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Hospital beds per death how does the UK compare globally

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Part of a longer series of papers on this topic, see http://www.hcaf.biz/2010/Publications_Full.pdf
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ABSTRACT

The last year of life accounts for 55% of entire lifetime hospital bed use. This is independent of the age at death and refutes claims that healthcare demand is largely driven by population growth and ageing. This article argues that the ratio of available beds per death can provide a useful benchmark for international comparisons of hospital bed provision. A figure of 372 beds per 1000 deaths is the international median, the average is 416, with an interquartile range of 170-604 beds per 1000 deaths. Within the countries of the UK, England has 20% fewer NHS beds per death than Wales and 32% fewer than Scotland and Northern Ireland. This implies that England ranks in the bottom third of countries, toward bed availability in less-developed countries. Countries with a very high provision of available beds per death, close to one bed per death, appear to include high intensity nursing home beds as an 'acute' bed. Despite considerable changes in technology, population age structure, and the number of deaths, the ratio of occupied beds per death for the medical group of specialties in England has remained roughly constant for the past 18 years indicating that available beds per death is a reliable measure of bed demand. After adjusting for population age-structure the UK, which has only recently embarked on moves toward higher integration, has only slightly more beds per 1,000 deaths than New Zealand with high levels of integration achieved over two decades. The UK is attempting to run with too few beds relative to its current level of integration.

KEY WORDS: capacity planning ■ deaths ■ hospital beds ■ healthcare ■ international comparisons ■ nearness-to-death

Introduction

It is often useful to make international comparisons using ratios regarding resources used in healthcare. Both the public and doctors need to be assured that their country has an adequate number of hospital beds, hence the need for international comparisons of bed numbers. The number of hospital beds is one area of interest, which is currently measured as the number of beds per 1000 population. This ratio ranges from 0.2 beds per 1000 people in places like Madagascar, the

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Republic of Niger and the Republic of Senegal through to 13.8 in Monaco and Japan (World Bank, 2018). This ratio suffers from the fact that it is not age-adjusted.

Until recently, it was assumed that age structure was the single most important determinant of bed demand. The method used to forecast bed numbers has remained unchanged for many years. This process has three components: forecasting future admissions, multipling this by forecast future length of stay to get occupied bed days, and then applying an occupancy margin (Pearse and Mazevska, 2016). However, these three steps can be open to bias (Farmer and Emami, 1990). In the UK, it has been government policy to reduce bed numbers; however, it has been recently demonstrated that despite reductions in available beds, the number of occupied beds (patients in a bed) in England has remained roughly unchanged for two decades (Jones, 2018a). A moderate influenza outbreak in January 2018 threw the NHS (especially England) into chaos as a result of massively high bed occupancy before the winter of 2017/2018 had begun (NHS England, 2018a).

In this study, the term 'deaths' always refers to the total number of population deaths and includes those in hospital, at home, in a hospice or any other location. In 1976, deaths in England and Wales peaked at 598 500, and then declined for the next 35 years reaching a low of 484 400 in 2011; a 19% reduction. Since then deaths have steadily risen. (Jones, 2017a). The resulting reduction in pressure on bed occupancy before 2011, caused by lower end-of-life bed demand, was largely ignored. Indeed, most current models for forecasting bed demand are based on the notion that demand depends entirely on age, hence the often-repeated mantra that the ageing population is increasing demand (Busse et al, 2002). With deaths in England and Wales increasing dramatically since 2011 (Jones, 2017c) and projected to increase by 27% between 2014 and 2040 (Bone et al, 2018), it becomes important to know whether deaths or age structure will drive the marginal changes in demand for beds.

Indeed, several studies have concluded that the omission of the nearness to death effect leads to gross over-estimation of the role of age in diverse aspects of health care such as cognitive decline and prescription costs (Rabbitt et al, 2008; Moore et al, 2017). Hence the ratio of available beds per death offers the possibility of a more reliable ratio for international comparison of bed availability.

This article uses data from 185 countries on the available beds per death and discusses how local and international bed provision can be understood. Table 1 illustrates the number of available beds according to type and the average occupancy for NHS beds in England. Bed occupancy is traditionally measured at midnight.

Table 1: Number of NHS Hospital beds in England and midnight average occupancy, by type of care, first quarter of 2018/19 financial year

Type of Care	Number of beds	Average midnight occupancy
Total	128,448	87.9%
General and Acute*	101,259	89.9%
Mental Illness	18,394	89.8%
Maternity	7,178	58.1%
Learning Disability	1,077	76.1%

*Footnote: *General and acute includes beds for adult and child admissions to acute hospitals. Data is from NHS England. Bed availability and occupancy data, 2018b. https://www.england.nhs.uk/statistics/ statistical-work-areas/bed-availability-andoccupancy/bed-data-overnight/*

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As can be seen in Table 1, acute hospital beds account for 79% of all NHS hospital beds. Occupied beds are a sub-set of total available beds and is determined by the occupancy margin, which depends on hospital size, complexity and bed availability relative to demand (Jones, 2011).

