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International Triage: Toward Global Holistic Health

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Abstract

We combined the four fundamental parameters of national health, life expectancy at birth (LE), under-five mortality rate (U5MR), maternal mortality ratio (MMR), and adult mortality rate (AMR) into one objective, unit-less, index we call national health, LE/(U5MR) (MMR) (AMR). This index, which varies from 2497 for Iceland to 0.009 for Sierra Leone, has no absolute significance, but is, rather, a measure of relative rank. We list the nations by national health and suggest that nations with health greater than 58 be considered healthy, while those with health less than 58 be considered sick. We estimated health equity as the ratio of national health to inequality in life expectancy at birth (IneqLE), and health efficiency as the ratio of national health to annual per capita health expenditure (Health$/c) in purchasing power parity. National health correlates almost perfectly with equity, and moderately with efficiency suggesting causal relationships. We suggest that equity is the condition for national health as efficiency is for global holistic health.

Key words: Health, Wealth, Nations, Equity, Efficiency

1. Introduction

Therapy begins with diagnosis, and that begins with tests that can distinguish the sick from the healthy. This applies to nations as well as people. But, for nations, the tests have been mired in subjective decisions about the parameter(s) to include and their relative importance (Murphy & Dix 2018; WHO 2000; Worstall 2019). We focus on fundamental parameters of unchallenged utility: Life expectancy at birth (LE), under-five mortality rate (U5MR), maternal mortality ratio (MMR), and adult mortality rate (AMR). Nations with long life expectancy and low mortality rates are clearly healthier that nations with the converse. But which parameters and which values for these parameters best distinguish healthy from sick nations? The question is complicated because the mortality rates do not correlate perfectly with each other or with LE. To alleviate this problem, we combined the four fundamental parameters into one objective, unit-less, index we call national health, LE/(U5MR) (MMR) (AMR). This index, which varies from 2497 for Iceland to 0.009 for Sierra Leone, has no absolute significance, but is, rather, a measure of relative rank, like the World Health Organization's composite index, the Bloomberg healthy country index, or theUnited Nation Development Program's Human Development Index (HDI).

The HDI is a composite of three parameters reflecting a nation's health, wealth, and education. It varies from 0.9 for the most developed nation to .3 for the least, suggesting, erroneously, that life in the least developed nation is more than 30% as fulfilling as life in the most developed nation. Unlike the HDI, the national health index focuses only on health, and it gives each of its four component parameters equal weight on a common scale. According to the national health index, life in the sickest nation is only0.00036% as vibrant as life in the healthiest.

The utility of a diagnostic index is determined by two properties, sensitivity (percent positive results among sick subjects) and specificity (percent negative results among healthy subjects). For nations, it is impossible to assess either parameter because there is no independent, "gold standard," by which to confirm the validity of any diagnostic index. We define nations with national health index greater than 58 as healthy, and nations with national health index less than 58 as sick. We offer evidence that this dichotomization is useful, although we cannot yet prove that it is optimal.

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Despite the obvious limitations in defining national health by one number, we rank the nations by national health index. We estimate health equity as the ratio of national health to inequality in life expectancy at birth (IneqLE), and health efficiency as the ratio of national health to annual per capita health expenditure (Health$/c) in purchasing power parity. National health correlates almost perfectly with equity, and moderately with efficiency suggesting causal relationships. We suggest equity is necessary for national health (Fuchs & Eggleston2018), as efficiency is for global holistic health.

2. Methods

Of the 194 nations listed in WHO 2019, the data required to calculate national health was available for 172. For convenience, we multiplied the national health index, LE/(U5MR) (MMR) (AMR), by 10,000. All data were obtained from WHO 2019, except for AMR, which was obtained from WHO 2016. Health efficiency is the ratio of national health to the nation's annual per capita health expenditure in purchasing power parity (Health$/c) from WHO 2019. Health equity is the ratio of national health to the nation's inequality in LE at birth (IneqLE) from UNDP 2016. The number of physicians per 10,000 people was also obtained from UNDP 2016.

