

The Lane Lecture

6 October 2022







A personal odyssey

A long wandering or voyage usually marked by many changes of fortune



Have workplace studies had their day?

Lane lecture

6 October 2022

Theme -1

Improving health and safety in the workplace – or the best management of occupational ill-health when it occurs – needs to be **evidence based.**

Theme -2

But as time goes by, the collection of data on workers and their exposures seems to be replaced by **data linkage** and **systematic reviews** that may give sustenance to **policy makers** but do little to address and resolve workplace issues.

Theme - 3

If the cardinal role of occupational health research is to evaluate **the effectiveness of interventions**, can we achieve all the steps along that path without studying the **workplace itself**?

What information can be used for 'evidence-based' decisions/policy?

Any (unbiased) data is better than no data at all [NC]

Some observations on workers exposed to methylene chloride.

- **Workplace studies:** to identify modifiable risk, to determine ways to reduce risk and to evaluate subsequent interventions
- **Data linkage:** to make use of databases collected for other purposes to see if they throw any light on health and occupation
- **Systematic reviews/meta-analyses:** to provide policy makers with risk assessments they can use to justify changes in regulation

'Regulatory science' - two sorts of research?

- One to meet the needs of policy makers and the other to identify modifiable workplace risks and interventions that work?

- An issue of funding:

If those **responsible for policy also fund research**, where will support come from for studies that are not on the policy radar, are politically sensitive or threaten accepted practice?

- HSE

If we all agree

That the best protection for workers is by intelligently conceived, implemented and enforced policy.

Is there still a role for workplace studies?

In discovering new hazards?

In evaluation of interventions?

In informing policy?

In tackling issues too new or too difficult for policy makers?

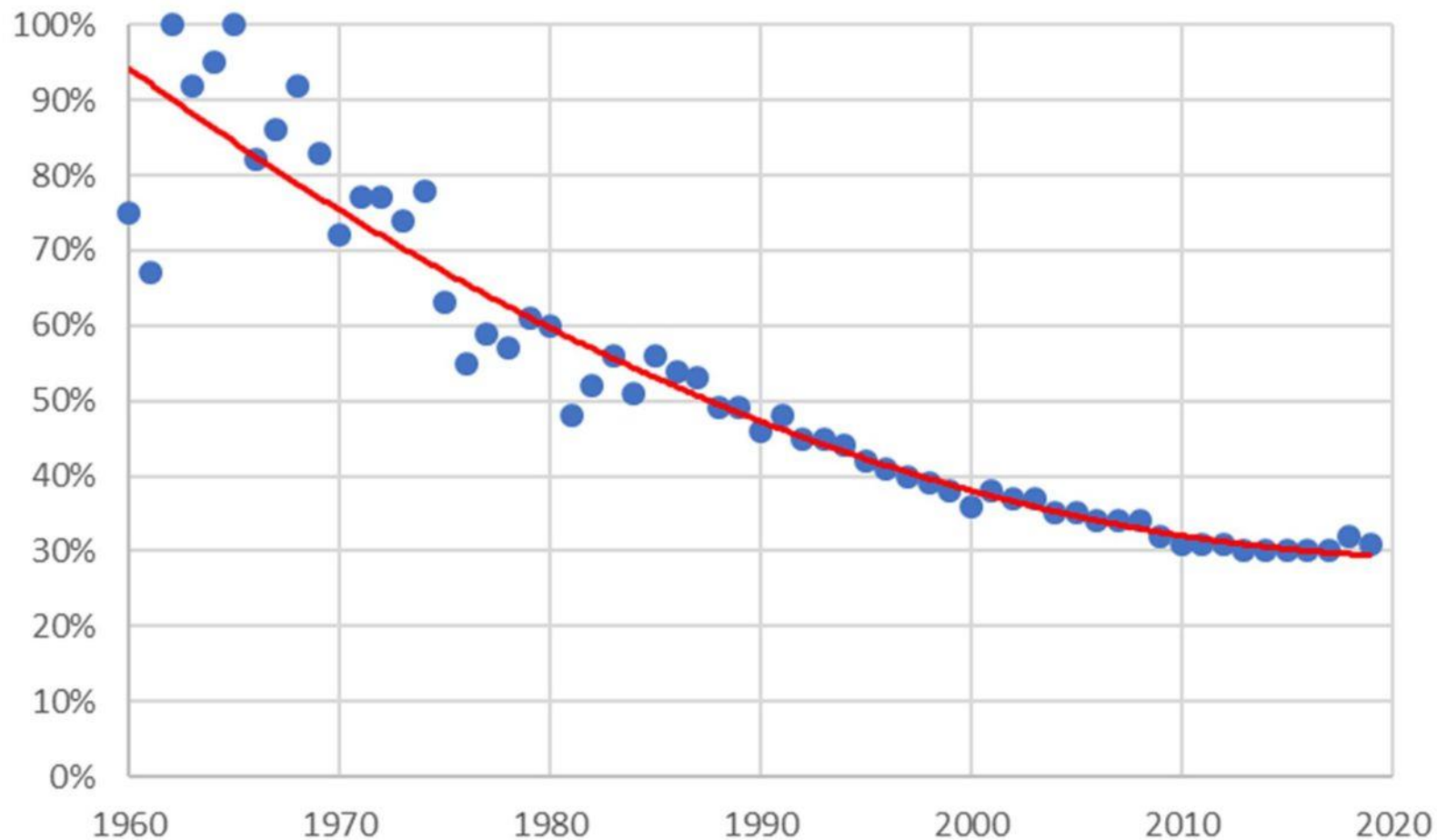
What do I mean by workplace studies?

