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Measuring universal health coverage based on an index of effective coverage of health services in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019

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Summary

Background Achieving universal health coverage (UHC) involves all people receiving the health services they need, of high quality, without experiencing financial hardship. Making progress towards UHC is a policy priority for both countries and global institutions, as highlighted by the agenda of the UN Sustainable Development Goals (SDGs) and WHO's Thirteenth General Programme of Work (GPW13). Measuring effective coverage at the health-system level is important for understanding whether health services are aligned with countries' health profiles and are of sufficient quality to produce health gains for populations of all ages.

Methods Based on the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, we assessed UHC effective coverage for 204 countries and territories from 1990 to 2019. Drawing from a measurement framework developed through WHO's GPW13 consultation, we mapped 23 effective coverage indicators to a matrix representing health service types (eg, promotion, prevention, and treatment) and five population-age groups spanning from reproductive and newborn to older adults (≥65 years). Effective coverage indicators were based on intervention coverage or outcome-based measures such as mortality-to-incidence ratios to approximate access to quality care; outcome-based measures were transformed to values on a scale of 0–100 based on the 2·5th and 97·5th percentile of location-year values. We constructed the UHC effective coverage index by weighting each effective coverage indicator relative to its associated potential health gains, as measured by disability-adjusted life-years for each location-year and population-age group. For three tests of validity (content, known-groups, and convergent), UHC effective coverage index performance was generally better than that of other UHC service coverage indices from WHO (ie, the current metric for SDG indicator 3.8.1 on UHC service coverage), the World Bank, and GBD 2017. We quantified frontiers of UHC effective coverage performance on the basis of pooled health spending per capita, representing UHC effective coverage index levels achieved in 2019 relative to country-level government health spending, prepaid private expenditures, and development assistance for health. To assess current trajectories towards the GPW13 UHC billion target—1 billion more people benefiting from UHC by 2023—we estimated additional population equivalents with UHC effective coverage from 2018 to 2023.

Findings Globally, performance on the UHC effective coverage index improved from 45·8 (95% uncertainty interval 44·2–47·5) in 1990 to 60·3 (58·7–61·9) in 2019, yet country-level UHC effective coverage in 2019 still spanned from 95 or higher in Japan and Iceland to lower than 25 in Somalia and the Central African Republic. Since 2010, sub-Saharan Africa showed accelerated gains on the UHC effective coverage index (at an average increase of 2·6% [1·9–3·3] per year up to 2019); by contrast, most other GBD super-regions had slowed rates of progress in 2010–2019 relative to 1990–2010. Many countries showed lagging performance on effective coverage indicators for non-communicable diseases relative to those for communicable diseases and maternal and child health, despite non-communicable diseases accounting for a greater proportion of potential health gains in 2019, suggesting that many health systems are not keeping pace with the rising non-communicable disease burden and associated population health needs. In 2019, the UHC effective coverage index was associated with pooled health spending per capita (r=0·79), although countries across the development spectrum had much lower UHC effective coverage than is potentially achievable relative to their health spending. Under maximum efficiency of translating health spending into UHC effective coverage performance, countries would need to reach $1398 pooled health spending per capita (US$ adjusted for purchasing power parity) in order to achieve 80 on the UHC effective coverage index. From 2018 to 2023, an estimated 388·9 million (358·6–421·3) more population equivalents would have UHC effective coverage, falling well short of the GPW13 target of 1 billion more people benefiting from UHC during this time. Current projections point to an estimated 3·1 billion (3·0–3·2) population equivalents still lacking UHC effective coverage in 2023, with nearly a third (968·1 million [903·5–1040·3]) residing in south Asia.

Interpretation The present study demonstrates the utility of measuring effective coverage and its role in supporting improved health outcomes for all people—the ultimate goal of UHC and its achievement. Global ambitions to

accelerate progress on UHC service coverage are increasingly unlikely unless concerted action on non-communicable diseases occurs and countries can better translate health spending into improved performance. Focusing on effective coverage and accounting for the world's evolving health needs lays the groundwork for better understanding how close—or how far—all populations are in benefiting from UHC.

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Research in context

Evidence before this study

Various approaches have been proposed for monitoring universal health coverage (UHC) service coverage, including those from WHO (ie, the UHC service coverage index, the official UN measure for the Sustainable Development Goal indicator 3.8.1) and the World Bank. Currently available service coverage metrics are heavily focused on infectious diseases as well as reproductive, neonatal, maternal, and child health, despite the recognition that advances towards UHC also require service provision for non-communicable diseases and delivering interventions to a broader range of population-age groups. Inconsistent trend estimation across indicators, if time series are generated, impedes measurements of progress—a priority emphasised in the member-state-led Political Declaration for the UN High-Level Meeting on Universal Health Coverage in 2019. Although the 2014 WHO and World Bank framework for UHC service coverage is explicitly focused on health-system effective coverage, efforts to date have focused on crude coverage or health-system resource inputs, or a combination of both. Effective coverage at the health-system level, or the fraction of potential health gains delivered by a health system, has yet to be incorporated into UHC monitoring efforts, even though WHO and member states have signalled increasing interest in understanding the impact of UHC beyond service coverage alone.

Added value of this study

Drawing from the WHO Thirteenth General Programme of Work (GPW13) Expert Reference Group and Task Force on Metrics recommendations on UHC monitoring and conceptual work on effective coverage of health systems, the present study offers a new measurement framework for UHC effective coverage, representing health needs and corresponding service types across the life course while accounting for potential health gains delivered to populations. The framework mapped 23 effective coverage indicators against five health service domains—promotion, prevention, treatment, rehabilitation, and palliation—and five population-age groups (ie, reproductive and newborn, children <5 years, children and adolescents aged 5–19 years, adults aged 20–64 years, and adults aged ≥65 years). Based on estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, these 23 effective coverage indicators involved either direct measures of intervention coverage (eg, antiretroviral therapy coverage) or outcome-based indicators, such as mortality-to-incidence ratios, to approximate access to quality care. We weighted each effective coverage indicator on the basis of potential health gains deliverable by health systems, as approximated by the disability-adjusted life-years associated with each effective coverage indicator, and aggregated them to produce the UHC effective coverage index. Three types of validity were assessed (content, known groups, and convergent) for the UHC effective coverage index and other multi-country service coverage measures (eg, the UHC service coverage index for 2017, as estimated by WHO, and the GBD 2017 UHC service coverage index for 2017). We also quantified relationships between pooled health spending per capita (ie, government expenditures, prepaid private spending, and development assistance for health) and UHC effective coverage performance to examine how well countries are currently translating resources into improved UHC effective coverage. Last, we estimated the number of population equivalents covered by effective health services from 2018 to 2023—a key component of WHO's GPW13—by assuming a direct translation of the UHC effective coverage index to a fractional metric and multiplying country-level population estimates.

Implications of all the available evidence

This study offers another step forward in measuring UHC effective coverage across settings, developing a measurement framework and methods for country and global stakeholders to better track progress in effective health service provision at the population level. Our results highlight the importance of including non-communicable disease indicators alongside interventions for reproductive, neonatal, maternal, and child health and for infectious diseases, as well as capturing potential health gains delivered by health systems at the population level. In combination, we expect these analytical advances to better identify where countries have improved effective health service delivery, and what health needs along the life course increasingly threaten further progress. Focusing on UHC effective coverage, both in terms of its measurement and its capacity for instilling greater accountability for improving health outcomes across the development spectrum, lays a data-driven path towards achieving UHC for all populations.

Introduction

Universal health coverage (UHC) is viewed as a crucial avenue through which improved health for all can be attained,[1,2] by ensuring all people can receive quality health services they need, without experiencing financial hardship. Global agendas and actors have amplified calls for UHC in recent years, driven at least in part by the explicit inclusion of UHC achievement in target 3.8 of the UN Sustainable Development Goals (SDGs)[3–5] and heightened emphasis within recent UN resolutions[1] and WHO programmatic objectives (eg, the target of 1 billion more people benefiting from UHC from 2018 to 2023 as part of WHO's Thirteenth General Programme of Work [GPW13]).[6,7] Regional and country-driven efforts to elevate UHC on policy agendas have occurred as well, both building upon long established UHC programmes (eg, in Japan,[8] much of western Europe,[9,10] and many countries in Latin America[11,12]) and galvanising newer commitments to UHC implementation (eg, in India, Kenya, and South Africa).[13] To better understand how actions and investments are delivering on the ultimate goal of UHC—improving health outcomes—it is essential to quantify and track trends in effective health service provision, as well as the extent to which advances in service coverage correspond with the potential health gains populations should experience.

In 2014, WHO and the World Bank published a UHC measurement framework in which service coverage was defined as a spectrum of services—promotion, prevention, treatment, rehabilitation, and palliation—across the life cycle.[14,15] This framework emphasised the importance of providing services for individuals' health needs throughout their lifespans and quantifying effective coverage of interventions delivered by health systems. Conceptually, effective coverage unites intervention need, use, and quality into a single metric, representing the proportion of health gain that could be potentially received from an intervention relative to what is actually experienced.[16,17] At the health-system level, effective coverage aims to capture the fraction of total potential health gains actually delivered relative to what a health system could have theoretically delivered.[16] To quantify such population-level health gains, Shengelia and colleagues outlined an approach to measure an aggregate of health-system effective coverage.[16] Effective coverage is a powerful measure: this metric not only demands accountability of intervention availability and use, but also requires that the services received are of sufficient quality to provide the health gains they are supposed to. Yet in practice, effective coverage has to date been rarely measured, particularly across countries and over time. Minimal uptake of effective coverage as a metric for UHC monitoring is at least partly due to data challenges, as most health data systems are not able to capture all three intervention components together (ie, need, use or receipt, and quality) and few data sources can adequately represent these dimensions for conditions involving more complex care (eg, cancer or stroke). Tracer or proxy indicators of effective coverage exist for certain interventions or cause groups (eg, cancers), and recent health-system research by Kruk and colleagues used mortality-to-incidence rates to garner insights into health-care quality in low-income to middle-income countries.[18] Nevertheless, to date no multi-country UHC measurement effort to our knowledge has sought to estimate effective coverage across health service domains and population-age groups within a cohesive analytical platform.

Following the 2014 WHO/World Bank UHC monitoring framework and SDG adoption in 2015, several multi-country health service coverage indices have been developed to inform UHC measurement.[19–26] Although each effort has shown recognition of prevailing data limitations and challenges with operationalising UHC service coverage across myriad settings,[21,24] they each have limitations in how well they capture country-level trends and health service needs across the life course.[17,27–31] First, current indices primarily rely solely on household survey point estimates from multi-country survey series, which can lead to various measurement limitations (ie, being primarily focused on low-income to middle-income countries; restricted sets of interventions captured; and lags in data availability for understanding trends). Second, most indices include either risk factor indicators (eg, prevalence of non-smoking and non-raised blood pressure in the UHC service coverage index,[19–21] the SDG indicator 3.8.1[4]) or health-system inputs or process indicators (eg, health workers per capita and hospital beds per capita in the UHC service coverage index; inpatient admission rates for Wagstaff and colleagues' service coverage index[23,24]), or both. The use of such proxy indicators, as well as those influenced by factors outside the health system (eg, tobacco prevalence), for service coverage measurement could misattribute successes in health service provision or misrepresent UHC service coverage. With non-communicable diseases accounting for at least 60% of early death and disability worldwide,[32] the omission of non-communicable disease indicators beyond risk factor prevalence proxies or cancer screening is at odds with the reality of countries' populations and health systems. Third, approaches used to construct overall indices of UHC service coverage typically involve somewhat arbitrary weighting schemes (eg, a series of geometric means[4,19–21] or weighted geometric means[23,24]), and thus might not capture the alignment of services provided given a country's health and demographic profile. Last, none of these approaches explicitly accounts for the potential health gains delivered through the health system, a limitation that inhibits our collective understanding of whether or how gains in UHC are improving health outcomes for all.

Recent developments from WHO indicate a revived interest in using effective coverage for UHC monitoring; these include the WHO GPW13 Expert Reference Group

(ERG) Task Force on Metrics recommendations on effective service coverage measurement[33] and the WHA72 resolution recommending country pilots on monitoring UHC effective coverage.[7] The GPW13 ERG also supported initial efforts to map health services against population-age groups within a measurement framework and to identify indicator options across the life course in order to estimate UHC effective coverage across countries.[33] The present analysis contributes to this endeavour through the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2019, mapping 23 effective coverage indicators across health service types and population-age groups for 204 countries and territories from 1990 to 2019. Based on the construct of health-system effective coverage, we aggregated individual effective coverage indicators to produce an overall index using health gain weights, which were derived from country-specific disease burden estimates relative to theoretical levels of burden avertable given intervention levels and associated effectiveness. We compared the performance of this UHC effective coverage measure against that of previous multi-country UHC service coverage indices[21,24,26] on a series of validity tests. We then assessed the relationships between pooled health spending per capita and index performance, aiming to capture how close—or how far—countries were in reaching UHC effective coverage frontiers relative to their current spending. Finally, we considered applications of this index for current global and national UHC priorities, such as translating index performance to the number of people covered by effective coverage for the GPW13 UHC billion target.

Methods

Overview

Our primary analysis involved three main steps: first, to use intervention coverage or compute proxy measures of effective coverage for 23 indicators; second, to calculate the fraction of potential health gains associated with each effective coverage indicator based on each location's disease burden profile; and third, to construct the overall UHC effective coverage index by weighting each effective coverage indicator relative to its health gains fraction. We then did secondary analyses, assessing UHC effective coverage performance relative to health spending and current trajectories towards the GPW13 UHC billion target. Each step is summarised below and further described in appendix 1 (pp 12–61).

This analysis uses estimates from the broader GBD 2019,[34–36] covering 204 countries and territories from 1990 to 2019. Details of disease-specific, injury-specific, and coverage-specific data inputs and processing, statistical synthesis approaches, and final models are available in the accompanying GBD 2019 capstone publications.[34–36] This study complies with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement,[37] with further information provided in the appendix 1 (pp 69–72).

Measurement of UHC effective coverage

Framework and indicators

Development of the UHC effective coverage measurement framework and selection of effective coverage indicators was based on consultation, methods testing, and refinement via the WHO ERG on the GPW13 from 2017 to 2019;[7,33,38,39] the background and details of this process are provided in the appendix 1 (pp 12–28). The resulting framework (figure 1) and currently included effective coverage indicators (table 1) sought to represent the range of different health services that populations need across their lifespans while recognising present data gaps and appeals for measurement parsimony (appendix 1 pp 18–28).

As applied in this analysis, the UHC effective coverage measurement framework involves 30 unique cells from a matrix of five health service types—promotion, prevention, treatment, rehabilitation, and palliation—against five population-age groups (reproductive and newborn, children younger than 5 years, children and adolescents aged 5–19 years, adults aged 20–64 years, and older adults aged ≥65 years). Treatment is subdivided into two separate groups: first, communicable diseases and maternal, newborn, and child health; and second, non-communicable diseases. Effective coverage indicators were then mapped to these cells to represent needed health services across the life course.

23 effective coverage indicators were included in the present analysis (table 1). As recognised in previous studies,[19–26] data for directly measuring effective intervention coverage are rarely available across health services, locations, and over time. Subsequently, we used viable proxy measures and analytical techniques to approximate effective coverage for conditions considered amenable to health care.[40–43] Criteria set forth by the WHO ERG guided selection of effective coverage indicators and preferred measurement approaches (appendix 1 pp 12–28).[33] Such criteria stipulated that effective coverage indicators should be currently measurable (ie, data and methods that support indicator measurement today); reflect differences in effective health services and not factors outside the immediate scope of health systems and UHC (eg, tobacco taxation and physical infrastructure such as roads and water systems); and use indicators already encompassed within the SDGs and GPW13, or draw from data systems required for monitoring of SDGs and GPW13. Several other indicator candidates were considered from 2017 to 2019 (appendix 1 pp 12–28), but inadequate data availability, access, or quality, or a combination of these factors, impeded their inclusion in the current analysis.

