Re: Liability (Oxford) Ltd

Emerging Risk

Nanotechnology Liabilities

London Novotel Tower Bridge, EC3N 2NR

08.45

Structure

- What is nano?
- Components of an insurance definition
- Some science
  - Official approach
  - Pragmatic approach
- The reasonable representation of risk
  - Decision tool
- Assessment of correlation
- Portfolio analysis

What do you need?

- You can ‘manage’ emerging liability risks using: policy limits, clauses such as pollution exclusions and avoidance of aggregation - even if you don’t exactly know what the “it” is.
- So what more do you usually need?

- A watertight definition
- Judgement/quantification of:
  - Exposure to hazard
  - Toxicity
  - Probability of harm
  - Probability of legal proof
  - Probable loss
- Leading to: bespoke actions for *EL, PL, EIL, Prof Ind, …*

Nano

- There are 25 million nanometres to the inch.
- NP are invisible.
- Unusual and interesting things happen to the very small.
    1. For delocalised quantum systems very small means between 1 nm and 200 nm.
    2. For localised quantum systems it means between 1 and 50 nm. More like 1 to 30 nm

- But there is nothing new for the first type; besides CNT and Bucky balls. Dyes, nitro amines, etc. have been with us on a modern industrial scale for 150 years.

An insurance definition must allow risk discrimination.

BUT

- NP are produced quite ‘naturally’
  - E.g. soot from a gas burner, roadside dust, virus, rock bashing
- and are made/included in products unintentionally
  - E.g. beer sediment, clay
- They are produced with a distribution of sizes
- They stick together to make normal sized dust, but this is reversible.
- Their size changes as they age.
- Most are completely passive ingredients.

Definition in contract

- Decide your own definition, if you think you need one.
- Key ingredients:
  - Novel properties/traits
  - …which are attributable to size
  - Deliberate or accidental or both
  - If you specify size(s) then state bounds and error margins
  - Allow for mixtures

  - Then assess false positive rate, false negative rate
  - Decide what rates are acceptable to you and adjust.

Toxicity

- In 2009 OECD promised to have worked it all out by 2014.
  - Exactly what is it that makes NP toxic? Foreseeability
  - Dose response effects and typical exposures. Size of the problem
  - Precautionary Duty of Care standards. Reasonable Duty of Care Standards
- In 2014 they realised that most of the research could not be generalised in the way that regulatory action can be transparent, reviewable, and protective. One NP cannot be compared with another.
- In 2015 they listed all the data to date and will try to form some opinion for regulators to act upon.

OECD list

- Fullerenes (C_{60}) and derivatives
- Single-walled carbon nanotubes (SWCNTs) and derivatives
- Multi-walled carbon nanotubes (MWCNTs) and derivatives
- Silver nanoparticles
- Iron nanoparticles
- Carbon black
- Titanium dioxide
- Aluminium oxide
- Cerium oxide
- Zinc oxide
- Silicon dioxide
- Polystyrene and derivatives
- Dendrimers
- Nanoclays and derivatives

OECD complexity problem

Explanatory variable	Biological change
Size distribution, Shape distribution, Solubility, Bio-persistence, Surface density, crystal structure, specific area, zeta potential, charge density, Aggregation pattern Agglomeration pattern Fragmentation products …	Inflammation Genetic changes Growth rate changes Reactive oxygen species Mortality Recognisable disease Epigenetic change …

Is this really helpful for insurers?

- Complete data is available for 4 or 5 so far.
- Foreseeability has not even got off the ground.
- Causation and duty of care are not possible.

- OECD approach takes no specific account of the emergent properties that make the NP commercially valuable.
- High risk issues would be flagged for Weapons, Medical, Pesticides, Biocides, Allergens, Catalysts and Epigenetic change agents.

New idea

- Most manufacturers, users and suppliers have no idea of the explanatory variables, except where they have commercial implications.
- These are:
  - Accessibility
  - Persistence
  - Aggregation behaviour
  - Size distribution
  - Shape
  - Ionic character
- They also know what the NP is supposed to do. Weapon etc.

What does the science say about these?

- Accessibility affects dose rate and ability to prove exposure.
- Persistence affects opportunity to interact. There are well defined thresholds for the known toxicity effects. Traces prove exposure.
- Aggregation affects opportunity to be removed and potency. Duty of care effect, causation.
- Size distribution affects potency. Causation.
- Shape affects location and inflammation. Causation mechanism.
- Ionic character affects DNA damage. Causation mechanism.
- In sum these measure the degree to which the NP has the opportunity to cause harm. They also shed light on provability.

