Future of Occupational Health

Can we do a better job when it comes to assessment of occupational exposure (for risk assessment)

Hans Kromhout

Division Environmental Epidemiology,
Institute for Risk Assessment Sciences,
Utrecht University, The Netherlands

I'm not a divine messenger nor a prophet and I don't have a crystal ball

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Yes of course and we should!

Even when dealing with new occupational hazards

Figure 3. Workers building and testing an MRI system. Image courtesy of Philips.

Annual exposure to SMF (T-min) for period 1984-2009

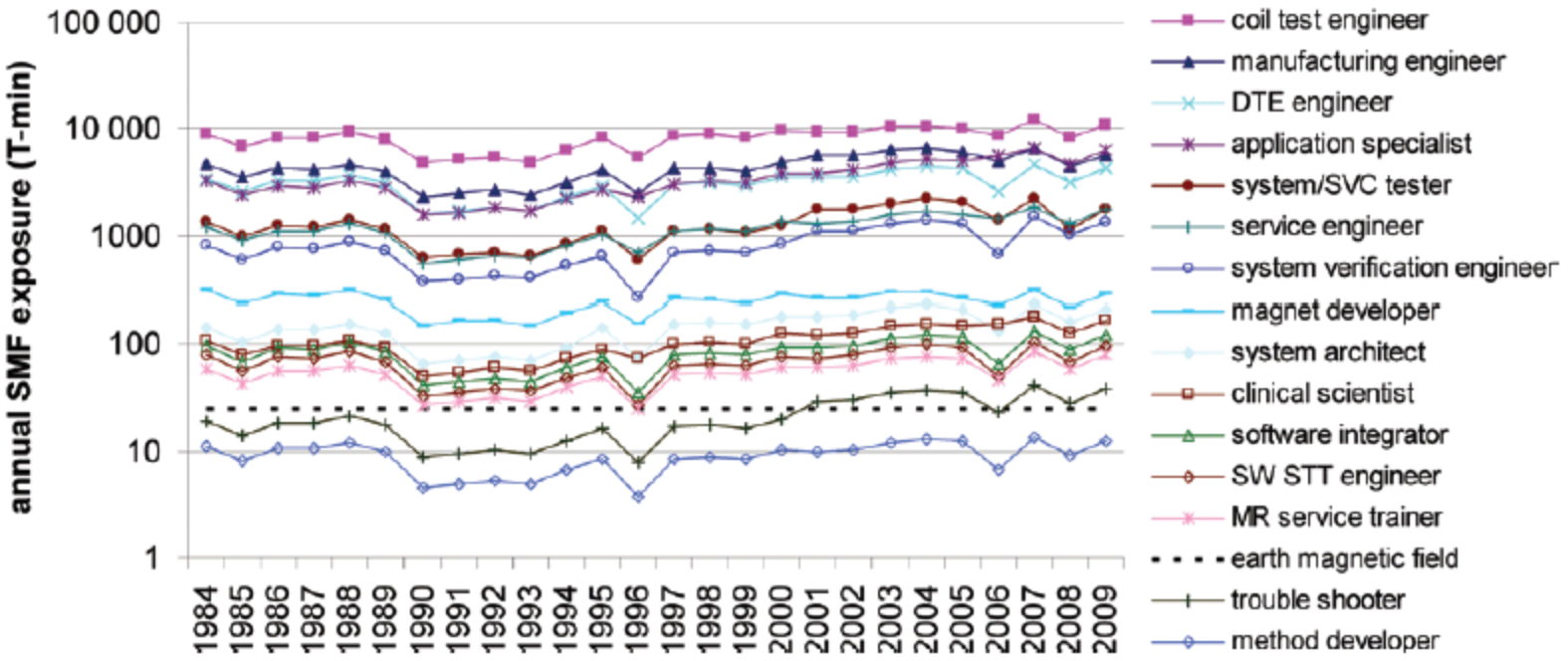

Fig. 3. Estimated annual cumulative exposure to B_0, i.e. CE ($B_{0,\,job,\,year}$) for each job title during the period 1984–2009. The annual continuous exposure to the SMF of the earth is indicated by the dotted line.

What do we need for risk assessment, to assess burden of occupational disease?

- Size of working populations
- Prevalence of exposures within these populations
- Exposure distributions of intensity, frequency and duration
- (Quantitative) exposure – disease associations

Workforce data readily available?

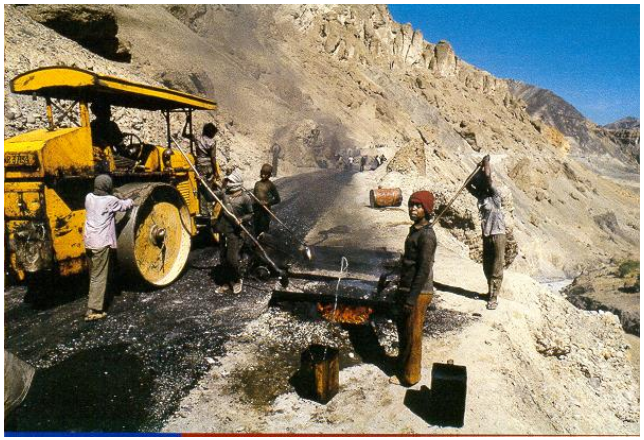

Photo Dick Ross/LINEAIR

- Yes and no
- In most industrialized countries we have labour statistics and regular censuses
- But what do we know about numbers of workers in (informal) sectors in less developed parts of the world?
- What about turnover rates? How long do workers stay?

