

metadata indicator definition explicitly includes all women of reproductive age. To properly monitor progress and identify challenges in achieving the health-related SDGs, it is critical to measure indicators' levels and trends in a timely, comparable, and complete manner.

Future GBD SDG monitoring

With its annual cycle, the GBD study has enabled the incorporation of a number of important revisions and additions to monitor the health-related SDGs. For GBD 2016, the most notable advances include improving UHC index (SDG indicator 3.8.1) to reflect a broader array of conditions covered by essential health services, as well as the addition of two violence indicators and vaccine coverage (SDG indicator 3.b.1). For vaccine coverage, we plan to further improve its measurement in GBD 2017, namely estimating the correlation structure between the coverage of individual vaccines to more precisely measure the UN's definition for SDG indicator 3.b.1 (ie, proportion of the target population covered by all vaccines included in their national programme).

The continued expansion and refinement of health-related indicator measurement is a key priority for GBD 2017 and beyond. Specifically, an assessment of health worker density and distribution (SDG indicator 3.c.1) is presently underway and will be included in GBD 2017. Pending data availability, estimating the proportion of people who feel safe walking alone around the area where they live (SDG indicator 16.1.4) also should be feasible for GBD 2017. Work is underway to estimate the coverage of treatment interventions for substance use disorders (SDG indicator 3.5.1), as well as the prevalence of sexual violence by non-intimate partners for women aged 15 years and older (SDG indicator 5.2.2). To date, however, estimating sexual violence by non-intimate partners has been severely limited by a paucity of data outside of western Europe and the USA. A key area of future work relates to the March, 2017, revisions to SDG indicator 3.8.2,⁵ which was modified to more directly capture financial risk protection by including an indicator of catastrophic household expenditures on health.

In the present study, we used a relatively simple approach for projecting trends for health-related SDG indicators through 2030. This method is based on using the historical rates of change for each country, with more recent trends weighted more heavily. This approach does not explicitly link the likelihood of SDG achievement to underlying investment areas to reach the SDGs; for example, increasing overall or specific types of DAH, enacting socioeconomic policies, implementing health programmes, expanding coverage of currently available interventions, scaling up new interventions or medical technologies, and reducing or preventing exposure to underlying risks. This more structured approach for projecting SDG achievement—including the ability to quantify the potential impact of different SDG investment scenarios—is currently under development as part of the GBD.

Strengths

A number of strengths, as well as limitations, exist for our study. The extensive GBD collaboration, which currently includes more than 2500 individuals from more than 135 countries and territories, is a core strength. This collective ownership model, in which GBD collaborators actively participate in the production, review, and use of results, addresses many recent critiques regarding the generation of global health estimates.⁶⁴ Specifically, the GBD collaborative network identifies and facilitates access to the latest, locally relevant data sources; works with individuals and institutions in reviewing and generating GBD estimates; and provides both national and subnational avenues for the translation and use of results for decision making.^{65–69} An increasing number of in-depth country engagements with the GBD are also producing subnational assessments of disease burden and maximising policy relevance. For instance, spearheaded by the Indian Council for Medical Research and the Public Health Foundation of India, GBD is presently undertaking state-level disease burden assessments in India, disaggregated by urban and rural areas as part of GBD 2016. This work has been characterised by intensive engagement with the Indian Government and the Indian scientific community in the production of estimates.

Recent changes to the global SDG monitoring framework, as well as the proposal of processes to consider indicator revisions annually and potential additions in 2020 and 2025,⁵ now establish the SDGs as a dynamic development agenda. This is unlike previous international goal-setting efforts, such as the MDGs.²¹ Subsequently, timely efforts to track newly added and revised indicators are central to the ability of the SDG agenda to evolve over time. By the nature of its annual reporting cycle, the extensive range of health indicators currently or potentially measured, and the location of work within academic and scientific organisations, the GBD study is well positioned to quickly respond to indicator revisions and expansion. This is highlighted by the incorporation of March, 2017, indicator refinements into GBD 2016 (eg, vaccine coverage [SDG indicator 3.b.1]), and our ability to report on important violence indicators that no other international agency currently includes. Of the new health-related SDG indicators proposed for consideration by the IAEG-SDGs, most could be incorporated into the GBD measurement cycle with relative ease; these indicators include psychoactive substance abuse, incidence of road traffic injuries, incidence of unintentional poisonings, prevalence of anaemia among women of reproductive age, and illnesses attributable to risk factors (air pollution and unsafe water, sanitation, and hygiene). Other indicators that cover, for example, other dimensions of mental health and NCDs have also been proposed. Continued improvements in indicator measurement are also facilitated through novel extensions and developments from the broader GBD study and related work, which is exemplified by

incorporating the HAQ Index into our UHC measure for GBD 2016. Another priority area for GBD expansion is the increased ability to track key health indicators, not only at subnational administrative levels, but also as a continuous geospatial surface. Research on mapping inequalities in child mortality at a 5 km × 5 km resolution in Africa has leveraged the GBD study,⁷⁰ providing an example of the increasing ability to track SDG indicator attainment at levels beyond national averages.