See Online for appendix 1

Four effective coverage indicators were measures of intervention coverage and 19 were mortality-based measures to proxy access to quality of care (table 1; appendix 1 pp 30–32). For the mortality-based measures, we primarily used mortality-to-incidence ratios (MIRs) and mortality-to-prevalence ratios (MPRs) for chronic or longer-term conditions (eg, diabetes or asthma). Without

better data on effective coverage, such mortality-based measures are viewed as suitable proxies,[33,44–46] providing good signals on what access to quality care should, at minimum, avert or protect against even if the onset of disease cannot be wholly prevented. The main exception was ischaemic heart disease, for which GBD input data coverage and quality on non-fatal outcomes were less robust than data on causes of death and related risks; subsequently, we used risk-standardised death rates instead of MIRs or MPRs to proxy effective coverage. As a statistical approach used in previous GBD analyses[41,43] and further described in the appendix 1 (pp 31–32), risk standardisation aims to better isolate variations in mortality associated with health-care access and quality from differences in underlying risk exposures mainly related to factors outside the health system.

Effective coverage indicators for intervention coverage were kept on their natural scale (0–100%), whereas the 19 other effective coverage indicators were transformed to values on a 0–100 scale (appendix pp 31–33). Across locations and from 1990 to 2019, 0 was set by values at the 97·5th percentile or higher (ie, "worst" levels of MIRs) and 100 by the 2·5th percentile or lower (ie, "best" levels of MIRs).

	Health service type					
Population age group	Promotion	Prevention	Treatment		Rehabilitation	Palliation
			Communicable diseases and MNCH	NCDs		
Reproductive and newborn	Met need for family planning with modern contraception	Antenatal, peripartum, and postnatal care for newborn babies Antenatal, peripartum, and postnatal care for mothers	Antenatal, peripartum, and postnatal care for newborn babies Antenatal, peripartum, and postnatal care for mothers			
Children younger than 5 years		DTP3 coverage MCV1 coverage	LRI treatment Diarrhoea treatment	Acute lymphoid leukaemia treatment		
Children and adolescents (5–19 years)			ART coverage	Acute lymphoid leukaemia treatment Asthma treatment Epilepsy treatment Appendicitis treatment Paralytic ileus and intestinal obstruction treatment		
Adults (20–64 years)			ART coverage TB treatment	Diabetes treatment IHD treatment Stroke treatment CKD treatment COPD treatment Cervical cancer treatment Breast cancer treatment Uterine cancer treatment Colon and rectum cancer treatment Epilepsy treatment Appendicitis treatment Paralytic ileus and intestinal obstruction treatment		
Older adults (≥65 years)			ART coverage TB treatment	Diabetes treatment IHD treatment Stroke treatment CKD treatment COPD treatment Cervical cancer treatment Breast cancer treatment Uterine cancer treatment Colon and rectum cancer treatment Epilepsy treatment Appendicitis treatment Paralytic ileus and intestinal obstruction treatment		

Figure 1: **UHC effective coverage measurement framework**

Additional information about the framework development process and selection of effective coverage indicators can be found in appendix 1 (pp 12–28). ART=antiretroviral therapy. DTP3=diphtheria-tetanus-pertussis vaccine, 3 doses. IHD=ischaemic heart disease. CKD=chronic kidney disease. COPD=chronic obstructive pulmonary disease. LRI=lower respiratory infection. MCV1=measles-containing-vaccine, 1 dose. MNCH=maternal, neonatal, and child health. NCDs=non-communicable diseases. TB=tuberculosis. UHC=universal health coverage.

	Effective coverage indicator	Metric	Effective coverage indicator measurement		Health gain weight inputs	Effectiveness category
			Numerator	Denominator		
Reproductive and newborn						
Promotion	Met need for family planning with modern contraception	Coverage	Females aged 15–49 years with demand for family planning met with modern contraception	Females aged 15–49 years with demand for family planning	50% of DALYs due to maternal disorders for females aged 10–54 years	5
Prevention; treatment, communicable diseases and MNCH	Antenatal, peripartum, and postnatal care for newborn babies	Early neonatal mortality rate	All-cause deaths during the first 7 days of life	Population of early neonates	Early neonatal deaths multiplied by life expectancy at birth (on the basis of theoretical minimum risk life table)	3
Prevention; treatment, communicable diseases and MNCH	Antenatal, peripartum, and postnatal care for mothers	Maternal mortality ratio	Deaths due to maternal disorders for females aged 10–54 years	Livebirths among females aged 10–54 years	50% of DALYs due to maternal disorders for females aged 10–54 years	1
Children younger than 5 years						
Prevention	DTP3 vaccine coverage	Coverage	Receipt of three doses of DTP vaccine among children aged 12–23 months	Children aged 12–23 months	DALYs due to diphtheria, tetanus, and pertussis for children younger than 5 years	1
Prevention	MCV1 coverage	Coverage	Receipt of MCV1 among children aged 12–23 months	Children aged 12–23 months	DALYs due to measles for children younger than 5 years	1
Treatment, communicable diseases and MNCH	LRI treatment	MIR	Mortality from LRIs for children younger than 5 years	Incidence of LRIs for children younger than 5 years	DALYs due to LRIs for children younger than 5 years	1
Treatment, communicable diseases and MNCH	Diarrhoea treatment	MIR	Mortality from diarrhoeal diseases for children younger than 5 years	Incidence of diarrhoeal diseases for children younger than 5 years	DALYs due to diarrhoeal diseases for children younger than 5 years	1
Treatment, NCDs	Acute lymphoid leukaemia treatment	MIR	Mortality from acute lymphoid leukaemia for children aged 1–4 years	Incidence of acute lymphoid leukaemia for children aged 1–4 years	DALYs due to acute lymphoid leukaemia for children aged 1–4 years	1
Children and adolescents (5–19 years)						
Treatment, communicable diseases and MNCH	ART coverage	Coverage	Populations aged 5–19 years living with HIV/AIDS and on ART	Populations aged 5–19 years living with HIV/AIDS	DALYs due to HIV for populations aged 5–19 years	1
Treatment, NCDs	Acute lymphoid leukaemia treatment	MIR	Mortality from acute lymphoid leukaemia for populations aged 5–19 years	Incidence of acute lymphoid leukaemia for populations aged 5–19 years	DALYs due to acute lymphoid leukaemia for populations 5–19 years	1
Treatment, NCDs	Asthma treatment	MPR	Mortality from asthma for populations aged 5–19 years	Prevalence of asthma for populations aged 5–19 years	DALYs due to asthma for populations aged 5–19 years	1
Treatment, NCDs	Epilepsy treatment	MPR	Mortality from epilepsy for populations aged 5–19 years	Prevalence of epilepsy for populations aged 5–19	DALYs due to epilepsy for populations aged 5–19 years	3
Treatment, NCDs	Appendicitis treatment	MIR	Mortality from appendicitis for populations aged 5–19 years	Incidence of appendicitis for populations aged 5–19 years	DALYs due to appendicitis for populations aged 5–19 years	1
Treatment, NCDs	Paralytic ileus and intestinal obstruction treatment	MIR	Mortality from paralytic ileus and intestinal obstruction for populations aged 5–19 years	Incidence of paralytic ileus and intestinal obstruction for populations aged 5–19 years	DALYs due to paralytic ileus and intestinal obstruction for populations aged 5–19 years	1
Adults (20–64 years)						
Treatment, communicable diseases and MNCH	ART coverage	Coverage	Population aged 20–64 years living with HIV/AIDS and on ART	Population aged 20–64 years living with HIV/AIDS	DALYs due to HIV for populations aged 20–64 years	1
Treatment, communicable diseases and MNCH	Tuberculosis treatment	MIR	Mortality from tuberculosis for populations aged 20–64 years	Incidence of tuberculosis for populations aged 20–64 years	DALYs due to tuberculosis for populations aged 20–64 years	1
Treatment, NCDs	Diabetes treatment	MPR	Mortality from diabetes for populations aged 20–64 years	Prevalence of diabetes for populations aged 20–64 years	DALYs due to diabetes for populations aged 20–64 years	3
Treatment, NCDs	IHD treatment	RSDR	Risk-standardised deaths from IHD for populations aged 20–64 years	Population aged 20–64 years	DALYs due to IHD for populations aged 20–64 years	2
Treatment, NCDs	Stroke treatment	MIR	Mortality from stroke for populations aged 20–64 years	Incidence of stroke for populations aged 20–64 years	DALYs due to stroke for populations aged 20–64 years	2
Treatment, NCDs	CKD treatment	MPR	Mortality from CKD for populations aged 20–64 years	Incidence of CKD for populations aged 20–64 years	DALYs due to CKD for populations aged 20–64 years	1

(Table 1 continues on next page)

	Effective coverage indicator	Metric	Effective coverage indicator measurement		Health gain weight inputs	Effectiveness category
			Numerator	Denominator		
(Continued from previous page)						
Treatment, NCDs	COPD treatment	MPR	Mortality from COPD for populations aged 20–64 years	Prevalence of COPD for populations aged 20–64 years	DALYs due to COPD for populations aged 20–64 years	3
Treatment, NCDs	Cervical cancer treatment	MIR	Mortality from cervical cancer for females aged 20–64 years	Incidence of cervical cancer for females aged 20–64 years	DALYs due to cervical cancer for females aged 20–64 years	1
Treatment, NCDs	Breast cancer treatment	MIR	Mortality from breast cancer for females aged 20–64 years	Incidence of breast cancer for females aged 20–64 years	DALYs due to breast cancer for females aged 20–64 years	1
Treatment, NCDs	Uterine cancer treatment	MIR	Mortality from uterine cancer for females aged 20–64 years	Incidence of uterine cancer for females aged 20–64 years	DALYs due to uterine cancer for females aged 20–64 years	1
Treatment, NCDs	Colon/rectum cancer treatment	MIR	Mortality from colon/rectum cancer for populations aged 20–64 years	Incidence of colon/rectum for populations aged 20–64 years	DALYs due to colon/rectum cancer for populations aged 20–64 years	1
Treatment, NCDs	Epilepsy treatment	MPR	Mortality from epilepsy for populations aged 20–64 years	Prevalence of epilepsy for populations aged 20–64 years	DALYs due to epilepsy for populations aged 20–64 years	3
Treatment, NCDs	Appendicitis treatment	MIR	Mortality from appendicitis for populations aged 20–64 years	Incidence of appendicitis for populations aged 20–64 years	DALYs due to appendicitis for populations aged 20–64 years	1
Treatment, NCDs	Paralytic ileus and intestinal obstruction treatment	MIR	Mortality from paralytic ileus and intestinal obstruction for populations aged 20–64 years	Incidence of paralytic ileus and intestinal obstruction for populations aged 20–64 years	DALYs due to paralytic ileus and intestinal obstruction for populations aged 20–64 years	1
Older adults (≥65 years)						
Treatment, communicable diseases and MNCH	ART coverage	Coverage	Population aged ≥65 years living with HIV/AIDS and on ART	Population aged ≥65 years living with HIV/AIDS	DALYs due to HIV for populations aged ≥65 years	2
Treatment, communicable diseases and MNCH	Tuberculosis treatment	MIR	Mortality from tuberculosis for populations aged ≥65 years	Incidence of tuberculosis for populations aged ≥65 years	DALYs due to tuberculosis for populations aged ≥65 years	2
Treatment, NCDs	Diabetes treatment	MPR	Mortality from diabetes for populations aged ≥65 years	Prevalence of diabetes for populations aged ≥65 years	DALYs due to diabetes for populations aged ≥65 years	4
Treatment, NCDs	IHD treatment	RSDR	Risk-standardised deaths from IHD for populations aged ≥65 years	Population aged ≥65 years	DALYs due to IHD for populations aged ≥65 years	3
Treatment, NCDs	Stroke treatment	MIR	Mortality from stroke for populations aged ≥65 years	Incidence of stroke for populations aged ≥65 years	DALYs due to stroke for populations aged ≥65 years	3
Treatment, NCDs	CKD treatment	MPR	Mortality from CKD for populations aged ≥65 years	Incidence of CKD for populations aged ≥65 years	DALYs due to CKD for populations aged ≥65 years	2
Treatment, NCDs	COPD treatment	MPR	Mortality from COPD for populations aged ≥65 years	Prevalence of COPD for populations aged ≥65 years	DALYs due to COPD for populations aged ≥65 years	4
Treatment, NCDs	Cervical cancer treatment	MIR	Mortality from cervical cancer for females aged ≥65 years	Incidence of cervical cancer for females aged ≥65 years	DALYs due to cervical cancer for females aged ≥65 years	2
Treatment, NCDs	Breast cancer treatment	MIR	Mortality from breast cancer for females aged ≥65 years	Incidence of breast cancer for females aged ≥65 years	DALYs due to breast cancer for females aged ≥65 years	2
Treatment, NCDs	Uterine cancer treatment	MIR	Mortality from uterine cancer for females aged ≥65 years	Incidence of uterine cancer for females aged ≥65 years	DALYs due to uterine cancer for females aged ≥65 years	2
Treatment, NCDs	Colon/rectum cancer treatment	MIR	Mortality from colon/rectum cancer for populations aged ≥65 years	Incidence of colon/rectum cancer for populations aged ≥65 years	DALYs due to colon/rectum cancer for populations aged ≥65 years	2
Treatment, NCDs	Epilepsy treatment	MPR	Mortality from epilepsy for populations aged ≥65 years	Prevalence of epilepsy for populations aged ≥65 years	DALYs due to epilepsy for populations aged ≥65 years	4
Treatment, NCDs	Appendicitis treatment	MIR	Mortality from appendicitis for populations aged ≥65 years	Incidence of appendicitis for populations aged ≥65 years	DALYs due to appendicitis for populations aged ≥65 years	2
Treatment, NCDs	Paralytic ileus and intestinal obstruction treatment	MIR	Mortality from paralytic ileus and intestinal obstruction for populations aged ≥65 years	Incidence of paralytic ileus and intestinal obstruction for populations aged ≥65 years	DALYs due to paralytic ileus and intestinal obstruction for populations aged ≥65 years	2

Additional information about the framework development process and selection of effective coverage indicators can be found in appendix 1 (pp 12–28). UHC=universal health coverage. DALYs=disability-adjusted life-years. MNCH=maternal, neonatal, and child health. DTP3=diphtheria-tetanus-pertussis vaccine, 3 doses. MCV1=measles-containing-vaccine, 1 dose. LRI=lower respiratory infection. MIR=mortality-to-incidence ratio. NCDs=non-communicable diseases. ART=antiretroviral therapy. MPR=mortality-to-prevalence ratio. IHD=ischaemic heart disease. RSDR=risk-standardised death rate. CKD=chronic kidney disease. COPD=chronic obstructive pulmonary disease.

Table 1: **Details of the 23 effective coverage indicators included in the UHC effective coverage index, by health service type**

Construction of UHC effective coverage index

As outlined by previous work,[14–17] population-level measures of effective coverage should represent the fraction of total health gains a health system could potentially provide, given currently available interventions, that a health system actually delivers. This construct is thus grounded in the principle of comparability—all health systems ought to maximise potential health gains for their populations—but also requires accounting for local health needs and epidemiological profiles. For instance, if a country currently experiences a high burden of diabetes and a comparatively lower burden of HIV, at least equal or even higher priority in expanding services for diabetes should occur relative to HIV in order to further support health gains.

To construct the UHC effective coverage index, we weighted each effective coverage indicator relative to their health gain weights, a metric approximating the population health gains potentially deliverable by health systems for each location-year. More detail is provided in the appendix 1 (pp 32–35), but in brief, calculations were based on three inputs for each effective coverage indicator and corresponding population-age group: estimates on the 0–100 scale, targeted disease burden, and effectiveness categories of associated interventions or services (table 1). For effectiveness, incremental values were assumed by category (ie, 90% effectiveness for category 1, 70% for category 2, 50% for category 3, and so on), as informed by studies published in the Cochrane Database of Systematic Reviews, the Tufts Cost-Effectiveness Analysis Registry and Global Health Cost-Effectiveness Analysis Registry, and Disease Control Priorities, third edition (DCP3); sensitivity analyses on shifting each effective coverage indicator by one category (ie, moving each category 2 indicator up to category 1 and then down to category 3) showed high correlations with current assignments (appendix 1 p 35).

