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Variations in amenable mortality—Trends in 16 high-income nations

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ABSTRACT

Background: There has been growing interest in the comparison of health system performance within and between countries, using a range of different indicators. This study examines trends in amenable mortality, as one measure of health system performance, in sixteen high-income countries.

Methods: Amenable mortality was defined as premature death from causes that should not occur in the presence of timely and effective health care. We analysed age-standardised rates of amenable mortality under age 75 in 16 countries for 1997/1998 and 2006/2007.

Results: Amenable mortality remains an important contributor to premature mortality in 16 high-income countries, accounting for 24% of deaths under age 75. Between 1997/1998 and 2006/2007, amenable mortality fell by between 20.5% in the US and 42.1% in Ireland (average decline: 31%). In 2007, amenable mortality in the US was almost twice that in France, which had the lowest levels.

Conclusions: Amenable mortality continues to fall across high-income nations although the USA is lagging increasingly behind other high income countries. Despite its many limitations, amenable mortality remains a useful indicator to monitor progress of nations.

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1. Background

There has been growing interest in comparisons of health system performance within and between countries. Healthcare is a major element of national budgets everywhere and while actual levels of expenditure vary across countries, all have come under increased pressure to ensure that resources are spent efficiently [1]. Assessing performance remains a challenge, however, and while existing frameworks use a range of indicators to capture the different aspects of health systems, frequently used indicators have no obvious direct link to health outcomes and the policy implications of comparisons are often unclear [2].

One approach that has been suggested to capture the contribution of health care to population health is the concept of 'amenable mortality' [3]. It derives from work by the American Working Group on Preventable and Manageable Diseases, which introduced the notion of 'unnecessary untimely deaths', reflecting premature death from a set of conditions that should not occur in the presence of timely and effective health care [4]. This concept was subsequently explored widely, especially in Europe [5–8], and it has been adopted as an indicator of the performance of health care systems by, among others, the English Department of Health [9] and the Organisation for Economic Cooperation and Development [10]. Experience with it has shown how health care has impacted positively on population health in many industrialised countries during the 1980s and 1990s [3]. However, the pace of change has differed among countries and over time. Recent work updating our cross-national study in the late-1990s [11] showed that progress in the USA as measured by this

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indicator was lagging behind other industrialised countries [12]. The present study builds on that work, updates trends and examines whether and how the US position has changed subsequently in comparison with other high-income countries.

2. Methods

2.1. Data

The principal data source was the WHO mortality database [13], with deaths coded according to the 9th and 10th revisions of the International Classification of Diseases, by sex and five year age bands (with infant deaths listed separately), for the period 1997/1998–2006/2007. To ensure comparability with previous work we extracted data for 13 countries of Western Europe, Australia, New Zealand and Japan; data for Germany were available to 2006 only. Data for the US were only available from this source to 2005 and were therefore complemented by data from the Centers for Disease Control and Prevention (CDC), for 1999–2007 [14]. Population data were obtained from the same sources.

Data were checked for consistency through inspection of trends. UK data for 1999 were corrected for known discontinuities affecting counts of deaths coded as pneumonia and cerebrovascular disease in particular [15,16]. In the US, implementation of ICD10 in 1999 led to discontinuities in counts of deaths coded as ischaemic heart disease (IHD) (I20–I25) in particular. While these are corrected for 1999–2007 in data from the CDC [17], 1998 data were available in sufficiently disaggregated format from the WHO only and had to be corrected for consistency for IHD with the later CDC figures.

2.2. Selection of causes of death

The selection of causes of death considered amenable to health care follows the classification used in our earlier work [3]. In brief, we consider conditions such as selected childhood infections, treatable cancers, diabetes, cerebrovascular disease and hypertension, and complications of common surgical procedures. We also include ischaemic heart disease (IHD) but we treat this cause differently in that we only consider 50% of IHD deaths as 'amenable'. This is based on a review of the evidence which suggests that between 40% and 50% of the IHD decline in industrialised countries can be attributed to improvements in health care [18,19]. Throughout this paper, the term 'amenable' mortality always includes 50% of IHD deaths. A detailed overview of the conditions included is given in Table 1.