Methods & Data

The total number of available hospital beds (acute and mental health, public and private) per 1000 population, and the crude mortality rate per 1000 population were obtained for 188 countries by the World Bank (World Bank, 2018). Hospital beds per 1000 population were divided by deaths per 1000 population to give beds per 1000 deaths. The number of available hospital beds and deaths in England, Northern Ireland, Scotland and Wales in 2016/2017 were obtained from their national websites (ISD Scotland, 2018; National Records of Scotland, 2018; NHS England, 2018b; Northern Ireland Information Analysis Directorate, 2018; Northern Ireland Statistics and Research Agency, 2018 Stats Wales, 2018; Office for National Statistics, 2018).

Regression was performed using the 'Curve Fit' function in Microsoft Excel.

Results

The World Bank (2018) defines a hospital bed as: "Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers. In most cases beds for both acute and chronic care are included." On average, 55% of a person's lifetime use of a hospital bed occurs in the last year of life (Hanlon et al, 1998). From this, it should be possible to determine whether deaths, as opposed to demographics, acts as the primary driver for hospital bed numbers, and how different countries rank according to this measure.

Figure 1 details hospital bed numbers (including mental health beds) per 1000 deaths for 188 countries (World Bank, 2018). Since the ratio of available beds per death remains roughly constant in the short term, it is not essential that data from all countries occur in the same year. Likewise, deaths per 1000 population only changes slowly over time. A figure of 372 available beds per 1000 deaths is the international median, while the interquartile range is 169–596 beds per 1000 deaths. Some 19 countries have over 900 beds per 1000 deaths and Monaco with 1586 beds per 1000 deaths has the highest number of available beds. As can be seen, the UK (322 beds per 1000 deaths) is nearing that of developing countries. Countries with approximately the same number of deaths per 1000 population as the UK (9 deaths per 1000 population) have an average of 524 beds per 1000 deaths compared to 322 in the UK. The USA (345 beds per 1000 deaths) also ranks poorly because it has a highly skewed health care system catering largely for those with health insurance, and an obsession with rapid discharge to contain insurance costs (Jones 2013, McKee et al 2017). The United Arab Emirates, Korea, the State of Kuwait and Japan rank highly at around 1 bed per death. France (736), Germany (773), Luxembourg (794), and Austria (844) all have more than double the number of beds per death as the UK.

Table 2. Available NHS beds per 1000 deaths 2016/2017 in the four countries of the UK

Country	Beds per 1,000 deaths
Northern Ireland	383
Scotland	379
Wales	325
England	260

Footnote: The number of available hospital beds and deaths in England, Northern Ireland, Scotland and Wales in 2016/2017 as per methods section.

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The NHS is run by devolved administration across its four countries with different policies, funding and administrative arrangements. The different levels of NHS beds per 1000 deaths in each country are given in Table 2. As can be seen, the UK average is greatly reduced by very low bed provision in England, which is 30% lower than that available in Scotland and Northern Ireland and 20% lower than that available in Wales.

One of the limitations of beds per 1,000 deaths as a ratio is that the 45% of lifetime bed usage which does not occur in the last year of life will be concentrated in relatively younger populations. In younger populations there will be fewer deaths and hence the ratio of beds per death will be increased. The number of deaths per 1,000 population is a measure of population age structure. Figure 2 illustrates the relationship between beds per 1,000 deaths and deaths per 1,000 population. As expected, younger populations with an associated lower deaths per 1,000 population do indeed show higher beds per 1,000 deaths The line of best fit for Figure 2 gives a logarithmic trend such that Beds per 1,000 deaths = 876 – 232.4 x ln (deaths per 1,000 population). This relationship can then be used to adjust the number of beds per 1,000 deaths in all countries to an equivalent to the UK with 9 deaths per 1,000 population (see section in discussion).

