Endocrine disrupting chemicals & the grain industry

Riana Bornman, SHSPH, UP
riana.bornman@up.ac.za

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Make today matter

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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Faculty of
Health Sciences

Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tša Maphelo

Conflict of interest statement

Opinions expressed and conclusions arrived at are those of myself, and are not necessarily to be attributed to the WRC, NRF, or any funder.

None of the funding sources listed here, any of my employers or any previous funders or employers had general or specific expectations or demands that restricted my freedom to design, conduct, interpret, or publish research.

I declare I have no actual or potential **competing financial** interests.

As scientist I declare that I am not bound by any Government, International Government Organization, Lobby Group, or NGO position or policy on DDT.

The papers I refer to here published **international, peer reviewed** journals.

Aims

1. Why should you as Industry be concerned

2. What can you do?

3. Background: all elements value chain

4. People and health

agbiz
agricultural business chamber
the way to prosperity

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Outline

- Background on EDCs
- Human health effects and EDCs African
- Hormone dependent cancers
- Climatic varibility

Definitions of EDCs

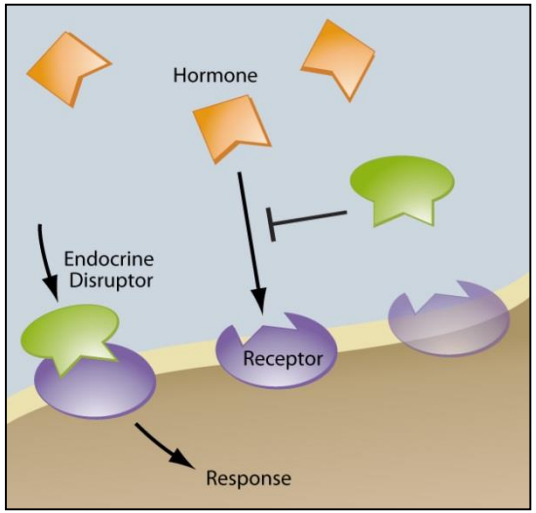
"…an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub) populations." (ICPS, 2012)

"… an exogenous chemical, or mixture of chemicals, that interferes with any aspect of hormone action" (Endocrine Society)

Endocrine Disruption?

change to the normal function of endocrine glands and hormone action, in any living species, imposed by external (anthropogenic) stressors

endocrine disruptors, are chemicals designed for a specific function…with a side effect of altering the function of the endocrine system.



Determination of EDC activity

- *in vitro* – cell line specific, estrogen, androgen, thyroid
- *in vivo* – laboratory animals like mice, rats, rabbits etc
  – multigenerational studies

EDC endpoints

- epidemiological studies
  - occupational workers
  - people living in an area - malaria IRS
  - mothers, children - pregnancy
- wildlife – birds, mice, frogs