As shown in figure 2, UHC effective coverage index estimates based on health gain weighting and an unweighted average across effective coverage indicators were positively associated (r=0·95); however, effects differed across countries.

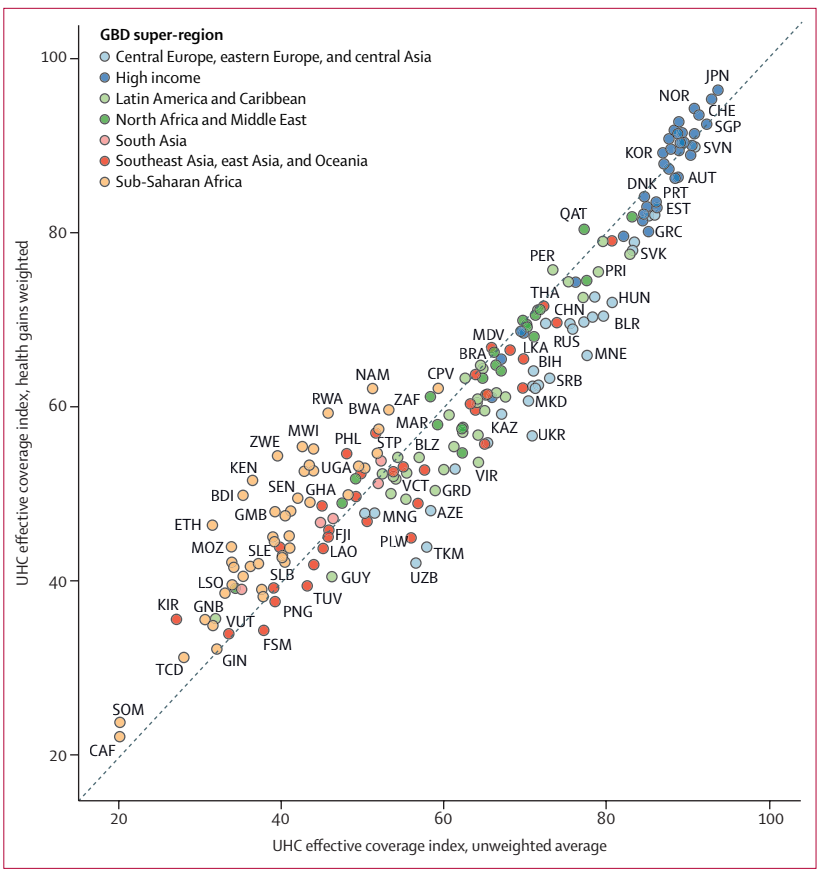


Figure 2: **Comparing the UHC effective coverage index in 2019 with health gains weighting to the unweighted index (unweighted average of effective coverage indicators) in 2019**

Locations are colour-coded by GBD super-region, and are abbreviated according to their ISO3 codes. ISO3 codes and corresponding location names are listed in appendix 1 (pp 64–68). UHC=universal health coverage. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

Validation

Since no gold-standard measures of UHC service coverage currently exist, we used three types of validity testing to compare UHC effective coverage index performance to previously published multi-country indices of UHC service coverage: the WHO UHC service coverage index for 2017;[21] UHC service coverage index from GBD 2017;[26] and service coverage index values from the World Bank.[24] Further details of these analyses are provided in the appendix 1 (pp 38–52), with results summarised in table 2.

For content validity, we computed the percentage of 30 cells (ie, combinations of health services and population-age groups) from the UHC effective coverage framework that were represented by indicators for each index. For known-groups validity, we assessed how well each index could discriminate between 16 country-pairs for which previous studies show "country A" as having better performance or progress on UHC service coverage than a similar "country B".[11,23,47–55] These pairs were selected a priori, and for each index we calculated the fraction of pairs correctly ordered on the basis of mean estimates and accounting for uncertainty where available. For convergent validity, we quantified how much variation in healthy life expectancy could be explained by each index after removing the average relationship between each index and overall sociodemographic development (as measured by Socio-demographic Index [SDI]). In general, the UHC effective coverage index based on health gain weights showed stronger performance across these three validity measures than previous UHC service coverage measures and the unweighted UHC effective coverage index (table 2; appendix 1 pp 38–52).

For the **Cochrane Database of Systematic Reviews** see https://www.cochranelibrary.com/cdsr/reviews

For the **Tufts Cost-Effectiveness Analysis Registry** see https://cevr.tuftsmedicalcenter.org/databases/cea-registry

For the **Global Health Cost-Effectiveness Analysis Registry** see https://ghcearegistry.org/ghcearegistry/

For more on **Disease Control Priorities, third edition** see https://dcp-3.org/

	Source	Content validity (proportion of cells covered)	Known-groups validity (proportion of 16 country pairs)		Convergent validity (variation of HALE explained, accounting for SDI)		
			Based on mean values	With uncertainty	Beta coefficient	Standard error	R^2
UHC effective coverage index, health gains weighted (reported 2019)	GBD 2019	40%	94%	63%	5·00	1·72	0·073
UHC effective coverage index, unweighted average (reported 2019)	GBD 2019	40%	94%	56%	4·19	1·49	0·068
UHC service coverage index for SDGs (reported 2017)	GBD 2017	33%	94%	69%	4·30	1·76	0·053
UHC service coverage index for SDG indicator 3.8.1 (reported 2017)	WHO 2019	20%	75%	..	4·21	1·88	0·044
Service coverage index (for most recent year reported)	World Bank 2020	17%	56%	..	1·24	1·18	0·010

Content validity was evaluated on the basis of the percentage of 30 matrix cells of health service types against population-age groups covered by each index. Known-groups validity was evaluated on the basis of the percentage of 16 country pairs correctly ranked based on country A's UHC or health-system performance being recognised as better than country B's performance; details are found in appendix 1 (pp 45–47). Convergent validity was evaluated on the basis of how much index performance could explain variation in HALE after controlling for levels of sociodemographic development (as measured by SDI). UHC=Universal health coverage. HALE=healthy life expectancy. SDI=Socio-demographic Index. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. SDGs=UN Sustainable Development Goals.

Table 2: **Results for content, known-groups, and construct validity across multi-country health service indices for UHC service coverage measurement**

Relationship between health spending and UHC effective coverage

To better understand potential drivers of UHC effective coverage, we used stochastic frontier metaregression to quantify UHC effective coverage frontiers—estimated maximum levels of UHC effective coverage index achieved given any amount of health spending per capita—and compared country-level UHC effective coverage performance relative to these frontiers. The magnitude of these gaps between the frontier and UHC effective coverage index values provides insights into potential inefficiencies, as well as measurement error, in translating health spending into improved UHC effective coverage at the population level. Further analytical details are in the appendix 1 (pp 53–59).

Since UHC aims to minimise financial hardship associated with receiving essential health services, we focused on assessing the relationship between pooled health spending per capita (ie, government spending, prepaid private health spending, and development assistance for health)[56] and UHC effective coverage performance. Alternative analyses, wherein out-of-pocket spending was included (ie, total health expenditure) and then development assistance for health was excluded (ie, pooled domestic health expenditures), were also done but are not reported here (appendix 2 pp 6–7).

See Online for appendix 2

Counting population equivalents with UHC effective coverage

Spurred by the GPW13 UHC billion target,[6] which calls for 1 billion more people benefiting from UHC by 2023, various approaches have been considered for translating performance metrics into the number of people covered by health services.[20,21,57,58] For this analysis, we used a similar approach currently recommended by WHO:[58] we applied index estimates as fractional metrics and multiplied these values by populations to approximate population equivalents with UHC effective coverage.

To assess UHC effective coverage trajectories and their contributions towards meeting the UHC 1 billion target, we first projected country-level UHC effective coverage index estimates through to 2023. These projections were based on stochastic frontier metaregression modelled relationships between UHC effective coverage index and total health spending per capita; a related method has been used previously by GBD[26,59] and is described further in the appendix 1 (pp 60–61). Taking UHC effective coverage index as a fraction, we multiplied these values by country-level GBD-based population forecasts through to 2023.[60] Last, we aggregated these estimates globally and by GBD super-region, and calculated additional population equivalents with UHC effective coverage from 2018 (the GPW13 baseline) to 2023.

Uncertainty analysis

GBD aims to propagate sources of uncertainty through its estimation process,[34–36] resulting in 1000 draws from the posterior distribution for each measure by location, age, sex, and year. We incorporated uncertainty quantified for each effective coverage indicator and associated disease burden based on GBD 2019 estimates, and did scaling, index construction, and UHC effective coverage index projections at the draw-level to reflect uncertainty. We report 95% uncertainty intervals (95% UIs) based on the ordinal 25th and 975th draws for each measure.

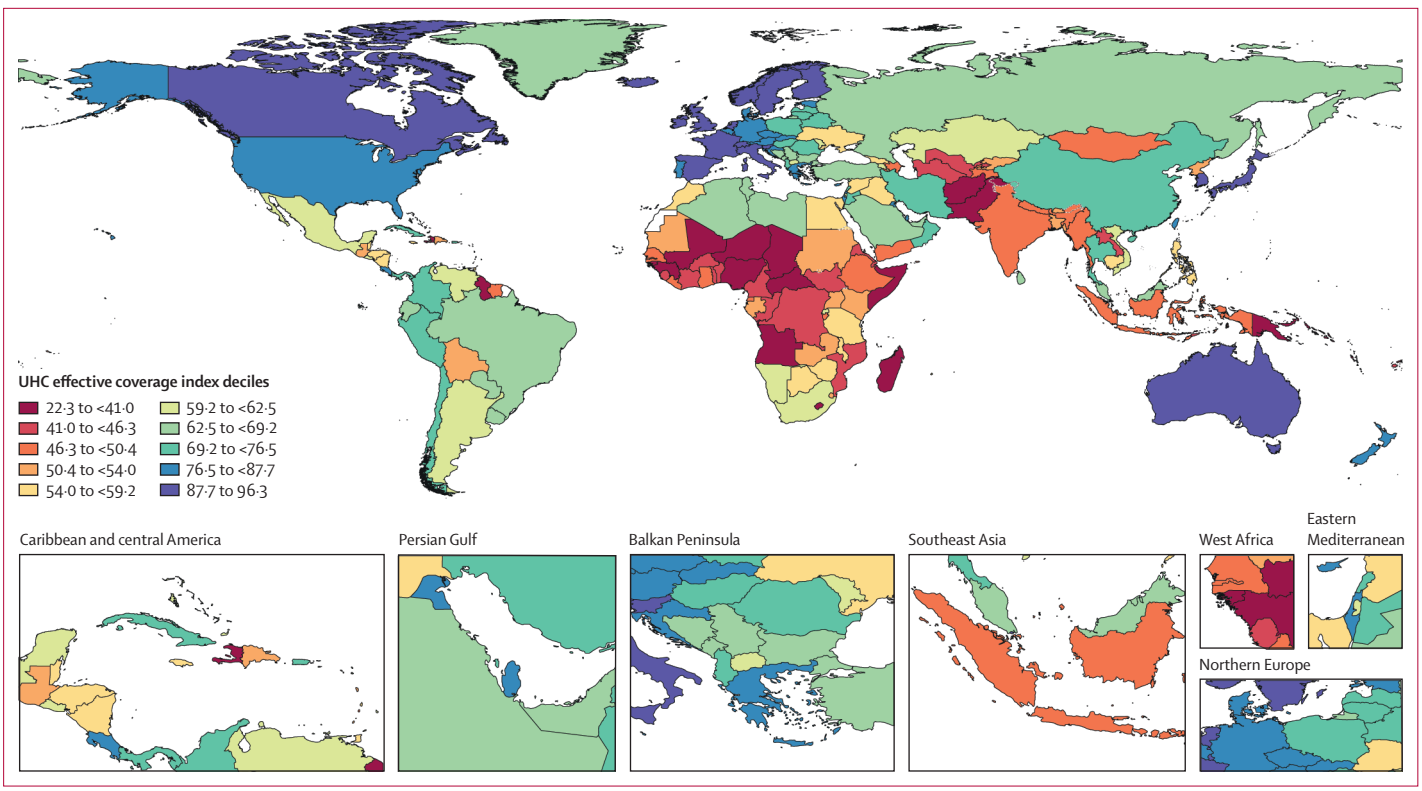
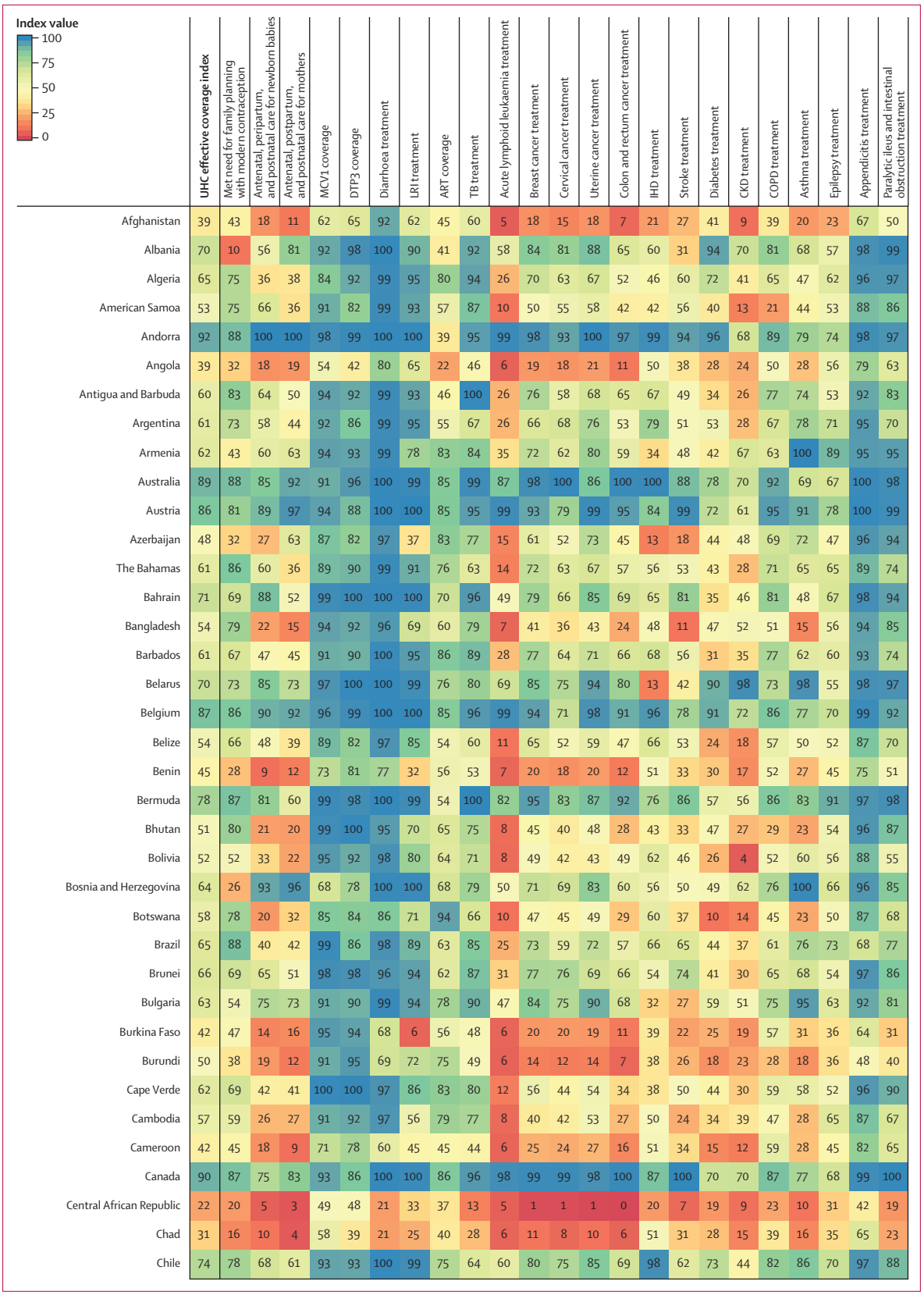


Figure 3: **Map of the UHC effective coverage index, by decile, in 2019**
Deciles are based on the distribution of UHC effective coverage index values in 2019. UHC=universal health coverage.