Discussion

While end-of-life corresponds to far higher bed use, it must also be remembered that any combination of environmental conditions leading to higher deaths is also likely to lead to higher levels of non-end-of-life emergency admissions, hence marginal changes in deaths remain a reliable indicator of the major contributors to hospital admissions, critical care, general bed use and clinical workload (Jones, 2018b). Figure 1 shows a distribution of available beds per 1000 deaths which ranges from the developing countries on the left to the developed countries on the right showing a logical progression. In the last year of life, nursing home beds can substitute for acute beds, and vice versa (Aaltonen et al, 2017; Bone et al, 2018). This moveable boundary may explain the very high ratio of beds per 1000 deaths seen in countries such as the State of Kuwait (1157), Monaco (1586), South Korea (1120) and Japan (1442). Examples of high beds per 1000 deaths occur across the full range of deaths per 1000 population in different countries (See Figure 2). Lower deaths per 1000 population implies a generally healthy younger population, hence factors other than population age structure determine the ratio of beds per 1000 deaths.

In this respect, a death in hospital represents the final of a series of lifetime admissions which mainly occur in the last six months of life (Busse et al 2012) and is highly modifiable by the totality of the healthcare system (Aaltonen et al, 2017; Bone et al, 2018). The entirety of the healthcare system in different countries merely predisposes toward different places of death such as nursing home, hospice, home or a hospital. There are wider cultural issues regarding 'respect' for the elderly and their care in the last months of life. The issue as to whether too few beds contributes to the overall mortality rate is somewhat problematic. Clearly, less developed countries have a higher mortality rate along with fewer hospital beds. Both are linked with relative affluence. It could be argued that a large part of acute hospital interventions, which occur in the last six months of life, should be delivered in more appropriate locations; hence policy pressure in England to move parts of end-of-life care to the home. The difficulty is that it is exceedingly difficult to determine exactly who is in the last six months of life (Jones et al, 2016).

After years of relentless bed closures, the UK has too few beds, especially in England, (Table 1). This can be attested by an average midnight acute occupancy in NHS England of 95.8% on 3 January 2018 (which includes pediatric wards and specialist hospitals) (NHS England, 2018a, b). This was despite advice from NHS England to virtually cease all routine elective surgery in England (The Times 2018,

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NHS England 2018c). Occupancy (at midnight) in mental health hospitals in England is also close to 100% (NHS England, 2018b). This situation is reflected in the poor ranking for the whole of the UK in Figure 1. Figure 1 also shows that each healthcare system has reached its own level of bed provision based on a variety of factors. A final decision regarding adequate bed provision can only be reached when higher intensity nursing home beds can be defined, and then counted, and then compared across countries. It is known that an adult admission by a person of any age to a medical specialty is associated with an increased risk of death in the next 12 months (Clark et al, 2014; Flojstrup et al, 2017). Existing models for forecasting bed demand require urgent revision and medical specialties are likely to have a higher component of end-of-life related bed demand while the surgical specialties will be a mix of the two with a possible higher age structure component.

Adjusted Beds per 1,000 Deaths

One of the limitations of Figure 1 was that it compared countries with vastly different deaths per 1000 population. Most Western countries cluster around 8 to 10 deaths per 1,000 population due to a common World War II baby boom. For example, Norway (8.1), Spain (8.2), USA (8.4), Portugal (9.1), Denmark/Sweden (9.6), Belgium (9.9). Australia (6.4) is an outlier due to Government policies supporting continuous inward migration of working age people, ongoing since the end of World War II.

The lowest ratio of deaths per 1,000 population all occur in the oil-rich Gulf countries with between 1.1 (UAE) to 3.2 (Saudi Arabia) deaths per 1,000 population. This very low ratio is sustained by a large and young migrant labour force from Africa and Asia who are employed in the construction and service sectors. Large hospitals have also been built and staffed based on oil-income. These countries have an average of 840 beds per 1,000 deaths.

After adjustment, the international median is 300 beds per 1,000 deaths (at 9 deaths per 1,000 population equivalent). The UK ranks very close to New Zealand and a comparison with this country warrants attention.

Since the 1980's New Zealand has been actively pursuing integrated health and social care (Cumming 2011). New Zealand has one of the lowest levels of expenditure on health care and numbers of acute beds per head of population (Malcolm 2007) and ranked highest for the level of integrated care of the seven countries in a Commonwealth Fund survey (Davis et al 2010).

In the UK, the Torbay integrated care organisation began operating in 2004/05 (Karakusevic 2010) and after five years of operation in 2009/10 had a ratio of beds per 1,000 deaths some 30% lower than comparable Primary Cate Organisations in England (Jones 2011). It should be clear from these facts that mature integrated care organisations are able to deliver a lower ratio of beds per death.

