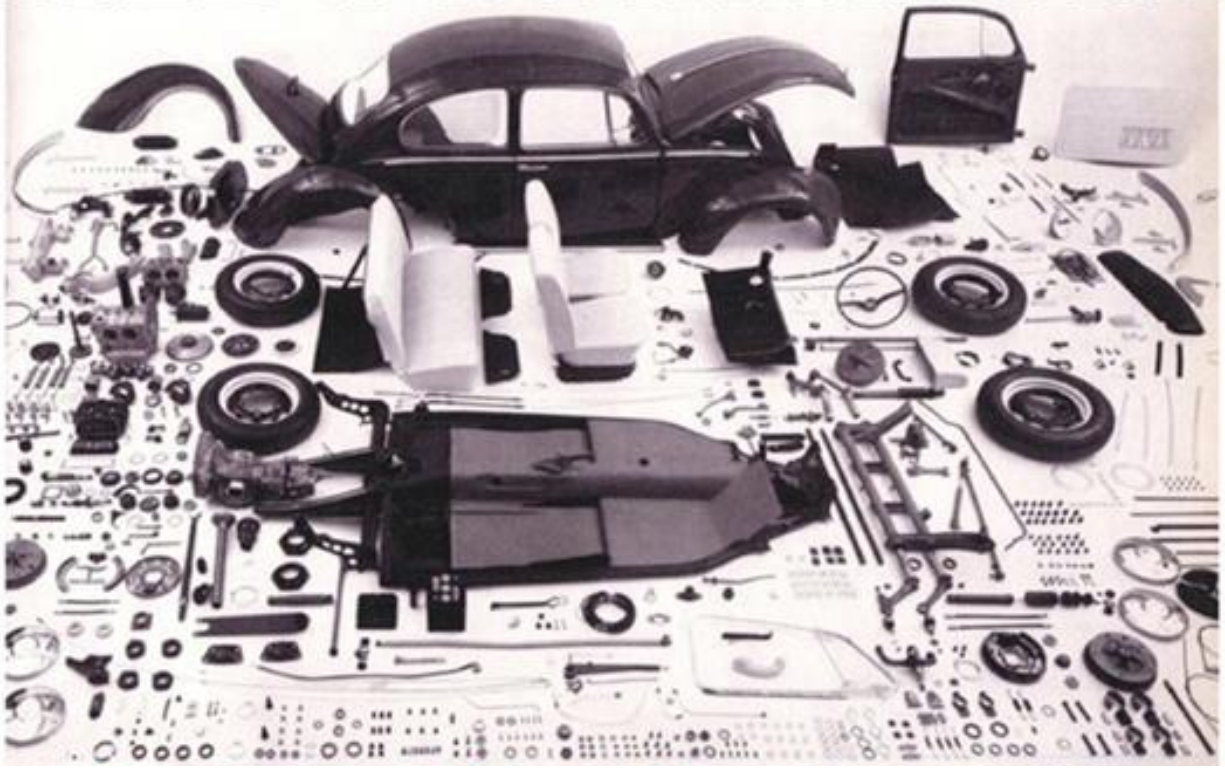
Carlo Modonesi
modonesi@unipr.it
Università degli Studi di Parma

Carlo Modonesi
modonesi@unipr.it

REDUCTIONISM



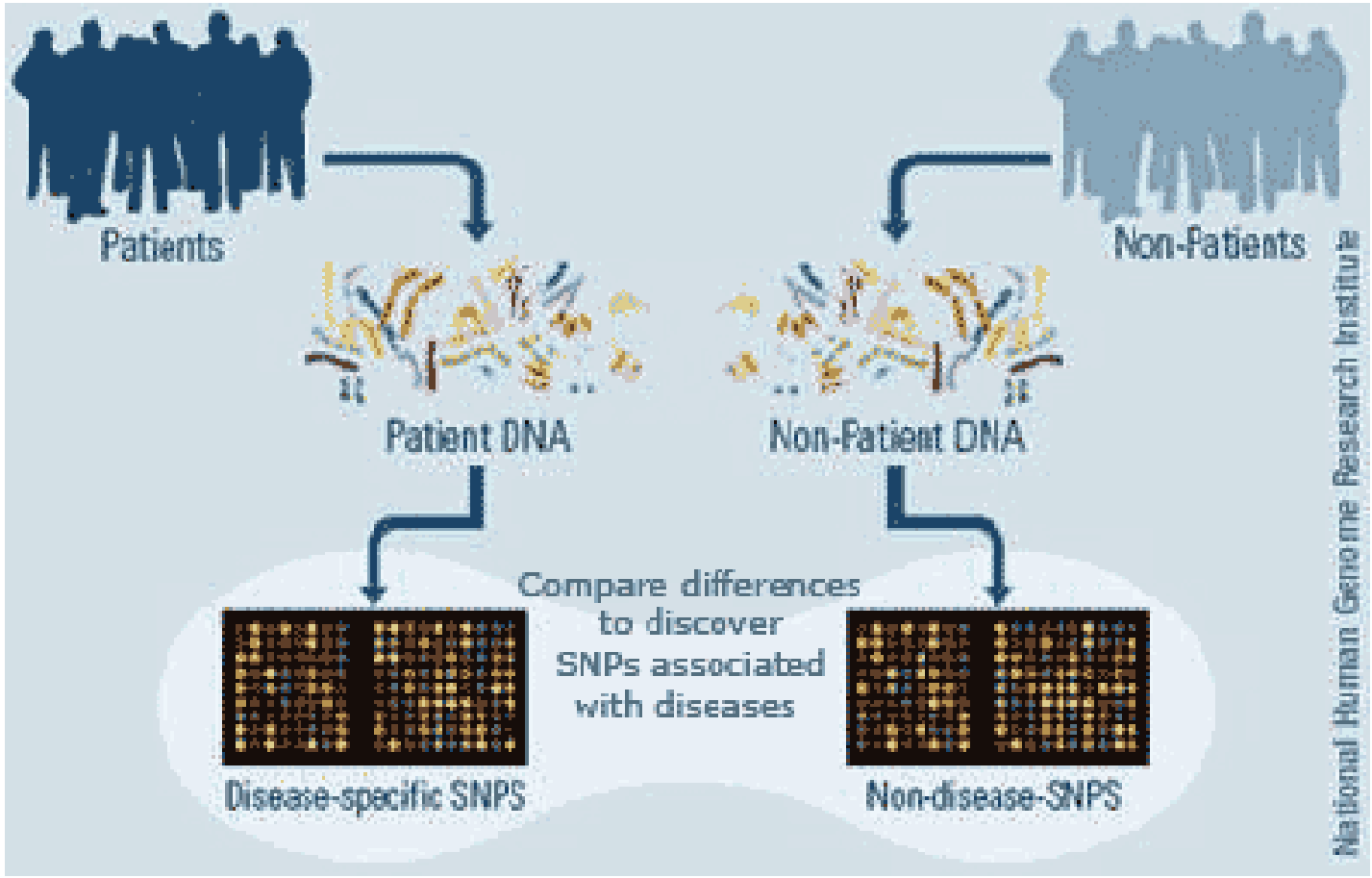
Carlo Modonesi
modonesi@unipr.it

Carlo Modonesi
modonesi@unipr.it

ARE YOUR GENES YOUR DESTINY?

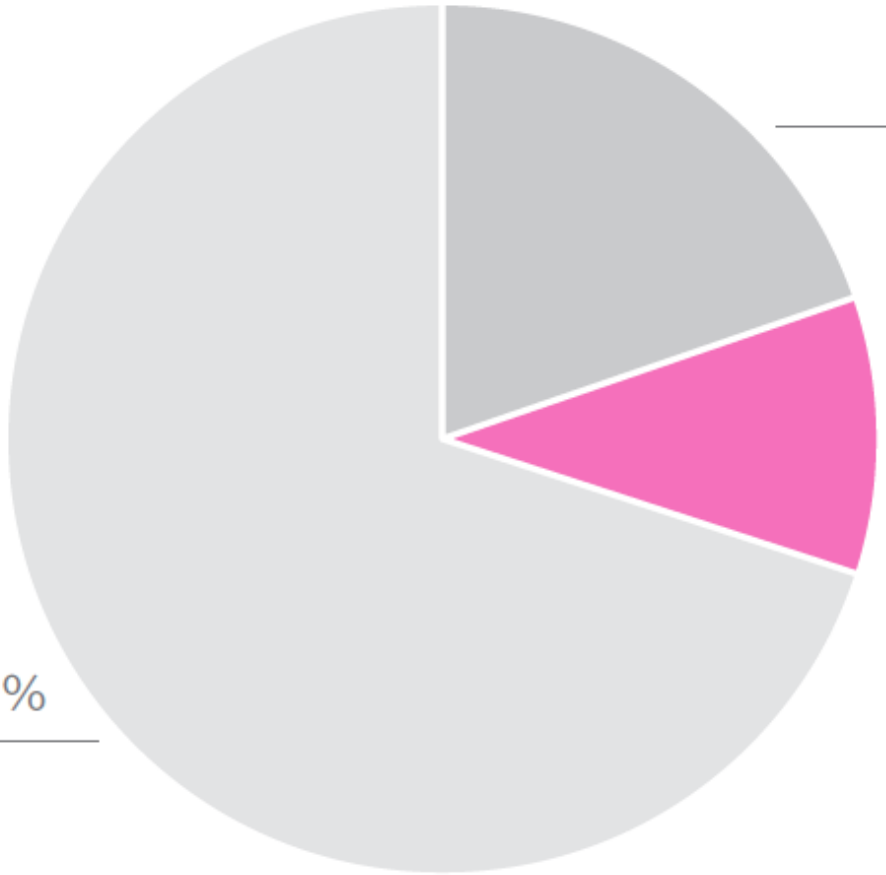
Carlo Modonesi
modonesi@unipr.it

Genome Wide Association Studies (GWAS)