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Prevalence of exposures in working populations

- Not everybody in the same job is exposed and for sure not to the same (chemical) agents
- Becomes increasingly more difficult when moving from broad categories of occupational exposures to specific agents
  - Blanc et al. 2005 (US) (n=1,876): **40%** reported exposure to vapours, gas, dust, or fumes in longest held job
  - National Hazard Exposure Worker Surveillance 2010 (Aus) (n=4,500): **43%** reported they were exposed to dust and/or gases, vapours, smoke or fumes
  - De Jong et al. 2014 (NL) (n=11,851; LifeLines Cohort): **45%** were assigned exposure to VGDF (via a JEM)

Prevalence of exposures in working populations

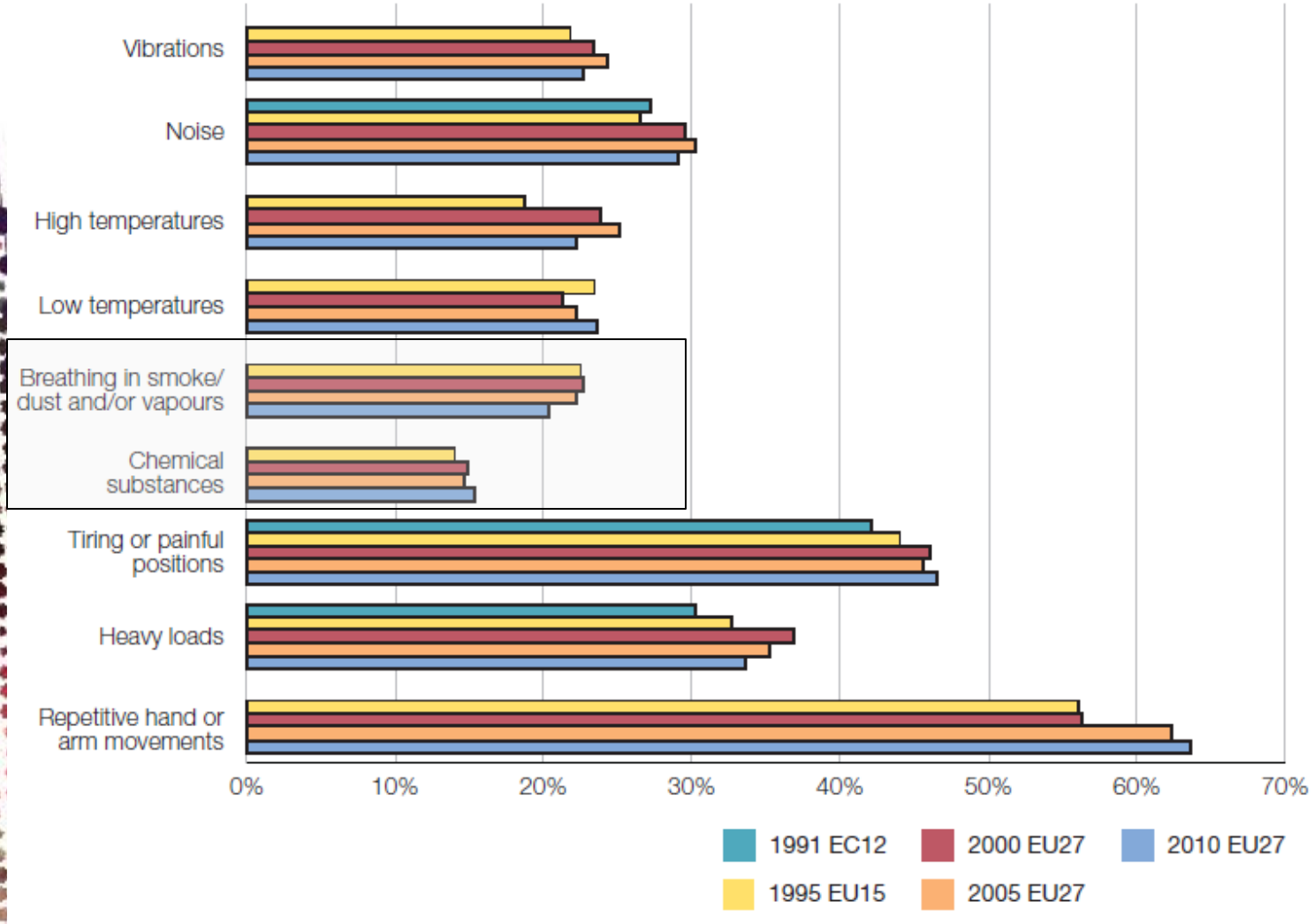
European Working Conditions Survey (EWCS)

Latest 5th survey 2010: 44,000 workers in EU27

First survey took place in 1990

Prevalence of exposures in working populations

Figure 17: Exposure to physical risks over time (% exposed quarter of time or more)



Prevalence of exposures in working populations

- But what about herbicides?
  - LifeLines: low n=132 (1.1%); high n= (0.3%)
- And to be even more specific Glyphosate?
  - Agricultural Health Study (US cohort):
  - 41% of farmers who applied herbicides applied Glyphosate, it heavily depended on what crop was grown

Corn	11%	Potatoes	5%
Grains	8%	Soybeans	76%
Greenhouses	16%	Tobacco	2%
Hay/Alfalfa	16%	Vineyards	55%
Orchards	67%		

Prevalence of exposures in working populations

- Can we rely on existing data (bases)?
  - Not really!
  - What is around and has been used?
    - CAREX 1990-1993, estimates of exposure prevalences for 139 carcinogens in 55 industrial classes for EU 15 (mainly extrapolations from Finnish and US data)
    - National Occupational Exposure Survey (NOES) carried out by NIOSH 1981-1983 for US
  - Outdated and questionable data that cannot be easily extrapolated to other parts of the world or time periods
  - Unmined resources: occupational exposure information generated in general population cohorts and case-control studies around the globe

Exposure intensity, frequency and duration

Do we have enough measurement data?

