



DS363: Design and Learning with Data

Spring 2024

Module 02

Data Thinking

Lecture 1

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Agenda

- Concepts of Data X

- Data Eco-system & Lifecycle
- Data Privacy & Ethics
- Data Integrity
- Data & Analytics Skills
- How to Improve Your Skills

“In this world of big data, basic data literacy—the ability to analyze, interpret, and even question data—is an increasingly valuable skill,”

says Harvard Business School Professor
Janice Hammond

- Data Exploration and Analytics by Examples

- Global Health Data by OurWorldInData



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Concepts of Data X

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[Adapted from A Beginner's Guide to Data & Analytics by Harvard Business School]

Data Science vs. Data Analytics

- **Data science** is the process of building, cleaning, and structuring datasets to analyze and extract meaning.
- **Data analytics**, on the other hand, refers to the process and practice of analyzing data to answer questions, extract insights, and identify trends.
 - *You can think of data science as a precursor to data analysis. If your dataset isn't structured, cleaned, and wrangled, how will you be able to draw accurate, insightful conclusions?*
- Every analysis should be a feedback loop that deepens your learning.
 - ~~“Every time you do an analysis, you don't just say, ‘Oh, the answer is 17. I'm done.’”~~
 - *What can I learn from the results of this analysis about the underlying context, about competition, about customers, about suppliers?*
 - *How do the results of this analysis validate or reinforce hypotheses I had before I did the analysis?*
 - *What did I learn that negates or calls into question the assumptions that I made going into the analysis?*

Data Science *in Business*

- To collect, organize, and maintain data—often to write algorithms that make large-scale analysis possible.
 - When designed correctly and tested thoroughly, algorithms can catch information or trends that humans miss.
 - They can also significantly speed up the processes of gathering and analyzing data.

Gain customer insights

- Data about your customers can reveal details about their habits, demographics, preferences, and aspirations.
- A foundational understanding of data science can help you make sense of and leverage it to improve user experiences and inform retargeting efforts.

Increase security

- You can also use data science to increase your business's security and protect sensitive information.
- For example, machine-learning algorithms can detect bank fraud faster and with greater accuracy than humans, simply because of the sheer volume of data generated every day.

Inform internal finances

- Your organization's financial team can utilize data science to create reports, generate forecasts, and analyze financial trends.
- Data on a company's cash flows, assets, and debts is constantly gathered, which financial analysts use to manually or algorithmically detect trends in financial growth or decline.

Streamline manufacturing

- Manufacturing machines gather data from production processes at high volumes.
- In cases where the volume of data collected is too high for a human to manually analyze it, an algorithm can be written to clean, sort, and interpret it quickly and accurately to gather insights that drive cost-saving improvements.

Predict future market trends

- Collecting and analyzing data on a larger scale can enable you to identify emerging trends in your market.
- By staying up to date on the behaviors of your target market, you can make business decisions that allow you to get ahead of the curve.

Data Analytics *in Business*

- The main goal of business analytics is *to extract meaningful insights from data that an organization can use to inform its strategy and, ultimately, reach its objectives.*
- Business analytics can be used for:

Budgeting and forecasting

- By assessing a company's historical revenue, sales, and costs data alongside its goals for future growth, an analyst can identify the budget and investments required to make those goals a reality.

Risk management

- By understanding the likelihood of certain business risks occurring—and their associated expenses—an analyst can make cost-effective recommendations to help mitigate them.

Marketing and sales

- By understanding key metrics, such as lead- to-customer conversion rate, a marketing analyst can identify the number of leads their efforts must generate to fill the sales pipeline.

Product development (or research and development)

- By understanding how customers reacted to product features in the past, an analyst can help guide product development, design, and user experience in the future.

Four Types of Analytics

- Analytics is used to extract meaningful insights from data that can drive decision-making and strategy formulation.
 - There are **four types of analytics** you can leverage depending on the data you have and the type of knowledge you'd like to gain.

Descriptive analytics

- looks at data to examine, understand, and describe something that's already happened.

Diagnostic analytics

- goes deeper than descriptive analytics by seeking to understand the “why” behind what happened.

Predictive analytics

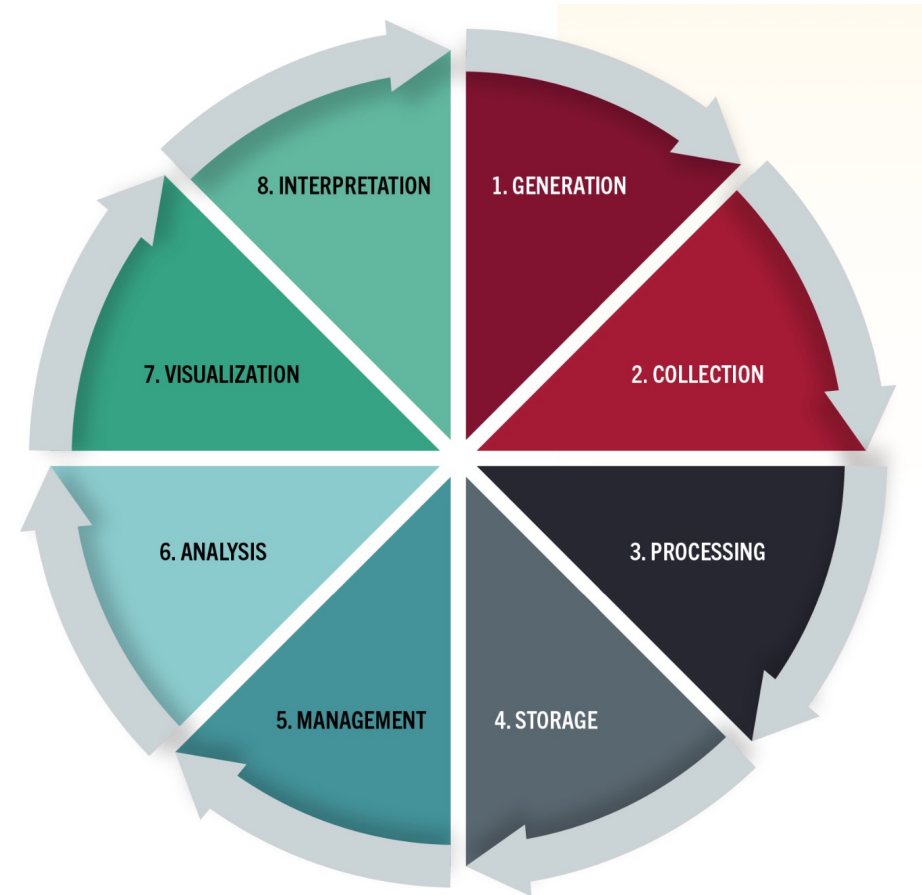
- relies on historical data, past trends, and assumptions to answer questions about what will happen in the future.

Prescriptive analytics

- identifies specific actions an individual or organization should take to reach future targets or goals.

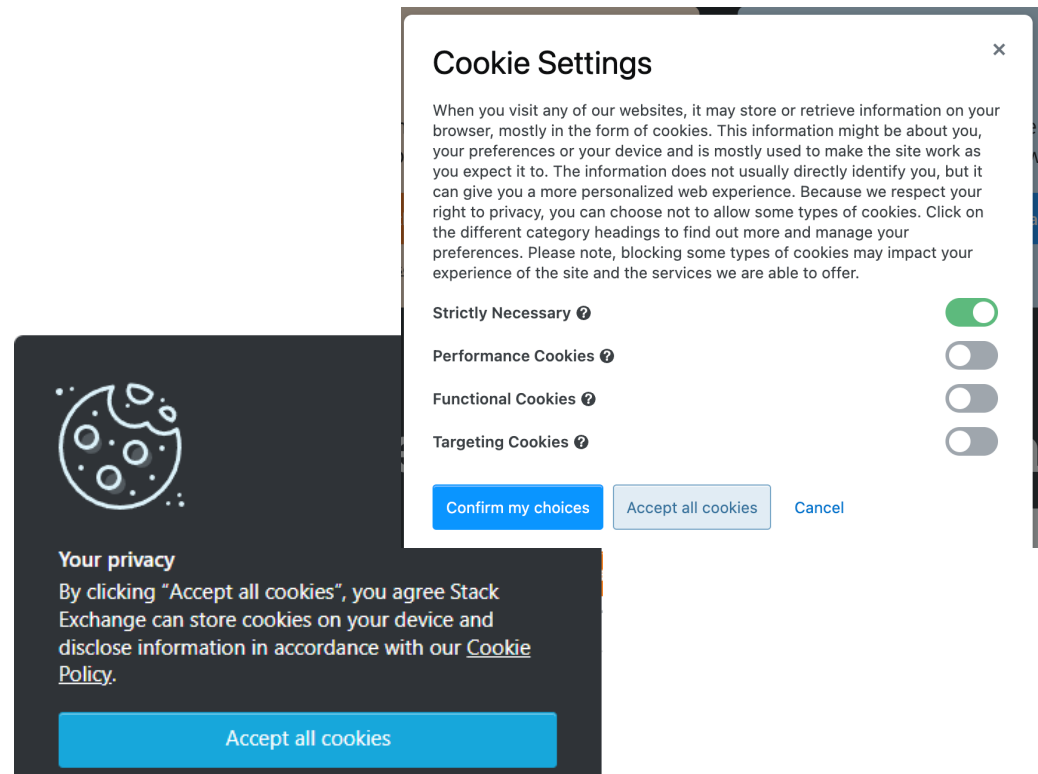
Data Ecosystem & Lifecycle

- ***Data ecosystem*** refers to the programming languages, packages, algorithms, cloud-computing services, and general infrastructure an organization uses to collect, store, analyze, and leverage data.
 - No two organizations leverage the same data in the same way. As such, each organization has a unique data ecosystem.
- ***Data life cycle*** describes the path data takes from when it's first generated to when it's interpreted into actionable insights.
 - This life cycle can be split into eight steps: generation, collection, processing, storage, management, analysis, visualization, and interpretation.
- A data project's steps are often described as a cycle because the lessons learned, and insights gleaned from one project typically inform the next. In this way, the final step of the process feeds back into the first, enabling you to start again with new goals and learnings.