Carlo Modonesi
modonesi@unipr.it

BREAST CANCER



Familial, 15-20%

Hereditary, 5-10%

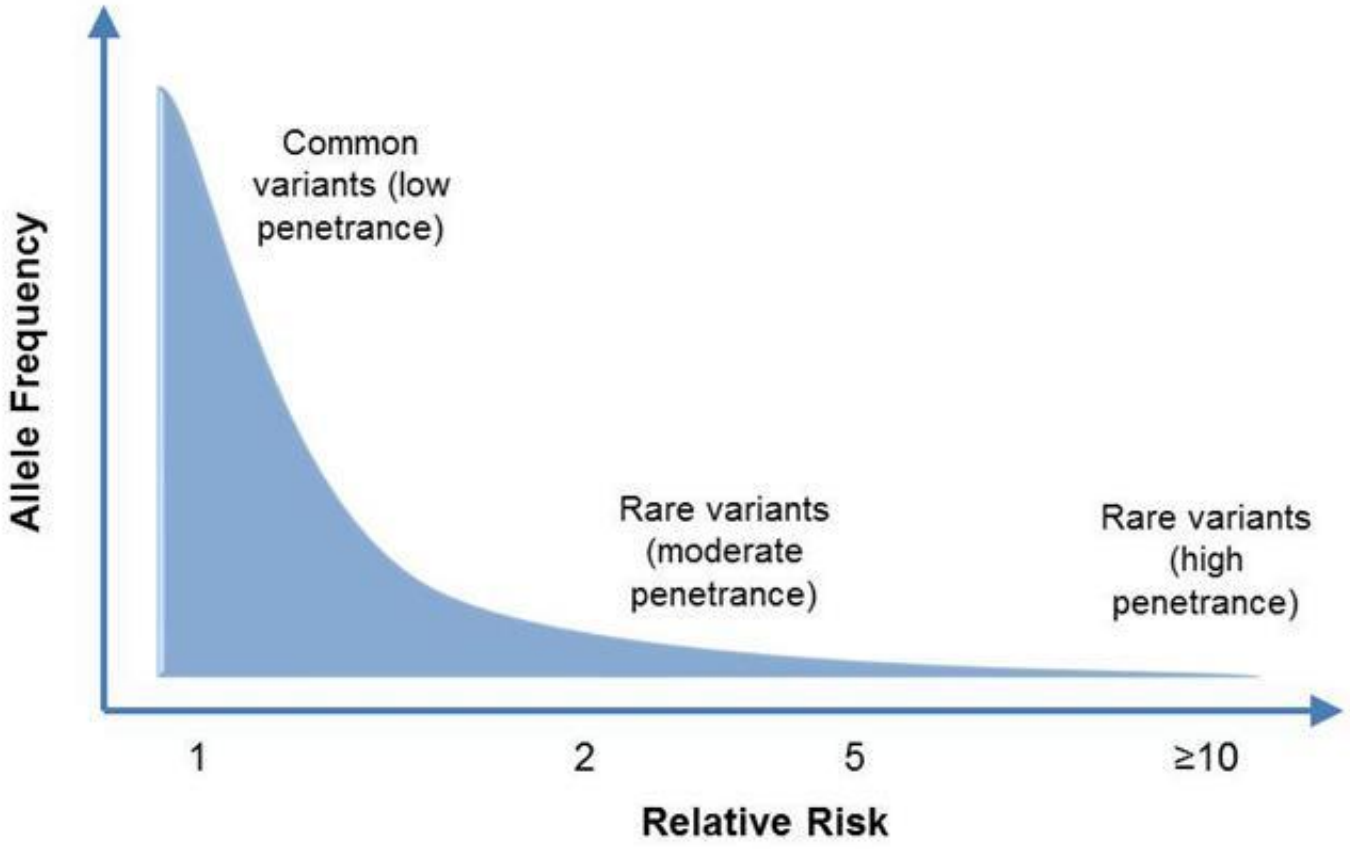
BRCA1, BRCA2 mutations can explain 25-50% of hereditary cancer cases

Sporadic, 70-80%

Carlo Modonesi
modonesi@unipr.it

National Cancer Institute
at the National Institutes of Health

Genetic Architecture of Cancer Risk



Carlo Modonesi
modonesi@unipr.it

Risk Individualization

Carlo Modonesi
modonesi@unipr.it

GENES

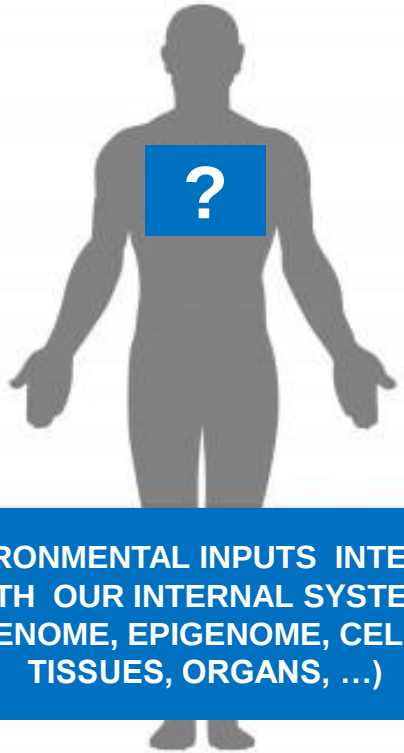
ENVIRONMENT

DEVELOPMENT

PHENOTYPE

Carlo Modonesi
modonesi@unipr.it

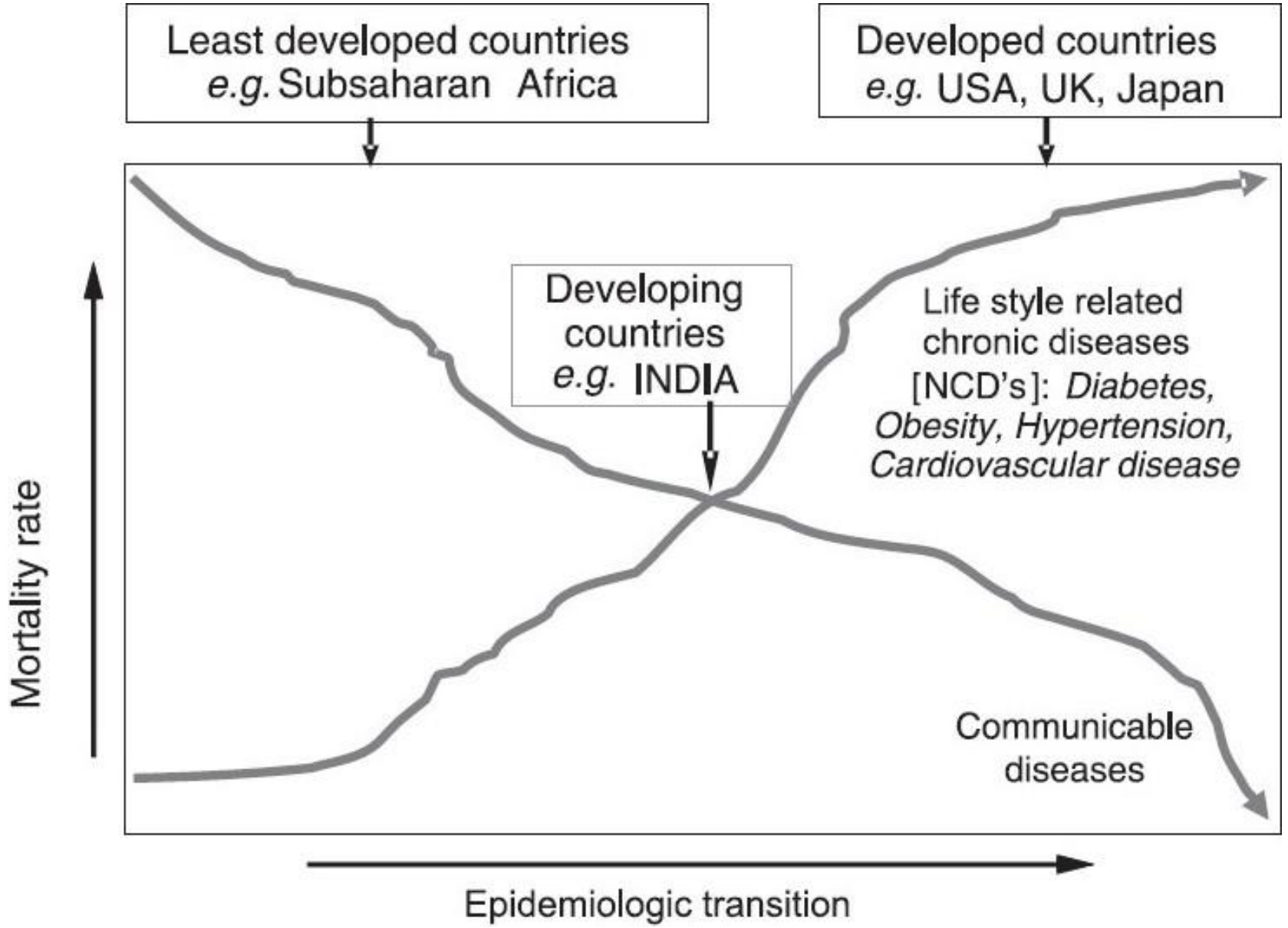
ENVIRONMENTAL INPUTS
Exposures, Nutrition, Lifestyle



