



**2023 REPORT**

# Imagine a World

Where innovations could save the lives  
of 2 million more mothers and babies

# Goalkeepers is dedicated to accelerating progress toward the Global Goals

In 2015, 193 world leaders agreed to 17 ambitious goals to end poverty, fight inequality, and stop climate change by 2030. Goalkeepers focuses on accelerating progress toward those goals, with a focus on Goals 1–6.

Cover: A mother and her newborn.  
© AlignMNH

Eight years in, the world is off track. But failure is not inevitable—if we collectively challenge our assumptions about how global progress is achieved.



# Contents

## 4 Introduction

by Melinda French Gates and Bill Gates  
Co-Chairs, Bill & Melinda Gates Foundation

## 8 Delivering hope



by Melinda French Gates  
Co-Chair, Bill & Melinda Gates Foundation

## 17 The baby knowledge boom



by Bill Gates  
Co-Chair, Bill & Melinda Gates Foundation

## 25 A final word

by Melinda French Gates and Bill Gates  
Co-Chairs, Bill & Melinda Gates Foundation

## 26 Explore the data

## 46 Sources and notes

# Introduction

by Melinda French Gates and Bill Gates  
Co-Chairs, Bill & Melinda Gates Foundation

When a mother dies during childbirth, the future dies with her.

The world doesn't just lose everything she is and will be. We also—all too often—lose her child. The chance of a baby reaching their first birthday drops to less than 37 percent when their mother dies during childbirth.

This happens 800 times a day. Once every two minutes, a mother dies from complications due to childbirth. By the time you finish reading this introduction, it will happen again.

Two decades ago, that wasn't the way progress was heading.

The early 2000s were a boom moment for virtually every measure of human well-being. Poverty rates. Educational achievement. Longevity. Things were improving. But nowhere was progress faster or more thrilling than with the health of mothers and their children.

This didn't happen by accident. In 2000, world leaders drafted the Millennium Development Goals (MDGs), which included ambitious targets for the health of mothers and newborns. In response, big new organizations helped accelerate progress, like Gavi, the Vaccine Alliance and the Global Fund to Fight AIDS, Tuberculosis, and Malaria. For the first time in human history, basic lifesaving health care was made available to hundreds of millions of people: AIDS medications, contraceptives, childhood vaccines, bed nets to prevent malaria.

It was a thrilling moment—until it ended. And when COVID-19 hit, the virus overwhelmed the clinics and health workers that had helped women deliver their babies safely. Since then, progress has continued to stall.

Every year, approximately 5 million children die before they reach their fifth birthday. Nearly another 2 million babies never take their first breath—they're stillborn. Although these deaths have continued to decline since the mid-2010s, they're not declining fast enough, especially for infants. Most child deaths—74 percent—happen during a baby's first year.

Meanwhile, for new mothers, progress has hit a brick wall. Globally, maternal mortality rates have remained stubbornly static over the past eight years, and in some countries, from the United States to Venezuela, they have risen.

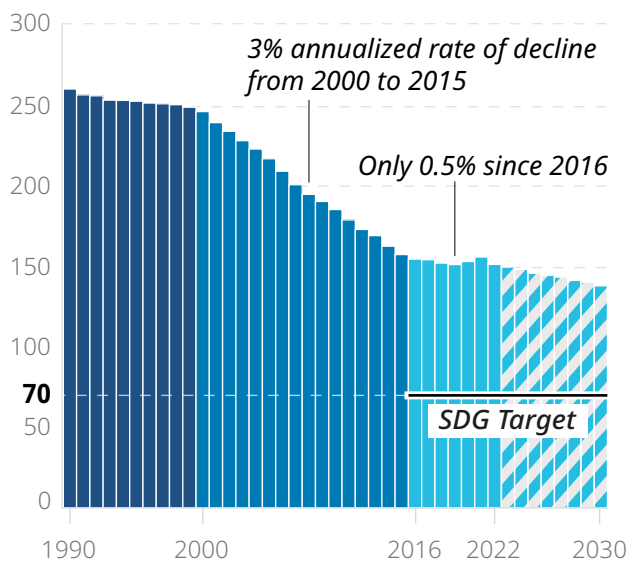
## Two SDG targets that are off track

Despite significant progress from 2000 to 2015, slowing improvement since then means the world is not on track to reach the Sustainable Development Goals for the survival of mothers or babies—not unless progress is accelerated.

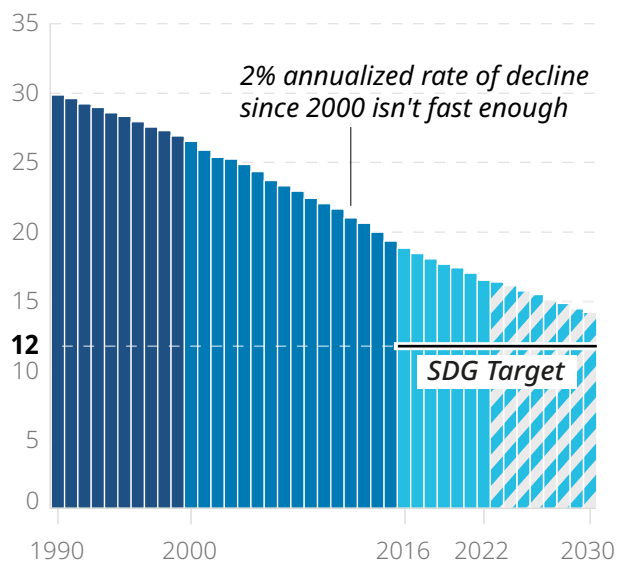
### Legend



Maternal deaths per 100,000 live births



Neonatal deaths per 1,000 live births



As we began developing this report, we knew we had to focus on these alarming statistics. It's true, there are so many new and complex issues confronting the world, from climate change-induced heat waves to recent breakthroughs in artificial intelligence (AI). Still, we believe our most ancient public health problem—the survival of mothers and babies—remains the most urgent.

2023 marks the halfway point for the successors to the Millennium Development Goals—the Sustainable Development Goals. The ambition was to end all preventable child deaths by 2030, and to cut the maternal mortality rate to less than 70 out of every 100,000 births. We are far off track on both goals—but that doesn't have to be the case.

In fact, there's a new and remarkable irony about the problem of maternal and neonatal mortality: In the 2010s, just as the problem was about to get worse, it also became more solvable. Doctors uncovered revolutionary information about maternal and child health—everything from the exact diseases that are killing children, to the role anemia can play in increasing blood loss during childbirth, to previously unknown ways in which a baby's health is linked to their mother's.

