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Burden of Disease and Costs of Endocrine Disrupting Chemicals in the European Union

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Summary

Thirteen chronic conditions with strong scientific evidence for causation by endocrine disrupting chemicals (EDCs)

- Based on current knowledge, probable costs are €157 billion; could be as much as €269 billion
- <5% of EDCs considered
- Endometriosis, fibroids, breast cancer and many other conditions not included yet, but will be focus of future work
- Economic numbers do not consider all costs associated with these chronic conditions

- Limiting our exposure to the most widely used and potentially hazardous EDCs is likely to produce substantial economic benefit.

Chemical environmental agents and the endocrine system

- European Union defines endocrine disrupting chemicals as "exogenous substance[s] that causes adverse health effects in an intact organism, or its progeny, secondary to changes in endocrine function"

- Highly heterogeneous group of molecules
  - industrial solvents/lubricants
  - flame retardants
  - aluminum can linings
  - plasticizers
  - pesticides
  - fungicides
  - pharmaceutical agents

Chemical environmental agents and the endocrine system

- First observation by Herbst and Bern of cancer in young girls exposed one to two decades earlier to diethylstilbestrol (DES), a synthetic estrogen prescribed to pregnant women in the 1950s and 1960s to prevent miscarriage

- Rapidly accumulating evidence suggests that EDCs contribute to disease and disability across the lifespan
  - Neurodevelopmental deficits and disabilities
  - Infertility
  - Obesity and diabetes
  - Reproductive cancers
  - Birth defects

Quantifying EDC disease burden and costs

- For EDCs, laboratory evidence is supplemented by varying levels of epidemiologic evidence
  - Each condition is clearly multifactorial.

- Absent estimates of the burden of disease and disability potentially produced by EDC exposures, high costs of alternatives are likely to outweigh concerns about the health consequences of using EDCs.

European context

- In Europe, 2009 and 2011 laws mandate limits on pesticides and biocides with endocrine disrupting properties that may have harmful health and environmental effects
  - EU Commission has requested impact assessment to assess the economic implications of the criteria under discussion
  - Our objective was to quantify a range of health and economic costs that can be reasonably attributed to EDC exposures in the European Union

Expert panels

- Steering Committee convened three panels focused on diseases with the most substantial evidence for EDC attribution
  - obesity/diabetes
  - male reproductive health
  - neurodevelopmental disability
- Two expert panels were also convened for breast cancer and female reproductive conditions, and their deliberations will be the basis for future reports
- Panelists selected based upon scholarly contribution

Disease burden and cost estimates

- Widely used approach first described by Institute of Medicine in 1981 to assess the “fractional contribution” of the environment to causation of illness
- Applied data from human studies along with most representative European biomarker data available
- Peer-reviewed, published cost data were used for each condition
  - Conservative estimate due to lack of economic data on lost work, human suffering, etc. for many conditions

Estimating total EDC attributable costs

- Adapted approach from Intergovernmental Panel on Climate Change
  - Probability of causation based upon strength of laboratory and human evidence
  - Probabilities were used to down-weight costs across thirteen exposure-response relationships
- Monte Carlo methods used to produce realistic ranges for total costs

Pesticides (used in agricultural production and homes)

- 13 million lost IQ points in each EU country → €124 billion lost earning potential

  →59,300 born each year with intellectual disability = additional €21.4 billion

- 1,555 obese 10 year olds = €24.6 million

- 28,200 50–64 year olds with diabetes = €835 million

Bellanger et al, Legler et al J Clin Endo Metab epub Mar 5 2015

Phthalates (used in food wraps, cosmetics, shampoos, vinyl flooring)

- 24,800 additional deaths among 55 – 64 year old men = €7.96 billion in lost economic productivity
- 618,000 additional assisted reproductive technology procedures costing €4.71 billion
- 53,900 50-64 year old women are obese = €15.6B
- 20,500 50-64 year old women are diabetic = €607M

Hauser et al, Legler et al J Clin Endo Metab epub Mar 5 2015

Flame retardants (used in electronics, furniture, mattresses)

- 873,000 lost IQ points →€8.4B lost earning potential

  →3,290 intellectually disabled children = additional €1.9 billion

- 6,830 new cases of testicular cancer = €850 million

- 4,615 children born with undescended testis = €130 million

Bellanger et al, Hauser et al J Clin Endo Metab epub Mar 5 2015

Other estimates of burden and disease and costs

- 316 autistic 8 year olds each year (multiple EDCs) = €199 million
- 31,200 10 year olds with ADHD (multiple EDCs) = €1.7 billion
- Bisphenol A (used in aluminum can linings, thermal paper receipts): 42,400 obese 4 year olds each year = €1.54 billion