ENVIRONMENTAL INPUTS INTERACT WITH OUR INTERNAL SYSTEMS (GENOME, EPIGENOME, CELLS, TISSUES, ORGANS, …)

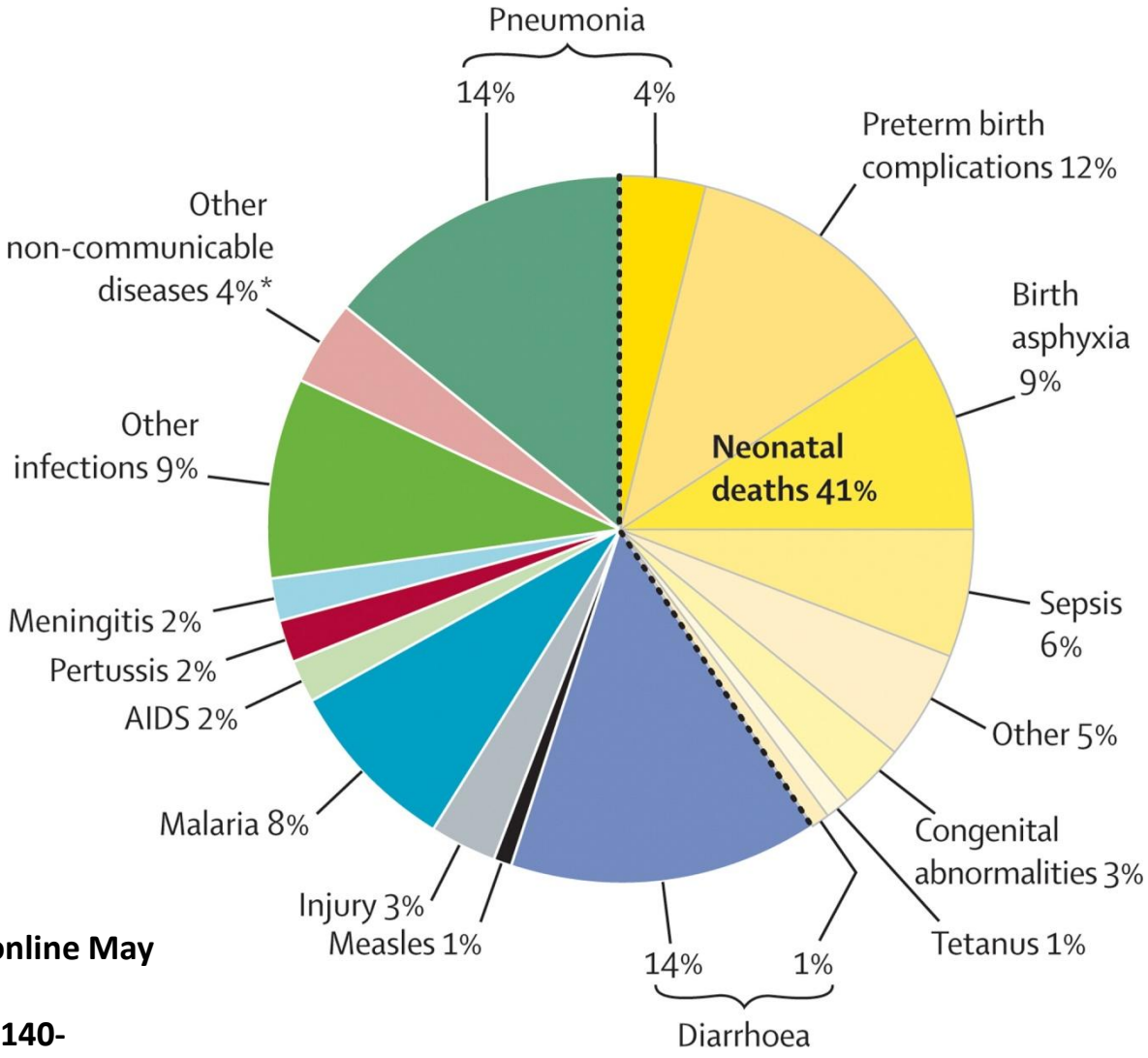
METABOLIC RESPONSE
Cancer Susceptibility Risk Factors and Other Health Outcomes

Carlo Modonesi
modonesi@unipr.it



Carlo Modonesi
modonesi@unipr.it

In 2008, infectious diseases caused 68% (5·970 million) deaths in children younger than 5 years worldwide.



thelancet.com online May 12, 2010
DOI:10.1016/S0140-6736(10)60549-1

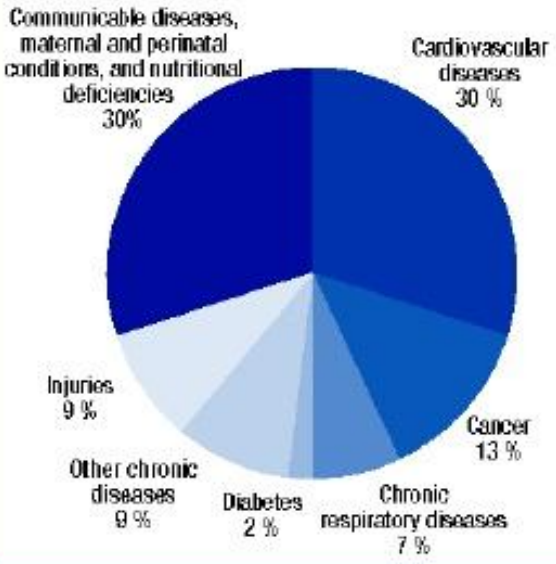
Carlo Modonesi
modonesi@unipr.it

Worldwide Infectious Disease

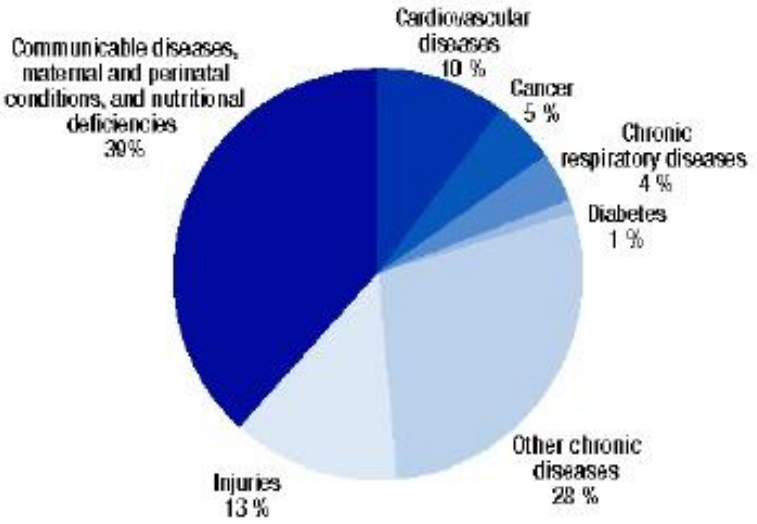
Main causes of death and global burden of disease (DALYs), world, all ages, projections for 2005

Disability-adjusted life year (attesa di vita corretta per disabilità)

