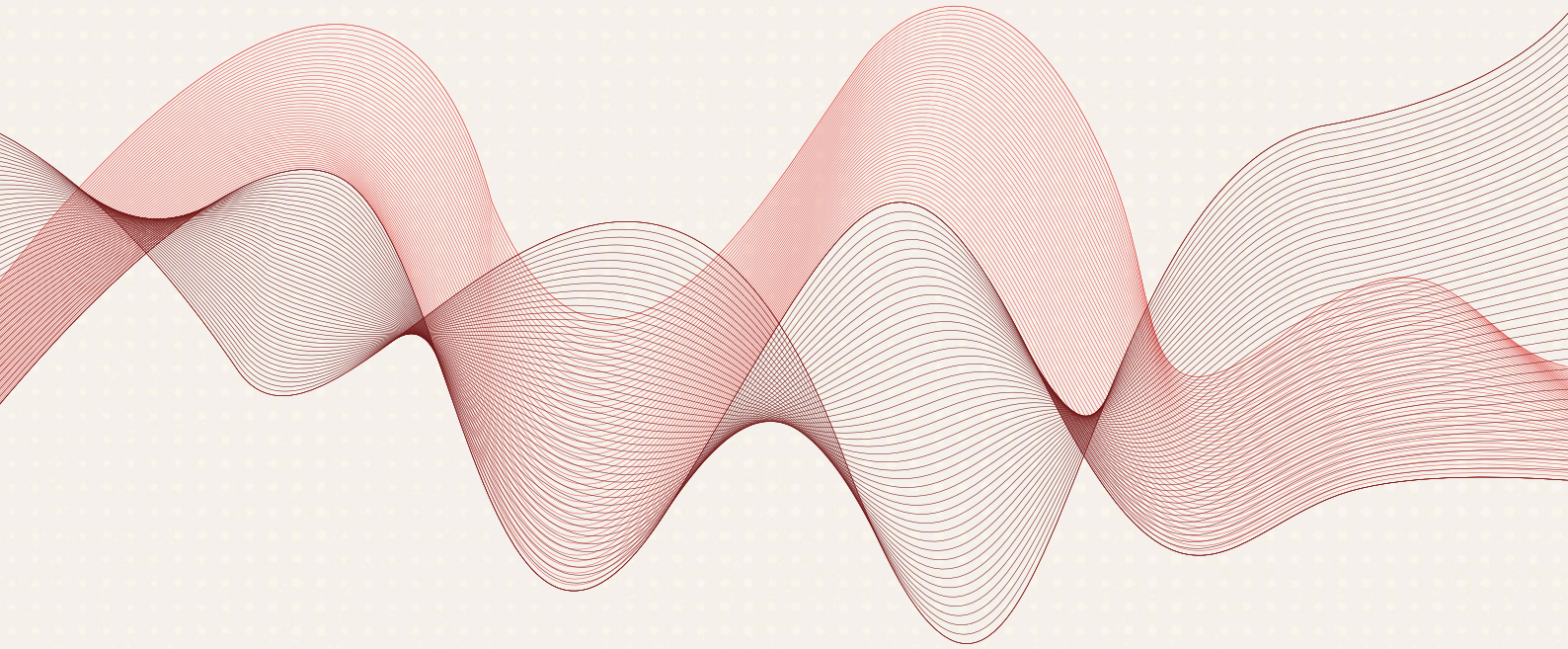

Disease Control Priorities, Fourth Edition
Volume 3, Interventions Outside the Health Care System

Economic Evaluation for Health Priority-Setting: Selecting Policy Sectors and Interventions for Assessment

Lisa A. Robinson (Harvard University)
Brad Wong (Mettalytics)

Working Paper 20, May 2025

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May 2025 Internal Review Draft

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Note: This is an initial draft developed for internal review, based on preliminary research. Comments are welcome and greatly appreciated. We expect that volume 3 of the Disease Control Project, Fourth Edition, will include several major sections. Section I will include chapters that provide background and guidance for the sections that follow. This paper, once revised, is intended to be the third chapter in that section. Drafts of the preceding two chapters, which address methods for economic evaluation, are posted on the project website (https://dcp4.w.uib.no/volumes/volume-3-interventions-outside-the-health-care-system/). The subsequent major sections of Volume 3 would then address policy areas selected based on the analysis summarized in this chapter.

Preface

Since the early 1990s, researchers involved in the Disease Control Priorities (DCP) effort have been evaluating options to decrease disease burden in low- and middle-income countries. This working paper was developed to support the third volume of the Fourth Edition of this effort, "Interventions Outside the Health Care System." It is posted to solicit comments and feedback, and ultimately will be revised and published as part of the DCP4 series.

DCP4 will be published by the World Bank. The overall DCP4 effort is led by Series Lead Editor Ole F. Norheim (Harvard University and University of Bergen); the Secretariat is hosted by the Bergen Centre for Ethics and Priority Setting. Initial core funding was provided by the Norwegian Agency for Development Cooperation and the Norwegian Research Council. More information on the project is available at: https://dcp4.w.uib.no/.

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The development of this chapter and the supporting database were led by Lisa A. Robinson and Brad Wong. We are very grateful for the help and support provided by many others. We thank Ole F. Norheim, David Watkins, and Kari Nadeau for their guidance and support. The analysis of ministerial functions was conducted by Daniel Cadarette; the analysis of global burden of disease data was conducted by Bryce Everett. Kiran Ahmad, Nancy Dubosse, Bryce Everett, William Garcia, Younsoo Jung, and Vanitha Sampath assisted in reviewing the literature and creating the database. Sameen Ahsan, Paula Alejandra Gutiérrez Baquero, Brooks Bowden, Allen Blackman, Eric Brunner, Donald Bundy, Jonathan Buonocore, Kevin Cromar, Joe Devlin, Victoria Fan, Mahelet Fikru, Robert Griffin, Heather Grob, Odd Hanssen, Sandra Hoffmann, Sue Horton, Linas Jasiukevicius, Marc Jeuland, Jeffrey Lazo, Ana Lopes, Samuel Miller, Jim Neumann, David Pannell, Arash Peykanfar, Ian Ross, Faraz Usmani, Dylan Walters, and several anonymous participants responded to our requests for completed benefit-cost analyses and related publicly-available models.

Comments are welcome and greatly appreciated. Please address correspondence to Lisa A. Robinson (robinson@hsph.harvard.edu) and Brad Wong (brad@mettalytics.com).

Contents

Summary

In volume 3 of the Fourth Edition of the Disease Control Priorities (DCP4) project, we evaluate interventions implemented outside the health care system that substantially improve public health in low- and middle-income countries. Our goal is to inform decisions by individual ministries and national governments as well as by international donors and other organizations.

To reach this goal, in this chapter we explore how to best organize the volume to address the needs of decision makers and other stakeholders, focusing attention on those areas where interventions may be most cost-beneficial.[1] We begin by providing background information for context. We consider how ministries are organized across different countries, recognizing that decisions are often made by individual ministries with responsibility for specific policy areas. We find that the number of ministries responsible for these types of interventions is large and their mandates are diverse. Thus it can be very challenging to coordinate across ministries to prioritize those investments most likely to lead to the largest improvements in public health.

We also consider the magnitude of the deaths and disease burden associated with risks and causes typically addressed outside the health care system, recognizing that cost-effective policies focused on the most significant problems may lead to the largest health gains. By decreasing the need for medical care, addressing these problems outside the health system also reduces the significant strain they place on those systems. We find that, in low- and middle-income countries, the most substantial contributors to poor health and premature death are ambient air pollution and tobacco use. Numerous other risks are also associated with a significant number of deaths and a large proportion of the disease burden.

Because resources are scarce and the costs and effectiveness of interventions vary, the remainder of this chapter delves into the evidence on the net benefits of investing in different policies. It may be more cost-beneficial, for example, to avert 1,000 deaths by addressing a lower ranked risk factor than by addressing one that is more significant. If it costs $800 million to avert 1,000 deaths attributed to a highly ranked risk factor, and $500 million to avert 1,000 deaths attributed to a lower ranked risk factor, the latter policy would not only be more cost-beneficial, but would also allow the $300 million difference to be used for other purposes.

To gain insight into what policies are likely to be most cost-beneficial, we review previously completed analyses of interventions typically implemented outside of the health care system, focusing on those that significantly affect public health in low- and middle-income countries. We use the results of that review to construct a database that includes over 120 completed

[1] We expect that DCP4 volume 3 will include several major sections, the first of which will include chapters that provide background and guidance for the sections that follow. This paper, once revised, is intended to be the third chapter in Section I. The preceding two chapters address the methods used for economic evaluation and are posted for review on the project website (https://dcp4.w.uib.no/volumes/volume-3-interventions-outside-the-health-care-system/). The subsequent major sections of volume 3 would then each address policy areas selected based on the analysis summarized in this chapter.

benefit-cost analyses of close to 300 interventions. Building on these analyses and other sources, we propose a structure for the remaining sections of this volume. Each subsequent section of the volume will include an overview of the problem and the evidence on the costs and benefits of related interventions, as well as benefit-cost analyses of potentially high impact interventions using consistent methods to promote comparability.

Our proposed approach for the structure of the remainder of this volume includes sections that address four major policy areas, where the available evidence suggests that the size of problem is large, interventions are likely to have large net benefits, and these interventions can be plausibly implemented in a way that benefits a substantial share of the affected population. Because the benefit-cost analysis research base is relatively robust in these four areas, there is a strong foundation for addressing them in this volume. These four areas are: (1) habitual and addictive goods (including tobacco use), (2) household air pollution, (3) ambient air pollution, and (4) water, sanitation and hygiene. We also identify several policy areas worthy of more attention, where the dearth of related studies means a much greater investment would be needed to conduct analyses to support prioritization. These include gender inequality, agriculture and nutrition, lead contamination, and road traffic injuries.

Because climate change will affect the costs and benefits of many related interventions, and many interventions targeted on other problems will have climate-related co-benefits, climate change is a theme that permeates this volume. More work is needed, however, to assess the health co-benefits of mitigation measures and the costs and benefits of feasible adaptation measures in LMICs. Adapting to rising temperatures involves interventions that address heat stress, extreme weather events, and many other problems. Thus we propose to include a final major section in this volume that summarizes the evidence on climate policies as well as other problems where more investigation is desirable.

The approaches to be used to further assess interventions in these policy areas in these subsequent sections are discussed in the preceding two chapters and an associated journal article: Chapter 1, "Economic Evaluation for Health Priority-Setting: Cost-Effectiveness Analysis and Benefit-Cost Analysis Primer;" Chapter 2, "Guidelines for Consistent and Comparable Economic Evaluation to Support Prioritization;" and "From Benefit-Cost Analysis to Social Welfare: A Pragmatic Approach."

1.0 Introduction

The overall goal of the Disease Control Priorities project, Fourth Edition (DCP4), is to summarize, produce, and help translate economic evidence into better priority setting for universal health coverage and for intersectoral and international action for health, focusing on low- and middle-income countries (LMICs). In this third volume, we consider interventions undertaken outside the health care system.[2] These interventions may address, for example, environmental, transportation, occupational, nutritional, behavioral, and other risks, including climate change. They may involve implementing regulations, developing targeted taxes, fees, or subsidies, or directly funding goods and services.

The aim is to:

- Aid decision-makers and stakeholders in comparing interventions implemented within and across policy sectors so as to identify those likely to yield the largest net improvements in health and welfare in different contexts. These include policies within the purview of individual government ministries as well as across ministries and other local, national, and international organizations.
- Encourage the use of resources, legal authority, and political interests beyond those available to the health care sector to address challenging public health problems more effectively.
- Identify understudied policy areas, where more research is warranted to better understand the impacts and determine whether related interventions should receive higher priority.

To compare and prioritize interventions undertaken outside of the health care sector, this volume relies primarily on conventional benefit-cost analysis (BCA), supplemented by application of alternative innovative approaches to economic evaluation. Three previous DCP4 working papers prepared to support volume 3 provide information on these methods, one of the three has now been published as a journal article.

1. Volume 3, Chapter 1, "Economic Evaluation for Health Priority-Setting: Cost-Effectiveness Analysis and Benefit-Cost Analysis Primer" (DCP4 working paper 3, Robinson and Hammitt 2024) summarizes frequently used approaches.
2. Volume 3, Chapter 2, "Guidelines for Consistent and Comparable Economic Evaluation to Support Prioritization" (DCP4 working paper 15, Robinson, Hammitt, and Wong 2024) describes the use of conventional benefit-cost analysis to support the goals of this volume.
3. "From Benefit-Cost Analysis to Social Welfare: A Pragmatic Approach" (*Journal of Benefit-Cost Analysis*, Ferranna, Hammitt, and Robinson 2024) provides one of the

[2] In contrast, we define health care system interventions as those typically implemented within the health care system, including policies that involve health care workers, are reimbursable through health insurance, and/or are implemented by a health ministry. These interventions are addressed in DCP4, volume 4, "Universal Health Coverage."

innovative approaches we plan to apply to supplement conventional benefit-cost analysis.

The current chapter provides the framework for organizing subsequent sections of this volume around policy areas, so as to address the needs of decision makers and other stakeholders. In this introductory section, we provide background information on two topics. First, recognizing that decisions are often made by individual ministries with responsibility for specific policy areas, we consider how ministries are organized across different countries. Second, understanding that policies focused on the most significant risks to health and longevity may lead to the largest improvements, we consider the magnitude of risks from different causes across countries.

In the subsequent sections, we discuss the extent to which the costs and benefits of interventions in each policy area have been addressed, based on our review of existing analyses. We use the results to focus subsequent work on those interventions that appear to lead to the largest net benefits. We also identify other policy issues worthy of attention based on available evidence, as well as problems for which little evidence on costs and benefits exists that are worthy of more evaluation in the future. It is important to note that the analysis in this chapter does not involve assessing the quality and suitability of the available studies; our goal at this point is simply to identify policy areas worthy of more exploration.

Further exploration, that includes evaluating and extending the existing research base, will be the subject of the subsequent parts of this volume. The work on each policy area will be led by subject matter experts, building on the analyses summarized here. For each area, we expect this additional work will include a more detailed discussion of the risks and the problems of concern, an evaluation of the available BCA literature, and identification of the subset of interventions that are expected to yield the largest net benefits. We will then apply a consistent approach to economic evaluation to support comparison across interventions, as described in Chapter 2 of this volume (Robinson, Hammitt, and Wong 2024).

1.1 Ministerial Organization[3]

Our focus in this volume is on interventions implemented outside the health care system that significantly affect public health. Such interventions involve diverse ministries responsible specific policy areas, other than those responsible for health care. In this section, we explore how ministries are organized across countries and consider the implications for the organization of this volume.

Our starting point is the Classification of the Functions of Government (COFOG) system, which was developed to examine the structure of government expenditure (Eurostat 2019).[4] Table 1 provides the COFOG classification structure, including 69 categories that both may,

[3] We thank Daniel Cadarette for conducting the research summarized in this section.

[4] We thank Peter Farup Ladegaard (World Bank) for suggesting that we organize this discussion around the functions government performs rather than around its form or structure.

and may not, support policies that significantly affect public health. However, as is evident from reviewing the table entries as well as the discussion later in this chapter, many if not most of the functional areas are likely to have some impact on health.

