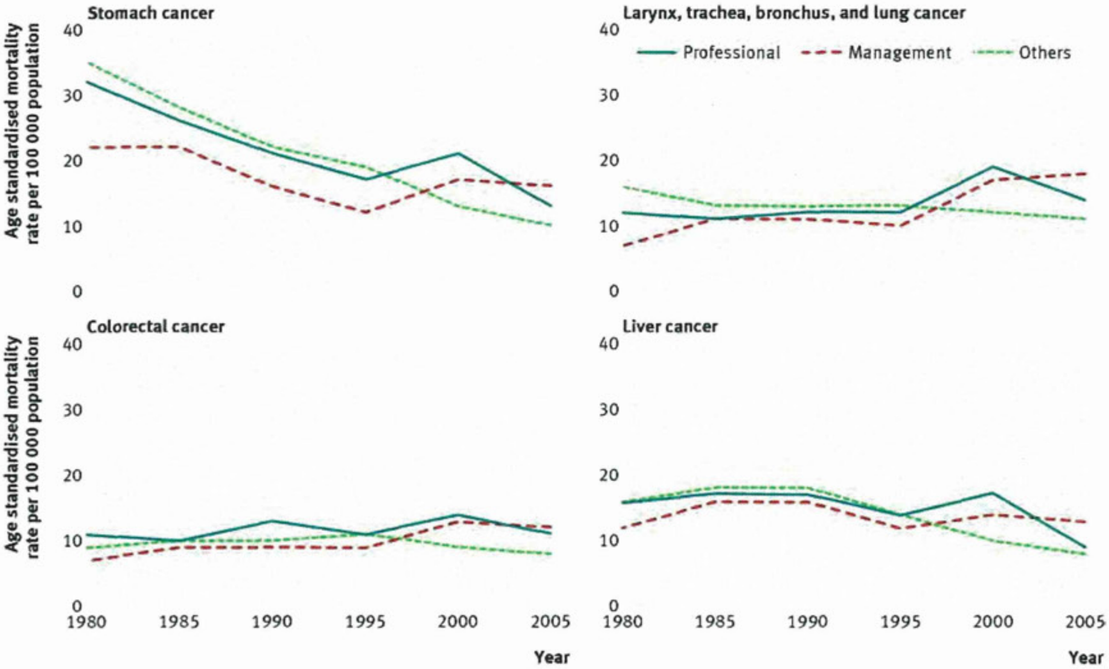

Fig 2 Temporal trends and comparisons of age standardised mortality rates (per 100 000) of four leading cancers, 1980-2005, in men aged 30-59 in Japan

GBD 2010 country results: a global public good

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The Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010) constitutes an unprecedented collaboration of 488 scientists from 303 institutions in 50 countries, focusing on describing the state of health around the world using a uniform method. Results for the world and 21 regions for 1990 and 2010 have been reported for 291 diseases and injuries, 1160 sequelae of these causes, and 67 risk factors or clusters of risk factors.[1-7] The burden of each disease, injury, or risk factor has been quantified in terms of deaths, years of life lost due to premature mortality (YLLs), years lived with disability (YLDs), and disability-adjusted life-years (DALYs).

Although only global and regional results have been reported so far, the underlying unit of analysis for GBD 2010 was 187 countries. Age-specific mortality was analysed for each country for each year from 1970 to 2010. Causes of death were estimated for each country from 1990 to 2010 with country-specific data and models. Disease and injury sequelae were estimated in most cases with a Bayesian meta-regression method (DisMod-MR) that includes estimation of systematic differences in incidence, prevalence, or excess mortality between countries within regions.[5] Systematic analysis of risk factor exposure, excess health risks associated with each risk–outcome pair, and counterfactual minimum risk levels of exposure were used to compute attributable burden. On the basis of these analyses, GBD 2010 provides a complete assessment of the burden of diseases, injuries, and risk factors for 187 countries including quantification of uncertainty in the estimates for 1990 and 2010, albeit with important limitations because of the scarcity of data for some outcomes in some countries and the need to use a range of statistical models to generate estimates. The availability of standardised estimates for each of the 187 countries over time provides an unprecedented opportunity to undertake comparative assessments, to benchmark country performance in control of critical diseases, injuries, and risks, and to stimulate evidence-based action.

Most of the scientists in the GBD 2010 collaboration volunteered their own time or raised their own funds to participate.[8] A key motivation for them was the opportunity to publish more detailed analyses of data, methods, and results for specific diseases, injuries, and risk factors. Many reports are in submission or in preparation and provide more detail for specific diseases, injuries, risk factors, and countries.[9] Although we expect that these reports will be important contributions to the scientific literature, we recognise that country results from the GBD are a global public good that could be a useful or even critical input into a more informed national, regional, and global dialogue about health challenges. Already, governments of several developed and developing countries have approached us seeking access to more detailed results. Because we believe that the dissemination and rapid availability of the detailed results is a moral imperative, we are providing global access to these details on March 5, 2013, through a series of online visualisations. To allow sufficient time for members of the GBD 2010 collaboration to report their own research findings, we will defer dissemination of public-use datasets of the underlying results presented in the visualisations until Sept 1, 2013. In this way, we believe that we can provide global access to these important results while at the same time respecting the intellectual investment of the collaboration's members. Nonetheless, anticipating that some governments might wish to have immediate access to more detailed information as an input to national policy dialogue, we have provided and will continue to provide detailed national disease burden results on request. We also encourage use of the visualisations or snapshots of their images for teaching, communication, and other educational purposes.

Alongside the reporting of global and regional results in *The Lancet*, five data visualisations were made available in December, 2012. For visualisation of country-level data, the Institute for Health Metrics and Evaluation (IHME) has developed new visualisations with expanded scope and functionality, which are being launched on March 5. Data visualisations can make complex information accessible and interpretable without advanced statistical or epidemiological training. The primary purpose of these visualisations is to allow health specialists, policy makers, the media, donors, and the general public to explore the patterns of health in different age and sex groups, countries, and time periods. Providing information on patterns of health to this broad audience could enhance the scope and quality of national, regional, and global dialogue about the main

For **data visualisations** see http://www.ihmeuw.org/GBDregionalviz

For more on the **expansion of scope and functionality of these visualisations** see http://www.ihmeuw.org/GBDcountryviz

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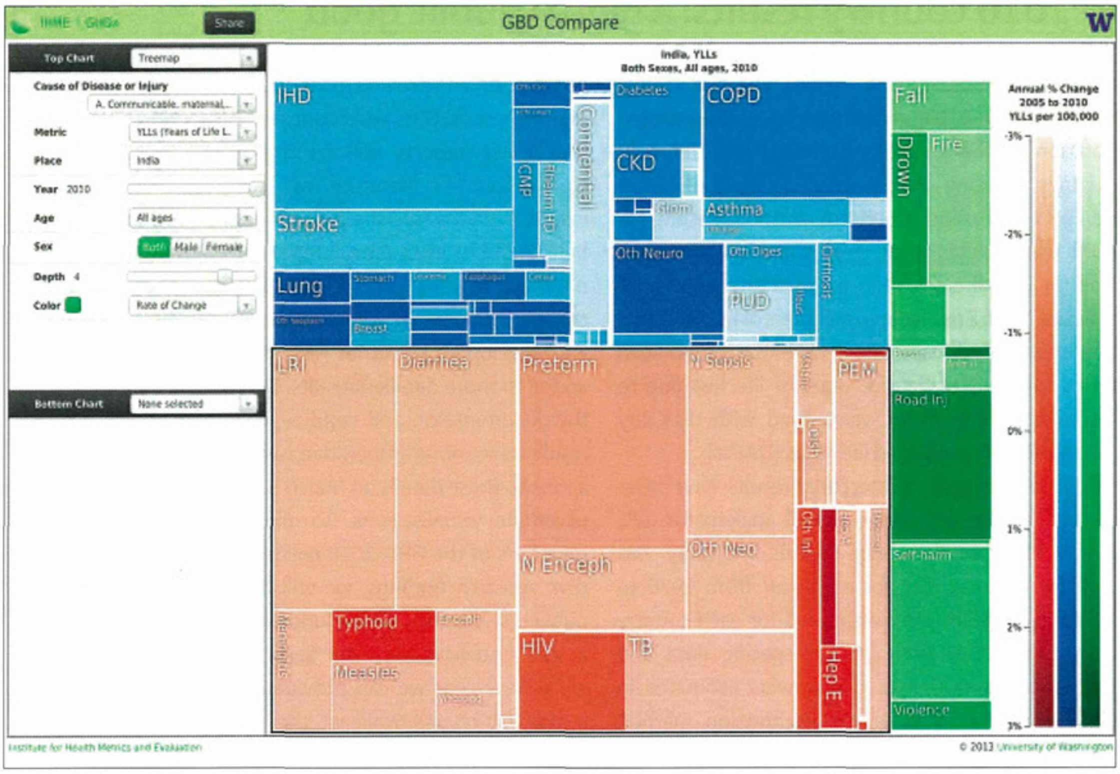

Figure 1: **Screenshot of an output from GBD Compare showing a treemap of YLLs in India in 2010**
Communicable, maternal, neonatal, and nutritional causes are coloured red; non-communicable causes are blue; and injuries are green. The shading of each colour can be altered to convey information about rates of change from 1990 to 2010, or the size of uncertainty intervals; in this figure, shading is according to rates of change. In some cases the labels for the boxes are not visible, but hovering over each rectangle provides full detail. This figure illustrates how, despite substantial reductions in mortality of children younger than 5 years and adults, communicable, maternal, neonatal, and nutritional disorders still account for 50·4% of YLLs. Results are for the fourth level of disease disaggregation.[10] YLLs=years of life lost due to premature mortality.

health challenges facing countries and pinpoint needs for realignment of resource allocation and strategic prioritisation. An important secondary purpose is to broaden the community of scientists who scrutinise the results. Such scrutiny will probably identify key scientific findings that have not yet been highlighted in GBD 2010 summary publications, discern many ways in which future estimates can be improved through inclusion of other data sources, discover alternative approaches to correct for bias or otherwise enhance the quality and comparability of data, identify outliers in existing estimates, and, perhaps most importantly, stimulate interest in new primary data collection.