Data Privacy & Ethics

- ***Data privacy***, also known as *information privacy*, is a subcategory of data protection that encompasses the ethical and legal obligation to protect access to personally identifiable information (PII), which is any information that can be linked to a specific individual.
 - Some examples of PII include full name, address, ID number, and passport number.
- Data privacy is made up of three key questions:
 - 1. What data is collected?
 - 2. How is the data stored?
 - 3. Who can access the data?



Data Privacy & Ethics

- *The ethics of data privacy* can be boiled down to the fact that
 - an **individual's consent** is necessary to collect, store, and use their personal information.
- As a data handler, you have a responsibility to be transparent with your subjects about
 - your intentions,
 - what their data will be used for, and
 - who will have access to it.
- In addition, you need to ensure your use of data doesn't cause harm to an individual or group of people.
 - This is referred to as *disparate impact* and is unlawful.

Data Integrity

- Data integrity is the accuracy, completeness, and quality of data as it's maintained over time and across formats.
 - Preserving the integrity of your company's data is a constant process.
- Threats to a dataset's integrity include:
 - **Human error:**
 - For instance, accidentally deleting a row of data in a spreadsheet.
 - **Inconsistencies across formats:**
 - For instance, a dataset in Microsoft Excel that relies on cell referencing may not be accurate in a different format that doesn't allow those cells to be referenced.
 - **Collection error:**
 - For instance, data collected is inaccurate or lacking information, creating an incomplete picture of the subject.
 - **Cybersecurity or internal privacy breaches:**
 - For instance, someone hacks into your company's database with the intent to damage or steal information, or an internal employee damages data with malicious intent.
- To maintain your datasets' integrity,
 - diligently check for errors in the collection, formatting, and analysis phases,
 - monitor for potential breaches, and
 - educate your team about the importance of data integrity.

Data & Analytics Skills

• 1. Critical Thinking

- Data science is a discipline that's built on a foundation of critical thinking.
 - From the first steps of determining the quality of a data source to determining the success of an algorithm, critical thinking is at the heart of every decision data scientists—and those who work with them
- If you're interested in using data to solve business problems, you need to be adept at thinking critically about challenges and solutions.
 - While data can provide many answers, it's nothing without a human's discerning eye.

• 2. Hypothesis Formation and Testing

- At the heart of data and analytics is the desire to answer questions.
 - The proposed explanations for these leading questions are called hypotheses, which must be formed before analysis takes place.
- An example of a hypothesis is, "I predict that a person's likelihood of recommending our product is directly proportional to their reported satisfaction with the product."
 - You predict the data will show this trend and must prove or disprove the hypothesis through analysis. Without a hypothesis, your analysis has no clear direction.

Data & Analytics Skills

• 3. Data Wrangling

- Data wrangling is the process of cleaning raw data in preparation for analysis.
 - It involves identifying and resolving mistakes, filling in missing data, and organizing and transferring it into an easily understandable format.
- This is an important skill for anyone dealing with data to acquire because it leads to a more efficient and organized data analysis process.
 - You can extract valuable insights from data more quickly when it's cleaned and in its optimal viewing format.

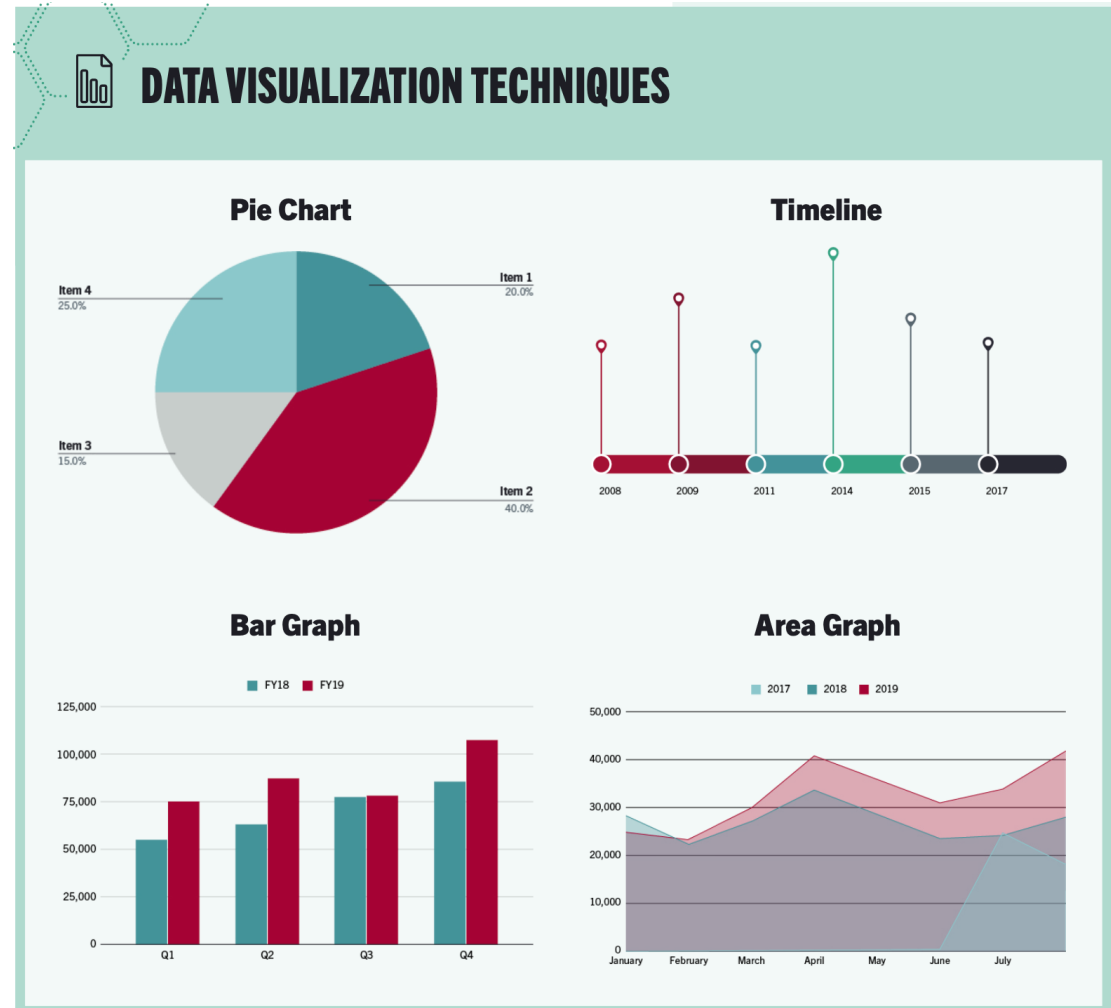
• 4. Mathematical Ability

- You don't have to be a mathematician to become data literate, but strong math skills become increasingly important as you deal with more complex analyses.
 - If you're not a data scientist or analyst, your work may not require you to understand the more complex mathematical concepts, but having a basic understanding of statistics can go a long way.
- A seasoned data professional needs a solid understanding of statistics, probability, linear algebra, and multivariable calculus.
 - Data scientists often call on statistical methods to find structure in data and make predictions, and linear algebra and calculus can make machine-learning algorithms easier to comprehend.

Data & Analytics Skills

• 5. Data Visualization

- It's crucial to know how to transform raw data into compelling visuals that tell a story.
- Some popular data visualization techniques that all business professionals should know include pie charts, bar charts, and histograms.
- To create these visualizations, use a data visualization tool.
- Examples include Microsoft Excel and Power BI, Google Charts, Tableau.



Data & Analytics Skills

• 6. Programming

- Programming languages, like Python and R, are commonly used to solve complex statistical problems with data.
- While programming skills are immensely valuable, they're not necessary for beginners dabbling in data.
 - It's more important to focus on effectively analyzing and visualizing data to draw conclusions.

• 7. Machine Learning

- As artificial intelligence grows in popularity, machine learning is a highly valuable skill for professionals working with big data.
- Machine learning refers to the use of computer algorithms that automatically learn from an in response to data.



How to Improve Your Skills

• 1. Embrace the Challenge

- The first step is to confront any mental barriers surrounding your ability to learn and develop data skills.
- Although data science has a reputation for being code-based and complex, its concepts are accessible if you have the desire and drive to learn and put in the work.

• 2. Consider Opposing Viewpoints

- While engaging with opposing viewpoints can help you expand your perspective, combat bias, and show your fellow employees their opinions are valued, it can also be a useful way to practice analytical skills.
- When analyzing data, it's crucial to consider all possible interpretations and avoid getting stuck in one way of thinking.
 - For instance, imagine you track users who click a button on your site to download an e-book. The data shows that the user's age is positively correlated with their likelihood to click the button; as age increases, downloads increase. At first glance, you may interpret this trend to mean that a user downloads the e-book because of their age.
- This conclusion doesn't take into consideration the variables that change with age.
 - For instance, perhaps the real reason older users are more likely to download the e-book is their higher level of responsibility at work, average income, or likelihood of being parents.
 - This example illustrates the need to consider multiple interpretations of data, and it specifically shows the difference between **correlation** (the trending of two or more variables in the same direction) and **causation** (when a trend in one variable causes a trend to occur in one or more other variables).
- To practice this skill, question your assumptions and ask others for their opinions. The more you actively engage with different viewpoints, the less likely you are to get stuck in a one-track mindset when analyzing data.

How to Improve Your Skills

- **3. Play Games or Brain Teasers**
 - Games, puzzles, and stories that require visualizing relationships between variables, examining situations from multiple angles, and drawing conclusions from known data points can help build the skills needed to analyze data. Some fun ways to practice analytical thinking include crossword puzzles, riddles, mystery novels, Sudoku, and logic puzzles.
- **4. Learn From Real-World Examples**
 - By exploring how other business professionals use data to solve problems, you can imagine what you'd do in their scenarios, evaluate the impact of their actions, and put that knowledge into practice.
 - You need to make it relevant and ask, 'Why do I care about this?' or 'Why do I want to look at a summary statistic?' or 'How is this going to be meaningful for a specific decision?'
 - By exposing yourself to cases from various industries.
- **5. Find a Community**
 - You can turn to online forums, social media, affinity groups within your organization or geographic area, or a cohort of learners in an online class.