**It's not an exaggeration to say that researchers have learned more about the health of mothers and babies over the past 10 years than they did in the century before that. Tragically, those solutions aren't reaching families in the communities where mothers and kids need them most. That needs to change.**

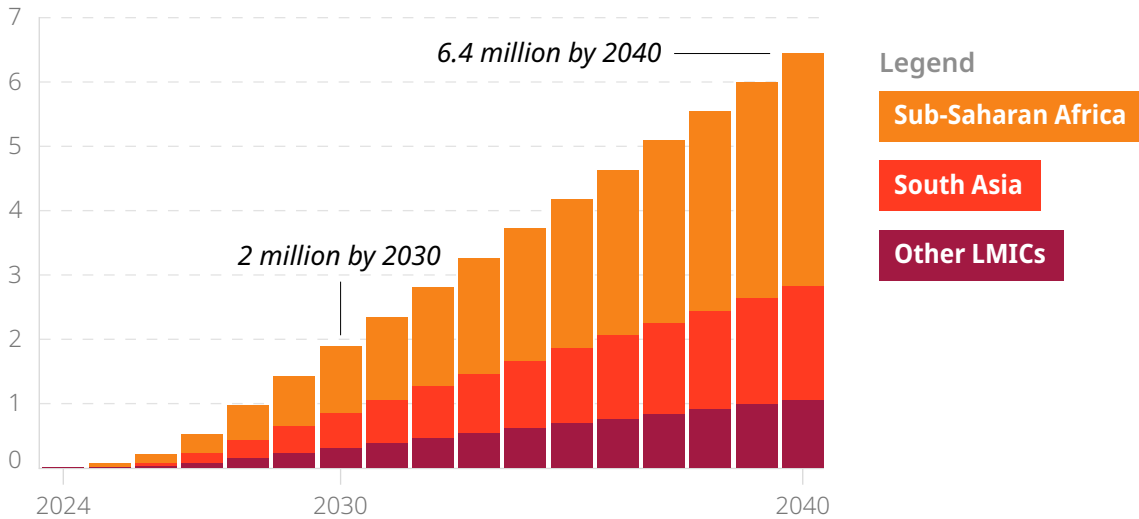
In the following essays, we'll describe how these insights are being turned into innovations and practices to accelerate progress and boost survival rates for mothers and babies. Typically, we focus only on low- and middle-income countries (LMICs), but researchers believe many of these breakthroughs could also be used to fight the epidemic of maternal mortality globally, including in the United Kingdom and the United States, where death rates for Black mothers have doubled since 1999.

What will these new innovations mean for the survival of mothers and babies? For this report, global health experts estimated how many additional lives might be saved if these new innovations were used widely in LMICs. The result? Nearly 1,000 mothers and babies each day through the end of the decade. Or 2 million lives.

## Opportunity to save millions of lives

By making new innovations accessible to those who need them most, 2 million additional lives could be saved by 2030—and 6.4 million lives by 2040.

### Millions of total lives saved



That's 2 million families spared an unimaginable heartbreak—and 2 million more people who can shape and enrich our world.

You don't need us to tell you what a remarkable achievement that would be.

Just look.



Close-up of mother kissing her newborn, in the United States.

© Getty Images

# Delivering hope

New breakthroughs could ensure that more women survive pregnancy and childbirth



**by Melinda French Gates**  
Co-Chair, Bill & Melinda Gates Foundation



In February, I was with my daughter, Jenn, when she gave birth to a daughter of her own. Welling up inside me were all the emotions a new grandparent feels: joy, excitement, pride—and, above all, immense gratitude.

In the best of circumstances, childbirth is an exhausting, emotional experience, something I knew from my own experience. It felt like just yesterday that I was giving birth to Jenn in a 14-hour labor that left me utterly drained and barely able to walk.

But in the worst of circumstances, childbirth isn't just draining—it's deadly, for mother and baby. Several years ago, I traveled to Malawi, where almost everyone I met had lost someone they loved. At a maternity clinic, the staff, dazed with grief, told me that just the week before, one of their own nurses had given birth, and they couldn't save her.

I'll never forget the pain I saw on their faces as they told me about the women they'd lost. The worst part is, so many of these deaths could have been prevented.

For nearly all of human history, we simply didn't know enough about preventing or treating the common childbirth complications that lead to death, such as postpartum hemorrhage or infection. Today, we know a great deal.

A mother holds her newborn daughter closely, in Canada.

© Getty Images



Yet, as is so often the case in global health, innovations aren't making their way to the people who need them most: women in low-income countries like Malawi, as well as Black and Indigenous women in high-income countries like the United States, who are dying at three times the rate of white women, even when holding for economic and education levels.

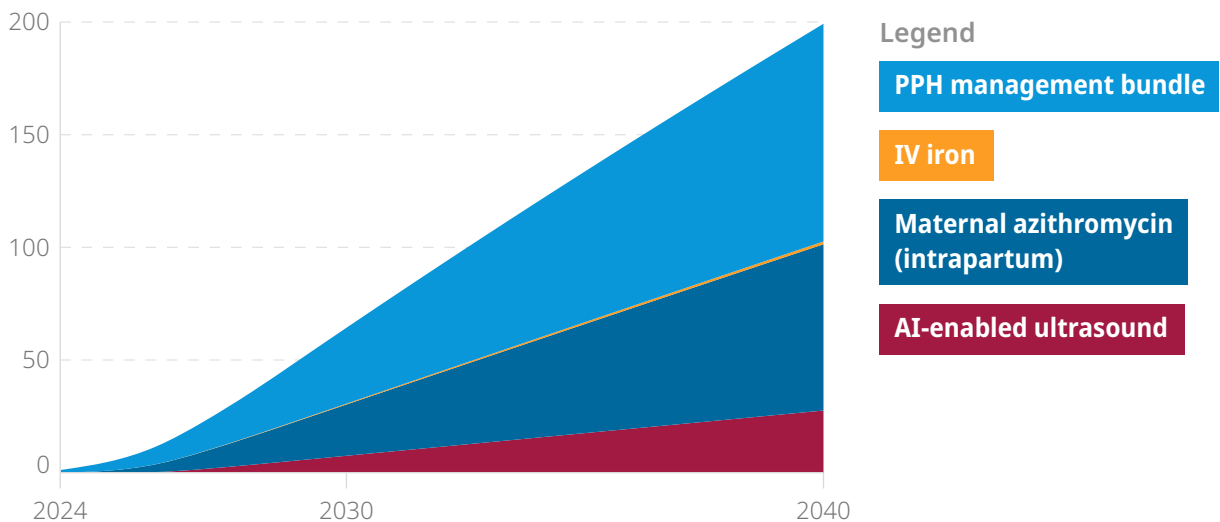
Brilliant researchers have developed new interventions that could ensure more women have access to lifesaving care. Their work is opening up new—and, importantly, low-cost and mobile—avenues of preventing and treating deadly childbirth complications. When combined with better primary health care and more resilient health systems, the three innovations that follow have the potential to save thousands of mothers' lives in LMICs around the world by 2030.