We are now making available many ways to examine GBD 2010 results: a general instrument to explore the burden of disease, four supplemental visualisations that provide different perspectives to examine the same underlying results, a benchmarking method, and two visualisations to explore some of the GBD primary input data. GBD Compare is the primary way to explore patterns of the burden of diseases, injuries, and risk factors both within a country and between countries. It has five different views, and for each of these views there are thousands of ways to explore the GBD findings. The treemap that is produced is effectively a rectangular pie chart, in which the size of each box for a disease or injury is proportional to the share of the total contributed by that disease (figure 1). Treemaps can be displayed for deaths, YLLs, YLDs, or DALYs. A treemap can be generated for any of the 20 GBD age groups or some summary age groups for males, females, or both sexes combined; for different geographical units (global, region, country); and for different years between 1990 and 2010. As part of the development of GBD Compare, we interpolated results for 1995 and 2000 using a very simple approach; care should be taken to avoid overinterpretation of the results for these years. Users can also display risk factor attribution to each of

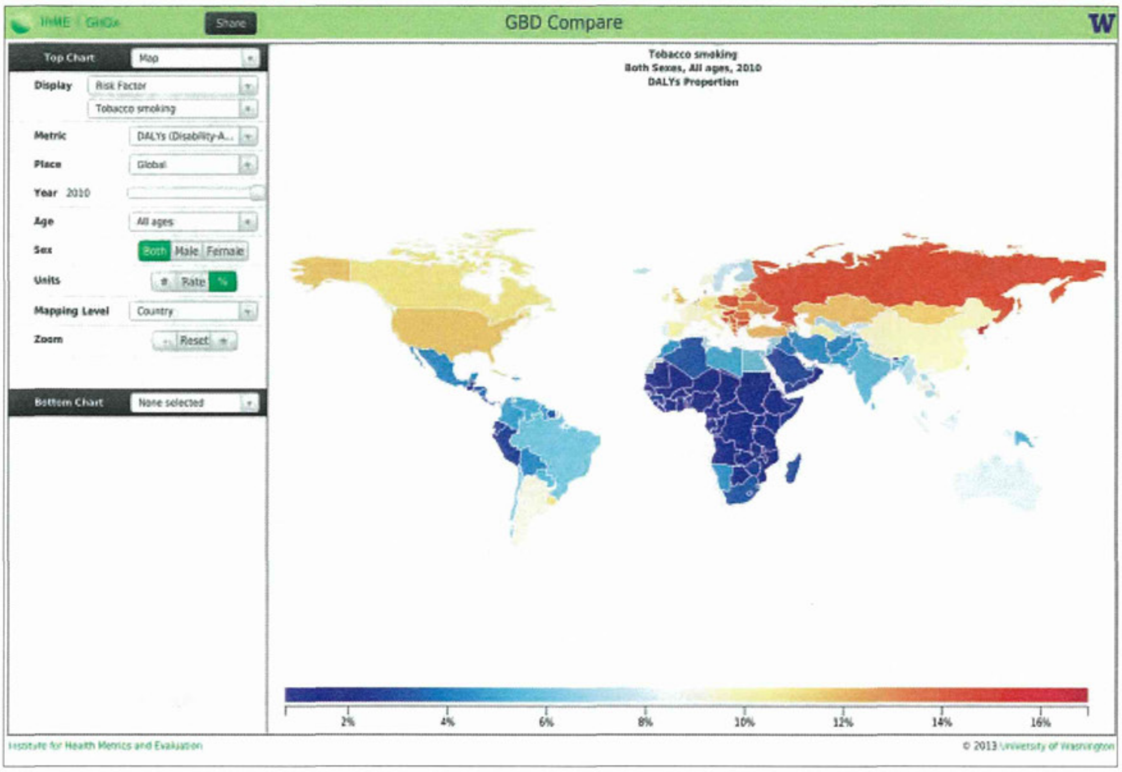

Figure 2: **Screenshot of an output of GBD Compare showing the percentage of DALYs attributable to tobacco by country in 2010 for both sexes combined**
DALYs=disability-adjusted life-years.

the causes. They can adjust the level of disaggregation of the cause list—eg, three broad causes or 21 second-level causes. GBD Compare can also show results for risk factors. Stacked bar charts show the number of deaths, YLLs, YLDs, and DALYs attributable to that risk factor, disaggregated by cause.

Users can produce maps for any disease, injury, or risk factor showing rates, numbers, or proportions of deaths, YLLs, YLDs, and DALYs to enable comparisons between countries (figure 2). Maps can be used to display the rank for a specific cause or risk factor within a country, effectively visualising their relative importance within each country. Because some countries are small in area, a user can zoom in or out on the map to examine specific areas such as the Caribbean, the Pacific, or Central America. Two other views show estimates for a quantity of interest over time with uncertainty or across age groups with uncertainty. In GBD Compare, users can display two views at once (figure 3). They can explore results by navigating between the top and bottom panels: clicking on a disease or injury on the treemap will display that cause on the map, and clicking a country on the map will switch the treemap to this country.

Four different visualisations provide supplemental views: GBD Arrow Diagrams, GBD Cause Patterns, GBD Uncertainty Visualization, and a healthy life expectancy and life expectancy visualisation (HALE/LE Visualization). GBD Arrow Diagrams allow the user to see—for a specific country, age group, and sex—the rank order of disease and injury causes or risk factors in terms of deaths, YLLs, YLDs, or DALYs, and how the rankings have changed between 1990 and 2010 (figure 4). The arrow diagrams change dynamically if a different age, sex, country, year, or metric is selected.

GBD Cause Patterns uses stacked column charts for 21 broad cause groups to show the selected burden metric, such as number, rate, or percentage, and allows comparisons between regions, any set of countries, age groups, both sexes, and years. It is a powerful way to understand how the age and broad cause composition of burden has changed from 1990 to 2010 for each metric. It is also a powerful

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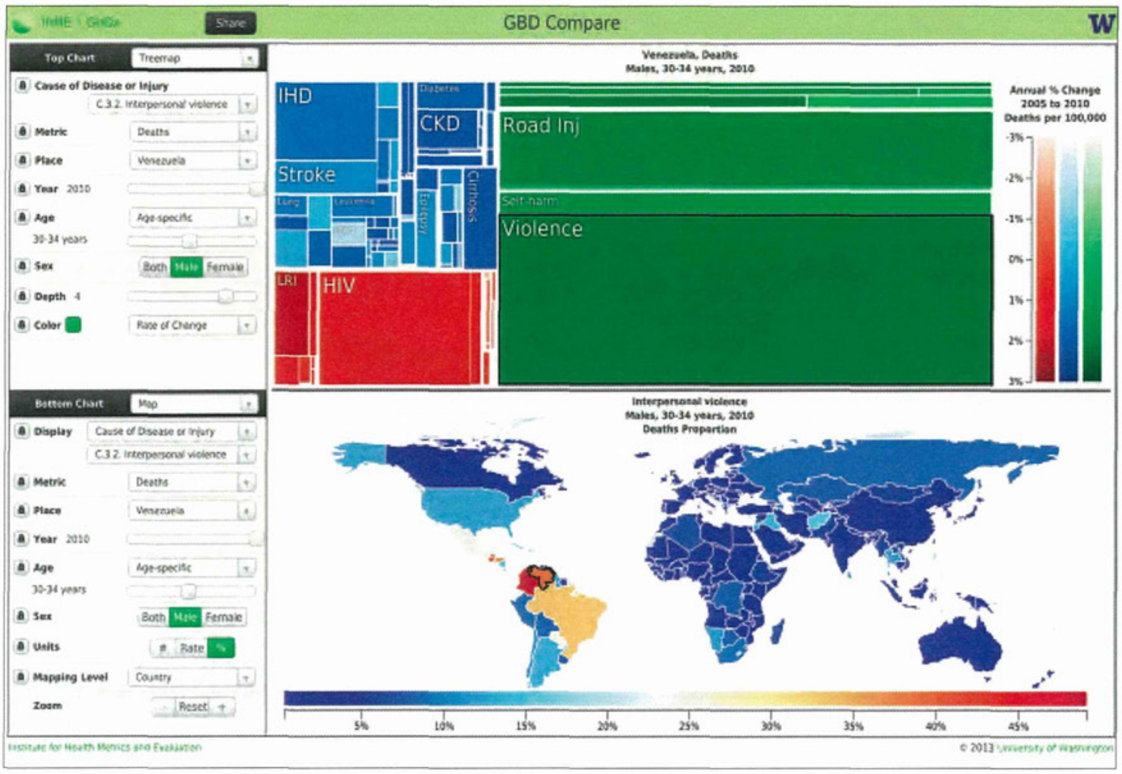