Deaths



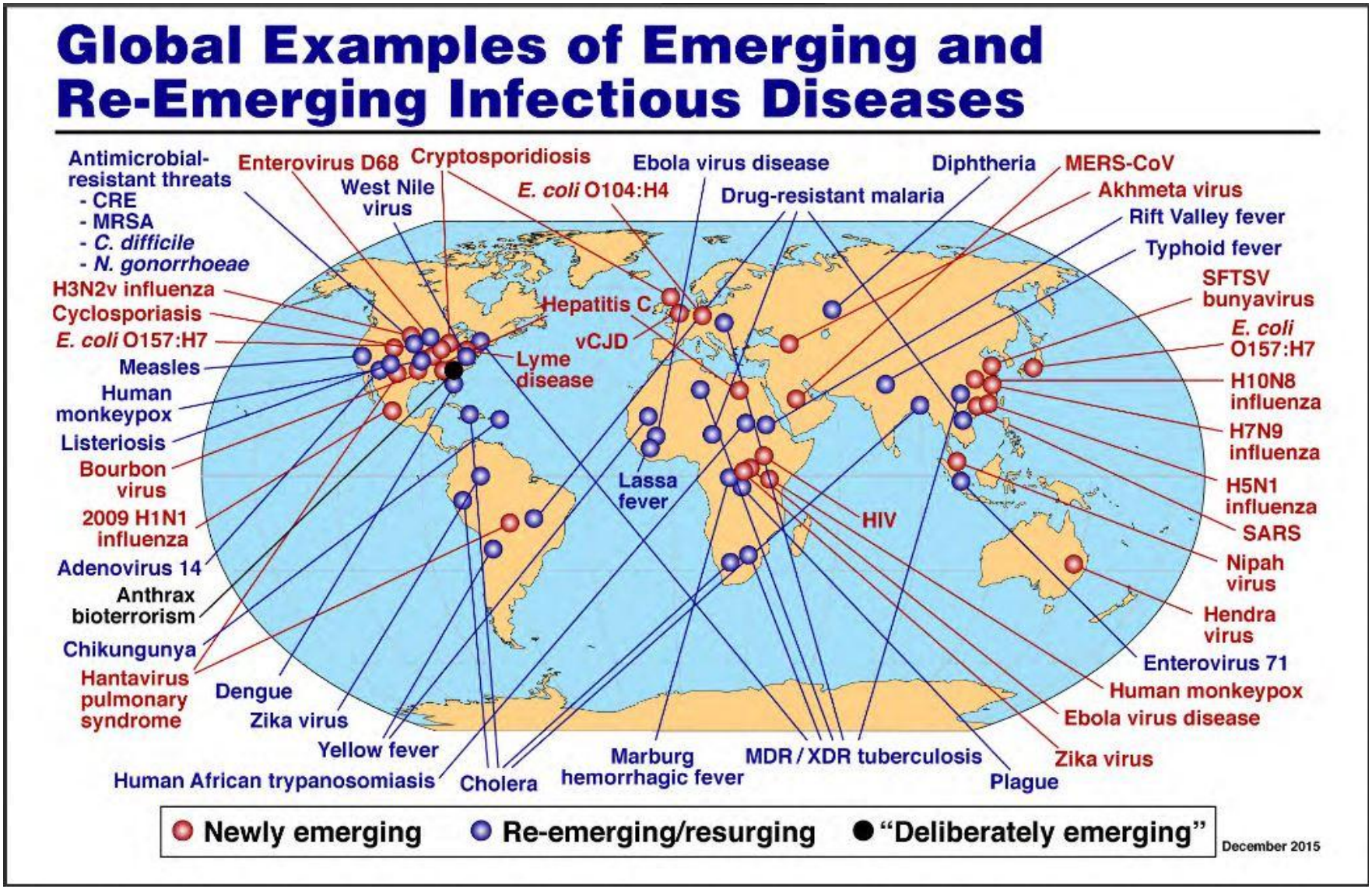
DALYs



World Health Organization at http://www.who.int/whosis/whostat2006highlights/en/index4.h

Carlo Modonesi
modonesi@unipr.it

Global Examples of Emerging and Re-Emerging Infectious Diseases



Carlo Modonesi
modonesi@unipr.it

Whenever there are large scale changes in society, climate, land use or population movements, there will also be new epidemiological problems.