Table 1. COFOG Classification Structure

01 - General public services	**06 - Housing and community amenities**
01.1 - Executive and legislative organs, financial and fiscal affairs, external affairs	06.1 - Housing development
01.2 - Foreign economic aid	06.2 - Community development
01.3 - General services	06.3 - Water supply
01.4 - Basic research	06.4 - Street lighting
01.5 - R&D General public services	06.5 - R&D Housing and community amenities
01.6 - General public services n.e.c.	06.6 - Housing and community amenities n.e.c.
01.7 - Public debt transactions	
01.8 - Transfers of a general character between different levels of government	**07 – Health**
	07.1 - Medical products, appliances and equipment
02 - Defense	07.2 - Outpatient services
02.1 - Military defense	07.3 - Hospital services
02.2 - Civil defense	07.4 - Public health services
02.3 - Foreign military aid	07.5 - R&D Health
02.4 - R&D defense	07.6 - Health n.e.c.
02.5 - Defense n.e.c.	
	08 - Recreation, culture and religion
03 - Public order and safety	08.1 - Recreational and sporting services
03.1 - Police services	08.2 - Cultural services
03.2 - Fire-protection services	08.3 - Broadcasting and publishing services
03.3 - Law courts	08.4 - Religious and other community services
03.4 - Prisons	08.6 - Recreation, culture and religion n.e.c.
03.5 - R&D Public order and safety	
03.6 - Public order and safety n.e.c.	**09 - Education**
	09.1 - Pre-primary and primary education
04 - Economic affairs	09.2 - Secondary education
04.1 - General economic, commercial and labour affairs	09.3 - Post-secondary non-tertiary education
04.2 - Agriculture, forestry, fishing and hunting	09.4 - Tertiary education
04.3 - Fuel and energy	09.5 - Education not definable by level
04.4 - Mining, manufacturing and construction	09.6 - Subsidiary services to education
04.5 - Transport	09.7 - R&D Education
04.6 - Communication	09.8 - Education n.e.c.
04.7 - Other industries	
04.8 - R&D Economic affairs	**10 - Social protection**
04.9 - Economic affairs n.e.c.	10.1 - Sickness and disability
	10.2 - Old age
05 - Environmental protection	10.3 – Survivors
05.1 - Waste management	10.4 - Family and children
05.2 - Waste water management	10.5 - Unemployment
05.3 - Pollution abatement	10.6 - Housing
05.4 - Protection of biodiversity and landscape	10.7 - Social exclusion n.e.c.
05.5 - R&D Environmental protection	10.8 - R&D Social protection
05.6 - Environmental protection n.e.c.	10.9 - Social protection n.e.c.

Source: Eurostat 2019, Table 3, p. 39.
n.e.c. = not otherwise classified

We examined the ministerial organization of a subset of the countries categorized as low- or middle-income by the World Bank as of 2022, focusing on the top ten countries by population in each of the low, lower-middle, and upper-middle country income groups.[5]

As illustrated in Appendix A, we found that the ministerial structure across countries varied significantly (Europa 2022). The total number of national government ministries ranged from 17 in Turkey and Colombia to 52 in India. In addition, the responsibilities of similarly named ministries appear to vary, often encompassing distinct but overlapping sets of government functions. For example, multiple countries have "Ministries of Science and Technology," while others have "Ministries of Higher Education and Scientific Research," which appear similar but likely engage in differing activities.

Given the diversity of the government structures among the countries in our data set, the results of this review do not suggest a clear organizational strategy along ministerial lines for this volume. However, understanding these functional areas and this diversity is a useful input into our thinking on this topic. Perhaps most importantly, this review suggests that improving health and longevity involves multiple ministries with varying missions and funding streams. Prioritizing interventions across ministries so as to maximize the net benefits of health-related policies is thus likely to require substantial coordination and collaboration, well-beyond what is likely currently the case in many countries.

1.2 Risk Factors

Since the early 1990s, the Global Burden of Disease (GBD) project has involved thousands of experts in systematically examining causes of disability and death globally. The 2021 edition (GBD Disease Collaborative Network, 2024) includes over 350 causes (i.e., diseases or injuries that can lead to death or disability), arranged in hierarchical levels.[6] The highest level includes (a) communicable, maternal, neonatal, and nutritional causes; (b) non-communicable diseases; and (c) injuries.[7] Each of these categories is then split into several subcategories.

The GBD project also tracks risk factors, defined as "potentially modifiable causes of disease or injury" (IHME 2024) and their relationship to these causes. A risk factor is an "attribute,

[5] Based https://data.worldbank.org/indicator/SP.POP.TOTL and https://data.worldbank.org/indicator/NY.GDP.MKTP.CD as viewed June 2023.

[6] This definition of "causes" differs from the use of the term elsewhere. While the GBD study focuses on diseases or injuries, elsewhere the term may be used to focus on the hazard that leads to the disease or injury, similar to how the GBD study defines risk factors. For example, within the field of risk analysis, it is common to use the terminology developed by the National Research Council (NRC) (1983). NRC defines risk assessment as "the use of the factual base to define the health effects of exposure of individuals or populations to hazardous materials and situations." It notes that risk assessment includes some or all of the following: (1) hazard identification, (2) exposure assessment, (3) dose-response assessment, and (4) risk characterization. It then defines risk management as the process of weighing alternative approaches to addressing the risk and selecting the most appropriate action.

[7] See Naghavi et al. (2024), Appendix 1, Table S2 (pp. 99-107) for the complete list of causes.

behavior, exposure, or other factor which is causally associated with an increased (or decreased) probability of a disease or injury." Risk factors are organized hierarchically into four levels. At the most aggregated level (Level 1), they are broadly categorized as environmental and occupational, behavioral, or metabolic risks. Levels 2, 3, and 4 disaggregate subsets of the risk factors to allow examination of both individual risks and clusters of risks that are policy relevant.

The GBD team reports several measures of the impacts of these risk factors on health and longevity. We focus on two of these measures: attributable disability-adjusted life years (DALYs) and attributable deaths. The DALY measure sums years of life lost (YLL) due to premature death and years lived with disability (YLD) due to illness or injury. It is estimated on a zero-to-one scale, where 1.0 is equivalent to death and zero equals full health. Nonfatal conditions are represented by values between zero and 1.0 depending on the extent of disability. For example, a health condition assigned a disability weight of 0.2 is equivalent to 80 percent of a year in full health. The disability weight is then multiplied by the duration of the condition. The disability weights used in the most recent (2021) iteration of the GBD study are based on the approach described in Salomon et al. (2015). That approach develops weights based on a survey that asks respondents around the world to compare two hypothetical individuals with different health states and identify which individual they deem healthier.

Because DALYs aggregate disability and death, and measure the latter based on life years lost (which vary by age), in what follows we also report attributable deaths to provide additional insights into the effects of the risk factors. Although we focus here on totals, substantial disaggregation (e.g., by age, gender, and location) is available on the GBD website.[8,9]

Table 2 summarizes the DALYs and deaths attributable to each Level 1 cause, for countries included in the 2021 GBD data that are categorized as LMICs by the World Bank for the same year.[10]

[8] https://www.healthdata.org/research-analysis/gbd

[9] The Third Edition of DCP (DCP-3) includes nine volumes (available at: https://www.dcp-3.org/), published between 2015 and 2018. Eight of the volumes focus on a subset of health conditions; the ninth volume integrates the findings. Each volume includes chapters discussing the burden estimates related to the topic of that volume, based on 2010 or 2016 GBD estimates as well as data from the World Health Organization and other sources. The extent to which the conditions addressed in each volume may be addressed by interventions implemented within or outside the health care system varies. The discussion in this chapter both relies on more recent data and focuses more explicitly on risks that are typically addressed by interventions outside the health care system.

[10] For calendar year 2021, the World Bank data include 216 countries, of which 135 are categorized as LMICs. For the same year, the GBD data include 204 countries and territories, of which 134 are categorized as LMICs by the World Bank.

Table 2. DALYs and Deaths Attributable to Level 1 Causes in LMICs (2021, in millions)

Cause	DALYs	Deaths
Communicable, maternal, neonatal, and nutritional causes	787.8 (33%)	15.3 (29%)
Non-communicable diseases	1,393.4 (58%)	33.9 (64%)
Injuries	213.4 (9%)	3.7 (7%)
Total	2,394.6 (100%)	52.9 (100%)

Source: Data downloaded from https://vizhub.healthdata.org/gbd-results/ on May 9, 2025.

In 2021, the GBD studies suggest that in 2021 there were about 68 million deaths globally, of which close to 10 million were attributable to COVID (Schumacher, Kyu, et al. 2024). As indicated in Table 2, almost 80 percent of all deaths (52.9 million) were in countries categorized as LMICs. The burden of disease and illness in LMICs accounted for 2.4 billion DALYs.

The burden of disease was overwhelmingly driven by non-communicable diseases (NCDs), which accounted for the largest share of both DALYs and deaths in LMICs. Communicable, maternal, neonatal, and nutritional causes were significant contributors. The estimates for this category were affected by the COVID pandemic. For LMICs, 73.3 million of the DALYs and 2.5 million of the deaths in the communicable disease category were attributed to COVID. Injuries, although comprising the smallest portion of total DALYs and deaths in these countries, still represent a substantial burden in absolute terms.

Altogether, the aggregation of Level 1 GBD causes underscores the enormous health challenges faced in LMICs, which are addressed across the four DCP4 volumes. Volume 1 addresses country level experience with priority setting, Volume 2 addresses pandemic prevention, preparedness, and response, and Volume 4 addresses interventions within the health care system.

Our interest in this Volume 3 is interventions outside the health system, which do not align neatly with the cause categories used in GBD. Examination of the causes included in each of the major categories in Table 2 suggests that the injury subcategories, such as road accidents, are often directly addressed by interventions outside the health care system, such as by improving safety features on cars and roadways. The relationship between interventions outside the health care system and the remaining types of causes in Table 2 (communicable, maternal, neonatal, and nutritional impairments; non-communicable diseases) is more complicated. For example, dietary improvements or reductions in air pollutant exposure are likely to reduce the incidence of several conditions; there is not a one-to-one correspondence between the health impairments described as causes and possible interventions.

To gain a better sense of the role of interventions implemented outside the health care system, we turn to the GBD risk factor data. The most recent GBD report addresses 88 risk factors across the four levels (Brauer et al. 2024).[11] While these risk factors are linked to specific health outcomes included in the cause categories above, some outcomes could not be

[11] See Brauer et al. (2024), Appendix 1, Table S1 (pp. 436-437) for the complete list of risk factors.

linked. Hence the total DALYs and total deaths attributed to risk factors differ from those linked to causes. Table 3 summarizes the results across the major risk factors for LMICs.

Table 3. DALYs and Deaths Attributable to Level 1 Risk Factors in LMICs (2021, millions)

Cause	DALYs	Deaths
Environmental and occupational risks	387.5 (27%)	11.6 (27%)
Behavioral risks	667.1 (46%)	15.9 (37%)
Metabolic risks	391.7 (27%)	15.0 (35%)
Total	1,446.3 (100%)	42.5 (100%)

Source: Data downloaded from https://vizhub.healthdata.org/gbd-results/ on May 9, 2025.

The extent to which each of these categories dominate the results depends on whether we focus on DALYs or deaths. Behavioral risks, such as nutritional deficits, tobacco, drug, or alcohol use, and abuse, account for 46 percent of the total DALYs and 37 percent of total deaths. If measured by DALYs, environmental and occupational risks are about equally important as metabolic risks, but less important than metabolic risks if measured by deaths. This result reflects the differences between the two measures. DALYs account for disability as well as age at death.

In terms of the risk factors in each of the categories in Table 3, those included in the environmental and occupational risks and behavioral risks categories are often directly addressed by interventions outside the health care system, such as control of exposures to chemical or other hazards. Risks in the third category, metabolic risks, are more likely to be directly addressed by interventions within the health care system, although interventions outside the health care system may affect several of these risks.

Given the above discussion, in Table 4 we list the DALYs and deaths associated with causes within the injury category and environmental, occupational, and behavioral risk factors, focusing on those related to the top 25 sources of DALYs and deaths in LMICs.[12] It is important to recognize that the data in the table include some double-counting, because some injuries are attributed to risk factors also listed in the table. In addition, the methods used to estimate DALYs and deaths vary. For injuries and other causes, the researchers collect and analyze data from thousands of sources (Naghavi et al. 2024). For the risk factors, data on exposure and risk are combined for each outcome associated with each risk factor to estimate the population attributable fraction (i.e., the proportional change in health risk that would occur if exposure to a risk factor were reduced to a theoretical minimum) (Brauer et al. 2024). Despite these limitations, the table allows us to identify the relative magnitude of the disease burdens that could potentially be addressed by interventions outside the health care system. The table is ordered by the number of DALYs; as is the case with the previous tables, the relative importance of each category varies if instead sequenced by the number of deaths.

[12] We focus on Level 3 causes and Level 2 risk factors within these categories, because these appear to be levels at which these data best match the problems addressed by the interventions discussed later in this chapter.

Table 4. DALYs and Deaths Attributable to Injuries and Environmental, Occupational, and Behavioral Risk Factors in LMICs (2021)

Category	DALYs (millions)	Deaths (thousands)
Child and maternal malnutrition	271.9	2,571.2
Air pollution	235.8	8,074.4
Tobacco	194.5	7,244.3
Dietary risks	178.1	7,211.2
Occupational risks	77.2	1,442.6
Unsafe water, sanitation, and handwashing	62.8	1,214.6
*Road injuries**	58.7	1,084.3
High alcohol use	56.9	1,383.0
Unsafe sex	42.3	855.9
Non-optimal temperature	38.9	1,906.0
Other environmental risks	35.8	1,622.6
*Falls**	32.9	605.2
*Self-harm**	26.9	581.3
*Interpersonal violence**	24.7	366.1
Drug use	16.6	292.3
*Drowning**	15.0	252.7
Low physical activity	12.5	515.8
Childhood sexual abuse and bullying	8.9	12.1
*Conflict and terrorism**	8.7	96.0
*Exposure to mechanical forces**	8.3	95.0
*Other unintentional injuries**	7.6	95.1
*Fire, heat, and hot substances**	7.5	105.8
Intimate partner violence	6.1	58.0
*Animal contact**	4.8	87.6
*Foreign body**	4.7	72.8
Other**	14.1	269.5

Source: Data downloaded from https://vizhub.healthdata.org/gbd-results/ on May 9, 2025; includes Level 2 risk factors for environmental, occupational, and behavioral risks and Level 3 causes for injuries.
* Estimates cannot be summed due to double counting across the injury and risk factor estimates; injury categories are marked with *italics*.
** "Other" includes injuries related to adverse effects from medical treatment, other transport injuries, poisonings, environmental heat and cold exposure, exposure to forces of nature, and police conflict and executions.

Table 4 suggests that one of the most important burden categories in terms of both DALYs and deaths is air pollution, with the second largest share of attributable DALYs (236 million) and the highest share of attributable deaths (8 million). Tobacco use is also important, accounting for the third largest share of DALYs (195 million) and the second largest share of deaths (7 million). Childhood and maternal malnutrition is responsible for the largest share of DALYs (272 million) as well as a significant share of deaths (2.6 million). DALY losses and deaths are also significant for dietary risks. The sequencing of the remaining entries varies across the measures. Several injury-related causes (road injuries, falls, self-harm, and interpersonal violence, and more) are present in the top 25 entries. Underlying all of these estimates are significant differences in exposure as well as population and socio-economic characteristics across LMICs.

The GBD authors also provide forecasts of burden changes through 2050 (Vollset et al. 2024). This context is continually changing. For example, the 2021 data reported above

include the effects of the COVID pandemic, and other factors (such as climate change) are likely to increasingly affect future trends. We do not report these forecasts here because the changing landscape of development assistance resulting from the U.S. withdrawal is likely to significantly these predictions. However, forecasts are of particular interest for the analyses in this volume, given that the effects of any interventions implemented as a result will be experienced several years into the future.

Any approach to estimating the global burden of disease and its association with different causes and risk factors will have both advantages and limitations, given the complexities of the issues, and other approaches may yield differing conclusions.[13] We focus here on the GBD studies here to provide context for the discussion that follows, given that they are reasonably comprehensive and well-established and widely used with substantial expert involvement. Yet they tell us very little about how to prioritize interventions, since these studies do not address the effectiveness or costs of approaches to reducing these risks.

In sum, while this analysis provides an important perspective on the policy sectors to consider in this volume, it does not allow us to estimate which policies may be most cost-beneficial. As noted in Ward and Goldie (2024):

> *Although estimates of disease burden are necessary, alone they are not sufficient for public health priority setting and planning. The effectiveness and costs of potential interventions to ameliorate various disease burdens are also crucial for policy considerations. For example, although a particular disease might have a large burden, that does not necessarily imply that it should receive the largest amount of resources, especially if there are few (or even no) cost-effective interventions available. Although GBD 2021 estimates of disease burden can be an important input for policy making, resource allocations that optimise global health outcomes also need to consider the cost-effectiveness and feasibility of specific interventions, and how they might differ by setting.*

For example, if it costs $800 million to avert 1,000 deaths attributed to a highly ranked risk factor, and $500 million to avert 1,000 deaths attributed to a lower ranked risk factor, the latter policy would not only be more cost-beneficial, but would also allow the $300 million difference to be used for other purposes. Given this concern, we turn our attention to the available evidence on intervention costs and benefits in the remainder of this chapter.

