BSc Global Health

Module: The Burden of Chronic Diseases
Lecture: The Era of Chemical Hazards
Date: Monday 5th December 2011

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Lecture Outline

Learning Outcomes

By the end of the lecture and the associated learning activities (reading, practical) you should:

- ✓ Be able to describe how the industrial revolution and continued industrialisation around the world has influenced chemical hazards and exposure.
- ✓ Have knowledge of several examples of chemical hazards that exist in the natural, built, and occupational environment that have an impact on health, and describe efforts that have been made to limit this impact.
- ✓ Be able to describe recent EU legislation that is aimed at characterising chemical hazards, and comment on the limitations that exist in the implementation of this legislation.

Lecture Outline

Outline

- Chemical hazards
  - Hazard and risk
  - What is a ‘chemical’ anyway?
  - An era of chemical hazards
- Examples of chemical exposure
  - Air pollution
  - Asbestos
- Investigating chemical hazards

- Summary

- Discussion of articles

- Research reading and discussion

Chemical Hazards

Chemical Hazards

Hazard and risk (basic definition)

Hazard: something with the potential to do harm

Risk: the likelihood of something doing harm in a given scenario

Chemical Hazards

What is a 'chemical hazard' anyway?

Broad definition (from OSHA) of a hazardous chemical:

"

- any chemical whose presence or use is a physical hazard or a health hazard.'

Chemicals defined as **"physical hazards"** include:

- *combustible liquids, compressed gases, explosives, flammables. Organic peroxides, oxidizers, pyrophorics, and unstable or water-reactive chemicals.*

Chemicals defined as **"health hazards"** include those that:

-*cause either acute or chronic health effects due to exposure by inhalation, ingestion or direct skin or eye contact. The term health hazard includes chemicals which are carcinogens, reproductive toxins, irritants, corrosives, sensitizers, and chemicals that damage a specific organ or system (e.g., hepatotoxins, nephrotoxins).*

"

OSHA - Hazard Communication Standard (29 CFR 1910.1200)

OSHA = Occupational Health and Health Administration (US Government)

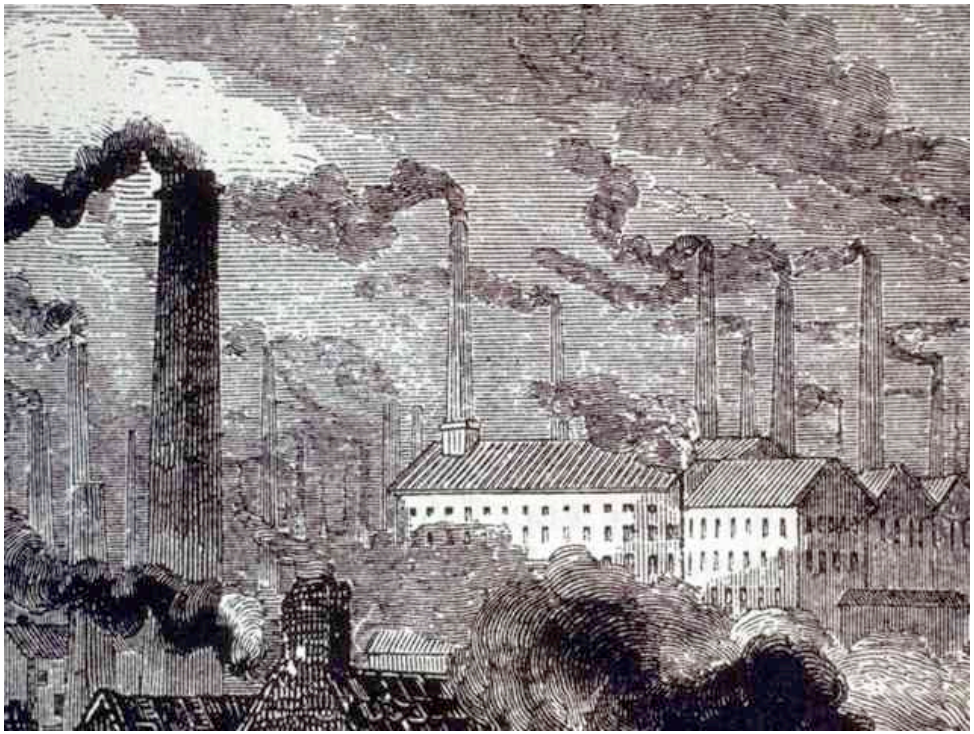
An era of chemical hazards

- Before the industrial revolution 18th and 19th century, main hazards for ill health were infection and deficiencies

- The massive increase in industrial processes :
  - large scale manufacturing
  - constructions
  - agriculture
  - etc

  …represented a period of growth worldwide (not everywhere equal).

