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<<NOTE TO USER: This is a large set of slides from which the presenter should select the most relevant ones to use in a specific presentation. These slides cover many facets of the issue. Present only those slides that apply most directly to the local situation in the region. You should replace the case studies as well as the figures with those relevant to your area and your audience>>

<<NOTE TO USER: This module presents several examples of risk factors that affect reproductive health. You can find more detailed information in other modules of the training package that deal with specific risk factors, such as lead, mercury, pesticides, persistent organic pollutants, endocrine disruptors, occupational exposures; or disease outcomes, such as developmental origins of disease, reproductive effects, neurodevelopmental effects, immune effects, respiratory effects, and others.>>

<<NOTE TO USER: For more information on reproductive health, please visit the website of the Department of Reproductive Health and Research at WHO:  
[www.who.int/reproductivehealth/en/](http://www.who.int/reproductivehealth/en/)>>

## LEARNING OBJECTIVES

**To describe case studies involving toxicant exposure and the resulting effect on male reproductive health**

- ❖ Pesticides: dichlorodiphenyltrichloroethane (DDT) and dichlorodiphenyldichloroethylene (DDE)
- ❖ Polychlorinated biphenyls (PCBs)
- ❖ Bisphenol A (BPA)

<<READ SLIDE.>>

This presentation will describe specific case studies related to male reproductive health and the environment.

**<<NOTE TO USER: This module will present case studies of specific exposure scenarios. Thus, if you would like more background information regarding male environmental reproductive health, please reference Module 1: Reproductive Environmental Health and Module 4: Male Environmental Reproductive Health.>>**

*Refs:*

- WHO. Department of Reproductive Health and Research, Partner Brief. Geneva, Switzerland, *World Health Organization*, 2009. WHO/RHR/09.02. Available at [whqlibdoc.who.int/hq/2009/WHO\\_RHR\\_09.02\\_eng.pdf](http://whqlibdoc.who.int/hq/2009/WHO_RHR_09.02_eng.pdf) – accessed 15 June 2011
- WHO. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference. New York, United States of America, *World Health Organization*, 1946.

## MALE REPRODUCTIVE HEALTH

- ❖ Disorders of male reproductive health may develop during fetal development, childhood, adolescence, or adulthood
- ❖ Multiple causes for alterations in male reproductive functioning
- ❖ Recent focus on potential exogenous, environmental causes



WHO

Reproductive health involves all of the reproductive processes, functions and systems at all stages of human life. This definition implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so.

Male reproductive disorders affect the health status and overall quality of life of a man. Male reproductive disorders may develop during various life phases. Alterations in proper reproductive functioning may be the result of various occurrences and experiences throughout fetal development, childhood, adolescence, or adulthood.

While much is known about the male reproductive system, its development, and many causes of specific disorders, the research pertaining to the mechanisms of action for certain pathologies is still largely unknown. However, exposure to environmental contaminants has been proposed in recent years to potentially contribute to male reproductive disorders. Research has been focused on exposures that occur during critical periods of development. This is still an emerging field of research that demands greater scientific investigation.

### Refs:

•UNDP/UNFPA/WHO/World Bank. Social science methods for research on reproductive health topics. Geneva, Switzerland, *UNDP/UNFPA/WHO/World Bank Special Programme on Research, Development, and Training in Human Reproduction*, 2006. Available at [whqlibdoc.who.int/hq/1999/WHO\\_RHR\\_HRP\\_SOC\\_99.1.pdf](http://whqlibdoc.who.int/hq/1999/WHO_RHR_HRP_SOC_99.1.pdf) - accessed 22 June 2010.

•WHO. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference. New York, United States of America, *World Health Organization*, 1946.