Studies that consider *exposures* and outcomes that relate to an individual worker's occupational health.

Bradford Hill (paraphrased): how can you prevent occupational disease unless you have a pretty good idea of what causes it?

This could include cohort studies with estimates of individual exposures from industry records and outcomes from registry data as well as prospective studies with measurement of both workplace exposure and outcome
[but rarely community-based studies – except perhaps case-referent)

Papers from industrial/occupational cohorts from 1960 to 2020 as a percentage of all papers from industrial/occupational and community-based/general population cohorts (PubMed search 28 May 2020).



Hans Kromhout Occup Environ Med 2020;77:587-588



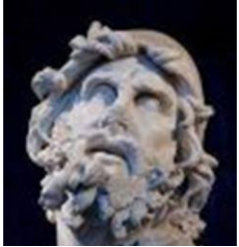
Does it matter?

*Analysing health effects of occupational exposures within community-based studies is often of **limited value** and might **grossly underestimate*** the burden of health effects from occupational exposures.*

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*may also find false positive effects – residual confounding

Scoping review of the last 12-months of OEM



Some important workplace studies – but still space for unconvincing studies using data linkage with exposures derived from job titles- the ‘community- based cohorts of limited value’

Also clever re-analyses of existing datasets to get results more in line with expectation and monthly systematic reviews. All no doubt methodologically impeccable but of any value?

Use of workplace studies

In identifying new hazards?

In evaluation of interventions?

In informing policy?

In tackling issues too new or too difficult to handle by policy makers?

Axiomatic: all advances in occupational medicine come from the observation of a perceptive physician