- Processes in the industrial revolution generated a considerable variety and quantity of waste product, but there was little knowledge of the effects of exposure and consequently, little legislation in place to control chemical hazards



An era of chemical hazards

- The growth in scientific knowledge relating to the effect of chemical hazards to human health has lead to policy changes and legislation for their control.

- Many of the significant chemical hazards that once existed have been identified and controlled effectively

- The era of chemical hazards is not over however:
  - emerging new chemicals / materials
  - e.g. manufactured nanoparticles

- More importantly, policy and legislation is often country or region specific, and therefore exposure to chemical hazards that are limited in one area may still be high in others. The contrast is often between developed and developing nations.

Chemical Hazards

An era of chemical hazards

- The effect of industrialisation, and the ability to greatly improve the efficiency of production and therefore cost of goods has been a catalyst in the current era – that of lifestyle hazards
  - dietary and exercise choices
  - obesity
  - type II diabetes

Examples of Chemical Exposure: Air Pollution

Examples of Chemical Exposure

Great smog of London, 1952

- Open coal fires commonly used to heat homes
- Smoke mixing with dense fog produced ‘smog’
- Early December 1952, this was experienced acutely in London.
- Visibility reduced virtually to zero

Examples of Chemical Exposure

Great smog of London, 1952

- During the smog, mortality increased (estimated ~4000 excess deaths, recently revised to ~12000)