- Yes, there is more than we think
- No, not from everywhere

But

- We should use what we learned last decades, to arrive at innovative ways to estimate exposure distributions spatially (between countries, between industries, between companies) and temporally (decades, seasonal, daily) resolved
- Estimating exposure distribution in systematic, reproducible and challengeable way is clearly needed
- It's time to start thinking and working outside the box of irreproducible results from expert judgements and use Bayesian frameworks where default distributions from standard algorithms are updated with actual measurements

Databases with individual exposure measurement data readily available at mainly IRAS, FIOH and IOM

Database	Type	Agent	N	Start	End
EXPOSYN	General	Crystalline Silica	149,000	1950	2009
EXPOSYN	General	Chromium	57,000	1960	2009
EXPOSYN	General	Nickel	53,000	1960	2009
EXPOSYN	General	Asbestos	72,000	1950	2009
EXPOSYN	General	PAH	26,000	1960	2009
EXASRUB	Rubber	Rubber dust	13,655	1979	2002
EXASRUB	Rubber	Rubber fumes	5,932	1979	2002
EXASRUB	Rubber	N-Nitrosamines	21,202	1979	2002
EXASRUB	Rubber	Specific solvents	8,615	1979	2002
AWE	Asphalt	Bitumen fume	1,312	1970	1997
AWE	Asphalt	Bitumen vapour	545	1970	1997
AWE	Asphalt	Benzo(a)pyrene	502	1970	1997
PAINTERS	Painters several industries	Toluene	304	1980	1999
PAINTERS	Painters several industries	Xylene	259	1980	1999
PAINTERS	Painters several industries	Ethylbenzene	259	1980	1999
PAINTERS	Painte				1999
PAINTERS	Painte				1999
WAUNC	Gener				1991
DERMDAT	Gener				1999
ENDTOX	Several industries	Endotoxin	3,340	1990	2004
ALLERGEN	Several industries	Dust, wheat allergen, moulds	1,500	1993	2002
WELDFUME	Several industries	Welding fumes, specific metals	9,396	1974	2008
ANTINEO	Health	Cyclophosphamide urine	149	1997	2002
ANTINEO	Health	Cyclophosphamide skin wipes	263	1997	2002
ANTINEO	Health	Cyclophosphamide glove	80	1997	2002
RISKOFDERM	General	Many dermal	1,000	2000	2003
IMA-DMP	Industrial Minerals	Respirable dust	21,966	2000	2013
IMA-DMP	Industrial Minerals	Respirable quartz	18,528	2000	2013
IMA-DMP	Industrial Minerals	Respirable crystalline silica	1,714	2000	2013
THAM	General	530 agents	73,558	1994	2007
PULP	Pulp and paper industry	339 agents	31,345	1951	1994
WOODEX	Wood	16 wood dusts	35,696	1986	2003
Carbon Black	Carbon black	Carbon Black	20,000	1989	1995

650,000 individual exposure measurements collected during 6 decades

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Exposure intensity, frequency and duration *what have we learned?*

- Workers doing the same job even at the same location are not likely to experience the same exposure (distribution) *(Kromhout et al. 1993; Rappaport et al. 1993)*

- Downward trends in measured exposure concentration do exist and concentrations tend to go down rather constantly with 6-8% annually (Vermeulen et al. 2000; Creely et al. 2007; de Vocht et al. 2007, 2008; van Rooij et al. 2008; Gallea et al. 2009) but not for all agents *(van Tongeren et al. 2009)* most likely not globally either

- Trends seem to be driven by development of technologies and introduction of better controls (only?)

