

All of this illustrates several important points, including the fact that astute clinical observation is crucial to discovery of occupational toxicants. Indeed, independent reports of similar adverse events are also necessary for prodding doctors and regulators to act on this inference. Finally, understanding of mechanisms and application of genomic tools have an important and growing place in OEM. OEM is a vast field that demands diverse skills from its practitioners. The OEM archive available is an outstanding place to visit to remember where the field has been, gain perspective on one's own research or practice and help maintain the vision of occupational and environmental health as a fast-moving field that includes everything from astute clinical practice to cutting edge molecular genomics.

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# OMICs technologies: an opportunity for “two-way” translation from basic science to both clinical and population-based research

Christopher Paul Wild

Vlaanderen *et al*<sup>1</sup> (*see page 136*) provide a timely summary of how OMICS technologies can be applied to research into the health effects of occupational and environmental exposures. The type of exciting advances being made in understanding pathogenesis at the molecular level is well illustrated by recent discoveries concerning epigenetic mechanisms of carcinogenesis.<sup>2</sup> This accumulation of mechanistic knowl-

edge is, in part at least, based on the technological advances of the various OMICS platforms summarised in the accompanying article.

Although Vlaanderen *et al* highlight the technology and structure their discussion around the different platforms, the important underlying message they provide is that knowledge of mechanisms can be translated into the clinical setting in relation to improved diagnosis, prognosis and treatment and into population studies to better understand the causes of disease. The ways in which this can be achieved are numerous, albeit in the early

stages of development. For example, the OMICS technologies promise to yield biomarkers to improve exposure assessment and to provide evidence supporting the biological plausibility of exposure–disease associations.<sup>3</sup> The results from genome-wide association studies are revealing key biological pathways through which environmental, occupational and lifestyle factors may exert their effects on human health. These latter observations provide opportunities to move from the genome-wide association studies to functional analyses of the impact of particular polymorphisms on disease risk.

Improved exposure assessment is a key requirement of epidemiology. Vlaanderen *et al* present examples of chemical exposures (arsenic and benzene) and to these one might add the areas of diet, obesity, physical inactivity and lifestyle where a better understanding of how these factors engender disease risk would be particularly valuable. Identification of the important pathways in human pathogenesis in relation to exposures may yield evidence-based opportunities to modulate the course of disease development. The conduct of small-scale interventions in people—for example, by dietary modulation, could be valuable in

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elucidating the mechanistic effects of particular exposures.

The drive to apply OMICS technologies to a clinical setting finds natural allays in the commercial sector—for example, for the development of diagnostic tests and new drugs. This coincides with the increasing financial incentives of cooperation between the public and private sector. In many countries, the emphasis of much publicly funded cancer research is similarly focused in the clinical domain. At the same time, the potential benefits of application of OMICS technologies to observational studies in populations are striking. Advances in this context include understanding the causes of disease and developing evidence-based prevention strategies. There is therefore a challenge and an opportunity to redefine the term “translational research” to encompass a “two-way translation” from basic sciences into both the clinic and the population. This twin-pronged approach would provide a far more balanced and integrated strategy to reducing the overall burden of disease through prevention and better treatment as well as making full use of the present and future investment in the OMICS technologies.

Despite the undoubted promise of applying OMICS to occupational and environmental health research, there are a number of checks and balances, specified by Vlaanderen *et al*, that are needed to maximise the chances of success. First, there is a need for true interdisciplinary

research between laboratory scientists, epidemiologists, occupational hygienists, biostatisticians, bioinformaticians and others to bring the different professional expertises to bear in the design and conduct of population studies. Potter<sup>4</sup> rightly emphasised the need to apply the principles of epidemiology (eg, accounting for bias, confounding, and reproducibility) to observational studies even when the technology being used is the exquisitely powerful one of OMICS. A new generation of multilingual researchers is needed who are comfortable with the languages of laboratory and population sciences. Second, careful method validation is required to ensure that the measurements made represent what is intended. Here, analytical precision is not equivalent to method validity. There is a challenge therefore for funders to be willing to support the unglamorous but vital foundation of validation research to later reap the benefits in population-based studies and public health. Third, as with other biomarker approaches, there are open questions concerning the intra-individual variation in levels over time, the relation of the markers to dose and/or disease as well as the relevance of measurements made in body fluids and peripheral cells to changes in the target organs.

Despite these caveats, OMICS technologies offer the promise of a new generation of biomarkers for population research, particularly in the elucidation of gene–

environment interactions in disease aetiology. In this context, the tailoring of methodologies to the biological samples available in biobanks linked to large prospective cohort studies will be an important feature in ensuring maximum benefit is drawn from investment in both domains. If this is achieved, then the OMICS technologies described have the potential to lead to step changes in understanding the causes and prevention of cancer and other diseases resulting from environmental and occupational exposures. Given the fact, even in a postgenomic age, that a predominance of human diseases has their origins in such exposures implies the opportunities to be manifold.

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# Integrated health impact assessment of cycling

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After years of decline in usage and image in the Western world from the 1950s onwards, the bicycle is now emerging as a centre of

interest for many researchers, policymakers, practitioners and advocacy groups in the health and environmental fields. The proportion of journeys taken by bicycle still varies greatly, from around 1% to 2% in the US up to 30% in The Netherlands. In the past decade, bicycle promotion policies have begun to flourish in Europe and North America, in particular the highly popular city bike sharing programs as seen in Paris, London or Barcelona.

The increasingly recognised benefits of cycling are driving the support for such

initiatives.<sup>1</sup> Cycling as a means of transportation facilitates the integration of healthy physical activity habits into daily routines, and has been shown to promote such benefits as cardiovascular health, fitness and healthy weight status.<sup>2–3</sup> As an alternative to motorised transportation, the bicycle can also contribute to improving air quality, lowering greenhouse gas emissions and reducing congestion. Other quality of life, health and environmental benefits may also accrue from policies and transport interventions that promote cycling.<sup>4–5</sup>

Nevertheless, cycling may bring about detrimental impacts as well, such as the risk of traffic injuries, increased inhalation of air pollution<sup>6</sup> and increased exposure to ultraviolet (UV) rays and noise. A growing and not yet conclusive body of research shows that cyclists are in general exposed to lower concentrations of traffic-related

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