The levels of integrated care vary greatly across the UK with England lagging behind the other three countries in the Union. It was only in 2018 that Health and Social Care became a single government department in England. Hence, 298 adjusted bed per 1,000 deaths in New Zealand represent an outcome of a mature integrated care health system while 320 beds per 1,000 deaths in the UK represent bed supply in a relatively immature integrated health care system. Very high bed occupancy in the UK coupled with escalating elective inpatient waiting lists testify to the fact that, relative to its level of integration, the UK is attempting to operate with too few beds. In this respect the level of beds per 1,000 deaths in New Zealand remains an aspirational goal to be achieved after years of hard work.

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Recommendations

In the short term, UK healthcare managers need to argue more strongly the case for additional beds. More beds do not automatically mean more staff, it simply allows a hospital to achieve operational efficiency and facilitates the rapid flow of patients from the emergency department into a bed in the correct inpatient specialty.

In the long term, far higher levels of integration need to be achieved with New Zealand providing an aspirational benchmark.

Conclusions

The provision of beds per 1000 deaths ranges from less than 200 in developing countries through to higher than 1000 in countries where more nursing home type care is counted as an acute bed. Somewhere over 380 is likely to indicate a functional and comprehensive health service. Existing models for forecasting bed numbers need to be modified to reflect the reality that just over half of a person's lifetime bed occupancy occurs in the last six months of life. This figure is subject to end-of-life system characteristics. Relatively younger populations, such as those typically present in large cities, will have a higher proportion of bed demand relating to age-structure, while in older populations the demographic component will be far less. International definitions of a high intensity nursing home bed need to be developed to aid in the understanding of how nursing home and acute beds substitute for one another.

Footnote

My (unpublished) research shows that New Zealand began reducing the ratio of beds per death from around 2001 onward. New Zealand therefore has a 17-year head-start compared to England regarding integrated care maturity. In my opinion the Private Finance Initiative (PFI) inflicted irreparable damage on bed numbers in England and the UK.

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Figure 1: Hospital beds per 1,000 deaths for different countries