Role of the funding source
The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results
National UHC effective coverage patterns in 2019
In 2019, UHC effective coverage performance showed some strong geographical patterns (figure 3), but sizeable heterogeneities also emerged. Various European countries, including Iceland, as well as Australia, Canada, Japan, Singapore, and South Korea, comprised the highest decile, followed by a more geographically diverse group in the ninth decile (eg, Costa Rica, Israel, New Zealand, Portugal, and the USA). Sub-Saharan Africa had among the widest range of UHC effective coverage performances in 2019, with two countries ranking in the sixth decile (Rwanda and South Africa) and 11 countries in the first decile; the countries in the first decile were mainly in western or central sub-Saharan Africa, but also spanned the continent (eg, Angola, Lesotho, Madagascar, and Somalia). Outside of sub-Saharan Africa, ten countries, including Afghanistan, Haiti, Pakistan, and Papua New Guinea, were also in the lowest decile in 2019. In east, southeast, and south Asia, countries largely fell between the eighth (China and Thailand) and second deciles (Laos), with India and Indonesia occupying the third decile. Within Latin America, various countries scored in the eighth or seventh deciles (eg, Chile, Colombia, Peru, and Brazil) but others saw UHC effective coverage index values within the fourth to fifth deciles (eg, Bolivia, Guatemala, and Nicaragua).

Performance on the overall UHC effective coverage index often corresponded with levels achieved across individual effective coverage indicators (figure 4); for instance, countries with effective coverage index values of 85 or higher generally had the vast majority of effective coverage indicators exceeding 80. Although high-performing locations usually had lower values for at least some subsets of indicators (eg, met need for family planning or antiretroviral therapy coverage), such indicators often represented areas of lower potential health gains—especially relative to effective coverage indicators proxying health services or interventions for conditions with higher potential health gains in these countries (eg, cardiovascular diseases, cancers, and diabetes). Countries and territories with fairly low overall UHC effective coverage index performance in 2019 (ie, <40) scored similarly low across most effective coverage indicators, although vaccine coverage and proxies for lower respiratory infection and diarrhoea treatment were among the main exceptions.



	UHC effective coverage index	Met need for family planning with modern contraception	Antenatal, peripartum, and postnatal care for newborn babies	Antenatal, postpartum, and postnatal care for mothers	MCV1 coverage	DTP3 coverage	Diarrhoea treatment	LRI treatment	ART coverage	TB treatment	Acute lymphoid leukaemia treatment	Breast cancer treatment	Cervical cancer treatment	Uterine cancer treatment	Colon and rectum cancer treatment	IHD treatment	Stroke treatment	Diabetes treatment	CKD treatment	COPD treatment	Asthma treatment	Epilepsy treatment	Appendicitis treatment	Paralytic ileus and intestinal obstruction treatment
Afghanistan	39	43	18	11	62	65	92	62	45	60	5	18	15	18	7	21	27	41	9	39	20	23	67	50
Albania	70	10	56	81	92	98	100	90	41	92	58	84	81	88	65	60	31	94	70	81	68	57	98	99
Algeria	65	75	36	38	84	92	99	95	80	94	26	70	63	67	52	46	60	72	41	65	47	62	96	97
American Samoa	53	75	66	36	91	82	99	93	57	87	10	50	55	58	42	42	56	40	13	21	44	53	88	86
Andorra	92	88	100	100	98	99	100	100	39	95	99	98	93	100	97	99	94	96	68	89	79	74	98	97
Angola	39	32	18	19	54	42	80	65	22	46	6	19	18	21	11	50	38	28	24	50	28	56	79	63
Antigua and Barbuda	60	83	64	50	94	92	99	93	46	100	26	76	58	68	65	67	49	34	26	77	74	53	92	83
Argentina	61	73	58	44	92	86	99	95	55	67	26	66	68	76	53	79	51	53	28	67	78	71	95	70
Armenia	62	43	60	63	94	93	99	78	83	84	35	72	62	80	59	34	48	42	67	63	100	89	95	95
Australia	89	88	85	92	91	96	100	99	85	99	87	98	100	86	100	100	88	78	70	92	69	67	100	98
Austria	86	81	89	97	94	88	100	100	85	95	99	93	79	99	95	84	99	72	61	95	91	78	100	99
Azerbaijan	48	32	27	63	87	82	97	37	83	77	15	61	52	73	45	13	18	44	48	69	72	47	96	94
The Bahamas	61	86	60	36	89	90	99	91	76	63	14	72	63	67	57	56	53	43	28	71	65	65	89	74
Bahrain	71	69	88	52	99	100	100	100	70	96	49	79	66	85	69	65	81	35	46	81	48	67	98	94
Bangladesh	54	79	22	15	94	92	96	69	60	79	7	41	36	43	24	48	11	47	52	51	15	56	94	85
Barbados	61	67	47	45	91	90	100	95	86	89	28	77	64	71	66	68	56	31	35	77	62	60	93	74
Belarus	70	73	85	73	97	100	100	99	76	80	69	85	75	94	80	13	42	90	98	73	98	55	98	97
Belgium	87	86	90	92	96	99	100	100	85	96	99	94	71	98	91	96	78	91	72	86	77	70	99	92
Belize	54	66	48	39	89	82	97	85	54	60	11	65	52	59	47	66	53	24	18	57	50	52	87	70
Benin	45	28	9	12	73	81	77	32	56	53	7	20	18	20	12	51	33	30	17	52	27	45	75	51
Bermuda	78	87	81	60	99	98	100	99	54	100	82	95	83	87	92	76	86	57	56	86	83	91	97	98
Bhutan	51	80	21	20	99	100	95	70	65	75	8	45	40	48	28	43	33	47	27	29	23	54	96	87
Bolivia	52	52	33	22	95	92	98	80	64	71	8	49	42	43	49	62	46	26	4	52	60	56	88	55
Bosnia and Herzegovina	64	26	93	96	68	78	100	100	68	79	50	71	69	83	60	56	50	49	62	76	100	66	96	85
Botswana	58	78	20	32	85	84	86	71	94	66	10	47	45	49	29	60	37	10	14	45	23	50	87	68
Brazil	65	88	40	42	99	86	98	89	63	85	25	73	59	72	57	66	65	44	37	61	76	73	68	77
Brunei	66	69	65	51	98	98	96	94	62	87	31	77	76	69	66	54	74	41	30	65	68	54	97	86
Bulgaria	63	54	75	73	91	90	99	94	78	90	47	84	75	90	68	32	27	59	51	75	95	63	92	81
Burkina Faso	42	47	14	16	95	94	68	6	56	48	6	20	20	19	11	39	22	25	19	57	31	36	64	31
Burundi	50	38	19	12	91	95	69	72	75	49	6	14	12	14	7	38	26	18	23	28	18	36	48	40
Cape Verde	62	69	42	41	100	100	97	86	83	80	12	56	44	54	34	38	50	44	30	59	58	52	96	90
Cambodia	57	59	26	27	91	92	97	56	79	77	8	40	42	53	27	50	24	34	39	47	28	65	87	67
Cameroon	42	45	18	9	71	78	60	45	45	44	6	25	24	27	16	51	34	15	12	59	28	45	82	65
Canada	90	87	75	83	93	86	100	100	86	96	98	99	99	98	100	87	100	70	70	87	77	68	99	100
Central African Republic	22	20	5	3	49	48	21	33	37	13	5	1	1	1	0	20	7	19	9	23	10	31	42	19
Chad	31	16	10	4	58	39	21	25	40	28	6	11	8	10	6	51	31	28	15	39	16	35	65	23
Chile	74	78	68	61	93	93	100	99	75	64	60	80	75	85	69	98	62	73	44	82	86	70	97	88

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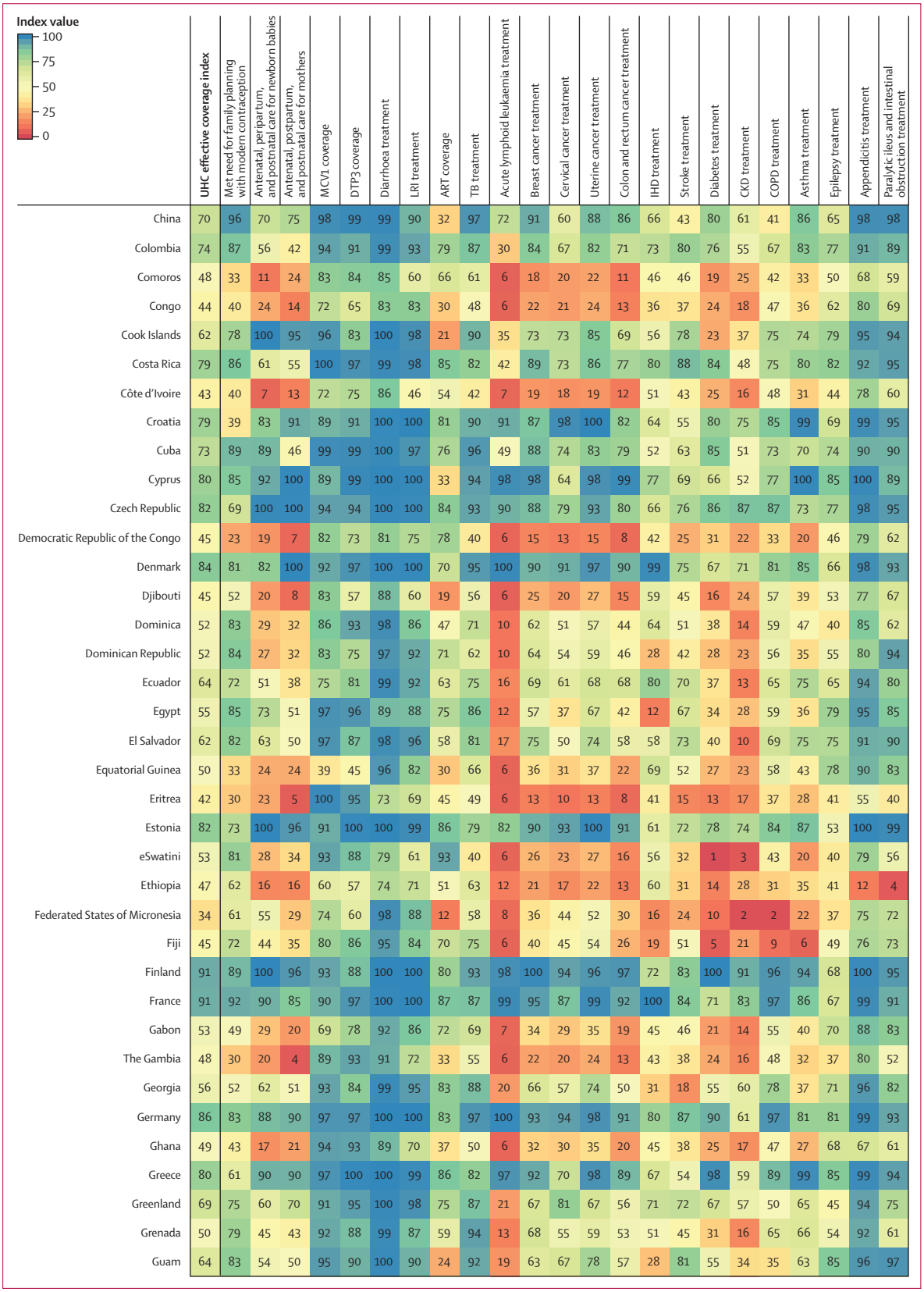

	UHC effective coverage index	Met need for family planning with modern contraception	Antenatal, peripartum, and postnatal care for newborn babies	Antenatal, postpartum, and postnatal care for mothers	MCV1 coverage	DTP3 coverage	Diarrhoea treatment	LRI treatment	ART coverage	TB treatment	Acute lymphoid leukaemia treatment	Breast cancer treatment	Cervical cancer treatment	Uterine cancer treatment	Colon and rectum cancer treatment	IHD treatment	Stroke treatment	Diabetes treatment	CKD treatment	COPD treatment	Asthma treatment	Epilepsy treatment	Appendicitis treatment	Paralytic ileus and intestinal obstruction treatment
China	70	96	70	75	98	99	99	90	32	97	72	91	60	88	86	66	43	80	61	41	86	65	98	98
Colombia	74	87	56	42	94	91	99	93	79	87	30	84	67	82	71	73	80	76	55	67	83	77	91	89
Comoros	48	33	11	24	83	84	85	60	66	61	6	18	20	22	11	46	46	19	25	42	33	50	68	59
Congo	44	40	24	14	72	65	83	83	30	48	6	22	21	24	13	36	37	24	18	47	36	62	80	69
Cook Islands	62	78	100	95	96	83	100	98	21	90	35	73	73	85	69	56	78	23	37	75	74	79	95	94
Costa Rica	79	86	61	55	100	97	99	98	85	82	42	89	73	86	77	80	88	84	48	75	80	82	92	95
Côte d'Ivoire	43	40	7	13	72	75	86	46	54	42	7	19	18	19	12	51	43	25	16	48	31	44	78	60
Croatia	79	39	83	91	89	91	100	100	81	90	91	87	98	100	82	64	55	80	75	85	99	69	99	95
Cuba	73	89	89	46	99	99	100	97	76	96	49	88	74	83	79	52	63	85	51	73	70	74	90	90
Cyprus	80	85	92	100	89	99	100	100	33	94	98	98	64	98	99	77	69	66	52	77	100	85	100	89
Czech Republic	82	69	100	100	94	94	100	100	84	93	90	88	79	93	80	66	76	86	87	87	73	77	98	95
Democratic Republic of the Congo	45	23	19	7	82	73	81	75	78	40	6	15	13	15	8	42	25	31	22	33	20	46	79	62
Denmark	84	81	82	100	92	97	100	100	70	95	100	90	91	97	90	99	75	67	71	81	85	66	98	93
Djibouti	45	52	20	8	83	57	88	60	19	56	6	25	20	27	15	59	45	16	24	57	39	53	77	67
Dominica	52	83	29	32	86	93	98	86	47	71	10	62	51	57	44	64	51	38	14	59	47	40	85	62
Dominican Republic	52	84	27	32	83	75	97	92	71	62	10	64	54	59	46	28	42	28	23	56	35	55	80	94
Ecuador	64	72	51	38	75	81	99	92	63	75	16	69	61	68	68	80	70	37	13	65	75	65	94	80
Egypt	55	85	73	51	97	96	89	88	75	86	12	57	37	67	42	12	67	34	28	59	36	79	95	85
El Salvador	62	82	63	50	97	87	98	96	58	81	17	75	50	74	58	58	73	40	10	69	75	75	91	90
Equatorial Guinea	50	33	24	24	39	45	96	82	30	66	6	36	31	37	22	69	52	27	23	58	43	78	90	83
Eritrea	42	30	23	5	100	95	73	69	45	49	6	13	10	13	8	41	15	13	17	37	28	41	55	40
Estonia	82	73	100	96	91	100	100	99	86	79	82	90	93	100	91	61	72	78	74	84	87	53	100	99
eSwatini	53	81	28	34	93	88	79	61	93	40	6	26	23	27	16	56	32	1	3	43	20	40	79	56
Ethiopia	47	62	16	16	60	57	74	71	51	63	12	21	17	22	13	60	31	14	28	31	35	41	12	4
Federated States of Micronesia	34	61	55	29	74	60	98	88	12	58	8	36	44	52	30	16	24	10	2	2	22	37	75	72
Fiji	45	72	44	35	80	86	95	84	70	75	6	40	45	54	26	19	51	5	21	9	6	49	76	73
Finland	91	89	100	96	93	88	100	100	80	93	98	100	94	96	97	72	83	100	91	96	94	68	100	95
France	91	92	90	85	90	97	100	100	87	87	99	95	87	99	92	100	84	71	83	97	86	67	99	91
Gabon	53	49	29	20	69	78	92	86	72	69	7	34	29	35	19	45	46	21	14	55	40	70	88	83
The Gambia	48	30	20	4	89	93	91	72	33	55	6	22	20	24	13	43	38	24	16	48	32	37	80	52
Georgia	56	52	62	51	93	84	99	95	83	88	20	66	57	74	50	31	18	55	60	78	37	71	96	82
Germany	86	83	88	90	97	97	100	100	83	97	100	93	94	98	91	80	87	90	61	97	81	81	99	93
Ghana	49	43	17	21	94	93	89	70	37	50	6	32	30	35	20	45	38	25	17	47	27	68	67	61
Greece	80	61	90	90	97	100	100	99	86	82	97	92	70	98	89	67	54	98	59	89	99	85	99	94
Greenland	69	75	60	70	91	95	100	98	75	87	21	67	81	67	56	71	72	67	57	50	65	45	94	75
Grenada	50	79	45	43	92	88	99	87	59	94	13	68	55	59	53	51	45	31	16	65	66	54	92	61
Guam	64	83	54	50	95	90	100	90	24	92	19	63	67	78	57	28	81	55	34	35	63	85	96	97