3. Results

Of the 172 nations studied, 49 are healthy and 123 are sick by the national health index. Table 1 lists the nations according to this index, along with health equity, and health efficiency. Iceland, with Health$/c = 5064, leads in health and equity. Belarus, with Health$/c = 318, leads in efficiency. USA, with Health$/c = 9870, leads in health expenditure. Besides USA, only Switzerland has Health$/c exceeding $9000. Beyond that, only Norway and Luxembourg have values exceeding $6000 (5), but 45 nations have a better national health index than USA, 42 have more health equity, and 114 more health efficiency.

Table 1: Nations Ranked by National Health, Equity, and Efficiency

Nation	Nat Health	Equity	Efficiency
Iceland	2497	861	0.493
Finland	1938	570	0.471
Sweden	1319	400	0.231
Italy	1276	425	0.466
Japan	1101	344	0.26
Norway	1000	303	0.134
Spain	988	282	0.413
Switzerland	850	224	0.086
Austria	825	223	0.176
Greece	819	221	0.532
Czechia	814	233	0.616
Israel	709	182	0.25
Cyprus	699	175	0.428
Slovenia	624	173	0.34
Australia	566	132	0.113
Singapore	542	181	0.22
Denmark	512	135	0.092
Netherland	494	134	0.104
Luxembour	491	189	0.078
Germany	489	132	0.104
Poland	467	90	0.577
Rep Korea	411	111	0.201
Ireland	411	111	0.086
Belgium	402	101	0.097
Canada	376	80	0.084
France	365	91	0.086
UK	338	75	0.085
Kuwait	296	41	0.277

Belarus	288	50	0.906
Monteneg	277	53	0.521
Malta	274	61	0.118
Portugal	268	69	0.149
Estonia	242	50	0.204
New Zeal	226	49	0.06
Croatia	222	49	0.251
Slovakia	207	39	0.176
UAE	193	33	0.146
Bahrain	132	21	0.12
Bos & Herz	127	19	0.286
Qatar	121	20	0.066
Lithuania	121	22	0.122
Saudi Arab	100	9.1	0.087
Serbia	73	9.2	0.148
Hungary	71	14	0.075
USA	70	12	0.007
Latvia	68	10	0.078
Lebanon	66	9.2	0.1
Bulgaria	63	8.1	0.103
Chile	59	7.8	0.05
Uruguay	57	6	0.041
Cuba	43.6	7.9	0.045
Oman	42.9	6.1	0.066
China	39	4.4	0.098
Turkey	38	3.3	0.081
Costa Rica	36	4.4	0.04
Kazakhstan	33	2.9	0.126
Brunei Dar	31	7.1	0.049
Albania	30	3	0.11
Maldives	27	3.8	0.026
Thailand	26	2.5	0.117
Iran	25	2.4	0.06
Barbados	23	3	0.02
Romania	22	2.6	0.046
Sri Lanka	21	2.6	0.137
Armenia	20	2	0.056
Malaysia	19.1	2.9	0.053
Ukraine	18.6	2.1	0.132
Russia	18	2.1	0.038
Argentina	13	1.3	0.136
Mexico	12.2	0.92	0.026
Moldova	11.6	1.3	0.067
Georgia	11.5	1.1	0.037
Grenada	11.4	1.3	0.022
Azerbaijan	10.8	0.5	0.04
Tunisia	10.4	0.85	0.04