How to Improve Your Skills

- **6. Engage with and Ask Big Questions of Your Data**
 - To engage with data further, ask questions. With each question comes an opportunity to uncover more insight and gain skills. These questions can lead you to learn a new coding language, analysis method, regression, or visualization tool to help solve a specific business problem.
 - Here are examples of questions to ask yourself when handling data:
 - *What am I hoping to understand?*
 - *What do I need to know to make a certain business decision?*
 - *What story is this data telling?*
 - *What do the relationships between variables mean for ____ at my company?*
 - *What if ____ changed? Which variables, trends, or forecasts would be impacted?*
 - *What needs to change in the data to get the desired outcome?*
 - *Why does the data trend in this direction, and what does it mean for the future?*
 - *How can I further analyze the data to get the answers needed to make important decisions?*

The Data-Driven Decision-Making Framework

- There are various tools and frameworks that can be beneficial when using data, one is the data-driven decision-making framework.

- **1. Understand the business problem:**

- What are you looking to understand or accomplish?*

- **2. Wrangle data:**

- Clean, validate, and organize the data.*

- **3. Create visualizations:**

- Present the data in a way that shows trends and relationships of interest.*

- **4. Generate hypotheses:**

- Formulate predictions based on emerging trends.*

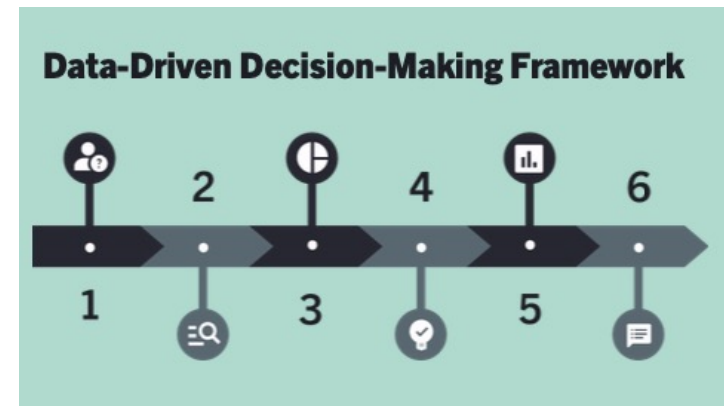
- **5. Conduct analysis:**

- Run statistical tests to determine if your hypotheses are correct.*

- **6. Communicate results:**

- Present your findings in the context of the original business problem.*

- Understanding data frameworks like this one gives you the capability to take a raw dataset, interpret its story, and use it to answer relevant business questions.





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Data Exploration and Analytics by Examples

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[Adapted from Lecture Notes on Global Health by OurWorldInData]

Global Health

Teaching Notes from **Our World in Data**

About these Teaching Notes

These teaching notes are part of a series of resources from Our World in Data. They have been designed to support those interested in teaching and learning about global development, and they require no background knowledge.

Here we touch on the following questions:

How does the general health situation of people in poor countries compare to the health of people in rich countries?

How are population health outcomes changing over time?

How difficult is it to improve health outcomes in poor countries?

What does this all mean in terms of policy?

For more teaching material visit: ourworldindata.org/teaching-notes

Global Health

- How does the general health situation of people in poor countries compare to the health of people in rich countries?
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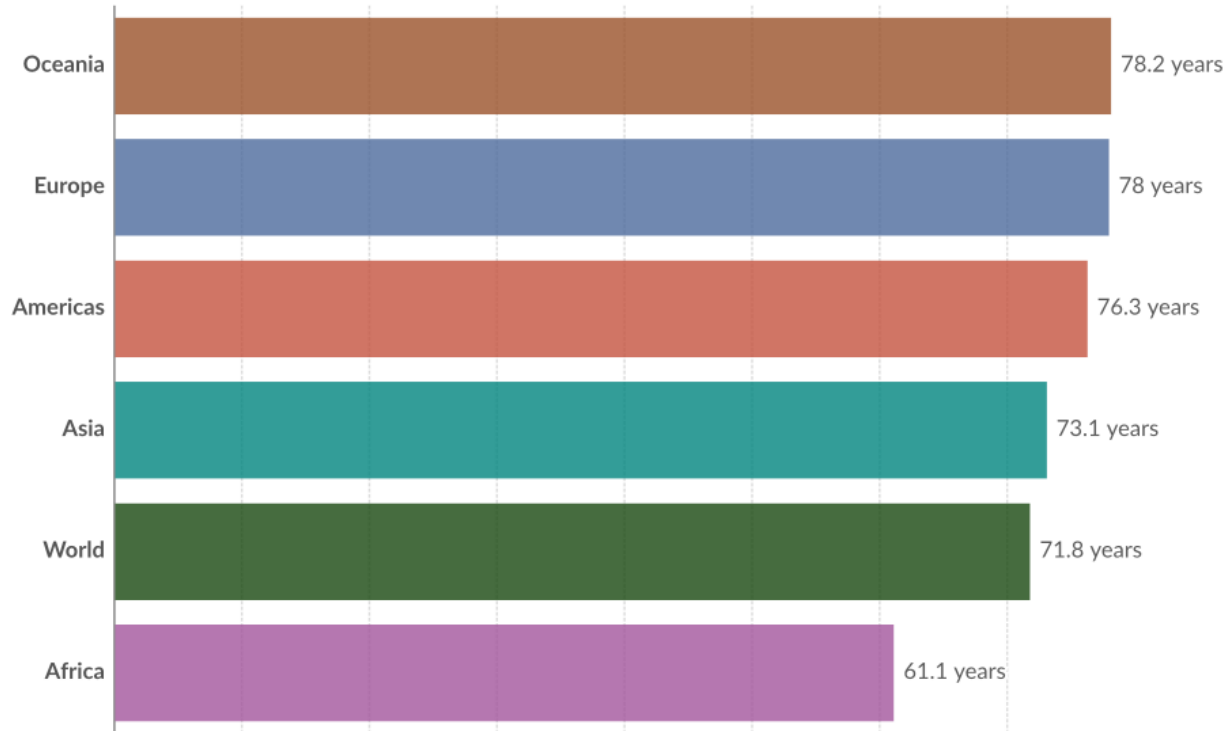
Life expectancy, 2015

The period life expectancy at birth, in a given year.



Table Map Chart

Edit countries and regions Settings



Data source: UN WPP (2022); HMD (2023); Zijdeman et al. (2015); Riley (2005) – [Learn more about this data](#)
 OurWorldInData.org/life-expectancy | CC BY

Download Share Explore the data →

In low-income countries, the average number of years that a newborn infant can expect to live (under current mortality patterns) is much lower than in high-income countries.

Life expectancy ranges from just over 50 years in the poorest countries to over 80 years in the richest countries.

You can read more about cross-country differences in life expectancy [here](#).

(Note: In this interactive map you can use the slider at the bottom to show estimates for any year. And you can click on any country to plot a time series for that country.)



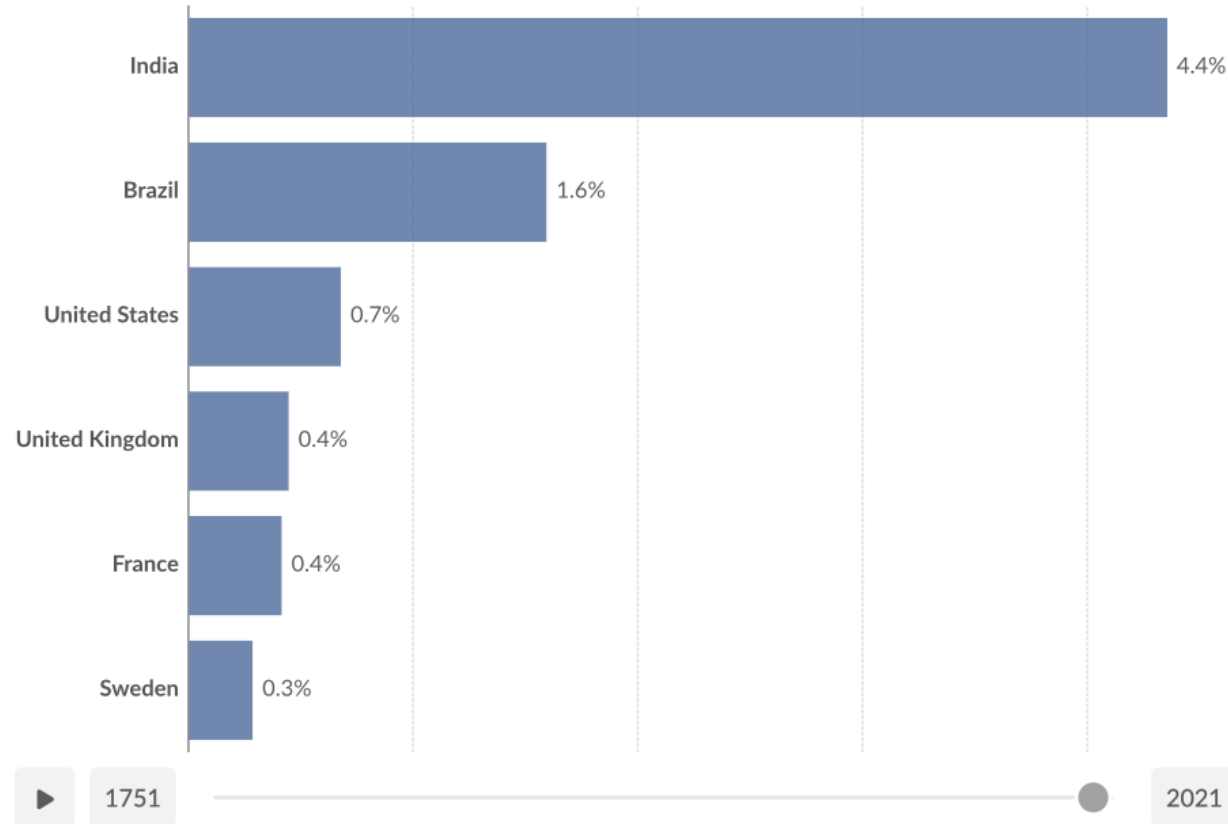
Child mortality rate, 2015

The estimated share of newborns who die before reaching the age of five.

Our World
in Data

Table Map Chart

Edit countries and regions



Data source: UN IGME (2023); Gapminder (2015) - [Learn more about this data](#)
OurWorldInData.org/child-mortality | CC BY



Explore the data →

Child mortality is higher in low-income countries.

In many countries in sub-Saharan Africa more than 10% of children die before their fifth birthday. In rich countries the corresponding figure is below 1%.