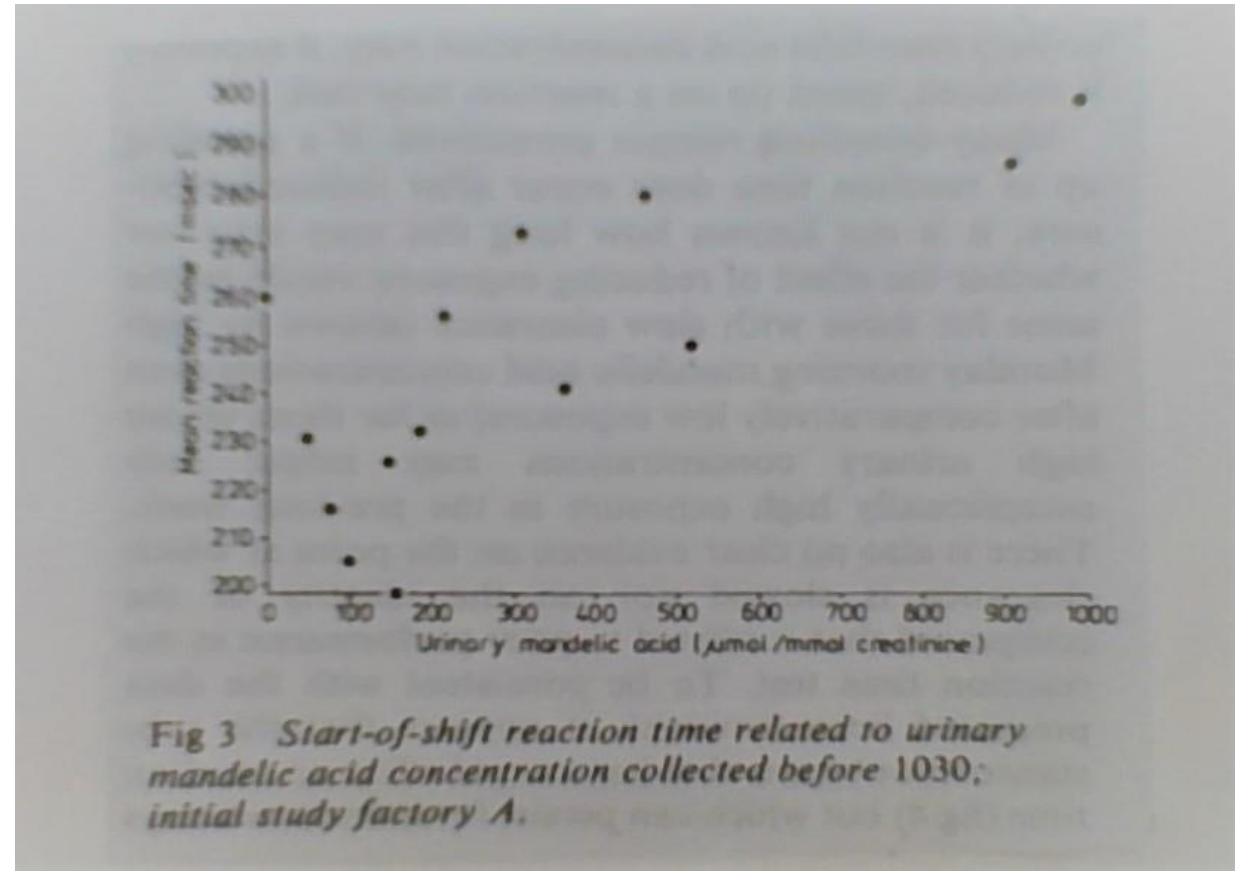


My first foray (1979) into workplace studies.

Geoff Wells, a perceptive Senior Employment Medical Advisor in East Anglia, noted mood change and tiredness in those exposed to styrene in boat building.

New hazard?

Mandelic acid concentration in urine (biomarker of styrene exposure) after a weekend strongly related to Monday morning reaction time