[13] An important example is Jamison et al. (2024), which discusses how countries could reduce the probability of premature death by 50% in their populations by addressing 15 priority conditions, including those that can be addressed by interventions within and outside of the health care system.

2.0 Evidence from Existing Benefit-Cost Analyses

To support decisions about how to organize this volume and subsequent analyses, we reviewed previously completed benefit-cost analyses of interventions implemented outside the health care system and synthesized the results.[14] In Section 2.1, we discuss the process we used to select and review these studies and the characteristics of the studies we identified. In Section 2.2, we discuss the findings. Section 3 then discusses the implications for the remainder of this volume.

2.1 Literature Review Process[15]

As is evident from the preceding discussion, interventions outside the health care system that significantly affect public health are implemented in numerous policy sectors and in many different forms. While not all of the 69 functional areas listed in Table 1 nor all of the myriad ministries listed in Appendix A address public health, many either directly or indirectly affect health and longevity. Similarly, the sources of disease burden listed in Table 4 could each be addressed by a wide range of interventions. The interventions themselves can take many forms, such as regulations, targeted taxes, fees, or subsidies, or direct provision of information or goods and services.

Further complicating these challenges is the terminology used to refer to economic evaluations. "Benefit-cost analysis" is at times used to describe any evaluation that considers both improvements and harms, whereas in this volume we use it more formally to refer to analyses that include monetary valuation consistent with the underlying welfare economic framework (see Robinson and Hammitt 2024, Robinson, Hammitt, and Wong 2024). In addition, analyses which meet that definition may be described using different terms, such as "cost-benefit analyses," "social return on investment analyses," or "investment cases."

As a result, a conventional approach to reviewing the literature would require applying a multitude of search terms and yield thousands of results, many of which will be irrelevant. Such review also runs the risk of missing potentially important contributions, both because naming conventions for interventions can take many forms and because many benefit-cost analyses are published in reports not indexed in bibliographic databases. Thus we followed a somewhat unconventional approach tailored to this context. As described in more detail below, we developed criteria for selecting analyses for consideration, reviewed analyses

[14] As noted earlier, we define health care system interventions as including policies that involve health care workers, are reimbursable through health insurance, and/or are implemented by a health ministry. These interventions are addressed in other DCP4 volumes.

[15] We thank Kiran Ahmad, Nancy Dubosse, Bryce Everett, William Garcia, Younsoo Jung, and Vanitha Sampath for assisting us in reviewing this literature and creating the database. We also thank Sameen Ahsan, Paula Alejandra Gutiérrez Baquero, Brooks Bowden, Allen Blackman, Eric Brunner, Donald Bundy, Jonathan Buonocore, Kevin Cromar, Joe Devlin, Victoria Fan, Mahelet Fikru, Robert Griffin, Heather Grob, Odd Hanssen, Sandra Hoffmann, Sue Horton, Linas Jasiukevicius, Marc Jeuland, Jeffrey Lazo, Ana Lopes, Samuel Miller, Jim Neumann, David Pannell, Arash Peykanfar, Ian Ross, Faraz Usmani, Dylan Walters and several anonymous participants for responding to our calls for completed benefit-cost analyses and related publicly-available models.

included in previous work, solicited contributions through widespread outreach, and conducted backwards and forwards citation searches. We then summarized the results in the database provided in Appendix B.

Our overall goal was twofold. The first was to collect completed benefit-cost analyses relevant to the objectives of this volume, as the basis for identifying the policy areas and interventions that will be the main focus of our analytic work. The second was to develop a publicly available, easily accessible database that can be used by others interested in these issues. Our hope is that this database will be used to inform near-term policy decisions as well as to provide a starting point for future research.

Our selection criteria are listed in Figure 1 and described below.

Figure 1. Selection Criteria

1. Conducted between 2008 and the present.
2. Quantifies impacts on deaths and/or nonfatal illnesses or injuries.
3. Values both benefits and costs using monetary measures.
4. Is publicly available and has undergone expert or peer review, as an academic journal article, a book or book chapter, or a report issued by a governmental or non-governmental organization.
5. Addresses intervention(s) typically implemented outside the health care system.
6. Focuses on a country or countries defined as low- or middle-income by the World Bank between 2008 and the present.

Note: We include only studies written in English to promote accessibility for a broad audience. While English is not necessarily the first language of those interested in the results, it is often used in academic discourse and publications and is the language most likely to be understood by a wide range of researchers

Criterion 1 (conducted between 2008 and the present) reflects our interest in using the results to identify and assess interventions that could be implemented in the future. Older studies are less likely to reflect conditions or data that are relevant to future policies, and will not reflect researchers' evolving understanding of how to best conduct these studies. Because many analyses combine data collected in different time periods, we select any study with a publication date of 2008 or later for consideration.

Criterion 2 (quantifies impacts on deaths and/or nonfatal illnesses or injuries) addresses our interest in evidence on the impacts of interventions on public health. Without quantification, we do not know the magnitude of these impacts. We also cannot calculate the monetary value of benefits for comparison to the costs of that intervention, nor can we compare the net benefits of the intervention to those of other interventions.

Criterion 3 (values both benefits and costs using monetary measures) relates to our interest in using the net benefit estimates from the database to identify policy sectors for additional assessment in this volume, as well as to provide data that may be useful to support near term policy decisions. Subsequent, more detailed assessments may include conducting new analyses (potentially including converting cost-effectiveness analyses or program evaluations into benefit-cost analyses) and updating existing analyses to reflect current conditions and best practice recommendations.

Criterion 4 (publicly available and has undergone expert or peer review) aligns with the goals of this effort: to develop a database that can be used as the foundation of this effort as well as to inform other analyses and decisions. To achieve this goal, the underlying studies should be accessible to those likely to use the analyses. In addition to peer-reviewed journal articles, publicly available analyses include reports from government agencies and international and other organizations. We include those analyses that provide evidence of expert peer review as evidence of quality. These include reports from organizations that are guided by independent expert panels or other forms of peer review as well as peer-reviewed journal articles,

Criterion 5 (addresses intervention(s) typically implemented outside the health care system) relates to the focus of this volume. These interventions may address, for example, environmental, transportation, occupational, nutritional, behavioral, financial, and other risks, including climate change. We exclude interventions typically implemented within the health care system (i.e., that involve health care workers, are not reimbursable through health insurance, and/or are not implemented by a health ministry), which are covered by Volume 4 of this effort.

Criterion 6 (focuses on a country or countries defined as low- or middle-income by the World Bank between 2008 and the present) reflects the targeting of this effort on low- and middle-income countries. Although there are many other ways to define these countries, we use the World Bank categories for this initial review. At the time we began collecting these analyses, data were available for 2008 through 2022; the countries included are listed in Figure 2.

Figure 2: Countries Classified and Low- or Middle-Income, 2008-2022

Country				
Afghanistan	Congo, Rep.	Iraq	Mozambique	St. Kitts and Nevis
Albania	Costa Rica	Jamaica	Myanmar	St. Lucia
Algeria	Côte d'Ivoire	Jordan	Namibia	St. Vincent and the Grenadines
American Samoa	Croatia	Kazakhstan	Nauru	Sudan
Angola	Cuba	Kenya	Nepal	Suriname
Antigua and Barbuda	Djibouti	Kiribati	Nicaragua	Syrian Arab Republic
Argentina	Dominica	Korea, Dem. Rep.	Niger	Tajikistan
Armenia	Dominican Republic	Kosovo	Nigeria	Tanzania
Azerbaijan	Ecuador	Kyrgyz Republic	North Macedonia	Thailand
Bangladesh	Egypt, Arab Rep.	Lao PDR	Pakistan	Timor-Leste
Belarus	El Salvador	Latvia	Palau	Togo
Belize	Equatorial Guinea	Lebanon	Panama	Tonga
Benin	Eritrea	Lesotho	Papua New Guinea	Tunisia
Bhutan	Eswatini (formerly Swaziland)	Liberia	Paraguay	Turkey
Bolivia	Ethiopia	Libya	Peru	Turkmenistan
Bosnia and Herzegovina	Fiji	Lithuania	Philippines	Tuvalu
Botswana	Gabon		Poland	Uganda
Brazil	Gambia, The	Madagascar	Romania	Ukraine
Bulgaria	Georgia	Malawi	Russian Federation	Uruguay
Burkina Faso	Ghana	Malaysia	Rwanda	Uzbekistan
Burundi	Grenada	Maldives	Samoa	Vanuatu
Cabo Verde	Guatemala	Mali	São Tomé and Principe	Venezuela, RB
Cambodia	Guinea	Marshall Islands	Senegal	Vietnam
Cameroon	Guinea-Bissau	Mauritania	Serbia	West Bank and Gaza
Central African Republic	Guyana	Mauritius	Seychelles	Yemen, Rep.
Chad	Haiti	Mexico	Sierra Leone	Zambia
Chile	Honduras	Micronesia, Fed. Sts.	Solomon Islands	Zimbabwe
China	Hungary	Moldova	Somalia	
Colombia	India	Mongolia	South Africa	
Comoros	Indonesia	Montenegro	South Sudan	
Congo, Dem. Rep.	Iran, Islamic Rep.	Morocco	Sri Lanka	

Notes: The table lists countries categorized by the World Bank as low- or middle-income in one or more years from 2008 through 2022. These include 151 out of the 218 countries the World Bank identifies. Detailed information on how these categories are determined and on the historical classification of each country is available here: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups. We rely on the versions of the spreadsheets with current and historical information available for download in February 2024.

We began our crowdsourcing effort by emailing a variety of individuals and groups in March 2024, including those involved in the DCP4 project and our broader networks as well as related professional organizations and listservs. We then reviewed the results as well as the studies included in earlier efforts. These earlier efforts included:

- The third edition of the Disease Control Priorities project (DCP3), including the literature review (Watkins et al. 2017) conducted to support Volume 7: "Injury

Prevention and Environmental Health" as well as analyses conducted as part of that project (summarized in Chang et al. 2018).

- Numerous reports from Copenhagen Consensus Center projects, posted on its website.[16]
- Case studies developed to support the *Reference Case Guidelines for Benefit-Cost Analysis in Global Health and Development* (Robinson et al. 2019).[17]

We also considered the results of previous reviews of the literature in several policy areas.

We then conducted backwards and forwards citation searches for each of the studies that met our selection criteria to identify additional studies. This step included reviewing the references listed in each included study to identify previous work, and using Google Scholar to identify subsequent work that cites each included study. We then added the studies that met our criteria to the database. The resulting database is included in Appendix B, followed by references to the underlying studies.

Note: The discussion in the remainder of this chapter relies on the May 20, 2025 version of the database. We are now soliciting comments on the database, including corrections to the data it contains and references to additional studies, and expect the number of studies it includes will increase. Hence the results that follow are preliminary and subject to change.

The database currently includes 121 studies that address close to 300 interventions. It is formatted as an Excel workbook to provide easy access by a variety of users. It includes four worksheets in addition to an introduction.

1. **"Goals and Criteria"** summarizes the goals of the analysis and the criteria used to select studies for inclusion, as discussed in more detail above.
2. **"Field Definitions"** describes each field included in the database.
3. **"Database"** provides the data from each study.
4. **"References"** lists the full citations for each included study, including the URL.

A major challenge in developing this database was the lack of consistent reporting across studies, in addition to substantial variation in the methods and contexts addressed in each study. For example, some focused on the effects on model plants or representative households, some considered the impacts on a specific subnational or national population, and some addressed the global population. The studies report the results in differing currencies for different years, using varying discount rates, and apply diverse methods to estimate and value costs and benefits.

[16] https://copenhagenconsensus.com/projects

[17] https://repository.chds.hsph.harvard.edu/repository/collection/bca-low-and-middle-income-countries/resource/3348/

Given this diversity, we selected fields to include in the database that provide an overview of each study, to aid users in identifying studies to explore in more detail. As discussed in more detail in the database itself, these include information identifying the study, the interventions considered and geographic scope, the size of population addressed, the total benefits and total costs attributable to each intervention, and the types of benefits considered.

As discussed in more detail in the sections that follow, there is somewhat of a mismatch between the causes and risk factors that account for the majority of DALYs and deaths in Table 4 and the interventions included in our database. To some extent, this results from our focus on interventions outside the health care system. Some highly ranked risks, such as child and maternal malnutrition (the top ranked risk factor when measured by DALYs and the fourth ranked when measured by deaths) are often addressed within a health care context. Our BCA database is dominated by analyses of ambient and household air pollution (109 of 291 interventions), the second largest risk factor when measured by DALYs and the first largest when measured by deaths. Seventy of the interventions address water, sanitation, and hygiene (WASH), the sixth largest risk factor when measured by DALYs and the ninth largest when measured by deaths. The remainder address other problems. This focus likely reflects at least in part the extent to which cost-beneficial interventions are feasible from a budgetary, technological, legal, and political perspective.

In Table 5, we summarize the geographic scope of these analyses; within each group, some interventions were assessed at the national level while others were assessed for a subpopulation. The table suggests substantial diversity in geographic scope, but also suggests that no country-specific analyses were identified for many of the over 200 countries categorized as LMICs by the World Bank.[18]

[18] Review of the reference list also indicates the important role the Copenhagen Consensus Center has played in this literature; about 40 percent of the studies were conducted as part of their projects. Brad Wong (Mettalytics), a co-author of this chapter and editor of this volume, was formerly the chief economist at the Copenhagen Consensus Center and contributed to many of these studies.

Table 5. Geographic Scope of Included Interventions [preliminary results, subject to change, based on May 20, 2025 version of database]

Geographic Area*	Number of Interventions
Global	30
Multiple Countries	26
Armenia	4
Bangladesh	14
Belarus	4
Brazil	4
Cambodia	1
China	36
Columbia	3
Ethiopia	1
Ghana	24
Guatemala	5
Haiti	17
India	47
Indonesia	2
Iran	12
Jamaica	2
Kazakhstan	4
Kenya	1
Kyrgyzstan	3
Malawi	8
Mexico	1
Mongolia	3
Mozambique	3
Nepal	3
Pakistan	11
South Africa	10
Suriname	4
Turkey	4
Uzbekistan	4
Total	**291**

*Per country counts include analyses conducted at a national or subnational level.

The analyses are diverse across numerous dimensions other than geographic scope, which makes it difficult to synthesize and compare the results. However, they provide insights into the types of interventions that are most likely to lead to significant net benefits, and into how to best organize this volume.

This diversity and data gaps pose significant challenges for the analyses included in subsequent sections of this volume, however. As discussed in more detail in Robinson, Hammitt, and Wong (2024) and elsewhere, the effects of interventions vary depending on the context, due to the numerous cultural, socio-economic, geographic, and other variables that influence their impacts. Many analyses included in our database focus on a particular country, or on a particular location within that country. Analyses conducted elsewhere may lead to substantially different conclusions.

In addition, these analyses use inconsistent methods which can obscure differences in impacts, given the challenges of distinguishing the effects of varying assumptions and parameter estimates from the effects of the intervention itself. Taking these challenges into account, we discuss the results of this review in the following section.

Chapter 2 of this volume (Robinson, Hammitt, and Wong 2024) discusses how we plan to address this variation in context in more detail. What interventions will lead to the highest net benefits and may be desirable to prioritize will vary substantially across and within countries. Assessing all high impact policies in all settings would be prohibitively expensive, hence we instead assess interventions in specific contexts and consider how their impacts might vary if implemented in other settings.

2.2 Literature Review Results

Note: These results are preliminary and subject to change as a result of ongoing review of the database and identification of additional studies.