You can read more about cross-country differences in child mortality [here](#).



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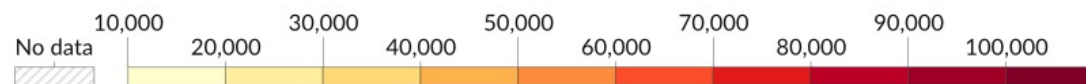
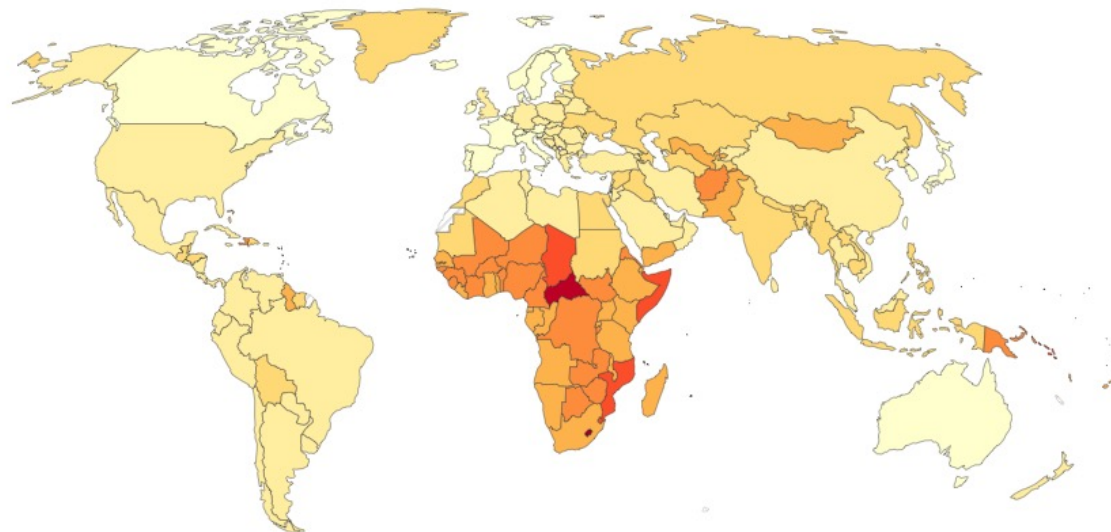
Burden of disease, 2019

Disability-Adjusted Life Years (DALYs) per 100,000 individuals from all causes. DALYs measure the total burden of disease – both from years of life lost due to premature death and years lived with a disability. One DALY equals one lost year of healthy life.

Our World
in Data

Table Map Chart

World



1990 2019

Data source: IHME, Global Burden of Disease (2019) – [Learn more about this data](#)

Note: To allow comparisons between countries and over time this metric is [age-standardized](#).

OurWorldInData.org/burden-of-disease | CC BY

Download Share Explore the data →

The "burden of diseases", which is a variable that combines mortality patterns with data on the prevalence of disability and illness, also shows that people in poorer countries have generally much worse health.

In this map darker colors represent a higher burden of disease. The burden of disease is measured in terms of Disability Adjusted Life Years, or 'DALYs'.

One DALY can be thought of as one lost year of healthy life (i.e. a year of life free from illness or disability).

You can read more about DALYs and the burden of disease [here](#).



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Global Health

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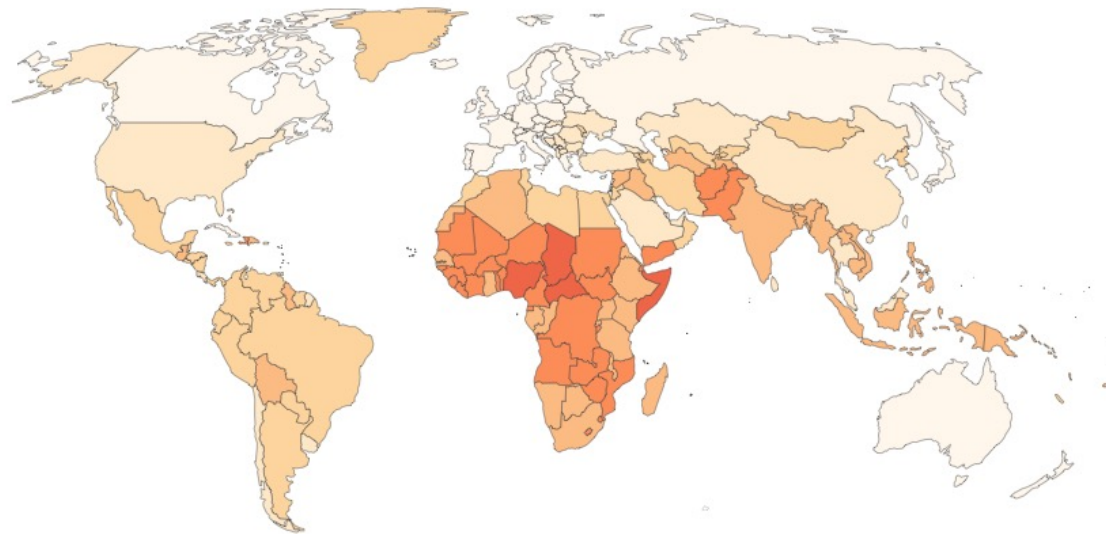
Child mortality rate, 2021

The estimated share of newborns who die before reaching the age of five.



Table Map Chart

World



Data source: United Nations, World Population Prospects (2022) - [Learn more about this data](#)

OurWorldInData.org/child-mortality | CC BY

Download Share Explore the data →

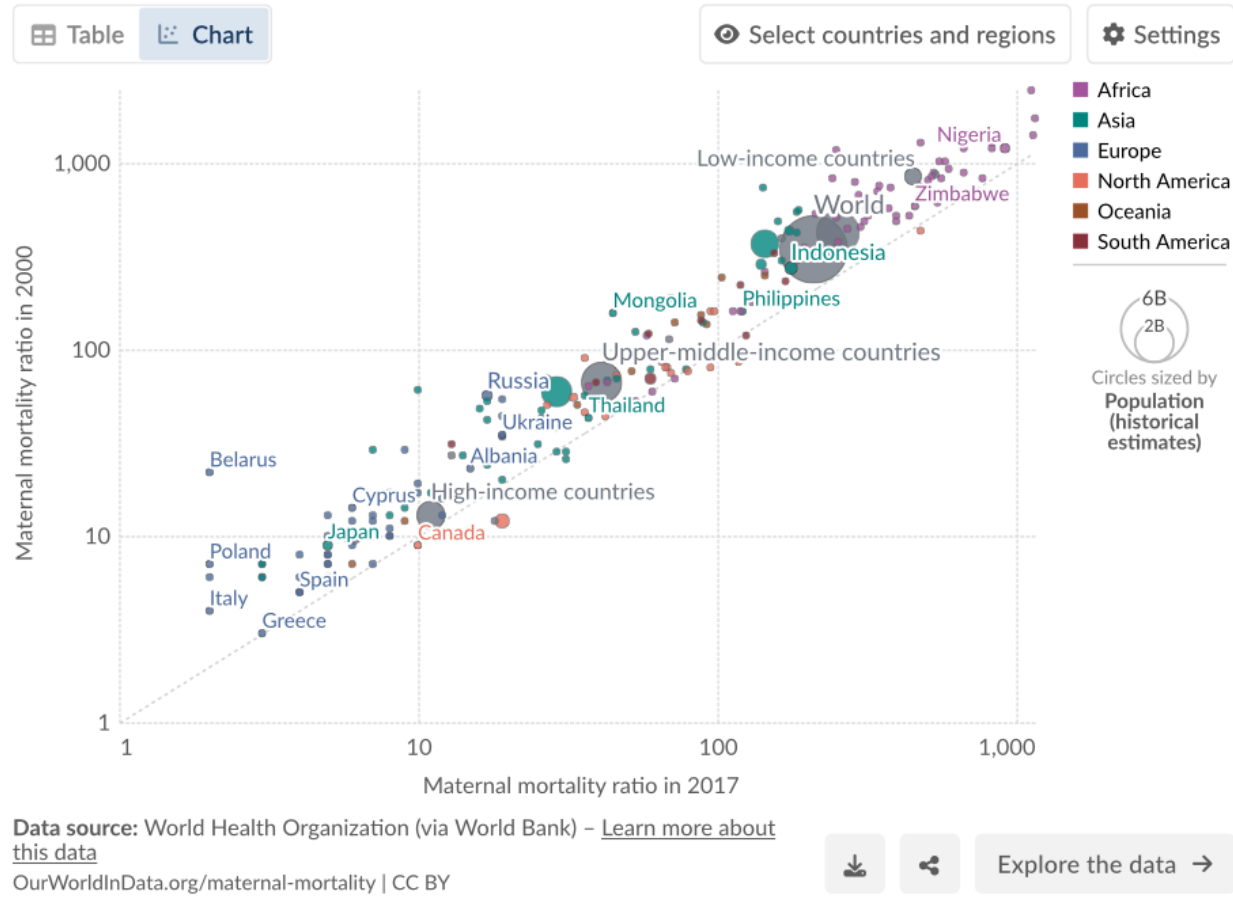
Child mortality has declined remarkably in all world regions. And since progress has been faster in the regions with the worst outcomes, we are also seeing convergence: the difference between the best-off and worst-off world regions was almost 30 percentage points in the 1950's and has reduced to less than 7 percentage points today.

(Note: In this interactive chart you can click on the option "Add country" to plot numbers for any country or world region. You can also select the "Map" tab to show levels for all countries.)



The maternal mortality ratio in 2000 and 2017

Maternal mortality ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births. Shown here is the modeled estimate as explained in the Sources. Countries above the grey line had a higher maternal mortality ratio in 2000 than in 2017.



And it's not just about child mortality. Maternal mortality has also declined across the world.

This chart shows the rates of maternal mortality across countries, in the years 1990 (vertical axis) and 2015 (horizontal axis). Countries above the diagonal line have seen improvements.

You can read more about maternal mortality [here](#).