As with previous work, an upper age-limit was set at 75 years, reflecting uncertainty about the extent to which deaths at older ages can be prevented by health care but also about the reliability of death certification in older people with multiple disease processes. Also in line with other work, younger age limits were applied to selected conditions, including diabetes mellitus (<50 years) because the preventability of deaths at older ages from diabetes remains controversial; selected childhood conditions (<15) (intestinal infectious diseases, whooping cough, measles,

and childhood respiratory diseases); and leukaemia (<45) because of recent evidence showing substantial improvements in mortality from leukaemia in the European Union up to age 44 since 1960, largely attributed to advances in treatment [20].

2.3. Analyses

We examined levels and trends in amenable mortality by calculating age-standardised death rates (per 100,000 population) for single causes and cause groups, by sex and combined, with direct standardisation to the European standard population [21]. Where the population of a country is below 10 million, we combined data from two years to reduce variation due to small numbers. We examine two points in time which, for simplicity, we refer to as combined years, with 1997/1998 as the starting point and 2006/2007 as the end point of the period under review. We combine sex-specific death rates using a simple average, weighted for the distribution of men and women in the population.

3. Results

Amenable mortality remains an important contributor to premature mortality in all 16 countries studied here, accounting, in 2006/2007, for an average of just under one-quarter of total mortality under age 75 for both sexes combined, ranging from 19.2% in France to 27.2% in New Zealand (Table 2) (average men: 21.2%; women: 30.2%).

Between 1997/1998 and 2006/2007, levels of amenable mortality fell by between 20.5% in the US and 42.1% in Ireland. Ten out of 16 countries recorded declines of 30% and more (average decline: 31%; men: 33.5%, women: 28.4%). This included countries such as Australia, Italy and Sweden which, in 1997/1998, already had comparatively low levels of amenable mortality.

The decline in amenable mortality was, to some extent, driven by falling death rates from ischaemic heart disease (IHD), although the reduction in mortality from this cause varied, ranging from 13.9% in Greece to 55.4% in the Netherlands (average: 40.9%; men: 40.0%, women: 44.1%). Mortality from causes other than those considered amenable to health care or from IHD also continued to fall in all countries, although at slower pace, by 6.6% in Finland to 22.2% in Italy (average: 14.2%; men: 15.4%, women: 11.3%).

By 2006/2007, combined levels of amenable mortality were lowest in France, at 55 deaths per 100,000 population, closely followed by Australia (56.92 per 100,000) and Italy (59.88) (Table 2). The highest levels were seen in the US, at 95.54 deaths per 100,000, followed by the United Kingdom (82.54) and Denmark (80.13). This 'ranking' is broadly reflected by sex-specific rates, although it is important to note that, among women, levels were lowest in Japan, at 48.01 deaths per 100,000 population, while among men, Greece and Finland were among those with the highest rates, after the US, at 93.21, 92.74 and 106.90, respectively.

Ireland, which, in 1997/1998, had recorded the highest death rate attributable to amenable causes among the 16 countries under study and in both men and women, had narrowed the gap with the best performing country, France, from an excess of 78% to 42% in 2006/2007.

Table 1

List of causes of death considered amenable to health care.

Cause of death considered amenable to health care	Age	International classification of diseases	
		9th revision	10th revision
Intestinal infections	0–14	001–9	A00–9
Tuberculosis	0–74	010–8, 137	A15–9, B90
Other infections (diphtheria, tetanus, septicaemia, poliomyelitis)	0–74	032, 037, 038, 045	A36, A35, A80
Whooping cough	0–14	033	A37
Measles	1–14	055	B05
Malignant neoplasm of colon and rectum	0–74	153–4	C18–21
Malignant neoplasm of skin	0–74	173	C44
Malignant neoplasm of breast	0–74	174	C50
Malignant neoplasm of cervix uteri	0–74	180	C53
Malignant neoplasm of cervix uteri and body of uterus	0–44	179, 182	C54, C55
Malignant neoplasm of testis	0–74	186	C62
Hodgkin's disease	0–74	201	C81
Leukaemia	0–44	204–8	C91–5
Diseases of the thyroid	0–74	240–6	E00–7
Diabetes	0–49	250	E10–4
Epilepsy	0–74	345	G40–1
Chronic rheumatic heart disease	0–74	393–8	I05–9
Hypertensive disease	0–74	401–5	I10–3, I15
Ischaemic heart disease: 50% of deaths	0–74	410–4	I20–5
Cerebrovascular disease	0–74	430–8	I60–9
All respiratory diseases (excl. pneumonia, influenza)	1–14	460–79, 488–519	J00–9, J20–99
Influenza	0–74	487	J10–1
Pneumonia	0–74	480–6	J12–8
Peptic ulcer	0–74	531–3	K25–7
Appendicitis	0–74	540–3	K35–8
Abdominal hernia	0–74	550–3	K40–6
Cholelithiasis and cholecystitis	0–74	574–5.1	K80–1
Nephritis and nephrosis	0–74	580–9	N00–7, N17–9, N25–7
Benign prostatic hyperplasia	0–74	600	N40
Misadventures to patients	0–74	E870–6, E878–9	Y60–9, Y83–4
Maternal death	0–74	630–76	O00–99
Congenital cardiovascular anomalies	0–74	745–7	Q20–8
Perinatal deaths, all causes, excluding stillbirths	0–74	760–79	P00–96, A33