Figure 3: Screenshot of an output of GBD Compare showing treemap of deaths in men aged 30–34 years in Venezuela and the proportion of deaths due to violence in this age group worldwide

way to visualise the differences in numbers, rates, or proportions between any set of countries. Country-level results, and comparisons between them, are potentially subject to greater uncertainties than are regional and global ones, so the clear presentation of those uncertainties is particularly important. The GBD Uncertainty Visualization displays the 95% uncertainty intervals for both numbers and ranks associated with each cause or risk for any combination of age groups, sexes, and region. HALE/LE Visualization allows users to compare life expectancy with healthy life lost (the difference between life expectancy and healthy life expectancy) for 1990 and 2010; results are displayed for all 187 countries and can be viewed by age group and sex. This visualisation was released in December, 2012.

Comparisons of outcomes have often been limited by a lack of comparability of measurements between countries. GBD 2010 invested substantial effort in a detailed endeavour to enhance the comparability of cause of death data both over time and across countries.[2,11] Similarly, the analysis of prevalence of the 1160 sequelae by different experts included substantial emphasis on controlling for variation in case definitions, recall periods, instrument design, and biomarker assays across studies. Residual issues of comparability and data quality undoubtedly remain; nonetheless, GBD 2010 provides a unique and comparable platform to examine differences in levels and trends in diseases, injuries, and risk factors across countries. In our experience, different users might want to select a customised set of countries to serve as relevant comparators. We are releasing a ranking instrument on March 5, for this purpose, and are developing others. In GBD Leading Cause, any set of countries can be examined using a heat map to look at differences in the leading causes of burden due to disease, injuries, or risk factors. These heat maps are analogous to those reported for DALYs at the regional level.[3]

Two visualisations explore the mortality and causes of death input data: Mortality Visualization and COD Visualization. Some researchers and analysts wish to understand what data were available to feed into the analysis of age-specific mortality or causes of death.

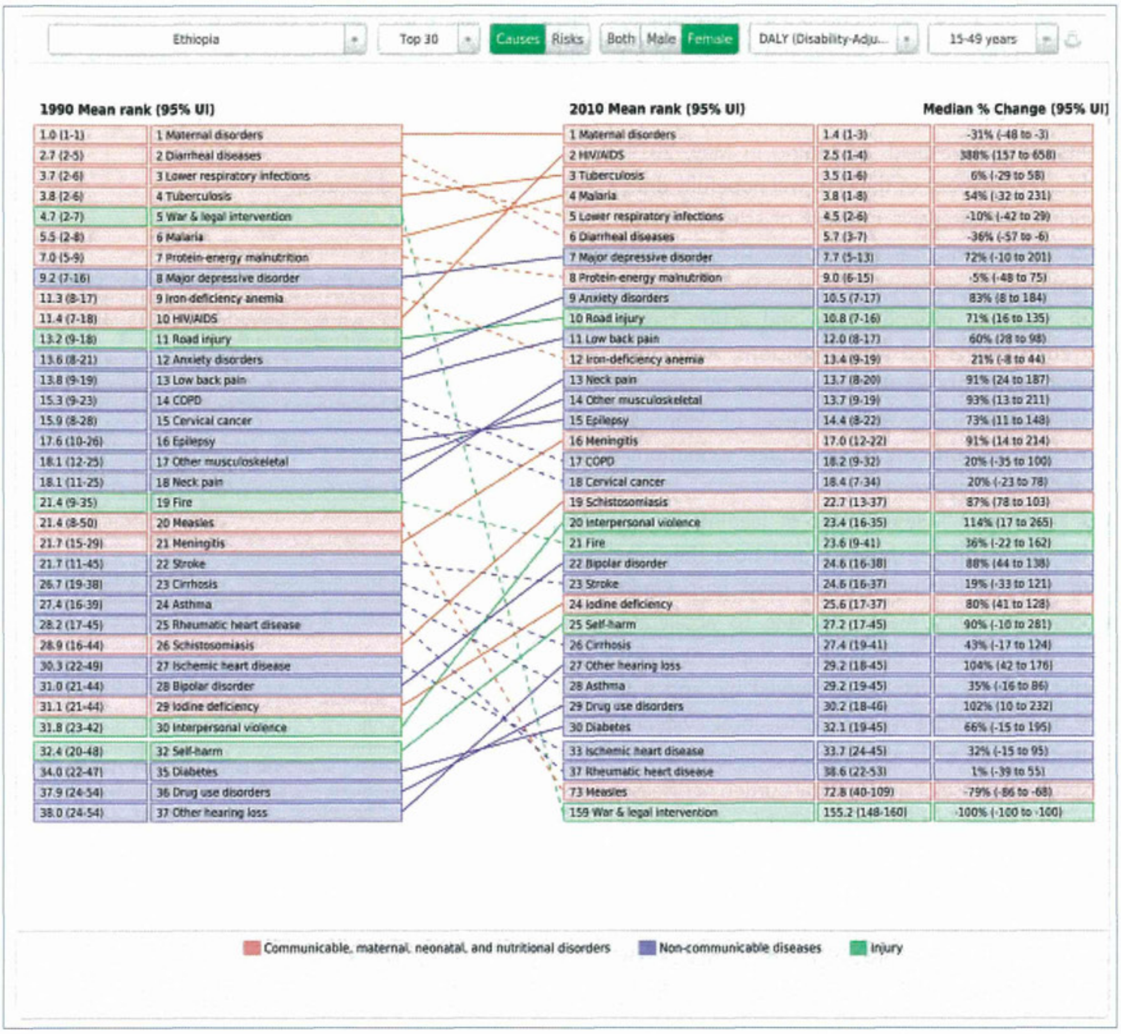

Figure 4: **Screenshot of an output of GBD Arrow Diagrams showing ranks of diseases and injuries as causes of DALYs in women of reproductive age in Ethiopia in 1990 and 2010**

DALYs=disability-adjusted life-years.

Mortality Visualization gives them access to country-specific estimates and the underlying data used for mortality of children younger than 5 years and adults aged between 15 and 60 years. These measures are the two critical summary measures of mortality experience used as inputs of developing life tables; for each country, the user can examine what studies are available and meta-data describing the provenance of that measurement. The visualisation also shows the various steps in development of estimates of the levels and trends in both adult and child mortality. COD Visualization provides access to the curated cause of death database that has been developed at IHME for GBD 2010. Users can view numbers, cause fractions, and rates for each age group and all ages combined. Each datapoint has metadata attached that are revealed by hovering over the datapoint. Some data points cannot be shown because data use agreements from the data holders restrict access.

Overall, these visualisations offer a unique opportunity to explore a number of results that, if displayed in a spreadsheet, would be displayed in millions of rows and be largely unusable. Allowing users to explore the data visually by key dimensions—country, age, sex, cause, year—will reduce barriers to access and vastly increase the number of potential users, thereby leading to greater data democratisation. To enhance the value and effect of GBD 2010 and to encourage greater use of these visualisations, further training and dissemination will be essential. Short videos on how to use them will be available online. Detailed training workshops on GBD methods will be held, beginning in May, 2013. Planned future revisions of the GBD will hopefully draw on a much more extensive network of scientists. This extended network will not only improve the quality of assessment, but will also provide a forum for continuing reflection, learning, interpretation, and action based on GBD 2010 results and future revisions. A broader understanding of GBD methods and access to national results will enable the growing number of countries with an expressed interest to undertake subnational burden of disease assessments.

For **videos** see http://www.healthmetricsandevaluation.org

For more on **training workshops** see http://www.healthmetricsandevaluation.org/gbd/training

See Online for appendix

Global and regional descriptions of leading causes of mortality and disease burden, and how they are changing, serve an important policy need, particularly for donors and policy makers looking to accelerate progress with key global health and development goals. Local policy will be much better served by, and will probably be much more responsive to, local evidence about major causes of health loss in populations. For this reason, the release of the national burden of disease estimates is expected to encourage and focus national policy responses to address leading health challenges in each country. We now have the evidence base to identify these challenges by age group, for males and females separately, for 291 causes of death and disability, and for most leading health risks. The challenge for national policy dialogue will be to make the most of this evidence to improve the health of individuals and populations. Plans that are underway to continuously update the GBD results will also enhance their usefulness by making it possible to track the links between resources, programme initiatives, and changes in health.