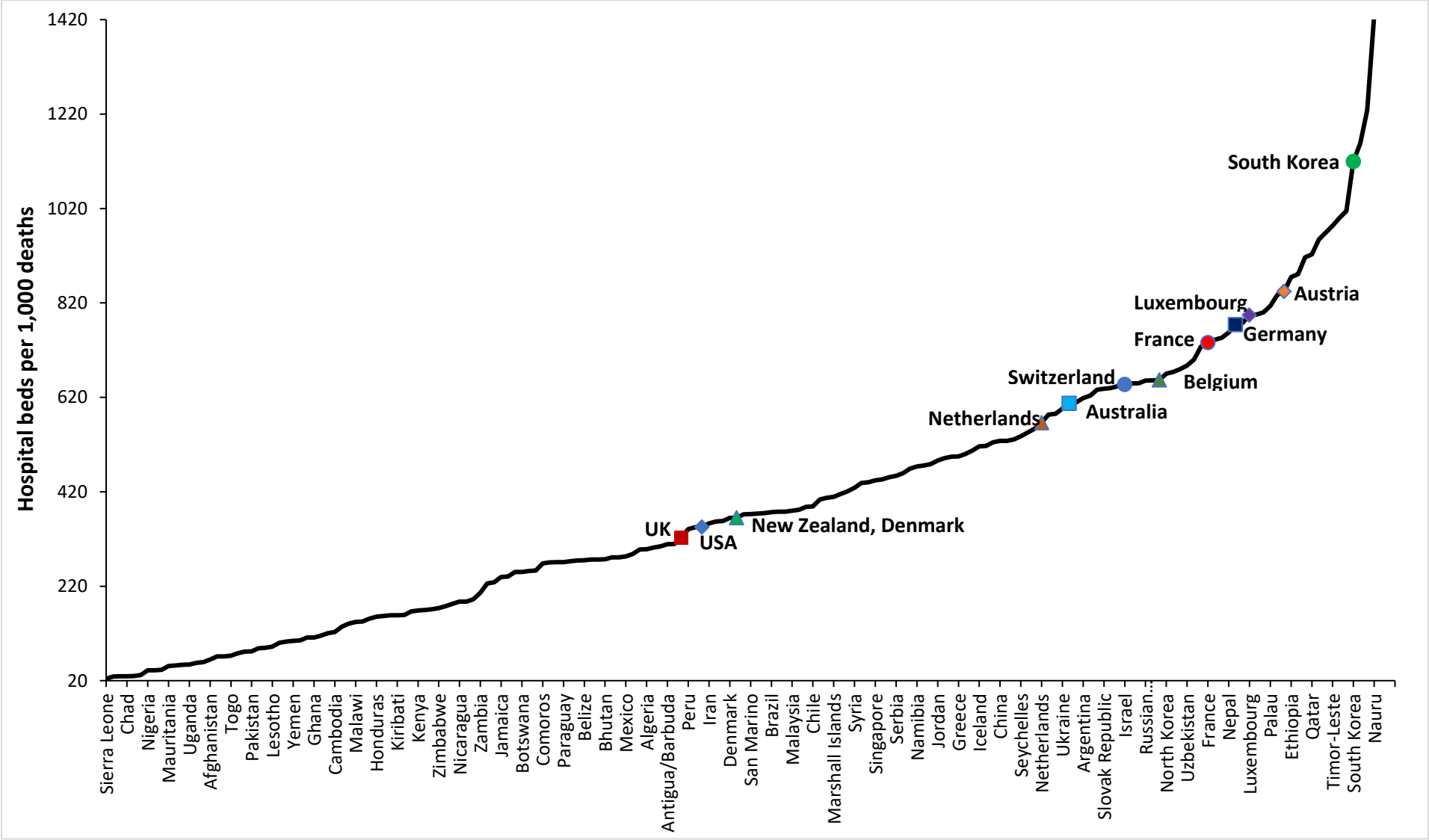

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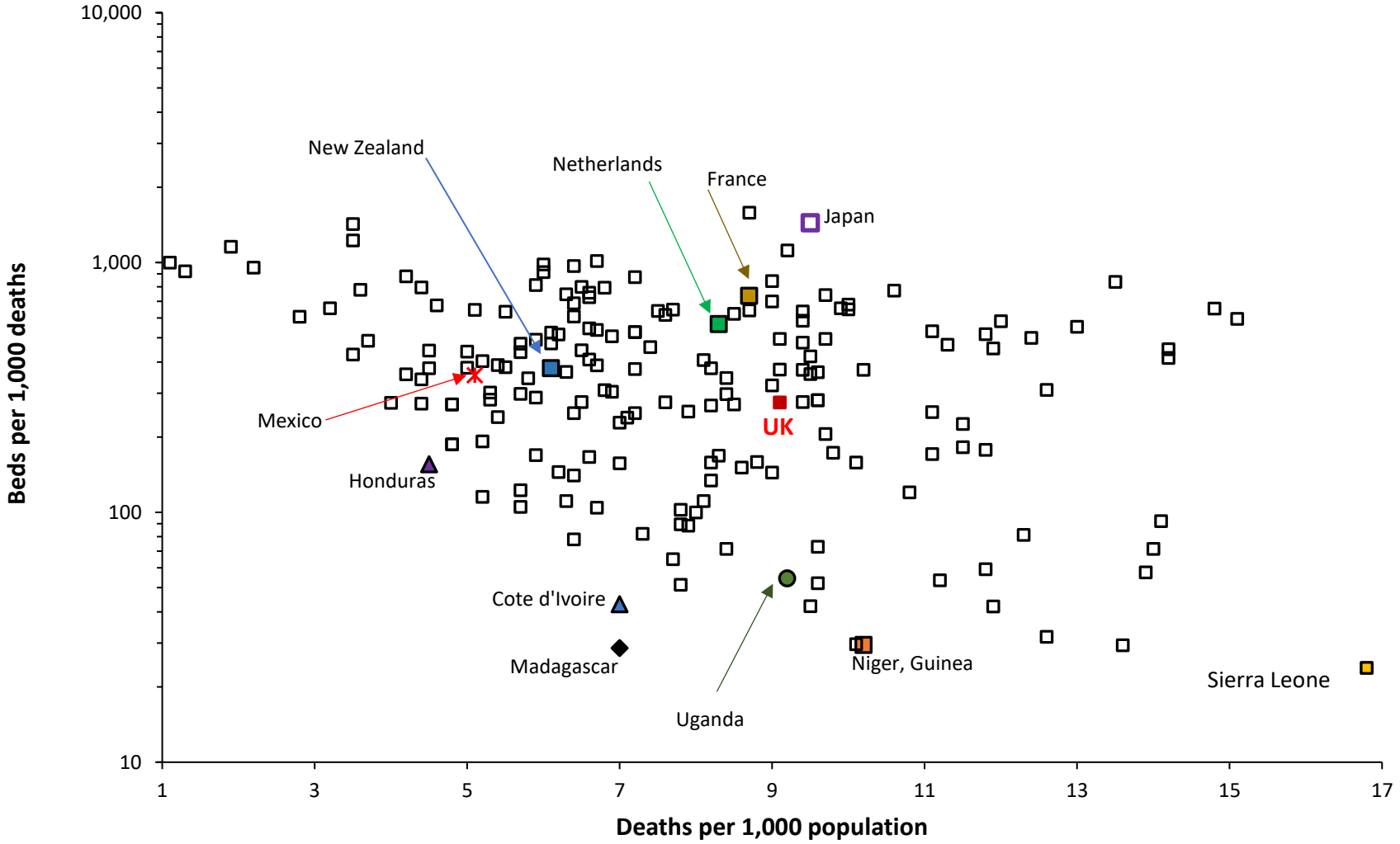
Figure 2: Relationship between beds per 1,000 deaths and the number of deaths per 1,000 population