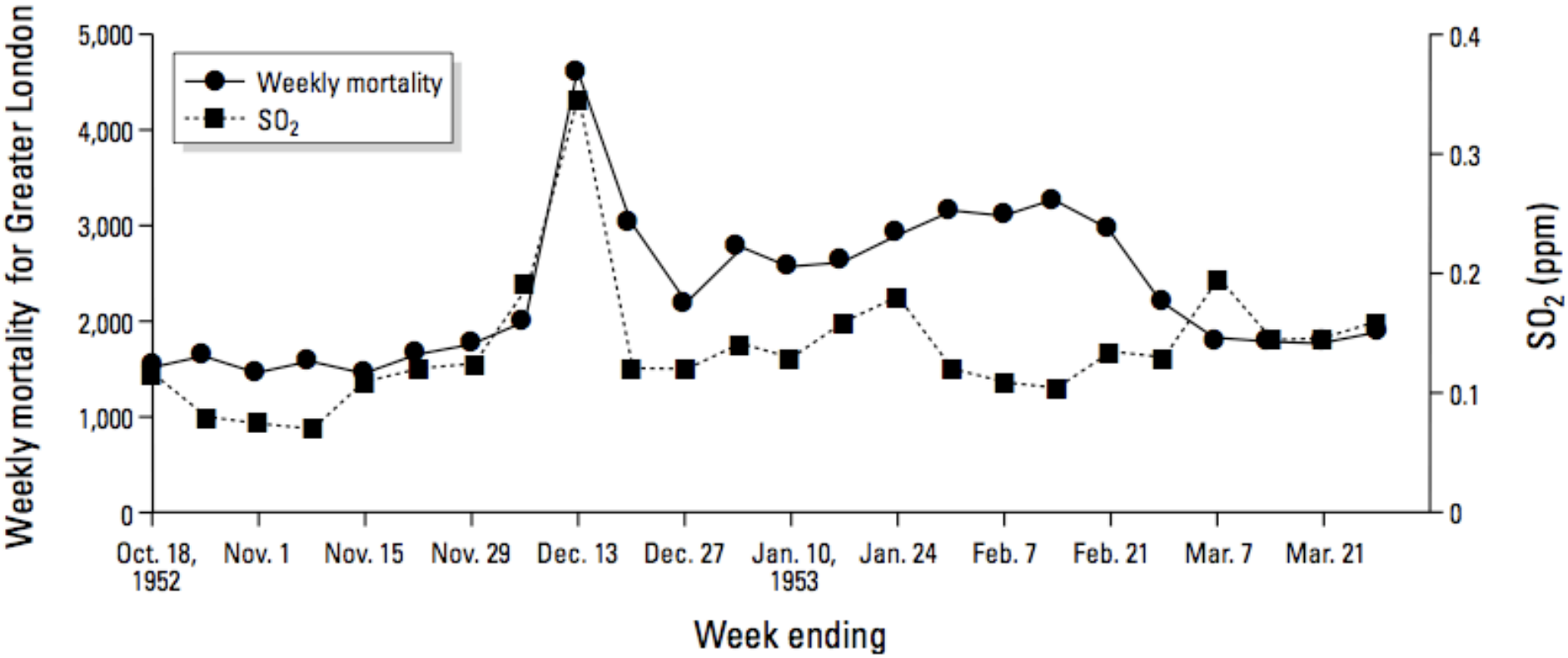


Figure 1. Approximate weekly mortality and SO_2 concentrations for Greater London, 1952–1953.

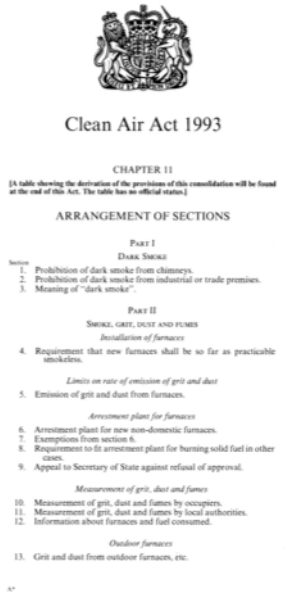
M L Bell and D L Davis. *EHP*. 2001.

Examples of Chemical Exposure

Clean Air Act 1956

- The 1952 London smog event was a catalyst/driver for the UK Clean Air Act of 1956
- Aim was to reduce city smoke
- Introduced legislation to prohibit burning of smoke-producing fuel in certain areas
- Updated subsequently, including in the Clear Air Act 1993

Clean Air Act 1993



Clean Air Act 1993

CHAPTER 11

[A table showing the derivation of the provisions of this consolidation will be found at the end of this Act. The table has no official status.]

ARRANGEMENT OF SECTIONS

PART I

DARK SMOKE

Section

1. Prohibition of dark smoke from chimneys.
2. Prohibition of dark smoke from industrial or trade premises.
3. Meaning of "dark smoke".

PART II

SMOKE, GRIT, DUST AND FUMES

Installation of furnaces

4. Requirement that new furnaces shall be so far as practicable smokeless.

Limits on rate of emission of grit and dust

5. Emission of grit and dust from furnaces.

Arrestment plant for furnaces

6. Arrestment plant for new non-domestic furnaces.
7. Exemptions from section 6.
8. Requirement to fit arrestment plant for burning solid fuel in other cases.
9. Appeal to Secretary of State against refusal of approval.

Measurement of grit, dust and fumes

10. Measurement of grit, dust and fumes by occupiers.
11. Measurement of grit, dust and fumes by local authorities.
12. Information about furnaces and fuel consumed.

Outdoor furnaces

13. Grit and dust from outdoor furnaces, etc.

Examples of Chemical Exposure

London Low Emmission Zone (LEZ)

- London still has some of the worst levels of pollution of all European cities
- LEZ In place from Feb 2008
- Targets larger, heavy, diesel-powered vehicles
- Aim is to reduce use of these vehicles and therefore reduce PM_{10} and NO_x

Examples of Chemical Exposure: Asbestos

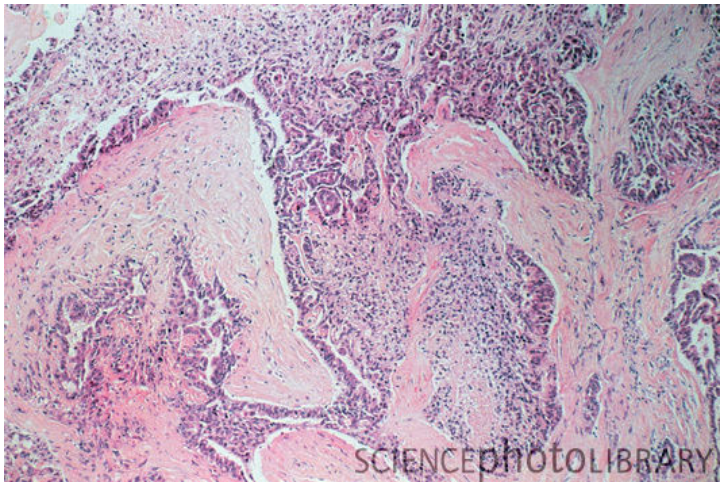
Examples of Chemical Exposure

Asbestos

- Asbestos is/was used as a building material
- Has favourable physical properties
- e.g. tensile strength, heat resistance
- Mined extensively worldwide until early 1900's
- Some/most forms give are toxic
- Fibres can cause lung damage, leading to mesothelioma