GBD 2010 Country Collaboration
cjlm@uw.edu

For members and their conflicts of interest see appendix.

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Health in the UK: could do even better?

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Countries are political entities; to analyse by country is a political act. So Christopher Murray and colleagues' report in *The Lancet*,[1] which compares health outcomes in the UK with those in other countries, is political. It is a political analysis and requires a political response—from UK politicians and from the body politic of the health professions.

The Global Burden of Disease (GBD) project assembled a stellar cast, and the UK authorship of Murray and colleagues' report[1] reads like an invite list for the public health hall of fame. Unquestionably, this report has the best possible science behind it. Key strengths include comprehensive coverage, a strong effort to ensure international comparability, and attention to disability not just mortality. Even so, there are points of methodology that merit comment before examination of substantive issues.

The report pits the UK against comparators in Europe and Australia, Canada, and the USA, and adopts a league table approach based on two timepoints—1990 and 2010. League tables are problematic for two reasons. First, rankings are notoriously unstable statistically,[2] especially if only two timepoints are compared. More

Mortality Risk amongst Nursing Home Residents Evacuated after the Fukushima Nuclear Accident: A Retrospective Cohort Study

Shuhei Nomura[1], Stuart Gilmour[1], Masaharu Tsubokura[2,3], Daisuke Yoneoka[1], Amina Sugimoto[1], Tomoyoshi Oikawa[3], Masahiro Kami[2], Kenji Shibuya[1]*

1 Department of Global Health Policy, Graduate School of Medicine, University of Tokyo, Bunkyo-ku, Tokyo, Japan, 2 Division of Social Communication System for Advanced Clinical Research, The Institute of Medical Science, University of Tokyo, Minato-ku, Tokyo, Japan, 3 Department of Internal Medicine, Minamisoma City General Hospital, Haramachi-ku, Minamisoma, Fukushima, Japan

Abstract

Background: Safety of evacuation is of paramount importance in disaster planning for elderly people; however, little effort has been made to investigate evacuation-related mortality risks. After the Fukushima Daiichi Nuclear Plant accident we conducted a retrospective cohort survival survey of elderly evacuees.

Methods: A total of 715 residents admitted to five nursing homes in Minamisoma city, Fukushima Prefecture in the five years before 11th March 2011 joined this retrospective cohort study. Demographic and clinical characteristics were drawn from facility medical records. Evacuation histories were tracked until the end of 2011. The evacuation's impact on mortality was assessed using mortality incidence density and hazard ratios in Cox proportional hazards regression.

Results: Overall relative mortality risk before and after the earthquake was 2.68 (95% CI: 2.04–3.49). There was a substantial variation in mortality risks across the facilities ranging from 0.77 (95% CI: 0.34–1.76) to 2.88 (95% CI: 1.74–4.76). No meaningful influence of evacuation distance on mortality was observed although the first evacuation from the original facility caused significantly higher mortality than subsequent evacuations, with a hazard ratio of 1.94 (95% CI: 1.07–3.49).

Conclusion: High mortality, due to initial evacuation, suggests that evacuation of the elderly was not the best life-saving strategy for the Fukushima nuclear disaster. Careful consideration of the relative risks of radiation exposure and the risks and benefits of evacuation is essential. Facility-specific disaster response strategies, including in-site relief and care, may have a strong influence on survival. Where evacuation is necessary, careful planning and coordination with other nursing homes, evacuation sites and government disaster agencies is essential to reduce the risk of mortality.

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Competing Interests: The authors have declared that no competing interests exist.

* E-mail: shibuyak@m.u-tokyo.ac.jp

Introduction

Following the Great East Japan Earthquake and subsequent tsunami on 11th March 2011[1,2], a level seven nuclear accident at Fukushima Dai-ichi nuclear power plant caused extensive social disruption and fear in Fukushima prefecture. On the 12th March, shortly after this accident, the Japanese government issued a mandatory evacuation order for those living within a 20 km radius of the nuclear plant and indoor shelter and voluntary evacuation instructions for residents of the 20 to 30 km zone, both of which caused dysfunction in hospitals, clinics, and welfare facilities, and loss of medical supplies[3].

Although all eight nursing home facilities in Minamisoma were located outside the compulsory 20 km evacuation zone, they were all within the 20 to 30 km indoor shelter and voluntary evacuation zone, and all elderly residents of all the homes were voluntarily evacuated irrespective of their individual state of health or care needs, because of the increasing fear of radiation and/or disruption of food, gasoline and medical supplies to this area. Questions about the safety of evacuation of elderly residents are of paramount importance to residents[4–7], medical and welfare institutions[4,8] and, of course, the Japanese government, whose emergency response to the radiation accident is controversial[9]; however, although initial reports suggested a chaotic evacuation with high overall mortality risk[10], there is no detailed understanding of mortality risks associated with the evacuation process[6].

Research on hurricane preparedness in the USA has suggested that evacuation can be associated with an approximately two-fold mortality risk[11,12]. US nursing homes are required to maintain evacuation plans, though compliance with these plans is not always robust and facility-specific factors may have a strong influence on the mortality and morbidity associated with evacuation[13]; furthermore, experience in the immediate aftermath of Katrina showed that even the best plans of specific facilities may be insufficient to prevent significant morbidity and mortality under a generalized infrastructure collapse, and that support from government both before and after a disaster is essential[14].

Given the importance of disaster- and facility-specific factors in determining the success of disaster plans and the possibility of significant increases in mortality due to evacuation, it is important to conduct detailed epidemiological assessments of the efficacy and safety of evacuation procedures in the aftermath of Japan's triple disaster. Almost a year since the nuclear accident, at the request of the local hospital, we conducted a retrospective cohort survival survey of nursing care home residents in Minamisoma city. Minamisoma city was the only town in Japan that was seriously affected by all three elements of the triple disaster, experiencing infrastructure destruction, significant radiation exposure, and a series of evacuation orders simultaneously. The experience of care home operators in Minamisoma thus paralleled many of the challenges faced in the aftermath of Hurricane Katrina. This is the first detailed assessment of mortality risk associated with evacuation of elderly residents after the Fukushima Dai-Ichi nuclear accident, and offers the first opportunity to explore evacuation-related mortality in detail, as well as a chance to generalize from the specific experience of care home operators in Minamisoma to some of the complex policy issues associated with multiple-cause disasters.

Materials and Methods

Ethics Statement

Ethical approval for the study was granted by the ethics committee of the Institute of Medical Science, the University of Tokyo, authorization number 23-61-3038. For monitoring residents' survival, an information sheet on the research objectives and confidentiality of study participation were sent to the care homes' presidents and verbal consent was obtained. The ethics committees agreed that written consent was not required for each care home resident.

Design, settings, and participants

Five of the eight care homes in Minamisoma participated in this study, representing 62% of all individuals resident in a care home at the time of the earthquake; of those that did not participate, one was unable to due to the loss of all records during the tsunami, and one could not provide sufficient quality evacuation or mortality records. Four facilities are intensive care homes for the elderly, which admit those who have difficulty rehabilitating at home. One facility is a rehabilitation facility for the elderly, which make efforts to enable residents to rehabilitate at home. All elderly residents who had been admitted to the five facilities between 11th March 2006 and 11th March 2011 were included in this study. Information on demographic and clinical characteristics and entry records was obtained from medical records at the facilities, which were recorded by the care practitioners for all residents at entry to the facility. Evacuation history was also recorded by the facilities at the end of 2011 or the beginning of 2012, and this data was collected along with date of withdrawal.

Demographic and clinical characteristics included age at withdrawal or death, sex, and care level, based on the Japanese Category of Condition of Need for Long-Term Care, a number between one and five measuring severity of care needs [15]. This grade is an indicator of severity of disability and does not necessarily indicate health condition[16]. Patients with care level 1 to 4 were defined as requiring low or moderate care and those with care level 5 as requiring high care. Evacuation history consisted of date and site of evacuation recorded separately for each evacuation. Many residents had multiple evacuations, so evacuation distances, indicating the distance between each resident's current location and their next evacuation site, were calculated for each evacuation site as the shortest distance between sites on a public road. Finally, we interviewed facility presidents to obtain further care home-specific evacuation details.

Data Analysis

To assess the impact of the earthquake on mortality, death incidence density before and after the earthquake was calculated as the number of deaths divided by sum of person-years at risk, which were measured from the date of admission until the end of the study period, death or withdrawal. Person-years of risk were divided into pre-and post-earthquake periods to compare relative mortality and crude relative mortality risk calculated as the ratio of post- and pre-earthquake mortality incidence densities. A seasonal or cohort effect in the data was investigated through visual inspection of a quarterly time-series trend of incidence density. Because Facility 4 lacked data for those who left the nursing home before the earthquake, the total person-years and incidence density before the earthquake was estimated based on the average proportion of person-years for the residents who left the nursing homes before the earthquake in other facilities. Thus the relative incidence density before the earthquake for this facility was an estimate.

