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Navigating the geography of mortality – towards a GPS for Public Health Policy

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Switzerland is a small, densely populated and prosperous country with a well-educated and skilled work force, highly developed economy, and a universal healthcare system. Its inclusive system of social welfare promotes sufficient living conditions for everybody from cradle to death, including the elderly and the very elderly. The health coverage includes a safety net for those who, owing to fundamental psychiatric morbidity, are in need of support. This coverage extends to well-established state-sponsored programmes for those at risk of falling outside the social mainstream, such as drug addicts. The combined effect of these factors means that life expectancy at birth is one of the highest, if not the highest, in the world, at about 81.0 years for men and 85.0 years for women [1]. One might, therefore, expect that mortality in the very elderly is attributable to a fairly common pattern of causes and that this pattern is similarly distributed across the regions of the country.

The "Mortality atlas of the main causes of death in Switzerland 2008–2012", published in the *Swiss Medical Weekly* [2], suggests otherwise; there are substantial regional differences in reported causes of death, for example between more urban and more rural areas. Chammartin et al. [2], analysed the spatial distribution of mortality in great microgeographical detail and accounted for a substantial number of causes of death. This includes four types of cardiovascular disease, 10 types of cancer, respiratory diseases, Alzheimer's disease, diabetes, influenza, pneumonia, liver diseases and two external causes of death. Their analysis yielded gender- and age-specific microgeographical maps that include types of dwelling and linguistic areas, with the use of several methods to filter out noise and produce smooth maps.

These maps and the surprisingly uneven distribution of reported causes of death that they reveal reflect Switzerland's unique geographical, cultural, political and organisational heterogeneity, especially along the alpine country's linguistic and topographical divisions. Switzerland, officially the Swiss Confederation, has about 2500 municipalities across an area of only 41 285 square kilometres and about 8 million inhabitants. This stands in contrast with, for example, Sweden's roughly 10 million inhabitants, 290 municipalities and 490 295 square kilometres. In Switzerland, direct democracy with regular votes on all conceivable aspects of public life at the national, cantonal and municipal level has led to the development and fine adaptation of rules to the specific circumstances of varied topography and microgeographical areas, including all aspects of the healthcare system. The process of direct democracy has almost always supported the maintenance of the comparatively high-quality healthcare system, including a high number and dense network of hospitals that in part cater for relatively small regional catchment areas.

The prevalence and general distribution of diseases comes as no surprise [2]. Cardiovascular diseases (36%), of these mostly heart diseases (73%), were the main causes of death between 2008 and 2012. These were followed by various forms of cancer, mainly of the lung, colon and rectum, breast, and prostate, together amounting to 27% of all deaths. External causes were third in prevalence, mainly suicide, which is at quite a high rate for Western Europe [3].

Surprisingly, however, the spatial patterns and clusters of the Swiss mortality data, gleaned from death certificates of the period 2008–2012, reveal significant and substantial differences between dwelling types and linguistic areas [2]. As mentioned above, Chammartin et al. accounted for many different types of diseases over the same time period [2]. While other studies may have smoothened out the impression of causes of death by subsuming different types of cancer into one category, the fine-grained approach of the study by Chammartin and colleagues reveals distinctions. For example, reporting of only a single category "cancer" would have obscured the regionally contrasting mortality patterns for lung versus gastric cancer [2].

Disparate patterns of causes of death may reflect geodemographic, cultural, environmental, economic and societal disparities, as well as the impact of factors relating to heredity, lifestyle (including e.g., smoking, exercise and diet), healthcare delivery and local variations in healthcare priorities. Tobacco consumption, for example, is significantly higher in the French-speaking part of Switzerland, especially amongst women. This corresponds more to the pattern of smoking in neighbouring France than in the German-speaking part of Switzerland [2, 4]. This pattern is mirrored by the increased rate of lung cancer amongst younger women in the French-speaking part of Switzerland

[2]. Prostate cancer was less prevalent as a cause of death in the Italian-speaking part of Switzerland [2]. Whether this might be a result of better screening or, perhaps, a more Mediterranean lifestyle remains unclear [2]. On the other hand, gastric cancer is more prevalent in the German-speaking part of Switzerland [2]. The striking correspondence between findings and the language areas or, should it be said, across the language barriers, is difficult to explain. In addition to health-related issues, this correspondence may reflect cultural differences in how deaths are reported rather than in real differences.

At least two thirds of older individuals and about 90% of those admitted for inpatient-care to Internal Medicine in the University Hospital of Zürich are multimorbid, that is, with two or more concurrent diseases that can lead to therapeutic conflicts [5]. How would doctors report, for example, the death of a patient who has recently undergone coronary stenting and concurrent atrial fibrillation with concurrent thrombocyte antiaggregation and anticoagulation and who bleeds to death because of a stomach ulcer, or, in an even more complex scenario, who is transferred to intensive care in shock and dies several weeks later from multiorgan failure? Are "traffic accidents" always traffic accidents or suicides, especially in mountainous areas? Is the deadly impact an "external" cause, such as when an elderly person falls because of frailty, visual problems and confusion because of dementia? Compared especially with a framework of classifying a death with a single cause, a root-cause analysis of reporting persons may yield disparate results. These results might be further influenced by cultural and regional differences in the reported reasons leading to death. These considerations suggest that reporting death as an event due to a single cause may be somewhat misleading, especially in the very elderly.

Whatever the current advantages and limitations of the approach by Chammartin et al. the striking maps of disease topography, analysed in microgeographical detail, may foreshadow a new period of epidemiological insight. Building on this, Public Health interventions will be based on ever more sophisticated and real-time, data-driven control systems for healthcare that use detailed and complex statistics. Such systems may help to guide corrective interventions up to the level of single primary care physicians, providing, in other words, the way toward a GPS (global positioning system) for Public Health!

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