European Industrial Minerals Association Dust Monitoring Programme

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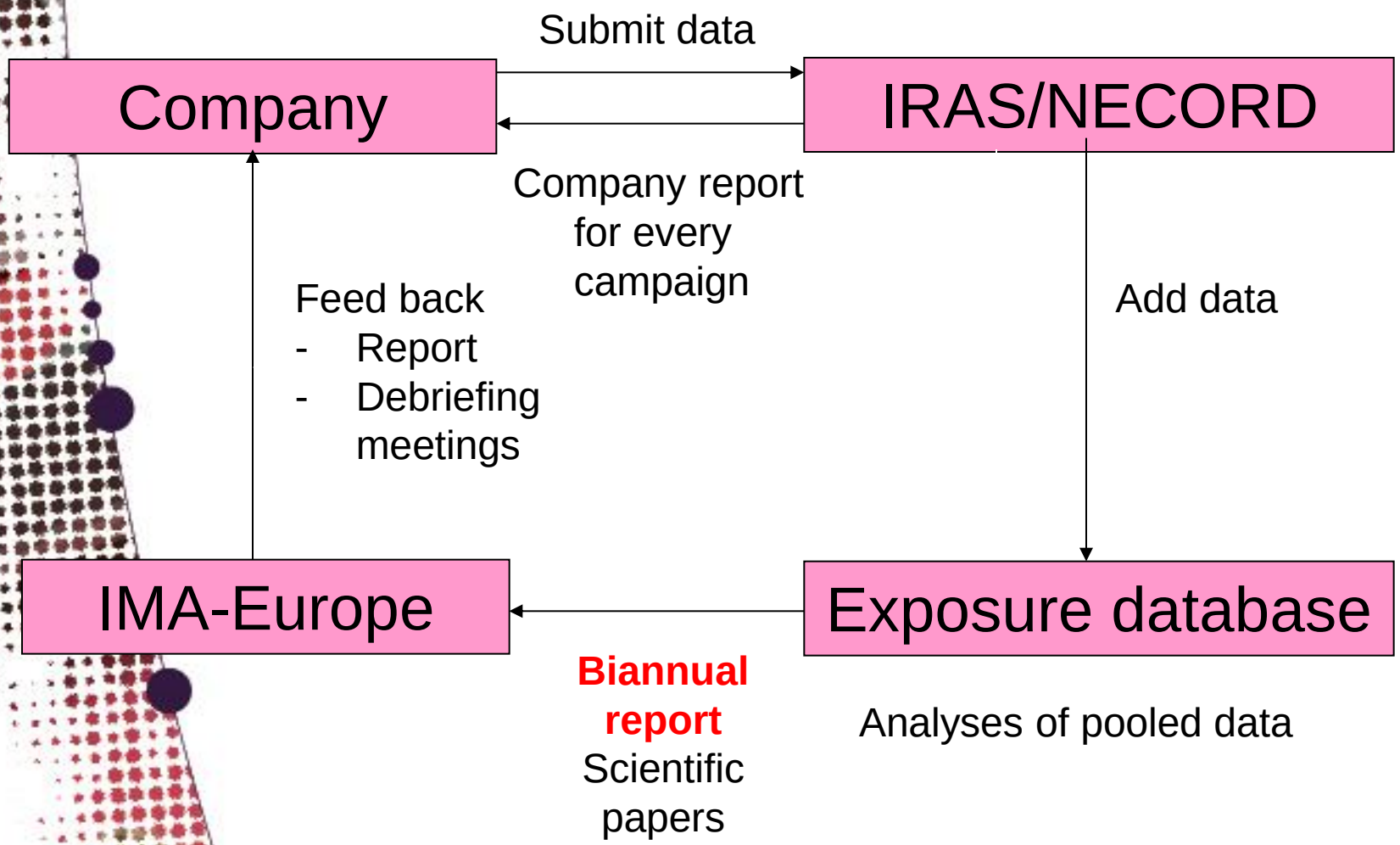
IMA-DMP
Lines of communication



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Measurement data in DMP database per 15/04/2013

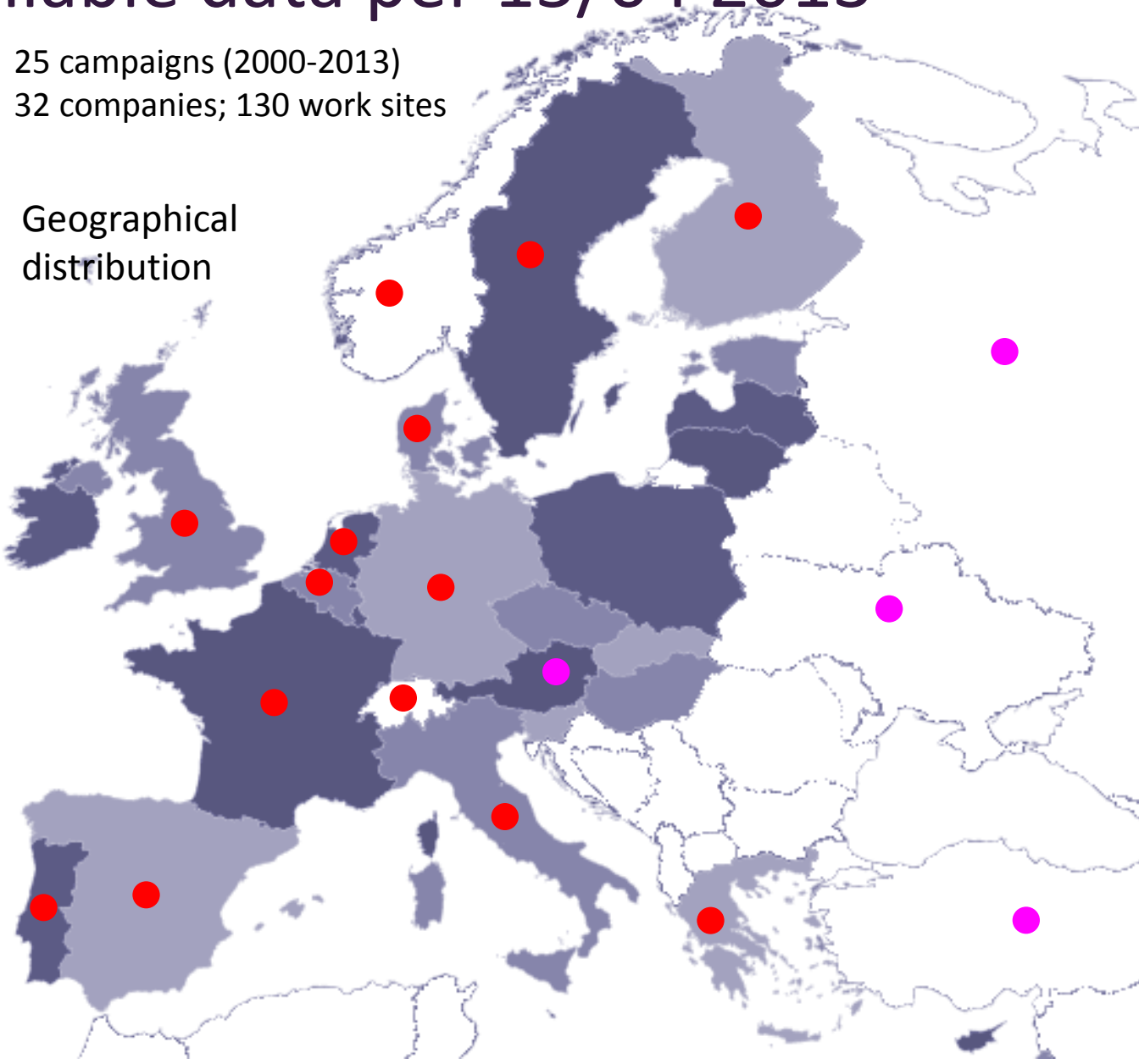
- Total 22,094 observations
- 21,966 respirable dust, 18,528 respirable quartz and 1,714 RCS measurements from 32 industrial mineral companies
- Data from 130 worksites located in 18 countries
- Collected between winter 2000/2001 until winter 2012/2013
- Representative for a total workforce of over 5,000