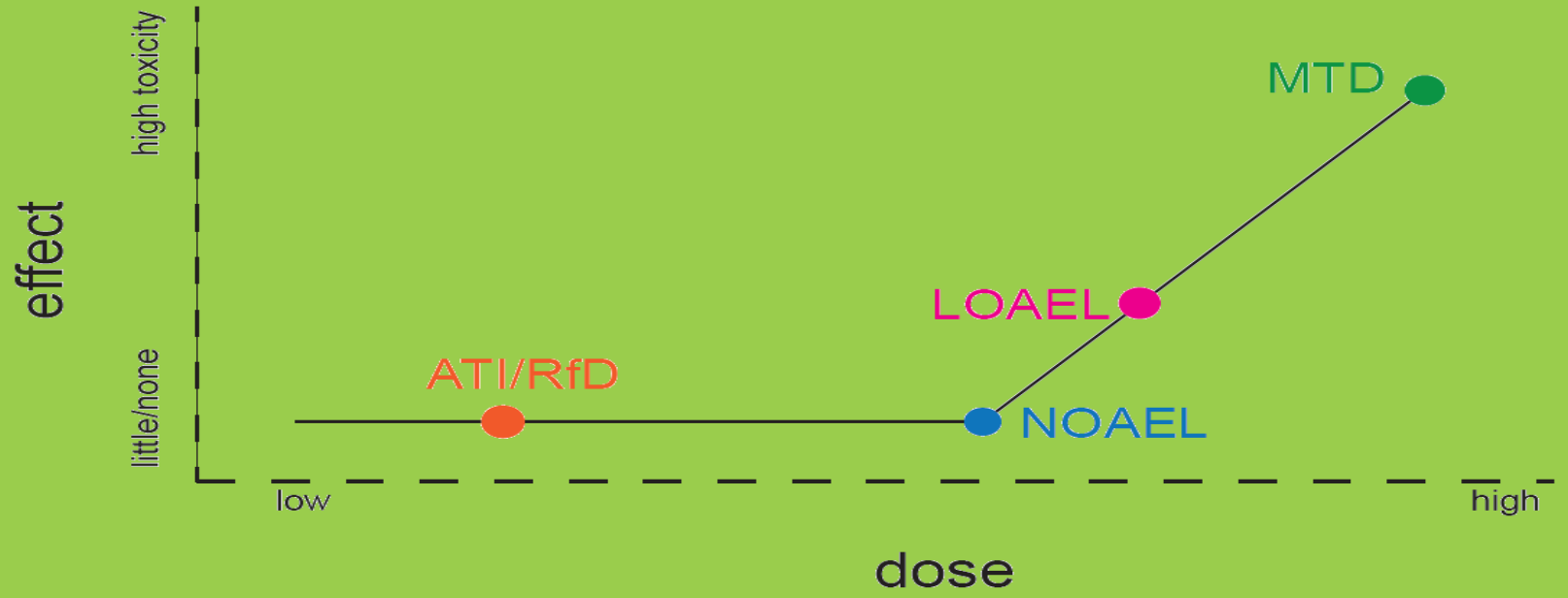
CHEMICAL SAFETY REGULATIONS

- carcinogenicity
- mutagenicity
- teratogenicity

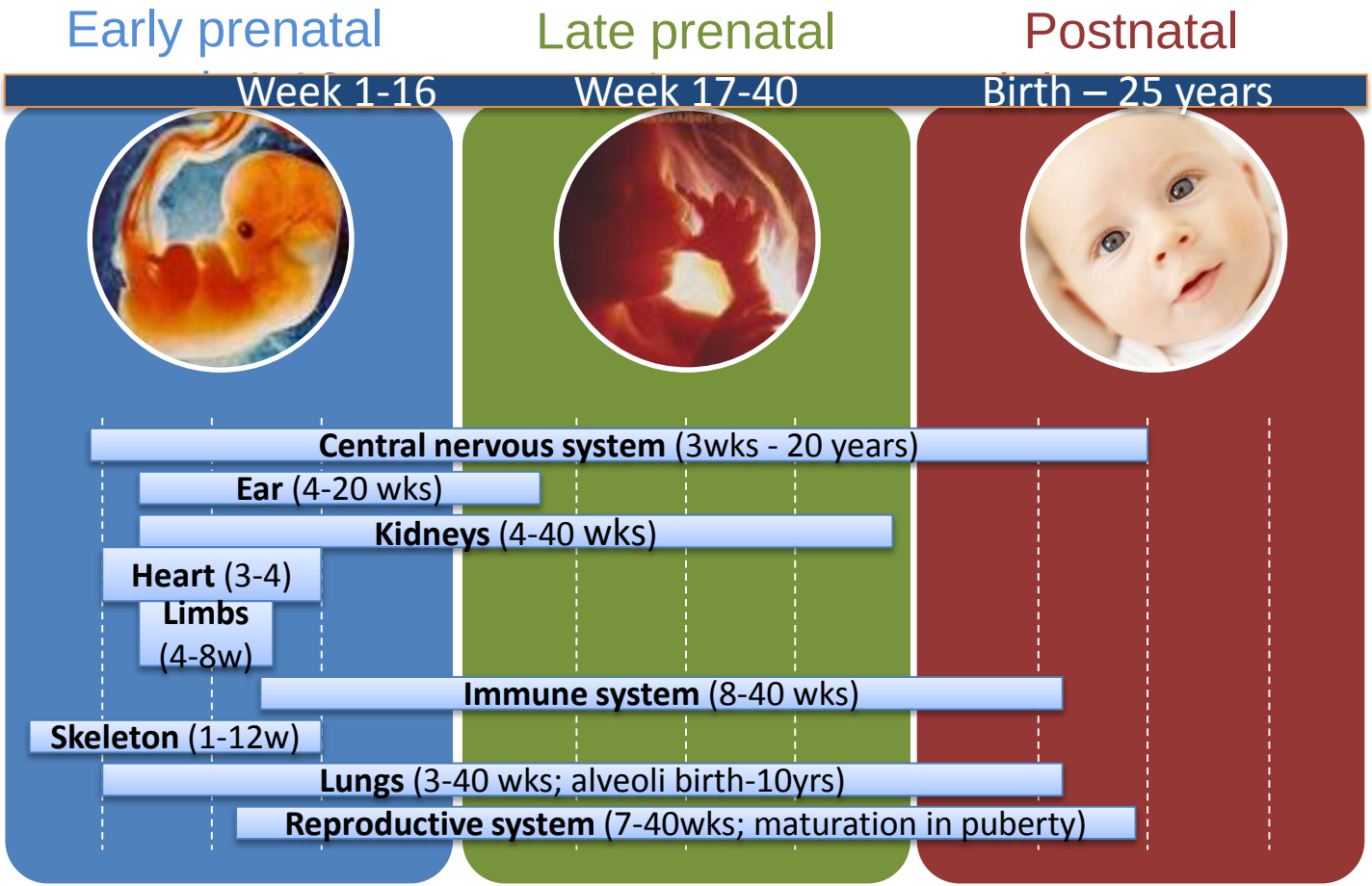
endocrine disrupting effects NOT TESTED…….

- 140 000+ chemicals in use. Global Chemicals Outlook (UNEP)