Largest mine: Asbestos, Quebec

Blue asbestos



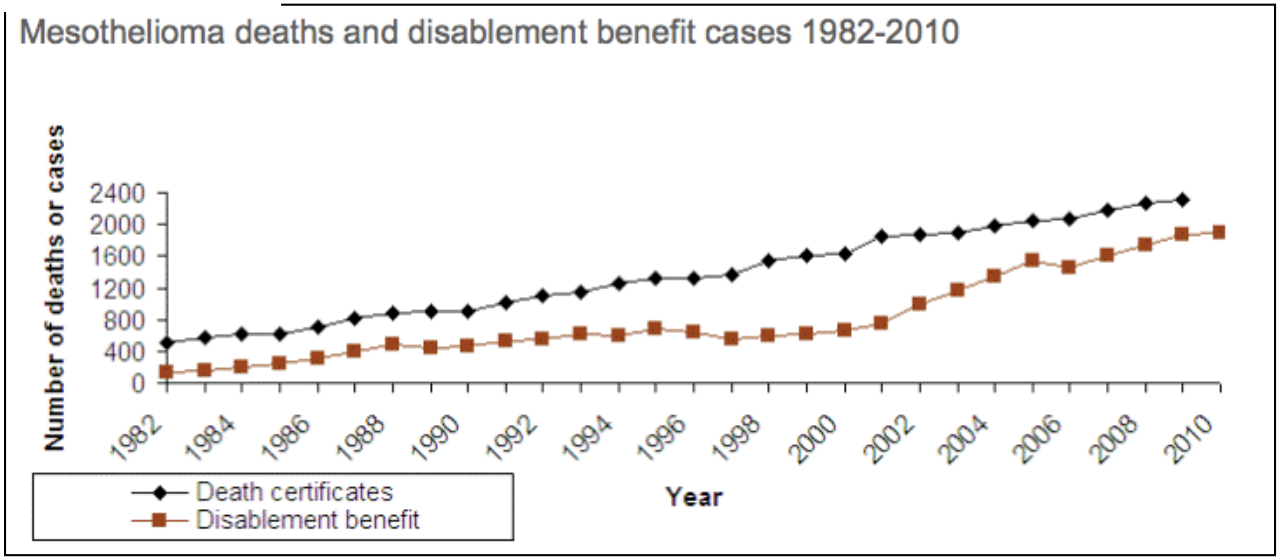
Mesothelioma

Examples of Chemical Exposure

Asbestos

▪The long latency of asbestos-related mesothelioma and other diseases mean that cessation of use will have an effect on death rates, but this may not be realised for many years.

