Waste management and health: Current state of affairs in Europe

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Waste and health

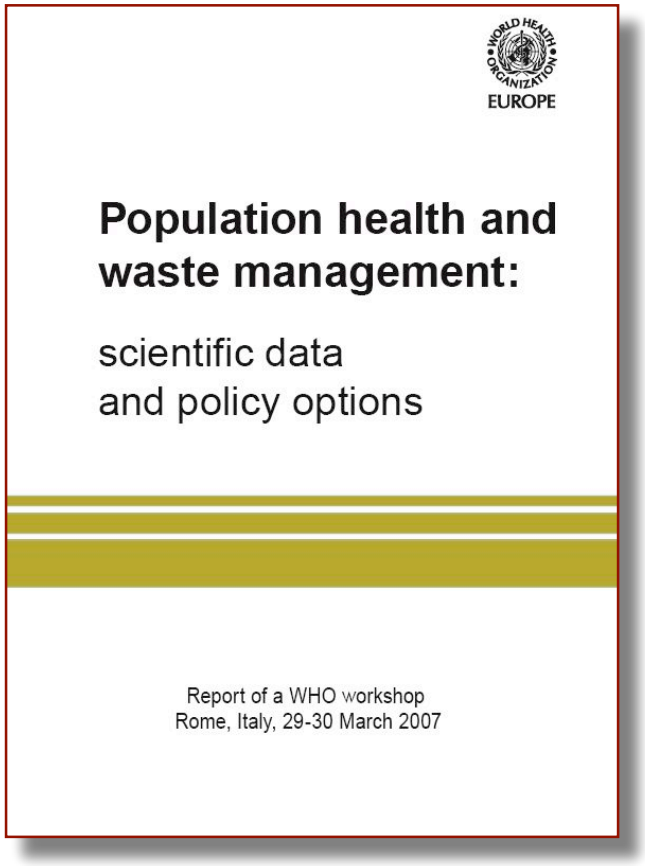
- Complexity and uncertainty
  - Various kinds of waste
  - Many agents
  - Many exposure paths
  - Interaction with other determinants

What's the question?

- What adverse health effects, if any?
  - facilities (residential, occupational)
  - mix of agents
  - pathway of exposure (air, soil, water, food, …)
- What is the comparative impact of different waste facilities/policies?
  - Scale
  - Costs and benefits
  - Equally distributed?
- What is the best strategy for
  - Develop waste policies
  - Create new facilities?

WHO Workshop, March 2007

- 26 participants, 4 WHO:
  - environmental epidemiology
  - health impact assessment
  - cost-benefit analysis
  - chemical hazard
  - public health
  - industry
  - NGOs
- 19 observers