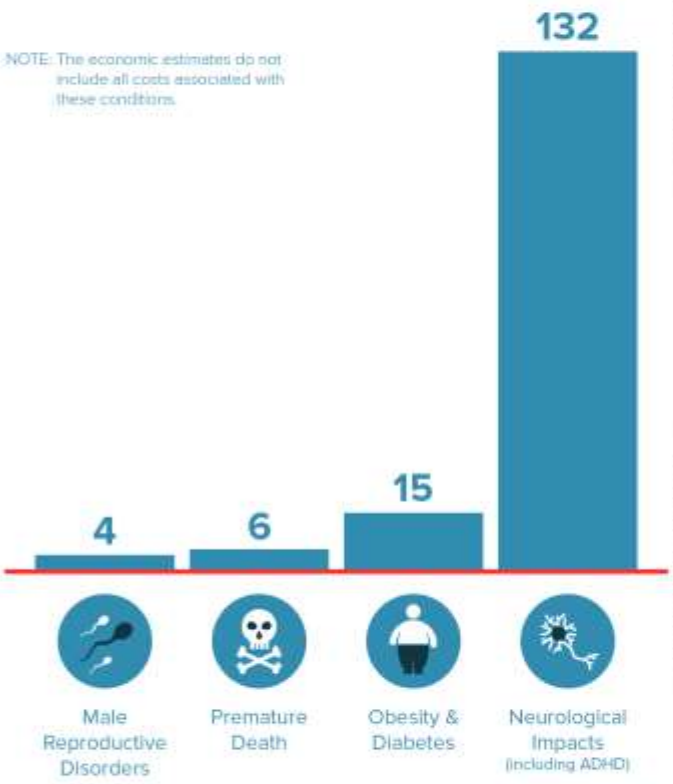
Bellanger et al, Legler et al J Clin Endo Metab epub Mar 5 2015

HEALTH EFFECTS FROM ENDOCRINE DISRUPTING CHEMICALS COST THE EU 157 BILLION EUROS EACH YEAR.

This is the tip of the iceberg: Costs may be as high as €270B.

€157B Cost by Health Effect

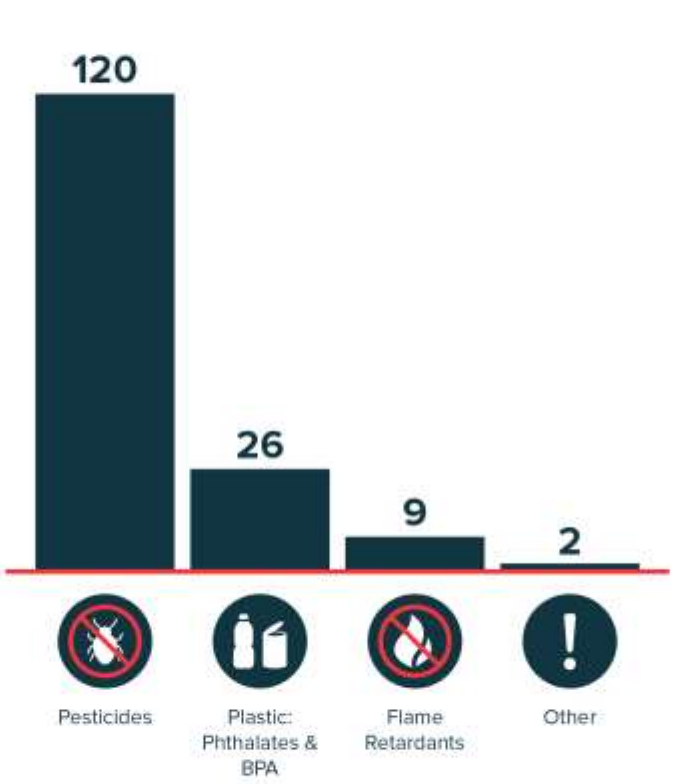
NOTE: The economic estimates do not include all costs associated with these conditions.



SOME EDC-RELATED HEALTH OUTCOMES NOT INCLUDED:

- Breast Cancer
- Prostate Cancer
- Immune Disorders
- Female Reproductive Disorders
- Liver Cancer
- Parkinson's Disease
- Osteoporosis
- Endometriosis
- Thyroid Disorders

€157B Cost by EDC Type



SOME EDCs NOT INCLUDED:

- Atrazine
- 2, 4-D
- Styrene
- Triclosan
- Nonylphenol
- Polycyclic Aromatic Hydrocarbons
- Bisphenol S
- Cadmium
- Arsenic
- Ethylene glycol

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Endocrine Disrupting Chemicals (EDCs) interfere with hormone action to cause adverse health effects in people.

"THE TIP OF THE ICEBERG"

The data shown to the left are based on fewer than 5% of likely EDCs. Many EDC health conditions were not included in this study because key data are lacking. Other health outcomes will be the focus of future research.