Available data per 15/04 2013

Number of observations within IMA DMP database		
Country	Resp Dust	Resp Quartz
Austria	67	36
Belgium	1250	994
Denmark	113	113
Finland	520	292
France	4630	3528
Germany	2103	2100
Greece	384	156
Italy	1053	855
Netherlands	1641	949
Norway	580	232
Portugal	296	296
Russia	42	42
Spain	3805	3474
Sweden	225	201
Switzerland		84
Turkey	45	45
Ukraine	174	172
UK	5038	4935
Total	21966	18528

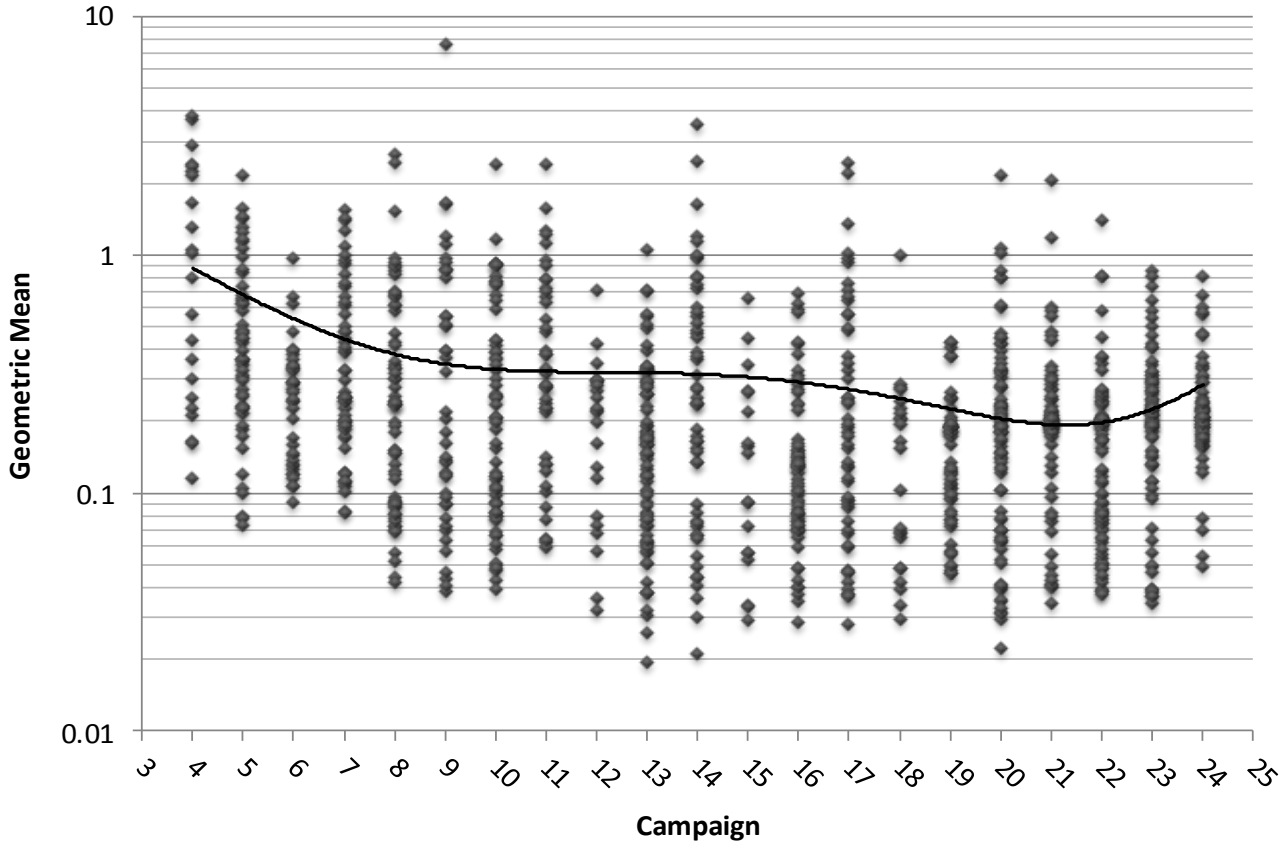
25 campaigns (2000-2013)
32 companies; 130 work sites