Belize	10.1	0.87	0.033
Bahamas	8.5	0.9	0.008
Cabo Verde	8.4	0.63	0.053
Brazil	8	0.56	0.008
Samoa	7.9	0.59	0.035
Mauritius	7.5	0.77	0.014
Ecuador	7	0.46	0.014
Jordan	6.8	0.57	0.03
Uzbekistan	6.7	0.28	0.05
St. Lucia	6.3	0.62	0.013
Peru	6	0.42	0.019
St. Vin & G	5.9	0.38	0.024
Egypt	5.89	0.44	0.045
Columbia	5.7	0.4	0.017
Viet Nam	5.4	0.38	0.044
Tajikistan	5.3	0.23	0.095
El Salvador	5.1	0.37	0.017
Fiji	5	0.41	0.028
Panama	4.7	0.41	0.004
Mongolia	4.42	0.26	0.031
Jamaica	4.35	0.37	0.015
Morocco	4	0.25	0.023
Kygyzstan	2.89	0.21	0.04
Tonga	2.78	0.2	0.014
Iraq	2.68	0.14	0.018
Vanuatu	2.65	0.17	0.024
Trin & Tob	2.54	0.15	0.002
Algeria	2.39	0.13	0.009
Honduras	2.23	0.11	0.011
Solomon	2.03	0.091	0.019
Nicaragua	2.02	0.14	0.011
Guatemala	1.83	0.11	0.008
Paraguay	1.83	0.1	0.006
Turkmenist	1.81	0.07	0.004
Dom Rep	1.66	0.1	0.004
Micronesia	1.32	0.067	0.003
Suriname	1.27	0.093	0.004
Indonesia	1.25	0.076	0.011
Philippines	1.11	0.069	0.009
Bangladesh	0.99	0.049	0.029
Cambodia	0.87	0.044	0.011
Bhutan	0.74	0.036	0.008
Madagasca	0.722	0.029	0.03
Sao Tome	0.721	0.027	0.007
Kiribati	0.68	0.026	0.004
India	0.57	0.024	0.009
Bolivia	0.544	0.019	0.003
Botswana	0.541	0.026	0.001

Nepal	0.53	0.027	0.012
Timor-Lest	0.44	0.018	0.006
S. Africa	0.41	0.016	0.001
Myanmar	0.39	0.015	0.006
Guyana	0.35	0.017	0.002
Pakistan	0.313	0.01	0.008
Rwanda	0.311	0.01	0.006
Laos	0.27	0.01	0.005
Papua	0.26	0.01	0.005
Senegal	0.25	0.01	0.005
Gabon	0.22	0.008	0.001
Namibia	0.184	0.008	0.0005
Djibouti	0.183	0.006	0.003
Ghana	0.168	0.006	0.002
Zambia	0.162	0.005	0.003
Sudan	0.148	0.005	0.001
Ethiopia	0.142	0.005	0.005
Uganda	0.129	0.004	0.003
Kenya	0.129	0.004	0.002
Comoros	0.123	0.004	0.002
Eritrea	0.119	0.005	0.004
Congo	0.116	0.003	0.002
Tanzania	0.113	0.004	0.003
Haiti	0.1	0.003	0.003
Afghanistan	0.095	0.003	0.002
Togo	0.085	0.003	0.002
Zimbabwe	0.083	0.003	0.0009
Burk Fas	0.078	0.002	0.002
Malawi	0.072	0.002	0.002
Angola	0.068	0.002	0.0007
Mauritania	0.066	0.002	0.001
Benin	0.063	0.002	0.002
Eq Guinea	0.063	0.002	0.0002
Gambia	0.052	0.002	0.002
Niger	0.051	0.001	0.002
Liberia	0.05	0.002	0.0007
Mozambiq	0.05	0.001	0.003
Guin-Bis	0.048	0.001	0.001
Burundi	0.047	0.001	0.002
Guinea	0.039	0.001	0.001
D. R. Congo	0.037	0.001	0.002
Cameroon	0.034	0.0009	0.0005
Mali	0.034	0.0008	0.001
Lesotho	0.026	0.0008	0.0003
So Sudan	0.024	0.0006	0.003
Nigeria	0.019	0.0005	0.0002
Chad	0.014	0.0003	0.0003
CAR	0.011	0.0002	0.0007

Sierra Leo	0.009	0.0002	0.0001

Differences between healthy and sick nations are summarized in Tables 2 and 3. Except for national health, all parameter distributions overlap between healthy and sick nations. This overlap is minimal for health equity, U5MR, MMR, and IneqLE.