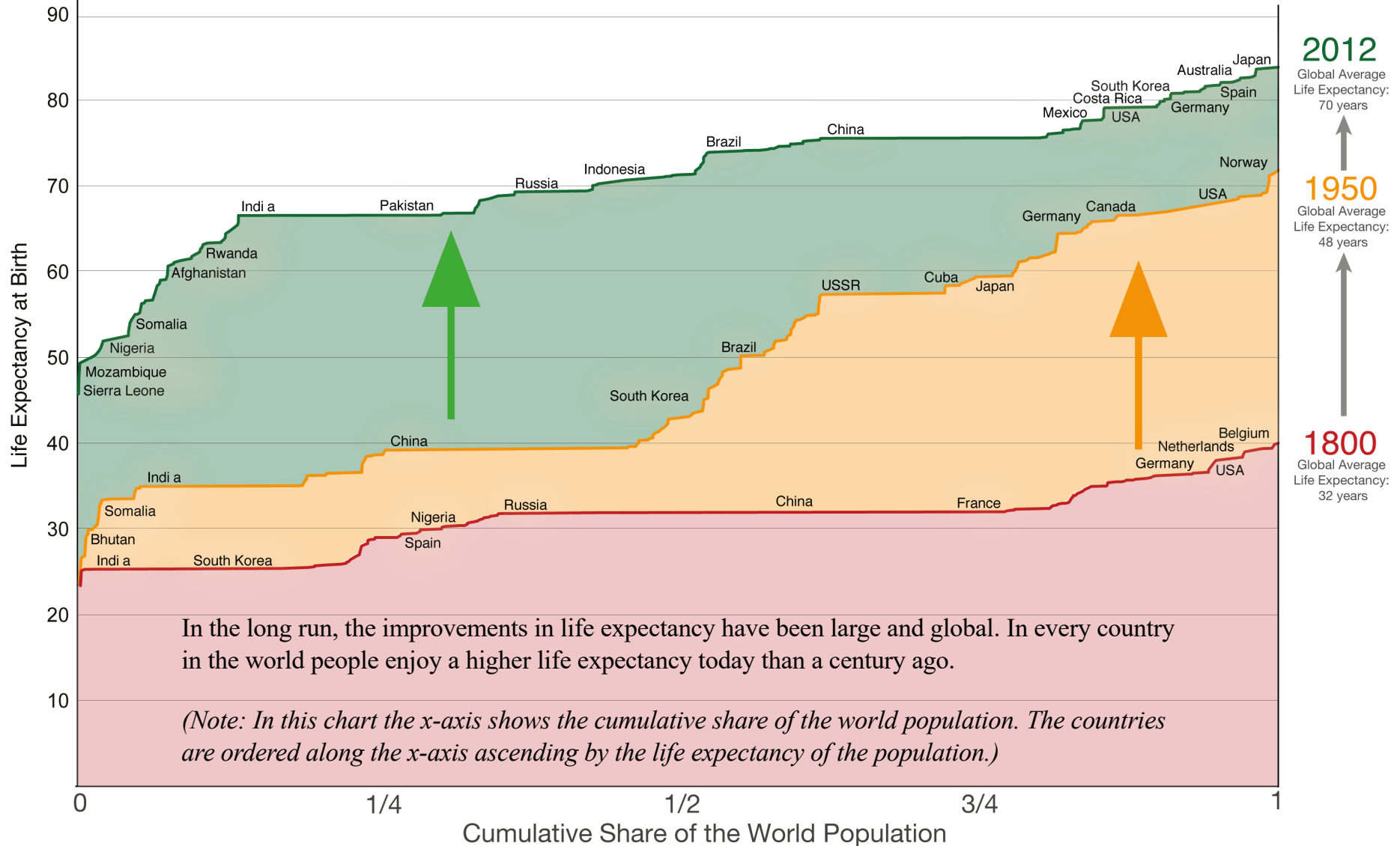
(Note: In this interactive scatter plot you can click on the continent labels on the right to highlight specific regions. And you can use the option "Search", at the bottom, to highlight specific countries.)





Life Expectancy of the World Population in 1800, 1950 and 2012

Countries are ordered along the x-axis ascending by the life expectancy of the population. Data for almost all countries is shown in this chart, but not all data points are labelled with the country name.



Data source: The data on life expectancy by country and population by country are taken from [Gapminder.org](https://gapminder.org).

The interactive data visualisation is available at [OurWorldinData.org](https://ourworldindata.org). There you find the raw data and more visualisations on this topic.

Licensed under [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) by the author Max Roser.

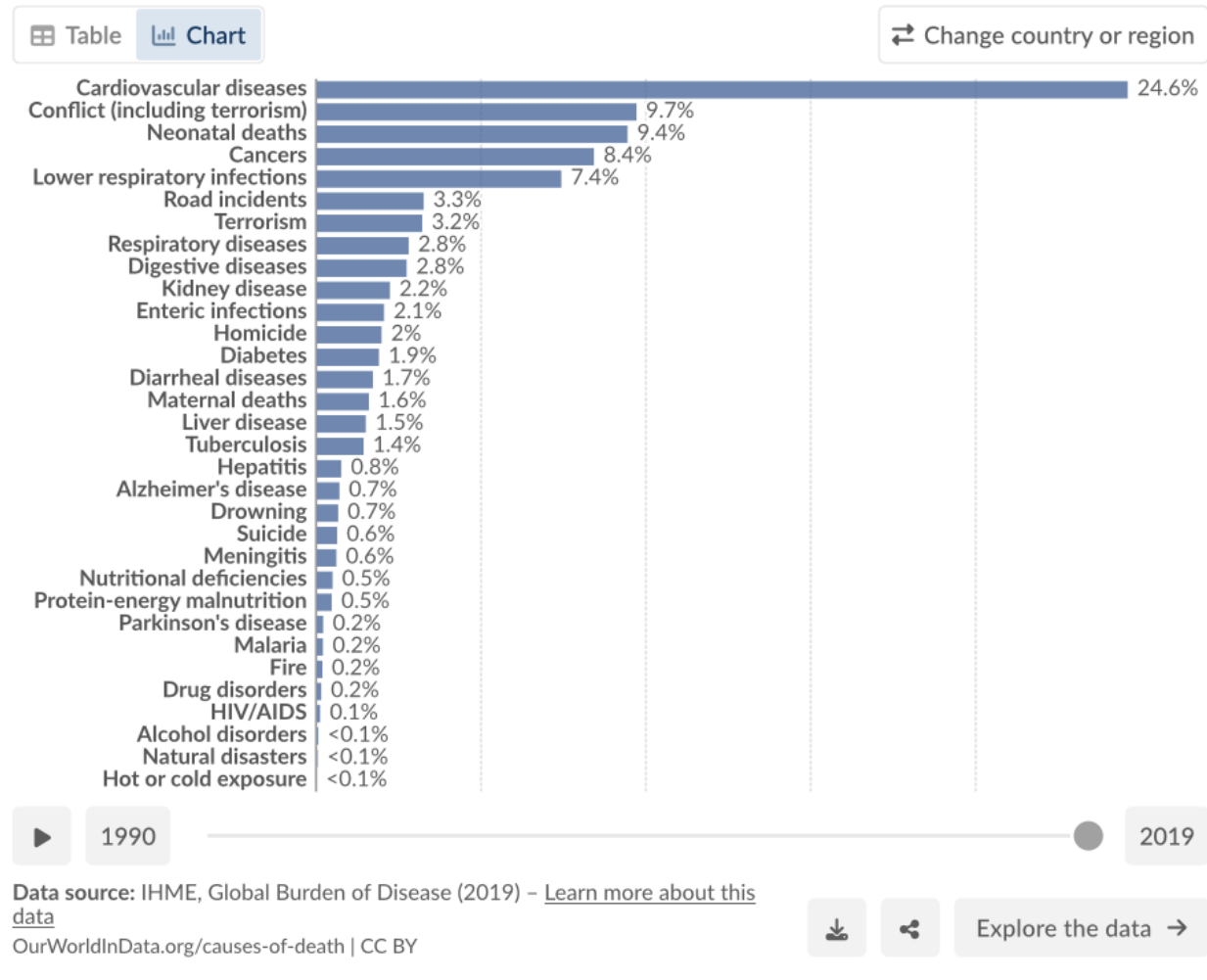
Global Health

- How does the general health situation of people in poor countries compare to the health of people in rich countries?
 - People in poor countries have much worse health than people in rich countries
- How are population health outcomes changing over time?
 - We know progress is possible
 - Today, a large share of deaths in low-income countries can be prevented
- How difficult is it to improve health outcomes in poor countries?
- What does this all mean in terms of policy?

Share of deaths by cause, Afghanistan, 2019



The estimated share of total annual deaths from each cause.



HIV/AIDS, Malaria, diarrheal diseases and conditions related to diet (malnutrition, nutritional deficiencies, etc.) are all preventable causes of death. These conditions all rank high among the leading causes of death in low-income countries.

(Note: In this interactive chart you can use the option "Change country" to plot the same variables for any country or region.)



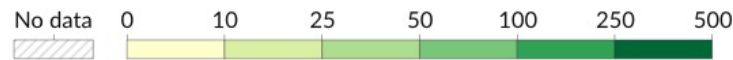
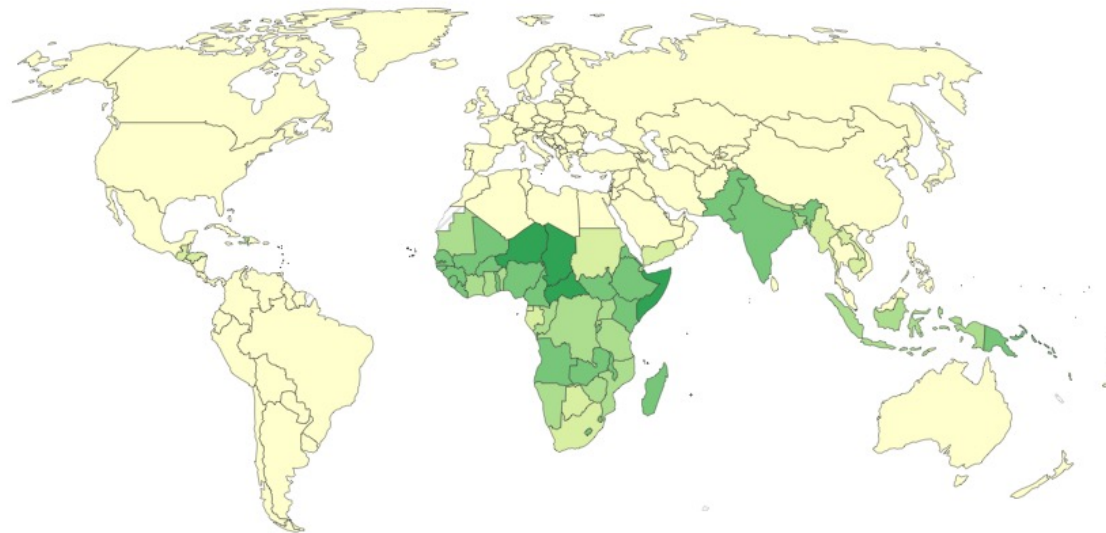
Death rate from unsafe water sources, 2019



Estimated annual number of deaths attributed to unsafe water sources per 100,000 people.