In this section, we discuss our findings from review of these studies. We organize the discussion by sorting the interventions into nine policy categories, to reflect the primary problem the intervention addresses. While several interventions affect more than one of these problems to varying extents, in a few cases the primary focus is difficult to discern (e.g., an intervention reduces emissions of greenhouse gases related to climate change as well as conventional air pollutants). For these interventions, we also note this secondary policy target. The policy areas are:

1. *Ambient air pollution*: interventions that mitigate emissions of conventional air pollutants from stationery or mobile sources. Many of these analyses also consider climate co-benefits.
2. *WASH (water, sanitation, and hygiene)*: interventions that relate to providing clean water, better sanitation, or improved hygiene.
3. *Household air pollution*: interventions that mitigate household air pollution, typically by reducing emissions from cookstoves and promoting use of cleaner energy sources.
4. *Addictive and habitual goods*: interventions to reduce consumption of addictive and habitual goods such as tobacco, alcohol, and salt, typically through regulation or taxes.
5. *Gender inequality*: interventions designed to address gender inequality, generally focusing on girls and women. These largely address improving education or reducing gender-based violence and child marriage.
6. *Agriculture and nutrition*: interventions that address health impacts through the food production system.[19]

[19] Interventions designed to improve nutrition that are typically implemented within the health care system are considered in DCP4 Volume 4.

7. *Road traffic injuries*: interventions to improve road or vehicle safety by reducing the risk of an accident (e.g. installing speed bumps) or protecting passengers or pedestrians (e.g., mandating helmet use).
8. *Climate change*: interventions focused on mitigating the rise in global mean temperature by reducing or sequestering greenhouse gas emissions, such as converting to renewable energy sources, and interventions focused on adapting to climate change, both *ex post* (e.g., protecting against heat stress) and *ex ante* (e.g., installing flood barriers or disaster early warning systems).
9. *Other*: interventions targeting other problems, such (non-gendered) conflict and violence, occupational risks, and lack of physical activity.

Many of the studies we consider do not take the effects of climate change into account, which complicates consideration of their impacts. As the effects of climate change on health become more visible, numerous new studies are being published and previous assessments need to be revisited. For example:

- Interventions that were less important in the past (e.g., to reduce heat stress) may now lead to more substantial net benefits.
- Interventions focused on other issues (e.g., emissions of conventional air pollutants) often yield climate co-benefits, increasing their overall net benefits and relative importance.
- Interventions that were previously assessed may need to be re-evaluated to address the implications of climate change (e.g., the impact of extreme weather on infrastructure projects), altering the relationship of costs to benefits.

As noted above and discussed in more detail in Chapters 1 and 2 of this volume (Robinson and Hammitt 2024, Robinson, Hammitt, and Wong 2024) as well as the *Reference Case Guidelines for Benefit-Cost Analysis* (Robinson et al. 2019), comparing the results of these analyses is challenging for several reasons.

- First, methodological differences can obscure differences in impacts. For example, the rate used to discount future consequences and the approach used to value reduced mortality risks can significantly affect the results.
- Second, context matters. An intervention implemented in one location may have very different impacts in another location, and these impacts may vary depending on the time period addressed.
- Third, many important impacts may not be quantified or valued and hence excluded from the cost and benefit estimates in some studies, in which case comparisons will be misleading.
- Fourth, the principal summary measure in conventional BCA is net benefits (benefits minus costs) because the benefit-cost ratio (BCR) (benefits divided by costs) depends on what is categorized as a benefit and what is categorized as a cost, which varies across analyses. In addition, ratios can be problematic because they are insensitive to

the magnitude of the impacts; an intervention with small net benefits may have a larger BCR than an intervention with very large net benefits.

In the discussion that follows, we focus on the BCR as a convenient measure for summarizing and comparing the interventions assessed, while recognizing the limitations of this measure.

Table 6 describes the contents of the database, which includes 291 interventions addressed across 121 studies.[20] Interventions addressing ambient air pollution and WASH comprise almost half the interventions assessed. When combined with the relatively large number of household air pollution analyses, related interventions represent over 60 percent of the database. Relatively few studies and interventions relate to road traffic injuries (14 interventions across four studies) or adaptation to climate change (seven interventions across four studies).

[20] By "study," we mean an individual article, book, or report, cited in the reference list associated with the database. By "intervention," we mean an action undertaken to address a particular problem by a government agency or other organization at a society-wide level.

Table 6: Database Description [preliminary results, subject to change, based on May 20, 2025 version of database]

	Number of interventions	Number of studies	Median BCR (IQR)	Modal discount rate	Median analytic time period in years (IQR)	Percent of interventions with reported...		
						Mortality impacts	Non-fatal health impacts	Non-health benefits
Ambient Air Pollution	65	29	3.7 (1.8-7.9)	6%	10 (1-24)	42%	57%	48%
WASH	70	29	3.2 (1.5-5.1)	5%	15 (6-20)	53%	97%	84%
Household Air Pollution	44	14	3.8 (2.6-5.7)	5%	10 (6-10)	73%	86%	84%
Habitual and Addictive Goods	29	12	13.0 (5.0-40.0)	3%	15 (15-15)	100%	97%	7%
Gender Inequality	25	10	4.1 (2.7-11.7)	5%	4 (2-10)	36%	92%	92%
Agriculture and Nutrition	19	15	5.3 (1.6-13.6)	3%	10 (7-16)	79%	84%	42%
Road Traffic Injuries	14	4	13.2 (4.9-60.6)	5%	20 (20-20)	64%	29%	36%
Climate Change: Mitigation	50	20	3.5 (2.1-7.3)	5%	12 (1-30)	60%	64%	62%
Climate Change: Adaptation	7	4	14.5 (6.0-18.3)	5%	43 (16-50)	71%	29%	100%
Other	24	16	3.6 (2.0-7.4)	3%	15 (5-20)	54%	88%	58%
All*	291	121	4.4 (2.1-10.0)	5%	12 (5-20)	61%	79%	63%

* The total number of interventions and studies do not sum to the number of interventions and studies presented in the table because some interventions are included in more than one category. BCR = benefit-cost ratio; IQR = interquartile range, i.e., the range that includes the values for the middle 50% of the entries.

Overall, the median BCR of the interventions is 4.4. These ratios need to be approached with substantial caution because of the issues noted earlier, which affect their comparability. However, the entries in the database suggest that the highest median BCRs are found in the habitual and addictive goods, road traffic, and climate categories. This result is not surprising for habitual and addictive goods, given that tobacco use poses high risks and many studies have found that related interventions have large net benefits. The high BCRs for road injuries are less well supported; nine of the 14 BCRs come from one paper which focuses on a single province in South Africa. For climate change, the high BCRs result from seven interventions across four studies that consider early warning systems for disaster planning, suggesting that substantially more work is needed to assess the costs and benefits of a more diverse set of climate adaptation strategies as well as the health-co-benefits of mitigation strategies.

As indicated by the table, the methods used across studies varies. The analytic time period covered is typically 10-15 years, with a modal discount rate of 3%, 5%, or 6% depending on the policy area. Approximately two-thirds of interventions also include non-health benefits, though this varies substantially by policy sector. We discuss the findings in each of these policy areas in more detail in the next section.

It is important to note that the analysis in this chapter does not involve assessing the quality and suitability of the studies included in the database. Our goal is simply to identify policy areas worthy of more exploration in this volume. That further exploration will include evaluation and extension of the existing research base, which may change the results of this assessment.

3.0 Implications for this Volume

As noted previously, the aim of Volume 3 of DCP4 is to identify and evaluate interventions typically implemented outside the health care system with the potential for significantly improving health and welfare. A key question is where to direct our analytical effort. The scope of interventions is incredibly large, essentially encompassing many if not most of the ministries discussed in Section 1.1. This poses challenges for our analytic work given the resources available, and also poses challenges for implementing the results. Cross-sectorial prioritization would require coordinating the work of numerous ministries, which are likely to have differing mandates, authorities, and political support.

This challenge is emphasized by the formulation of the 17 sustainable development goals (United Nations, 2015), which are widely considered to encompass almost all government policy sectors. However, only one SDG relates to health. Crudely, the scope of this volume is plausibly 16 times larger than the potential scope of a volume focused solely on the health sector.

Another challenge is that there has been no similar, prior multi-sectoral work to guide our efforts, except for several Copenhagen Consensus Center prioritization projects (e.g. Lomborg 2015; 2023). However, those projects focus on maximizing welfare (Lomborg 2023), rather than public health, and include many outcomes that are not directly related to improved health and longevity. In organizing this volume and determining how to best focus our efforts, we confront a methodological "chicken-and-egg" paradox: determining precise and well-informed research priorities is contingent on further empirical investigation, yet initiating that investigation, in the context of constrained analytic resources, requires substantial professional judgement given the limited evidence base.

To address this challenge, we rely on three criteria to identify topic areas around which to structure the additional assessment to be conducted to support this volume. These criteria are designed to identify policy areas that include feasible interventions with large net benefits that are likely to significantly improve public health. The criteria are:

1. The size of the health problem addressed is substantial and large relative to other problems in LMICs.
2. Interventions implemented to address the problem outside of the health care system have high BCRs, with a substantial share of the benefits related to improving health and longevity.
3. These high BCR interventions can plausibly be delivered to a large share of the unserved, addressable population experiencing the problem.

An additional, albeit less stringent, organizing principle comes into play when making these assessments. The goal of this chapter is to identify and organize topic areas such that subject matter experts can conduct more detailed investigations that build on available research in the

subsequent sections of this volume. Therefore, throughout we also consider how research disciplines self-organize when grouping problems and interventions.

We draw upon a variety of sources to make these assessments, particularly the estimates of disease burden discussed in Section 1.2 as well as the studies in the BCA database. Based on these assessments (discussed in detail below), we divide the policy areas introduced in Section 2.2 into three categories to reflect the strength and confidence of our comparison to the three criteria above. We also include an additional topic not covered in the database, lead pollution, for which there is emerging evidence of a large health problem that would be cost-beneficial to address.

Category 1: High ratings across all criteria

- Habitual and addictive goods

Category 2: High or moderately high ratings across all criteria

- Household air pollution
- Ambient air pollution
- Water, sanitation, and hygiene (WASH)

Category 3: Potentially high ratings across 2 or 3 criteria and/or notable limitations in evidence

- Road traffic injuries
- Gender inequality
- Agriculture and nutrition
- Lead pollution
- Climate change

3.1 Habitual and Addictive Goods

Habitual and addictive goods is the only topic area with high ratings across all three of our prioritization criteria. The attributable deaths and DALYs for this area are 17.1 million and 316.2 million respectively in 2021, the largest of all topic areas, indicating a very large problem size.

Approximately 60% of the attributable DALYs and 40% of the attributable deaths relate to tobacco. There are approximately 1 billion tobacco users in LMICs (WHO 2021), suggesting a large, unaddressed population. Tobacco taxes are commonly suggested policy levers to address this challenge and there is strong evidence that increasing prices reduces demand and consumption of tobacco products (Chaloupka, Straif, and Leon 2011; Guindon, Paraje, and Chaloupka 2015; Nargis et al. 2020). The health benefits of taxes are plausibly large with one estimate suggesting 50 million deaths would be averted over 50 years from 50% increase in taxes on tobacco, alcohol and sweetened beverages (The Task Force on Fiscal Policy for Health 2024).

BCAs of tobacco taxes in LMICs generally report very high BCRs. Watkins et al. (2023), building upon efforts under DCP3 (Jamison et al. 2018) and the NCD Countdown Collaborators (NCD Countdown 2030 Collaborators 2022) model the impacts of tobacco taxes in lower-middle-income countries, and find a BCR of ~100. Older analyses conducted by the Copenhagen Consensus report BCRs in the range of 20-40 (Jha, Nugent, and Verguet 2012; Jamison, Jha, and Bloom 2008). A series of country level investment cases conducted by the WHO Noncommunicable Disease Control unit report lower BCRs for tobacco taxes (WHO 2017, WHO 2018a, WHO 2018b, WHO 2018c, Kontsevaya, 2018, Farrington et al. 2019a, Farrington et al. 2019b, WHO 2023). This is partially driven by the monetization of mortality risk reduction using foregone wages in the country studies. As discussed in more detail in the previous chapters in this volume (Robinson and Hammitt 2024, Robinson, Hammitt, and Wong 2024), these values are substantially lower than the value per statistical life estimates used in Watkins et al. (2023), which include the value individuals place on averting the less tangible effects of dying prematurely.

Alcohol is another addictive and habitual good with a large problem size. Fifty-seven million DALYs and 1.4 million deaths are attributed to high alcohol consumption. Moreover, 17% of adults in LMICs - approximately 750 million people - engage in high episodic drinking, indicating a large addressable population that can be targeted with intervention (Xu et al. 2022). Like tobacco, taxes are often suggested to address excess consumption (Nelson 2013). Watkins et al. (2023) note a BCR of ~50 for alcohol taxes indicating a very high return from intervention.

While taxes on tobacco and alcohol are frequently advocated due to their demonstrated effectiveness in improving public health, practical implementation can be challenging. Overly complex tax structures create incentives to substitute lower taxed goods while complicating enforcement (Nargis et al. 2019). Tobacco manufacturers often employ compensating strategies such as pricing discounts which may undermine the objectives of the tax (Nargis et al. 2019). Furthermore, higher taxes encourage illicit trade, creating or expanding black markets for untaxed or counterfeit goods (Task Force on Fiscal Policy for Health, 2024). Alternative policy options such as restricting advertising, providing health warnings on packages, or limiting allowable sales outlets appear to be understudied in LMIC contexts.

Excessive salt consumption is another problem in this category that is large in size (1.9 million deaths and 41.2 million DALYs) with a large, addressable population. A review and modelling analysis of sodium surveys noted that 181 out of 187 countries had higher mean sodium consumption than recommended (Powles et al. 2013). The country level NCD investment cases report high BCRs from salt control programs (IQR: 13-91), suggesting these could be effective measures to improve health.

Overall, the evidence indicates that there is substantial potential for high net benefits and large health impacts from interventions that curb the consumption of habitual and addictive

goods via taxes and regulation, as well as a need to consider other forms of interventions, such as restrictions on advertising or sales outlets.

3.2 Household Air Pollution

Household air pollution remains a major global health challenge, with around 2.1 billion people still relying on dirty fuels - such as solid fuels and traditional biomass - for cooking and heating (WHO 2024b). These fuels expose households, often in rural and low-income settings, to high levels of indoor pollutants. Evidence links household air pollution to increased risk of negative health outcomes including acute respiratory infections, asthma, lung cancer, tuberculosis, cerebrovascular disease, chronic obstructive pulmonary disease, ischemic heart disease, low birth weight, still birth and all-cause mortality (Lee et al. 2020). As a result, household air pollution is associated with the third largest number of attributable DALYs when GBD risk factors are reported at Level 3, accounting for 111.3 million DALYs in 2021 across LMICs.

The key intervention to address household air pollution is the provision and promotion of improved cooking stoves. Within this intervention, one option is to convert cooking stoves that use fuels such as wood, charcoal and biomass to burn them in a way that reduces emissions of fine particulate matter. These are often called “improved cookstoves.” Alternatively, another option is to provide cookstoves that use cleaner fuels such as liquified petroleum gas (LPG) or electricity.

The BCA database contains 44 separate interventions related to household air pollution, but only 32 report a BCR. Of these 32, 16 relate to the adoption of cleaner fuels, and 16 relate to improved cookstoves. Analyses of improved cookstoves, without a change of fuel type, have a median BCR of 5.3. Analyses of fuel change interventions report lower BCRs, with a median of 2.7. This difference primarily stems from the fact that clean fuels are more costly than unclean fuels and represent a re-occurring additional cost. Improved cookstoves, on the other hand, typically involve only the one-time cost of the stove. However, improved cookstoves that rely on unclean fuels typically have lower modelled health effects than switching to cleaner fuels like LPG (e.g. Larsen, Dalaba, and Wong 2020).

Researchers have noted key challenges in translating a clear intervention with strong theoretical case for impact – clean cookstoves and fuels – into improved health in populations. While the overall evidence base indicates improvement in health outcomes, this is not the case in all studies (Quansah et al. 2017; Dillon et al. 2025). Various context-specific factors may explain this limited effectiveness, including a delay between health outcome improvements and cookstove that extends beyond the time period assessed (Checkley et al. 2021), confounding by insufficient reduction in ambient air pollution (Kaali, Jack, and Lee 2021; Mortimer et al. 2017; Tielsch et al. 2016), and limited uptake and/or discontinuation of cookstoves (Rhodes et al. 2014). A probabilistic cost-benefit analysis that incorporates many of these factors indicates that a non-trivial percentage of outcomes result in negative net benefits (Jeuland and Pattanayak 2012). Despite the challenges, addressing

household air pollution presents an important opportunity to improve health outcomes outside the health sector.