Table 2: Median and Distribution of Parameters Among Healthy Nations

Healthy Nations (n = 49)

Parameter	Percentiles				
	2.5%	5%	50%	95%	97.5%
LE	74.4	74.8	81.1	83.2	84.0
U5MR	2	2	4	8	9
MMR	3	3	7	18	21
AMR	50	51	69	155	160
IneqLE	2.7	3.0	4.3	7.9	10.2
Health$/c	350	469	2044	8657	9862
Physicians	9.5	14.8	31.9	55.6	73.5
National Health	60	65	376	1629	2357
Health Equity	7.9	8.6	90	498	788
Health Efficiency	.018	.055	.134	.597	.834

Table 3: Median and Distribution of Parameters Among Sick Nations

Sick Nations (n = 123)

Parameter	Percentile				
	2.5%	5%	50%	95%	97.5%
LE	53.2	58.0	70.2	77.0	78.4
U5MR	8	8	31	110	111
MMR	16	23	129	722	852
AMR	80	93	178	340	386
IneqLE	6.7	7.9	19.8	40.4	42.9
Health$/c	19	23	153	1036	1154
Physicians	0.2	0.3	4.7	36.1	42.5
National Health	.015	.028	1.3	35	43
Equity	.0003	.0008	.076	4.3	6.1
Efficiency	.0002	.0004	.008	.108	.131

Correlation coefficients among the parameters are displayed in Tables 4 and 5. Notice that LE, U5MR, MMR, and AMR do not correlate perfectly with each other, or with national health. The information in the national health index, therefore, is unique. The correlation between national health and equity is strong and positive in both healthy and sick nations. The correlation coefficient between national health and equity, r, over all 172 nations is .991. The correlation between national health and efficiency is moderate and positive in sick nations. Over all 172 nations, the r between national health and health efficiency is .681, and, between health equity and health efficiency is .629.

Table 4: Correlation Coefficients Between Parameters for Healthy Nations (n = 49)

	U5MR	MMR	AMR	IneqLE	Heal$/c	Phys.	Equity	Efficie.	Health
LE	-.585	-.386	-.834	-.792	.631	.058	.556	-.118	.563
U5MR		.447	.264	.770	-.313	-.055	-.626	-.380	-.635
MMR			.362	.587	-.275	-.302	-.575	-.500	-.636
AMR				.549	-.468	-.029	-.475	.151	-.487
IneqLE					-.476	-.261	-.606	-.190	-.616
Heal$/c						.117	.393	-.303	.393
Phys.							.160	-.052	.173
Equity								.388	.992
Efficie.									.419

Table 5: Correlation Coefficients Between Parameters for Sick Nations (n = 123)

	U5MR	MMR	AMR	IneqLE	Heal$/c	Phys.	Equity	Effici.	Health
LE	-.936	-.856	-.940	-913	.582	.561	.531	.050	.597
U5MR		.878	.822	.936	-.529	-.570	-.484	.080	-.557
MMR			.794	.840	-.457	-.528	-.397	-.074	-.470
AMR				.811	-.465	-.475	-.485	-.033	-.545
IneqLE					-.589	-.601	-.592	-.085	-.646
Heal$/c						.551	.565	-.000	.581
Phys							.593	-.027	.629
Equity								-.009	.948
Efficien.									.685

All 49 healthy nations have health equity greater than 7.7. With the single exception of Cuba, with health equity of 7.9, all 123 sick nations have health equity less than 7.7. Of the 49 healthy nations, only one has U5MR greater than eight, and only two have MMR greater than 17. Of the 123 sick nations, only two have U5MR less than eight or MMR less than 17. The differences in LE and AMR between healthy and sick nations exhibit more overlap.