Table Map Chart

World



Data source: IHME, Global Burden of Disease (2019) - [Learn more about this data](#)

Note: To allow comparisons over time and between countries with different age-profiles this rate is age-standardized.

[OurWorldInData.org/water-access](https://ourworldindata.org/water-access) | CC BY

Download Share Explore the data →

Lack of access to clean water affects health even when it doesn't kill you: repeated bouts of diarrhea during childhood permanently impair both physical and cognitive development.

This map shows death rates attributed to unsafe water. Roughly speaking, it shows us the number of deaths from drinking unclean water relative to the size of the population in each country.

Two cheap “miracle drugs” could already save thousands of children: chlorine for purifying water; and salt and sugar, the key ingredients of **oral re-hydration solutions**.



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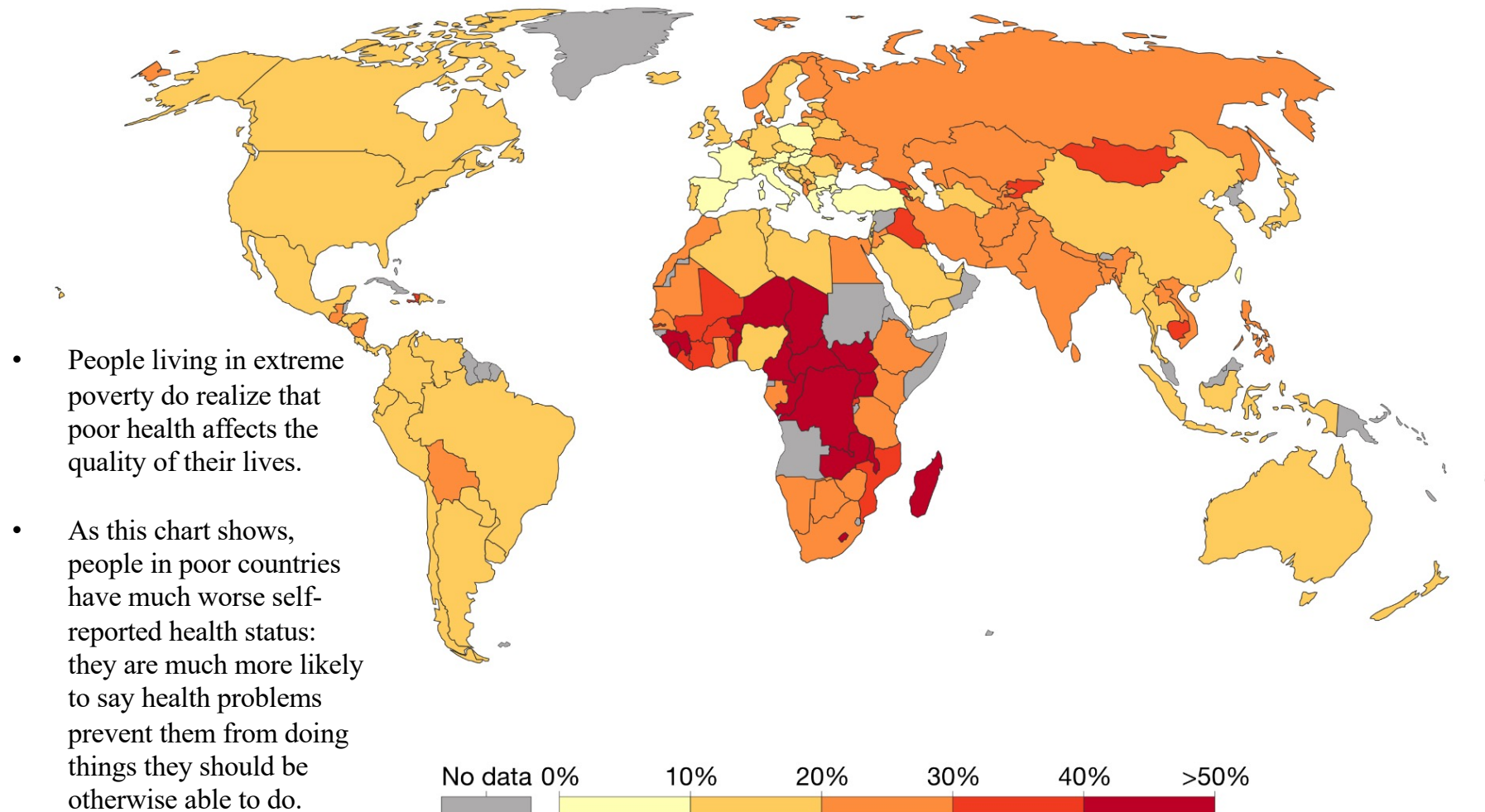
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- How difficult is it to improve health outcomes in poor countries?
 - **If prevention is an option, why is it not more common?**
 - *It's not that people in extreme poverty don't care about their health*
- What does this all mean in terms of policy?

Self-reported health problems (ages 30-49), 2017

Share of people ages 30-49 who responded yes to the question "Do you have any health problems that prevent you from doing any of the things people your age normally can do?"

Our World
in Data



Source: Gallup World Poll

OurWorldInData.org • CC BY-SA

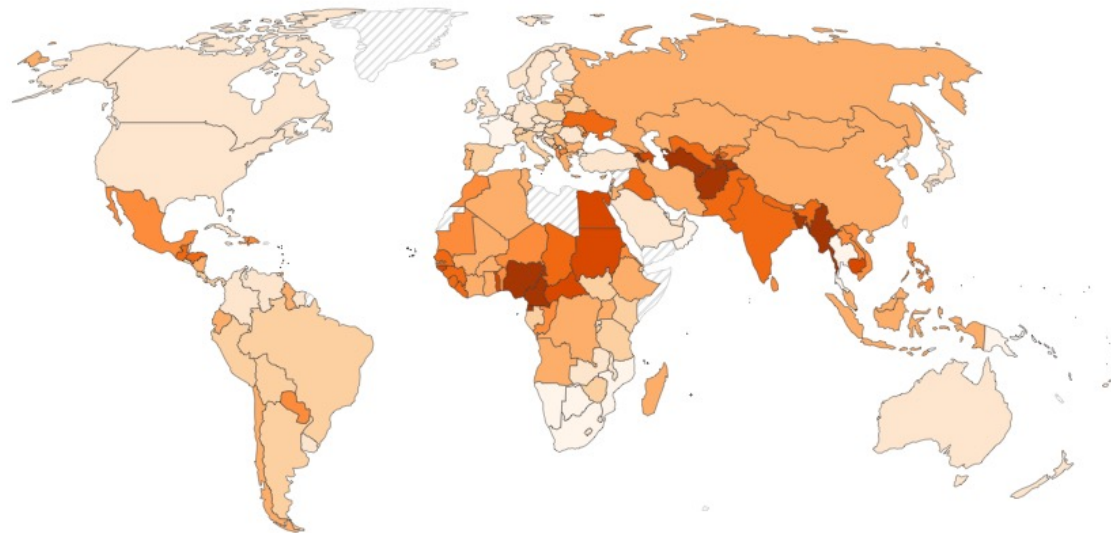
Share of out-of-pocket expenditure on healthcare, 2019

Out-of-pocket expenditure on healthcare as percent of total current healthcare expenditure.

Our World
in Data

Table Map Chart

World



No data 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%



2000

2019

Data source: World Health Organization (via World Bank) – [Learn more about this data](#)

Note: 'Out-of-pocket' refers to direct outlays made by households to healthcare providers.

OurWorldInData.org/financing-healthcare | CC BY



Explore the data →

Poor people spend a large share of their limited disposable income on health care.

Indeed, as this chart shows, a large fraction of health care services in poor countries are purchased directly by households with 'out-of-pocket' resources.

But this spending doesn't always translate into effective treatment: In countries such as Nigeria, India, Bangladesh, and Thailand, health care providers without formal medical training account for **between one-third and three-quarters of primary care visits**.



