Int J Public Health (2016) 61:405–407
DOI 10.1007/s00038-015-0755-y

COMMENTARY

Molecular and genomic sciences in health: apply the established rules of evidence

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Received: 6 October 2015 / Accepted: 8 October 2015 / Published online: 26 October 2015

Molecular biology and genomic research provide fascinating insights into the intricate functioning of human life at the cellular level (Parrington 2015). Promises abounded on how their achievements will improve population health. "We now have the possibility of achieving all we ever hoped for from medicine", stated the then UK Science Minister Lord Sainsbury in the year 2000 when the human genome had first been sequenced, in agreement with many of the scientists involved (BBC 2000). Fifteen years later the health impact of "omics" has been disappointing—equally so for "public health genomics" (Boccia et al. 2014), for "genomic medicine" (Hall et al. 2010), and for "personalised" or "precision medicine" (James 2014). This is no longer the view of only a minority—it is supported by recent pieces in the *New England Journal of Medicine* (NEJM) (Bayer and Galea 2015) and in *The Journal of the American Medical Association* (JAMA) (Joyner and Paneth 2015).

And yet, inspite of the limited health impact so far, the current funding landscape is increasingly biased towards favouring *omics* research over other areas of health research (Bayer and Galea 2015). A case in point is the EU's proposed new Horizon 2020 health work programme for 2016/17, which allocates about 70 % of the overall indicative budget of 934 million Euros to a call on personalised medicine (European Commission 2015). Does "omics" hold such unique promises that a special case can be made, temporarily exempting it from the need to demonstrate its impact? Researchers and politicians defend the budgetary needs with incessant claims of impending success in developing tools to improve population health. But this is not the only issue. Recently, it has been argued that public health has allegedly missed out on *omic*-based discoveries, thus hindering their implementation. In Germany, the "National Academy of Sciences Leopoldina" and two other distinguished academies published a joint statement on the future development of, and required structures for, public health in the country (Leopoldina 2015). Apart from many valid propositions (including the call for a solid evidence base for public health interventions), they again claim that "…genomics and other Omics on a population basis, the new science of molecular evolution of infectious diseases and, importantly, the genomic understanding of the evolution of man ("evolutionary medicine") open up new vistas to understanding health and disease, public health and prevention…" (Leopoldina 2015). In view of the criticism in NEJM and JAMA that evidence is lacking, this appears over-enthusiastic and premature with regard to public health.

Enthusiasm is an important driver of scientific progress. However, publicly funded research must also stand the scrutiny of process and outcome evaluation. Public health does have a lot to show, for example in the field of tobacco control in western countries. Smoking rates have declined in many population groups, followed by declines in cancer and cardiovascular disease rates. In the case of Germany, HIV/AIDS prevention campaigns involving a broad range of stakeholders have contributed to a decline both in new infections as well as in stigmatisation. With respect to improving public health outcomes, interventions to

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influence social determinants remain the top priority (Marmot et al. 2012). While the health impact of molecular and genomic sciences on the population level has been marginal in comparison, these fields have created far more economic interest than public health research work usually does. Anticipation of future business opportunities by industry (and all too often by politics as well) may lead to bypassing established rigorous evaluation procedures. For example, genomic-based diagnostics need to be evaluated using the same established criteria that apply to other screening techniques (Wilson and Jungner 1968). This has been blatantly neglected in direct-to-consumer marketing of genomic tests (Bellcross et al. 2012; Boccia et al. 2014).

While there are researchers working in genomics who have a strong public health perspective (Probst-Hensch et al. 2011), indifference to population health is still common, as the following example illustrates. Bansal et al. (2015) used modified strains of a worm, *Caenorhabditis elegans*, as a system for lifespan studies in the lab. The authors find that lifespan is not correlated with healthspan: long-lived mutants spent a higher proportion of time in a frail state of health. They summarise: "If applied to humans, this would likely lead to unsustainable healthcare costs and demonstrates the importance of examining healthspan as opposed to lifespan for future research." In fact, public health research has done exactly that for many years. Studies on population health metrics, for example, on-going at least since the early 1990s, were at least partly based on the question whether gains in life expectancy have been followed by improvements in health status (Murray et al. 2002). In the ensuing debate on the "compression of morbidity", substantial evidence generated by demographers and epidemiologists points towards continuous progress in healthy survival (Vaupel 2010)—supported by many societal (including, but not restricted to, medical) measures (Fries et al. 2011) that *C. elegans* simply has no access to.

How should we proceed? First, scientists from the different fields need to be on equal footage. Molecular biologists and genomic researchers should rest assured that their peers in public health admire their impressive work in basic sciences (we really do). But the road from bench to bedside is long and rocky, and even more so the road from bench to population. A public health perspective is essential to evaluate the population-level potential of "omics" research findings. If both sides listen to each other with modesty and true respect for each other's work, a constructive dialogue can ensue that may bring more health benefit to populations than each side can achieve on their own. Unfortunately, the Leopoldina statement fails to be exemplary in this respect. It downplays achievements of public health research in Germany (Künzli 2015) while calling for more "downstream implementation, to 'do what we know'" in the field of "public health genomics" (Leopoldina 2015).

Second, it should be critically analyzed why so little money goes into public health research, compared to molecular and genomic research (Bayer and Galea 2015). The EU needs to find a better balance between its stated focus on economic growth and its obligation to improve population health (IEA et al. 2014). The World Health Report 2013 could show the way: it has rightly highlighted the key role of public health interventions to prevent morbidity and mortality from the most prevalent diseases. In addition, it provides an agenda for "Research for universal health coverage", ensuring that everyone has access to quality health services, irrespective of the personal financial means or the economic situation of their country (WHO 2013). This requires the strengthening of health systems; access to essential medicines and technologies; and dedicated, well-trained staff. Not only public health, but also molecular and genomic sciences need to provide evidence that their endeavours can contribute.

Acknowledgments The authors wish to thank Jacqueline Müller-Nordhorn for helpful comments on an earlier version of this paper.

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