See Trasande et al. The Journal of Clinical Endocrinology & Metabolism
http://press.endocrine.org/edc

Implications for US

- Findings from Europe strongly suggest that a similarly large burden of disease may be attributable to EDCs in the United States
  - Data from the Centers for Disease Control and Prevention suggest that exposures to EDCs are in many cases equal to if not higher than those in the EU.
  - More importantly, this speaks to the importance of reprising these analyses in the US context.

Importance of policy

- Cost of brominated flame retardants likely to be higher in the US, as use is more stringently limited in Europe.

- Levels of phthalates (DEHP) have decreased 17-37% in the US between 2001-10 and costs of attributable disease are likely to have decreased over that period.

- EDCs are used globally, and our findings support careful regulation as part of the Strategic Approach to International Chemicals Management.

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Thanks!

- Funding
  - John Merck Fund, Broad Reach, Oak Foundation

- Steering committee: R. Thomas Zoeller, Andreas Kortenkamp, Philippe Grandjean, John Peterson Myers, Joe DiGangi, Martine Bellanger, Jerry Heindel

- Expert panel leads: Russ Hauser, Ana Soto, Paul A. Fowler, Patricia Hunt, Juliette Legler, Ruthann Rudel, Niels Skakkebaek

- Other participants: Barbara Cohn, Frederic Bois, Sheela Sathyanarayana, Jorma Toppari, Anders Juul, Ulla Hass, Bruce Blumberg, Miquel Porta, Eva Govarts, Barbara Demeneix

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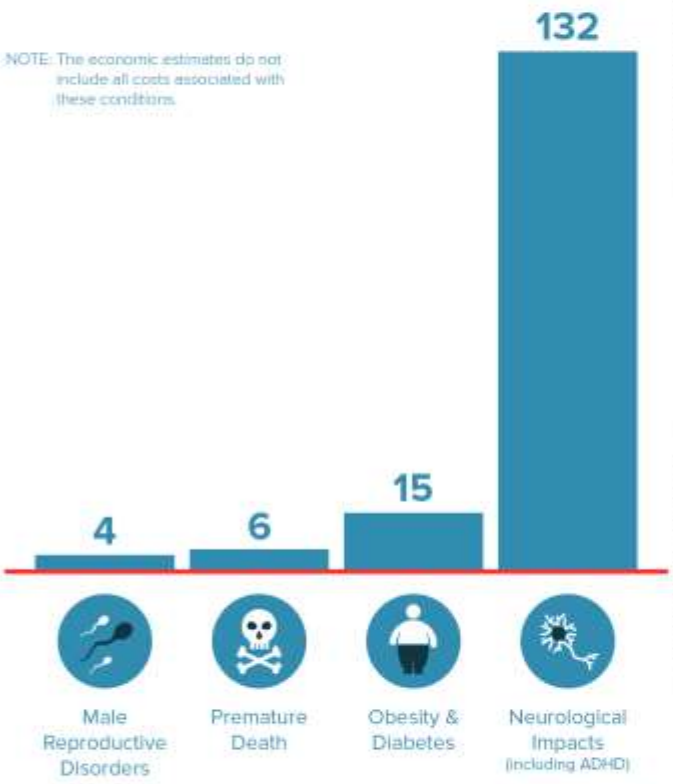

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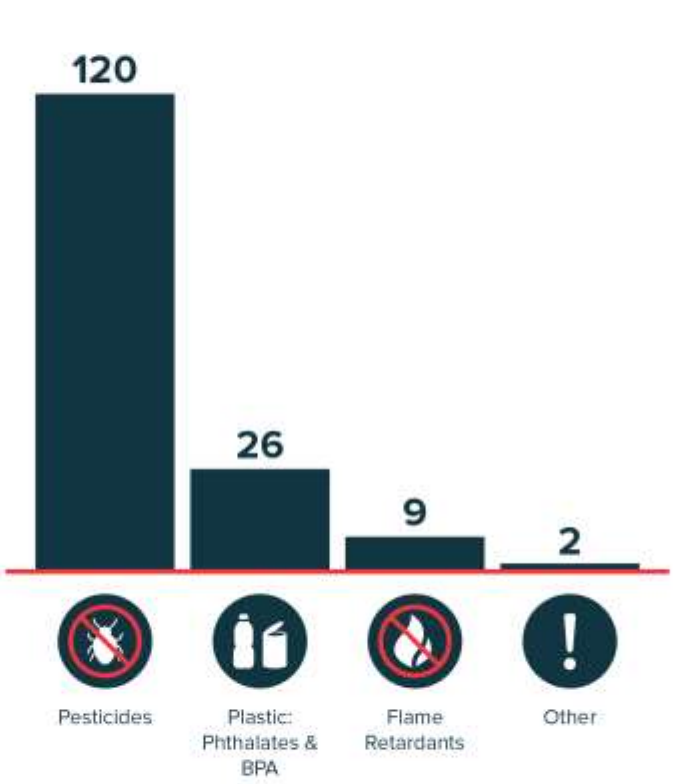

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