3.3 Ambient Air Pollution

Almost all the world's population lives in places where levels of ambient air pollution do not meet WHO Air Quality Guidelines (WHO 2024a). Exposure to ambient air pollution leads to 111.5 million DALYs and 4.3 million deaths in LMICs, making it one of the most harmful risk factors contributing to the global burden of disease. From a burden of disease and addressable population standpoint, ambient air pollution is a clear priority for improving health outcomes outside the health sector.

In the BCA literature, there is substantial heterogeneity in the types of interventions studied. This results in part from the characteristics of the pollutants of concern, which may require differing control technologies. Although particulate matter is generally the pollutant of most concern, ozone, carbon monoxide, lead, sulfur dioxide, nitrogen dioxide and others adversely impact health. These pollutants are emitted from a variety of sources, including industry as well as motor vehicles and other activities. The policy instruments that may be authorized or accepted also vary, including regulations, taxes and fees, and subsidies for developing or using cleaner fuel sources or technologies. Another important factor is geography, since air pollutants can travel long distances. Pollution levels in one area may result from emissions in entirely different political jurisdictions. The result is variation in baseline levels of air pollution within and across countries, which affects the relative costs and benefits of alternative interventions.

Within the BCA database, many BCRs of air pollution strategies lie within the range of 1-10, though there are examples of higher BCRs (e.g. 60 for coal plant emissions reduction in Brazil, Howard et al. (2019), 15-20 for restricting high-emissions vehicles in China (Zhou et al. 2022). Some interventions do not pass a cost-benefit test, e.g. coal-to-gas power plant transition in Beijing (Jin, Andersson, and Zhang 2017), reducing industrial production by 10% in Iran (Rezazadeh et al. 2022). There does not appear to be a clear strategy for reducing air pollution that consistently delivers higher BCRs compared to other sectors or strategies. However, because the size of the affected population is very large, given that air pollutants travel long distances, the magnitude of net benefits may be greater than suggested by these BCRs.

As noted earlier, the benefits of these interventions may increase substantially once the effect of climate change is taken into account. Many interventions that mitigate air pollution also reduce emissions of greenhouse gases and vice versa. Given the substantial problem size and scope, and the likelihood that some interventions will have relatively high BCRs and net benefits, we include ambient air pollution in the list of research priorities for this volume.

3.4 Water, Sanitation and Hygiene (WASH)

WASH represents an area with a large amount of attributable mortality and DALYs, 1.8 million and 97.4 million respectively in 2021 across LMICs, indicating a large problem size. The BCRs across interventions are also reasonably large. The BCA database includes 71 WASH analyses, the largest of any topic area, with 19 BCAs relating to water infrastructure, 43 to sanitation infrastructure, one for hygiene, and seven for both water and sanitation infrastructure. The evidence indicates, broadly speaking, that these BCRs are typically within the range of 1-5 with a median of 3.2. Of the benefits from WASH interventions, approximately 40% on average relate to health and longevity (Ross 2021).

The potential ability of WASH interventions to reach unserved populations is very large. Approximately 2.2 billion people lack access to safe drinking water and 3.5 billion people lack access to safely managed sanitation (UNICEF and WHO 2023). Thus, while the typical return on WASH interventions appears modest, they may lead to potentially large net benefits should they reach sufficient scale. For example, the Government of India's Swachh Bharat (Clean India) campaign delivered a BCR of 4.7 – a good but not exceptional return – representing $727 in benefits per household per year, of which 55% were health benefits (Hutton et al. 2020). However, the sheer magnitude of the campaign, reaching 100 million households, indicates that the net benefits would be in the billions of dollars.

In addition, many BCAs only quantify two types of benefits from WASH interventions: time savings and improved health from averted diarrheal disease. However, emerging evidence suggests nutrition and cognitive benefits in some contexts, as well as enhanced safety and empowerment for women from improved sanitation (Orgill-Meyer 2022). To the extent that the 3.5 billion people lacking safely managed sanitation would experience these effects, the benefits will be much greater than suggested by the BCRs.

Finally, promising evidence from a meta-analysis of randomized trials indicates a 25% reduction in all-cause child mortality from point of use water treatment (Kremer et al. 2023). The BCAs in our database do not usually model these impacts, instead relying on meta-analyses of reduction in diarrheal disease prevalence (e.g. Wolf et al. 2018) as proxy for reduction in diarrheal related mortality. However, the meta-analytic results leverage an increased sample size that is sufficiently powered to measure changes in child mortality. They suggest decreased child mortality from all causes could significantly increase overall benefits. Using the meta-analytic results, the authors estimate a cost per death averted of approximately $3,000. Applying typical value per statistical life estimates (Lomborg, 2023), point of use water treatment in many lower-middle income countries would generate BCRs in the range of 10-30. Across all types of WASH interventions, the potential net benefits suggest this category is important to address in this volume.

3.5 Road Traffic Injuries

Road traffic injuries were responsible for 1.1 million deaths and 58.7 million DALYs in 2021 and represent the leading cause of death and disability for those aged 5-29. Half of traffic-

related mortality is associated with vulnerable road users, i.e. cyclists, pedestrians and motorcyclists (WHO 2023). Ninety percent of road traffic injuries occur in LMICs, although these countries account for only about 60% of all vehicles globally.

A systematic review of 19 studies across LMICs noted that legislative measures (e.g. seat belt use, helmet use, speed, alcohol levels) reduced crashes and traffic-related health impacts across different contexts (Staton et al. 2016). The same review noted reductions in road traffic injuries from speed control infrastructure, enforcement of traffic laws and public education campaigns. The findings of this review were broadly confirmed by a subsequent systematic review of 33 studies (Tavakkoli et al. 2022).

The BCA database does not include many analyses of interventions to reduce road traffic injuries in LMICs. A modelling study of 75 LMICs reported that a $6.5 billion annual investment in a suite of road safety initiatives (seat belt and helmet use, alcohol restrictions, speed enforcement, graduated licensing and road infrastructure investment) over the period 2016-2030 would avert 1 million deaths and 3 million serious injuries by 2030 (Symons et al. 2019). The central BCR from this study is 7.6, with net benefits in excess of $600 billion. A study from South Africa reported very high BCRs (11+) from targeted infrastructure investments (roundabouts, traffic lights, rumble strips) in the Western Cape province. Speed enforcement and public campaigns also had large BCRs of 21 and 15 respectively (Vanderschuren et al. 2020). While the economic evidence is limited, the investment case of evidence-based interventions (Symons et al. 2019) across 75 LMICs indicates substantial potential for net health and welfare benefits from road safety interventions.

3.6 Gender Inequality

Under the category of gender inequality, we include two major policy challenges with substantial impacts on public health: intimate partner violence and child marriage.[21] Intimate partner violence is widespread globally, with 27% of women aged 15-49 experiencing sexual or physical intimate partner violence in their lifetime, and 13% experiencing it in the year before they were surveyed (Sardinha et al. 2022). The prevalence of sexual and physical intimate partner violence is higher in low-income countries and regions (Sardinha et al. 2022). Experiencing intimate partner violence is associated with a higher risk of depression and mental health disorders for the victim (White et al. 2024), and a higher risk of low-birth weight, pre-term birth, child underweight, wasting and sub-optimal breastfeeding for children of the victim (Carreno et al. 2024; Hill et al. 2016).

Every year 12 million girls are married early, and across the world there are an estimated 650 million girls and women who were married before the age of 18 (UNFPA 2020). Child marriage is widespread, though prevalence varies by region. Sub-Saharan Africa has a 37% prevalence, South Asia a 30% prevalence, and Latin America a 25% prevalence of child

[21] There are other dimensions of the gender inequality problem such as wage gaps, unequal rights and differential access to services. However, these do not primarily or directly impact health outcomes as substantially as gender-based violence and child marriage.

marriage (Malhotra and Elnakib 2021b). Child marriage is associated with having more children over the lifetime, pregnancy at earlier ages, giving birth outside a healthcare facility, and physical intimate partner violence (Fan and Koski 2022). Early pregnancy is associated with poor birth outcomes such as low birth weight and preterm birth (Gibbs et al. 2012). Child marriage is associated with poorer childhood development and stunting (Efevbera et al. 2017).

Within the GBD hierarchy, gender-based violence can be plausibly linked to one cause, interpersonal violence (24.7 million DALYs, 366 thousand deaths), It can also be linked to at least two large (Level 3) risk factors; child growth failure (74.0 million DALYs, 888 thousand deaths) and low-birth weight and short gestation (160.0 million DALYs, 1.6 million deaths), both of which are encompassed under malnutrition (a Level 2 risk). However, unlike other causes and risk factors summarized in this section (e.g. road traffic injuries or WASH), the link between gender-based violence and the GBD categories is not as direct. Therefore, the size of the health problem is unclear, though the widespread prevalence of both intimate partner violence and child marriage, and the large attributable DALYs to correlated risk factors, suggests the challenge is substantial.

There are few BCAs of interventions to address gender-based violence. One potential reason is that, until recently, there has been a dearth of high quality, experimental evidence on interventions to address intimate partner violence and child marriage in LMICs (Malhotra and Elnakib 2021a; Bacchus et al. 2024). Regarding intimate partner violence, community-based prevention programs show promising evidence of impact. Community-based programs are locally driven, participatory initiatives that engage community members and leaders to shift harmful gender norms, promote respectful relationships, and build supportive environments, ultimately aiming to reduce intimate partner violence by fostering collective behavioral change. A recent systematic review (Bacchus et al. 2024) noted that all seven identified studies on community-based programs reported reductions in intimate partner violence. Randomized control trials (RCTs) demonstrated substantial reductions in intimate partner violence, from a 77% reduction in the odds of experiencing any form of intimate partner violence in the Democratic Republic of Congo (Falb et al. 2023) to a 32% reduction in the risk of sexual or physical intimate partner violence in Uganda (Kyegombe et al. 2015).

Community-based programs are not particularly costly, with one estimate noting a per person cost of $12.88 in 2004 USD (Jan et al. 2011), approximately equivalent to $19.20 in 2024 currency. BCAs of community-based programs (which used effects from the Uganda study, Kyegombe et al. (2015) and a $13 cost per person) reported BCRs of 9 in Rajasthan and 19 in Andhra Pradesh, India (Raghavendra, Chadha, and Duvvury 2018a; 2018b). These large returns suggest the potential for substantial net benefits of community programs if they can be scaled. However, to the best of our knowledge, there are no other BCAs of community interventions. More research using more recent evidence would be useful to confirm these findings.

For child marriage, a review of 30 quasi-experimental and RCT studies suggests that education, labor market and livelihoods training show the strongest evidence of impact, while cash transfers have less evidence of impact (Malhotra and Elnakib 2021a). Community mobilization may also be impactful but there is limited evidence for this intervention (Erulkar, Medhin, and Weissman 2017). BCAs in our database primarily come from Copenhagen Consensus country projects, and tend to reinforce the findings of Malhotra and Elnakib (2021a). Policies that promote education and/or life skills tend to have higher BCRs (median BCR = 4.4, n=11) than policies that provide incentives to delay marriage (average BCR = 3, n =2), though the number of analyses in each category is small.

A BCA of a package of child marriage interventions across 31 countries noted a central BCR of 7.4, with benefits due to increased schooling and lifetime productivity (Rasmussen et al. 2019). This BCR is slightly higher than the average BCRs seen in Copenhagen Consensus analyses, though this is potentially due to differences in the discount rates used in the study (3%) and those of Copenhagen Consensus projects (5-8%). These differences can lead to large variation in lifetime productivity benefits, which stretch decades into the future. Overall, the limited evidence indicates that child marriage interventions can have reasonable returns that, given the size of the problem, would generate large net benefits for health and human welfare.

3.7 Agriculture and Nutrition

In 2023, an estimated 733 million people suffered from hunger, and 864 million experienced severe food insecurity, indicating a substantial problem size. Africa is the region with the highest prevalence of hunger at 20.4 percent, with Asia second at 8.1 percent. Approximately 2.8 billion people cannot afford a healthy diet (FAO, IFAD, UNICEF, WFP and WHO 2024). There is a clear and large addressable population who could benefit from interventions related to agriculture and nutrition.

Food availability is an important determinant of human health. Throughout human history, and particularly since 1700, substantial expansions in the availability of food have coincided with profound improvements in human health and longevity (Fogel and Costa 1997). For example, the Green Revolution is estimated to have averted 3-to-6 million child deaths per year across LMICs by the year 2000 (von der Goltz et al. 2020). Food quality, proxied by variables such as dietary diversity, the consumption of key vitamins, nutrients and protein and the limitation of unhealthy foods, has also long been recognized as an important factor in human health. Poor diets are associated with sub-optimal child health and nutrition indicators, chronic disease and obesity (Siekmans et al. 2024).

Within the GBD framework, 280.4 million DALYs and 2.6 million deaths are attributed to child and maternal malnutrition while 178.1 million DALYs and 7.2 million deaths are attributed to a variety of dietary risks. These risk factors are plausibly mitigated by interventions related to agriculture, nutrition, and food systems, making this a potentially fruitful area for further investigation (Willett et al. 2019; Sharma et al. 2021). However, the

evidence base, as indicated by several systematic reviews, paints a mixed picture of the impacts of some relevant interventions on human health. An early systematic review noted that agriculture interventions improved food production, but not all improved human health and nutrition (Berti, Krasevec, and FitzGerald 2004). Home gardening interventions have an inconsistent impact on morbidity, vitamin A status, and anemia (Haby et al. 2016), and a positive but statistically insignificant impact on child anthropometric indicators (Girard et al. 2012; Masset et al. 2012). However, biofortification of wheat improves child growth indicators (Gunaratna et al. 2010).

While there is sufficient evidence from some systematic reviews, many key agricultural interventions lack evidence on their health impacts. For example, agricultural input subsidies are a main policy lever for many LMIC governments, yet a systematic review noted only four studies (three from Malawi) that estimated any impact on health outcomes (Walls et al. 2018). Similarly, a review of food price policies on health impacts found only four studies, of which two were from LMICs (Dangour et al. 2013). This dearth of evidence likely relates to the challenges of implementing multidisciplinary research. Overall, it is unclear how much of the 459 million attributable DALYs and ~10 million deaths from child and maternal malnutrition and poor dietary diversity combined could be addressed by agriculture and nutrition interventions. Complicating the discussion is that a substantial share of this burden can be effectively addressed within the health system (Bhutta et al. 2013), although further analysis and comparison of interventions within and outside of the health care system seems warranted.

Much like the systematic review evidence, the BCA evidence is mixed and limited. The largest category of economic evaluations relate to staple grain fortification, with BCRs ranging between 5 and 34 (Qureshy, Alderman, and Manchanda 2023; Bagriansky et al. 2023; Kancherla et al. 2021; Ghauri 2015; MQSUN 2014). Three studies on the fortification of other foods (salt, ghee) have BCRs between 2 and 58 (Horton, Wesley, and Venkatesh Mannar 2011; MQSUN 2014; Makkar et al. 2022). We identified one BCA of nutrition-sensitive agriculture which reported a BCR range of 1.3-1.7 (Aryeetey et al. 2020). Two BCAs of homestead production of nutritious food reported BCR ranges with an order of magnitude difference (3.6-24.7, 0.6-6) depending on the assumptions used (Gelli et al. 2022; Dragojlovic et al. 2020). Lastly, BCAs of school meals fall within a range of 3-10 (WFP 2018, Turkson, Baffour, and Wong 2020; Alderman et al. 2025). Overall, the evidence suggests substantial potential for agriculture and nutrition interventions to have a large impact on health. However, the evidence of impact is limited and mixed, both in terms of effectiveness and return-on-investment, with results appearing to be highly context-specific. More work is needed to summarize the evidence, including under what contexts one might expect interventions with larger net benefits for health and welfare.

3.8 Lead Pollution

While there are no lead pollution BCAs in our database, this policy arena has recently gained prominence as a neglected, high-burden challenge that can be addressed cost-effectively in

LMICs (Working Group on Understanding and Mitigating the Global Burden of Lead Poisoning 2023). Within the GBD framework, lead pollution was a risk factor for 33.9 million DALYs in 2021, estimated via mediated impacts of lead on hypertension and cardiovascular disease. However, a recent study which assesses the impact on cardiovascular disease via other channels beyond hypertension indicates that the health burden could be six times higher than current estimates (Larsen and Sánchez-Triana 2023). That study, using values of statistical life for mortality and future earning loss from IQ degradation in children, estimated an annual cost of $7 trillion globally from lead pollution exposure.

