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Mapping the geography of child mortality: a key step in addressing disparities

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A hallmark of the past decade has been the remarkable progress made in reducing maternal and child mortality, an achievement credited in some measure to the Millennium Development Goals. The reduction in child deaths from an estimated 12·7 million under-5 deaths in 1990 to fewer than 6 million deaths by 2015 is a remarkable achievement in global health.[1] The fact that this reduction is less than uniform and varies widely between countries and in populations within countries has also been well recognised. The usual measures of such differentials have included both direct measures of mortality and coverage of key lifesaving interventions. In its last report, the independent expert review group for maternal and child health reported that the well-known mortality gradient by socioeconomic status was not evident for newborn mortality.[2]

The study by Marshall Burke and colleagues[3] evaluated geospatial trends in under-5 mortality from 82 Demographic and Health Surveys in 28 countries in sub-Saharan Africa. The investigators used a 10 km ×10 km matrix to map under-5 mortality and assessed the association between changes in mortality and clustering with contextual and relevant data from Demographic and Health Surveys and other data sources. Their analysis shows that most (75%) of the variation in under-5 mortality could be explained by sub-national factors with the dominant factors being climate change, malaria burden, and conflict. Several limitations should be considered when assessing the work, such as limited availability of local health system information at the level of granularity needed for geospatial analysis, limited information on population migration patterns, and the timings of the surveys. Another limitation is the lack of information on disaggregated mortality analysis by age groups (such as for neonatal mortality versus post-neonatal mortality) or indeed analysis by cause of deaths.

These limitations notwithstanding, the general findings that changes in under-5 mortality and clustering frequently transcended boundaries and were more responsive to local factors than to national factors are important and borne out by other evidence. Murray and colleagues first pointed out the enormous disparities in epidemiological patterns of adult mortality in the USA and coined the term "eight Americas" in 2006,[4] and subnational geographic disparities in relation to childhood mortality[5] and stunting[6] have been studied in several low and middle-income countries (LMICs).

What are the implications of such analyses for the future? Geospatial depictions of differentials in mortality, as well as access to services and coverage of interventions, represent an extremely powerful approach to the assessment of inequities. Although Burke and colleagues[3] did not relate mortality trends to subnational or regional administrative units, these are critically important in understanding more proximal determinants and policy responses to disparities. In an analysis of life expectancy patterns by counties, investigators from the Institute of Health Metrics and Evaluation estimated that, against a time-series of life expectancy in the ten nations with the lowest mortality, counties in the USA ranged from being 15 calendar years ahead for men and 16 calendar years ahead for women to more than 50 calendar years behind for both sexes.[7] In other more complex analysis that used regular reporting system information from 2851 counties of 31 provinces in mainland China, Wang and colleagues[8] used small area mortality estimation models, spatiotemporal smoothing, and Gaussian process regression to synthesise data and obtain county-level mortality estimates. Linking of geospatial data to administrative units can be an extremely powerful advocacy and planning tool, especially in LMICs. A major limitation, however, is one of data availability at the level of the smallest administrative units and the power of the surveys at that level of specificity. Although Bayesian methods are often used in such analyses at these smallest of sampling units,[9] such assessments are fraught with errors according to measures used and neighbourhood effects, and such analytical methods are beyond the capacity of most health system programmes for monitoring and evaluation. However, these analyses and their depiction are hugely effective for conveying complex messages and targeting of efforts to reduce disparities.

Analyses such as those used by Burke and colleagues[3] rely on periodic cross-sectional surveys that are not linked to available or civic registration and vital

statistics databases. These surveys are also limited by the inevitable time lag between analyses and feedback to health systems and policy makers, especially at the local level. Although vital registration systems might take a long time to reach all at-risk populations in LMICs, innovative options could potentially be developed for data collection and feedback, which might in turn make small unit analysis possible. The usefulness of community-based health workers for data collection and monitoring of mortality trends in Ethiopia is one such example[10] and should pave the way for the development of similar low cost and effective systems for monitoring and evaluation. This data revolution is a crucial part of the move towards greater transparency and accountability set out in the Sustainable Development Goals.

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1 GBD Child Mortality Collaborators. Global, regional, national and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality during 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; **388:** 1725–74.
2 The independent expert review group (iERG). Final report 2015. Geneva: World Health Organization, 2015.
3 Burke M, Heft-Neal S, Bendavid E. Sources of variation in under-5 mortality across sub-Saharan Africa: a spatial analysis. *Lancet Glob Health* 2016; published online Oct 25. http://dx.doi.org/10.1016/S2214-109X(16)30212-1.
4 Murray CJ, Kulkarni SC, Michaud C, et al. Eight Americas: investigating mortality disparities across races, counties, and race-counties in the United States. *PLoS Med* 2006; **3:** e260.
5 Arku RE, Bennett JE, Castro MC, et al. Geographical inequalities and social and environmental risk factors for under-five mortality in Ghana in 2000 and 2010: bayesian spatial analysis of census data. *PLoS Med* 2016; **13:** e1002038.
6 Di Cesare M, Bhatti Z, Soofi SB, Fortunato L, Ezzati M, Bhutta ZA. Geographical and socioeconomic inequalities in women and children's nutritional status in Pakistan in 2011: an analysis of data from a nationally representative survey. *Lancet Glob Health* 2015; **3:** e229–39.
7 Kulkarni SC, Levin-Rector A, Ezzati M, Murray CJ. Falling behind: life expectancy in US counties from 2000 to 2007 in an international context. *Popul Health Metr* 2011; **9:** 16.
8 Wang Y, Li X, Zhou M, et al. Under-5 mortality in 2851 Chinese counties, 1996–2012: a subnational assessment of achieving MDG 4 goals in China. *Lancet* 2016; **387:** 273–83.
9 Sartorius BK, Sartorius K, Chirwa TF, Fonn S. Infant mortality in South Africa—distribution, associations and policy implications, 2007: an ecological spatial analysis. *Int J Health Geogr* 2011; **10:** 61.
10 Amouzou A, Kidanu A, Taddesse N, et al. Using health extension workers for monitoring child mortality in real-time: validation against household survey data in rural Ethiopia. *PLoS One* 2015; **10:** e0126909.