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Supplementary Material

Figure S1: Adjusted beds per 1,000 deaths (adjusted to 9.0 deaths per 1,000 population as in the UK)

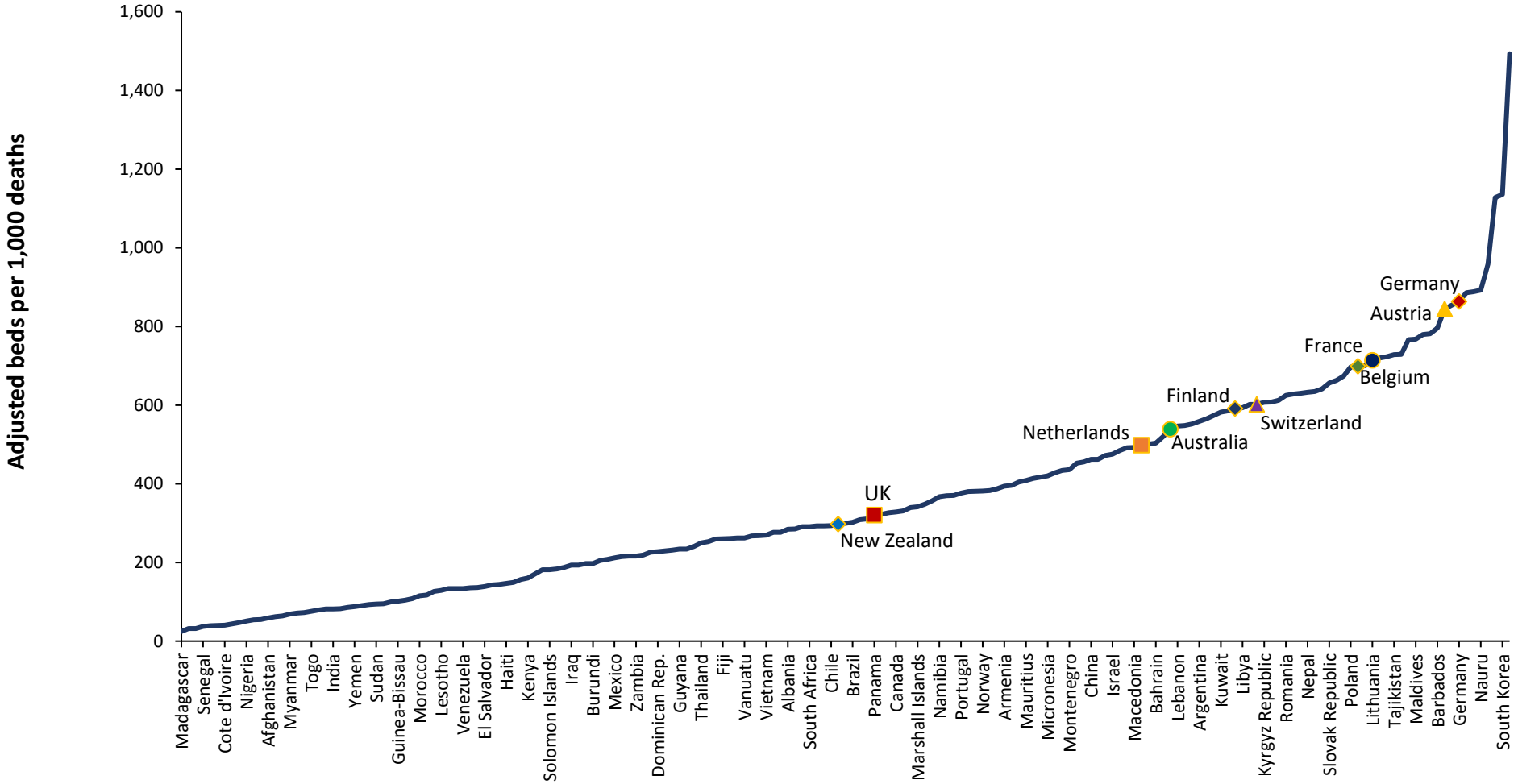

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Table S1: World Bank data for various countries and calculated beds per 1,000 deaths. Adjusted beds per 1,000 deaths are at 9.0 deaths per 1,000 population, as per the UK.