Source: Adapted from Nolte and McKee [3].

Conversely, in the US, this gap increased from 59% in 1997/1998 to 74% in 2006/2007. The US also recorded the highest death rate from all causes under age 75 years in both men and women.

We estimated the number of deaths in the United States (as the 'worst performing' country on this indicator) that could have been saved if the US had achieved levels of amenable mortality seen in comparator countries. Taking the average level of amenable mortality in fifteen OECD countries excluding the United States as lower bound and the average of the three top-performing countries (Australia, France, and Italy) as upper bound, we estimated that, in 2006/2007, between 59,500 and 84,300 deaths under age 75 could have been saved in the US.

4. Discussion

Deaths from causes that are considered amenable to timely and effective health care remain an important contributor to the mortality experience under age of 75 in high income countries. Although mortality from these conditions has fallen consistently in all countries between 1997/1998 and 2006/2007, as we have shown previously [12], the scale and pace of improvement has varied. We show that ten out of 16 countries experienced a decline of 30% or more; however in the USA and in Greece this was just over 20%. As a consequence, in 2007, levels of amenable

mortality in the US were almost twice those seen in France, which had the lowest levels. All-cause mortality was also highest in the US, among both men and women.

The concept of amenable mortality reflects what should be possible in the presence of timely and effective health care [4]. It acknowledges that attribution of an outcome (here death) to a particular aspect of health care is intrinsically problematic because of the multi-factorial nature of most outcomes. As a consequence, when interpreting findings, a degree of judgement is needed, as deaths from many causes are the final stage in a complex chain of events, some shaped by underlying social and economic factors, lifestyles, and previous use of preventive and curative health care [3]. The complexity of these interlinking factors, acting over different time periods, precludes any simple adjustment for them. In particular, the findings must be viewed in the context of potential differences in underlying disease incidence and severity of disease at presentation. However, the latter is a function of health seeking behaviour and although it is partly outside the scope of health services it also reflects access to care and thus is, in part, amenable to health system design.

This analysis has been at the country level only and has not disaggregated mortality by region, ethnicity or socioeconomic characteristics, so concealing potentially large variations within populations [3]. Evidence from Australia, New Zealand and the United States consistently

Table 2

Age-standardised death rates (per 100,000), age 0–74, from selected causes in 16 OECD countries, 1997/1998 and 2006/2007.