Reducing lead exposure primarily includes reducing exposure to lead sources. High levels of lead exposure come from informal battery recycling, mining, electronic waste, and consumption of spices and paint (Ericson et al. 2021; WHO and UNEP 2020). Reducing exposure is feasible, with one before-after study noting that a public education campaign with monitoring of spice vendors and millers reduced the presence of detectable lead in 631 spice samples from 47% to 0% over four years (Forsyth et al. 2023).

There are many BCAs related to reducing lead risks in high income countries, including those conducted by governmental and intergovernmental groups as well as academic researchers. One pathbreaking U.S. study (Levin and Schwartz 2023) considered 17 health endpoints associated with lead exposure and found benefits estimates that vastly exceeded what had been estimated previously. However, few BCAs have been conducted in LMICs where the sources of exposure and the feasible interventions vary. The Center for Global Development Working Group estimates that an investment of $350 million over seven years would be sufficient to make substantial progress against lead pollution (Working Group on Understanding and Mitigating the Global Burden of Lead Poisoning 2023). Given the substantial costs estimated in Larsen and Sánchez-Triana (2023), the potential net benefits of intervention appear very large. However, additional research is needed, including more BCAs of lead exposure reduction strategies.

3.9 Climate Change

Climate change is a large and growing problem that has implications for most if not all of the policy areas and interventions we consider. As a result, future analyses of the interventions covered in the previous sections need to be adapted to take the effects of climate change into account. Both baseline health and baseline environmental conditions are likely to change in ways that will affect the incremental impacts of these policies over time (e.g., Willets and Campbell-Lendrum 2022). For example, rising temperatures may increase the prevalence of pathogens in food and water, the proclivity towards violence, and many other risks to health and longevity − increasing the costs of associated interventions as well as the potential benefits. Some interventions undertaken to address other problems may also have significant climate co-benefits, altering the relationship of benefits to costs. For example, efforts to reduce emissions of conventional air pollutants often also affect the emission of greenhouse gases, as do changes in agricultural or forestry practices as well as urban planning and infrastructure investments.

We divide this discussion into two parts, focusing on issues that in the absence of climate change would be of less concern. These include country-level policies to: (1) mitigate climate change by reducing or sequestering heat-trapping greenhouse gas emissions; and (2) adapt to climate change or become more resilient to its effects.[22] In both cases, we focus on interventions that may have significant effects on health and longevity in LMICs, consistent with the focus throughout this volume.

The health risks associated with rising temperatures include, for example, those attributable to increasing heat stress, extreme weather events (high precipitation, drought, and sand and dust storms, etc.), infectious disease transmission, food insecurity, and many other factors. In addition to the direct effects on health, these changing conditions lead to economic losses, which in turn also affect health – decreasing the ability to finance access to medical treatment and prevention as well as to healthy food and living conditions more generally.

The climate literature is large and complex, and growing rapidly.[23] The discussion here is intended as a brief overview of its relationship to our criteria for identifying topic areas and interventions for consideration in this volume. More detailed information on this and the preceding policy areas will be provided in the subsequent sections of this volume.

Mitigation: In 2016, the Paris Agreement was adopted by 196 countries, including many LMICs.[24] Its goal was to keep the increase in global average temperature below 2°C compared to pre-industrial levels; ideally below 1.5°C. Under the agreement, countries are required to submit "nationally determined contributions" which describe their climate mitigation efforts.[25] However, as documented in the 2024 Lancet Countdown report (Romanello et al. 2024), by 2023 the increase in annual mean surface temperature had reached 1.45°C and record highs were subsequently recorded throughout 2024. The potential effects of this increase on health and longevity are substantial, as are the potential macroeconomic effects (e.g., World Bank 2023), which in turn adversely affect the resources available to protect health and wellbeing more generally. While rising temperatures mean that there is an increasingly critical need to mitigate greenhouse gas emissions, they also signal the incredible difficulty of doing so.

At the global level, the burden is immense. For example, Jamison et al. (2024, supplemental material) estimate that, depending on the degree of mitigation, annual heat-related excess

[22] See Carleton et al. (2024) for more formal and detailed discussion of these concepts and methods, review of related economics literature, and recommendations for future work.
[23] For detailed discussion of country-level level mitigation and adaptation efforts, see the World Bank's Country Climate and Development Reports, available here: https://www.worldbank.org/en/publication/country-climate-development-reports; World Bank (2023) summarizes the reports completed to-date.
[24] For more information on the Paris Agreement, see: https://unfccc.int/process-and-meetings/the-paris-agreement.
[25] See Nachtigall et al. (2024) for an overview and analysis of the OECD Climate Actions and Policies Measurement Framework (CAPMF), which is a structured database of mitigation actions undertaken to meet these targets. Dinh et al. (2024) review the approaches used to value health in the mitigation literature.

deaths would range from 1.0 and 1.7 million in 2100, and may reach as high as 7.3 million. A report from the World Economic Forum (Wyman 2024) takes into account several pathways through which climate change affects health and longevity. It estimates that under a "middle of the road" mitigation pathway, deaths may reach 14.5 million by 2050, accounting for 2.0 billion DALYs. Not surprisingly, these effects are larger in regions that are poorer, more densely populated, and warmer. A recent review (Sharma et al. 2025) notes, however, that more work is needed to quantify the local impacts of climate on health.

Several studies in our database estimate the health co-benefits of global mitigation strategies, including meeting the Paris Agreement targets using a suite of different policies, often related to transitioning to cleaner energy sources (Markandya et al. 2018; Vandyck et al. 2018; Sampedro et al. 2020). The estimated net benefits from these policies globally are often very large, measured in the billions or trillions of dollars over multiple decades. Of the 63 interventions in our database that address conventional air pollutants, 41 also explicitly address decreases in greenhouse gas emissions, as is the case for two of the 46 household air pollution interventions, and four of the 14 road traffic interventions, as well as the studies of interventions related to deforestation. Many of the remaining studies do not estimate the effects of the interventions on greenhouse gases, but these effects may be significant.

Although the size of this problem is large, local climate mitigation efforts may not significantly benefit local populations if only greenhouse gas emissions are considered, unless the amount of mitigation is very large and not offset by increased greenhouse gas emissions elsewhere. Mitigation costs will be experienced locally if not subsidized by other countries or organizations.[26] Yet greenhouse gases travel through the atmosphere and impact temperatures globally. Thus while mitigation efforts will aid LMICs in meeting their targets under the Paris Agreement, they will not necessarily directly improve the health of their own populations if co-benefits are not considered.

These health co-benefits of mitigation efforts are potentially very large, as indicated by the Lancet "Pathfinder" commission report (Whitmee et al. 2024) and the interventions included in the related database.[27] However, few of the interventions identified in that database have been subject to full BCAs (e.g., Rice et al. 2025), and hence these impacts are under-represented in our database.

Organizationally, in this volume we propose to include mitigation co-benefits in the analyses of the interventions in each of the policy areas discussed above, and to explore the extent to which mitigation efforts outside of these areas should be included given the magnitude of their effects.

[26] Glennerster and Jayachandran (2023) argue that mitigation efforts are more cost-effective in LMICs than in high-income countries, implying that higher income countries should subsidize mitigation efforts in LMICs.
[27] The database is available here: https://www.lshtm.ac.uk/research/centres-projects-groups/pathfinder-initiative.

Adaptation and resilience: In the climate change context, adaptation typically refers to actions taken in response to climate change (*ex-post*), while resilience refers to actions taken in advance, anticipating climate impacts (*ex-ante*). For simplicity, we use the term "adaptation" to refer to both types of interventions. In this section, we discuss adaptation strategies outside of those in the policy areas discussed earlier. As noted previously, further assessment is needed in each of the previously discussed policy areas to determine the extent to which the implementation of related interventions, and their costs and benefits, are affected by climate change.

Of the interventions in our database, seven mention adaptation to climate change as a specific goal. All of these interventions relate to extreme weather, including early warning systems and flood protection. However, many other interventions could be undertaken to adapt to climate change. For example, there are many options for addressing heat stress, including providing shade, cooling shelters, air conditioning units, and so forth. Interventions to improve water storage and use, manage land to reduce wildfire risks, and plant heat resistant crops, also likely have health benefits, but these benefits are rarely included when estimating costs and benefits. Thus climate adaptation is an area where a substantial increase in the consideration of health benefits and the use of BCA more generally seems warranted.

3.10 Summary

The above discussion suggests that there are several promising areas worthy of further investigation in this volume, which include interventions likely to lead to large net benefits and to substantially improve public health. We summarize our assessment in Table 7.

Table 7: Summary Comparison of Policy Areas to Criteria [preliminary results, subject to change, based on May 20, 2025 version of database]

Policy Area	Attributable DALYs	Attributable deaths	Interventions (BCR ranges)	Potential unserved / addressable population
Habitual and addictive goods	316.2 million	17.1 million	Tobacco tax (BCR 15-50) Alcohol tax (BCR > 50) and alcohol regulation (BCR 2-12) Salt reduction policies (BCR 15-100)	1 billion tobacco users (WHO 2021) ~750 million (17% of adults) engaging in high episodic drinking (Xu et al. 2022) Almost entire global population consuming too much salt (Powles et al. 2013)
Household air pollution	111.3 million	3.1 million	Clean cookstove promotion (BCR 4-9) LPG promotion (BCR 2-3)	2.1 billion people cooking with dirty fuels (WHO 2024b)
Ambient air pollution	111.5 million	4.3 million	Reduce emissions from agriculture, power plants, transport and industry (BCR 1-10)	99% of the global population living in places where WHO air quality guidelines are not met (WHO 2024a)
WASH	97.4 million	1.8 million	Point-of-use chlorination of existing water sources (Likely high BCR) Improved water (BCR 1-5) Improved sanitation (BCR 1-5) Hygiene promotion (limited evidence)	2.2 billion without access to safe drinking water, 3.5 billion without access to safely managed sanitation, 2.0 billion without access to basic hygiene services (UNICEF and WHO 2023).
Road traffic injuries	58.7 million	1.1 million	Integrated package of: · Seatbelt and helmet usage · Enforcement of alcohol and speed limits · Graduated learning system · Better traffic infrastructure (BCR = 7-10)	Billions of individuals around the world exposed to risk of road traffic accidents including pedestrians, cyclists, drivers and passengers of motorbikes and cars. 1.2 million road deaths were recorded in 2021, 90% from LMICs (WHO 2023)
Gender inequality	Unknown share of DALYs attributable to: · Child growth failure (risk) = 74.0 million · LBW and short gestation (risk) = 160.0 million · Interpersonal violence (cause): 24.7 million	Unknown share of deaths attributable to: · Child growth failure (risk) = 0.9 million · LBW and short gestation (risk) = 1.6 million · Interpersonal violence (cause): 0.4 million	Community based prevention programs to address IPV (potentially high BCR, limited evidence) Direct incentives to delay child marriage (BCR 3) Boost girls' education (BCR 3-5)	27% of women who have experienced physical and/or sexual violence in their lifetime (UNFPA 2020), and more at risk. 12 million girls who are married every year before 18 (Malhotra and Elnakib 2021b) and more at risk.

Policy Area	Attributable DALYs	Attributable deaths	Interventions (BCR ranges)	Potential unserved / addressable population
Agriculture and nutrition	Unknown share of DALYs attributable to: · Child and maternal malnutrition (risk) = 271.9 million · Dietary risks (risk) = 178.1 million	Unknown share of deaths attributable to: · Child and maternal malnutrition (risk) = 2.6 million · Dietary risks (risk) = 7.2 million	Fortification of staple grains (BCR 5-15) Nutrition sensitive agriculture (limited evidence) Biofortification (limited evidence, potentially high BCR) School feeding (BCR 3-10)	864 million experiencing severe food insecurity (FAO, IFAD, UNICEF, WFP and WHO 2024)
Lead pollution	33.9 million according to GBD; potentially 3.5x higher according to Larsen and Sánchez-Triana (2023)	1.5 million	Eliminate lead in paint (potentially high BCR)	815 million children with unsafe, elevated blood lead levels (Working Group on Understanding and Mitigating the Global Burden of Lead Poisoning 2023)
Climate change	40.3 million; potentially much larger and growing	1.9 million; potentially much larger and growing	Mitigate greenhouse gas emissions, typically through transition to cleaner energy sources (BCR ~1-10) Adapt to natural disasters largely though early warning systems and flood control (BCR ~1-60)	Potentially global over the long run

Notes: Habitual and addictive goods is the sum of DALYs attributable to the following risk factors: high alcohol use, tobacco, drug use, high sodium, high sweetened beverages and high trans fatty acids. WASH, household air pollution, ambient air pollution and occupational risks have direct equivalent risk factor categorizations in GBD. Climate change is the sum of DALYs attributable to non-optimal temperature (risk) and exposure to forces of nature (cause). LBW = low birth weight. LPG = liquid petroleum gas. BCR = benefit-cost ratio. GBD = Global Burden of Disease.

Addressing habitual and addictive goods has the greatest demonstrated potential in terms of problem size, net benefits of interventions, and affected population. Research suggests that taxes in particular are likely to be highly cost-beneficial, although practical implementation can be challenging due to limited tax administration capacity and incentives for emergence of illicit markets. Additional BCAs that account for these challenges and consider alternatives to taxation would be useful to better inform policy.

Addressing household air pollution via the provision of cleaner cookstoves and fuels is another promising area with plausibly large net benefits. Again, implementation challenges remain a primary concern. More research is needed to clarify what factors are most likely to promote uptake and sustained use, and to design and assess policies that best address these barriers.

Ambient air pollution interventions also show significant promise due to their broad population impact and substantial health benefits. Many previous studies do not take the co-benefits of reducing greenhouse gas emissions into account. Once these climate co-benefits are considered, the benefits of these interventions will likely increase significantly. The costs and benefits of interventions to reduce air pollution exposure is a very active area of research; the main challenge is determining what interventions are most likely to be feasibly and cost-effectively implemented in different contexts.

Interventions addressing WASH also offer substantial potential for improving health and longevity. While there is already a rich body of BCA scholarship in this area, as evidenced by the large number of entries in the database, several potential benefits are worthy of increased attention, including improved cognition, averted stunting, and perceptions of safety, particularly among women. Additionally, further exploring the costs and benefits of different incentives and inducements for household investments in WASH (e.g. subsidies, vouchers, loans, public campaigns) would generate informative policy insights (Radin et al. 2020). Finally, recent research suggests that further economic evaluation of point-of-use water treatment is needed, given its potential to generate large net benefits.

Road traffic injuries represent a large addressable health problem, particularly for individuals aged 5-29 where it is the leading cause of death in LMICs. Mandatory seatbelt and helmet use requirements appear to effectively reduce these impacts. However, substantially more benefit-cost analyses are needed to evaluate these and alternative interventions in LMICs.

Addressing gender-based violence and child marriage also ranks high in terms of the size of addressable population and potential for high benefits from intervention. However, more work is needed on a number of related topics. First, other than violence-related injury, the impact of this problem on the health of women and their children requires more attention. The existing evidence suggests plausible impacts on maternal mortality, child growth, low-birth weight and short gestation; areas that contribute significantly to the burden of disease. The available BCAs often do not account for these health impacts, instead focusing on long

term productivity gains from improved schooling (Rasmussen et al. 2019). Some of the most promising interventions such as community engagement are deserving of more attention.

Historically, the health of the human population has been closely coupled with food availability, demonstrating agriculture's foundational role. The substantial burden of disease linked to malnutrition and dietary risk factors supports this notion. And yet we did not find any BCAs that explicitly model the human health impacts of increasing agricultural yields in LMICs. Instead, much of the economic evidence relates to interventions designed to address nutrition deficiencies such as staple grain fortification and nutrition sensitive agriculture. While the former consistently appears as a high BCR intervention, further cross-disciplinary research is needed, including understanding which contexts would generate higher returns from intervention.

Lead exposure appears to be a highly promising policy area, likely to lead to significant health improvements if addressed by interventions outside the health system. The size of the problem is large as is the addressable population. Given that interventions to address lead exposure have been reasonably well-studied in high income countries, one question is the extent to which that research provides a starting point for assessing interventions in LMICs, addressing an important research gap.