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Global Health

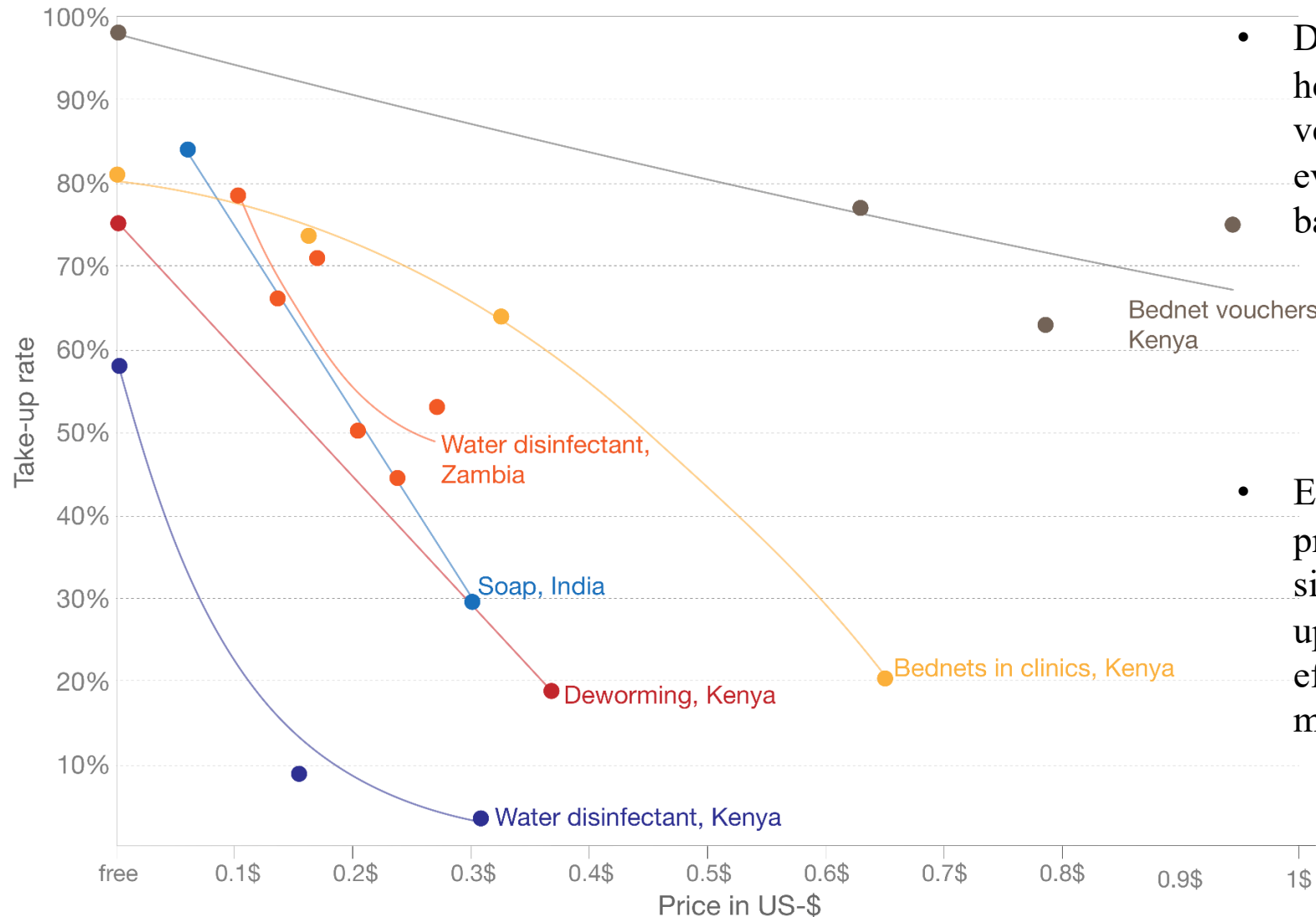
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- How difficult is it to improve health outcomes in poor countries?
 - **If prevention is an option, why is it not more common?**
 - *Most people have a tendency to under-invest in prevention – and this is also true in poor countries*
- What does this all mean in terms of policy?

Higher prices for preventive healthcare products lead to declining demand



Dots show product take-up rates at various price levels. These correspond to demand observed in policy experiments where prices were changed exogenously.

The demand curves (i.e. the lines of best fit) give us an idea of how sensitive demand is to changes in prices.



- Demand for preventive health care products is very sensitive to prices, even at very low baseline prices.

- Even small increases in prices can result in a significant fall in take-up rates of basic and effective health measures.

Source: based on JPAL Bulletin (2011). "The Price is Wrong", Poverty Action Lab.

This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing. Licensed under [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) by the authors in 2018.

Global Health

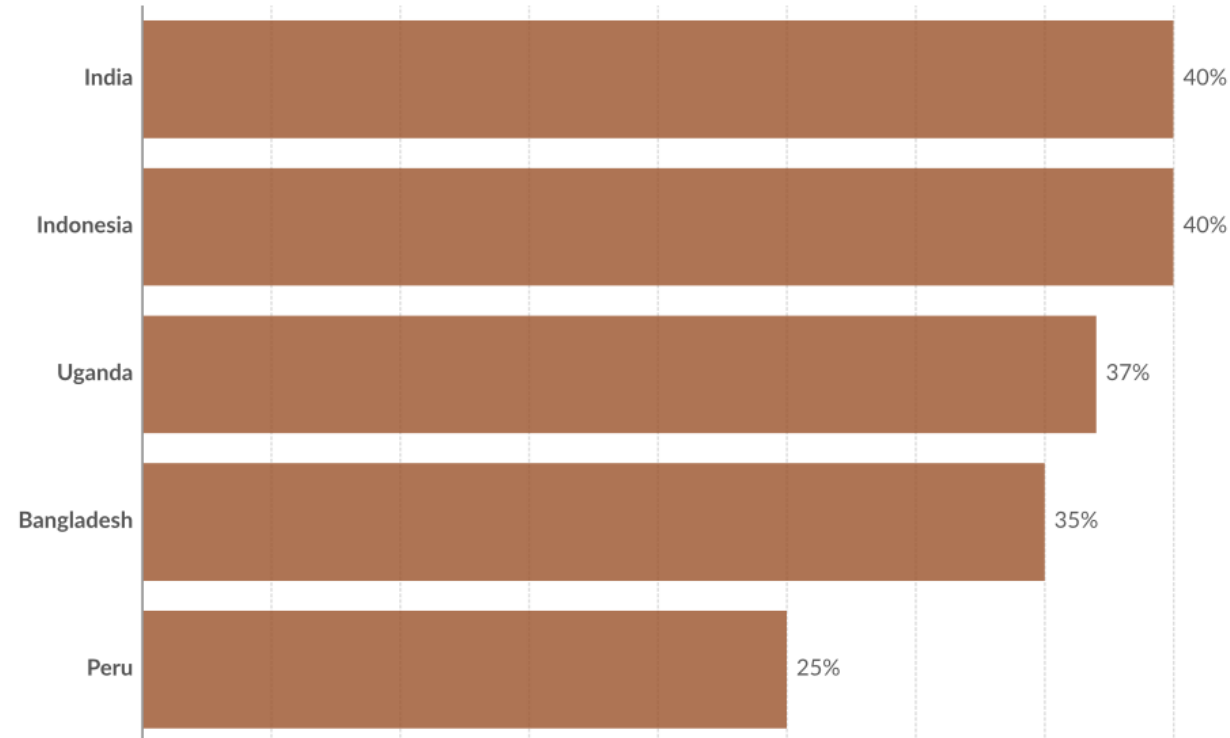
- How does the general health situation of people in poor countries compare to the health of people in rich countries?
 - People in poor countries have much worse health than people in rich countries
- How are population health outcomes changing over time?
 - We know progress is possible
 - Today, a large share of deaths in low-income countries can be prevented
- How difficult is it to improve health outcomes in poor countries?
 - **If prevention is an option, why is it not more common?**
 - *Under-investing in preventive measures can have dramatic consequences when available treatment is deficient*
- What does this all mean in terms of policy?

Health provider absence rate, 2003

Our World
in Data

Providers were counted as absent if they could not be found in primary health centers for any reason at the time of a random unannounced spot check (see source for further detail).

Table Chart



Data source: Chaudhury, Hammer, Kremer, Muralidharan, and Rogers (2006), Missing in Action: Teacher and Health Worker Absence in Developing Countries - [Learn more about this data](#)

Note: Fieldwork was conducted between October 2002 and April 2003.
OurWorldInData.org/financing-healthcare | CC BY

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Between October 2002 and April 2003 researchers conducted a cross-country study to measure absenteeism among health providers (doctors, nurses, etc.). This chart shows their results. They found that in India, for example, 40% of health workers were absent from their job at the time of an unannounced spot check.

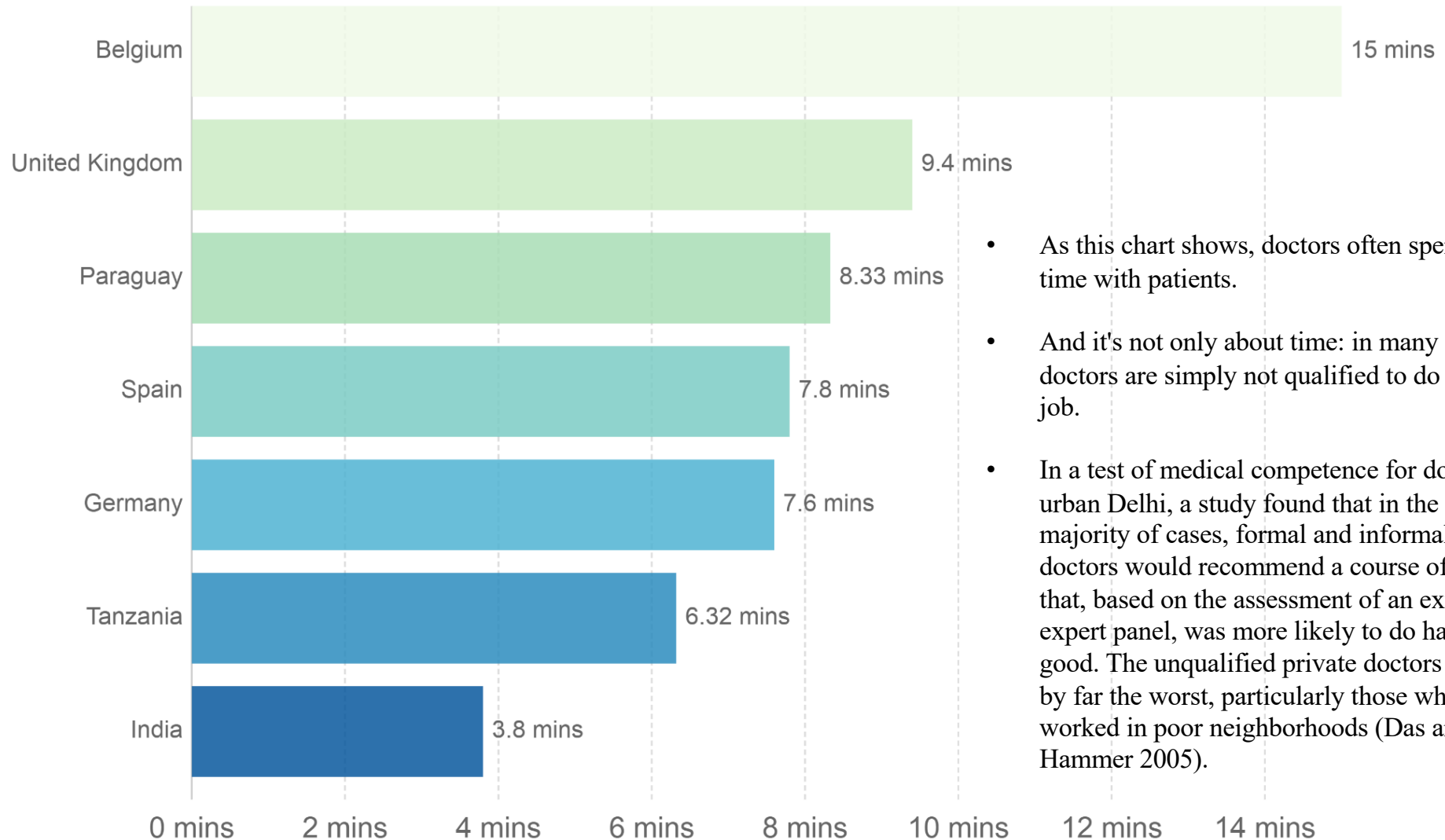
This is evidence of a complicated reality: In low-income countries doctors and health providers in primary health centers are often absent from their job.