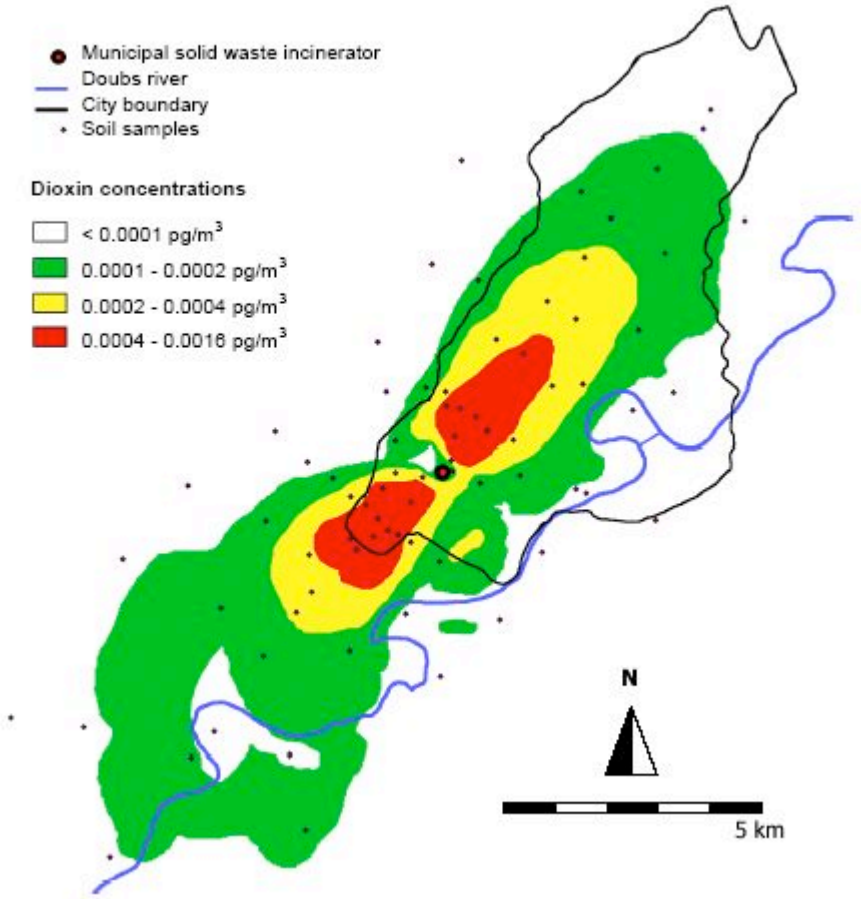
WHO workshop objectives

- Review the current scientific evidence on health effects, with special reference to landfilling and incineration
- Review the contribution of state-of-the-art technology in reducing emissions and population exposures
- Clarify what exposures are likely to be most relevant in terms of health and the degree of population exposures in European countries

WHO workshop objectives (2)

- Analyse case studies from European countries
- Review and evaluate health-based approaches to support decision-making in waste management
- Provide guidance and support to policy-makers engaged in waste management

Atmospheric diffusion model for dioxin exposure assessment



Municipal solid waste incinerator, Besançon, France

Association of NHL with dioxin exposure

Dioxin exposure	Cases	Controls	OR (95% CI)
Very low	42	441	1.0
Low	91	952	1.0 (0.7-1.5)
Intermediate	58	681	0.9 (0.6-1.4)
High	**31**	**146**	**2.3 (1.4-3.8)**

• *Floret N et al.* ***Epidemiology*** *2003;14:392-398*

Incinerators: evidence (1)

- Most of time confounding makes studies hard to do and even harder to interpret and, as in landfill studies, increases in relative risk are difficult to detect because are generally caused by long-term low-level exposures.
- However, studies pointing to an increase in STS and NHL support a possible etiologic role of 2,3,7,8 TCDD.
  - mainly coming from Italy (Comba et al., Biggeri et al., Zambon et al.), and France (Viel et al., Floret et al.);
  - among people living in the vicinity of old generation plants.

Incinerators: evidence (2)

- In some studies (but not all) in which risk excesses were found, alternative interpretations, e.g. involving exposures from sources other than the incinerators were put forward
- Stack emissions from modern plants are much reduced compared to old generation plants
- The few studies carried out on new generation incinerators are difficult to compare with the previous ones, because of these differences in technology between the plants

Incinerators: evidence (3)