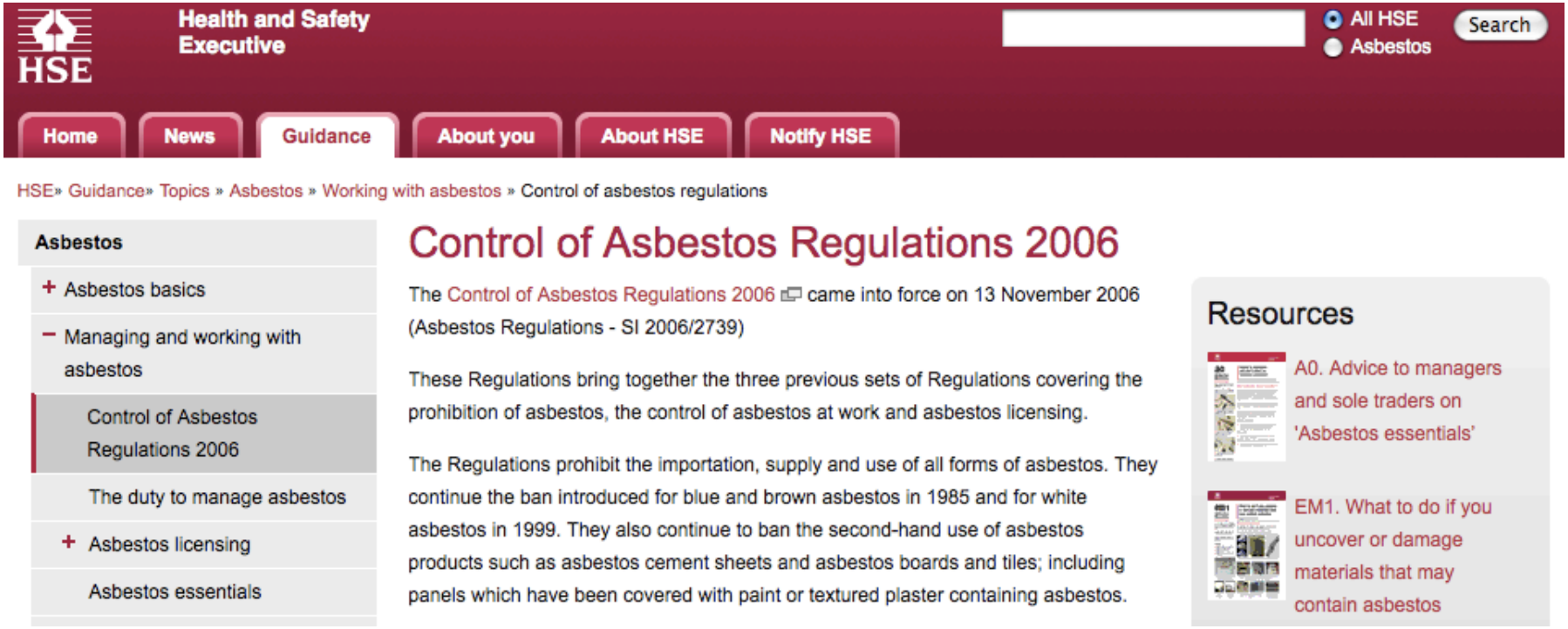
Deaths from mesothelioma (2009)	2 321
Estimated asbestos related lung cancer deaths	2 000*
Deaths from asbestosis without mention of mesothelioma (2009)	411
Newly assessed cases of asbestosis (IIDB)	1 015
Newly assessed cases of diffuse pleural thickening (IIDB)	505
Cases of non malignant pleural disease reported to specialist physicians (THOR/SWORD)	778



Examples of Chemical Exposure

Asbestos

- Asbestos still mined in some areas of of the world
- EU banned import, production, use of asbestos.
- Worldwide, only 60 countries have banned its use, despite health implications.
- Estimated that 4000-5000 deaths in the UK are related to asbestos exposure.



Investigating Chemical Hazards

Aromatic Amines

Investigating chemical hazards

- Chemical toxicity (other deleterious effect) can be investigated in a number of different ways.

- *Q: What are the main strengths and weaknesses of the following approaches?*

    - *in vitro* chemical exposures
    - *in vivo* chemical exposures
    - randomised controlled trials
    - nested case-control studies
    - anecdotal reports

- *Q: Are some kinds of chemical exposures more difficult to explore than others?*

Summary

Overview

- Chemical hazards are generally defined as those that are deleterious to health upon exposure
- Air pollution is an example of an environmental exposure, a product of the built environment
- Asbestos is an example of both an occupational and environmental chemical hazard
- The ability to characterise chemicals allows their hazardous potential to be assessed
  - Policy and legislation can be informed
  - Improvements to public health and occupational surroundings can be made
- The evidence for the hazard a chemical presents may be assessed in many different ways. Each has strengths and weaknesses in relation to assessing environmental, occupational and lifestyle exposures