	SDR _{0–74} 1997/1998				SDR _{0–74} 2006/2007				% amenable mortality of all causes (2006/2007)	% change 1997/1998–2006/2007			
	Amenable causes	IHD (50%)	Other causes	All causes	Amenable causes	IHD (50%)	Other causes	All causes		Amenable causes	IHD (50%)	Other causes	All causes
<i>Both sexes combined</i>													
Australia	87.95	27.38	203.70	319.03	56.92	13.97	164.57	235.46	24.2	35.3	49.0	19.2	26.2
Austria	108.92	34.63	232.23	375.78	67.33	18.25	201.70	287.29	23.4	38.2	47.3	13.1	23.6
Denmark	113.01	29.11	307.22	449.34	80.13	13.95	265.66	359.74	22.3	29.1	52.1	13.5	19.9
Finland	116.22	43.16	239.26	398.64	73.78	26.14	223.36	323.28	22.8	36.5	39.5	6.6	18.9
France	75.62	12.39	267.68	355.68	55.00	8.08	223.75	286.83	19.2	27.3	34.7	16.4	19.4
Germany	106.18	31.75	245.84	383.77	76.42	19.61	209.49	305.52	25.0	28.0	38.2	14.8	20.4
Greece	97.27	26.00	213.53	336.80	76.65	22.38	186.77	285.80	26.8	21.2	13.9	12.5	15.1
Ireland	134.36	48.11	248.45	430.92	77.82	24.51	196.81	299.14	26.0	42.1	49.1	20.8	30.6
Italy	88.77	19.33	224.46	332.56	59.88	11.47	174.62	245.97	24.3	32.5	40.7	22.2	26.0
Japan	81.42	8.93	192.97	283.31	61.17	7.39	166.11	234.67	26.1	24.9	17.2	13.9	17.2
Netherlands	96.89	26.07	239.42	362.37	65.55	11.62	200.85	278.02	23.6	32.3	55.4	16.1	23.3
New Zealand	114.54	36.76	225.82	377.12	78.64	21.33	189.65	289.62	27.2	31.3	42.0	16.0	23.2
Norway	98.64	31.20	215.92	345.76	63.63	14.67	188.97	267.27	23.8	35.5	53.0	12.5	22.7
Sweden	88.44	30.34	190.94	309.72	61.25	18.02	173.33	252.60	24.2	30.7	40.6	9.2	18.4
UK	126.45	42.47	224.80	393.72	82.54	22.42	202.85	307.82	26.8	34.7	47.2	9.8	21.8
USA	120.22	39.46	278.06	437.74	95.54	25.69	258.85	380.08	25.1	20.5	34.9	6.9	13.2
				Average					24.4	31.3	40.9	14.0	21.2
<i>Men</i>													
Australia	99.41	40.81	272.63	412.86	62.29	21.62	213.81	297.72	20.9	37.3	47.0	21.6	27.9
Austria	132.17	53.60	328.72	514.49	79.21	29.25	278.92	387.38	20.4	40.1	45.4	15.1	24.7
Denmark	120.83	43.43	383.51	547.77	83.84	20.35	337.64	441.83	19.0	30.6	53.1	12.0	19.3
Finland	150.39	69.57	341.86	561.81	92.74	43.22	317.93	453.89	20.4	38.3	37.9	7.0	19.2
France	85.87	20.35	397.33	503.55	60.97	13.66	326.96	401.60	15.2	29.0	32.9	17.7	20.2
Germany	125.25	48.29	343.63	517.17	87.41	30.45	289.20	407.06	21.5	30.2	37.0	15.8	21.3
Greece	113.32	40.74	298.70	452.76	93.21	36.20	269.20	398.61	23.4	17.7	11.1	9.9	12.0
Ireland	157.57	72.47	322.34	552.38	85.14	38.11	250.54	373.78	22.8	46.0	47.4	22.3	32.3
Italy	101.20	30.73	321.30	453.23	64.78	18.10	244.56	327.44	19.8	36.0	41.1	23.9	27.8
Japan	101.60	13.61	276.97	392.18	74.98	11.59	238.54	325.11	23.1	26.2	14.8	13.9	17.1
Netherlands	106.03	39.16	322.22	467.41	66.61	17.30	256.27	340.19	19.6	37.2	55.8	20.5	27.2
New Zealand	126.52	55.99	289.15	471.67	85.36	32.88	232.85	351.09	24.3	32.5	41.3	19.5	25.6
Norway	115.48	49.23	286.58	451.28	69.18	22.91	239.51	331.60	20.9	40.1	53.5	16.4	26.5
Sweden	104.73	46.93	245.18	396.85	67.58	27.56	216.41	311.54	21.7	35.5	41.3	11.7	21.5
UK	144.76	63.05	284.28	492.09	91.27	34.47	253.78	379.51	24.0	37.0	45.3	10.7	22.9
USA	136.61	56.79	358.55	551.95	106.90	37.18	328.18	472.26	22.6	21.7	34.5	8.5	14.4
				Average					21.2	33.5	40.0	15.4	22.5
<i>Women</i>													
Australia	76.64	14.13	135.66	226.42	51.62	6.42	116.00	174.05	29.7	32.6	54.6	14.5	23.1
Austria	87.00	16.74	141.27	245.01	56.08	7.83	128.51	192.42	29.1	35.5	53.2	9.0	21.5
Denmark	105.38	15.13	232.75	353.26	76.51	7.67	195.09	279.27	27.4	27.4	49.3	16.2	20.9
Finland	83.73	18.05	141.68	243.47	55.58	9.74	132.58	197.90	28.1	33.6	46.1	6.4	18.7
France	65.89	4.83	144.62	215.33	49.39	2.84	126.88	179.10	27.6	25.0	41.2	12.3	16.8
Germany	88.05	16.01	152.80	256.86	65.87	9.22	133.06	208.15	31.6	25.2	42.4	12.9	19.0
Greece	81.52	11.54	129.93	222.99	60.40	8.82	105.89	175.11	34.5	25.9	23.6	18.5	21.5