Richard Levins, 1981

Carlo Modonesi
modonesi@unipr.it

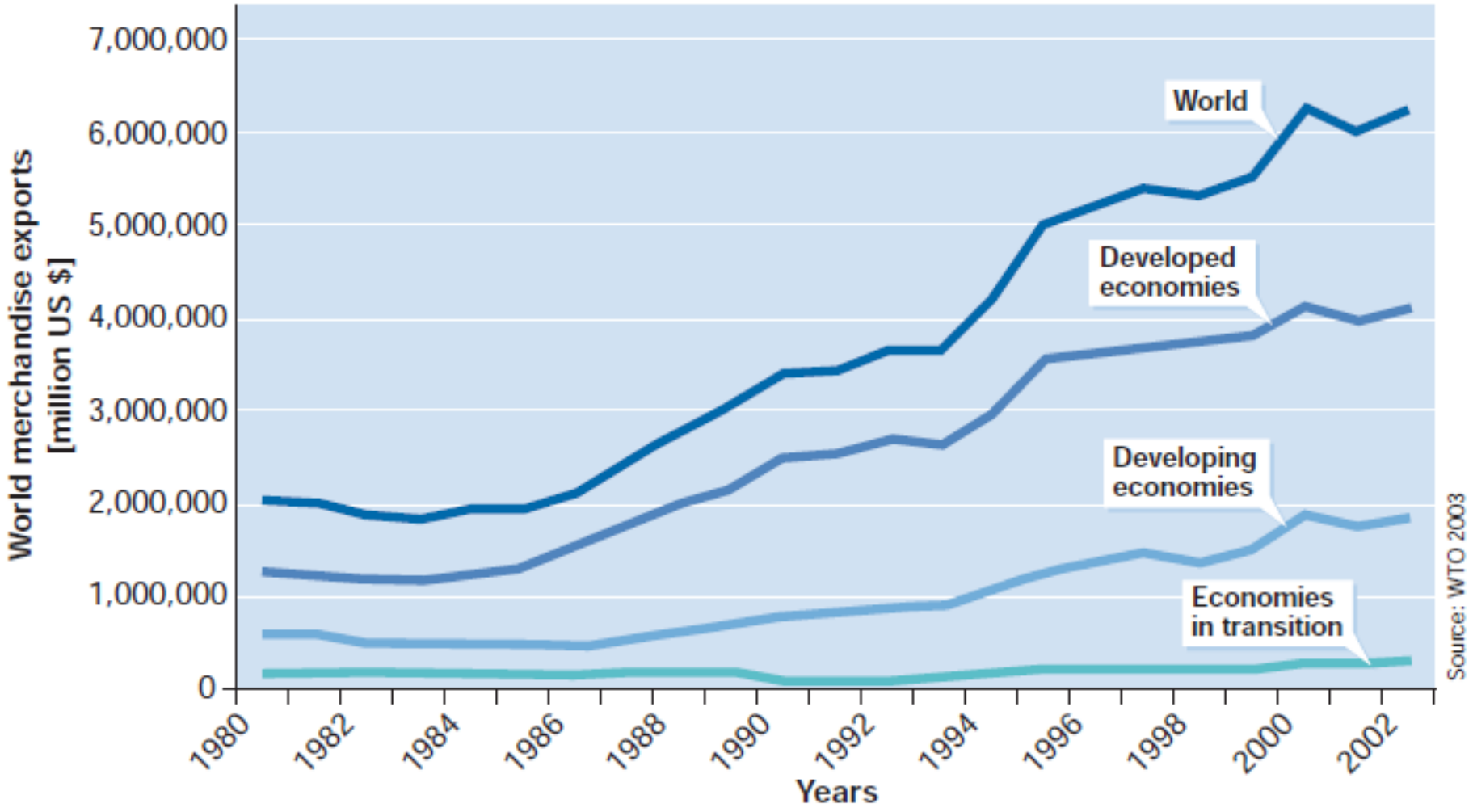


Fig 1 | World merchandise exports by levels of economic development, 1980–2002

Carlo Modonesi
modonesi@unipr.it

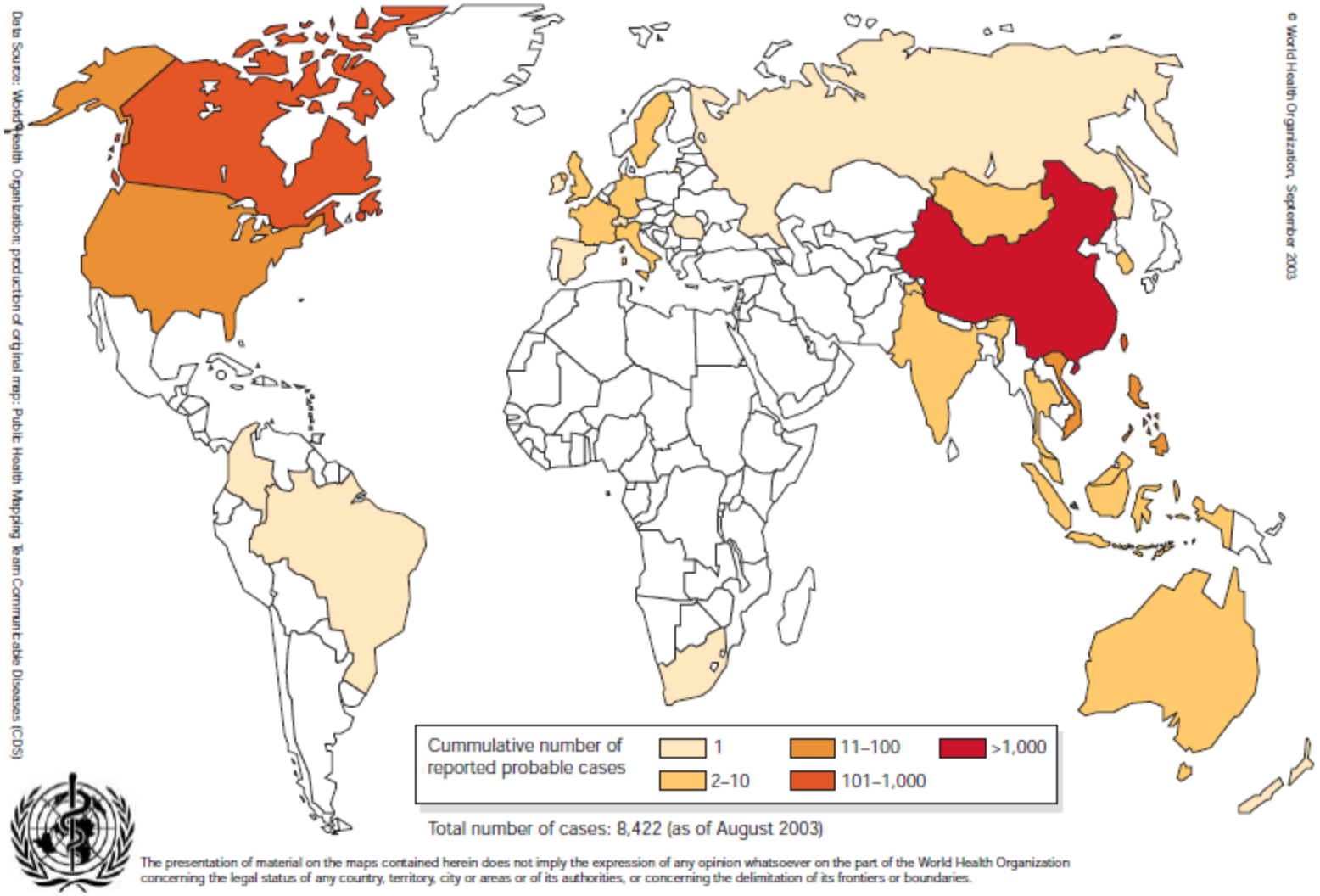


Fig 4 | SARS: cumulative number of reported probable cases as of 7 August 2003

SARS - *Severe acute respiratory syndrome*

Carlo Modonesi
modonesi@unipr.it

OPEN ACCESS Freely available online July 2014 | Volume 8 | Issue 7 | e3056 PLOS | NEGLECTED TROPICAL DISEASES

Editorial

Outbreak of Ebola Virus Disease in Guinea: Where Ecology Meets Economy

Daniel G. Bausch[1,2]*, Lara Schwarz[3]

1 Tulane School of Public Health and Tropical Medicine, New Orleans, Louisiana, United States of America, **2** United States Naval Medical Research Unit No. 6, Lima, Peru, **3** McGill University, Montreal, Canada

- Independent Science News | Food, Health and Agriculture Bioscience News -
http://www.independentsciencenews.org -

Neoliberal Ebola: The Agroeconomic Origins of the Ebola Outbreak

Posted By *jrlatham* On July 27, 2015 @ 12:05 am In (Un)Sustainable Farming,Commentaries,Health | 1 Comment

Carlo Modonesi
modonesi@unipr.it

Empirical evidence of the public health benefits of tropical forest conservation in Cambodia: a generalised linear mixed-effects model analysis

Lancet Planet Health 2017; 1: e180–87

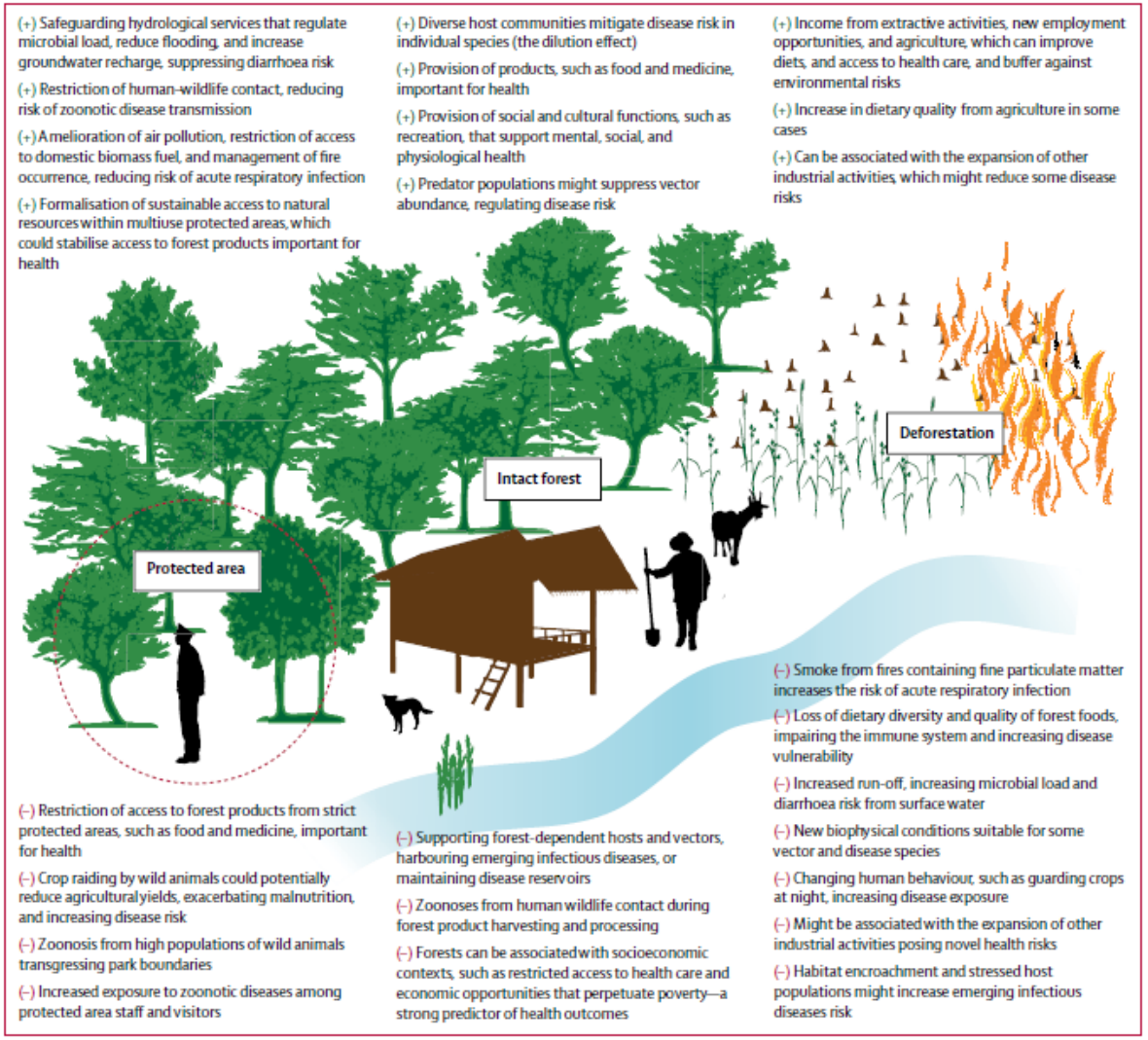
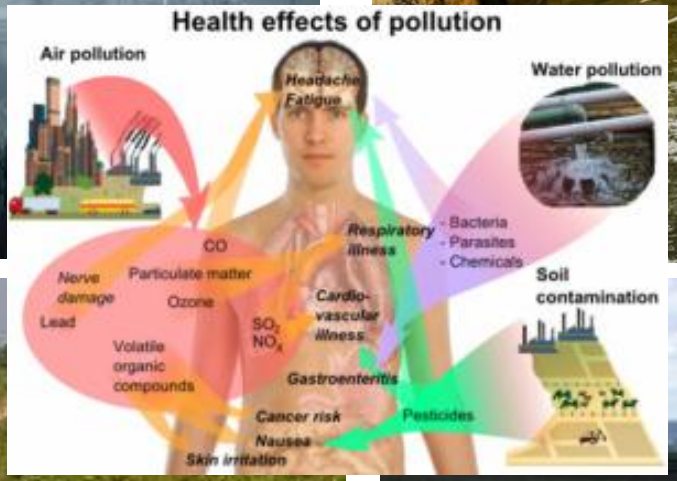


Figure 1: **Examples of potential links between protected areas, forest coverage, deforestation, and health**

Carlo Modonesi
modonesi@unipr.it



Carlo Modonesi
modonesi@unipr.it

Contents lists available at ScienceDirect

Environmental Research

journal homepage: www.elsevier.com/locate/envres

Commentary

The environmental roots of non-communicable diseases (NCDs) and the epigenetic impacts of globalization

Paolo Vineis [a,b,*], Silvia Stringhini [c], Miquel Porta [d,e]

[a] MRC-PHE Centre for Environment and Health, School of Public Health, Imperial College, St. Mary's Campus Norfolk Place, W2 1PG London, United Kingdom
[b] Human Genetics Foundation, Torino (HuGeF), Italy
[c] Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital, 1010 Lausanne, Switzerland
[d] Hospital del Mar Institute of Medical Research (IMIM), CIBER en Epidemiología y Salud Pública (CIBERESP), Barcelona, Spain
[e] School of Medicine, Universitat Autònoma de Barcelona, Barcelona, Spain

Carlo Modonesi
modonesi@unipr.it

Developmental origins of non-communicable disease: Implications for research and public health

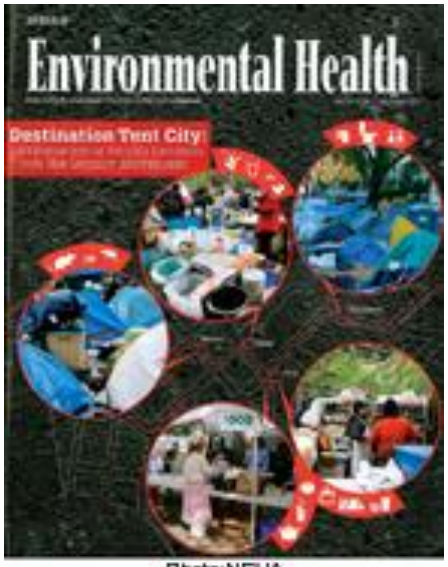


Photo: NEHA

“The risk of many non-communicable diseases is set during development. Exposures to environmental chemicals during development can increase disease risk later in life”.