Of the 49 healthy nations, all but two (USA = .007 and Chile = .045) have health efficiency equal to or greater than 0.08. Of the 123 sick nations, all but eight (Turkey = .081, Tajikistan = .095, China = .097, Albania = .110, Thailand = .117, Kazakhstan = .126, Ukraine = .132, and Sri Lanka = .137) have health efficiency less than 0.08. Of the 49 nations with health > 58, only (Chile = 10.3 and Bahrain = 9.2)have less than 19.2 physicians/10,000 people. Of the123 nations with health < 58, only twenty have more than 19.2 physicians/10,000 people.

4. Discussion

Both health and wealth are relative terms, dependent on frame of reference. If we view ourselves as individuals, like polar bears or moles, health and wealth can seem independent of each other. If, on the other had, we view ourselves holistically as members of one collective organism like bees in a hive or termites in a colony, health and wealth are connected.

Before Einstein, physicists thought space and time were independent. Now we know they differ between observers in different frames of reference. We can say the same of health and wealth. From rich people's perspective, hoarding is harmless, even laudable. Their wealth doesn't cause other's poverty (Sachs 2005; Singer 2009). And other's poverty doesn't diminish their health. But they're operating in an individual frame of reference. Poor people tend not to share that perspective. Poor people see hoarded wealth as the cause of, and cure for, their poverty. From the holistic frame of reference, disease or poverty for anyone threatens the whole, and, therefore, everyone.

Between physical frames of reference, it's neither time nor length that remains constant, but the speed of light in a vacuum, c. And because c remains constant, rulers and clocks must vary between frames of reference. In a similar manner, neither health nor wealth remains constant between perspectives. To a rich person, a dollar is insignificant. To a starving person, it's survival for a day. From an individual perspective, wealth shields the rich from diseases of the poor. From a holistic perspective, disparity in wealth or health is a disease that threatens the whole.

Between health/wealth perspectives, it's necessity that remains constant. Whether rich or poor, the minimum daily requirements are the same. And because necessity remains the same, health and wealth must vary between frames of reference. But the two frames are not equally valid. Relativity physics tells the truth, but classical physics tells it easier and with insignificant difference when observers are close and moving in the same frame of reference. The holistic perspective is like relativity. It tells the truth: "No man is an island, entire in itself" (Donne, 1952). But it's not an easy truth to appreciate when you've got more than you need and others have less. And between people in the rich frame of reference, that appreciation isn't worth much effort. But the truth is inflexible: Money is like a fat-soluble vitamin, essential in some minimal amount, but toxic in excess. If I hoard more than I need, I cause the insufficiency of those with less, and because we are all components of the same whole we would all suffer from my excess. To achieve holistic health, we must establish equitable wealth.

"Whereas recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice, and peace in the world" (United Nations, 1948),it should rank among our highest priorities. It doesn't, in large part, because national boundaries get in the way. Healthy nations prefer to waste resources within their boundaries than export those resources across boundaries to achieve equitable health. One answer is charity, e.g., Partners in Health, Doctors Without Borders. Another answer is international triage, which could be manifested in a world tax that takes from rich nations according to their ability to pay tax and gives to poor nations according to their need for aid. Table 1 ranks nations by ability to give and need for aid. A complementary answer is efficiency. As nations spend more like Belarus, the nation with highest health efficiency, they will have better health and more ability to give foreign aid.

Belarus spends on patient accessibility, leading all nations in Central and Eastern Europe in number of inpatient treatment clinics per capita and in number of clinic visits per capita (AP-Companies 2018). Physicians are surrogates for patient accessibility, and of the 49 healthy nations, only 10 have more physicians/c than Belarus. By contrast, USA, the least efficient healthy nation, and among the least efficient of all nations, spends on health care providers, making physicians, pharmaceutical executives, insurers, and medical-equipment manufacturers wealthy at the expense of the poor (Case & Deaton 2020). If that weren't bad enough, some 25% of America's exorbitant health care spending is waste (Shrank, Rogstad & Parekh 2019).

If COVID has taught us anything, it's that we're all connected. Infection anywhere threatens everywhere. Excessive or wasteful health spending within one nation is efficient health spending denied another nation. The path to holistic global health is international health equity and the path to that is international triage. Spend where spending is most needed without regard for national borders.

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