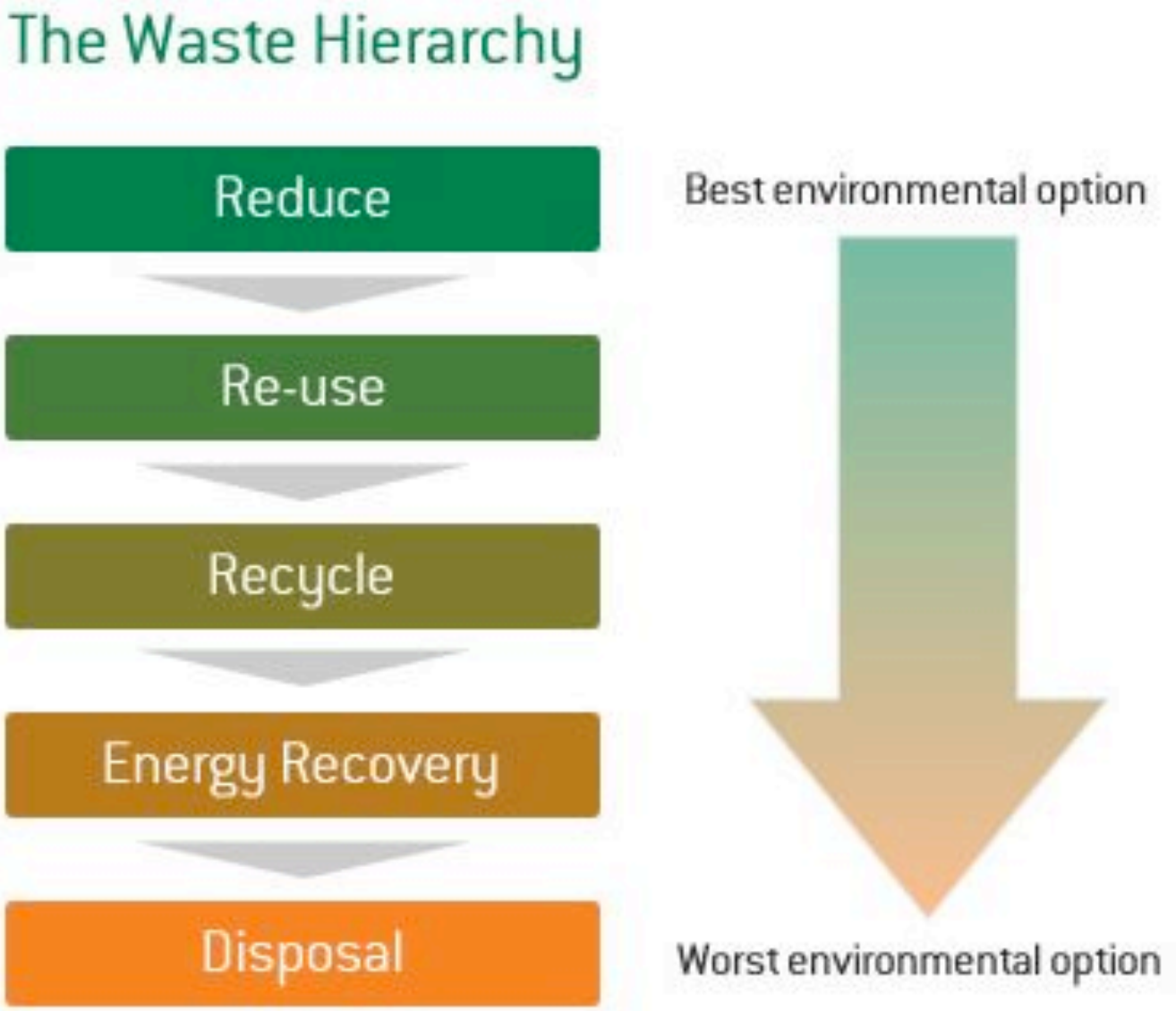
- The adoption of the “Best Available Technology”, enforced by the EU, results in the fact that the occurrence of measurable health effects on populations resident in close proximity of new generation incinerators is becoming less likely
- However their overall impact on the general environment and on human health through indirect mechanisms of action, has not been evaluated yet
- In particular waste incineration, currently on the increase in many countries, may be a non-negligible contributor of greenhouse gases and persistent pollutants on a global scale

Priorities for epidemiological studies in waste and health

- Further insights are unlikely to be gained from distance-based studies, given their substantial limitations.
- If progress is to be made, it seems necessary to consider exposure pathways and biomarkers of exposure and effect, and compare waste-related exposures with those due to other sources of pollution.
- A first step towards “new generation” epidemiological studies (that can better characterize exposure through the use of biomarkers) has already been taken, especially in the case of incinerators.

Consensus on conclusions

- Available evidence not conclusive, have limitations, but cannot be ignored or overlooked
- More data needed, from enahnced methods (esp on exposure asessment)
- Existing knowledge must contribute to policy decisions
- Value of European waste Hierarchy


The Waste Hierarchy
Reduce
Re-use
Recycle
Energy Recovery
Disposal
Best environmental option
Worst environmental option

Conclusions

- “Suggestive” or “inconclusive”?
- Complexity of landfill exposure will seriously hamper our ability to produce hard scientific evidence of exactly what exposures lead to what health effects – should we wait for the evidence to build?
- Waste reduction, waste recycling, waste disposal?
  - How critical is the health evidence for reordering our priorities?
- Listen to residents and “clean up the mess”
    - Environmental regulation with real teeth
    - Making sure that current landfill followed best practice would be one step forward to reduce health effects
    - Should sites be proximal to residential areas?
- No further light to be gained from distance based studies – look at exposure pathways and biomarkers of exposure and effect, comparing to other pollution sources

Risk governance

- Available knowledge does not provide univocal picture
- From scientific “proof” to “balance of evidence”
- Operating and communicating “grey areas” (often the case in modern env health)
- Value of case studies

In practice?