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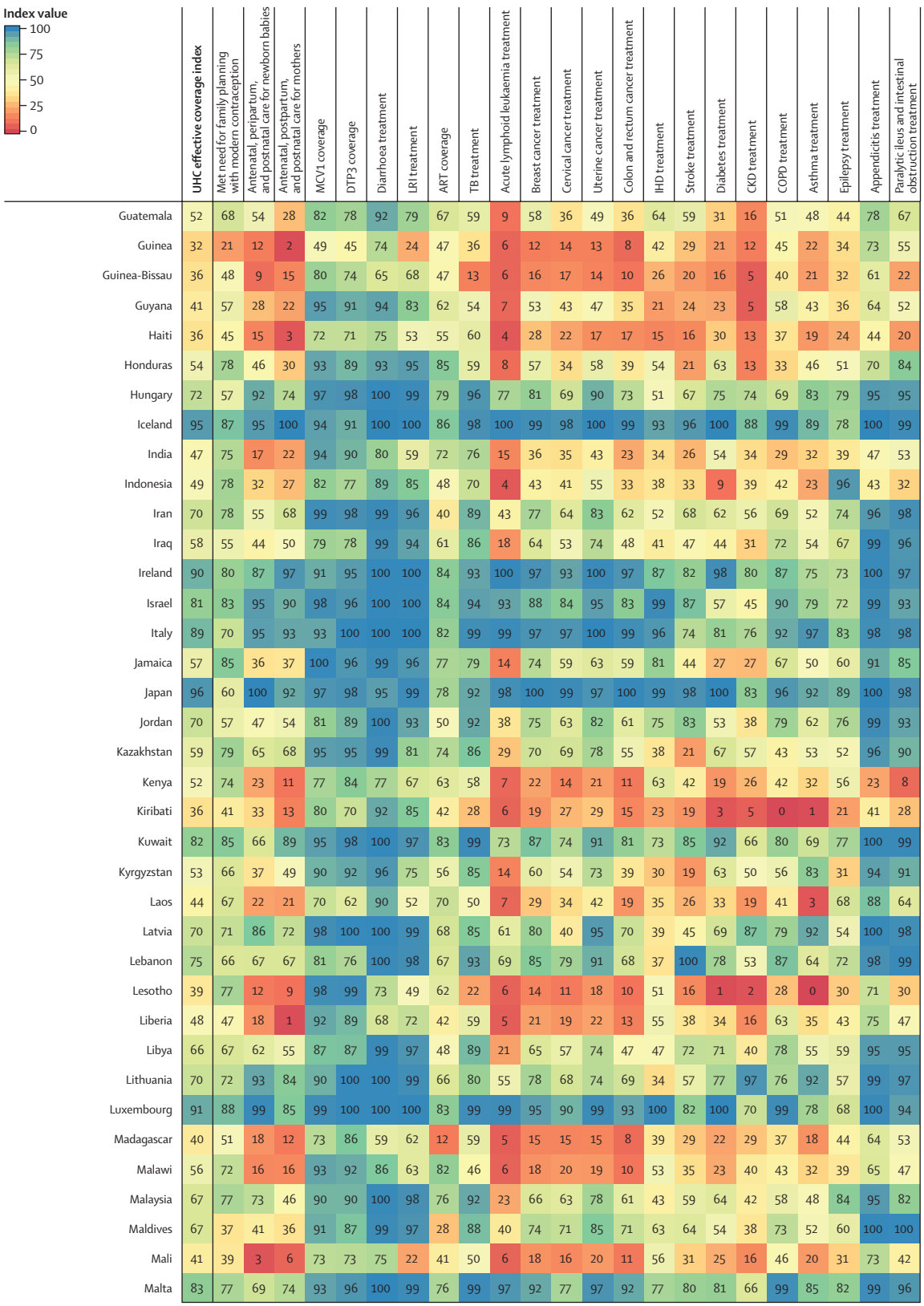

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Guatemala	52	68	54	28	82	78	92	79	67	59	9	58	36	49	36	64	59	31	16	51	48	44	78	67
Guinea	32	21	12	2	49	45	74	24	47	36	6	12	14	13	8	42	29	21	12	45	22	34	73	55
Guinea-Bissau	36	48	9	15	80	74	65	68	47	13	6	16	17	14	10	26	20	16	5	40	21	32	61	22
Guyana	41	57	28	22	95	91	94	83	62	54	7	53	43	47	35	21	24	23	5	58	43	36	64	52
Haiti	36	45	15	3	72	71	75	53	55	60	4	28	22	17	17	15	16	30	13	37	19	24	44	20
Honduras	54	78	46	30	93	89	93	95	85	59	8	57	34	58	39	54	21	63	13	33	46	51	70	84
Hungary	72	57	92	74	97	98	100	99	79	96	77	81	69	90	73	51	67	75	74	69	83	79	95	95
Iceland	95	87	95	100	94	91	100	100	86	98	100	99	98	100	99	93	96	100	88	99	89	78	100	99
India	47	75	17	22	94	90	80	59	72	76	15	36	35	43	23	34	26	54	34	29	32	39	47	53
Indonesia	49	78	32	27	82	77	89	85	48	70	4	43	41	55	33	38	33	9	39	42	23	96	43	32
Iran	70	78	55	68	99	98	99	96	40	89	43	77	64	83	62	52	68	62	56	69	52	74	96	98
Iraq	58	55	44	50	79	78	99	94	61	86	18	64	53	74	48	41	47	44	31	72	54	67	99	96
Ireland	90	80	87	97	91	95	100	100	84	93	100	97	93	100	97	87	82	98	80	87	75	73	100	97
Israel	81	83	95	90	98	96	100	100	84	94	93	88	84	95	83	99	87	57	45	90	79	72	99	93
Italy	89	70	95	93	93	100	100	100	82	99	99	97	97	100	99	96	74	81	76	92	97	83	98	98
Jamaica	57	85	36	37	100	96	99	96	77	79	14	74	59	63	59	81	44	27	27	67	50	60	91	85
Japan	96	60	100	92	97	98	95	99	78	92	98	100	99	97	100	99	98	100	83	96	92	89	100	98
Jordan	70	57	47	54	81	89	100	93	50	92	38	75	63	82	61	75	83	53	38	79	62	76	99	93
Kazakhstan	59	79	65	68	95	95	99	81	74	86	29	70	69	78	55	38	21	67	57	43	53	52	96	90
Kenya	52	74	23	11	77	84	77	67	63	58	7	22	14	21	11	63	42	19	26	42	32	56	23	8
Kiribati	36	41	33	13	80	70	92	85	42	28	6	19	27	29	15	23	19	3	5	0	1	21	41	28
Kuwait	82	85	66	89	95	98	100	97	83	99	73	87	74	91	81	73	85	92	66	80	69	77	100	99
Kyrgyzstan	53	66	37	49	90	92	96	75	56	85	14	60	54	73	39	30	19	63	50	56	83	31	94	91
Laos	44	67	22	21	70	62	90	52	70	50	7	29	34	42	19	35	26	33	19	41	3	68	88	64
Latvia	70	71	86	72	98	100	100	99	68	85	61	80	40	95	70	39	45	69	87	79	92	54	100	98
Lebanon	75	66	67	67	81	76	100	98	67	93	69	85	79	91	68	37	100	78	53	87	64	72	98	99
Lesotho	39	77	12	9	98	99	73	49	62	22	6	14	11	18	10	51	16	1	2	28	0	30	71	30
Liberia	48	47	18	1	92	89	68	72	42	59	5	21	19	22	13	55	38	34	16	63	35	43	75	47
Libya	66	67	62	55	87	87	99	97	48	89	21	65	57	74	47	47	72	71	40	78	55	59	95	95
Lithuania	70	72	93	84	90	100	100	99	66	80	55	78	68	74	69	34	57	77	97	76	92	57	99	97
Luxembourg	91	88	99	85	99	100	100	100	83	99	99	95	90	99	93	100	82	100	70	99	78	68	100	94
Madagascar	40	51	18	12	73	86	59	62	12	59	5	15	15	15	8	39	29	22	29	37	18	44	64	53
Malawi	56	72	16	16	93	92	86	63	82	46	6	18	20	19	10	53	35	23	40	43	32	39	65	47
Malaysia	67	77	73	46	90	90	100	98	76	92	23	66	63	78	61	43	59	64	42	58	48	84	95	82
Maldives	67	37	41	36	91	87	99	97	28	88	40	74	71	85	71	63	64	54	38	73	52	60	100	100
Mali	41	39	3	6	73	73	75	22	41	50	6	18	16	20	11	56	31	25	16	46	20	31	73	42
Malta	83	77	69	74	93	96	100	99	76	99	97	92	77	97	92	77	80	81	66	99	85	82	99	96

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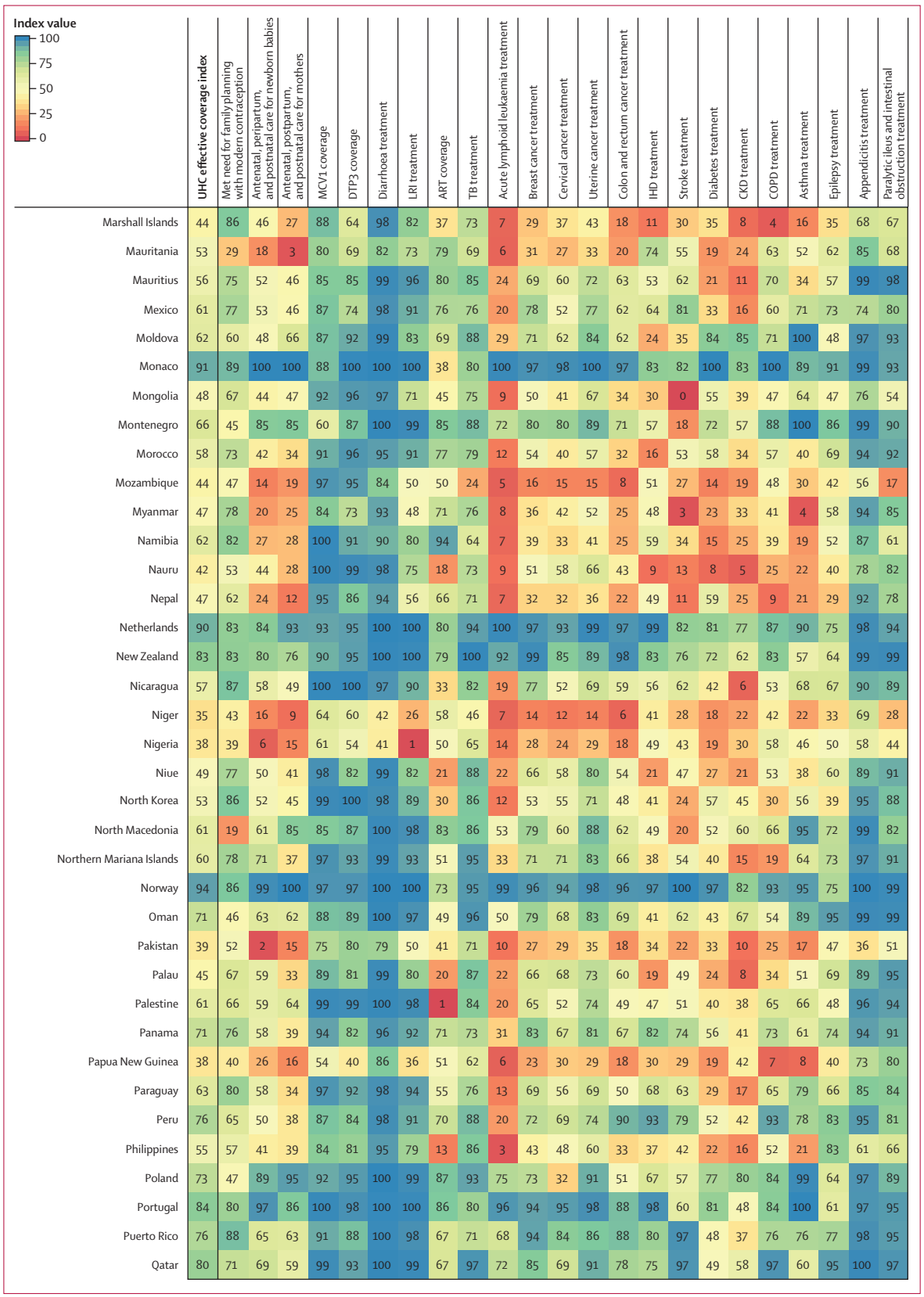