Survival probability was assessed using the Kaplan-Meier product limit method, comparison of which was on the basis of the Wilcoxon test and Log-rank test, and plotted with survival curves. Effects of the earthquake itself and mortality risk associated with the evacuation procedures implemented by each nursing home were examined using cox proportional hazards multiple regression. Comparison of survival before and after the earthquake was initially conducted without evacuation history data, to measure the effects of the earthquake on mortality. Evacuation history was explored using only post-earthquake data to estimate risks associated with different evacuation patterns. In both analyses, variables were selected using backward-stepwise model-building. Both analyses included a fixed effect to model unobserved, facility-specific confounders. In the analysis comparing pre-and post-earthquake mortality, a facility-earthquake interaction term was included to test for the possibility of facility-specific moderators of evacuation- or earthquake-related mortality. All analyses were conducted using Stata/MP 11.

The report is presented in accordance with STROBE guidelines.

Results

Basic characteristics of care home residents

From 11th March 2006 to 11th March 2011 records were collected for all 596 elderly residents from four of five facilities. Data on residents who had left the facility before the earthquake were missing in one facility. Characteristics of the 715 residents included in this study are shown in Table 1, and interview results with facility presidents and information on facility-specific care level are summarized in Table 2. Other facility-specific evacuation details are described in Table 3. Average number of evacuations indicates the average number of times each facility's residents evacuated.

Table 1. Subject characteristics.

Characteristic	Total residents	Number of residents on March 11, 2011	Percentage of total residents
Sex			
Male	192	80	42
Female	523	248	47
Facility Number			
1	144	72	50
2	94	50	53
3	99	50	51
4	119†	69	58
5	259	87	34
Age at death or withdrawal			
50–69	30	21	70
70–79	110	52	47
80–89	339	153	45
90+	236	102	43
Care Level			
Low/moderate	399	224	56
High	316	104	33
Number of deaths by Facility			
1	78	23	29
2	43	12	28
3	52	9	17
4	75	25	33
5	57	6	11

†Pre-disaster data included only those who died.
doi:10.1371/journal.pone.0060192.t001

Table 2. Interview results.

Facility	1	2	3	4	5
Type	Intensive care	Intensive care	Intensive care	Intensive care	Rehabilitation
Basic characteristics					
In-house nutritionists	No	No	Yes	Yes	Yes
Medical service	No	No	No	No	Yes
Presence of adjacent hospital	Yes	No	No	Yes	No
Before the initial evacuation					
Short evacuation from tsunami	No	Yes	No	No	No
Continuity of food preparation	Poor	Poor	Good (until 17/3/2011)	Good	Good
Heating	No	No	Yes	Yes	Yes
Time to initial evacuation	19/3/2011	19/3/2011	19/3/2011	15–22/3/2011	17–22/3/2011
During the evacuation					
Suitability of vehicles for evacuation	Poor	Poor	Poor	Good	Good
Support of government	No	No	No	Yes	Yes
After initial evacuation					
Continuity of care	Poor	Poor	Poor	Good	Good
Care quality of evacuation site	Poor	Poor	Poor	Fair	Fair

doi:10.1371/journal.pone.0060192.t002

Table 3. Evacuation history by facility.

	Facility Number				
	1	**2**	**3**	**4**	**5**
Study end	1/12/2011	1/12/2011	1/12/2011	2/2/2012	31/8/2011
Average number of evacuations	2.9	2.6	3.1	1.7	1.0
Average evacuation distance (km) by stage					
Initial	306	303	325	203	242
Second	238	193	261	238	N/A
Third	209	143	223	97	N/A
Fourth	52	145	161	48	N/A

doi:10.1371/journal.pone.0060192.t003

Examination of possible cohort- and season-effects

The time-series of quarterly death incidence density for the whole study period is shown in Figure 1. No seasonal effect or upward trend, which might indicate a cohort effect, were observed before the earthquake, suggesting limited observable influence of seasonal or trend effects on the high increase in mortality incidence density after the earthquake.

Facility-specific mortality risk

Details of the facility-specific relative mortality risk based on the incidence death density are shown in Table 4. A three- to four-fold increase in mortality was observed in three facilities. Facility 5, which did not show a significant increase in mortality, had only one evacuation with a distance of 240 km, suggesting that evacuation number and distance are relevant to the increase in mortality risk; however, Facility 4 had a relatively similar evacuation profile (Table 2), and experienced increased mortality density.

Probability of survival

Figure 2 shows probability of survival before and after the earthquake for all facilities combined. Analysis time started from the date of nursing home admission and the date of the earthquake respectively. A significant influence of the earthquake on mortality was observed. Facility-specific probability of survival after the earthquake is shown in Figure 3, plotted against analysis time from the date of the earthquake, and shows a large difference between Facility 5 and Facility 1. Facility 5 evacuated once, approximately 240 km distance, while Facility 1 experienced about three evacuations ranging in distance from 200 to 300 km, suggesting that this differential mortality might be explained by the influence of long and repeated evacuations. Facility 4, however, also had high mortality compared with Facility 5 even though their evacuation profiles were relatively similar. This might indicate that other facility-specific evacuation processes are associated with these differences in mortality.

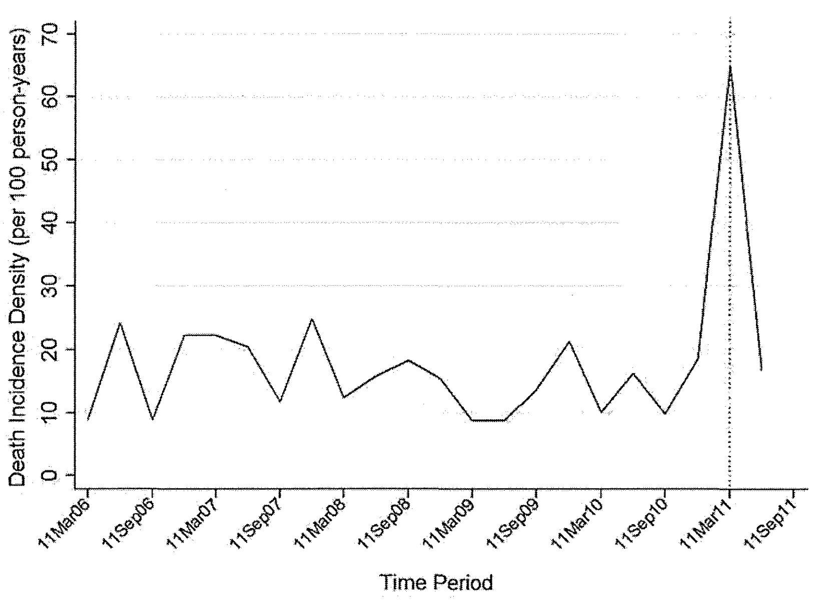

Figure 1. Time series trend of death in elderly homes. Dotted line indicates the time of the earthquake (11/3/2011)
doi:10.1371/journal.pone.0060192.g001

Table 4. Facility-specific relative death incidence density.

Facility	Disasters	Population	Death	Incidence Density (/100 person-years)	Relative Risk	95% Confidence interval
1	Before	144	55	14.82	3.78	NA
	After	72	23	56.09		2.22 to 6.26
2	Before	94	31	12.89	3.01	NA
	After	50	12	38.87		1.41 to 6.04
3	Before	99	43	17.36	1.63	NA
	After	50	9	28.24		0.70 to 3.38
4	Before	119†	50	13.95†	3.93††	NA
	After	69	25	54.75		2.36 to 6.57††
5	Before	259	51	15.69	0.98	NA
	After	87	6	15.41		0.34 to 2.29
Combined	Before	596†	230	14.91†	2.68††	NA
	After	328	75	39.82		2.04 to 3.49††

†does not include those who left before the earthquake in Facility 4
††estimated values
doi:10.1371/journal.pone.0060192.t004

Regression analysis

Findings from the multiple regression analysis without any evacuation history data indicated that mortality after the earthquake increased by a factor of three in Facility 1 (Table 5). The interaction term for facility and earthquake suggests significant differences in post-earthquake mortality between facilities. Facility-specific hazard ratios with confidence intervals are shown in Table 6 and indicate that Facilities 1, 2 and 4 experienced significantly elevated mortality after the earthquake.

Table 7 shows results of the Cox multiple regression analysis with evacuation history. After adjusting for facility, age, care level, sex and evacuation distance, initial evacuation had twice the mortality of subsequent evacuations. Evacuation distance had no significant impact on mortality, indicating that regardless of length of the evacuations a lot of the residents died after the initial evacuation, and/or that more resilient residents who survived it could also have survived subsequent evacuations.