- Given complexities (including social), best use resources such as
  - Health Impact Assessment (HIA)
  - Surveillance
- Principles
  - Stakeholders
  - Transparency of process
  - Precautionary principle
- In line with recent European orientations
  - Health systems, stewardship
  - Health in All Policies

Waste: A thorny issue

- Reactions: Too “soft” on incineration?
  - Consider full cycle and externalities
  - Growing toxification of waste stream
- Reactions: maximise efficiency
  - Success stories (e.g., Sweden)
  - Re-assess waste hierarchy

Problems with review of health evidence

- Publishing bias towards “positive” findings
- “Absence of evidence is not evidence of absence”
  - Looking where others have looked before – the “me too” publishing phenomenon
  - Looking at health outcomes for which information is most readily available
- Multiple testing and chance findings
- Extrapolation
- Observational epidemiological studies are by definition not experimental and open to bias

Landfills

- The exposure pathways and types of exposure associated with landfills are complex :
  - involving air, water, soil and food;
  - involving inhalation, ingestion and skin contact;
  - involving a wide range of different chemicals, some of them known carcinogens, allergens, or teratogens, and present in chemical mixtures with unknown synergistic effects;
  - relating to lanfilling practice, often years before the time of exposure which may have been poorly documented or illegal.

Landfills

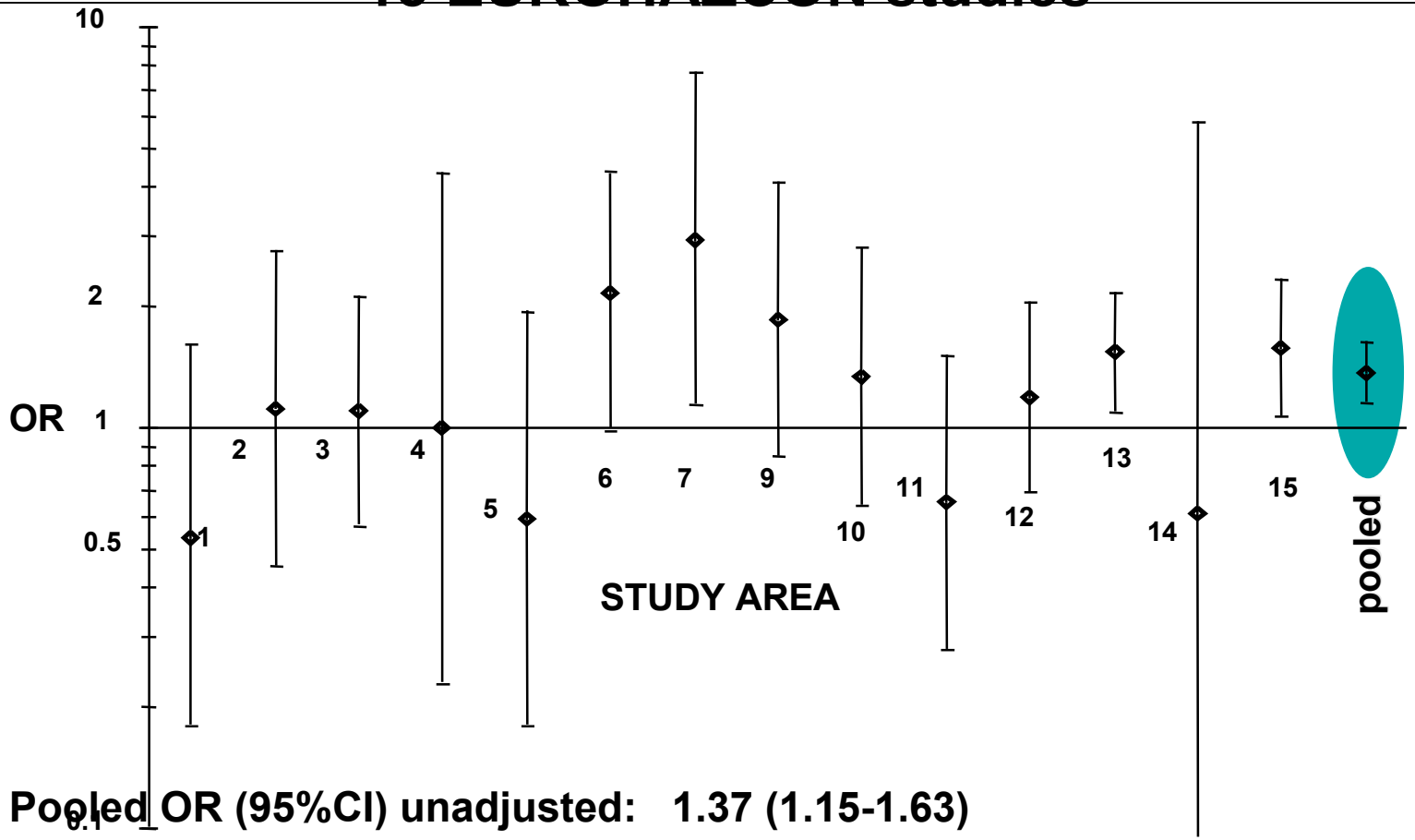
- Screening rule: several epidemiological studies, including at least one case-control or cohort, showing fairly consistent associations and evidence of exposure-risk relationship after controlling for potential confounders.
  - **low birth weight;**
  - **total birth defects;**
  - **central nervous system birth defect;**
  - **cardiovascular birth defects;**
  - **genitourinary birth defects.**