Barouki *et al. Environmental Health* 2012, **11**:42

Carlo Modonesi
modonesi@unipr.it

PROTECTING CHILDREN FROM THE ENVIRONMENT

Environmental risks include air pollution, chemicals, poor water, sanitation and hygiene.

CHILDREN ARE AFFECTED BY:

Air pollution

Inadequate water, sanitation and hygiene

Built environment

Second-hand smoke

Climate change

Hazardous wastes

UV radiation

Hazardous chemicals

CHILDREN ARE ALSO AFFECTED BY EMERGING THREATS SUCH AS:

Persistent organic pollutants / endocrine-disrupting chemicals

e-Waste

Minimising these risks are key to protecting children and achieving the Sustainable Development Goals.

World Health Organization

Carlo Modonesi
modonesi@unipr.it

RSP Revista de Saúde Pública
http://www.rsp.fsp.usp.br/

Childhood cancer and environmental integrity: a commentary and a proposal

Carlo Modonesi[I,II], Enrico Oddone[III], Celestino Panizza[IV], Gemma Gatta[V]

[I] Department of Life Sciences. University of Parma. Parma, Italy
[II] Cancer Registry and Environmental Epidemiology Unit. Fondazione IRCCS Istituto Nazionale dei Tumori. Milano, Italy
[III] Department of Public Health. Experimental and Forensic Medicine. Occupational Medicine Unit. University of Pavia. Pavia, Italy
[IV] Service for Occupational Safety and Prevention. Local Health Unit (ASL). Brescia, Italy
[V] Evaluative Epidemiology Unit. Fondazione IRCCS Istituto Nazionale dei Tumori. Milano, Italy

“Preventive and precautionary policies based on the eco-geographical distribution of childhood cancer should be a pre-requisite of the effort to protect the new generations from the environmental hazards”.

Carlo Modonesi
modonesi@unipr.it

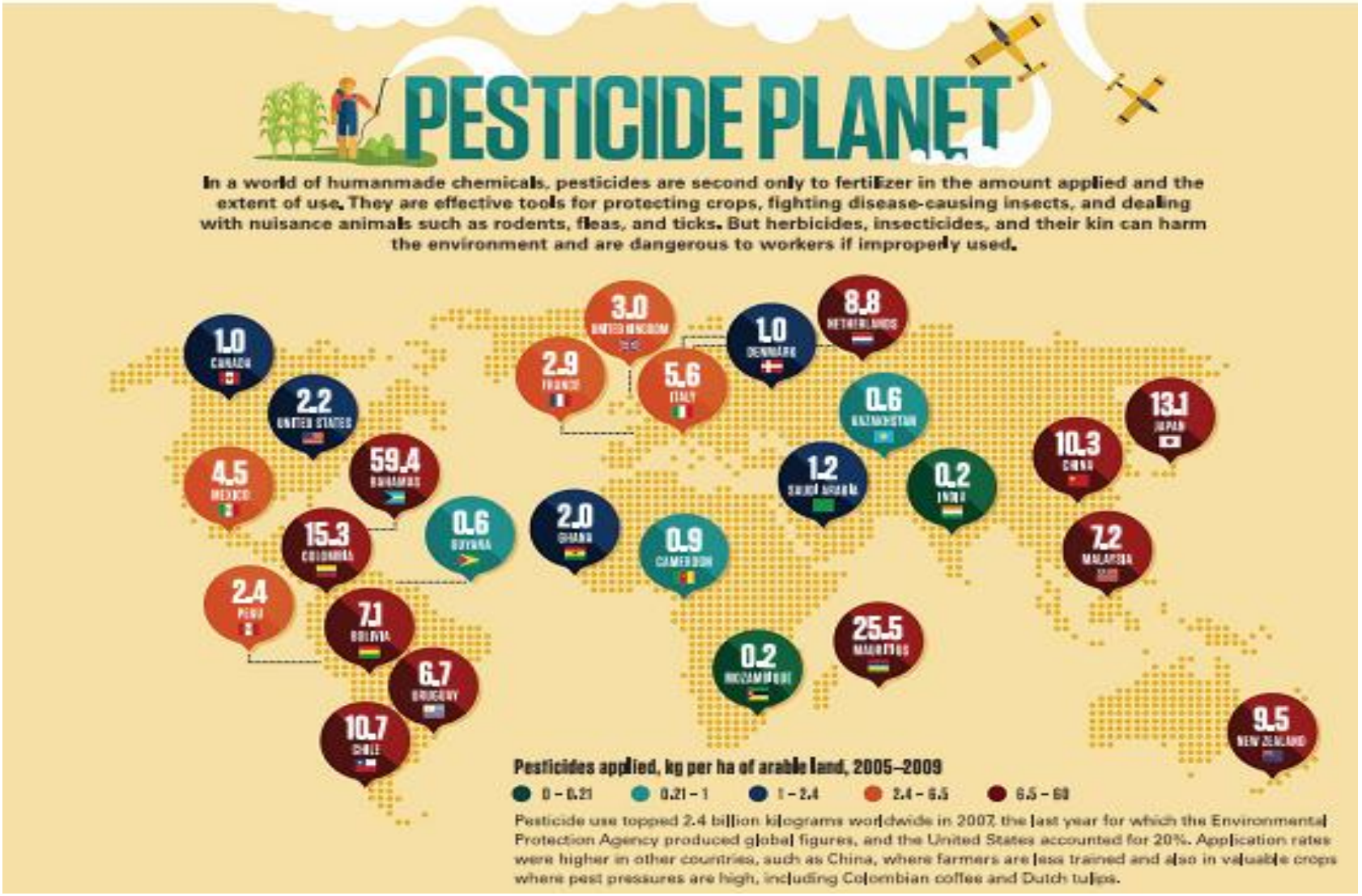
Agriculture

Carlo Modonesi
modonesi@unipr.it

Carlo Modonesi
modonesi@unipr.it

Smarter Pest Control

www.sciencemag.org/special/pesticides



Science, 2013, 341, 6147

Carlo Modonesi
modonesi@unipr.it

Table 2. Available Hazard Rankings of Pesticides and Metabolites Analyzed

Note: Where hazard data are available for the pesticide and the metabolite(s), both are listed separately. Otherwise only pesticide hazard data are listed with the metabolite in parentheses. No data are available for DMP, DMTP, DMDTP, DEP, DETP, or DEDTP.

Chemical (Metabolite) [Parent]	Summary Acute Toxicity Rating[a]	Summary Cancer Rating[b]	Endocrine Disruptor Status[c]	Date of Most Recent U.S. EPA Risk Assessment[d]	Chronic, Non-cancer RfD or MRL[e]		
					U.S. EPA		ATSDR MRL
					RfD	PAD	
Carbaryl (1-Naphthol)	Moderate	Possible	Yes	2003	0.01	0.01	NA
Chlordane (Oxychlordane, *trans*-Nonachlor)	Moderate	Probable	Yes	1998	0.0005	NA	0.0006
Chlorpyrifos (3,5,6-Trichloro-2-pyridinol)	Moderate	Unlikely	Yes	2001	0.0003	0.00003	0.001
2,4-D	Moderate	Possible	Yes	1988	0.01	NA	NA
2,4-Dichlorophenol [2,4-D, Triclosan]	Slight	Possible	Yes	1988	0.003	NA	0.003
DDT (DDE)	Moderate	Probable	Yes	1996	0.0005	NA	0.0005
Hexachlorobenzene	Extreme	Probable	Yes	1991	0.0008	NA	0.00005
beta-HCH [Lindane]	Not acutely toxic	Probable	Yes	1993	NA	NA	0.0006
Heptachlor (Heptachlor epoxide)	High	Probable	Yes	1992	0.0005	NA	NA
Lindane	High	Probable	Yes	2002	0.0003	0.0016	0.00001
Malathion	Moderate	Possible	Yes	2000	0.024	0.024	0.02
Methyl parathion	Extreme	Unclassifiable	Yes	2003	0.00025	0.00002	0.0003
Naphthalene (1-Naphthol, 2-Naphthol)	Moderate	Known, Prop. 65	NA	1998	0.02	NA	0.02
para-Nitrophenol	High	Unclassifiable	NA	1996[f]	NA	NA	NA
Pentachlorophenol or PCP	High	Probable	Yes	1993	0.03	NA	0.001
ortho-Phenylphenol	High	Probable	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol [Pentachlorophenol, HCH, HCB]	Moderate	Possible	NA	1988	0.1	NA	NA
2,4,6-Trichlorophenol [Pentachlorophenol, HCH, HCB]	Slight	Probable	NA	1989	0.0003	NA	NA

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC – USA, 2004)