Table 2 (Continued)

	SDR ₀₋₇₄ 1997/1998				SDR ₀₋₇₄ 2006/2007				% change 1997/1998–2006/2007			
	Amenable causes		All causes		Amenable causes		All causes		Amenable causes		All causes	
	IHD (50%)	Other causes	IHD (50%)	Other causes	IHD (50%)	Other causes	IHD (50%)	Other causes	IHD (50%)	Other causes	IHD (50%)	Other causes
Ireland	111.48	175.57	311.12	70.49	10.89	143.00	224.39	31.4	36.8	54.8	18.6	27.9
Italy	77.08	133.42	219.13	55.26	5.21	108.58	169.05	32.7	28.3	39.6	18.6	22.9
Japan	62.06	112.42	178.92	48.01	3.39	97.12	148.52	32.3	22.6	23.5	13.6	17.0
Netherlands	87.94	158.43	259.62	64.52	6.06	146.64	217.21	29.7	26.6	54.3	7.4	16.3
New Zealand	102.89	164.29	285.26	72.20	10.26	148.23	230.69	31.3	29.8	43.2	9.8	19.1
Norway	82.16	146.75	242.48	58.14	6.51	138.94	203.58	28.6	29.2	52.0	5.3	16.0
Sweden	72.53	137.95	224.62	55.01	8.61	130.82	194.44	28.3	24.2	39.1	5.2	13.4
UK	108.83	167.29	298.72	74.14	10.82	153.81	238.76	31.1	31.9	52.1	8.1	20.1
USA	104.56	201.18	328.65	84.50	14.52	191.47	290.49	29.1	19.2	36.6	4.8	11.6
	Average							30.2	28.4	44.1	11.3	19.1

Notes: years combined for countries with population <10 million: Austria, Denmark, Finland, Ireland, New Zealand, Norway, and Sweden.

points to higher levels of amenable mortality among, respectively, the indigenous population and African Americans compared to non-indigenous populations and white Americans [22–24]. In the US however the gap varies substantially by state [25], suggesting that observed differences cannot solely be attributed to lifestyle or biological factors. Evidence from Europe is less clear-cut with findings from for example the Netherlands pointing to higher levels of selected amenable conditions among the migrant population, although the contribution of health care to these differences remains uncertain [26]. Thus, while the impact of health care on differences between selected population groups is still inadequately understood, research evidence on diabetes suggests that health care can play a substantial part in narrowing the gap due to socioeconomic status [27,28] and ethnicity [29].

Crucially, it is important to reiterate that amenable mortality is only an indicator. The concept is limited in that it captures mortality under the age 75 and so considers only about half of the mortality experience in high income countries [12]. This risks devaluing the role of curative care for those at older ages. However, extending the concept beyond age 75 poses the problem of obtaining evidence for the preventability of death at older ages because such patients are often excluded from trials. Also, the reliability of death certification becomes increasingly questionable at older ages given the frequent presence of multiple disease processes.

A key observation from this brief research note is the apparent continuing lower performance of the US health care system as assessed by the concept of amenable mortality, contrasting with continued improvements in other high-income countries, and while the space available does not permit a detailed examination of the underlying reasons for its poor performance, potential factors include the lack of universal coverage and high cost of care.

To conclude, despite its many limitations, amenable mortality remains a useful indicator to monitor progress of nations.

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