Discussion of Articles

Discussion

Articles

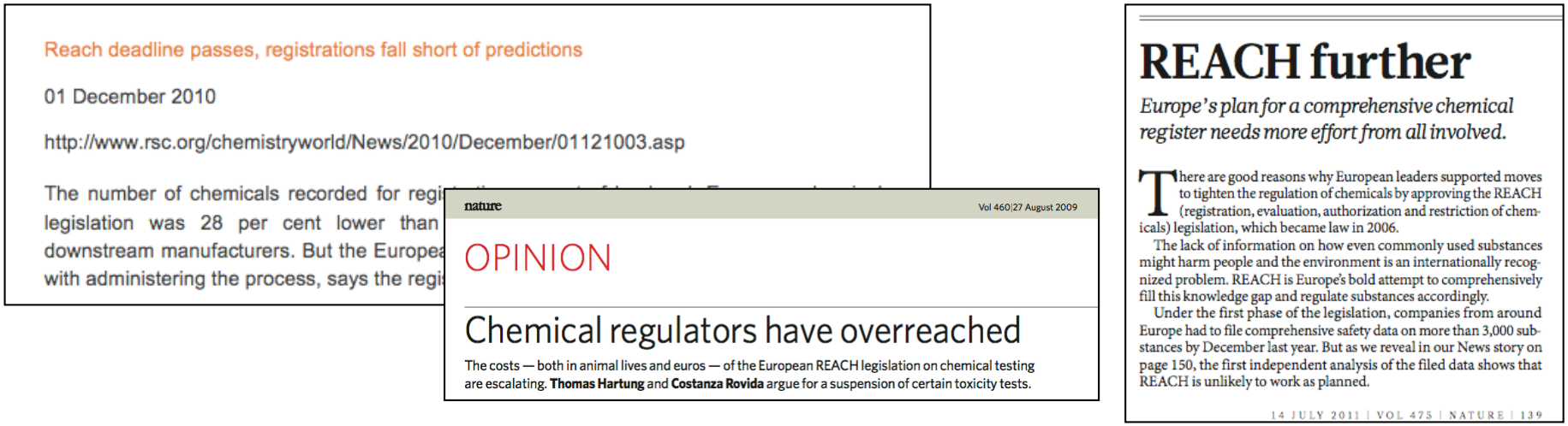
The course outline in the handbook requested the following reading be done before the session:

Hartung and Rovida. 2009. Chemical regulators have overreached. *Nature*. 460 1081-1082.

Turley. 2010. Reach deadline passes, registrations fall short of predictions.
Online: http://www.rsc.org/chemistryworld/News/2010/December/01121003.asp

Editorial. 2011. REACH further. *Nature.* 475, 139–140

Please work with a revise the materials (10 mins) ready for a group discussion.



Reach deadline passes, registrations fall short of predictions

01 December 2010

http://www.rsc.org/chemistryworld/News/2010/December/01121003.asp

The number of chemicals recorded for regi
legislation was 28 per cent lower than
downstream manufacturers. But the Europea
with administering the process, says the regi

nature Vol 460|27 August 2009

OPINION

Chemical regulators have overreached

The costs — both in animal lives and euros — of the European REACH legislation on chemical testing are escalating. **Thomas Hartung** and **Costanza Rovida** argue for a suspension of certain toxicity tests.

REACH further

Europe's plan for a comprehensive chemical register needs more effort from all involved.

There are good reasons why European leaders supported moves to tighten the regulation of chemicals by approving the REACH (registration, evaluation, authorization and restriction of chemicals) legislation, which became law in 2006.

The lack of information on how even commonly used substances might harm people and the environment is an internationally recognized problem. REACH is Europe's bold attempt to comprehensively fill this knowledge gap and regulate substances accordingly.

Under the first phase of the legislation, companies from around Europe had to file comprehensive safety data on more than 3,000 substances by December last year. But as we reveal in our News story on page 150, the first independent analysis of the filed data shows that REACH is unlikely to work as planned.

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Discussion

Article 1 Discussion

The article is written by two prominent toxicologists and discusses the European Union REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation.

- What is REACH?
- What would it achieve?
- What are the major problems with REACH cited in this article?
- The main testing paradigm for toxicity is animal models.
  - What other methods are available?
  - What are their limitations?
- Do you think REACH is likely to succeed?