Discussion

This study — the first assessment on the health impact of the evacuation after the Fukushima Dai-ichi nuclear accident — showed that under very different disaster conditions, elderly homes in Minamisoma experienced higher increases in mortality risk than US nursing homes that evacuated in the wake of Hurricane Katrina[12], but that increases in mortality were highly dependent

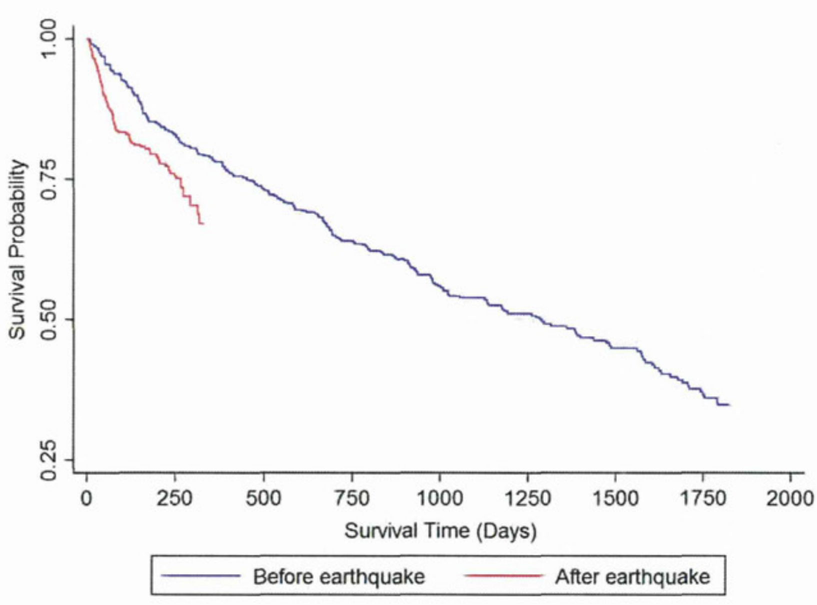

Figure 2. Estimated pre- and post-earthquake survival.
doi:10.1371/journal.pone.0060192.g002

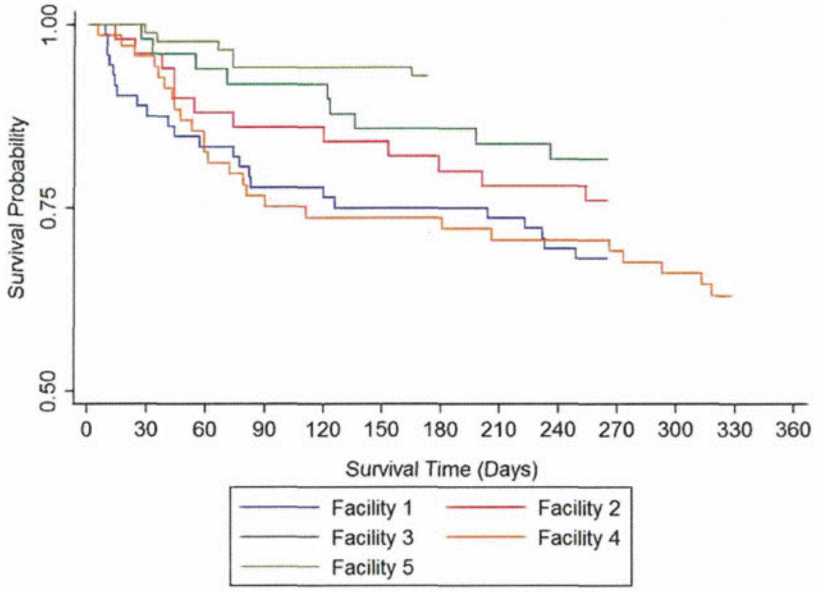

Figure 3. Estimated post-earthquake survival by facility.
doi:10.1371/journal.pone.0060192.g003

Table 5. Multiple regression model of survival by period.

Variable	Hazard ratio	95% Confidence interval	T statistic	P-value
Facility Number				
1	1.00	NA		
2	0.76	0.50 to 1.14	−1.32	0.2
3	1.01	0.70 to 1.45	0.07	0.9
4	1.20	0.85 to 1.68	1.04	0.3
5	1.04	0.72 to 1.52	0.21	0.8
Sex				
Male	1.00	NA		
Female	0.72	0.55 to 0.96	−2.28	0.02
Age				
50–69	1.00	NA		
70–79	1.37	0.61 to 3.09	0.77	0.4
80–89	1.79	0.84 to 3.80	1.52	0.1
90+	3.11	1.46 to 6.62	2.95	0.003
Care Level				
Low/moderate	1.00	NA		
High	2.05	1.60 to 2.63	5.65	<0.001
Earthquake				
Before	1.00	NA		
After	2.88	1.74 to 4.76	4.13	<0.001
Facility-earthquake interaction				
1	1.00	NA		
2	0.83	0.40 to 1.74	−0.48	0.6
3	0.48	0.22 to 1.05	−1.83	0.07
4	0.82	0.46 to 1.47	−0.66	0.5
5	0.27	0.11 to 0.65	−2.88	0.004

doi:10.1371/journal.pone.0060192.t005

Table 6. Post-earthquake facility-specific hazard ratios.

Facility Number	Facility-specific hazard ratio	95% Confidence interval
1	2.88	1.74 to 4.76
2	2.40	1.24 to 4.67
3	1.39	0.69 to 2.81
4	2.37	1.49 to 3.76
5	0.77	0.34 to 1.76

doi:10.1371/journal.pone.0060192.t006

on facility-specific factors. Significant increases in mortality after the earthquake were shown in three facilities, and the initial evacuation was associated with twice as many deaths as subsequent evacuations.

There was also a substantial difference in mortality risks across facilities. These differences may be affected by factors such as residents' psychological state or health condition at the time of evacuation, facility-specific evacuation patterns, and the conditions in evacuation sites to which elderly evacuees were admitted[13,14]. Evacuation distance did not show a significant influence on mortality in the present study. But it was not possible to investigate with certainty whether increases in mortality were due to generalized stress from the earthquake[17–19], facility-specific evacuation processes or care quality at evacuation sites because there was no non-evacuated control. According to the interview results with the facility presidents (Table 2), both facilities 4 and 5 evacuated to a distance of about 200 km with support from the government about two weeks after the nuclear accident, but mortality rates were quite different. Facility 4 is an intensive care home for the elderly, whose residents are constantly in and out of the hospital, and this facility's president thought that evacuation might have imposed a higher burden on its residents than in Facility 5, which also had onsite medical services. Facilities 1, 2 and 3 evacuated their residents to areas 300 km or more from Minamisoma city immediately after the nuclear accident without any support from the government. Because of this unplanned relocation, facilities in the evacuation area were not prepared for the evacuees' care: residents had only simple floor mattresses (Japanese *futon*) and medical supplies ceased for three days. This, rather than evacuation distance itself, might explain the high mortality after the initial evacuation; however, it is difficult to measure the quality and continuity of care quantitatively in evacuation sites because no reliable records exist from that period.

Before the earthquake, the Ministry of Internal Affairs and Communications conducted a national survey to investigate prefectural support for disaster management plans for elderly people. This survey assessed whether facilities had an evacuation plan in accordance with the Evacuation Guidelines for Disaster Management[20]. In 2006, 54 of 59 municipalities (91.5%) in Fukushima prefecture reported that they had formulated evacuation strategies[21]. These strategies comprised a five point system in cooperation with the prefectural government: (1) development

Table 7. Multiple regression model of survival by evacuation characteristics.

Variable	Hazard ratio	95% Confidence interval	T statistics	P-value
Facility Number				
1	1.00	NA		
2	0.59	0.28 to 1.26	−1.37	0.2
3	0.46	0.21 to 1.02	−1.91	0.06
4	0.90	0.27 to 3.30	−0.16	0.9
5	0.12	0.03 to 0.47	−3.08	0.002
Sex				
Male	1.00	NA		
Female	0.70	0.40 to 1.22	−1.25	0.2
Age				
50–69	1.00	NA		
70–79	0.58	0.15 to 2.29	−0.78	0.4
80–89	0.83	0.26 to 2.68	−0.31	0.8
90+	1.81	0.56 to 5.90	0.99	0.3
Care Level				
Low/moderate	1.00	NA		
High	2.09	1.33 to 3.28	3.20	0.001
Evacuation distance (km)				
<150	1.00	NA		
>=150 & <300	1.01	0.35 to 2.91	0.02	1.0
>=300	0.92	0.41 to 2.07	−0.19	0.8
Evacuation type				
Initial	1.94	1.07 to 3.49	2.20	0.03
Subsequent	1.00	NA	−0.48	0.6

doi:10.1371/journal.pone.0060192.t007

of an information communication system among disaster-mitigation organizations and social welfare institutions; (2) sharing of elderly residents' data among responsible agencies; (3) implementation of evacuation planning; (4) establishment of support systems in evacuation sites; and (5) coordination and cooperation of relevant organizations in times of disaster[20]. Our findings, however, reveal that the preparation level for a major disaster varied widely between facilities and furthermore, in reality some facilities did not coordinate evacuations with the prefectural government in Minamisoma.