Start of research interests in



behavioral toxicology

solvents

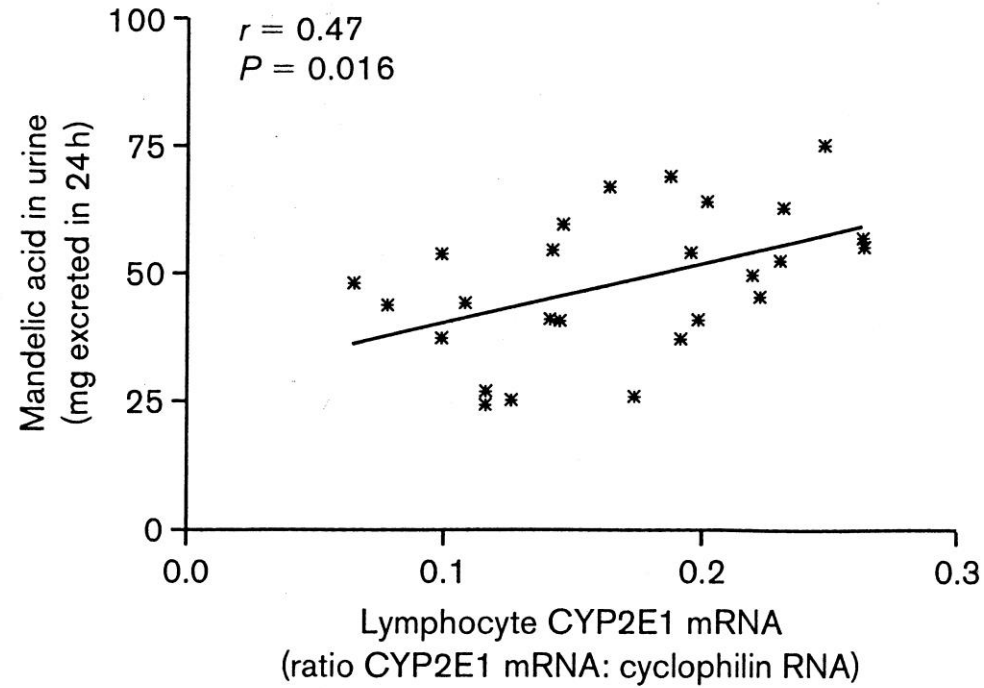
biomonitoring

toxicokinetics

genetic polymorphisms

and **workplace studies**

Haufroid et al 2002 Pharmacogenetics



ODIN (THOR): perceptive physicians?



The Occupational Disease Information Network (that gave rise to THOR) was set up, here in Manchester, in part to allow **perceptive physicians** to report new hazards and to know these would be heard, analysed and, if warranted, investigated.

Can record linkage identify new hazards (or hazardous occupations)?

Potentially – if there is solid occupational exposure data.

Few population records collect (and code) even a relevant job title.

Potential of UK longitudinal census??

Death certificates

Decennial Supplement

Jewel in the UK occupational health crown

UK Occupational Mortality Decennial Supplement since 1851

I consider that a major contribution of the supplement is to serve as a reference against which comments about possible occupational hazards can be checked. [M R Alderson, 1986]

The emphasis in the latest volume has been to encourage research into a wide range of possible associations. [A.J. Fox, 1979]

Lung cancer in butchers

Found in occupational mortality analyses in UK and also Denmark and Sweden with a recommendation (Fox et al, 1982) that historic prospective cohort [workplace] studies should be carried out to see if the excesses could be confirmed and the causes found.

They were and did.

The overwhelming majority of studies of *different designs* (including all the cohort mortality and cancer incidence studies) indicate at least a 30% excess risk of lung cancer in meat and poultry plant worker [Johnson and Choi 2012]

Charles Veys and bladder cancer



Perceptive physician testing clinical observation.

A voluntary notification scheme for bladder tumours was started in 1965 for deaths registered in Stoke-on-Trent.

A full and detailed lifelong occupational history was taken by the coroner's office and supplemented as available to the coroner.

Compared with national rates no overall excess of bladder cancer, but 18% , in men, appeared to be occupational, the majority in rubber workers

Silicosis register : new outcomes



Records for all workers registered 1931-1992 with the silicosis medical panel as working in the pottery, refractory or sandstone industries were stored in Stoke-on-Trent. N=5115 met inclusion criteria.

Exposure duration and concentration estimated from individual files

Vital status was obtained from DSS and cause of death from ONS.

Significant excess of **lung cancer, COPD and renal cancer**.

Thanks to **Sue Turner and Gary Burgess**.

Conclusion 1: Are workplace studies useful in detecting new hazards/new outcomes?

Yes – and they are also needed to confirm suggestions from data linkage

Workplace studies

In discovering new hazards?

In evaluation of interventions?

In informing policy?

In tackling issues too new or too difficult to handle by policy makers?

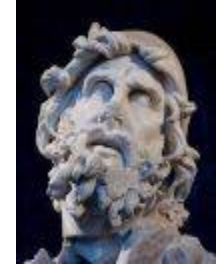
Evaluation of policy interventions

HSE Workplace Health Expert Committee – Evidence review paper

Evaluating interventions in work-related ill-health and disease

Strong evidence may be ignored or weak evidence rapidly taken-up depending on political acceptability or fit with other ideas about what works