Shape effect

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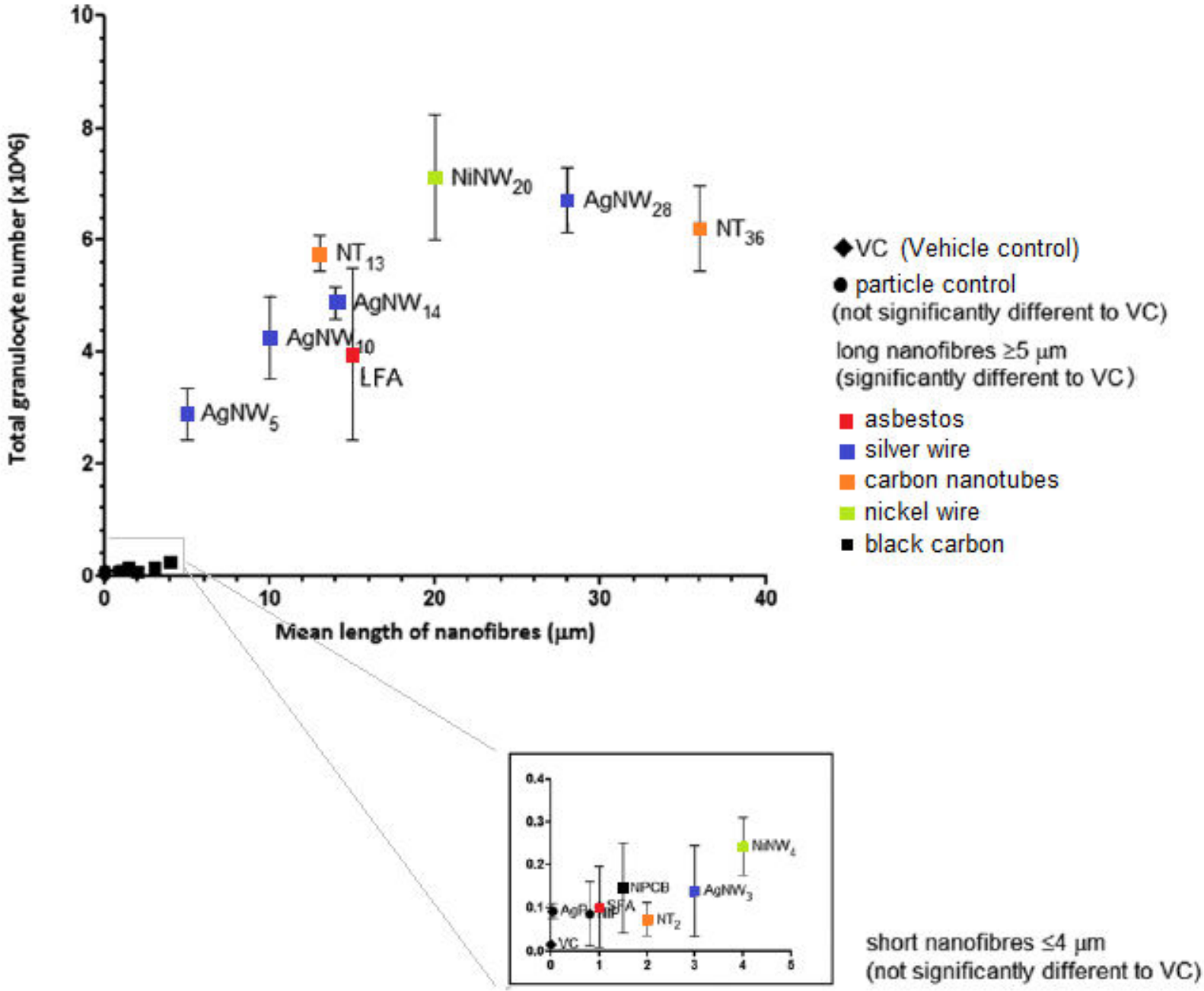