Geographical distribution

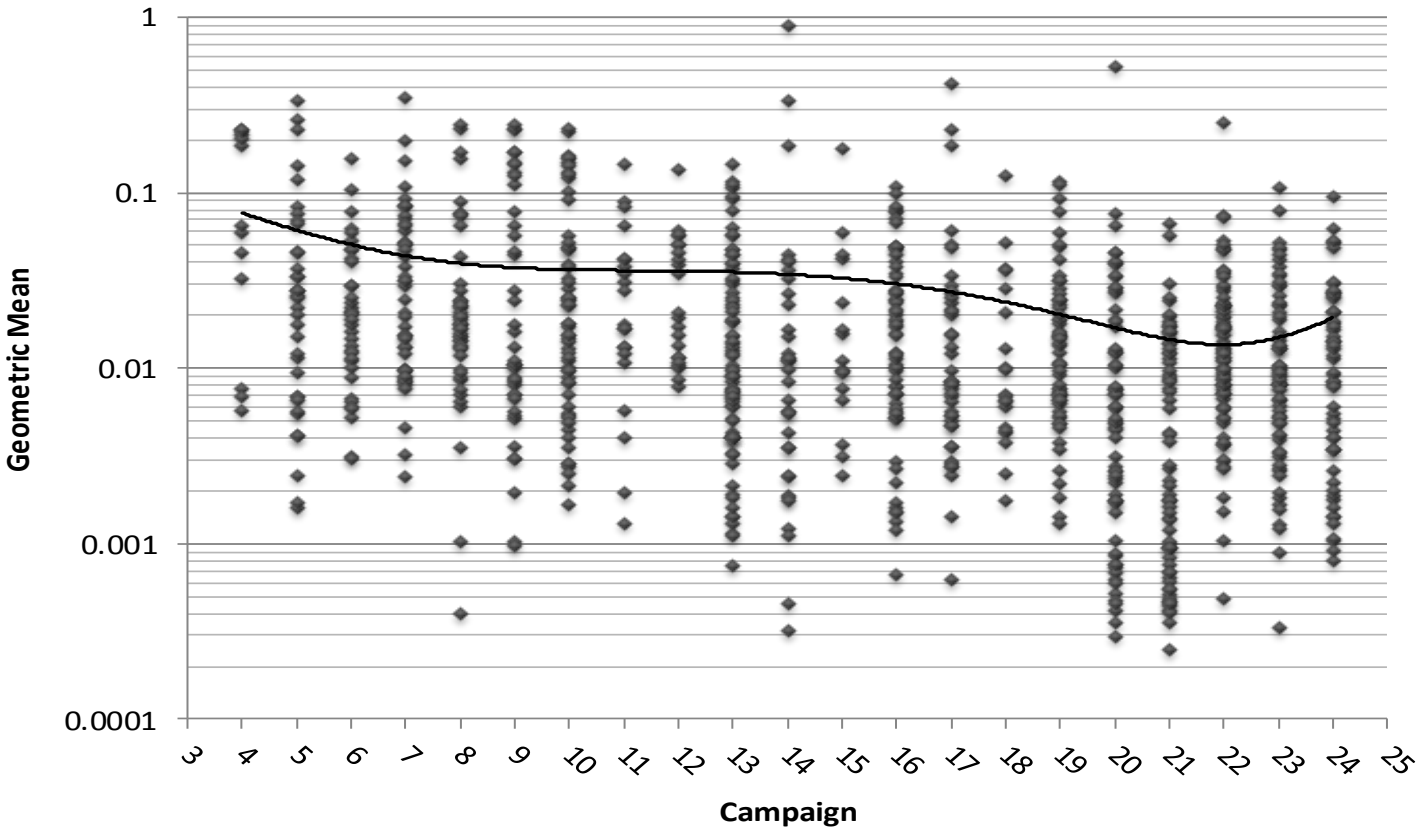


Temporal trends in respirable dust concentration in mg/m^3

(1,150 cells)



Temporal trends in respirable quartz concentration in mg/m^3 (992 cells)



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Remarkable downward trends

- Between start of DMP average respirable dust concentration has on average come down from 0.9 to 0.2 mg/m^3, but in the last three years has gone up again to 0.3 mg/m^3

- For respirable quartz the downward trend has reduced average concentration from 0.08 to 0.01 mg/m^3, but has recently risen again to 0.02 mg/m^3

A reversed trend due to economic hard times?

Mineral	Trend per campaign (respirable dust)	Trend per campaign (respirable quartz)
All	**-5.5%**	**-6.0%**
2002 – 2009	**-7.9%**	**-5.6%**
2009 – 2013	**+1.5%**	**+8.0%**