Carlo Modonesi
modonesi@unipr.it

2015 IARC *Monograph* Pesticide Classifications

Name	Rank (within class)	Usage notes	PubMed Human cancer	PubMed Mechanisms	Prior IARC (year)	2015 evaluation (Human, Animal, Mechanisms)	Current IARC (2015)
Organophosphate pesticides							
Parathion	1	Restricted	6	578	3 (1987)	H: Inad. A: Sufficient	Group 2B
Malathion	2	High	12	370	3 (1987)	H: Limited A: Sufficient M: Strong	Group 2A
Diazinon	5	High	16	215	-	H: Limited A: Limited M: Strong	Group 2A
Glyphosate	7	High	9	204	-	H: Limited A: Sufficient M: Strong	Group 2A
TCVP	13	Active	1	40	3 (1987)	H: Inad. A: Sufficient	Group 2B
Organochlorine and chlorophenoxy pesticides							
DDT	1	Restricted POP	190	953	2B (1991)	H: Limited A: Sufficient M: Strong	Group 2A
Lindane	2	Active POP	51	545	2B (1987)	H: Sufficient A: Sufficient M: Strong	Group 1
2,4-D	1	High	84	420	2B (1991)	H: Inad. A: Limited	Group 2B

Carlo Modonesi
modonesi@unipr.it

Pesticides reduce regional biodiversity of stream invertebrates

Mikhail A. Beketov[a,1], Ben J. Kefford[b], Ralf B. Schäfer[c], and Matthias Liess[a]

[a]Department of System Ecotoxicology, Helmholtz Centre for Environmental Research - UFZ, 04318 Leipzig, Germany; [b]Centre for Environmental Sustainability, School of the Environment, University of Technology Sydney, Sydney, NSW 2007, Australia; and [c]Quantitative Landscape Ecology, Institute for Environmental Sciences, University of Koblenz-Landau, 76829 Landau, Germany

Edited by David Pimentel, Cornell University, Ithaca, NY, and accepted by the Editorial Board May 13, 2013 (received for review March 25, 2013)

- We analyzed the effects of pesticides on the regional taxa richness of stream invertebrates in Europe (Germany and France) and Australia.
- Pesticides caused statistically significant effects on both the species and family richness in both regions, with losses in taxa up to 42% of the recorded taxonomic pools.
- Furthermore, the effects in Europe were detected at concentrations that current legislation considers environmentally protective.
- Thus, the current ecological risk assessment of pesticides falls short of protecting biodiversity, and new approaches linking ecology and ecotoxicology are needed.

Carlo Modonesi
modonesi@unipr.it

Environ Sci Pollut Res
DOI 10.1007/s11356-014-3277-x

Published online: 19 July 2014

WORLDWIDE INTEGRATED ASSESSMENT OF THE IMPACT OF SYSTEMIC PESTICIDES ON BIODIVERSITY AND ECOSYSTEMS

Risks of large-scale use of systemic insecticides to ecosystem functioning and services

Madeleine Chagnon · David Kreutzweiser · Edward A.D. Mitchell · Christy A. Morrissey · Dominique A. Noome · Jeroen P. Van der Sluijs

Assessment of ecological impacts and services:

- Terrestrial soil ecosystem functions
- Freshwater ecosystem functions
- Biological pest control
- Pollination (wild plants and crops)
- Insecticide resistance

Conclusions

There is increasing evidence that **the widespread use of insecticides (ie: neonicotinoids) is causing harm** to beneficial organisms and therefore **reducing ecosystem services and human health**.

Carlo Modonesi
modonesi@unipr.it

Environ Sci Pollut Res
DOI 10.1007/s11356-015-4388-8

Published online: 10 May 2015

RESEARCH ARTICLE

Emerging and priority contaminants with endocrine active potentials in sediments and fish from the River Po (Italy)

Viganò Luigi [1] · Mascolo Giuseppe [2] · Roscioli Claudio [1]

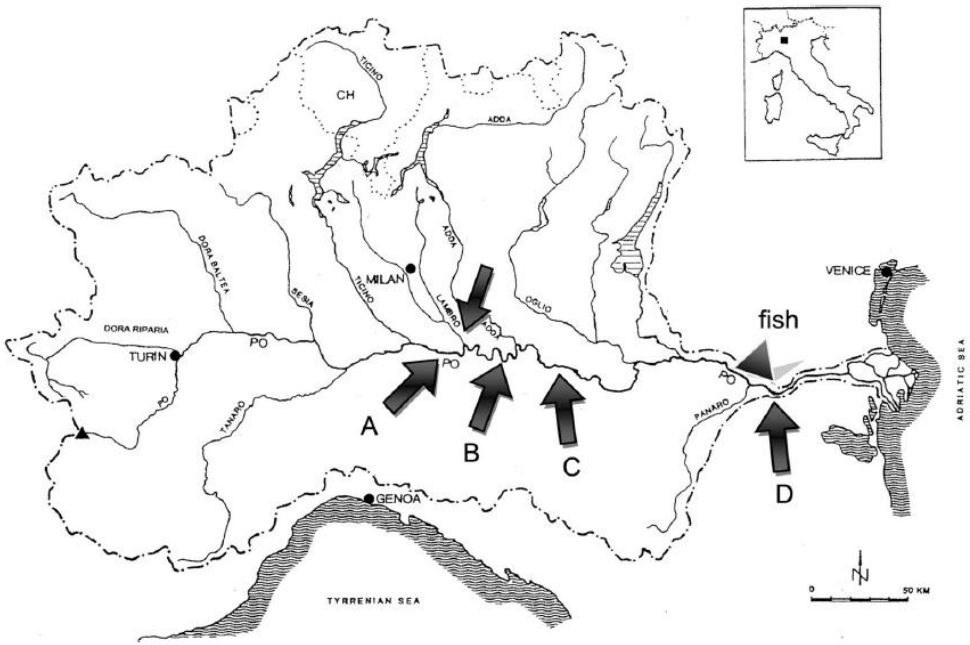


Fig. 1 Map of the River Po basin showing the sediment and fish sampling sites. In stretches A, B, C, and D of the River Po and within the River Lambro, composite sediment samples were collected. Fish specimens were captured along a portion of stretch D

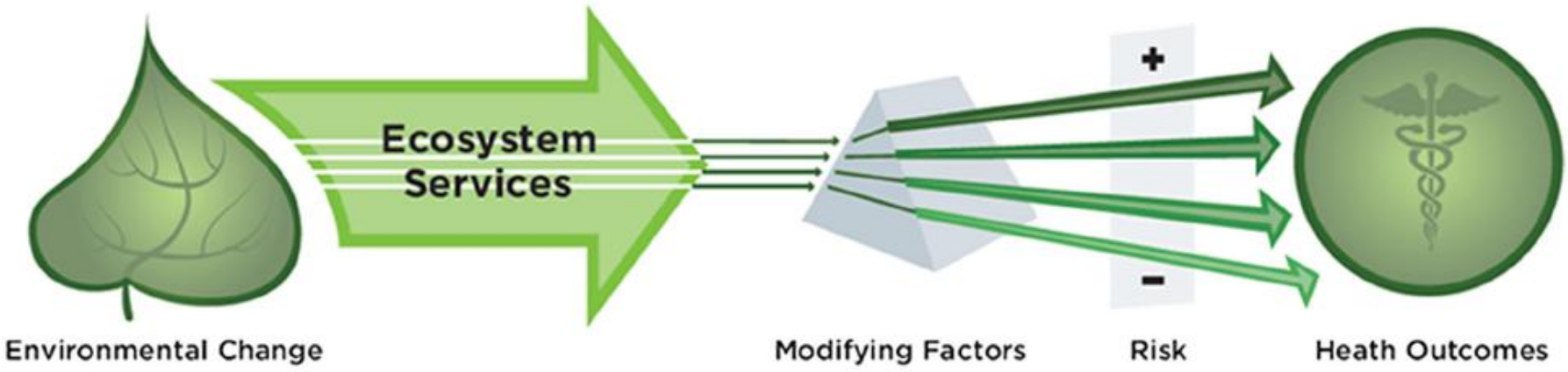
Carlo Modonesi
modonesi@unipr.it

Ecosystem services threatened by agricultural contaminants

- pollination of wild and cultivated plants
- control of agricultural
- purification of air and water (clean water supply)
- soil preservation and fertility
- decomposition and detoxification of toxic agents
- cycling of matter
- climate regulation
- conservation of human health and well-being
- etc.

Int J Agronomy and Plant Prod, 1 (1), 11-23, 2010 (modified)

Carlo Modonesi
modonesi@unipr.it



Carlo Modonesi
modonesi@unipr.it

HEALTH FARMER'S PICTURE

- low percentage of smokers and greater physical activity → "professional protection" from many diseases.

- greater occupational exposure to a number of toxic factors (ie: pesticides) → increased risk for some tumors and neurodegenerative diseases.

- growing suspicion that other degenerative diseases (nervous, immune, endocrine and reproductive) are associated with exposure to pesticides

Carlo Modonesi
modonesi@unipr.it

Some recent study findings include:

- Farmers have a higher risk for developing some cancers, including prostate cancer;
- Gloves matter. Use of chemically resistant gloves can reduce pesticide exposure 50 to 80%;
- Rotenone and paraquat are linked to increased use of developing Parkinson's disease;
- Allergic asthma in men and women may be associated with use of some organophosphate insecticides
- Accidental high pesticide exposure events may affect health later in life
- Diabetes and thyroid disease risk may increase for users of some organochlorine chemicals

Carlo Modonesi
modonesi@unipr.it

Occupational exposures

The link between Parkinson and pesticides has been officially recognized in France.