Here's how.

## A big impact for mothers

Low-cost innovations can prevent thousands of women in LMICs from dying during pregnancy and childbirth.

### Thousands of total deaths prevented



## Treating postpartum hemorrhage

Postpartum hemorrhage (PPH) is the number one cause of maternal death. The World Health Organization estimates that PPH, which means losing more than half a liter of blood within 24 hours of childbirth, affects 14 million women

every year—killing 70,000 of them, primarily in low-income countries. Those who survive often face long-term, disabling complications, such as heart or kidney failure.

Dr. Hadiza Galadanci, an obstetrician and researcher from Nigeria, explains that there is a critical flaw in the way PPH is diagnosed: Health care workers often have a hard time recognizing how much blood loss is too much blood loss. The only tool they have is a rough visual estimate. In a study they called E-MOTIVE, Dr. Galadanci and a team of researchers in four African countries with high maternal mortality found that about half of the women who experience PPH were never diagnosed at all. Therefore, they never got lifesaving treatment.

There is a simple, low-cost way to identify when blood loss is dangerously excessive: a drape that looks like a V-shaped plastic bag. When this calibrated obstetric drape is hung at the edge of the bed, collected blood rises like mercury in a thermometer. And in a busy hospital ward, that visual gauge tells providers which patients are in danger in just a single glance.



Dr. Galadanci reviewing the postpartum hemorrhage bundle with health workers, in Nigeria.

© Nelson Owoicho

When PPH is identified, doctors, nurses, and midwives have long relied on a series of five treatments to stop the bleeding: uterine massage, oxytocic drugs, tranexamic acid, IV fluids, and genital-tract examination. But those interventions were being delivered sequentially—and far too slowly. So the researchers asked providers to bundle the interventions, administering all five at once.

The results were dramatic: In a trial of 200,000 women, providers who used drapes and followed the updated E-MOTIVE guidelines were able to decrease cases of severe bleeding by a remarkable 60 percent.

## Preventing PPH in the first place

A common cause of postpartum hemorrhage is anemia, or severe iron deficiency.

Anemia affects as many as 37 percent of pregnant women around the world. In some places in South Asia, that rate jumps as high as 80 percent. Anemia is a dangerous condition on its own, but it is also deeply intertwined with PPH: If a woman has severe anemia, she is much more likely to bleed heavily during her delivery. And even worse, because anemia reduces how much oxygen the blood can carry, anemic women cannot survive the same volume of blood loss as nonanemic women. It's a vicious cycle.

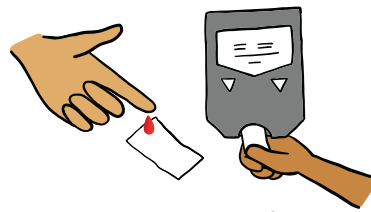
Symptoms of anemia include fatigue or feeling faint or dizzy—things that might happen simply because you're pregnant. Every pregnant woman should have access to maternal micronutrient supplements—high-quality prenatal vitamins that include iron—which can prevent most mild maternal anemia cases. But diagnosis and targeted treatment are necessary to address moderate and severe cases of anemia. So once again, a primary challenge is diagnosis. Screening for anemia during pregnancy is one of the most important tests we can do to ensure a woman's health and survival. And just one example of why antenatal care is so important.

If anemia is diagnosed, the traditional treatment is supplemental iron delivered via tablets. But taking iron orally can cause unpleasant side effects and requires women to keep up with a consistent regimen for up to 180 days.

But a Nigerian obstetrician and researcher named Dr. Bosede Afolabi is working on bringing a promising new intervention to her home country: a one-time, 15-minute intravenous (IV) infusion of iron. It's an IV drip that can replenish women's iron reserves during pregnancy—or even after pregnancy—and it could help treat severe cases of anemia quickly and effectively.

## IV iron quickly replenishes women's iron reserves

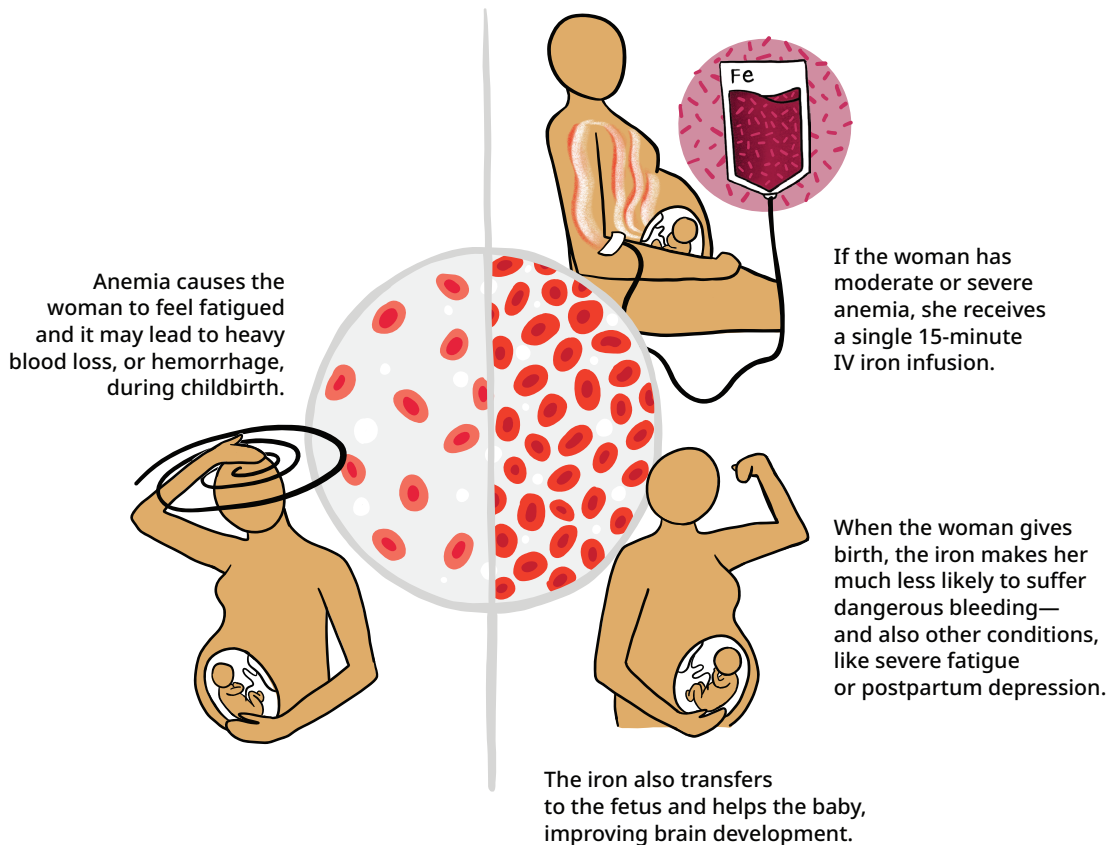
### Diagnosis



During routine antenatal care, health workers discover a woman suffers from anemia.