Overall conclusions

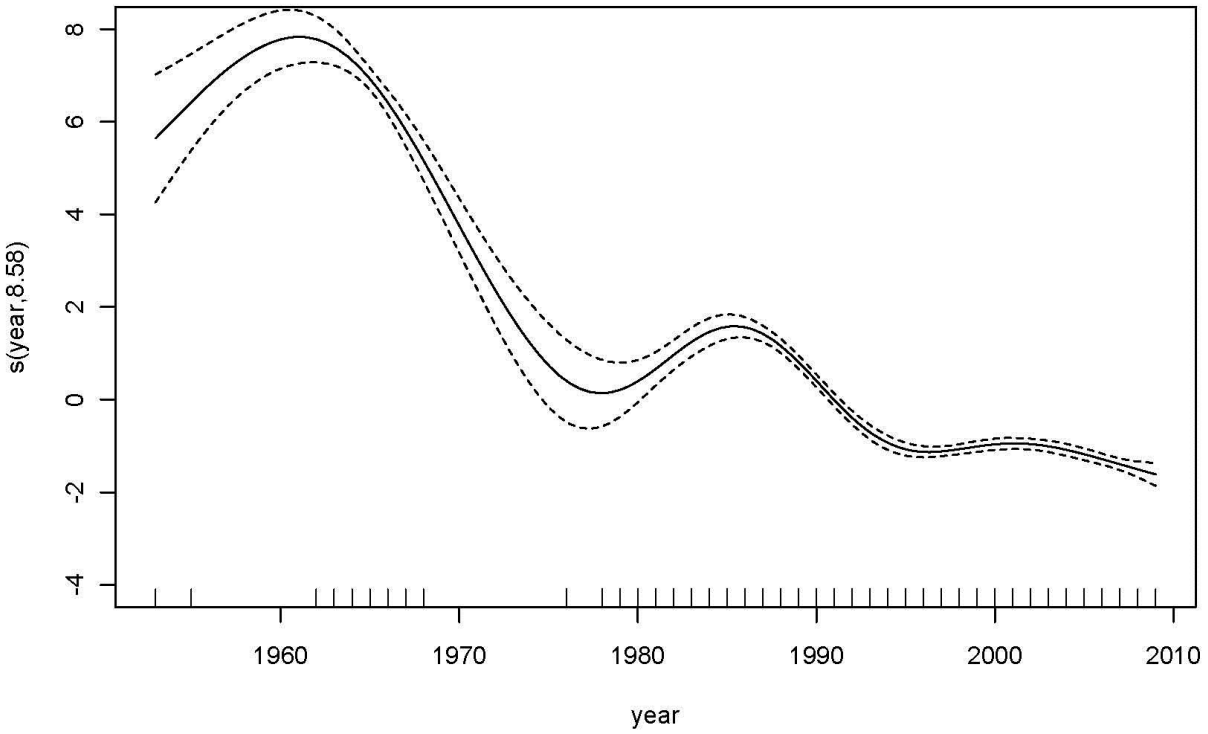
- Additional analyses for changed trends in respirable dust concentrations, point at sites with less than 50 employees and in particular in Southern Europe (Greece, Italy, Spain, Portugal and France)
- For respirable quartz concentrations we see patterns even somewhat worse

Overall conclusions

- Recent economic crisis is the most likely culprit
  - Downsizing of workforces resulting in more diverse (including more dusty) tasks and potentially less time for good housekeeping (no proof however that time allocation to main tasks is affected!)
  - Cutting costs resulting in delayed or less maintenance, or delayed investments in control measures and new machinery, which apparently is more the case in the more severely affected regions and at small sites

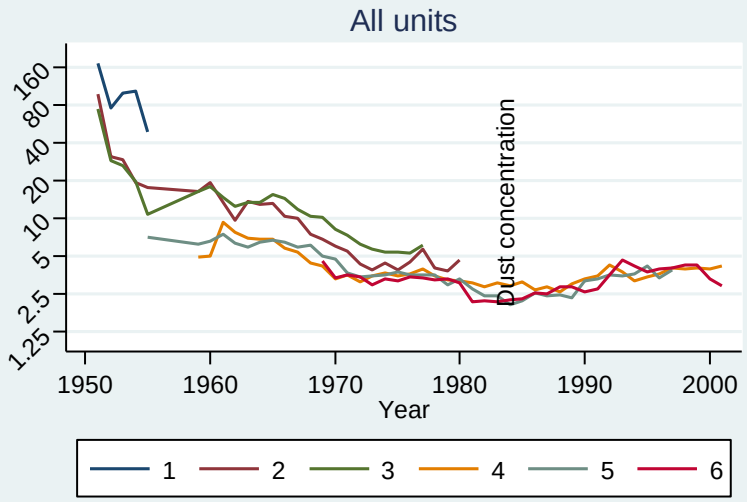
Isolated event?

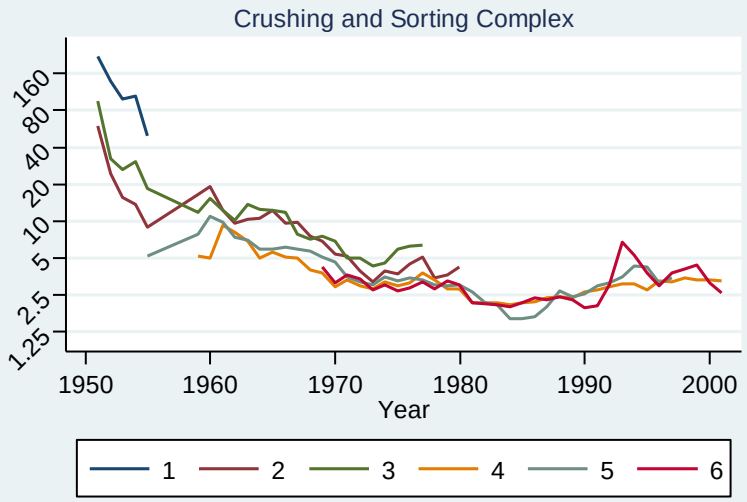
Trends in exposure quartz across industries in Europe (ExpoSyn)