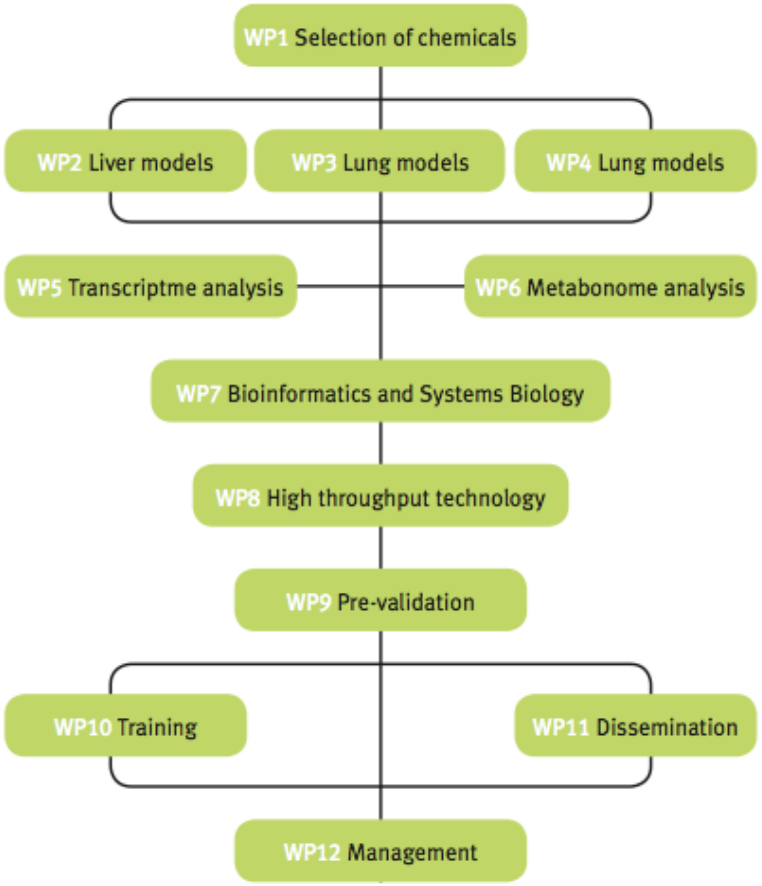
Discussion

Chemical Risk Assessment

- Assessment of chemical carcinogenicity has typically been conducted using a 2-year rodent bioassay
  - Expense
  - Ethics
  - Time
  - Relevance to man

- Post-genomics profiling tools, combined with in vitro exposure assay may provide a means of rapid screening of chemicals
  - Metabonomics
  - Transcriptomics
  - Proteomics
  - (Epi)genomics

- Example: EU FP6 carcinoGENOMICS



carcinoGENOMICS
a Project of the European Union

Discussion

Article 2 Discussion

The article discusses the recent submission deadline for REACH where safety dossiers were required for chemicals produced in very high volume. This was the first of three submission deadlines for REACH.

- What was the outcome of the submission process?
- What might have affected the number of chemicals submitted for registration?
- How might REACH affect downstream manufacturing?
- How might the requirement to submit dossiers on chemicals affect companies?

Discussion

Article 3 Discussion

The article is a editorial comment on REACH.

- What is the editorial stance?
- What – if any – problems does it cite with REACH?

Research Reading and Discussion

Who decides what is a chemical hazard?

Discussion

Articles

Over recent years there have been a number of letters written into international epidemiology journals commenting on how experimental, epidemiological and other evidence used by expert groups to classify chemical hazards.

In groups of 2-3, please choose 2-3 articles and read through them online.
Make notes on which issues are raised by the various authors.
What is your own opinion on the issue?
Are any suggestions made that are useful?

(1)Boffetta, P.; McLaughlin, J. K.; La Vecchia, C.; Tarone, R. E.; Lipworth, L.; Blot, W. J. *J Natl Cancer Inst 2008, 100, 988-995.*
(2)Clapp, R. W.; Kriebel, D. *J Natl Cancer Inst 2009, 101, 211-212; author reply 213-214.*
(3)Vineis, P. *Int J Epidemiol 2009, 38, 675-677.*
(4)Boffetta, P.; McLaughlin, J. K.; La Vecchia, C.; Tarone, R. E.; Lipworth, L.; Blot, W. J. *Int J Epidemiol 2009, 38, 678-679.*
(5)Hauptmann, M.; Ronckers, C. M. *Int J Epidemiol, 39, 1677-1679; author reply 1679-1680.*
(6)Wild, C. P.; Cogliano, V. J. *Int J Epidemiol, 40, 253-261.*
(7)Erren, T. C. Int J Epidemiol 2011 (online ahead of print).
(8)Wild, C. P.; Straif, K. S. *Int J Epidemiol* 2011 (online ahead of print).
(9)McLaughlin, J. K.; Boffetta, P.; La Vecchia, C.; Lipworth, L. ; Blot, W. J.; Tarone, R. E. *Int J Epidemiol* 2010 (online ahead of print).
(10) Vineis, P. *Int J Epidemiol 2011 (online ahead of print).*