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Marshall Islands	44	86	46	27	88	64	98	82	37	73	7	29	37	43	18	11	30	35	8	4	16	35	68	67
Mauritania	53	29	18	3	80	69	82	73	79	69	6	31	27	33	20	74	55	19	24	63	52	62	85	68
Mauritius	56	75	52	46	85	85	99	96	80	85	24	69	60	72	63	53	62	21	11	70	34	57	99	98
Mexico	61	77	53	46	87	74	98	91	76	76	20	78	52	77	62	64	81	33	16	60	71	73	74	80
Moldova	62	60	48	66	87	92	99	83	69	88	29	71	62	84	62	24	35	84	85	71	100	48	97	93
Monaco	91	89	100	100	88	100	100	100	38	80	100	97	98	100	97	83	82	100	83	100	89	91	99	93
Mongolia	48	67	44	47	92	96	97	71	45	75	9	50	41	67	34	30	0	55	39	47	64	47	76	54
Montenegro	66	45	85	85	60	87	100	99	85	88	72	80	80	89	71	57	18	72	57	88	100	86	99	90
Morocco	58	73	42	34	91	96	95	91	77	79	12	54	40	57	32	16	53	58	34	57	40	69	94	92
Mozambique	44	47	14	19	97	95	84	50	50	24	5	16	15	15	8	51	27	14	19	48	30	42	56	17
Myanmar	47	78	20	25	84	73	93	48	71	76	8	36	42	52	25	48	3	23	33	41	4	58	94	85
Namibia	62	82	27	28	100	91	90	80	94	64	7	39	33	41	25	59	34	15	25	39	19	52	87	61
Nauru	42	53	44	28	100	99	98	75	18	73	9	51	58	66	43	9	13	8	5	25	22	40	78	82
Nepal	47	62	24	12	95	86	94	56	66	71	7	32	32	36	22	49	11	59	25	9	21	29	92	78
Netherlands	90	83	84	93	93	95	100	100	80	94	100	97	93	99	97	99	82	81	77	87	90	75	98	94
New Zealand	83	83	80	76	90	95	100	100	79	100	92	99	85	89	98	83	76	72	62	83	57	64	99	99
Nicaragua	57	87	58	49	100	100	97	90	33	82	19	77	52	69	59	56	62	42	6	53	68	67	90	89
Niger	35	43	16	9	64	60	42	26	58	46	7	14	12	14	6	41	28	18	22	42	22	33	69	28
Nigeria	38	39	6	15	61	54	41	1	50	65	14	28	24	29	18	49	43	19	30	58	46	50	58	44
Niue	49	77	50	41	98	82	99	82	21	88	22	66	58	80	54	21	47	27	21	53	38	60	89	91
North Korea	53	86	52	45	99	100	98	89	30	86	12	53	55	71	48	41	24	57	45	30	56	39	95	88
North Macedonia	61	19	61	85	85	87	100	98	83	86	53	79	60	88	62	49	20	52	60	66	95	72	99	82
Northern Mariana Islands	60	78	71	37	97	93	99	93	51	95	33	71	71	83	66	38	54	40	15	19	64	73	97	91
Norway	94	86	99	100	97	97	100	100	73	95	99	96	94	98	96	97	100	97	82	93	95	75	100	99
Oman	71	46	63	62	88	89	100	97	49	96	50	79	68	83	69	41	62	43	67	54	89	95	99	99
Pakistan	39	52	2	15	75	80	79	50	41	71	10	27	29	35	18	34	22	33	10	25	17	47	36	51
Palau	45	67	59	33	89	81	99	80	20	87	22	66	68	73	60	19	49	24	8	34	51	69	89	95
Palestine	61	66	59	64	99	99	100	98	1	84	20	65	52	74	49	47	51	40	38	65	66	48	96	94
Panama	71	76	58	39	94	82	96	92	71	73	31	83	67	81	67	82	74	56	41	73	61	74	94	91
Papua New Guinea	38	40	26	16	54	40	86	36	51	62	6	23	30	29	18	30	29	19	42	7	8	40	73	80
Paraguay	63	80	58	34	97	92	98	94	55	76	13	69	56	69	50	68	63	29	17	65	79	66	85	84
Peru	76	65	50	38	87	84	98	91	70	88	20	72	69	74	90	93	79	52	42	93	78	83	95	81
Philippines	55	57	41	39	84	81	95	79	13	86	3	43	48	60	33	37	42	22	16	52	21	83	61	66
Poland	73	47	89	95	92	95	100	99	87	93	75	73	32	91	51	67	57	77	80	84	99	64	97	89
Portugal	84	80	97	86	100	98	100	100	86	80	96	94	95	98	88	98	60	81	48	84	100	61	97	95
Puerto Rico	76	88	65	63	91	88	100	98	67	71	68	94	84	86	88	80	97	48	37	76	76	77	98	95
Qatar	80	71	69	59	99	93	100	99	67	97	72	85	69	91	78	75	97	49	58	97	60	95	100	97

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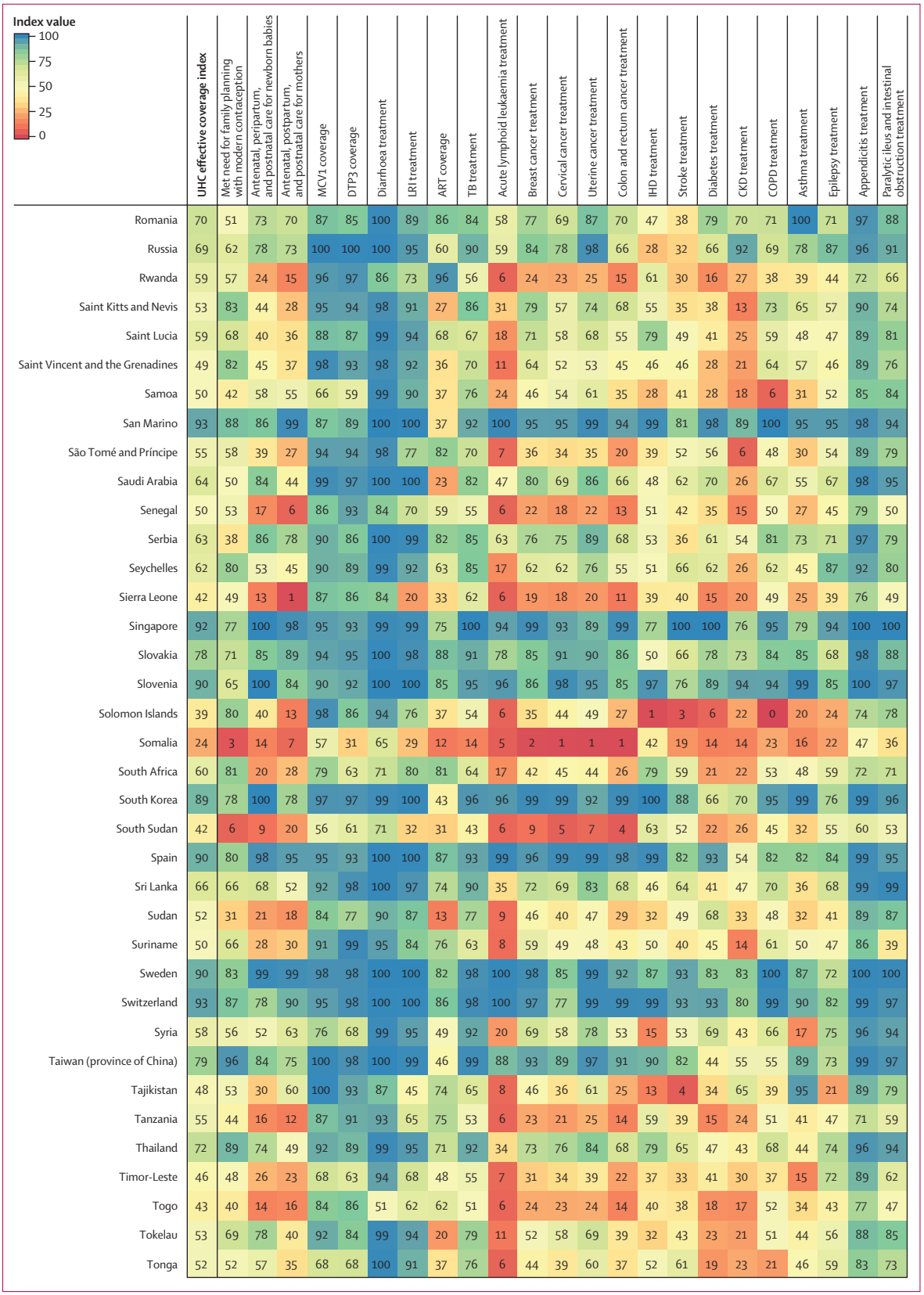

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Romania	70	51	73	70	87	85	100	89	86	84	58	77	69	87	70	47	38	79	70	71	100	71	97	88
Russia	69	62	78	73	100	100	100	95	60	90	59	84	78	98	66	28	32	66	92	69	78	87	96	91
Rwanda	59	57	24	15	96	97	86	73	96	56	6	24	23	25	15	61	30	16	27	38	39	44	72	66
Saint Kitts and Nevis	53	83	44	28	95	94	98	91	27	86	31	79	57	74	68	55	35	38	13	73	65	57	90	74
Saint Lucia	59	68	40	36	88	87	99	94	68	67	18	71	58	68	55	79	49	41	25	59	48	47	89	81
Saint Vincent and the Grenadines	49	82	45	37	98	93	98	92	36	70	11	64	52	53	45	46	46	28	21	64	57	46	89	76
Samoa	50	42	58	55	66	59	99	90	37	76	24	46	54	61	35	28	41	28	18	6	31	52	85	84
San Marino	93	88	86	99	87	89	100	100	37	92	100	95	95	99	94	99	81	98	89	100	95	95	98	94
São Tomé and Príncipe	55	58	39	27	94	94	98	77	82	70	7	36	34	35	20	39	52	56	6	48	30	54	89	79
Saudi Arabia	64	50	84	44	99	97	100	100	23	82	47	80	69	86	66	48	62	70	26	67	55	67	98	95
Senegal	50	53	17	6	86	93	84	70	59	55	6	22	18	22	13	51	42	35	15	50	27	45	79	50
Serbia	63	38	86	78	90	86	100	99	82	85	63	76	75	89	68	53	36	61	54	81	73	71	97	79
Seychelles	62	80	53	45	90	89	99	92	63	85	17	62	62	76	55	51	66	62	26	62	45	87	92	80
Sierra Leone	42	49	13	1	87	86	84	20	33	62	6	19	18	20	11	39	40	15	20	49	25	39	76	49
Singapore	92	77	100	98	95	93	99	99	75	100	94	99	93	89	99	77	100	100	76	95	79	94	100	100
Slovakia	78	71	85	89	94	95	100	98	88	91	78	85	91	90	86	50	66	78	73	84	85	68	98	88
Slovenia	90	65	100	84	90	92	100	100	85	95	96	86	98	95	85	97	76	89	94	94	99	85	100	97
Solomon Islands	39	80	40	13	98	86	94	76	37	54	6	35	44	49	27	1	3	6	22	0	20	24	74	78
Somalia	24	3	14	7	57	31	65	29	12	14	5	2	1	1	1	42	19	14	14	23	16	22	47	36
South Africa	60	81	20	28	79	63	71	80	81	64	17	42	45	44	26	79	59	21	22	53	48	59	72	71
South Korea	89	78	100	78	97	97	99	100	43	96	96	99	99	92	99	100	88	66	70	95	99	76	99	96
South Sudan	42	6	9	20	56	61	71	32	31	43	6	9	5	7	4	63	52	22	26	45	32	55	60	53
Spain	90	80	98	95	95	93	100	100	87	93	99	96	99	99	98	99	82	93	54	82	82	84	99	95
Sri Lanka	66	66	68	52	92	98	100	97	74	90	35	72	69	83	68	46	64	41	47	70	36	68	99	99
Sudan	52	31	21	18	84	77	90	87	13	77	9	46	40	47	29	32	49	68	33	48	32	41	89	87
Suriname	50	66	28	30	91	99	95	84	76	63	8	59	49	48	43	50	40	45	14	61	50	47	86	39
Sweden	90	83	99	99	98	98	100	100	82	98	100	98	85	99	92	87	93	83	83	100	87	72	100	100
Switzerland	93	87	78	90	95	98	100	100	86	98	100	97	77	99	99	99	93	93	80	99	90	82	99	97
Syria	58	56	52	63	76	68	99	95	49	92	20	69	58	78	53	15	53	69	43	66	17	75	96	94
Taiwan (province of China)	79	96	84	75	100	98	100	99	46	99	88	93	89	97	91	90	82	44	55	55	89	73	99	97
Tajikistan	48	53	30	60	100	93	87	45	74	65	8	46	36	61	25	13	4	34	65	39	95	21	89	79
Tanzania	55	44	16	12	87	91	93	65	75	53	6	23	21	25	14	59	39	15	24	51	41	47	71	59
Thailand	72	89	74	49	92	89	99	95	71	92	34	73	76	84	68	79	65	47	43	68	44	74	96	94
Timor-Leste	46	48	26	23	68	63	94	68	48	55	7	31	34	39	22	37	33	41	30	37	15	72	89	62
Togo	43	40	14	16	84	86	51	62	62	51	6	24	23	24	14	40	38	18	17	52	34	43	77	47
Tokelau	53	69	78	40	92	84	99	94	20	79	11	52	58	69	39	32	43	23	21	51	44	56	88	85
Tonga	52	52	57	35	68	68	100	91	37	76	6	44	39	60	37	52	61	19	23	21	46	59	83	73

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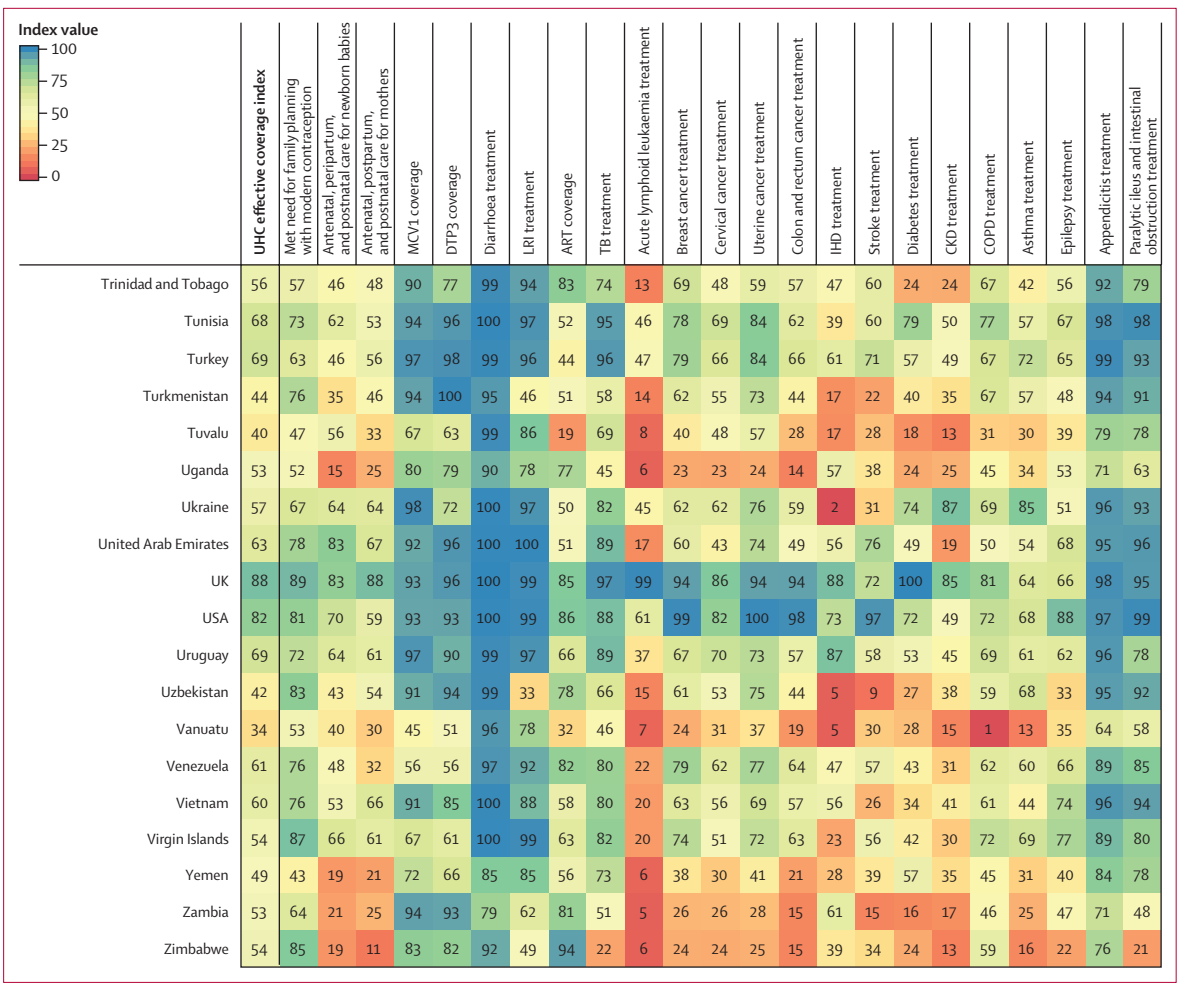

