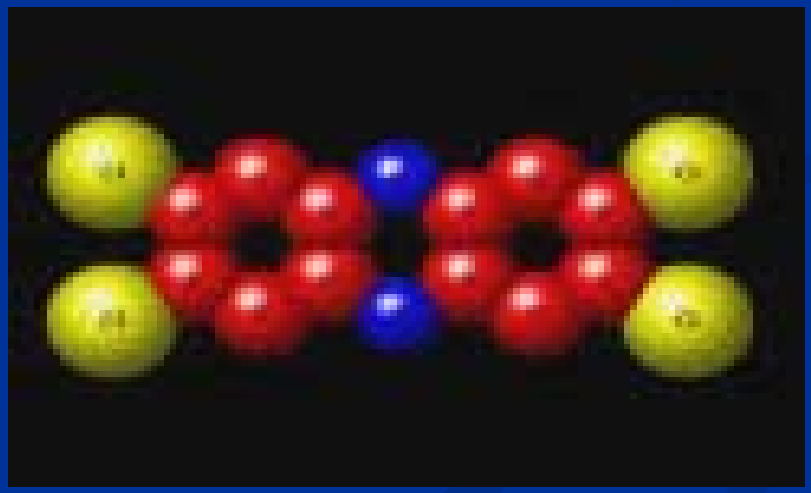
What is Dioxin?

- Chlorinated dibenzo-p-dioxins= a family of 75 chemicals
- Colorless, odorless solids
- Prototype is 2,3,7,8-TCDD (most toxic)
- Exist as mixtures (TEQ)
- Not intentionally manufactured



Sources

- Chlorine bleaching processes at pulp and paper mills
- Waste & drinking water treatment
- Chemical manufacturing contaminants
- Released into air in emissions
- Uncontrolled combustion of household wastes

Fate of CDDs

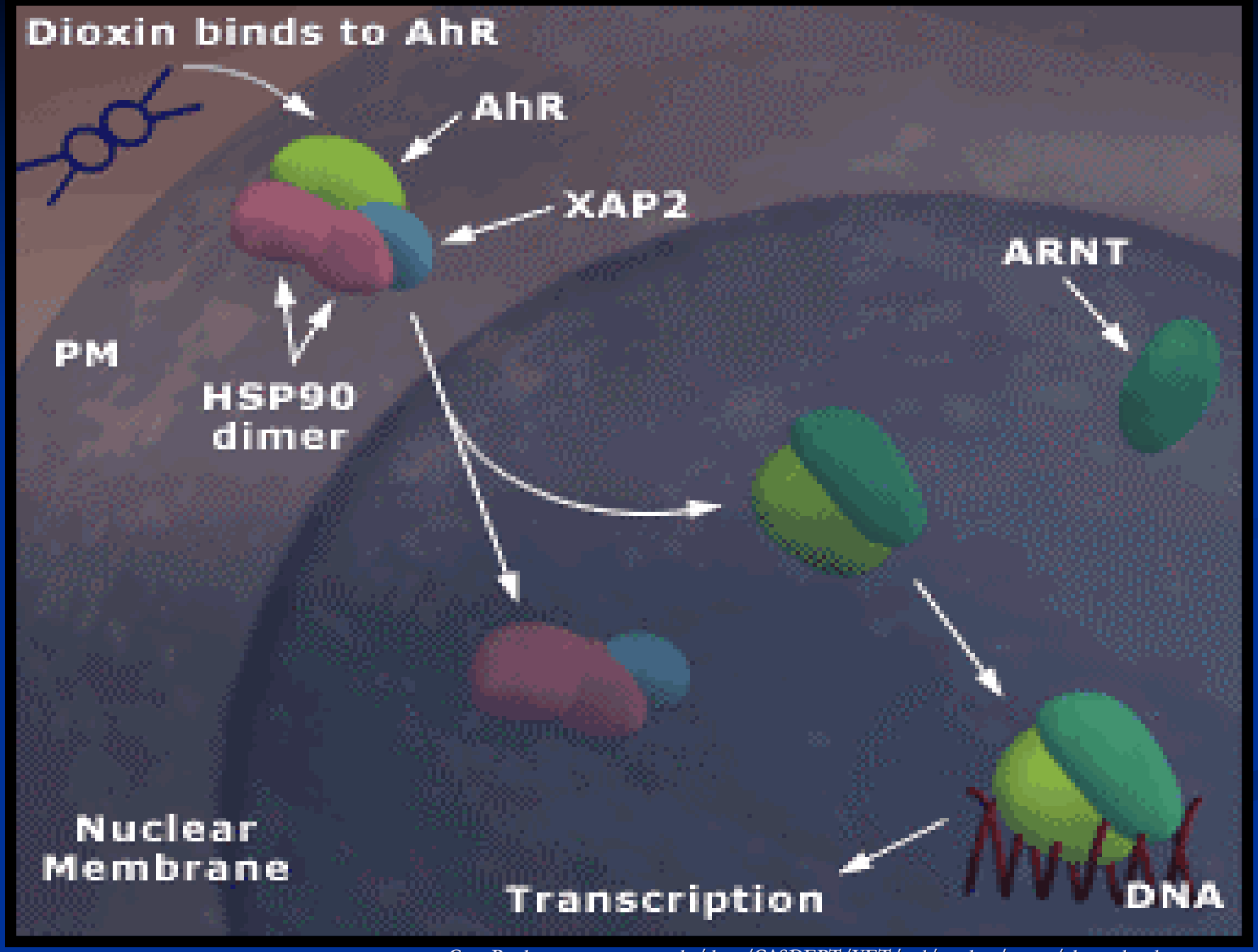
- Persistent
- Emissions: may be transported in air long distances
- Waste water: most attaches to soil- sediment
- Concentrate in food chain
- Overall environmental levels declining in US