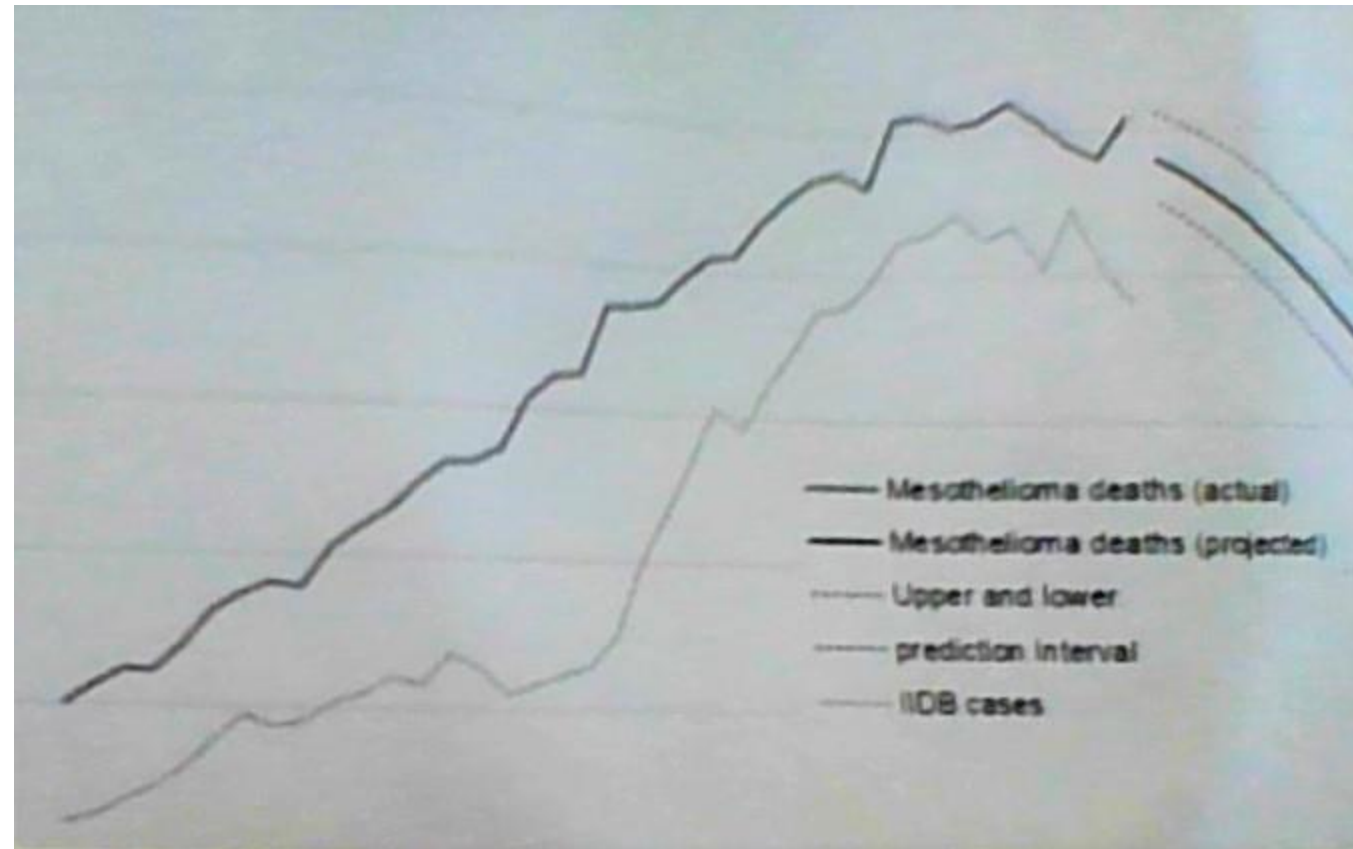
Circa 1975:



Refusal of the Department of Education to allow us to evaluate the effect of comprehensive schools on bright working-class children's achievements, using the 1946 and 1958 birth cohorts

'This is a policy decision we have no interest in evaluating'

Some evaluations of policy may be done:
mesothelioma statistics for Great Britain, 2022



Other examples of evaluating policies: essentially **before/after** designs

- Measuring the impact of the European chromium directive: Rates of contact dermatitis before/after directive [Bensefa et al, 2017]
- Work related fatalities following Robens-type reforms in New Zealand [Lilley et al, 2022]
- Changes in allergic contact dermatitis reported to EPIDERM following interventions to reduce latex exposure [Turner et al, 2012]

Workplace studies may allow stronger evaluative designs

Experimental or quasi-experimental..... [Cherry NM, 2008]

Importance of **cluster randomized trials** in occupational health.

Wildland firefighters in North America use **no respiratory protection (RPE)**

Operational set-up in Alberta ideal for a cluster randomized trial of RPE.

Pilot work in 2019. Full intervention study designed and funded for 2020

Protocol

Outcome measure: urinary 1-hydroxypyrene (PAH metabolite).