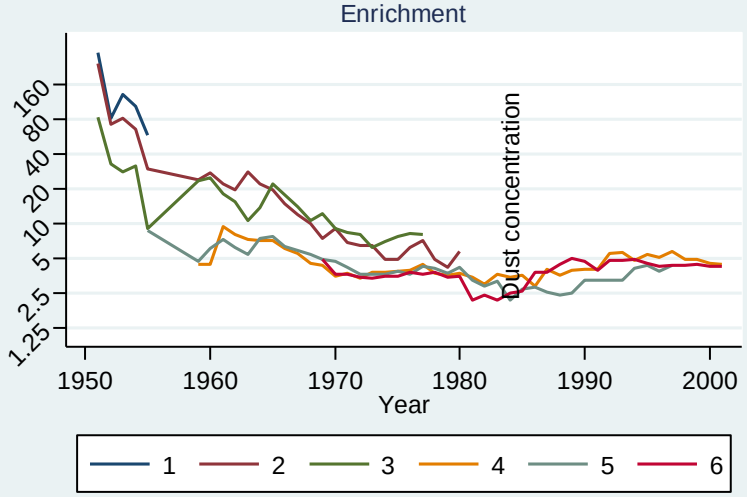


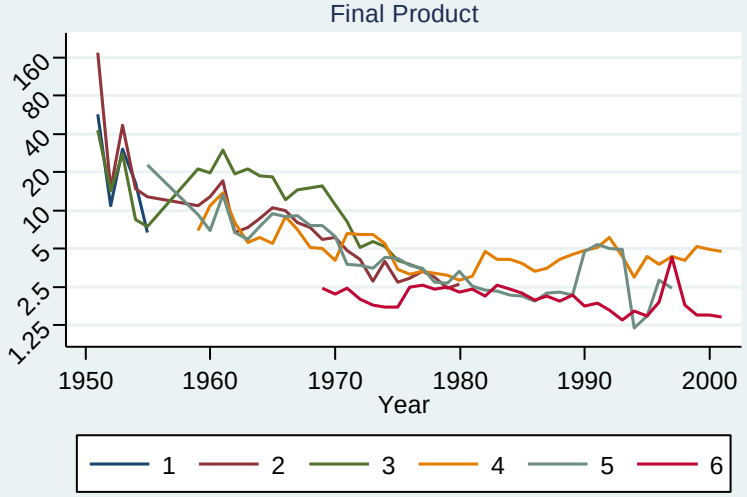
Isolated event?

Asbestos exposure in UralAsbest









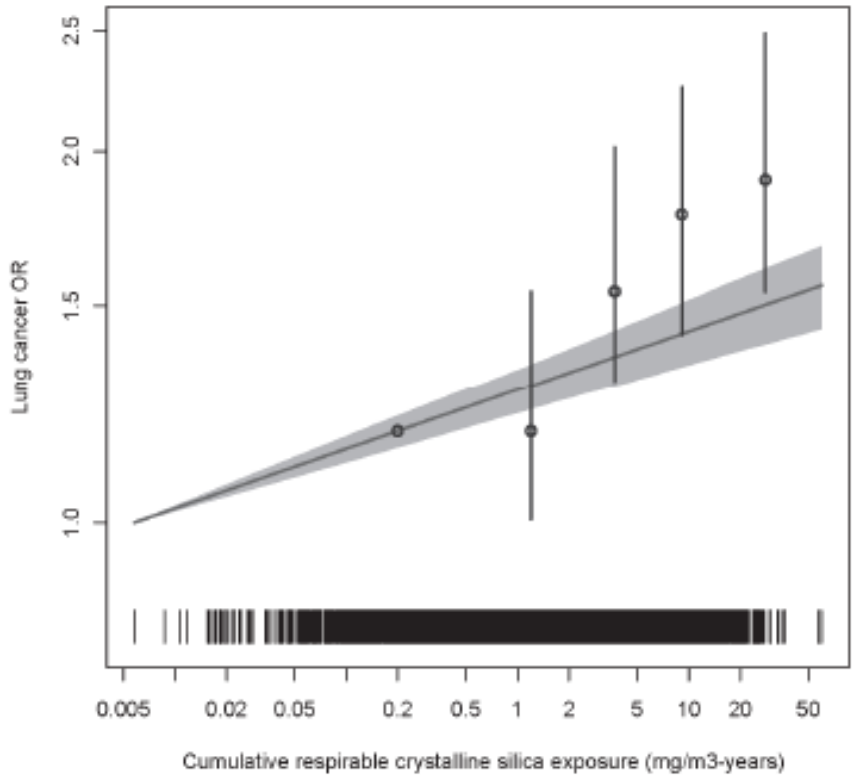
(Quantitative) exposure – disease associations

- With occupational exposure assessment improving (becoming more quantitative) quantitative ERC's are becoming the norm (even within studies of the general population)

- With information on prevalence and level of exposure readily available burden of disease due to occupational (chemical) exposures could be more precisely estimated

(Quantitative) exposure – disease associations

Figure 1. Exposure-response relation between RCS exposure and lung cancer risk obtained with SYN-JEM in the SYNERGY population (straight line, 95% CI presented by the grey shade) using GAM. The rug plot indicates the distribution of cumulative RCS exposure. Risk estimates from the pooled industrial cohort studies by Steenland *et al.* (2001)(3) are presented by the dots (with lines for the 95% CI). Risk estimates of Steenland *et al.* were re-scaled to the mid-point of their reference category (0.2 mg/m^3-years).



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The future of Improved Exposure Assessment will result in:

- Information on prevalence and level of exposures on a global scale
- Quantitative ERCs from human observational studies

- Will eventually allow for more accurate and precise estimates of burden of disease from occupational (chemical) exposures