### No intervention

### Intervention



Anemia isn't just a cause of postpartum hemorrhage; it's also an effect—one that can lead to long-term consequences ranging from heart disease to depression. So this solution could mean not just saving women's lives but also helping them lead better ones.

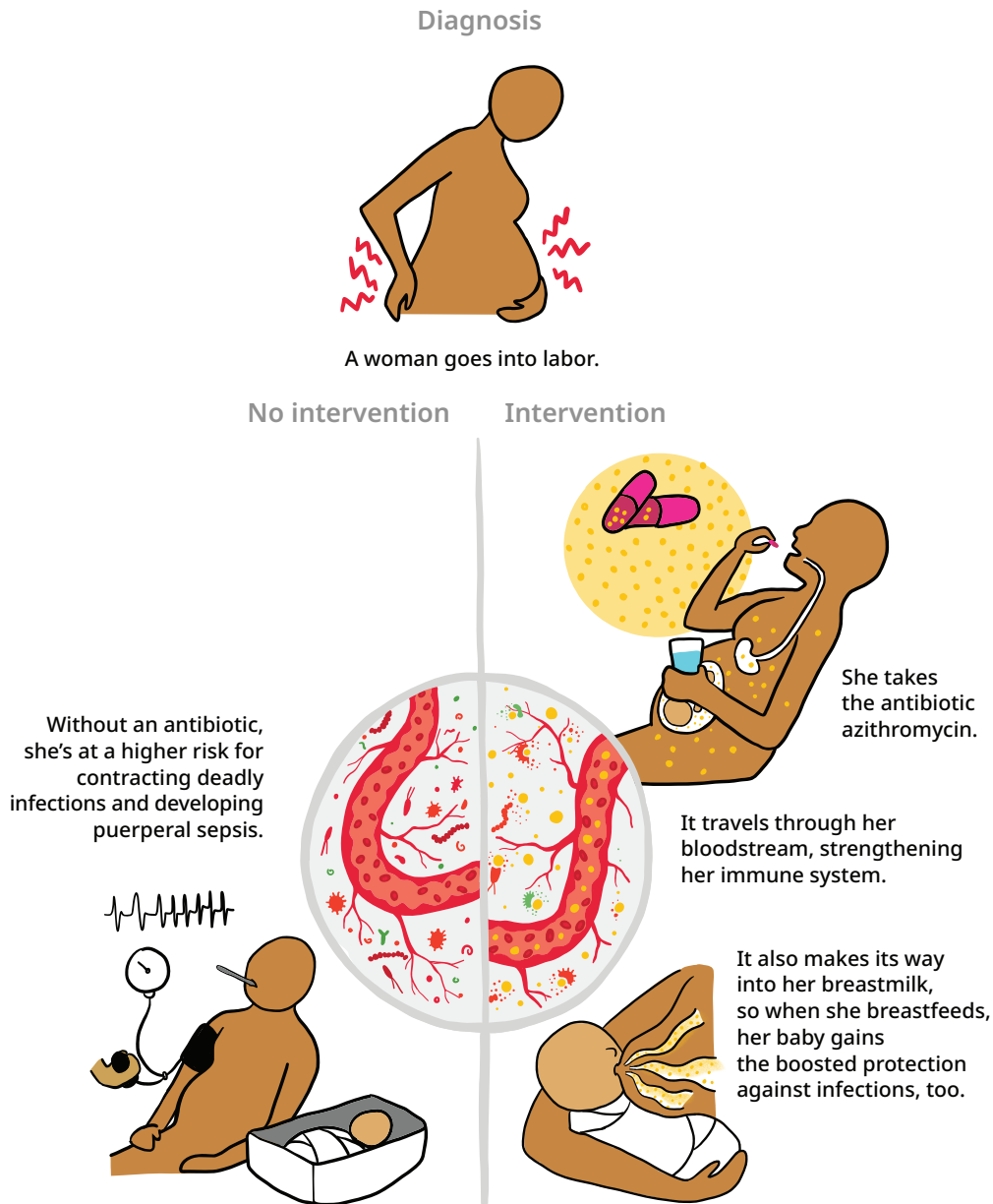
## Preventing infections

Another leading cause of maternal death and disability is infection that leads to sepsis—an extreme, full-body inflammatory reaction. In recent years, researchers have discovered that one of the most promising new ways to prevent infection during pregnancy happens to be one of the most commonly used antibiotics in the world.

For decades, azithromycin has been used to treat a variety of bacterial infections, most commonly eye and respiratory infections. Now we're learning that when given during labor, azithromycin also reduces maternal infections, therefore preventing those infections from spiraling into sepsis. During a trial across sub-Saharan Africa, it reduced sepsis cases by a third. That's a remarkable discovery—one that could be very useful in places where most births are at home.

And it could also be a game-changer in the United States, where 23 percent of maternal deaths are from sepsis.

## Azithromycin reduces infection risk



The United States has some of the most abysmal—and most inequitable—maternal mortality rates among high-income countries. American women are more than three times more likely to die from childbirth than women in almost every other wealthy country. But, as I noted earlier, the biggest crisis is among Black and Indigenous women.

I still remember the shock I felt when I read tennis star Serena Williams’s account of how close she came to dying from serious blood clots after giving birth—simply because her own doctors wouldn’t believe her that something was wrong. That shock only grew when I read, just this past April, that Tori Bowie, a Black American track and field Olympian, died from childbirth complications in her home. And these are just the stories we hear about in headlines.

It’s remarkable that a common antibiotic like azithromycin has the potential to address the cause of nearly a quarter of American maternal deaths.

But as Serena’s harrowing experience and Tori’s tragic death demonstrate, one antibiotic is not enough. The systemic inequalities that deny the highest-quality care to Black and Indigenous women also need to be addressed—urgently.

## **A powerful engine for progress**

These are three of the innovations that are reshaping maternal health—and there are others just on the horizon, especially as researchers learn more about how to use AI to improve maternal health care.