Country Name	Deaths per 1,000 population	Beds per 1,000 population	Beds per 1,000 deaths	Adjusted beds per 1,000 deaths
Madagascar	7.0	0.2	29	25
Niger	10.2	0.3	29	32
Guinea	10.1	0.3	30	32
Senegal	7.0	0.3	43	37
Sierra Leone	16.8	0.4	24	39
Chad	13.6	0.4	29	40
Cote d'Ivoire	12.6	0.4	32	40
Burkina Faso	9.5	0.4	42	44
Mauritania	7.8	0.4	51	47
Nigeria	11.9	0.5	42	51
Benin	9.6	0.5	52	54
Uganda	9.2	0.5	54	55
Afghanistan	7.7	0.5	65	59
Mali	11.2	0.6	54	62
Egypt	6.4	0.5	78	64
Myanmar	8.4	0.6	71	68
Mozambique	11.8	0.7	59	72
Pakistan	7.3	0.6	82	73
Togo	9.6	0.7	73	76
Angola	13.9	0.8	58	80
Bangladesh	5.7	0.6	105	82
India	7.9	0.7	89	82
Tanzania	7.8	0.7	90	82
Guatemala	5.2	0.6	115	86
Yemen	6.7	0.7	104	88
Eritrea	6.3	0.7	111	91
Liberia	8.0	0.8	100	93
Sudan	7.8	0.8	103	94
Cambodia	5.7	0.7	123	95
Cent. African Rep.	14.0	1.0	71	99
Guinea-Bissau	12.3	1.0	81	101
Ghana	8.1	0.9	111	104
Honduras	4.5	0.7	156	108
Morocco	6.4	0.9	141	116
Indonesia	6.2	0.9	145	117
Gambia	8.2	1.1	134	127
Lesotho	14.1	1.3	92	129
Philippines	5.9	1.0	169	134
Nicaragua	4.8	0.9	188	134
Venezuela	4.8	0.9	188	134
Bolivia	7.0	1.1	157	135
Cameroon	10.8	1.3	120	136
El Salvador	6.6	1.1	167	139
Samoa	5.2	1.0	192	143
Malawi	9.0	1.3	144	144
Haiti	8.6	1.3	151	147
Kiribati	8.2	1.3	159	150
Djibouti	8.8	1.4	159	157
Kenya	8.3	1.4	169	160
Congo	10.1	1.6	158	171
Belize	4.0	1.1	275	181
Solomon Islands	5.4	1.3	241	182
Zimbabwe	9.8	1.7	173	183
Costa Rica	4.4	1.2	273	187

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Country Name	Deaths per 1,000 population	Beds per 1,000 population	Beds per 1,000 deaths	Adjusted beds per 1,000 deaths
Iraq	4.8	1.3	271	193
Paraguay	4.8	1.3	271	193
St. Lucia	7.0	1.6	229	197
Burundi	11.1	1.9	171	198
Rwanda	6.4	1.6	250	205
Jamaica	7.1	1.7	239	208
Mexico	5.3	1.5	283	212
Swaziland	11.8	2.1	178	215
Equatorial Guinea	11.5	2.1	183	216
Zambia	9.7	2.0	206	216
Botswana	7.2	1.8	250	219
Ecuador	5.3	1.6	302	226
Dominican Rep.	5.9	1.7	288	227
Bhutan	6.5	1.8	277	229
Algeria	5.7	1.7	298	231
Guyana	7.9	2.0	253	234
Peru	4.4	1.5	341	234
Colombia	4.2	1.5	357	241
Thailand	7.6	2.1	276	249
Comoros	8.2	2.2	268	253
Iran	5.1	1.8	353	259
Fiji	6.9	2.1	304	260
St. Kitts and Nevis	8.5	2.3	271	261
Antigua/Barbuda	6.8	2.1	309	262
Vanuatu	4.5	1.7	378	262
Syria	3.5	1.5	429	268
Georgia	11.5	2.6	226	268
Vietnam	5.8	2.0	345	270
Malaysia	5.0	1.9	380	277
Uruguay	9.1	2.5	275	277
Albania	9.4	2.6	277	284
Andorra	8.4	2.5	298	285
Tunisia	5.5	2.1	382	291
South Africa	11.1	2.8	252	291
Sweden	9.6	2.7	281	293
Trinidad and Tobago	9.6	2.7	281	293
Chile	5.4	2.1	389	294
New Zealand	6.3	2.3	365	298
Cabo Verde	5.2	2.1	404	299
Brazil	6.1	2.3	377	302
Singapore	4.5	2.0	444	308
Jordan	3.7	1.8	486	311
Panama	5.0	2.2	440	320
United Kingdom	9.0	**2.9**	**322**	**322**
Tonga	6.7	2.6	388	327
Canada	7.2	2.7	375	328
United States	8.4	2.9	345	331
Turkey	5.7	2.5	439	340
Marshall Islands	6.6	2.7	409	342
Oman	2.8	1.7	607	348
Spain	8.2	3.1	378	357
Namibia	5.7	2.7	474	367
Sao Tome Principe	6.5	2.9	446	370
Italy	9.5	3.4	358	371
Portugal	9.1	3.4	374	376
Denmark	9.6	3.5	365	380
Bahamas	6.1	2.9	475	381