Limitations

A number of specific limitations for SDG indicators exist, described in the underlying GBD papers as well as in appendix 1. Of note, for sanitation (a key determinant of health) we have used a proxy indicator based on measuring the fraction of the populations that have unimproved sanitation, improved sanitation without a sewer connection, and improved sanitation with a sewer connection. This does not take into account whether waste is safely managed or treated. For the vaccine coverage indicator, we used a proxy indicator based on the geometric mean of vaccine coverage of individual vaccines and did not explicitly account for the correlation structure that exists between individual vaccines.

As noted in more detail above, we have used a relatively simple approach for projecting SDG indicator values. Limitations also exist in terms of the construction of the health-related SDG index. Ideally, we would develop an index that scales indicator values to SDG target values. We have not implemented this in GBD 2016 for several reasons. First, 13 of the health-related SDG indicators do not presently specify a target. Second, a subset of SDG targets are relatively modest for many middle-SDI to high-SDI countries (eg, reducing MMR to <70 deaths per 100 000 livebirths), and the effect of rescaling to these targets is that any differences beyond the target are ignored. In constructing the health-related SDG index, we used the geometric rather than arithmetic mean. The geometric mean allows for partial substitutability (ie, poor performance on one indicator is only partially offset by good performance on another), while the arithmetic mean allows for complete substitutability (ie, poor performance on one indicator can be completely offset by good performance on another indicator). As a result, stagnating progress on some indicators—most notably indicators such as childhood overweight and harmful alcohol use—can have a notable effect on progress and our projections based on past trends of the overall health-related SDG index. As noted in appendix 1, constructing the health-related SDG index using the arithmetic mean suggests somewhat more optimistic but qualitatively similar progress on the health-related SDGs as measured by the index, with no country showing a decline. As part of future iterations of the GBD we will continue to test and refine alternative index construction approaches that can take into account SDG targets.

Our assessment reflects ongoing gaps in data availability and coverage across countries for some indicators and remains a major limitation to any SDG monitoring effort, including GBD. For example, data for the violence indicators are sparse, particularly for non-intimate partner violence, men as victims of sexual violence, and psychological violence. Measurement issues, such as the variability and accuracy of self-report of different types of violence across settings, pose additional challenges. Limitations also exist for the water, sanitation, and hygiene indicators, particularly in view of the relative absence of data to estimate safe sanitation management. A benefit of the GBD study is that it can help identify these data gaps, both over time and by location, and provide an interim solution to data gaps through the use of standardised estimation approaches. Nevertheless, the GBD is not, and should not be, a replacement for investing in high-quality, routine health information systems that are crucial for measuring and evaluating SDG progress at national and subnational levels. Last, any limitations of GBD 2016 relevant to the 37 currently measured health-related SDG indicators apply.^{28–32}

Conclusion

Understanding where countries are, and where they are likely to go on the basis of past trends, is essential to guide strategic and investment decisions to achieve the SDG agenda by 2030. With this updated GBD analysis of the SDGs, we measure 37 of the 50 health-related SDG indicators from 1990 to 2016, and provide projections of SDG attainment by 2030 on the basis of past trends. For a subset of indicators, such as under-5 mortality and neonatal mortality, MMR, and malaria, projected levels of SDG achievement are promising, particularly among higher-SDI countries. However, these more positive projections for SDG attainment appear to be the exception, with most countries, especially countries in western and central sub-Saharan Africa and low-SDI countries, facing a challenging road toward SDG achievement by 2030 on the basis of current trajectories. It is increasingly clear that the health-related SDG agenda hinges upon markedly accelerating progress, particularly among the world's poorest populations. Succeeding in this endeavour is not yet an impossibility—nonetheless, it will demand extraordinary financial and political commitment by national and international agencies alike to ensure that truly no one is left behind in 2030.

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Please see the appendix 1 for more detailed information about individual authors' contributions to the research, divided into the following categories: managing the estimation process; writing the first draft of the manuscript; providing data or critical feedback on data sources; developing methods or computational machinery; applying analytical methods to produce estimates; providing critical feedback on methods or results; drafting the work or revising it critically for important intellectual content; extracting, cleaning, or cataloguing data; designing or coding figures and tables; and managing the overall research enterprise.

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