- ?~ 800 or more chemicals to consider
- **concerns about estrogen, androgen and thyroid hormones**

TRADITIONAL APPROACHES TO DOSE SELECTION



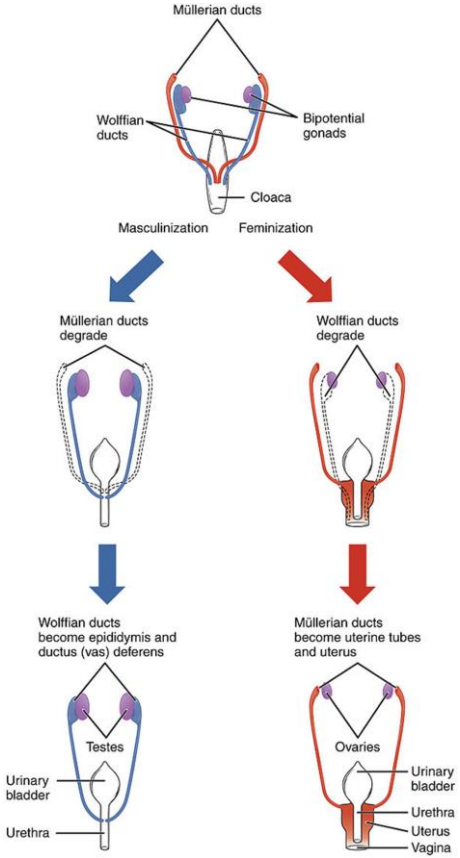
RISKS RELATED TO WINDOWS OF EXPOSURE



Diethylstilbestrol (DES)