Image: WHO

## MALE REPRODUCTIVE HEALTH AND THE ENVIRONMENT

- ❖ Focuses on exposure to contaminants found in the environment, specifically during critical periods of development
- ❖ All the physical, chemical, biological and social factors that may affect the origin, growth, development and survival of a person in a given setting

*Some examples include:*

- **Specific synthetic chemicals**
- **Some metals**
- **Air contaminants**

**Still an  
emerging  
issue!**

Reproductive health and the environment focuses on exposures to environmental contaminants during critical periods of human development. These periods are directly related to reproductive health throughout the life course, including the period before conception, at conception, fertility, pregnancy, child and adolescent development, and adult health.

Environmental toxicants may potentially induce effects in human reproductive processes, specifically, for male reproductive health. However, the extent of this hypothesis must be supported through greater levels of research.

Currently, health care providers are growing increasingly aware of the potential for environmental factors to influence male reproductive health status.

### *Refs:*

- WHO. Global assessment of the state of the science of endocrine disruptors. Geneva, Switzerland, WHO/PCS/EDC, 2002. Available at [www.who.int/ipcs/publications/new\\_issues/endocrine\\_disruptors/en/](http://www.who.int/ipcs/publications/new_issues/endocrine_disruptors/en/) - accessed 23 June 2010.
- Woodruff T. Proceedings of the Summit on Environmental Challenges to Reproductive Health and Fertility: executive summary. *Fertility and Sterility*, 2003, 89 (2),1-20.

## INTERNATIONAL TRENDS

- ❖ Exposure to specific environmental contaminants suspected to adversely affect male reproductive health
- ❖ In some countries, male infertility has increased and sperm quality has decreased dramatically during the last decades
- ❖ However, underreporting, lack of global data, and limited human studies make it difficult to establish that male reproductive disorders are increasing



WHO

<<READ SLIDE.>>

Ref:

•Mathur PP, Saradha B, Vaithinathan S. Impact of environmental toxicants on testicular function. *Immunol., Endo. and Met. Agents in Med. Chem*, 2008 (1):79-90.

*In the last 50 years the incidence of infertility, testicular and prostate cancers and associated maladies has increased significantly. Infertility now affects 15-20% of couples as opposed to 7-8% fifty years ago. Average sperm counts among adult men have decreased by 50% since 1938, with a decline of 2% every year from 1973. This decline in male reproductive health has been linked to an increased presence in the environment of man-made chemical contaminants in the form of pesticides and plastics. Rapid and unplanned industrialization caused large amounts of these synthetic compounds and their by-products to be released in the environment (air, soil, water and food). Studies have shown that occupational exposure to pesticides caused neonatal deaths, congenital defects, testicular dysfunction and male infertility. Despite vehement opposition from the plastics industry, plastics and plasticizers have been proven to cause trans-generational reproductive abnormalities and infertility. Many of these chemicals found in our environment and households have estrogenic properties "xenoestrogens" and are toxic because they affect the endocrine system "endocrine disruptors". Endocrine disruptors have been shown to disturb the pro-oxidant/anti-oxidant system of the cells, thereby leading to generation of oxygen free radical and reactive oxygen species (ROS). If not suitably metabolized, free radicals are potentially harmful because they destabilize electrolytic balance within cells. Trace amounts of ROS are beneficial to spermatozoa and aid their capacitation, hyperactivation and acrosome reaction. But increased ROS have been shown to cause the peroxidation of polyunsaturated fatty acids (PUFA). Mammalian spermatozoa, being rich in PUFA, are more susceptible to ROS attack, and are vulnerable targets of ROS-producing polychlorinated biphenyls.*

Image: WHO



## Case Study 1:

### DDT (dichlorodiphenyltrichloroethane) and sperm quality in South Africa

The first case study that will be presented will be about the pesticide dichlorodiphenyltrichloroethane (DDT) and its effect on the reproductive health of men in South Africa.