EUROHAZCON: risk of congenital malformation near hazardous waste landfills

- Multi-centre European study : 8 centres in 5 countries,
- Existing, regional, population-based congenital malformation registers,
- Case-control studies,
- 24 hazardous waste sites, open or closed,
- Late 1980s/early 1990s,
- Exposure:
  - distance of residence less than 3 km vs 3-7 km,
  - hazard potential ranking by expert consensus.

Source: Dolk in WHO workshop, 2007

Non-chromosomal congenital anomalies
Odds ratios for residence within 3 km from waste site:
15 EUROHAZCON studies



Pooled OR (95%CI) unadjusted: 1.37 (1.15-1.63)

Pooled OR (95%CI) adjusted*: 1.33 (1.11-1.59)

*** adjusted for socio-economic status, maternal age, and year of birth.**

Source: Dolk in WHO workshop, 2007

Interpretation

- Classification of anomalies:
  - minor anomalies excluded;
  - neural tube defects, some cardiac anomalies, chromosomal anomalies also showed significant excesses.
- Underestimation of effects:
  - exposure misclassification:
    - no ambient exposure measurements,
    - no human biomarkers.
  - migration.
- Extrapolation:
  - heterogeneity of sites: how does it relate to the risk of any one site?
  - past vs present landfill engineering.

Landfills: evidence (1)

- Despite some limitations, the scientific literature on the health effects of landfills provides some indication of the association between residing near a landfill site and adverse health effects.
- The evidence, somewhat stronger for reproductive outcomes than for cancer, is not sufficient to establish the causality of the association.

Source: WHO, 2007

Landfills: evidence (2)

- However a public health response is warranted because:
  - a small but significant excess risk of several reproductive adverse outcomes is found;
  - a large proportion of population is potentially exposed to landfills;
  - the level of available evidence suggest that the potential health implications cannot be dismissed.
- Given the difficulty of using residence location as a proxy for exposure and the long latency, fewer studies concern cancer.
- In combination with poor exposure classification, this can lead to very low power of the study to find a real risk.

Categories of health-care waste

Waste category	Description and examples
Infectious waste	Waste suspected to contain pathogens e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues or fluids e.g. body parts; blood and other body fluids; fetuses
Sharps	Sharp waste e.g. needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

http://www.healthcarewaste.org/en/documents.html?id=1

Health-care waste generation according to national income level[a]

National income level	Annual waste generation (kg/head of population)
High-income countries:	
— all health-care waste	1.1–12.0
— hazardous health-care waste	0.4–5.5
Middle-income countries:	
— all health-care waste	0.8–6.0
— hazardous health-care waste	0.3–0.4
Low-income countries:	
— all health-care waste	0.5–3.0

[a]Sources: Commission of the European Union (1995), Halbwachs (1994), Durand (1995).

DESTINY	ITALY		SLOVAKIA (2002)		ENGLAND	
	Thousands tons	[%]	Thousands tons	[%]	Thousands tons	[%]
Landfill	17,910	56	1,192	78	22,180	77
Incineration	2,590	8	65	4	2,590	9
Recycled/composted	7,650	24	76	5	3,740	13
Other	3,790	12	191	13	290	1
TOTAL	31,940	100	1,524	100	28,800	100
MSW generation per capita/kg	560		283		587	

Health care system waste

- How big is the problem?
- Efficiency
- Exemplary role

→An important agenda!