Of course, these breakthroughs aren’t silver bullets on their own—they require countries to keep recruiting, training, and fairly compensating health care workers, especially midwives, and building more resilient health care systems. But together, they can save the lives of thousands of women every year. And that’s not all.

Improving maternal health also means improving infant health and survival. It means stronger families, more vibrant communities, and more prosperous societies. We have seen over and over again that when countries actually prioritize and invest in women’s health, they unleash a powerful engine for progress that can reduce poverty, advance gender equality, and build resilient economies.

**“Improving maternal health also means improving infant health and survival. It means stronger families, more vibrant communities, and more prosperous societies.”**

– Melinda French Gates

That’s why, more than anything, we need to rally the will to invest in these breakthroughs—so they actually get to the women who need them most—and fund the remarkable researchers who will discover the next ones.

Dr. Afolabi explained that in the Yoruba language, the traditional greeting to a woman who has given birth is “Eku ewu omo,” which translates to, “Well done for getting through the danger of childbirth.”

Thanks to her, and others like her, more women will live long enough to hear those words. And maybe one day, when breakthroughs have reached women all around the world and childbirth is far less dangerous, all they’ll hear is “Well done.”



# The baby knowledge boom

A decade of research into why kids in the poorest places die is now unlocking ways to save millions



by **Bill Gates**  
Co-Chair, Bill & Melinda Gates Foundation



It's been almost a decade, but it's still hard for me to tell this story without choking up.

It was 2016, and I was visiting a hospital in Johannesburg, South Africa—specifically, Soweto, the township on the city's outskirts, which had some of the highest child mortality rates in the world.

Even at wakes and funerals it's sometimes shocking for me to see a dead body, but this didn't look like any dead body I had seen before. It was so small, covered in plastic. Only after I stepped closer did I recognize it was a newborn baby, maybe a day or two old.

Afterwards, I collected myself and went outside. The child's parents were there.

I had met parents who'd lost children before, but not like this. When children died in poorer countries, they were never brought to a hospital or a morgue. Sometimes, a health worker would travel to the home and ask what had happened, but medical examiners and doctors didn't perform an autopsy—not until CHAMPS.

Child Health and Mortality Prevention Surveillance, CHAMPS, is an initiative our foundation started in 2015. The idea was

A mother and her two healthy babies, in Senegal.

© AlignMNH

to learn more about the root causes of child death by taking blood and tissue samples from children who'd died, but no one was quite sure whether, on the worst day of their lives, the parents would agree. The couple outside the Soweto hospital were among the first to volunteer, and I wanted to learn why.

“We just don't want this to happen to another family,” they told me.

That's what sticks with me—not simply the tragedy, but the kernel of hope. Those parents saw a bigger picture on the day their greatest fear was realized. And it was up to the rest of the world to do better by them and millions of parents like them: We had to find out why children were dying to keep them alive.

Even ten years ago, public health officials had only the vaguest information about why babies were dying. Back then, any record of a child's death would generally list one of the four most common causes: diarrhea, malnutrition, pneumonia, or premature birth. But each was a vast ocean of different illnesses, with scores of different causes and cures. Pneumonia, for example, is linked to more than 200 types of pathogens.

Answering “Why did a child die?” felt a little bit like being asked to find a child lost at sea—except you were only told which ocean to search in, Atlantic or Pacific. There was an expanse of missing information, so our foundation decided to help fill that void by funding research including three landmark studies. In addition to CHAMPS, which was aimed at explaining the most inscrutable causes of death, there was also the Pneumonia Etiology Research Child Health Study, PERCH, which examined the causes of childhood pneumonia, while the Global Enteric Multicenter Study, GEMS, did the same for diarrheal diseases.

As doctors compiled and compared case after case, a clearer (and often surprising) picture of child death emerged. For instance, some pathogens were less likely than was expected, like pertussis, which causes whooping cough, but others were more likely than we expected, like *Klebsiella*, which can be harder to treat.

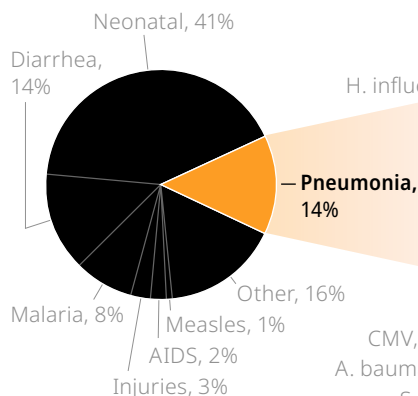
Imagine if doctors didn't know why American men were susceptible to heart attacks—and then, in the span of two years, they discovered the links to high cholesterol and smoking. That's what happened with infant pneumonia, and the new information about *Klebsiella* is leading doctors to change what antibiotics they use.

## More precise understanding of why children die

CHAMPS data provides hyper-detailed information about which pathogens are causing deaths, guiding the development of improved treatments and vaccines.

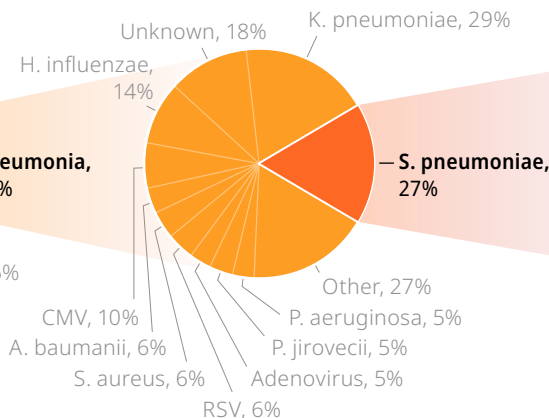
**1**

Reported causes of child mortality globally were limited in 2010



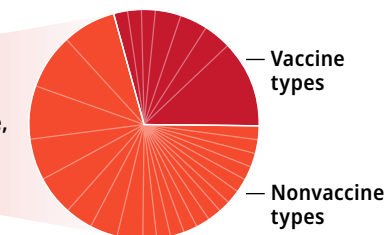
**2**

CHAMPS provides more detail, identifying specific pathogens causing deaths



**3**

CHAMPS also provides details on the types of pathogens to help determine how well vaccines work



**Vaccine types:**  
3, 1, 19F, 23F, 9V, 18C, 19A

**Nonvaccine types:**  
Nontypeable, mixed, 19B, 12F/44, 17F, 10A, 35B, 48, 8, 9L/9N, 11B/11C, 13, 15A/15F, 15B/15C, 21, 22F, 23A, 23B, 24B/24F, 32A/32F, 37

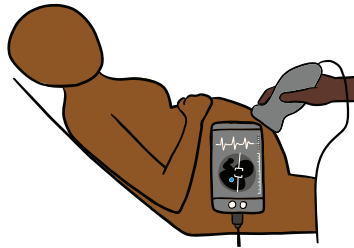
This is the crux of what I call “the baby knowledge boom.” Thanks to studies like CHAMPS, GEMS, and PERCH, the medical field has begun to understand precisely when and why some babies are dying, which allows them to keep others alive.