Random allocation of Alberta wildfire crews to

- normal practice
- enhanced skin hygiene
- RPE (mask)
- Enhanced skin hygiene plus RPE

Follow-up at successive rotations from the start to end of the fire season with collection of urine samples **to assess PAH absorption.**

Covid happened: no fieldwork in 2020 and we scrambled in **mid-2021 to approximate protocol**

In Alberta

Crews within forest areas randomized

In BC

Firefighters within crews randomized

- normal practice
- enhanced skin hygiene
- Enhanced skin hygiene plus **discretionary use** of N95 fit-tested mask

Results: effect of intervention on 1-HP

Discretionary use mask allocation

Prediction of log 1-HP/creatinine

beta coefficient - **0.67** **p=0.021** in respiratory model

So those allocated masks absorbed less PAH (and had fewer respiratory symptoms).

Conclusions 2: Use of workplace studies to evaluate interventions?

- Absolutely!

Use of workplace studies

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Policy, policy makers and policy influences

Using the term **policy makers** to include a wide range

- A jurisdiction
- A trade body
- An employer or group of employers
- NIOSH
- IARC

Use of workplace studies to inform policy?

Policy makers need 'evidence' to make evidence-based decisions

Turn to **systematic reviews/meta-analyses** to get a consistent story

But

Systematic reviews have their limitations: **the most informative study may be in the one that is different** and so excluded

Consistency v conformity



- Consistency: same answer reached in quite a wide variety of situations and techniques so we can justifiably infer that the association is not due to **some constant error or fallacy that permeates every inquiry** [Bradford-Hill, 1965].
- Pressure for studies to use the same design, exposure matrix and/or outcome measures: easier for systematic review and meta-analysis. But to increase certainty, **we need different approaches**, even if interpretation requires intellectual effort.

Systematic reviews in occupational health

Jos Verbeek: 'Cochrane works' 157 reviews address occupational health outcomes

Non-drug interventions for sleepiness and sleep problems for shift workers who work nights

We found 17 randomised controlled trials (with 556 participants) to include in this review. We rated the quality of evidence provided by most of the included studies to be between low and very low.

Interventions to reduce the risk of coronavirus SARS-CoV-2 (severe acute respiratory syndrome coronavirus-2) infection among workers outside healthcare settings

We screened more than 13 thousand reports, and included one study

So systematic reviews *may* help policy makers

But only if there is a range of good workplace studies of different design

Is a systematic review of a handful of studies of varying strength more useful to policy makers than reading the studies themselves?