Note: Spraying indoor walls with synthetic pesticides such as DDT, malathion or pyrethroids is an effective method to interrupt transmission and protect communities from malaria. Experts are concerned however, that incorrect application and management of DDT can have a damaging effect on the environment and health. There is also concern over increasing mosquito resistance to the pesticide. Efforts are under way to combat malaria with an incremental reduction of reliance on DDT, by supporting sustainable alternatives. These include chemical and non-chemical methods ranging from increasing distribution of insecticide-treated nets, eliminating potential mosquito breeding sites, environmental engineering, securing homes with mesh screens and deploying mosquito repellent trees and the introduction of fish that eat mosquito larvae.

*Ref:*

•WHO/UNEP. Healthy environments for healthy children: key messages for action. *WHO/UNEP*. 2010. Available at [www.who.int/ceh/publications/hehc\\_booklet\\_en.pdf](http://www.who.int/ceh/publications/hehc_booklet_en.pdf) – accessed 31 October 2011.

## SPERM QUALITY AMONG MEN IN SOUTH AFRICA

- ❖ Men in a South African town were found to have decreased sperm quality by WHO parameters
  1. Marked by lower motility
  2. Decreased ejaculate volume
  3. High incidence of abnormal sperm cells (teratospermia)
  4. Low levels of sperm cells in semen (oligospermia)
- ❖ One similarity between the men: All lived in endemic malaria areas that were annually sprayed with the pesticide dichlorodiphenyltrichloroethane (DDT)

<<READ SLIDE.>>

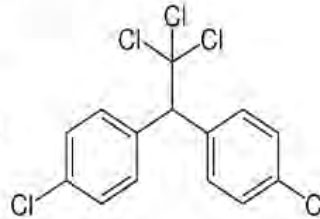
<<NOTE TO USER: for more information about WHO parameters regarding sperm quality, please see Module 4: Male Reproductive Health and the Environment or reference WHO laboratory manual for the examination of human semen and sperm-cervical mucus interaction. Cambridge University Press, 5<sup>th</sup> edition, 2010.>>

Ref:

•Aneck-Hahn N et al. Impaired semen quality associated with environmental DDT exposure in young men living in a malaria area in the Limpopo Province, South Africa. *Journal of Andrology*, 2007, 28(3).

## POTENTIAL SUSPECT: DDT

- ❖ Men chronically exposed to DDT (dichlorodiphenyltrichloroethane) due to annual mosquito spraying within homes
- ❖ DDT is a pesticide and a persistent organic pollutant (POP)
  - ❖ Does not breakdown in the environment
  - ❖ Accumulates in biological tissues
- ❖ DDT is an estrogenic compound
- ❖ Breakdown metabolite, DDE (dichlorodiphenyldichloroethylene), is anti-androgenic



### <<READ SLIDE.>>

The pesticide DDT [1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane or dichlorodiphenyltrichloroethane] is one of the twelve persistent organic pollutants under negotiation at the Stockholm Convention to restrict or ban their use due to their toxicity to human health and to the environment. DDT was widely used to control malaria by killing the mosquito that carries the parasite during the last half of the 20th century. However, several countries banned its use in the 1970s and 1980s because of the possibility of long-term adverse effects on human health and the environment.

Several studies have proven that within the body, DDT exhibits estrogenic activity and its metabolite, DDE (dichlorodiphenyldichloroethylene) is a strong anti-androgen. Thus, both DDT and its breakdown product have the potential to alter hormonal signaling in the human body.

DDT: dichlorodiphenyltrichloroethane

DDE: dichlorodiphenyldichloroethylene

#### Refs:

- Hodgson E, Levi PE. Pesticides: an important but underused model for the environmental health sciences. *Environ Health Perspect*, 1996, 104(1):97-106.
- Turusov V, Rakitsky V, Tomates L. Dichlorodiphenyltrichloroethane (DDT): ubiquity, persistence, and risks. *Environ Health Perspect*, 2002, 110:125-128.

#### Image:

DDT. Available at [commons.wikimedia.org/wiki/File:DDT.svg](https://commons.wikimedia.org/wiki/File:DDT.svg) - accessed 5 August 2010. This image is public domain.

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