Another great example is how doctors are helping premature babies breathe—by using novel methods to “fast-forward” their lung growth. If a doctor sees that a mother is going to give birth prematurely, they can give her antenatal corticosteroids, or ACS. The ACS “exercises” the fetus’s lungs, which accelerates their growth, packing a few weeks’ worth of maturation in just a few days. Our foundation estimates that ACS could save the lives of 144,000 infants in sub-Saharan Africa and South Asia by 2030 and nearly 400,000 by 2040.

But that’s just a fraction of the lives we can save if we apply what researchers learned about nutrition in the past decade.

# Antenatal corticosteroids fast-forward baby's lung growth

## Diagnosis

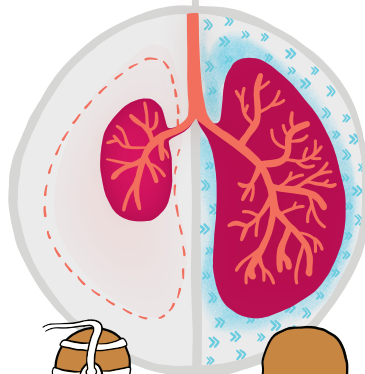
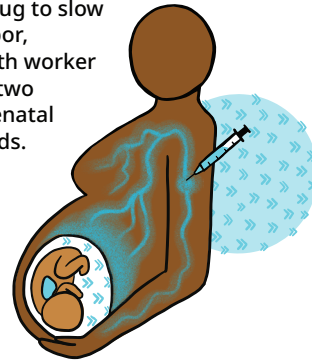


A woman develops a condition that will likely lead to premature delivery. With a mobile ultrasound, health workers realize the labor is preterm.

## No intervention

## Intervention

If necessary, the team can give a drug to slow down the labor, and the health worker administers two shots of antenatal corticosteroids.



The baby's lungs are underdeveloped.

These steroids travel through the mother's bloodstream, through the placenta, to the baby, where it helps speed up lung growth.

The baby is born— but in respiratory distress and needs a machine and some medication to help breathe.



The baby is born, breathing easily.

## Gut check

If you've seen medical TV shows like *CSI* or *House, MD*, you already have some sense for how an initiative like CHAMPS works. Doctors and pathologists sit on a “decode panel,” reviewing cases, battling ideas back and forth, until they come to a full conclusion on all the steps that led to a person's death.

This level of detail is important because, outside of unexpected accidents, few people die for just one reason. Instead, death is a chain reaction. For example, a baby who dies of pneumonia likely wasn't just fine before getting sick. She likely was born premature or was undernourished. The best way to keep a child alive isn't to treat the pneumonia that will kill her. That's a last resort. Rather, we should try to stop the first link in the causal chain from being formed in the first place.

Studies like CHAMPS helped us understand that often that first link is malnutrition.

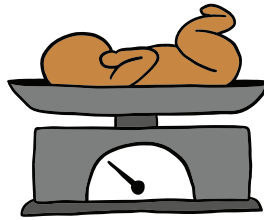
Believe it or not, I think this is positive news. Because our growing understanding of why children die has proceeded alongside a second, arguably bigger knowledge boom—this one involving our grasp of nutrition.

If we've packed 100 years of learning about maternal and child mortality into the past decade, researchers have probably crammed 1,000 years' worth of knowledge about the microbiome in the same decade, which is the teeming universe of bacteria that lives inside our digestive tracts. For example, the child health field used to think of breastmilk as only food for the newborn. But we've now learned that it's also food for the bacteria that naturally live in the gut of the baby.

These bacteria—the most common ones are called *bifidobacteria*—break down specific sugars in the milk, turning it into nutrients. Without these good bacteria it doesn't matter how well you feed your baby; their digestive system would still have a really hard time absorbing the milk's nutrients. Which is why doctors are now recommending that babies—especially those born too soon or too small—are given a probiotic supplement with *bifidobacteria* in it.

## B. infantis improves baby's gut microbiome

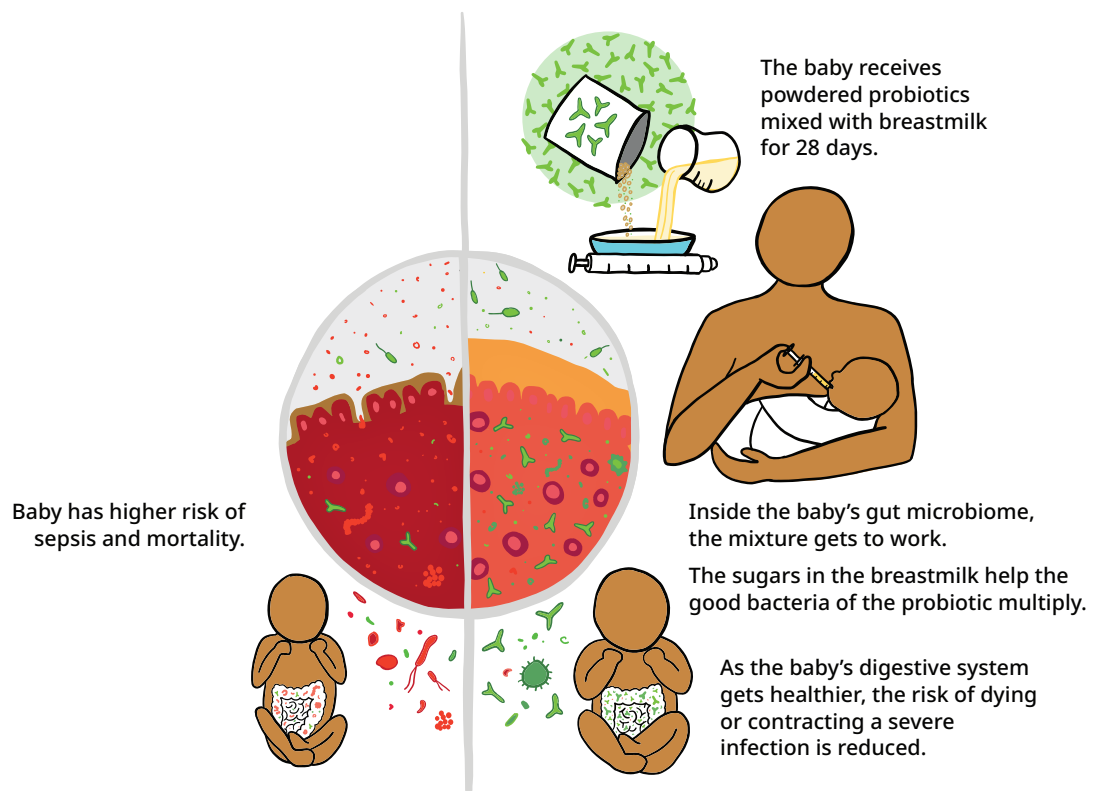
### Diagnosis



A baby is born preterm, small for gestational age, or at a low birth weight.