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Trinidad and Tobago	56	57	46	48	90	77	99	94	83	74	13	69	48	59	57	47	60	24	24	67	42	56	92	79
Tunisia	68	73	62	53	94	96	100	97	52	95	46	78	69	84	62	39	60	79	50	77	57	67	98	98
Turkey	69	63	46	56	97	98	99	96	44	96	47	79	66	84	66	61	71	57	49	67	72	65	99	93
Turkmenistan	44	76	35	46	94	100	95	46	51	58	14	62	55	73	44	17	22	40	35	67	57	48	94	91
Tuvalu	40	47	56	33	67	63	99	86	19	69	8	40	48	57	28	17	28	18	13	31	30	39	79	78
Uganda	53	52	15	25	80	79	90	78	77	45	6	23	23	24	14	57	38	24	25	45	34	53	71	63
Ukraine	57	67	64	64	98	72	100	97	50	82	45	62	62	76	59	2	31	74	87	69	85	51	96	93
United Arab Emirates	63	78	83	67	92	96	100	100	51	89	17	60	43	74	49	56	76	49	19	50	54	68	95	96
UK	88	89	83	88	93	96	100	99	85	97	99	94	86	94	94	88	72	100	85	81	64	66	98	95
USA	82	81	70	59	93	93	100	99	86	88	61	99	82	100	98	73	97	72	49	72	68	88	97	99
Uruguay	69	72	64	61	97	90	99	97	66	89	37	67	70	73	57	87	58	53	45	69	61	62	96	78
Uzbekistan	42	83	43	54	91	94	99	33	78	66	15	61	53	75	44	5	9	27	38	59	68	33	95	92
Vanuatu	34	53	40	30	45	51	96	78	32	46	7	24	31	37	19	5	30	28	15	1	13	35	64	58
Venezuela	61	76	48	32	56	56	97	92	82	80	22	79	62	77	64	47	57	43	31	62	60	66	89	85
Vietnam	60	76	53	66	91	85	100	88	58	80	20	63	56	69	57	56	26	34	41	61	44	74	96	94
Virgin Islands	54	87	66	61	67	61	100	99	63	82	20	74	51	72	63	23	56	42	30	72	69	77	89	80
Yemen	49	43	19	21	72	66	85	85	56	73	6	38	30	41	21	28	39	57	35	45	31	40	84	78
Zambia	53	64	21	25	94	93	79	62	81	51	5	26	26	28	15	61	15	16	17	46	25	47	71	48
Zimbabwe	54	85	19	11	83	82	92	49	94	22	6	24	24	25	15	39	34	24	13	59	16	22	76	21

Figure 4: **Performance on the UHC effective coverage index and 23 effective coverage indicators, by location, in 2019**
Locations are reported in alphabetical order. The UHC effective coverage index and individual effective coverage indicators are reported on a scale of 0–100. Four indicators (met need for family planning, MCV1 coverage, DTP3 coverage, and ART coverage) are based on intervention coverage, whereas the remaining effective coverage indicators use measures such as mortality-to-incidence ratios to approximate access to quality care; inputs and measurement approaches for each indicator and index are further described in appendix 1 (pp 30–32). ART=antiretroviral therapy. CKD=chronic kidney disease. COPD=chronic obstructive pulmonary disease. DTP3=diphtheria, tetanus, pertussis vaccine, 3 doses. IHD=ischaemic heart disease. LRI=lower respiratory infection. MCV1=measles-containing vaccine, 1 dose. TB=tuberculosis. UHC=universal health coverage.

Many countries with middle-range performance on UHC effective coverage (ie, about 45–70) in 2019 had a mixture of fairly high values on most indicators for communicable diseases and reproductive, neonatal, maternal, and child health but comparatively lower scores on many non-communicable diseases, likely mirroring their variable epidemiological profiles and thus populations' health needs. For some countries, especially those in sub-Saharan Africa (eg, Namibia, Rwanda, and Kenya), communicable diseases (eg, HIV) and reproductive, neonatal, maternal, and child health still ranked among indicators with highest potential health gains in 2019, even though non-communicable diseases such as cardiovascular diseases and diabetes are on the rise.[35] With their fairly high levels of coverage or services proxied by effective coverage indicators for communicable diseases and for reproductive, neonatal, maternal, and child health, several of these countries had higher UHC effective coverage index performance under a health gains weighting approach than under the assumption that each effective coverage indicator could deliver equal health gains to populations across different settings (figure 2). By contrast, in many other countries—especially those in Latin America, central and eastern Europe, and Oceania—non-communicable diseases accounted for a greater proportion of potential health gains by 2019; consequently, these countries' relatively poor performances on several effective coverage indicators proxying non-communicable disease services underpinned lower overall UHC effective coverage index values. High levels of vaccine coverage and performance on effective coverage indicators such as maternal care still contributed to UHC effective coverage performance for such countries; however, these health areas generally

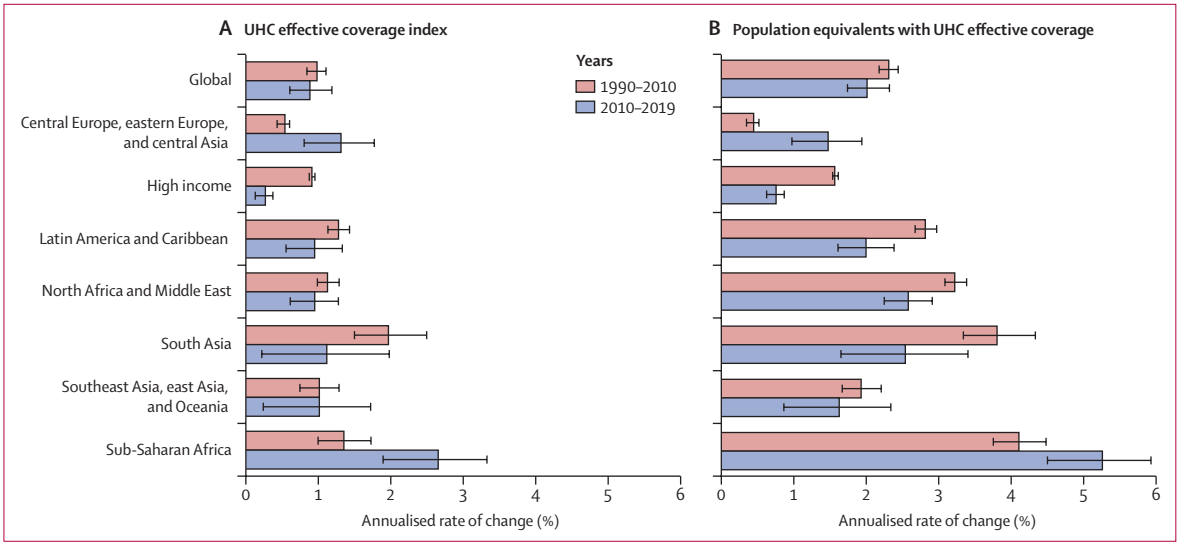

Figure 5: **Annualised rate of change in the UHC effective coverage index (A) and population equivalents with UHC effective coverage (B), globally and by GBD super-region, 1990–2010 and 2010–2019**

Values reflect the average annualised rate of change on the UHC effective coverage index and population equivalents with UHC effective coverage between each time period. Population equivalents are based on taking the UHC effective coverage index as a fraction and multiplying these values by the total population for a given location-year to approximate populations covered with UHC effective coverage. UHC=universal health coverage. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

represented a smaller fraction of population-level health gains than many non-communicable diseases in these settings. Health gain weights, by country and territory, for each effective coverage indicator are available in the appendix 2 (pp 11–13) and via online data tools.

For more on the **online data tools** see http://ghdx.healthdata.org/gbd-2019

Pace of progress on UHC effective coverage

Since 1990, UHC effective coverage performance improved, albeit at variable rates of progress over time and across GBD super-regions (figure 5). The global average increased from 45·8 (95% UI 44·2–47·5) in 1990 to 60·3 (58·7–61·9) in 2019, while the absolute range in performance essentially remained the same (ie, 73·0-point difference in 1990 *vs* 74·0-point difference in 2019). By 2019, the UHC effective coverage index spanned from 95 or higher in Japan (96·3 [95·0–97·4]) and Iceland (95·3 [93·6–96·8]) to lower than 25 in the Central African Republic (22·3 [16·3–29·3]) and Somalia (23·9 [17·1–31·1]; appendix 2 pp 14–20). Globally, the pace of progress on UHC effective coverage was somewhat slower, albeit not significantly, from 2010 to 2019 (0·9% [0·6–1·2] annualised increase) than from 1990 to 2010 (1·0% [0·8–1·1] annualised increase). Similarly, at the global level, annualised rates of change for population equivalents with effective coverage were slightly lower from 2010 to 2019 (2·0% [1·7–2·3]) than from 1990 to 2010 (2·3% [2·2–2·4]), although this difference was not significant. However, some of these patterns diverged by GBD super-region (figure 5), as well as at the country level (appendix 2, pp 14–20). For instance, in sub-Saharan Africa, UHC effective coverage index performance improved at an average of 2·6% (1·9–3·3) per year from 2010 to 2019, surpassing its annualised rate of change from 1990 to 2010 (1·3% [1·0–1·7] average increase per year). Central Europe, eastern Europe, and central Asia also had significantly faster progress from 2010 to 2019 (1·4% [0·8–1·8] average annual increase) than from 1990 to 2010 (0·5% [0·4–0·6] annual increase).

Relationship between health expenditure and UHC effective coverage

Country-level performance on UHC effective coverage widely varied across different levels of pooled health spending per capita (figure 6), highlighting how increased health spending is necessary but insufficient on its own to improve UHC effective coverage. Overall, the UHC effective coverage index was associated with pooled health spending per capita (r=0·79), but this relationship was varied at different levels of spending. Up to about $2500 (US$, adjusted for purchasing power parity) in pooled health spending per capita, increasingly higher expenditures generally paralleled higher performance on UHC effective coverage index; beyond that, higher expenditures did not correspond as consistently with further improvements in UHC effective coverage performance.

The UHC effective coverage frontier charts the highest UHC effective coverage performances, as achieved by countries in 2019, across different levels of pooled health spending per capita (figure 6); in other words, this frontier represents the relative efficiency—or inefficiency—with which countries could translate their health spending into improved UHC effective coverage. Countries including South Korea, Cyprus, Costa Rica, Peru, and

Rwanda were among those setting this performance frontier at their corresponding levels of pooled health expenditure per capita. Conversely, countries across the sociodemographic spectrum (ie, Central African Republic, Lesotho, Turkmenistan, Saudi Arabia, and the USA) showed large gaps between their estimated UHC effective coverage index performances in 2019 and what could have been achievable on the UHC effective coverage frontier given these countries' levels of pooled health spending. To reach a UHC effective coverage index of at least 80, under maximum efficiency, countries would need to reach US$1398 in pooled health spending per capita (per year). Equivalent analyses and figures for total health expenditure per capita (ie, pooled health spending plus out-of-pocket spending) and pooled domestic health expenditure per capita (ie, pooled health spending minus development assistance for health) are provided in appendix 2 (pp 6–7).

Counting population equivalents with effective coverage for the UHC billion target

Based on current projections, an estimated 5·0 billion (95% UI 4·8–5·1) population equivalents would have UHC effective coverage in 2023 (table 3). This would translate to 388·9 million (358·6–421·3) more population equivalents with UHC effective coverage over the five-year GPW13 evaluation period (2019–23, with 2018 as the baseline), or the equivalent of adding an average of 77·8 million (71·7–84·3) population equivalents per year during this time. From 2018 to 2023, sub-Saharan Africa was estimated to contribute the most additional population equivalents with UHC effective coverage (ie, 94·5 million [83·6–104·8]). By 2023, an estimated 3·1 billion (3·0–3·2) population equivalents would not have UHC effective coverage, with nearly a third residing in south Asia (ie, an estimated 968·1 million [903·5–1040·3]).

Discussion

Summary of the main findings

The present study offers a new approach to monitoring progress on UHC service coverage: measuring country-level effective coverage and thus better representing how well health systems are delivering health gains relative to their populations' health needs. Amid global advances on the UHC effective coverage index since 1990, our findings show a gap of more than 70 points between locations with the highest and lowest levels of UHC effective coverage remained in 2019. Particularly among low-middle to middle-SDI countries, performance of effective coverage indicators for non-communicable diseases was far lower than levels reached for several communicable diseases and maternal and child health indicators—a pattern suggesting that many countries' health systems and financing priorities are not moving as quickly as their epidemiological and demographic transitions. Higher pooled health spending per capita generally corresponded with higher UHC effective

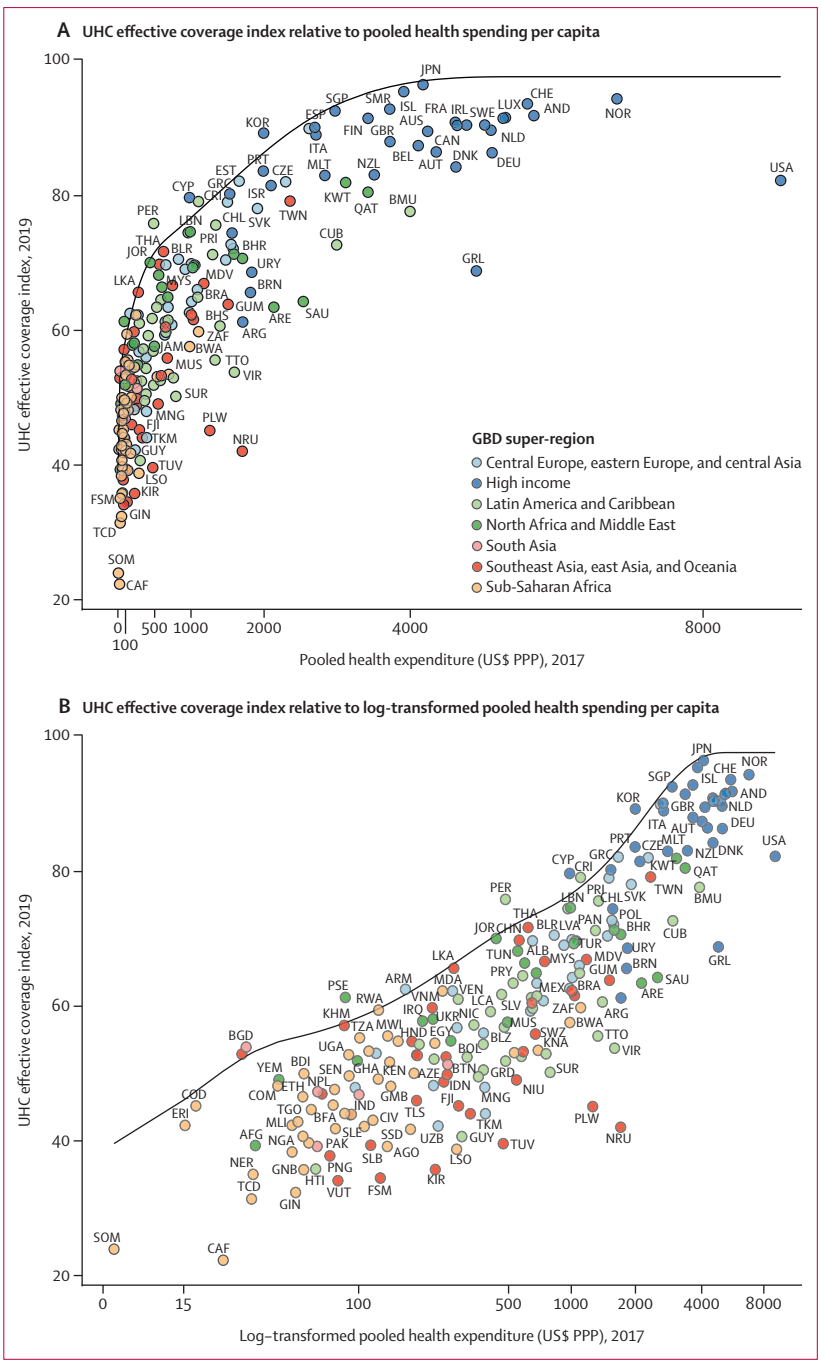

Figure 6: **UHC effective coverage index frontier relative to pooled health spending per capita (A) and log-transformed pooled health spending per capita (B)**

Pooled health spending per capita includes government health expenditures, prepaid private expenditures, and development assistance for health. All health spending estimates are for 2017 measured in 2019 PPP-adjusted US$ adjusted for inflation. The black line represents the frontier values estimated for UHC effective coverage in 2019 relative to spending per capita in 2017. Locations are colour-coded by GBD super-region, with a subset abbreviated according to their ISO3 codes. ISO3 codes and corresponding location names are listed in appendix 1 (pp 64–68). UHC=universal health coverage. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. PPP=purchasing-power parity.