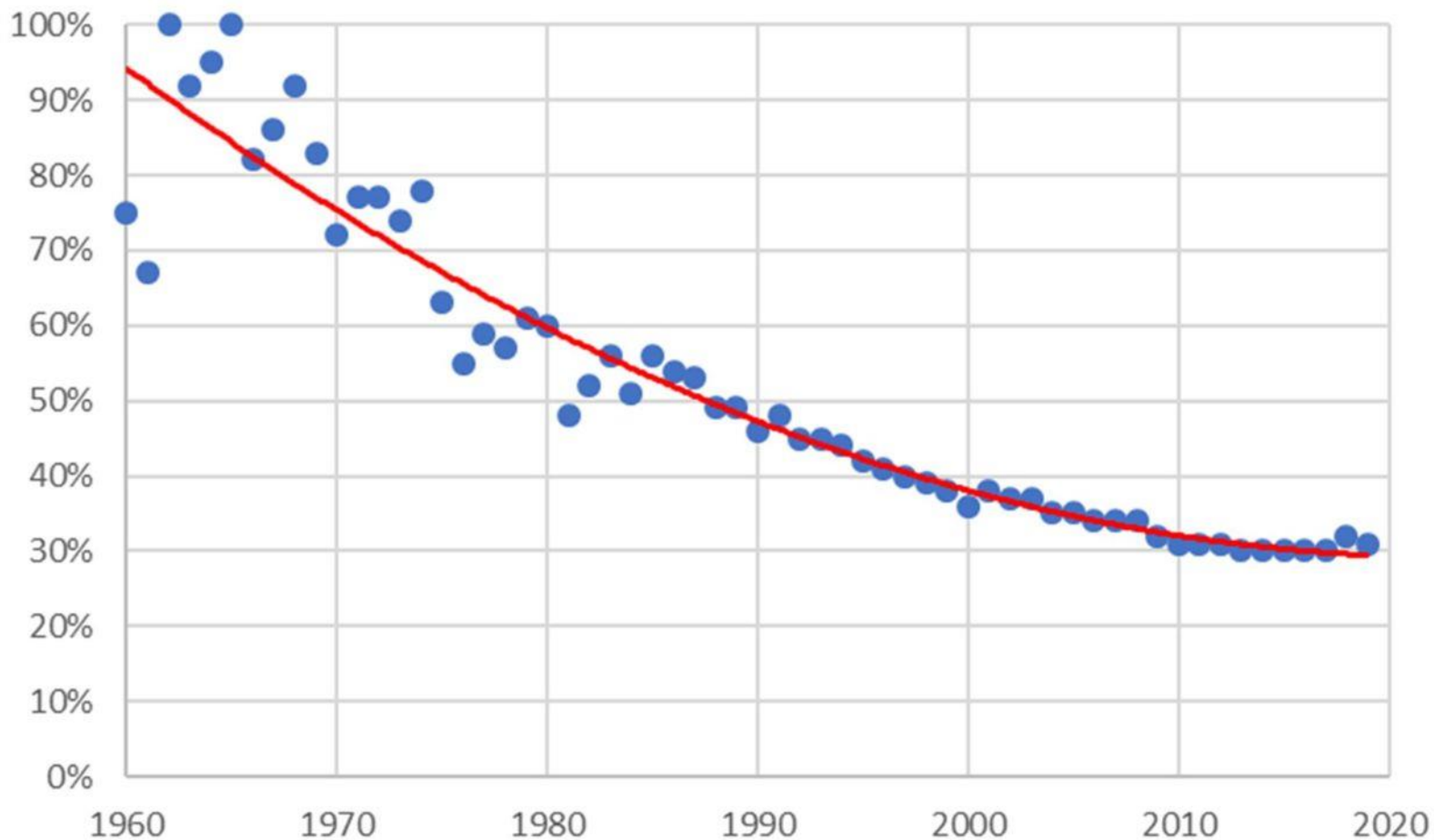
Role of a 'scoping' review?

IARC: use of workplace studies to inform decisions

The International Agency for Research on Cancer (IARC) reaches decisions on the certainty with which a substance (or sometimes an occupation) may be considered a human carcinogen.

For occupational exposures, evidence has very largely come from **cohort studies**, the strongest epidemiological design for this question, but now less evident in the literature.

Papers from industrial/occupational cohorts from 1960 to 2020 as a percentage of all papers from industrial/occupational and community-based/general population cohorts (PubMed search 28 May 2020).



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IARC: use of key characteristics

In IARC's occupational cancer assessments, **key characteristics** of effect are derived from biomarker studies from the worksite.

- act as an electrophile; be genotoxic; alter DNA repair ; induce epigenetic alterations; induce oxidative stress;
- induce chronic inflammation; be immunosuppressive; modulate receptor-mediated effects; cause immortalization;
- alter cell proliferation, cell death, or nutrient supply.

A key role for workplace studies? But is there funding for studies of adequate power, designed to answer questions of dose-effect, executed by competent teams and knowledgeably reviewed?

?Publication

Conclusion 3:

Can workplace studies inform policy?

- If they are included appropriately in systematic reviews or meta-analysis
- If they are reviewed and assessed competently by policy making bodies
- If there has been ongoing knowledge translation by **the study team, working with policy makers.**

Wildland firefighters in Alberta will be issued masks for discretionary use for the 2023 fire season.

Use of workplace studies

In discovering new hazards?

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Funding of workplace studies **too new or difficult for systematic review or extrapolation**

While in Manchester

Gulf war illness (MRC)

Dippers flu (HSE)

Declining sperm count/endocrine disruptors (HSE, Department of Environment, Department of Health , the European Chemical Industry Council) .

In Canada since 2000

Wildfire disaster (Alberta Labour/Canadian Institutes for Health Research (CIHR))

Covid-19 and health care workers (CIHR/CITF)

Too difficult

Migrant workers (Alberta Labour);Bakers; **Pregnant welders** (Alberta Labour/CIHR)

Pregnancy welders

Is the **fetus at risk** if a woman welds during pregnancy?