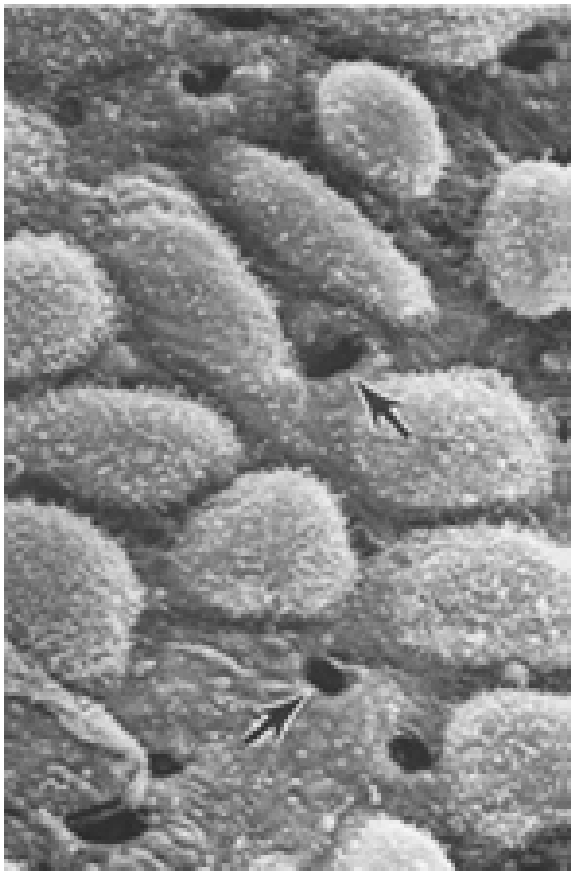
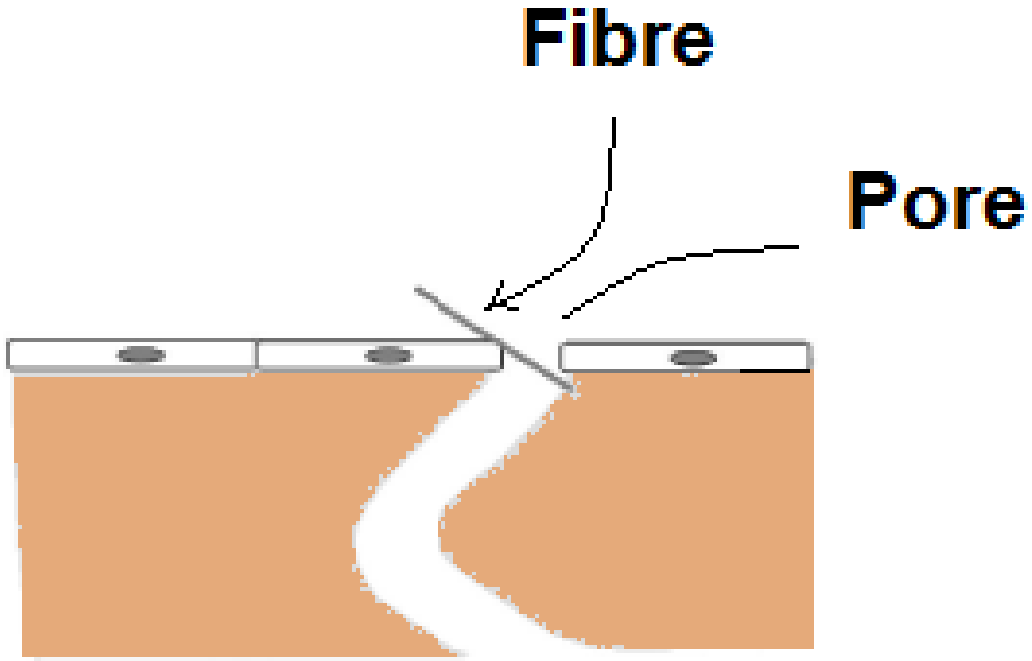
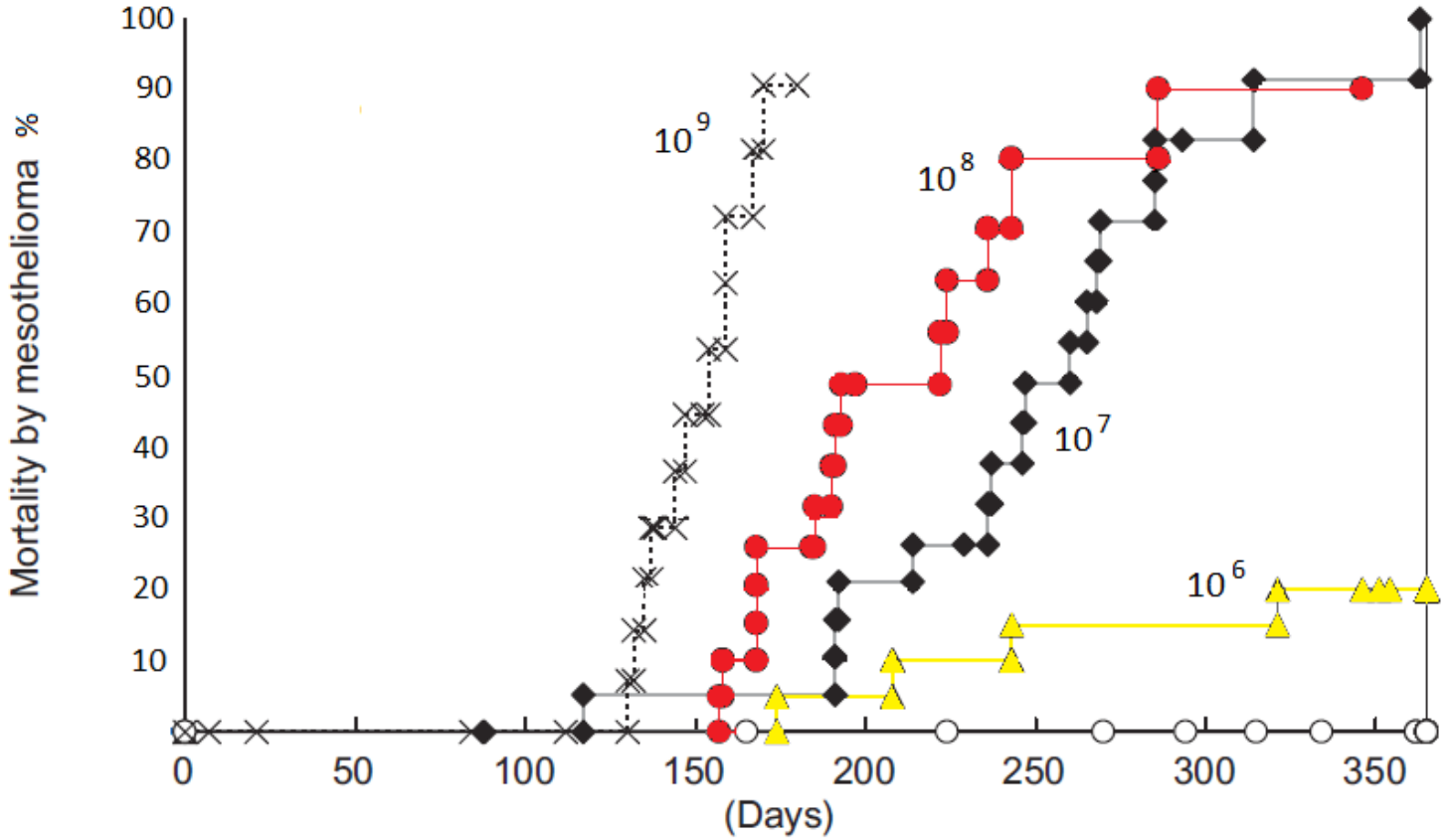