Climate change is the area where there appears to be the strongest need for more BCAs that take health into account. The health consequences are large and growing, potentially affecting much of the global population over time, if more significant actions to mitigate greenhouse gas emissions and adapt to the effects of rising temperatures are not implemented soon. Many of the actions undertaken in other policy areas are likely to affect, or be affected by, climate change over the long run – changing the relationship of their costs and benefits. More attention to the health effects of mitigation actions is needed, as are more analyses of the costs and benefits of diverse adaptation efforts.

As demonstrated by the large body of scholarship on the social determinants of health, a substantial share of overall public health is determined by policy actions and conditions that are implemented outside of the health care sector (Marmot et al. 2008). However, recognizing the scale and nature of these determinants represents only the initial step, since the largest health challenges do not necessarily have the most cost-effective solutions (Glied and Robinson 2023). Additional work is required to identify, estimate the returns, and prioritize the vast array of non-health sector interventions that would generate the largest impacts on health and welfare, particularly given the reality of limited resources, as envisioned for the remainder of this volume.

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Appendix A: Ministerial Organization by Country

Our review of ministerial organization focused on the countries with the 10 largest populations in each of the World Bank's low-, lower middle income, and upper-middle income categories as of 2022.[28] Because there is little information on the structure of North Korea's government (which has the tenth largest population among low-income countries), we also included Burkina Faso, which has the 11th largest population.

A.1 Low-income countries

Ethiopia

1. Ministry of Agriculture
2. Ministry of Culture and Tourism
3. Ministry of Education
4. Ministry of Finance
5. Ministry of Foreign Affairs
6. Ministry of Health
7. Ministry of Innovation and Technology
8. Ministry of Labour and SociaI Affairs
9. Ministry of Mines and Petroleum
10. Ministry of National Defence
11. Ministry of Peace
12. Ministry of Revenues
13. Ministry of Science and Higher Education
14. Ministry of Trade and Industry
15. Ministry of Transport
16. Ministry of Urban Development and Construction
17. Ministry of Water, Irrigation and Electricity
18. Ministry of Women, Children and Youth

Congo, Dem. Rep.

1. Ministry of Agriculture
2. Ministry of the Budget
3. Ministry of the Civil Service, Administrative Modernization and Innovation in Public Services
4. Ministry of Communication and the Media
5. Ministry of Culture, the Arts and Heritage
6. Ministry of Digital Technology
7. Ministry of Employment, Labour, and Social Security
8. Ministry of Entrepreneurship and Small and Medium-sized Enterprises
9. Ministry of The Environment and Sustainable Development
10. Ministry of External Trade
11. Ministry of Finance
12. Ministry of Fishing and Stockbreeding
13. Ministry of Foreign Affairs
14. Ministry of Gender, Families and Children
15. Ministry of Higher and University Education
16. Ministry of Hydrocarbons
17. Ministry of Human Rights
18. Ministry of Industry
19. Ministry of Infrastructure and Public Works
20. Ministry of the Interior, Security, Decentralization and Traditional Affairs
21. Ministry of Justice
22. Ministry of Land Management
23. Ministry of Mining
24. Ministry of National Defence and War Veterans
25. Ministry of the National Economy
26. Ministry of Planning
27. Ministry of Postal Services, Telecommunications and New Information and Communication Technologies
28. Ministry of Primary, Secondary and Technical Education
29. Ministry of Professional Training and Crafts
30. Ministry of Properties and Real Estate Affairs
31. Ministry of Public Health, Hygiene and Disease Prevention
32. Ministry of Regional Integration
33. Ministry of Relations with Parliament
34. Ministry of Rural Development
35. Ministry of Research and Technological Innovation
36. Ministry of Social Affairs, Humanitarian Actions and National Solidarity
37. Ministry of Sport and Leisure
38. Ministry of Tourism
39. Ministry of Town Planning and Housing
40. Ministry of Transport, Communication Routes and Improving Access to Isolated Regions
41. Ministry of Water Resources and Electricity
42. Ministry of Youth, Initiation of New Citizenship and National Cohesion

Uganda

1. Ministry of Agriculture, Animal Industry and Fisheries
2. Ministry of Defence and Veteran Affairs
3. Ministry of Disaster Preparedness and Refugees
4. Ministry of East African Community Affairs
5. Ministry of Education and Sports
6. Ministry of Energy and Minerals Development

[28] Based https://data.worldbank.org/indicator/SP.POP.TOTL and https://data.worldbank.org/indicator/NY.GDP.MKTP.CD as view June 2023.

7. Ministry of Finance, Planning and Economic Development
8. Ministry of Foreign Affairs
9. Ministry of Gender, Labour and Social Affairs
10. Ministry of Health
11. Ministry of Information, Communications Technology and National Guidance
12. Ministry of Internal Affairs
13. Ministry of Justice and Constitutional Affairs
14. Ministry of Lands, Housing and Urban Development
15. Ministry of Local Government
16. Ministry of Public Service
17. Ministry of Science, Technology and Innovation
18. Ministry of Security
19. Ministry of Tourism, Wildlife and Antiquities
20. Ministry of Trade, Industry and Co-operatives
21. Ministry of Water and Environment
22. Ministry of Works and Transport

Sudan

1. Ministry of Agriculture and Natural Resources
2. Ministry of Cabinet Affairs
3. Ministry of Culture and Information
4. Ministry of Defence
5. Ministry of Education
6. Ministry of Energy and Petroleum
7. Ministry of Federal Government
8. Ministry of Finance and Economic Planning
9. Ministry of Foreign Affairs
10. Ministry of Health
11. Ministry of Higher Education and Scientific Research
12. Ministry of Industry
13. Ministry of the Interior
14. Ministry of Irrigation and Water Resources
15. Ministry of Justice
16. Ministry of Labour and Administrative Reform
17. Ministry of Livestock
18. Ministry of Religious Affairs and Endowments
19. Ministry of Social Development
20. Ministry of Trade and Supply
21. Ministry of Transport and Infrastructure
22. Ministry of Youth and Sports

Afghanistan

1. Ministry of Agriculture, Irrigation and Livestock
2. Ministry of Borders and Tribal Affairs
3. Ministry of Civil Aviation and Transport
4. Ministry of Dawat-u-Ershad
5. Ministry of Defence
6. Ministry of Disaster Management
7. Ministry of Economy
8. Ministry of Education
9. Ministry of Finance
10. Ministry of Foreign Affairs
11. Ministry of Hajj
12. Ministry of Higher Education
13. Ministry of Industry and Commerce
14. Ministry of Information and Culture
15. Ministry of Interior Affairs
16. Ministry of Justice
17. Ministry of Labour and Social Affairs
18. Ministry of Martyrs and Disabled Affairs
19. Ministry of Mines and Petroleum
20. Ministry of the Propagation of Virtue and the Prevention of Vice
21. Ministry of Public Health
22. Ministry of Public Works
23. Ministry of Refugees
24. Ministry of Rural Rehabilitation and Development
25. Ministry of Telecommunications
26. Ministry of Water and Energy

Yemen, Rep.

1. Ministry of Agriculture, Irrigation and Fisheries
2. Ministry of Civil Service and Insurance
3. Ministry of Defence
4. Ministry of Education
5. Ministry of Electricity and Energy
6. Ministry of Expatriate Affairs
7. Ministry of Finance
8. Ministry of Foreign Affairs
9. Ministry of Higher Education, Scientific Research and Vocational Training
10. Ministry of Industry and Trade
11. Ministry of Information, Culture and Tourism
12. Ministry of the Interior
13. Ministry of Justice
14. Ministry of Legal Affairs and Human Rights
15. Ministry of Local Administration
16. Ministry of Oil and Minerals
17. Ministry of Planning and International Co-operation
18. Ministry of Public Health and Population
19. Ministry of Public Works and Highways
20. Ministry of Religious Endowments and Guidance
21. Ministry of Social Affairs and Labour
22. Ministry of Telecommunications and Information Technology
23. Ministry of Transport
24. Ministry of Water and the Environment
25. Ministry of Youth and Sports

Mozambique

26. Ministry of Agriculture and Rural Development
27. Ministry of Culture and Tourism
28. Ministry of the Economy and Finance
29. Ministry of Education and Human Development
30. Ministry of Foreign Affairs and Co-operation
31. Ministry of Gender, Children and Social Welfare

32. Ministry of Health
33. Ministry of Industry and Commerce
34. Ministry of the Interior
35. Ministry of Justice and Constitutional and Religious Affairs
36. Ministry of Labour, Employment and Social Security
37. Ministry of Land and Environment
38. Ministry of Mineral Resources and Energy
39. Ministry of National Defence
40. Ministry of Public Works, Housing and Water Resources
41. Ministry of Science, Technology and Higher Education
42. Ministry of Sea, Inland Water and Fisheries
43. Ministry of State Administration and Public Service
44. Ministry of Transport and Communications
45. Ministry of Veterans' Affairs

Madagascar

1. Ministry of Agriculture and Stockbreeding
2. Ministry of Communication and Culture
3. Ministry of Digital Development, Digital Transformation, Postal Services and Telecommunications
4. Ministry of the Economy and Finance
5. Ministry of Energy and Hydrocarbons
6. Ministry of the Environment and Sustainable Development
7. Ministry of Fishing and the Blue Economy
8. Ministry of Foreign Affairs
9. Ministry of Handicrafts and Trades
10. Ministry of Higher Education and Scientific Research
11. Ministry of Industrialization, Trade and Consumer Affairs
12. Ministry of the Interior and Decentralization
13. Ministry of Justice
14. Ministry of Labour, Employment, the Civil Service and Social Law
15. Ministry of Mining and Strategic Resources
16. Ministry of National Defence
17. Ministry of National Education
18. Ministry of Population, Social Protection and the Promotion of Women
19. Ministry of Public Health
20. Ministry of Public Security
21. Ministry of Public Works
22. Ministry of Technical Education and Professional Training
23. Ministry of Territorial Management and Land Affairs
24. Ministry of Tourism
25. Ministry of Transport and Meteorology
26. Ministry of Water, Sanitation and Hygiene
27. Ministry of Youth and Sport

Niger

1. Ministry of Agriculture
2. Ministry of the Civil Service and Labour
3. Ministry of Communication
4. Ministry of Culture, Tourism and Handicrafts
5. Ministry of Employment and Social Protection
6. Ministry of Energy and Renewable Energy Sources
7. Ministry of the Environment and the Fight against Desertification
8. Ministry of Equipment
9. Ministry of Finance
10. Ministry of Foreign Affairs and Co-operation
11. Ministry of Higher Education and Research
12. Ministry of Humanitarian Action and Disaster Management
13. Ministry of Industry and Youth Entrepreneurship
14. Ministry of the Interior and Decentralization
15. Ministry of Justice
16. Ministry of Land Management and Community Development
17. Ministry of Mining
18. Ministry of National Defence
19. Ministry of National Education
20. Ministry of Petroleum
21. Ministry of Planning
22. Ministry of Postal Services and New Information Technologies
23. Ministry of Professional Training
24. Ministry of the Promotion of Women and the Protection of Children
25. Ministry of Public Health, Population and Social Affairs
26. Ministry of Stockbreeding
27. Ministry of Town Planning, Housing and Sanitation
28. Ministry of Trade
29. Ministry of Transport
30. Ministry of Water Resources
31. Ministry of Youth and Sport

Korea, Dem. People's Rep.

[incomplete]

1. Ministry of Foreign Affairs
2. Ministry of Public Health

Burkina Faso

1. Ministry of Agriculture and Animal and Fishing Resources
2. Ministry of the Civil Service, Labour and Social Security
3. Ministry of Communication, Culture, the Arts and Tourism
4. Ministry of Defence and War Veterans
5. Ministry of Digital Transition, Postal Services and Electronic Communications
6. Ministry of the Environment, Energy, Water and Sanitation
7. Ministry of the Economy, Finance and Planning

8. Ministry of Foreign Affairs, Regional Co-operation and Burkinabe Abroad
9. Ministry of Gender and the Family
10. Ministry of Health and Public Hygiene
11. Ministry of Higher Education, Research and Innovation
12. Ministry of Industrial Development, Trade, Handicrafts and Small and Medium-sized Enterprises
13. Ministry of Infrastructure and Improving Access to Isolated Regions
14. Ministry of Justice and Human Rights
15. Ministry of Mines and Quarries
16. Ministry of National Education, Literacy and the Promotion of National Languages
17. Ministry of National Solidarity and Humanitarian Action
18. Ministry of Religious and Traditional Affairs
19. Ministry of Sports, Youth Empowerment and Employment
20. Ministry of Territorial Administration, Decentralization and Security
21. Ministry of Town Planning, Land Affairs and Housing
22. Ministry of Transport, Urban Mobility and Road Safety

A.2 Lower-middle-income countries

India

1. Ministry of Agriculture and Farmers' Welfare
2. Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
3. Ministry of Chemicals and Fertilizers
4. Ministry of Civil Aviation
5. Ministry of Coal
6. Ministry of Commerce and Industry
7. Ministry of Consumer Affairs, Food and Public Distribution
8. Ministry of Corporate Affairs
9. Ministry of Culture
10. Ministry of Defence
11. Ministry of Development of North Eastern Region
12. Ministry of Earth Sciences
13. Ministry of Education
14. Ministry of Electronics and Information Technology
15. Ministry of Environment, Forest and Climate Change
16. Ministry of External Affairs
17. Ministry of Finance
18. Ministry of Fisheries, Animal Husbandry and Dairying
19. Ministry of Food Processing Industries
20. Ministry of Health and Family Welfare
21. Ministry of Heavy Industries and Public Enterprises
22. Ministry of Home Affairs
23. Ministry of Housing and Urban Affairs
24. Ministry of Information and Broadcasting
25. Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation
26. Ministry of Labour and Employment
27. Ministry of Law and Justice
28. Ministry of Micro, Small and Medium Enterprises
29. Ministry of Mines
30. Ministry of Minority Affairs
31. Ministry of New and Renewable Energy
32. Ministry of Panchayati Raj
33. Ministry of Parliamentary Affairs
34. Ministry of Personnel, Public Grievances and Pensions
35. Ministry of Petroleum and Natural Gas
36. Ministry of Ports, Shipping and Waterways
37. Ministry of Power
38. Ministry of Railways
39. Ministry of Road Transport and Highways
40. Ministry of Rural Development
41. Ministry of Science and Technology
42. Ministry of Skill Development and Entrepreneurship
43. Ministry of Social Justice and Empowerment
44. Ministry of Statistics and Programme Implementation
45. Ministry of Steel
46. Ministry of Textiles
47. Ministry of Tourism
48. Ministry of Tribal Affairs
49. Ministry of Women and Child Development
50. Ministry of Youth Affairs and Sports
51. Department of Atomic Energy
52. Department of Space

Pakistan

1. Ministry of Climate Change
2. Ministry of Commerce
3. Ministry of Communications
4. Ministry of Defence
5. Ministry of Defence Production
6. Ministry of Economic Affairs
7. Ministry of Energy
8. Ministry of Federal Education and Professional Training
9. Ministry of Finance and Revenue
10. Ministry of Foreign Affairs
11. Ministry of Housing and Works
12. Ministry of Human Rights
13. Ministry of Information and Broadcasting
14. Ministry of Information Technology and Telecommunications
15. Ministry of Inter-provincial Co-ordination
16. Ministry of the Interior
17. Ministry of Law and Justice
18. Ministry of Maritime Affairs
19. Ministry of Narcotics Control
20. Ministry of National Food Security and Research

21. Ministry of National Health Services, Regulations and Co-ordination
22. Ministry of Overseas Pakistanis and Human Resource Development
23. Ministry of Parliamentary Affairs
24. Ministry of Planning Development and Special Initiatives
25. Ministry of Poverty Alleviation and Social Safety
26. Ministry of Privatization
27. Ministry of Railways
28. Ministry of Religious Affairs and Inter-faith Harmony
29. Ministry of Science and Technology
30. Ministry of States and Frontier Regions
31. Ministry of Water Resources