If so, **which exposures** need to be addressed?

Here the 'perceptive physician' was a (female) welding instructor

Why is this difficult for policy makers?

Conflict of precautionary principle and gender equality

Why welders in Alberta?



Study procedure

- Preliminary **focus groups** with women welders (2010)
- **Validation** of a draft exposure questionnaire, observing welders on-the-job (2010)
- **Recruited women welders** and a referent group of women **electricians** across Canada through apprenticeship boards (2011-2017)
- Followed them with detailed trade specific exposure questionnaires **every 6 months for up to 5 years** (2011-2018).
- Collected **mailed-in urine samples** to measure metal concentration
- Collected data on **every pregnancy** with detailed exposure questionnaire, early and late in pregnancy.

Exposure estimation

- **Developed** a welding-specific JEM from published data, using type of welding, base metals and consumables.
- **Calibrated** by measuring welding fume during structured welding (by type of welding, base metals and consumables) in a welding lab
- **Validated** predicted exposures to aluminum, chromium, nickel and manganese for each welder against these metals in mailed-in urine samples

Thanks to **Jean-Michel Galarneau**

What did we find?

- Fetal loss: same high rate in welders and electricians.

In welders

- Increased fetal loss with manipulating heavy objects, and with whole body vibration.
- Gestation decreased with perceived heat intensity.
- Birth weight decreased with whole body vibration.
- **No** relation to metals in welding fume or to estimates of total particles.

Is the fetus at risk?

Yes – from ergonomic factors.

No - from welding fume.

Precautionary principle or gender equality?

‘Evidence-based’ policy would allow women welders but aim to improve ergonomics for both women and men.

Conclusion 4:

Workplace studies may be particularly valuable in emerging issues – where there may indeed be no other option

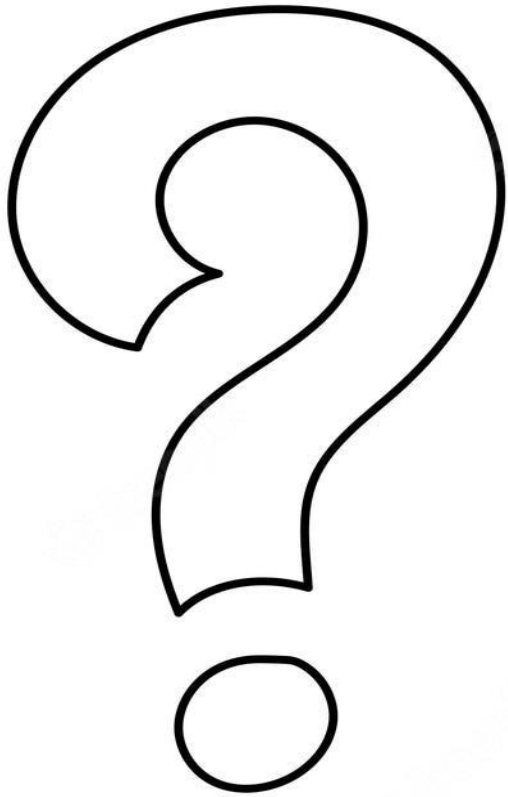
So why do people **NOT** do workplace studies

- **Hard**: to get access, funding, ongoing collaboration
- **Slow**: prospective studies of exposures and outcomes may take years
- **Unforgiving**: no-one else to blame if the answer is unclear or unexpected
- **Unfamiliar**: many occupational health researchers seem never to have stepped inside a workplace (except their own)
- The **siren call** of office based/data linkage studies with rapid publications that advance careers
- Have **no training or expectation** that this is their goal.

What do we miss by cutting out the workplace?

- We don't understand exposures
- We don't understand the worker
- We lose opportunities to build alliances to influence workplace health
- We lose teamwork with occupational health practitioners
- We fail to develop skills to carry out workplace investigations
- We may completely miss new hazards
- We have no credibility in suggesting and evaluating mitigations
- We shift our sense of responsibility from workers to regulators

So, have workplace studies had their day?



Are workplace studies still needed?

There is **no other credible source** of data to inform policy or interventions

Community based/data linkage studies?

Key characteristics?

Systematic reviews?

Meta-analyses?

We do need them (and need to do them well).

So should we regard them as a **necessary evil?**

or as the **lifeblood of occupational health?**



They have been for me.