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Country Name	Deaths per 1,000 population	Beds per 1,000 population	Beds per 1,000 deaths	Adjusted beds per 1,000 deaths
Norway	8.1	3.3	407	382
Bosnia/Herzeg.	9.4	3.5	372	383
Ireland	5.9	2.9	492	387
Armenia	12.6	3.9	310	394
Saudi Arabia	3.2	2.1	656	396
San Marino	10.2	3.8	373	405
Mauritius	7.4	3.4	459	409
Qatar	1.3	1.2	923	414
Iceland	6.2	3.2	516	417
Micronesia	6.1	3.2	525	421
UAE	1.1	1.1	1,000	428
Grenada	6.9	3.5	507	434
Montenegro	9.5	4.0	421	436
Seychelles	6.7	3.6	537	452
Sri Lanka	6.6	3.6	545	456
China	7.2	3.8	528	462
Dominica	7.2	3.8	528	462
Suriname	4.6	3.1	674	472
Israel	5.1	3.3	647	475
Cyprus	5.5	3.5	636	485
Brunei Darussalam	3.6	2.8	778	491
Macedonia	9.4	4.5	479	492
Slovenia	9.1	4.5	495	498
Australia	6.4	3.9	609	501
Bahrain	2.2	2.1	955	503
Greece	9.7	4.8	495	520
Netherlands	8.3	4.7	566	539
Lebanon	4.4	3.5	795	547
Estonia	11.3	5.3	469	548
Serbia	11.9	5.4	454	552
Argentina	7.6	4.7	618	558
Uzbekistan	6.4	4.4	688	565
Malta	7.5	4.8	640	573
Kuwait	1.9	2.2	1,158	582
Latvia	14.2	5.9	415	585
Switzerland	7.7	5.0	649	591
Libya	4.2	3.7	881	593
Cuba	8.5	5.3	624	602
Finland	9.4	5.5	585	602
Kyrgyz Republic	6.6	4.8	727	607
Azerbaijan	6.3	4.7	746	608
Croatia	11.1	5.9	531	612
Romania	11.8	6.1	517	625
Moldova	12.4	6.2	500	628
Tuvalu	8.7	5.6	644	630
Nepal	6.6	5.0	758	633
Bulgaria	14.2	6.4	451	635
Palau	5.9	4.8	814	641
Slovak Republic	9.4	6.0	638	656
St. Vincent/Grenadines	6.5	5.2	800	663
Luxembourg	6.8	5.4	794	674
Poland	10.0	6.5	650	697
Belgium	9.9	6.5	657	699
Gabon	9.0	6.3	700	700
Lithuania	12.0	7.0	583	714
France	8.7	6.4	736	720
Hungary	13.0	7.2	554	723

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Country Name	Deaths per 1,000 population	Beds per 1,000 population	Beds per 1,000 deaths	Adjusted beds per 1,000 deaths
Tajikistan	6.0	5.5	917	729
Czech Republic	10.0	6.8	680	729
Ethiopia	7.2	6.3	875	766
Maldives	3.5	4.3	1,229	768
Kazakhstan	9.7	7.2	742	779
Timor-Leste	6.0	5.9	983	782
Barbados	6.4	6.2	969	796
Austria	9.0	7.6	844	844
Mongolia	6.7	6.8	1,015	855
Germany	10.6	8.2	774	863
North Korea (!)	13.2	8.8	670	886
Ukraine	15.1	9.0	596	888
Nauru	3.5	5.0	1,429	892
Russian Federation	14.8	9.7	655	959
Belarus	13.5	11.3	837	1,128
South Korea	9.2	10.3	1,120	1,135
Japan	9.5	13.7	1,442	1,493
Monaco	8.7	13.8	1,586	1,553

Footnote: (!) Beds data for North Korea may be unreliable