the screenees, the absence of which seriously detracts from any screening proposal. The second is the large Number Needed to Screen, which implies that very few people who are screened will benefit; a large NNS also implies a potentially large number of false-positive results and unnecessary treatments (Vineis et al., 2001). To assess the role of a gene-environment interaction and screening in a population we need to know the penetrance of the genetic trait and its frequency. A useful approach is to combine penetrance and frequency by computing the number needed to screen (NNS) in order to prevent one case of cancer. There are examples, in fact, of screening activities characterized by high, or very high, NNS: one is screening for phenylketonuria, a monogenic disease with a frequency of one in 10 000–12 000 in white people; population screening is successful in most western countries. However, this is a particular case, since there is a very effective and non-invasive preventive measure (dietary restriction). No similar example is available for carcinogens.

Small businesses

By Elsebeth Lynge PhD and Avima Ruder PhD

For several of the agents discussed at the meeting, accumulation of additional epidemiologic data is complicated by the fact that exposed workers come primarily from small businesses with a high turnover. As occupational cancer cohorts have traditionally been recruited from large factories, exploitation of new data sources is warranted. For historical cohort studies, the literature provides some examples of rosters for recruitment of workers from small businesses. These include union records (Ruder et al., 2001), workers participating in health surveys (Winter et al., 1990), or workers in biological monitoring programs (Anttila et al., 1998). Computerized census records may also provide information on workers from small businesses (Boffetta et al., 1994), and more detailed information may be obtained if the original census forms are available (Lynge et al., 2006). Agricultural census data may be used to identify farmers (e.g. Kristensen et al., 1996). In countries with national business and pension scheme registers, these data sources may be used for identification of workers from small businesses (Sorensen et al., 2007). Use of the listed rosters for epidemiological studies requires that they have sufficient information on identification (name, date of birth, address at time of recruitment, etc) for the later follow up of the registered workers.

For cross-sectional surveys, study participants may be recruited from numerous small workplaces (Calvert et al., 1998). Recruitment can be difficult because the shop or business owner may act as gatekeeper and effectively bar access to the workers (McKernan et al., 2008). One possible solution would be recruiting currently employed workers outside the workplace. If there were a good validated biomarker for recent exposure, such as end-exhaled breath levels of tetrachloroethylene (PCE) for dry cleaners, workplaces could be bypassed. Potential participants—for example, dry-cleaning operators and spotters--would be recruited through advertisements in the appropriate ethnic press/radio stations to come to a Saturday morning study site. PCE breath analysis would be used to determine eligibility (above a threshold for potentially exposed; nondetectable for potential referents). A half-day of tests and interviews would begin with a medical exam and, for example, for dry cleaners at increased risk of cervical cancer, a Pap test evaluated on site (so further tests could be offered the same day if dysplasia or other positive results were found). Blood would be drawn to test for PCE level and biomarkers of exposure, genetic susceptibility, and effect. Testing for possible neurological, renal, liver, and other health effects would be included in the exam, depending on costs and funding. An occupational history would be taken (including asking the number of workers at the current job), and questions relative to health and lifestyle would be included. Approaches could be made to some of the shops whose workers participated to do environmental sampling and pre- and post-shift testing of the workers. Shops would only be approached if the workforce was large enough so the participating workers could not be identified, and if the exposures (based on the workers' breath levels) were high enough to merit testing. Data based on volunteers should be interpreted in light of the potential selection bias.

Resources

By Jack Siemiatycki PhD

The present document sets out some recommendations for improving our capacity to prevent cancer by identifying its causes. This report deals only with a small fraction of potentially carcinogenic agents, those for which there is some as yet inconclusive evidence of carcinogenicity; for most other agents there exists little or no evidence one way or another. But even the modest research agenda outlined here will be difficult to achieve given current trends in the research environment. In particular, there has over the past two decades been a precipitous decline in the amount of research produced to address issues of environmental/occupational risk factors for cancer. This has been most evident in epidemiologic research. The proximal cause is that there are fewer epidemiologists working in the area of environmental/occupational etiology of cancer. This is not a place to engage in analysis or speculation on the reasons for this unfortunate trend. Such analysis would have to include but not be limited to consideration of the role of training opportunities, career opportunities, funding opportunities and legal-ethical barriers to accessing human subjects and their personal data. If measures are not taken to stem the decline of this area of research, we will be stuck in the future with the same limited epidemiologic knowledge base we have today. It is imperative that appropriate authorities, and we believe national and international public health agencies should be the prime movers, should take stock of this problem to understand its causes and to find ways of solving it.

References for overarching topics

Anttila A, Pukkala E, Riala R, Sallmen M, Hemminki K. Cancer incidence among Finnish workers exposed to aromatic hydrocarbons. *Int Arch Occup Environ Health* 1998; 71: 187-193.

Boffetta P, Andersen A, Lynge E, Barlow L, Pukkala E. Employment as hairdresser and risk of ovarian cancer and non-Hodgkin's lymphomas among women. *J Occup Med* 1994; 36: 61-65.

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