On Monday, May 7, 2012, the decree recognizing Parkinson's disease as a professional disease in the agricultural sector came into force, and explicitly establishes a causal link between this disease and the use of pesticides.

http://www.parkinson-italia.it

Parkinson Italia
è membro di: EPDA European Parkinson's Disease Association

Carlo Modonesi
modonesi@unipr.it

General problems

- Generally speaking, the risk of cancer in farmers increases significantly for the following sites:
  - Hemopoietic system: multiple myeloma → monoclonal gammopathy, non-Hodgkin lymphoma, Hodgkin lymphoma, leukemia (risk factors: pesticides)
  - Brain (risk factors: pesticides)
  - Lip (risk factors: sun, smoking or other tobacco uses, pesticides)
  - Stomach (risk factors: pesticides)
  - Skin (risk factors: sun, pesticides)
  - Prostate (risk factors: pesticides)
  - Soft tissues (risk factors: pesticides)
  - Other tumor sites have a seemingly greater risk but need further research: lung, colon, kidney and breast.

SOURCES:
- Bassil KL, et al., Cancer health effects of pesticides: systematic review. Can Fam Physician. 53, 10; 2007.
- Blair A. et al, Epidemiologic Studies in Agricultural Populations: Observations and Future Directions, J. Of Agromed. 14, 2009.
- *Weichenthal S. et al.* A Review of Pesticide Exposure and Cancer Incidence in the Agricultural Health Study Cohort; EHP 118,8; 2010.

Carlo Modonesi
modonesi@unipr.it

Residential exposure in pregnancy

Increased risk (fetuses and newborns) evidence for:

- developmental problems (particularly brain structures)
- infertility and malformations of the sexual apparatus
- spontaneous abortion and perinatal death
- delayed fetal development
- childhood tumors (blood, brain, kidney)

SOURCES:

- **Bell EM et al. A case-control study of pesticides and fetal death due to congenital anomalies. Epidemiology, 2001, 12:148.**
- **Berkowitz GS et al. In utero pesticide exposure, maternal paraoxonase activity, and head circumference. Environ Health Perspect, 2004, 112:388.**
- **Eskenazi B et al. Association of in utero organophosphate pesticide exposure and fetal growth and length of gestation in an agricultural population, Environ Health Perspectives, 2004, 112 (10): 1116-1124.**
- **Nurminen T. Maternal pesticide exposure and pregnancy outcome. J Occup Environ Med, 1995,37:935.**
- **Weidner IS et al. Cryptorchidism and hypospadias in sons of gardeners and farmers. Environ HealthPerspect, 1998, 106:793.**
- **Whyatt RM et al. Prenatal insecticide exposures birth weight and length among an urban minority cohort. Environ Health Perspect , 2004, 112:1125.**

Carlo Modonesi
modonesi@unipr.it

Residential exposure in childhood

Increased risk evidence for:

- development and growth pathologies

- neuropsychological disorders

- cancer (brain tumors, acute leukemia)

- increased susceptibility to infections

SOURCES:

- **Children in the New Millennium: Environmental Impact on Health. UNEP, UNICEF, WHO, 2002.**
- **Eskenazi B et al, Exposures of children to organophosphate pesticides and their potential adverse health effects. EnvironHealthPerspect, 1999, 107(3).**
- **Leiss JK et al. Home pesticide use and childhood cancer: a case-control study. Am J Public Health, 1995, 85:249.**
- **Ma X et al. Critical windows of exposure to household pesticides and risk of childhood leukaemia. Environ Health Perspect, 2002, 110:955.**
- **Pogoda JM et al. Household pesticides and risk of pediatric brain tumors. Environ Health Perspect, 1997, 105:1214.**

Carlo Modonesi
modonesi@unipr.it

Carlo Modonesi
modonesi@unipr.it

Malathion

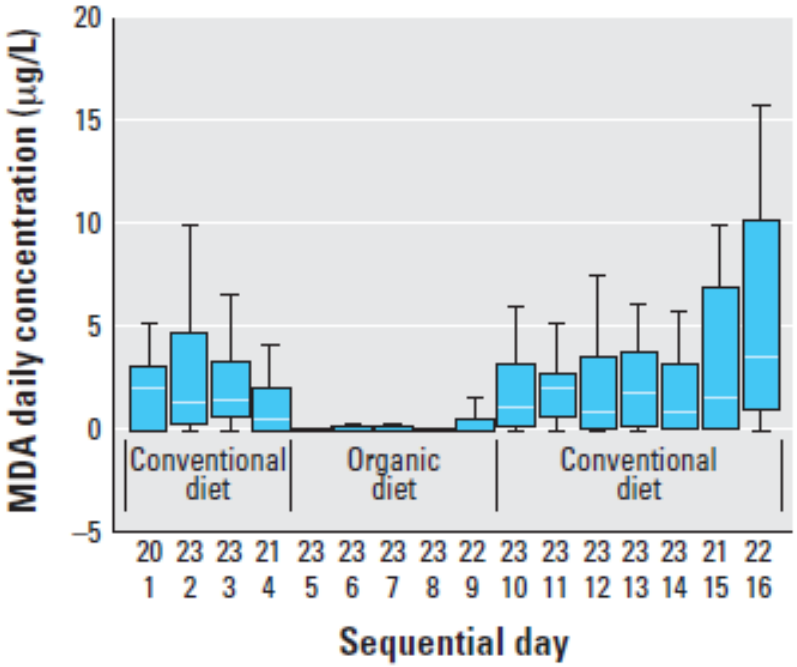


Figure 1. Box plots of DVWA of MDA concentrations in 23 children 3–11 years of age for 15 consecutive days in which conventional and organic diets were consumed. The top row of numbers on the *x*-axis represents numbers of children.

Chlorpyrifos

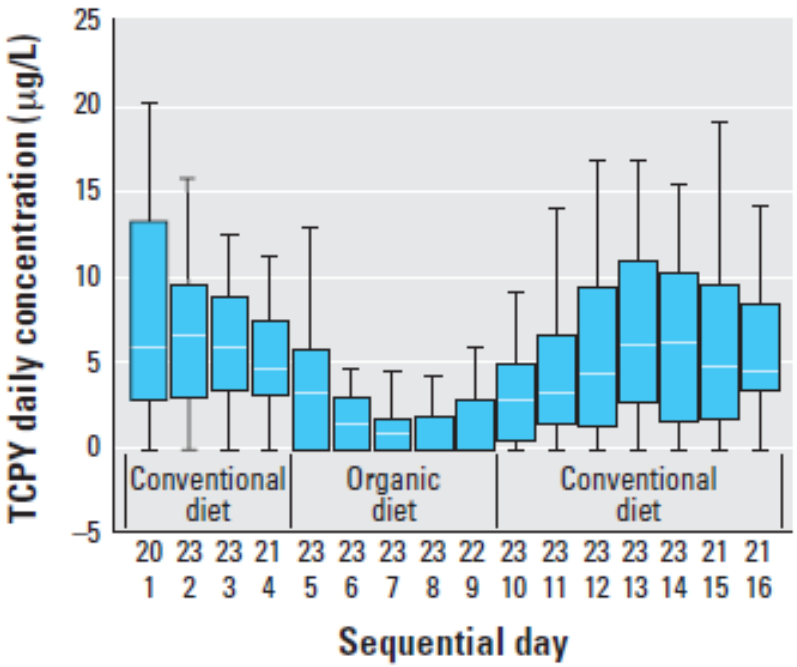


Figure 2. Box plots of DVWA of TCPY concentrations in 23 children 3–11 years of age for 15 consecutive days in which conventional and organic diets were consumed. The top row of numbers on the *x*-axis represents numbers of children.

Carlo Modonesi
modonesi@unipr.it

BENEFITS OF AGROECOLOGY

- Protection of public health
- Healthy products
- Healthy environment
- Sound local economy
- Better nutritional contents of foods
- Agricultural productivity
- Deep and surface water protection
- Social sustainability
- Air protection
- Increased fertility of soil
- Biodiversity conservation
- Lower impact on climate
- Community cohesion
- Emigration reduction
- Jobs
- Attraction toward rural landscapes
- Recovery of the agricultural tradition

Carlo Modonesi
modonesi@unipr.it

Se il mondo smettesse di aspettarsi che gli scienziati abbiano sempre ragione, avremmo risolto una buona parte del problema degli errori. Perché nella scienza avere torto è positivo, perfino necessario – purché gli scienziati lo riconoscano, purché ammettano apertamente il loro errore invece di mascherarlo.
Ma finché le carriere resteranno condizionate dalla produzione di un fiume di ricerche abbellite in modo da sembrare più giuste di quanto non siano, gli scienziati continueranno a produrle. La scienza è un'impresa nobile, ma a basso rendimento.

John Ioannidis
Professor of Disease Prevention and Health Research and Policy
Stanford University

Carlo Modonesi
modonesi@unipr.it

Carlo Modonesi
modonesi@unipr.it

Avvenire.it

Serietà, libertà, spiritualità: le virtù per un futuro umano

Roberto Righetto
giovedì 27 aprile 2017

Le tre virtù essenziali per il futuro:

1) **la serietà**, cioè il rendersi conto della reale posta in gioco in mezzo a tutte le chiacchiere sul progresso;

2) **il coraggio**, il saper prendere posizione di fronte alla possibile distruzione del pianeta;

3) **la libertà**, capace di resistere al potere suggestionante dei media e cui si arriva solo con un'educazione, interiore ed esteriore.

(da: Romano Guardini, 1954)