	UHC effective coverage index (95% UIs)		Population equivalents with UHC effective coverage (95% UI)*		
	2018	2023	Added from 2018–23	Covered in 2023	Not covered in 2023
Global	59·8 (58·3 to 61·3)	61·7 (60·1 to 63·3)	388·9 (358·6 to 421·3)	5·0 billion (4·8 to 5·1)	3·1 billion (3·0 to 3·2)
Central Europe, eastern Europe, and central Asia	63·2 (61·0 to 65·5)	65·2 (62·7 to 67·6)	9·1 (7·5 to 10·9)	273·0 (262·5 to 282·8)	145·5 (135·7 to 156·1)
High income	85·8 (84·3 to 87·1)	87·1 (85·5 to 88·5)	31·6 (28·8 to 34·3)	958·3 (940·7 to 972·8)	141·5 (127·0 to 159·1)
Latin America and Caribbean	63·2 (61·1 to 65·1)	65·6 (63·3 to 67·8)	33·6 (30·8 to 36·5)	398·5 (384·7 to 412·0)	209·0 (195·6 to 222·8)
North Africa and Middle East	60·0 (57·9 to 61·9)	61·9 (59·6 to 64·0)	43·0 (39·8 to 45·9)	402·3 (387·6 to 416·1)	247·8 (233·9 to 262·5)
South Asia	46·0 (42·6 to 49·2)	48·4 (44·6 to 51·9)	88·9 (73·5 to 102·8)	909·4 (837·2 to 974·0)	968·1 (903·5 to 1040·3)
Southeast Asia, east Asia, and Oceania	64·2 (60·7 to 67·6)	66·9 (63·0 to 70·5)	88·2 (74·4 to 102·8)	1·5 billion (1·4 to 1·5)	726·3 (647·9 to 811·6)
Sub-Saharan Africa	43·9 (41·4 to 46·5)	46·2 (43·3 to 49·1)	94·5 (83·6 to 104·8)	555·6 (521·1 to 590·1)	647·1 (612·7 to 681·7)

Population equivalents based on taking the UHC effective coverage index as a fraction and multiplying these values by total population for a given location-year to approximate populations covered with UHC effective coverage. UHC=universal health coverage. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. 95% UI=95% uncertainty interval. *Reported in millions unless otherwise indicated.

Table 3: **Projected UHC effective coverage performance in 2023 and additional population equivalents with UHC effective coverage from 2018 to 2023, globally and by GBD super-region**

coverage. Nonetheless, country-level performance varied widely and many countries fell well below levels achieved by other countries with similar amounts of health expenditures, emphasising the importance of increasing both health-system efficiencies and funding for UHC. To achieve at least 80 on the UHC effective coverage index, countries would need to reach $1398 pooled spending per capita—and do so under maximum efficiency. An estimated 388·9 million more population equivalents would have UHC effective coverage between 2018 and 2023, falling well short of the GPW13 target of 1 billion more people benefiting from UHC during this time. Genuinely advancing toward UHC requires prioritising—and thus monitoring—effective coverage and health systems' capacities for improving outcomes for all people throughout the world.

Past progress, current challenges, and accelerating future gains on UHC effective coverage

By 2019, UHC effective coverage improved substantially for many countries, and for some countries the pace of progress has accelerated since 2010. This was particularly evident in sub-Saharan Africa; this GBD super-region nearly doubled its average annual improvements from 2010 to 2019 compared to 1990–2010. Such gains could be related to heightened funding—and thus prioritisation—for HIV, vaccines and childhood infectious diseases, and maternal health during the Millennium Development Goal (MDG) era.[61,62] As further illustrated by the UHC effective coverage frontier, up to about $2500 per capita, rising levels of UHC effective coverage index generally paralleled pooled health spending; this trend highlights the important role of increasing funding for UHC to jumpstart progress, particularly for countries that still have very low UHC effective coverage in 2019. Yet even at the frontier, reaching better UHC effective coverage performance requires much higher pooled health spending per year: an estimated $1398 per capita to reach 80, and then $2538 per capita to reach 90 and $3424 per capita to reach 95. At present, the only countries achieving 90 or higher on the UHC effective coverage index and such levels of pooled health spending per capita are within the high-income GBD super-region. Substantially increasing total health spending could be one avenue for elevating UHC effective coverage performance; however, many countries still have high out-of-pocket spending relative to their total spending,[56,61] which is strongly related to household catastrophic health expenditures and directly counter to improving financial risk protection within UHC. Focusing on domestic heath spending while also elevating efficiency could be another viable route; our results show that many countries would theoretically achieve much higher UHC effective coverage if they could better translate current amounts of pooled spending per capita into improved performance. How to best address such inefficiencies will markedly vary across contexts, and will require accounting for country-level differences in health-system orientations and structures, political stability and governance systems, and distribution of health resources among populations. Further examination of approaches used by countries near or at the UHC effective coverage frontier relative to their pooled health spending (eg, Rwanda, Peru, South Korea, and Costa Rica) might help identify tractable policy pathways to improved efficiency.

Poor performance on various non-communicable diseases has severely hindered progress on UHC effective coverage in many countries—a trend that is likely to only worsen until quality health services for non-communicable diseases are better prioritised by countries and development partners alike. Especially among low-middle SDI to middle-SDI countries, earlier advances on UHC effective coverage were mainly propelled by improving health services focused on communicable diseases, child health, and maternal care. As cardiovascular disease, diabetes, cancers, and other

non-communicable diseases became leading causes of early death and disability, they also emerged as population health needs with the highest potential health gains—that is, where health systems could increasingly deliver the most improved outcomes via effective coverage of interventions and services. Re-orienting countries' health systems towards providing effective health services for non-communicable disease is not trivial, especially if their prior focus (and funding) had a more limited scope for the types of services provided, equipment used, and health workforce training required. However, continued inaction also has likely costs: if health systems remain too focused on health problems of the past, and fail to effectively respond to where the largest potential health gains exist today, it can be increasingly difficult to translate current levels of health spending into improved UHC effective coverage. For instance, only a few high-SDI countries (eg, Japan, Switzerland, and South Korea) averaged non-communicable disease performance equal to or higher than effective coverage indicators focused on communicable diseases and maternal and child health by 2019.[63] Unless deliberate efforts are taken now to recalibrate health-system and funding priorities, the ability to alter current trajectories for UHC effective coverage could diminish.

To catalyse faster gains in the SDG era, WHO's GPW13 set forth its bold billion targets,[6] with the UHC target calling for 1 billion more people benefiting from UHC by 2023, relative to 2018. Current projections have the world falling well short of this ambition, with an estimated 388·9 million (358·6–421·3) more population equivalents having UHC effective coverage by 2023. Even these estimates are likely to be optimistic, as they do not account for trends in financial risk protection—the other key dimension of UHC—nor do they explicitly account for populations' needs for multiple health services. Nonetheless, this initial assessment offers important considerations for the remaining years of GPW13 and then through to 2030. With more than 3 billion population equivalents estimated to lack UHC effective coverage in 2023, targeting populous regions or countries that currently have low UHC effective coverage and investing in service expansion could be one option to accelerating future progress. For instance, south Asia, in combination with southeast Asia, east Asia, and Oceania, was estimated to have nearly 1·7 billion population equivalents without UHC effective coverage in 2023. However, on the basis of current levels of health spending, many countries in these regions already fell below their potential UHC effective coverage performance in 2019. For most countries, heightened health spending alone is unlikely to deliver on ambitious UHC targets; rather, a combination of improving alignment of health systems with population health needs and bolstering efficiencies is likely to chart faster and perhaps more sustained gains.

Current challenges and future directions for measuring UHC effective coverage

Our measurement framework is grounded in the construct of effective coverage at the health-system level,[16] aiming to represent a country's ability to improve health outcomes in accordance with the health needs and disease burden of its population. From this perspective, effective coverage should capture the fraction of potential population-level health gains actually delivered by the health system, relative to what the health system could have provided at maximum performance of current interventions or services. As such, we used health gain weights to construct the overall UHC effective coverage index and to more heavily weight effective coverage indicators for which a given country's health could produce greater health gains through available interventions. By contrast, the unweighted average of effective coverage indicators implies equal potential health gains irrespective of a country's epidemiological profile or effectiveness of the associated interventions or services, or a combination of both. Equally weighting interventions and their potential for improving health is directly counter to the reality of UHC programmes, which are subject to each country's unique health-system structures, political demands, and health priorities. To capture what can—or should—be achievable through health systems' provision of effective services, we believe the health gains weighting approach can better track country-led UHC investments and policy implementation. Going forward, assessments of UHC effective coverage should strive to apply this method beyond the national level, aiming to capture inequalities in potential health gains not only by location but also within population-age groups, by sex, and across other important sociodemographic dimensions (eg, race/ethnicity and migrant status).

Routinely measuring UHC effective coverage requires the existence and maintenance of several functional data systems. Many, if not most, indicators or data systems, or both, that are needed to measure effective coverage indicators are already encompassed within the health-related SDGs, which UN member states have committed to monitoring. These include functional vital registration systems that accurately record causes of death; periodic household surveys that include biomarker data and information on intervention coverage; and disease incidence registries based on administrative systems and notifications for specific causes (eg, cancers and kidney disease).[64] Deliberate investments by national governments, as well as international agencies where appropriate, are important for strengthening these data systems and identifying how they can be used together to monitor trends in effective coverage.

The UHC effective coverage index and corresponding UHC effective coverage measurement framework represent important steps towards capturing a range of needed health services across the life course; nonetheless, as underscored by its multi-year development process

(appendix 1 pp 6–21), considerable gaps persist between the breadth of the original candidate effective coverage indicators and those used in the present analysis. Minimal data on rehabilitative services and palliation across countries and over time hindered their direct inclusion or the use of suitable proxy effective coverage indicators. Recent steps by WHO (ie, publishing its first world report on vision[65] and upcoming report on hearing,[66] and its GPW13 indicator on oral morphine availability[6]) suggest that data collection for these areas could be increasingly prioritised. A similar paucity of routinely collected data on mental health services and substance use disorder interventions precluded their use in the current UHC effective coverage index. In the future, triangulation of data sources including administrative records, health facility records, and community-based surveys might inform such measurements.[67] Effective coverage indicators on emergency services and trauma care were also considered but ultimately excluded because of data limitations and ongoing methodological challenges (ie, appropriately isolating improvements in effective health services from advances in transportation safety).

For non-communicable diseases, we relied on outcome-based effective coverage indicators, preferring to approximate access to quality non-communicable disease care through measures such as MIRs rather than assuming that risk exposure, screening rates, or health-system inputs, or a combination of these factors, can appropriately capture effective service provision for non-communicable diseases. Many national data systems already collect data on cause-specific mortality and disease incidence or prevalence, and when analysed together they should reflect variations in access to and quality of health services and serve as good proxy measures amid imperfect data realities for non-communicable disease services. Conversely, using indicators such as non-tobacco use and non-elevated blood pressure[4,19,21] or inpatient admission rates pushes the world further away from understanding improved outcomes delivered by health systems and effective service provision. If, or when, the quantity and quality of data for measuring health services for non-communicable diseases improve, we would prefer to use more direct measures of effective coverage over outcome-based proxy indicators. For instance, our ideal effective coverage indicator for diabetes treatment would be the proportion of people with diabetes on treatment and meeting specified treatment targets such as glycated haemoglobin lower than 8%. Household surveys such as the WHO STEPwise approach to surveillance (STEPS) are increasingly collecting these data, and time series estimates by location and population-age group could be easily derived if sufficient access to such microdata is possible.

In sum, the indicators included in the present study are not meant to be prescriptive; rather, our primary objective was to establish a robust, comparable measurement framework from which UHC effective coverage could be assessed across settings and inform efforts to incorporate effective coverage into UHC monitoring. Continuing to advance effective coverage measurement of UHC in the future, especially if the main alternative is adhering to past measures with known drawbacks and narrow operationalisations of health services for all populations, is strongly supported by the broader GBD study and its collaborators.

Limitations

Our study is subject to limitations beyond those already described. First, this analysis draws from GBD 2019 estimates of outcomes, intervention coverage, and SDG indicators,[34–36] and thus broader GBD 2019 limitations also apply to the present study (eg, availability and quality of vital registration data, model coherence between cause-specific mortality and non-fatal measures, and new modelling approaches for risk factors and related outcomes). In the case of ischaemic heart disease, for example, new data on the interplay of household air pollution, blood pressure, and ischaemic heart disease mortality resulted in implausible risk-standardised death rates for many low-SDI to low-middle SDI countries when we only accounted for joint exposures to metabolic risks considered amenable to health care.[41,43] We thus included household and outdoor air pollution in risk standardisation and plan to further examine these risk mediation pathways in the future.

Second, health gain weights were based on classifying intervention sets into five effectiveness categories, as informed by published literature provided by Cochrane, the Tufts Cost-Effectiveness Analysis Registry, and DCP3.For some effective coverage indicators, especially treatment of more chronic conditions, distilling a wide range of reported effectiveness on available interventions into a summary assessment was quite difficult. Sensitivity analyses based on shifting each indicator's categorisation up and down one group showed similar overall UHC effective coverage index values (appendix 1 p 35). Formally simulating the range of effectiveness across interventions and incorporating this uncertainty into health gains weighting is an important future avenue for measurement of the UHC effective coverage index.

Third, due to limited data quantity or quality (or both), we could not include several original candidates for effective coverage indicators (appendix 1 pp 12–28), including seven expressly recommended by the GPW13 ERG: HPV vaccination, hepatitis C treatment, effective management of hypertension and diabetes, cataract surgery, refractive error correction, and dental care.[33] As data availability improves alongside methods for estimating these indicators across countries, we plan to test the inclusion of these indicators, and thus some country-level UHC effective coverage index values and rankings might change. Since data are generally more easily available for better-funded interventions and health

areas, it is possible that our current estimates of UHC effective coverage are overly optimistic.

Fourth, we excluded several effective coverage indicators for which high potential health gains could only be achieved in select locations because of local exposures (ie, malaria and neglected tropical diseases) or current introduction status (eg, pneumococcal conjugate vaccine [PCV]). Subsequently, our results might under-estimate UHC effective coverage in some locations (eg, countries with high coverage of effective malaria interventions) or over-estimate performance in others (eg, countries that have a high pneumonia burden but have yet to introduce PCV). Additional methodological testing is needed to better incorporate these locally relevant intervention needs within a global measurement framework.

Fifth, we did not explicitly account for the effects of potential community-level interventions and their contribution to potential health gains (eg, herd immunity garnered from very high coverage of MCV1 or DTP3). Future work should consider whether or how such effects can be incorporated into this measurement framework, particularly given the toll of recent measles outbreaks worldwide.[68]

Sixth, results of our known-groups validity testing might have varied if more or different country-pairs were selected (appendix 1 pp 45–47). Showing performance based on country means and uncertainty underscores the need to further strengthen data collection and overarching measurement for UHC effective coverage at the country level. Furthermore, it stresses the importance of estimating and reporting uncertainty in monitoring UHC, a limitation of current WHO and World Bank service coverage indices.

Seventh, approximating populations with UHC effective coverage by assuming the UHC effective coverage index as a fractional metric and multiplying by population does not account for multimorbidities, nor does it represent the distribution of needed services received within a given population. Measuring UHC effective coverage at increasing granularity (ie, subnational locations and by disaggregated age groups or sex, or both) could help improve our understanding of the distribution of health services within a given population.

Conclusion

This study provides a new measurement framework and metric on UHC effective coverage, supporting country and global stakeholders in their efforts to track improved performance over time. By striving to capture potential health gains delivered by health systems, we hope to better diagnose and address challenges that otherwise impede the ultimate objective of UHC: improving health for all people and leaving no one behind. If current trends hold, the world will fall short of delivering on its UHC ambitions for the GPW13 and SDGs. Although this outcome is not yet inevitable, the window for meaningful action and health-system changes is rapidly narrowing. By focusing on UHC effective coverage and populations' health needs across the lifespan, we strengthen the evidence base for bringing UHC closer to reality for all.

Contributors

Please see 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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Declaration of interests

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Data sharing

To download the data used in these analyses, please visit the Global Health Data Exchange at http://ghdx.healthdata.org/gbd-2019.

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