- First orally active synthetic estrogen 1938, since 1947 prescribed to prevent abortion
- 1970 first case clear cell vaginal cancer, 1971 more cases, FDA withdrew DES
- Not effective, WORSE
- Reproductive health effects girls and boys
- Endocrine disruptive – estrogenic
- Growth stimulant feedlots

Male urogenital development



MRH and Environmental EDCs

- male reproductive health ↓
- incidences testicular cancer, hypospadias and cryptorchidism ↑
- similar reproductive problems many wildlife species
- clinical, laboratory research changes inter-related, origin fetal life
- exposure male fetus to supranormal levels estrogens

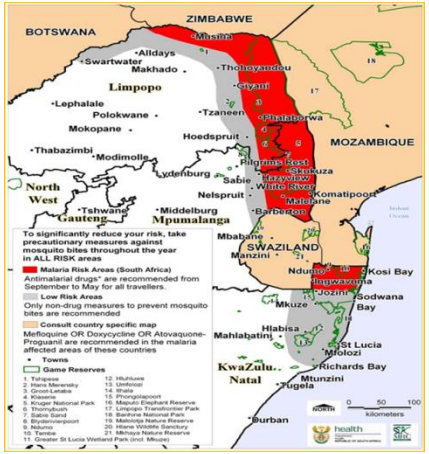
"adverse trends male reproductive health at least in part associated with exposure to estrogenic or anti-androgenic environmental chemicals during fetal life"

Toppari et al., EHP 1996;104 Suppl 4:741-803

1,1,1-trichloro-2,2-bis-(4-chlorophenyl)ethane (DDT)

chemically technical DDT is a mixture

- 63–77% *p,p'*-DDT insecticidal
- 8–21% *o,p'*-DDT contaminant



- applied DDT estrogenic **o,p'-DDT, p-p'-DDT**
- persistent metabolite **p,p'-DDE** anti-androgen

EDC

Bulger & Kupfer 1983; Sharpe & Skakkebaek 1993; Danzo1997; Kelce et al. 1995; Guillette et al.1995

Indoor Residual Spraying

pyrethroids

WHO: combined human and animal data raise concern for effects of exposure to DDT on female reproductive health, further data needed (IPCS, 2011).

DEVELOPMENTAL ORIGINS OF HEALTH AND DISEASE (DOHaD)

EDC-2: The Endocrine Society's Second Scientific Statement on Endocrine-Disrupting Chemicals

A. C. Gore, V. A. Chappell, S. E. Fenton, J. A. Flaws, A. Nadal, G. S. Prins, J. Toppari, and R. T. Zoeller

***Endocrine Reviews* 36:E1–E150, 2015**

HEALTH CONDITIONS
STRONG EVIDENCE EDC

1. obesity and diabetes
2. female reproduction
3. male reproduction
4. hormone-sensitive cancers in females
5. prostate
6. thyroid
7. neurodevelopment and neuroendocrine systems

Andrea C Gore et al., 2015

CHEMICALS WITH EDC ACTIVITY

- Bisphenol A
- Phthalates
- Pesticides
- Persistent organic pollutants such as DDT, PCBs, PBDEs, and dioxins

Andrea C Gore et al., 2015

Neurobehavioral Deficits, Diseases, and Associated Costs of Exposure to Endocrine-Disrupting Chemicals in the European Union

Martine Bellanger, Barbara Demeneix, Philippe Grandjean, R. Thomas Zoeller, and Leonardo Trasande

J Clin Endocrinol Metab 100: 1256–1266, 2015

- polybrominated diphenyl ether
- organophosphate exposures

- intellectual disability and lost IQ points
- autism spectrum disorder
- attention-deficit hyperactivity disorder

EDC exposures Europe contribute substantially to neurobehavioral deficits and disease, with a high probability of €150 billion costs/year.