### No intervention

### Intervention



This next part is gross, but amazing. *Bifidobacteria* are different depending on where you're from. Babies in India have different gut bacteria than babies in the United States, so these probiotics have to be tailored hyper-locally—or in this case, “diaper locally.” Researchers swab the poop of a baby, isolating the bacteria that live in their intestines, then analyze the unique way they work in their digestive tract and can create locally tailored probiotics based on that research.

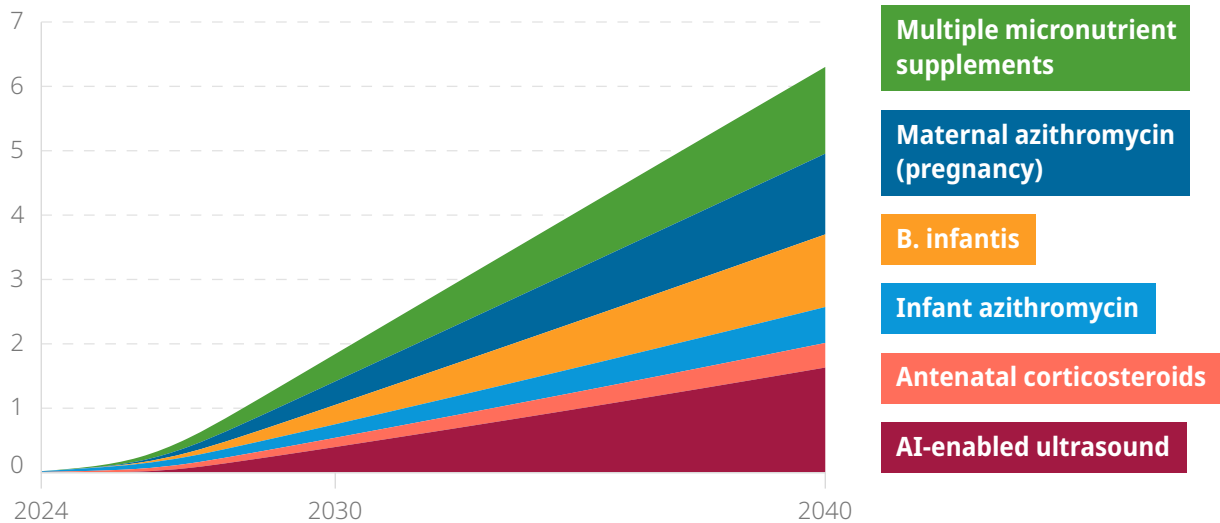
There are other new supplements to fight malnutrition, but maybe the biggest innovation is *when* doctors are providing them: in the womb. The medical field used to think that you couldn't treat malnutrition until a child was about six months old and started eating. But new research has found that the baby's microbiome and the mother's are connected. If a pregnant woman has abundant bifidobacteria, good bacteria can spread from her digestive tract to the child's; this way, the baby is born already having a healthy gut.

Studies show these probiotics help babies gain an additional 5 grams of weight per day in the late stages of pregnancy and can improve baby's growth when given to the baby after birth.

## Delivering healthy babies and saving millions of lives

Low-cost innovations can prevent millions of stillbirths and infant deaths in LMICs.

Millions of total deaths prevented



## Remembering Soweto

*“We just don’t want this to happen to another family.”*

What those parents in Soweto said to me has echoed in my mind for over seven years, and I’ve often wondered how I might respond if I saw them again.

I think I would be honest. It might not be possible to protect every family, to guarantee a world of zero newborn deaths. Zero is a hard number.

But that doesn't mean we can't come very, very close.

Over the past decade, the field of child health has moved faster and farther than I thought I'd see in my lifetime. And if our delivery can keep pace with our learning—if researchers can keep developing new innovations and health workers can get them to every mother and child that needs them—then doctors could all but guarantee a baby would survive their crucial first days.

That's what I would tell them. That's what, together, I believe we can show them.

**“Over the past decade, the field of child health has moved faster and farther than I thought I'd see in my lifetime.”**

– Bill Gates



# A final word

*One last note to our readers, by Melinda French Gates and Bill Gates*

If there's one thing you take away from this report, we hope it's hope itself—the belief that the world can save the lives of 1,000 more mothers and babies every day through the end of the decade.

But you should also know: It's not a done deal. Those lives will be saved only if all mothers and babies have access to both quality health care services and the innovations we wrote about in this report.

We need policy changes, political will, more investment into women's health, and health care workers—including midwives. We need to listen to what women want and ensure that women have a say in their own health care. And ultimately, we need to commit together that we no longer accept preventable deaths of mothers and babies around the world.

The world has come so far so quickly in our understanding of how to save the most fragile lives. Together, we can translate that knowledge into tangible progress.

To paraphrase our friend, the late Dr. Paul Farmer, “The biggest failure we have in providing health care to mothers and children is a failure of imagination... If we can send a rover to Mars, we can imagine a world where mothers and babies can live long and healthy lives.”

# Explore the data

Each year, Goalkeepers share the latest estimates on 18 indicators, ranging from poverty to education. These indicators help us understand the progress toward the Sustainable Development Goals—where innovation and investment are creating bright spots, and where we’re collectively falling short. This data reminds us that progress is possible, but not inevitable.

Halfway to the deadline for the SDGs, the world is off track. Urgent action is needed if the world is going to meet the SDG targets and create a more equitable and safe future for all by 2030.