This study had several limitations. There was potential underestimation of relative mortality risk after the earthquake in the Cox proportional hazards analyses, because Facility 4 lacked data on residents who left the facility before the earthquake, which would result in overestimates of incidence density before the earthquake and subsequent underestimation of the relative mortality risk after the earthquake. In addition to this, because there was only one evacuation in Facility 5 it is difficult to compare this facility with the remaining four due to lack of reference to the initial evacuation. However, a sensitivity analysis excluding Facility 5 indicated little influence of this limitation on the regression analysis results. Therefore, the finding that initial evacuation is the most dangerous appears to be robust. Another limitation is that only five of eight nursing homes were involved in this study: one facility lost the residents' records during the tsunami, one had insufficient data for inclusion in the study, and one refused to participate. Because the facilities recorded health information intermittently and/or outsourced health care to external providers, it was not possible to obtain a comprehensive picture of the residents' level of physical health. Unfortunately, the chaotic situation in the prefecture at the time and the rapid reduction in service providers within Minamisoma made obtaining health records from diverse providers within Minamisoma impossible[22]. Thus the confounding effect of poor health on mortality risk during evacuation can only be inferred at a facility level and adjusted for through the fixed effects model, and it is possible that a more refined set of confounders would enable a better understanding of individual-specific risk factors. Future studies on the impact of forced evacuation on the general elderly population are needed to generalize our findings, and to better understand these facility-level influences, such future studies should include detailed interviews and other forms of qualitative research to establish the context in which evacuation mortality occurred.

The necessity of evacuation of vulnerable residents in a post-disaster setting is a controversial issue[9]. The rarity of radiation disasters means that, to date, findings on evacuation-related mortality have been confined to more conventional storm- or earthquake-related disasters. In such settings, such as the aftermath of hurricane Katrina, the decision about whether to evacuate was based on the viability of sheltering in place given the available resources, but in Fukushima the decision to evacuate was at least partly driven by concerns about radiation risk[23] even though there has been no evidence of acute radiation syndrome occurring in residents living in radiation affected areas, or even of high levels of internal exposure[24]. Evacuation has adverse effects, not only on mortality but also clinical status relevant to lifestyle diseases, and leads to an increase in cardiovascular events or other chronic disease sequela[19]. Despite this, fear of radiation exposure in the affected area was severe enough to make evacuation inevitable: almost all residents of Minamisoma city evacuated in a relatively short period. Questions, therefore, about the safety of evacuation of elderly residents and how best to balance the competing risks of radiation exposure and evacuation mortality are of paramount importance. Where the severity of infrastructure collapse and structural damage does not in itself warrant evacuation, careful judgment needs to be exercised in deciding the risk of mortality due to radiation, as it is possible that the evacuation process itself will yield higher mortality than can be expected from radiation exposure. The need for this balancing of risks may apply even in situations where it may ultimately be judged unsafe for residents to return to the affected area, since delays in evacuation, or staggering of evacuation between different institutions on the basis of evacuation mortality risk and preparedness, may lead to significant reductions in mortality due to the initial evacuation process. In this respect, radiation-related evacuations differ from storm-related evacuations, since there may be little or no infrastructure damage in the former, and with proper preparation and support elderly care homes may be able to shelter in place for sufficient time to adequately prepare evacuation sites and mechanisms, and thus reduce the burden of mortality.

In a post-disaster situation where infrastructure collapse affects the essential conditions for maintaining elderly peoples' health[25,26], evacuation may be essential regardless of the environmental risks posed by radiation exposure. However, the findings of this study indicate that evacuation may not be the best life-saving strategy. In-site relief and care should also be considered as an alternative strategy for disaster planning[27]. Although the Japanese government had issued guidelines for the evacuation strategy and most facilities had been assessed positively, their preparations were not necessarily sufficient to meet the challenges of this triple disaster. The USA maintains a system of regular monitoring and oversight, including fines for breaches and insufficient preparation [13], but the same degree of oversight is lacking in Japan and enforcement mechanisms have not been established: in consequence of this a 2011 review of Japanese facilities found many lacked detailed plans [28]. The national government should consider urgently updating its requirements of nursing homes, reviewing current plans, and strengthening monitoring systems to ensure all areas of the country learn from the lessons of Minamisoma and are prepared for the worst possible contingencies.

This study shows that even under the extreme circumstances experienced in the aftermath of the Great East Japan Earthquake and subsequent radiation accident, some facilities were able to ensure that their residents suffered no significant increase in mortality risk. Balancing the competing risks of radiation exposure and evacuation mortality is of paramount importance when infrastructure collapse and damage do not themselves warrant evacuation. Health planners, disaster coordinators and facility managers in areas that may be subject to similar disasters should consider the lessons of Minamisoma, Fukushima when developing their own plans for disaster response.

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Author Contributions

Conceived and designed the experiments: SN SG MT. Performed the experiments: SN SG DY KS. Analyzed the data: SN SG DY. Contributed reagents/materials/analysis tools: SN SG MT AS TO MK KS. Wrote the paper: SN SG KS.

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特集／「社会保障と税の一体改革」とは いったい何だったのか

～消費税増税で社会保障は充実するのか～

視点　我が国の医療の進むべき道：グローバルヘルスの観点から

●第 37 回診療報酬請求事務能力認定試験（医科）：問題と解答

医学通信社

我が国の医療の進むべき道：グローバルヘルスの観点から

東京大学医学系研究科国際保健政策学教室教授　渋谷健司

1 保健医療は投資という発想

私は国内外の保健医療政策の研究を専門にしているが，この道に足を踏み入れたのは千葉県の田舎の病院で救急当直の合間にたまたま読んだ一冊のレポート，世界銀行の「世界開発報告1993年度版：健康への投資」であった[1]。当時はラリー・サマーズが主任エコノミストであり，世界銀行が従来のインフラ整備から人間開発へとシフトを始めた時期であった。また，世界保健機関（WHO）のリーダーシップ欠如に対する批判が世界中で巻き起こり，世界の保健政策の中心がジュネーブからワシントンへ移ろうとしている時期でもあった。

そのレポートには，発展途上国においても急速に高齢化と疾病構造の変化が進展していること，費用効果分析によると予防のみならず治療にも対費用効果の高い介入があること，そして，何よりも**健康は投資であり必ずしもコストではないこと**，が実証的に示されていた。それまで，WHOを中心とした，途上国といえば感染症と母子保健対策，そして基本的サービスへのアクセスを軸とした政策議論に慣れていた私には目から鱗の落ちる思いであり，筆頭著者を調べ，彼に会いにボストンまで行ったのが，保健医療政策との付き合いの始まりであった。

時は巡り，ちょうど20年後の2013年，世界の保健政策は再度，ジュネーブからワシントン，そしてシアトルへと移り，国内では社会保障が大きな政治アジェンダになった。しかし，世界的には欧州を中心とした経済危機の影響が世界を蝕み，国内的には惰性と既得権益のために医療を含む社会保障に関しては時代遅れの制度が継続し，その結果，真の弱者への保護は手薄く，また若い世代への負担が増大している。

現行の税と社会保障の一体改革は，増税という既存の制度の維持に必要な財源の調達に関する議論に終始している。しかし，**今こそ「健康への投資」というメッセージを再度検討すべき時期に来ているのではないだろうか。**そして，それは，必ずしも健康な生産労働人口を増やすというエコノミスト的ロジックのみでなく，斜陽化する製造業に代わる産業としての保健医療の構築という意味合いも含まれる。事実，保健医療の海外展開は世界の潮流であり，本稿では，グローバルな文脈から我が国の医療制度，そして我が国が今後国内外において採るべき戦略に関して私見を述べたい。

2 グローバル化する保健医療

保健医療制度は元来，各国の歴史や文化，社会経済状態，法制度に密接に関わるローカルなものである。しかし，グローバル化の流れのなかで，保健医療もそれと無関係ではいられなくなってきた。

「**グローバルヘルス**」とは，主に国内の人口を対象とする公衆衛生，植民地熱帯病を対象とする熱帯医学，先進国から途上国への技術移転を目的とする国際保健，それらがグローバル化の流れのなかで結びついた分野のことである。日本語では「**国境を越える保健医療課題**」と訳されるが，それは，先進国と発展途上国間での双方向の連携，そして経験と知識の共有が必要であり，きわめて学際的かつイノベーションを重視し，社会医学に限らず，ワクチン開発等の基礎研究や臨床も含まれる[2]。

このグローバルヘルス興隆の始まりは2000年に遡る。当時の国連事務総長コフィ・アナンが提唱し，国連加盟189カ国が合意したミレニアム開発目標（MDGs）である。MDGsは2015年までに国連加盟各国が達成すべき開発目標であるが，8つの目標のうち実に3つが保健医療関連目標であり，このMDGsによって保健医療は世界の開発のアジェンダとなった。

このような流れを受け，アメリカでは2005年頃から「グローバルヘルス」という言葉が使われ出したが，近年，この言葉は瞬く間に世界中に広まった。今や世界の主な大学にはグローバルヘルスを標榜する教室が存在し，さ

渋谷　健司（しぶや　けんじ）
1991年，東京大学医学部医学科卒．同年，帝京大学付属市原病院麻酔科医員（研修医）として勤務。93年，東京大学医学部付属病院医師（産婦人科）を経て，米国ハーバード大学リサーチ・フェロー。99年に同大学より公衆衛生学博士号取得。同年，帝京大学医学部産婦人科助手。2000年，衛生学公衆衛生学講師。01年に世界保健機関（WHO）シニア・サイエンティスト（保健政策のエビデンスのための世界プログラム）就任。04年にWHOコーディネーター（評価・保健情報システム/保健統計・エビデンス）を経て，現職。