Many Sources of EDCs

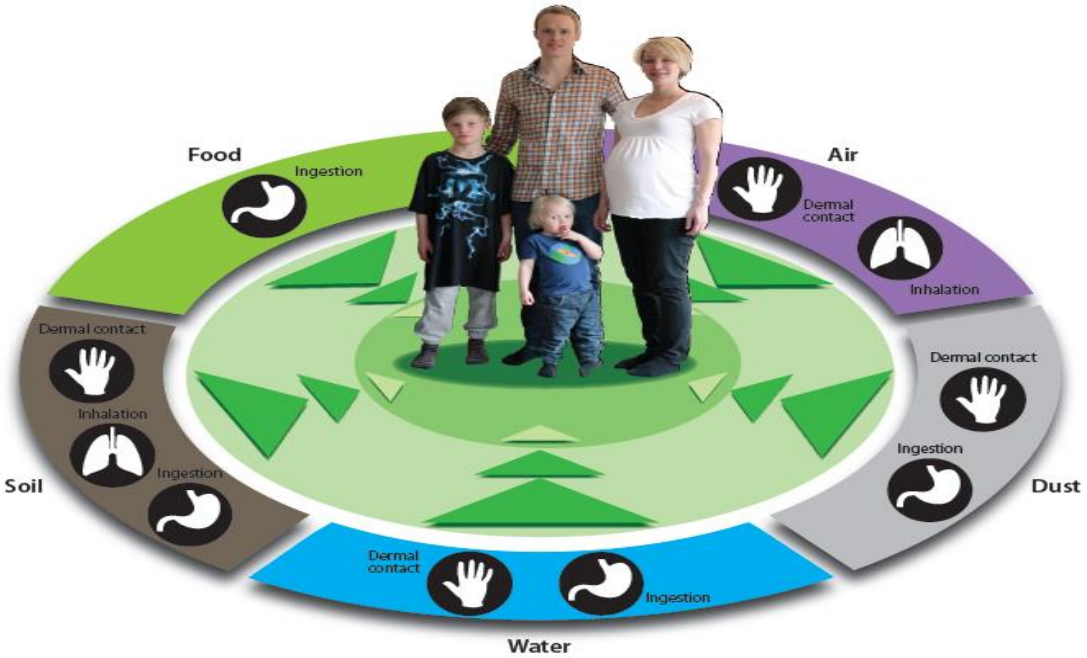
- Industrial chemicals produced and used in large quantities,
  - Flame retardants
- By-products in industrial processes or from environmental or metabolic transformations
- Active ingredients, additives, and preservatives in consumer products
  - Insecticides, herbicides, fungicides
  - Personal care products and pharmaceuticals
  - Food and other packaging
  - Clothing, electronics including e-waste, carpets, furniture, cleaning products
- Contaminants in food and drinking water
  - Pesticides, plasticizers, industrial chemicals, metals, hydrocarbons

Sources of EDCs

ARC • LNR

Excellence in Research and Development

How are we exposed to EDCs?