Nigeria

1. Ministry of Agriculture and Rural Development
2. Ministry of Aviation
3. Ministry of Communication and Digital Economy
4. Ministry of Defence
5. Ministry of Education
6. Ministry of the Environment
7. Ministry of the Federal Capital Territory
8. Ministry of Finance, Budget and National Planning
9. Ministry of Foreign Affairs
10. Ministry of Health
11. Ministry of Humanitarian Affairs, Disaster Management and Social Development
12. Ministry of Industry, Trade and Investment
13. Ministry of Information and Culture
14. Ministry of the Interior
15. Ministry of Justice
16. Ministry of Labour and Employment
17. Ministry of Mines and Steel Development
18. Ministry of Niger Delta Affairs
19. Ministry of Petroleum Resources
20. Ministry of Police Affairs
21. Ministry of Power
22. Ministry of Science and Technology
23. Ministry of Transportation
24. Ministry of Water Resources
25. Ministry of Women's Affairs and Social Development
26. Ministry of Works and Housing
27. Ministry of Youth and Sports

Bangladesh

1. Ministry of Agriculture
2. Ministry of Chittagong Hill Tracts Affairs
3. Ministry of Civil Aviation and Tourism
4. Ministry of Commerce
5. Ministry of Cultural Affairs
6. Ministry of Defence
7. Ministry of Disaster Management and Relief
8. Ministry of Education
9. Ministry of Environment, Forests and Climate Change
10. Ministry of Expatriates' Welfare and Overseas Employment
11. Ministry of Finance
12. Ministry of Fisheries and Livestock
13. Ministry of Food
14. Ministry of Foreign Affairs
15. Ministry of Health and Family Welfare
16. Ministry of Home Affairs
17. Ministry of Housing and Public Works
18. Ministry of Industries
19. Ministry of Information and Broadcasting
20. Ministry of Labour and Employment
21. Ministry of Land
22. Ministry of Law, Justice and Parliamentary Affairs
23. Ministry of Liberation War Affairs
24. Ministry of Local Government, Rural Development and Cooperatives
25. Ministry of Planning
26. Ministry of Posts, Telecommunications and Information Technology
27. Ministry of Power, Energy and Mineral Resources
28. Ministry of Primary and Mass Education
29. Ministry of Public Administration
30. Ministry of Railways
31. Ministry of Religious Affairs
32. Ministry of Road Transport and Bridges
33. Ministry of Science and Technology
34. Ministry of Shipping
35. Ministry of Social Welfare
36. Ministry of Textiles and Jute
37. Ministry of Water Resources
38. Ministry of Women and Children Affairs
39. Ministry of Youth and Sports

Philippines

(Executive Departments)

1. Department of Agrarian Reform
2. Department of Agriculture
3. Department of Budget and Management
4. Department of Education
5. Department of Energy
6. Department of the Environment and Natural Resources
7. Department of Finance
8. Department of Foreign Affairs
9. Department of Health
10. Department of Human Settlements and Urban Development
11. Department of Information and Communications Technology
12. Department of the Interior and Local Government
13. Department of Justice
14. Department of Labor and Employment
15. Department of National Defense
16. Department of Public Works and Highways

17. Department of Science and Technology
18. Department of Social Welfare and Development
19. Department of Tourism
20. Department of Trade and Industry
21. Department of Transportation

Egypt, Arab Rep.

1. Ministry of Agriculture and Land Cultivation
2. Ministry of Antiquities and Tourism
3. Ministry of Awqaf (Islamic Endowments)
4. Ministry of Civil Aviation
5. Ministry of Communications and Information Technology
6. Ministry of Culture
7. Ministry of Defence
8. Ministry of Education
9. Ministry of Electricity and Renewable Energy
10. Ministry of Finance
11. Ministry of Foreign Affairs
12. Ministry of Health and Population
13. Ministry of Higher Education
14. Ministry of Housing, Utilities and Urban Communities
15. Ministry of Immigration and Egyptian Expatriates Affairs
16. Ministry of the Interior
17. Ministry of Investment and International Co-operation
18. Ministry of Justice
19. Ministry of Legal and Parliamentary Affairs
20. Ministry of Local Development
21. Ministry of Manpower
22. Ministry of Military Production
23. Ministry of Petroleum and Mineral Resources
24. Ministry of Planning and Economic Development
25. Ministry of Public Enterprise Sector
26. Ministry of Social Solidarity
27. Ministry of State for Environmental Affairs
28. Ministry of State for Scientific Research
29. Ministry of Supply and Internal Trade
30. Ministry of Tourism
31. Ministry of Trade and Industry
32. Ministry of Transport
33. Ministry of Water Resources and Irrigation
34. Ministry of State for Youth and Sports

Vietnam

1. Ministry of Agriculture and Rural Development
2. Ministry of Construction
3. Ministry of Culture, Sports and Tourism
4. Ministry of Education and Training
5. Ministry of Finance
6. Ministry of Foreign Affairs
7. Ministry of Health
8. Ministry of Home Affairs
9. Ministry of Industry and Trade
10. Ministry of Information and Communications
11. Ministry of Justice
12. Ministry of Labour, War Invalids and Social Affairs
13. Ministry of National Defence
14. Ministry of Natural Resources and the Environment
15. Ministry of Planning and Investment
16. Ministry of Public Security
17. Ministry of Science and Technology
18. Ministry of Transport

Iran, Islamic Rep.

1. Ministry of Agriculture
2. Ministry of Co-operatives, Labour and Social Affairs
3. Ministry of Cultural Heritage, Tourism and Handicrafts
4. Ministry of Culture and Islamic Guidance
5. Ministry of Defence
6. Ministry of Economic Affairs and Finance
7. Ministry of Education
8. Ministry of Energy
9. Ministry of Foreign Affairs
10. Ministry of Health and Medical Education
11. Ministry of Industries, Mines and Trade
12. Ministry of Information and Communications Technology
13. Ministry of Intelligence
14. Ministry of the Interior
15. Ministry of Justice
16. Ministry of Petroleum
17. Ministry of Roads and Urban Development
18. Ministry of Science, Research and Technology
19. Ministry of Sport and Youth Affairs

Tanzania

1. Ministry of Agriculture
2. Ministry of Community Development, Gender, Women and Special Groups
3. Ministry of Culture, Art, and Sports
4. Ministry of Defence and National Service
5. Ministry of Education, Science and Technology
6. Ministry of Energy
7. Ministry of Finance and Planning
8. Ministry of Health
9. Ministry of Foreign Affairs and East African, Regional and International Co-operation
10. Ministry of Home Affairs
11. Ministry of Information, Communications and Information Communication Technology
12. Ministry of Investment, Industry and Trade
13. Ministry of Justice and Constitutional Affairs
14. Ministry of Labour, Youth, Employment and the Disabled
15. Ministry of Lands, Housing and Human Settlements Development
16. Ministry of Livestock and Fisheries
17. Ministry of Minerals
18. Ministry of Natural Resources and Tourism

19. Ministry of Water and Irrigation
20. Ministry of Works, Transport and Communications

Myanmar

1. Ministry of Agriculture, Livestock and Irrigation
2. Ministry of Border Affairs
3. Ministry of Commerce
4. Ministry of Construction
5. Ministry of Co-operatives and Rural Development
6. Ministry of Defence
7. Ministry of Education
8. Ministry of Electricity and Energy
9. Ministry of Ethnic Affairs
10. Ministry of Foreign Affairs
11. Ministry of Health
12. Ministry of Home Affairs
13. Ministry of Hotels and Tourism
14. Ministry of Immigration and Population
15. Ministry of Industry
16. Ministry of Information
17. Ministry of International Co-operation
18. Ministry for Investment and Foreign Economic Relations
19. Ministry of Labour
20. Ministry of Legal Affairs
21. Ministry of Natural Resources and Environmental Conservation
22. Ministry of Planning and Finance
23. Ministry of Religious and Cultural Affairs
24. Ministry of Social Welfare, Relief and Resettlement
25. Ministry of Sports and Youth Affairs
26. Ministry of Transport and Communications

A.3 Upper-middle-income countries

China

1. Ministry of Agriculture and Rural Affairs
2. Ministry of Civil Affairs
3. Ministry of Commerce
4. Ministry of Culture and Tourism
5. Ministry of Ecology and Environment
6. Ministry of Education
7. Ministry of Emergency Management
8. Ministry of Finance
9. Ministry of Foreign Affairs
10. Ministry of Housing and Urban-Rural Development
11. Ministry of Human Resources and Social Security
12. Ministry of Industry and Information Technology
13. Ministry of Justice
14. Ministry of National Defence
15. Ministry of Natural Resources
16. Ministry of Public Security
17. Ministry of Science and Technology
18. Ministry of State Security
19. Ministry of Transport
20. Ministry of Veterans Affairs
21. Ministry of Water Resources

[Not included]

- National Health Commission (Listed under category of "State Commissions and Government Offices")

Indonesia

1. Ministry of Administrative and Bureaucratic Reform
2. Ministry of Agrarian and Spatial Planning
3. Ministry of Agriculture
4. Ministry of Communications and Information Technology
5. Ministry of Co-operatives and Small and Medium Enterprises
6. Ministry of Defence
7. Ministry of Education, Culture, Research and Technology
8. Ministry of Energy and Mineral Resources
9. Ministry of Environment and Forestry
10. Ministry of Finance
11. Ministry of Foreign Affairs
12. Ministry of Health
13. Ministry of Home Affairs
14. Ministry of Industry
15. Ministry of Investment/BKPM
16. Ministry of Law and Human Rights
17. Ministry of Manpower
18. Ministry of Marine Affairs and Fisheries
19. Ministry of Public Works and Public Housing
20. Ministry of Religion
21. Ministry of Social Affairs
22. Ministry of State-owned Enterprises
23. Ministry of Tourism
24. Ministry of Trade
25. Ministry of Transportation
26. Ministry of Villages, Disadvantaged Regions and Transmigration
27. Ministry of Women's Empowerment and Child Protection
28. Ministry of Youth and Sports

[Not included]

- Office of the Co-ordinating Minister for Economic Affairs
- Office of the Co-ordinating Minister for Human Development and Culture
- Office of the Co-ordinating Minister for Political, Legal and Security Affairs
- Office of the State Secretary

Brazil

1. Ministry of Agriculture, Livestock and Food Supply
1. Ministry of Citizenship
2. Ministry of Communications

3. Ministry of Defence
4. Ministry of the Economy
5. Ministry of Education
6. Ministry of the Environment
7. Ministry of Foreign Affairs
8. Ministry of Health
9. Ministry of Infrastructure
10. Ministry of Institutional Security
11. Ministry of Justice and Public Security
12. Ministry of Labour and Social Security
13. Ministry of Mines and Energy
14. Ministry of Regional Development
15. Ministry of Science, Technology and Innovation
16. Ministry of Tourism
17. Ministry of Women, Family and Human Rights

Russian Federation

1. Ministry of Agriculture
2. Ministry of Civil Defence, Emergencies and Disaster Relief
3. Ministry of Construction, Housing and Utilities
4. Ministry of Culture
5. Ministry of Defence
6. Ministry of Development of the Russian Far East and the Arctic
7. Ministry of Digital Development, Communications and the Mass Media
8. Ministry of Economic Development
9. Ministry of Education
10. Ministry of Energy
11. Ministry of Finance
12. Ministry of Foreign Affairs
13. Ministry of Health Care
14. Ministry of Industry and Trade
15. Ministry of Internal Affairs
16. Ministry of Justice
17. Ministry of Labour and Social Protection
18. Ministry of Natural Resources and Ecology
19. Ministry of Science and Higher Education
20. Ministry of Sport
21. Ministry of Transport

Mexico

Secretariats of State

1. Secretariat of State for Agriculture and Rural Development
2. Secretariat of State for Communications and Transport
3. Secretariat of State for Culture
4. Secretariat of State for the Economy
5. Secretariat of State for Energy
6. Secretariat of State for the Environment and Natural Resources
7. Secretariat of State for Finance and Public Credit
8. Secretariat of State for Foreign Affairs
9. Secretariat of State for Health
10. Secretariat of State for the Interior
11. Secretariat of State for Labour and Social Security
12. Secretariat of State for National Defence
13. Secretariat of State for the Navy
14. Secretariat of State for Public Education
15. Secretariat of State for Public Function
16. Secretariat of State for Public Security and Citizen Protection
17. Secretariat of State for Territorial, Urban and Agrarian Development
18. Secretariat of State for Tourism
19. Secretariat of State for Welfare

Türkiye

1. Ministry of Agriculture and Forestry
2. Ministry of Culture and Tourism
3. Ministry of Energy and Natural Resources
4. Ministry of the Environment and Urban Planning
5. Ministry of Family and Social Services
6. Ministry of Foreign Affairs
7. Ministry of Health
8. Ministry of Industry and Technology
9. Ministry of the Interior
10. Ministry of Justice
11. Ministry of Labour and Social Security
12. Ministry of National Defence
13. Ministry of National Education
14. Ministry of Trade
15. Ministry of Transport and Infrastructure
16. Ministry of Treasury and Finance
17. Ministry of Youth and Sports

Thailand

1. Ministry of Agriculture and Co-operatives
2. Ministry of Commerce
3. Ministry of Culture
4. Ministry of Defence
5. Ministry of Digital Economy and Society
6. Ministry of Education
7. Ministry of Energy
8. Ministry of Finance
9. Ministry of Foreign Affairs
10. Ministry of Higher Education, Science, Research, and Innovation
11. Ministry of Industry
12. Ministry of the Interior
13. Ministry of Justice
14. Ministry of Labour
15. Ministry of Natural Resources and Environment
16. Ministry of Public Health
17. Ministry of Social Development and Human Security
18. Ministry of Tourism and Sports
19. Ministry of Transport

South Africa

1. Ministry of Agriculture, Land Reform and Rural Development
2. Ministry of Basic Education
3. Ministry of Communications and Digital Technologies
4. Ministry of Co-operative Governance and Traditional Affairs
5. Ministry of Defence and Military Veterans
6. Ministry of Employment and Labour
7. Ministry of Finance
8. Ministry of Forestry, Fisheries and the Environment
9. Ministry of Health
10. Ministry of Higher Education, Science and Innovation
11. Ministry of Home Affairs
12. Ministry of Human Settlements
13. Ministry of International Relations and Co-operation
14. Ministry of Justice and Correctional Services
15. Ministry of Mineral Resources and Energy
16. Ministry of Police
17. Ministry of Public Enterprises
18. Ministry of Public Service and Administration
19. Ministry of Public Works and Infrastructure
20. Ministry of Small Business Development
21. Ministry of Social Development
22. Ministry of Sports, Arts and Culture
23. Ministry of Tourism
24. Ministry of Trade, Industry and Competition
25. Ministry of Transport
26. Ministry of Water and Sanitation

Colombia

1. Ministry of Agriculture and Rural Development
2. Ministry of Culture
3. Ministry of the Environment and Sustainable Development
4. Ministry of Finance and Public Credit
5. Ministry of Foreign Affairs
6. Ministry of Health and Social Protection
7. Ministry of Housing, Cities and Territorial Development
8. Ministry of Information Technology and Communications
9. Ministry of the Interior
10. Ministry of Justice and Law
11. Ministry of Labour
12. Ministry of Mines and Energy
13. Ministry of National Defence
14. Ministry of National Education
15. Ministry of Sports
16. Ministry of Trade, Industry and Tourism
17. Ministry of Transport

Argentina

1. Ministry of Agriculture, Livestock and Fishing
2. Ministry of Culture
3. Ministry of Defence
4. Ministry of Economy
5. Ministry of Education
6. Ministry of Environment and Sustainable Development
7. Ministry of Foreign Affairs, International Trade and Worship
8. Ministry of Health
9. Ministry of the Interior
10. Ministry of Justice and Human Rights
11. Ministry of Labour, Employment and Social Security
12. Ministry of Productive Development
13. Ministry of Public Works
14. Ministry of Science, Technology and Innovation
15. Ministry of Security
16. Ministry of Social Development
17. Ministry of Territorial Development and Housing
18. Ministry of Tourism and Sports
19. Ministry of Transport
20. Ministry of Women, Gender and Diversity

Appendix B: Benefit-Cost Analysis Database

Note: Draft database is available from project team upon request; final version will be included in this appendix, along with a discussion of its structure and use as well as results.

Appendix B: References

[Reflects contents of May 20, 2025 review draft of database; will be updated to include additional studies received as a result of that review. Also needs to be checked and reformatted]

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