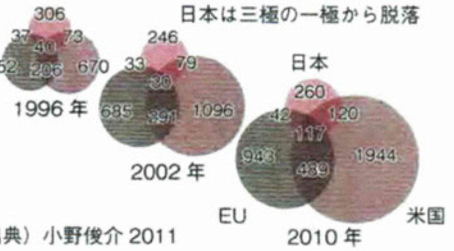
らには，米戦略国際問題研究所（CSIS）や英王立国際問題研究所（チャタムハウス）といった著名な外交政策シンクタンクにおいてもグローバルヘルスに関する部門が設けられている。

このように，保健医療のグローバル化は世界の潮流となっている。アジア諸国においても，タイやシンガポール，インドはメディカルツーリズムを推進しており，患者も医師も国境を越えて移動している。また，韓国は医療を国家戦略と定め，済州島での医療特区構想（各国の医師免許を容認，医師の所得税撤廃）を提唱し，韓流ブーム戦略さながらの大胆な施策を打ち出している。さらに，世界各地で「財源不足，医師不足，低収入の環境で，どのように良い医療を提供するか」という課題に対する様々な革新的取組みがなされており（例：営利型慈善病院，バウチャー制度，タスクシフティング，ICT活用等），我が国がこのような事例から学ぶべきものは多い。

他方，我が国では，こうした世界の潮流に逆行している。不活化ポリオワクチン輸入と国内生産の例をとっても明らかなように，**数十年前の金融行政の護送船団を思わせる旧態然とした仕組みは，我が国の保健医療のグローバル化と発展を大きく妨げている。**例えば臨床開発の分野においては，**図表1**に示すように，欧米では特に共同開発数が急激に増加しているが，我が国のみが過去15年間ほとんど変わらない[3]。

また，我が国の保健医療のグローバル化の遅れは，保健関連ODAにも如実に示されている。2000年にMDGsが宣言されて以降，世界的には保健関連ODA予算は急増したのに対し，OECD加盟国のうち我が国のみが縮小している。また，日本の保健医療分野に対するODAは，ODA全体のわずか2%であり，これはOECD諸国平均の15%と比べてきわめて低い[4]。未だに「健康への投資」という戦略的発想がないのが日本なのである。

図表1　日米欧・臨床開発プロジェクト数の推移



出典）小野俊介 2011

3 皆保険制度がグローバルヘルスのアジェンダに

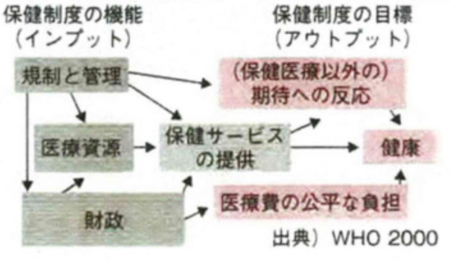
現在のグローバルヘルスの特徴は2つある。まず，その関係者が多様であること。WHOの財政的・政策的求心力の低下に伴い，官民連携型の国際機関やビル・ゲイツがマイクロソフトを引退後に設立したビル･アンド･メリンダ・ゲイツ財団（ゲイツ財団）などの民間財団，そして近年では民間企業の存在感が増している。また，活動の中心が小規模な個別のプロジェクトから多国間・官民連携を軸とする大規模なプログラム，そしてアジェンダ設定やルール作りへと変化していることが挙げられる。

次に，世界的な高齢化と疾病構造の変化により，優先課題が感染症から生活習慣病対策，そして皆保険制度構築へと変化している。2005年の第58回世界保健機関総会では，財政的に持続可能な皆保険制度の構築に向け努力することを加盟国に求める決議が採択された。実際，過去10年間でガーナやルワンダといった低所得国においても，低コストで国民皆保険を実現するための保険制度が導入されはじめている。皆保険制度構築は今最もホットなグローバルヘルスのアジェンダなのである[5]。

4 なぜランセットが日本の保健医療制度の特集をしたか？

2011年は，我が国が皆保険制度を達成してから50年目にあたる年であった。その節目に，イギリスのランセット誌と共同で，日本の保健医療制度を特集する機会を得た[6]。ご存知のように，ランセット誌は世界で数百万人の読者をもつ世界で最も権威のある医学雑誌の一つである。しかし，ランセット誌がニュー・イングランド・ジャーナル・オブ・メディシンやJAMAなどのライバル誌と異なるユニークな点は，現編集長のリチャード・ホートンの編集方針によるところが大きい。もちろん最大の読者である一般臨床家対象の論文が中心であるが，世界の医療制度，人権，健康と社会的公正，戦争等のテーマも定期的に取り上げる，きわめて社会派的な雑誌なのである。それもそのはず，1823年の創刊時の編集長

図表２　保健制度パフォーマンス分析の枠組み



出典）WHO 2000

トーマス・ウェイクリーのモットーは，「読者に情報を伝え，楽しませ，そして，社会を変革すること」であり，その伝統が今も連綿と生きている。

なぜそのランセットが日本の医療制度の特集を企画したかといえば，それは，リチャード・ホートン本人の言葉がすべてを物語るであろう。「**日本の医療制度は日本国民のみならず，世界の人々の健康のバロメーターであるという点でも，きわめて重要である。…日本は大変なソフトパワーをもっている。世界における確固たる地位を確保する努力と国内での政策を改善する力を発揮しようとしている**」[7]。閉塞感に覆われた国内状況だが，世界の我が国に対する信頼と期待はいまだに高いのである。

特に，我が国の医療制度は２つの点で世界的にも注目を集めている。まず，**低コストで良好な健康指標を実現し，公平性を徐々に高めてきた皆保険制度は，今まさにグローバルヘルスの主要課題となっており**，特に，高度経済成長を迎えようとする発展途上国のモデルとなりうること。次に，**高度経済成長期に作られた現行制度が少子高齢化の進む現在の日本では持続不可能**になっており，今後どのような制度を構築していくのか，我が国の将来ビジョンが試されている点である。

5　保健医療制度パフォーマンス分析の枠組み

ランセット日本特集号では，編集部から３つの要望があった。まず，過去と現在のみならず将来を見据えること。次に，日本の特殊事情のみならずグローバルな教訓も示すこと。そして，エビデンスに基づく議論をすることであった。分析の枠組みは，筆者もその枠組み作りに関わった「世界保健報告2000年度版：保健制度パフォーマンスの改善」の枠組みを用いた（**図表２**）[8]。

保健制度パフォーマンス分析は，元々は次の５つの重要な比較分析を行うことを目的としたものであった。①健康アウトカムのばらつきはどのくらい保健医療制度の相違によって説明できるのか，②保健医療制度パフォーマンスの改善によって健康アウトカムはどのくらい改善できるか，③どの保健医療制度が健康アウトカムを改善するのによいか，④どの保健医療制度が対費用効果が高いか，⑤保健医療制度のパフォーマンスの決定要因は何か。

この枠組みは，保健医療制度をその機能（インプット）と目標（アウトプット）に分けたシンプルなものであるが，ともするとインプット（財源や医療従事者数など）の議論に終始する医療制度改革の議論において，何が本質であるかを忘れないためにはきわめて有用である。保健医療制度の主な目標は，健康アウトカムの増進であり，それに加えて，保健サービス以外の期待への対応や医療費の公平な負担を達成することが重要であるとしている[8]。

6　我が国の保健医療制度の現状と課題：グローバルヘルスの観点から

Savedoffらの研究によると，皆保険が成り立つ条件としては，経済成長，人口構成が若いこと，そして，政治的後押しがあることの３つがあるという[5]。我が国が皆保険を達成した1961年前後の政治，社会経済状況を鑑みれば，日本はまさにその３条件を満たしていた。つまり，我が国の皆保険制度は，加入者の負担による社会保険制度をもとに，まだ若く経済成長のまっただなかにできた，いわば発展途上国モデルである。50年後の今，この条件が満たされつつあるのが，現在のアジアやアフリカの多くの新興国である。第２次大戦後，発展途上国型の皆保険制度を完璧に作り上げた我が国のこれまでの経験と教訓こそが，これから世界で生かされるのである。

北原茂実氏（医療法人社団KNI理事長）は，こうした点を鑑み，我が国の保健医療の産業化と制度のパッケージ輸出を提言している[9]。実際，経済成長が急速に起こる場合，保健医療供給体制のキャッチアップは通常遅れるために，確実に保険制度が導入されるのであれば，初期投資は十分に回収できる。この際，大切なことは，保険制度に関する研修や単独の病院建設といった従来のODAプロジェクトや企業のCSRではなく，**現地で持続可能なビジネスモデルを開発することや付加価値のある戦略形成支援**である。例えば，日本型の医療を中心とし，保健医療システムにITを導入し，同時に日本式教育での現地の人材育成，さらには公務員共済や企業共済を組み合わせて日本の病院と提携し，企業の福利厚生を充実させることで日本式システムをパッケージとして導入することが可能であり，経済的リターンとともに外交的に