- food, water, air, soil
- dust (newer)
- *in utero,* breast milk

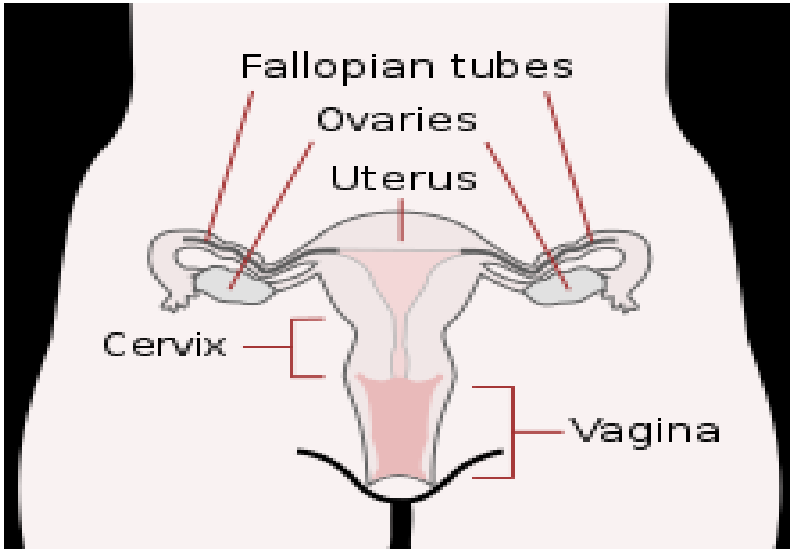
- multiple sources

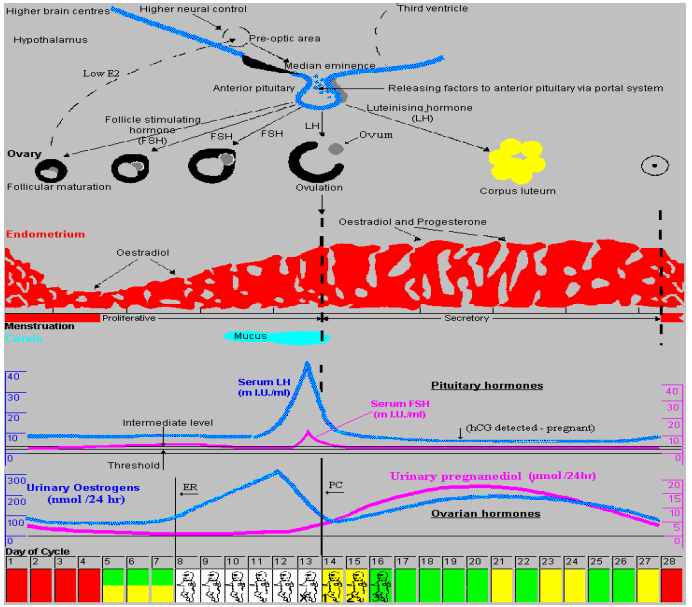
- exposures vary with
  - diet
  - location
  - lifestyle
  - occupation
  - age

Other associations with EDCs

- prostatic cancer
- thyroid disruption, cancer
- neurodevelopmental and NE effects
- female hormone-dependent cancers

EDC and Female Reproduction





We can no longer afford….

Croplife/AVCASA

PESTICIDES

1. disposing of empty containers
2. how to handle pesticides safely
3. poisoning
4. protective clothing
5. safety measures
6. storing agrochemicals and stock remedies
7. **what does the label say?**

Do not assume……..

- not reasonable to assume a chemical is safe until proven otherwise
- replacement chemicals also EDC effects
- body burden long-lived and short-lived chemicals may induce permanent changes
- changes present in offspring
- transgenerational effects of EDCs - imprints on exposed individual's DNA may persist for generations

Precautionary principle

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

1998 Wingspread Statement

Climate varibility

African Continent

- inadequate education, poverty, malnutrition augmented by natural disasters
- **still dealing legacy issues** poverty, civil wars, land degradation, and diseases
- **traditional environmental health hazards**
  - lack of access to safe water
  - indoor air pollution from solid fuel combustion
  - lack of sanitation and hygiene
- HIV/AIDS epidemic - strain economy, labour, AND medical services

Challenge in Africa

Infectious killers

1. HIV/AIDS
2. Malaria
3. TB
4. acute respiratory infections
5. diarrhoeal disease
6. vaccine-preventable diseases

Brundtland, 2002; Boutayeb, 2006

malnutrition common contributor

~2020 NCD (ie. DM, HT) cause 7/10 deaths

Africa's shifting burden of disease

Knowing is not enough;
we must apply.

Willing is not enough;
we must do.

Johann Wolfgang von Goethe

The health of the next generations is in our hands!


Ro livhuwa!