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Time that doctors spend with a patient

Average time that a doctor spends with every patient. India figure refers to Delhi and cannot be applied nationwide. The timing of recorded values differ country to country. Cross country comparisons should be made with caution.



- As this chart shows, doctors often spend little time with patients.
- And it's not only about time: in many cases doctors are simply not qualified to do their job.
- In a test of medical competence for doctors in urban Delhi, a study found that in the majority of cases, formal and informal doctors would recommend a course of action that, based on the assessment of an external expert panel, was more likely to do harm than good. The unqualified private doctors were by far the worst, particularly those who worked in poor neighborhoods (Das and Hammer 2005).

Global Health

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- How difficult is it to improve health outcomes in poor countries?
- What does this all mean in terms of policy?

Global Health

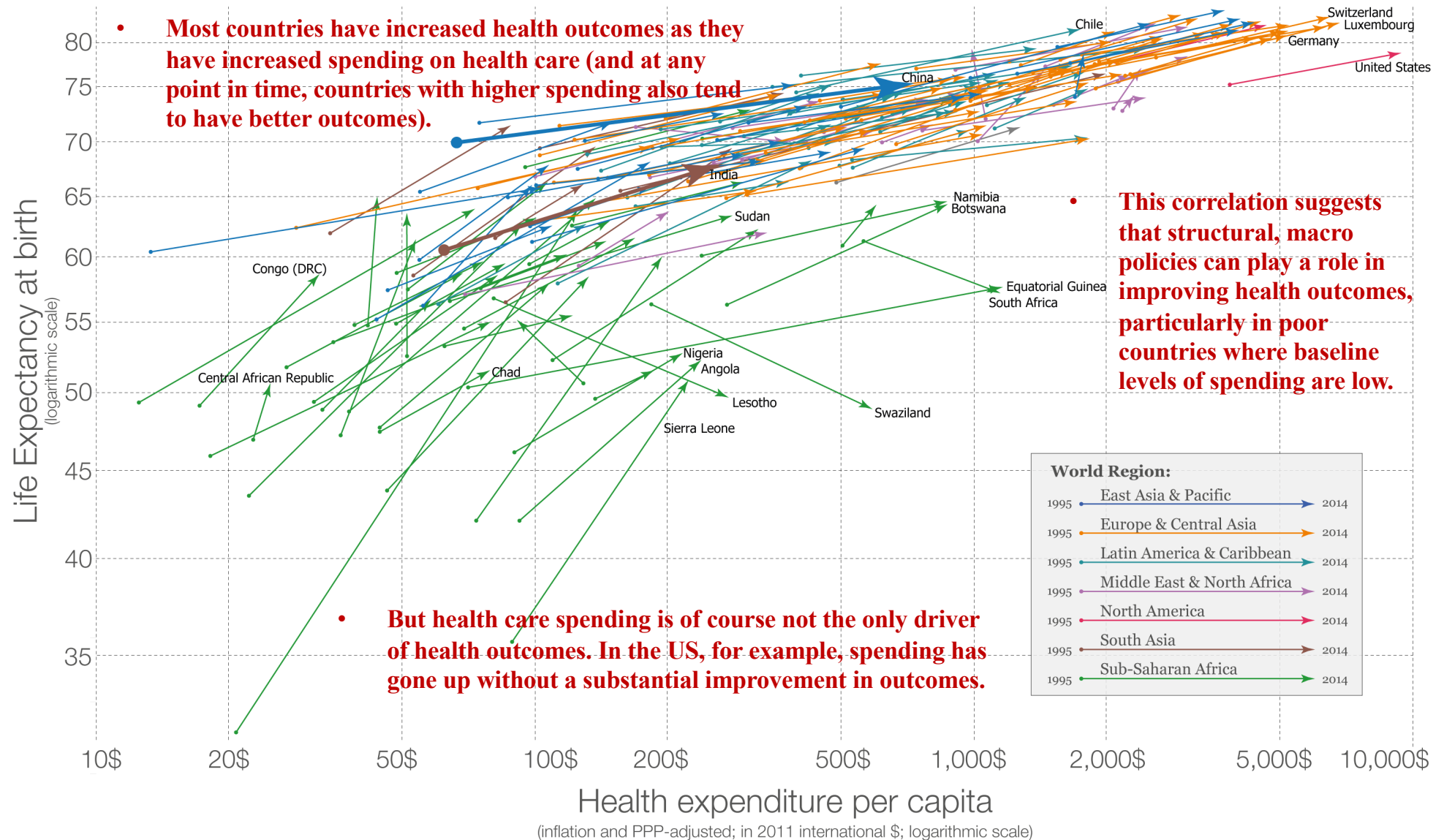
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 - **What can be done?**
 - *Regulation and macro policies that increase the availability and quality of services are important*



Life expectancy is increasing as more money is spent on health

The arrows show the change for all countries in the world, from 1995 (earliest available data) to 2014 (latest available data). [Not all countries are labelled]

Total health expenditure is the sum of public and private health expenditures. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation.



Data source: World Bank

The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic.

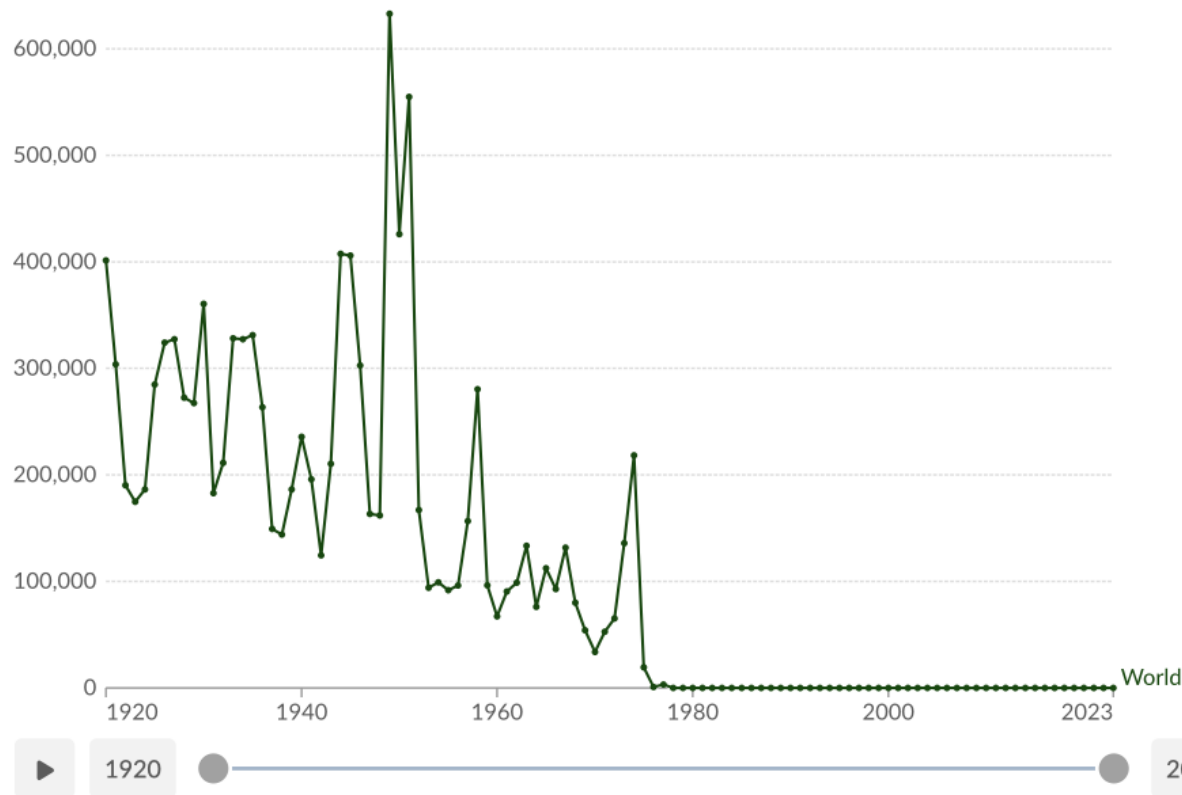
Licensed under [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) by the author Max Roser.

Smallpox cases reported worldwide

The historical number of smallpox cases reported is lower than the actual number of cases in those years, due to limited testing and reporting.

Our World
in Data

Table Chart



Data source: WHO (2023) - [Learn more about this data](#)
OurWorldInData.org/smallpox | CC BY

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Explore the data →

Vaccination campaigns are a concrete example of a macro-level health intervention that has been shown to work.

The WHO estimates that vaccinations today avert **2 to 3 million deaths every year**.

And historical returns have been huge: Large-scale vaccination campaigns enabled the world to eradicate smallpox. As this chart shows, we went from hundreds of thousands of cases every year, to complete eradication in only a couple of decades.

You can read more about the eradication of smallpox [here](#).



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Global Health

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 - **What can be done?**
 - *Incentives of providers, as well as patient-level interventions are also very important*

Small incentives that nudge people to act today, rather than indefinitely postpone, can have large positive effects. Regulation of health providers and subsidies to drastically lower prices can also help substantially.

"We should recognize that no one is wise, patient, or knowledgeable enough to be fully responsible for making the right decisions for his or her own health. For the same reason that those who live in rich countries live a life surrounded by invisible nudges, the primary goal of health-care policy in poor countries should be to make it as easy as possible for the poor to obtain preventive care, while at the same time regulating the quality of treatment that people can get."

(Banerjee and Duflo, Poor Economics, Page 78)





DS363: Design and Learning with Data

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Thank you~

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