Human Exposure

- 95% diet (meat, dairy, fish, breast milk)
- Proximity to hazardous waste site or incinerator
- Air, water, skin contact: less significant
- Occupational
- Half-life ~ 8.5 years

Dioxin Toxicity

- Potent animal toxicants
- Tremendous species variability
- Dioxins have a common toxic mechanism
- Alter basic steps for cell growth and development
- Results in broad impact in animals:
  - Reproductive/developmental
  - Immunologic
  - Skin
  - Cancer



Gary Perdew www.cas.psu.edu/docs/CASDEPT/VET/ppl/perdew/pages/ah_rec.html

Human Toxicity

- Occupational studies (chemical workers)
- Accidents

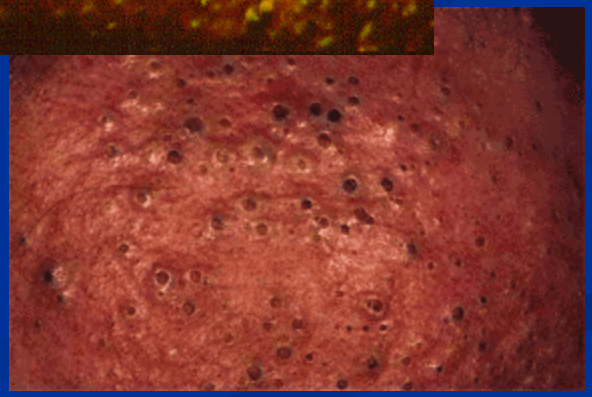
  Missouri, Italy, Asia
- Breast milk
  - Netherlands
- Vietnam veterans

Human Cancer

- Dioxin is a human carcinogen
- Exposure to TCDD increases the risk of cancer at multiple sites, including lung CA
- Overall increased risk in occupational/accident studies is 40-100%
- Possible association with STS
- Little if any association with NHL or skin CA

Human Non-cancer Effects

- Good evidence
  - Chloracne
    - Acute high level or chronic
    - Persists 10 years
  - Liver enzyme changes
    - No evidence for disease
    - Higher in drinkers
  - Reproductive hormone changes
    - Decreased testosterone
    - Decreased libido



Human Non-cancer Effects

- Possible effects
  - Blood lipids: ↑ TG/cholesterol
  - Diabetes
  - Post-natal development
    - Neurobehavioral
    - Thyroid
    - Liver enzymes
    - Platelets

Human Non-cancer Effects

- Good evidence in animals, but human data inconclusive
  - Circulatory
  - Immunologic
    - No change in children of Seveso at 2 years
    - Limited data on depressed T-cell function
  - Semen changes
  - Endometriosis

Human Non-cancer Effects

- Emerging Issues: further study needed
  - Miscarriage rate
  - Birth defects
    - Majority studied are paternal exposures
    - Misclassification may have occurred
  - Dental effects
  - Sex ratio
  - Growth measures
    - Decreased length (transient) & birth weight
    - Increased preterm birth & neonatal death rate

Human Non-cancer Effects

- Lack of evidence for:
  - Long-term thyroid gland effect
  - Renal effect
  - Pulmonary effect
  - Adult neurologic effect

General Population Body Burden

- Estimated to be 25 ppt (pg TEQ/g lipid)
- Approaches the levels at which adverse events are expected
- No clear indication of disease
- Scientific limitations
- Increased risk of cancer may be 1: 1,000 increased chance

Special Populations

- Children may be at greater risk for illness related to environmental contaminants
  - Increased outdoor play
  - Increased hand-to-mouth activities
  - Shorter stature- dust, soil, vapors
  - Higher intake rate, lower body weight = greater dose
  - Critical, rapid growth stages
  - Latency

Midland

- Michigan vital statistics & MRCIF
  - No persistently elevated numbers of specific cancer types
  - Higher than expected numbers of all cancers combined for zip code 48640

Midland

- MBDR
  - No increased anencephaly, spina bifida, cleft lip in Midland County
  - Limitations

Special Populations

- Fetuses, infants and children may be more susceptible based on rapid growth & development
- Unknown whether children in the general population are experiencing health effects from dioxin
- Immunocompromised

Prevention

- Avoid contact with soils near contaminated or hazardous waste sites
- Discourage children from eating dirt/putting toys in their mouth, hand hygiene
- Diet
  - Fish advisory
  - Avoid food sources from contaminated areas
  - Wash & peel fruits & vegetables from contaminated areas
- Smoking/alcohol
- Recreation
- Do not stop breast feeding