Explanation





Based on: *Cancer Sci* (2012) Vol.103 p 1440–1444
Detectable risk in man would be at around 0.1 f.ml^{-1} for 45 years.



Practical help

- Risk Threshold Tool
- Correlated loss
- Portfolio assessment

Online risk threshold tool

- Insurance Act requires policy-holders (Brokers) to make a fair representation of the risk.
- Ask them if there are any above-threshold nanomaterials in use, handled or created.
- http://www.reliabilityoxford.co.uk/nanomaterials/

Opinions and APA scores

Don’t much worry about:

- Silver nanoparticles in clothing, on surfaces. A few micro-grammes ingested per day is OK. Never inject it. 54 to 72
- Zinc oxide, topically or 25 micro-grammes per m^3 as a dust. As a precaution try to avoid spray sun lotion and dust handling. 36
- Carbon black, topically. ‘Avoid’ paint spray. 36

Low concern cont..

- Graphene. 36
- SWCNT – 36 to 144
- Calcium carbonate in supplements 18
- Clay 18
- Nano sized food 18
- CAS: 31274-51-8 . 54

Some concern

- SiO_2 – epigenetic and allergen adjuvant 144
- MWCNT as a cancer risk amplifier and accelerator with known carcinogens. Not carcinogenic at 5 milligrammes m^{-3}. typical high exposures = 400 microgrammes m^{-3}. Fibrosis is likely at massive exposures. 432
- TiO_2 E171 ‘food’ colouring. 108
- TIG and RSW welding. 144
- Cerium oxide – persistent in plants. 108 to 216

Do what?

- The threshold for concern is a score of 80 to 100 or above.
- 75% of all possible NP are below 80

Suggested response

- If advised of > 80 score add in specific toxicity factors. E.g. allergens
- Then add in the traditional risk management issues. E.g. volume of production, who is the target, is the outcome attributable to NP
- Explore correlated loss scenarios and assess your portfolio.

Correlated losses (3 mechanisms to consider)

- Multiple uses are commonplace
    - silver appears in clothing, ‘health’ drinks, fridges…
    - CNT in textiles, electronics, pharmaceuticals (not yet)
    - Clays in food containers and furniture (not yet).

- Mass exposure is not rare
    - Cerium oxide is a fuel additive
    - Carbon black in paints, cosmetics and tyres
    - Metal oxides in cosmetics
    - Food itself, “fibre” and fumed silica in food

- Multiple product lines E.g. BI, PI and GL would all react to a major event. RDS should identify common trigger types.

Portfolio exposure? Two available approaches.

1. Get an expert to tell you who produces, uses or handles that NP.
   - Assign NAICS codes and trace NAICS code transactions against your portfolio.

2. Use “Big Data” to identify who produces, uses or handles that NP.
   - Use “Big Data” on your portfolio to impute which policies are affected.

- Either way, sum limits, sum premium.

- Get an expert to tell you the jurisdiction total loss. Stochastic modelling ensues. PML.