**Interact with the data**  
Visit our website to view an interactive version of these charts and access the raw data.

[gates.ly/explorethedata](https://gates.ly/explorethedata)



Poverty



Stunting, Agriculture



Maternal Mortality, Under-5 Mortality, Neonatal Mortality, HIV, Tuberculosis, Malaria, Neglected Tropical Diseases, Family Planning, Universal Health Coverage, Smoking, Vaccines



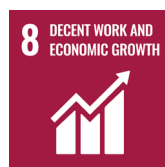
Education



Gender Equality



Sanitation



Financial Services for the Poor

# Poverty

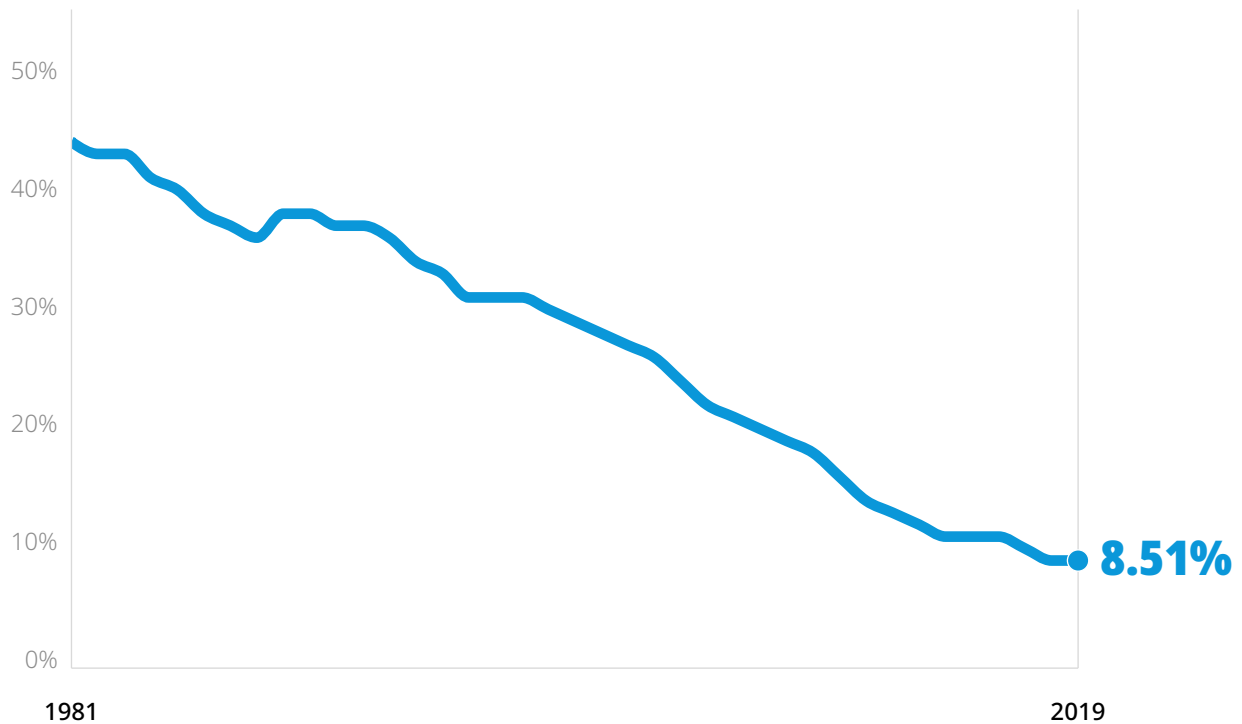


## SDG Target 1.1

Eradicate extreme poverty for all people everywhere.

It is estimated that the pandemic pushed 70 million more people into extreme poverty in 2020, increasing the total number of people living in extreme poverty from 659 million in 2019 to 729 million in 2020. At the current pace, nearly 7% of the world's population will remain in extreme poverty—that's 574 million people in extreme poverty by 2030.

### Percentage of population below the international poverty line (US\$2.15/day)



#### Legend

Historical average

# Stunting

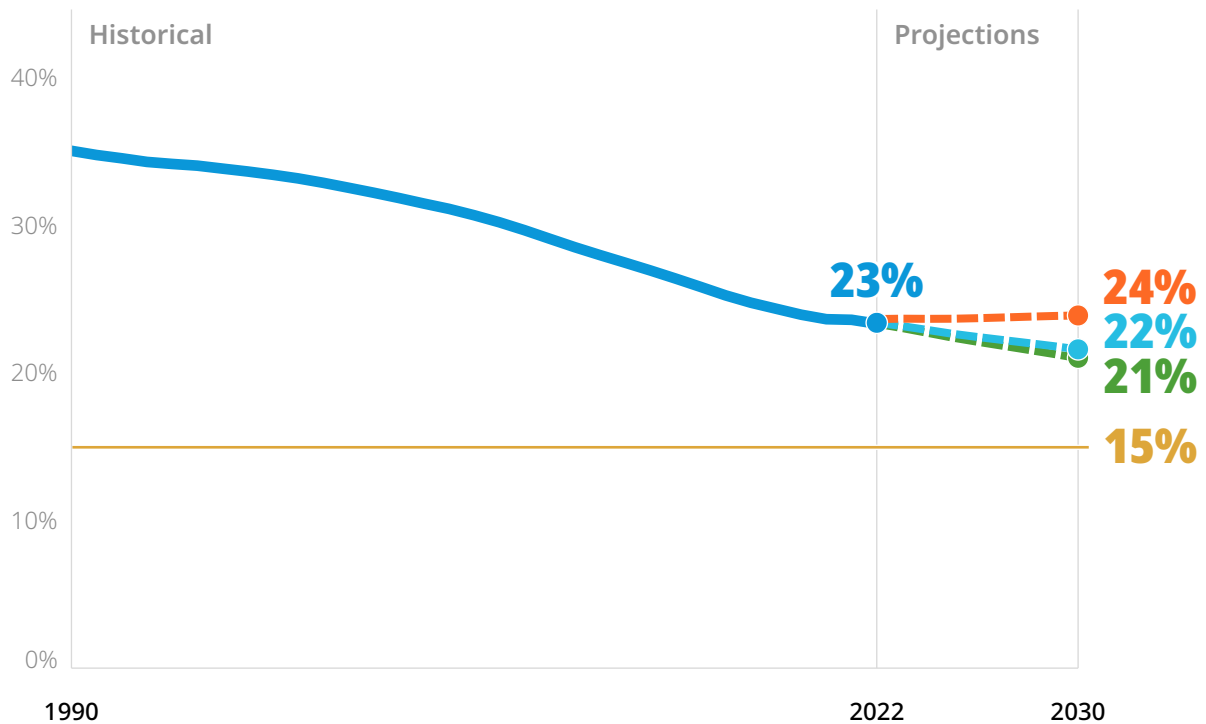


## SDG Target 2.2

End all forms of malnutrition, including achieving, by 2025, the internationally agreed-upon targets on stunting and wasting in children under five.

Stunting among children under age 5 decreased from 24% in 2021 to 23% in 2022. The 2030 projection estimates that 22% of children under age 5 will be stunted—missing the 2025 stunting target of 15%.

### Prevalence of stunting among children under age 5



#### Legend



# Agriculture

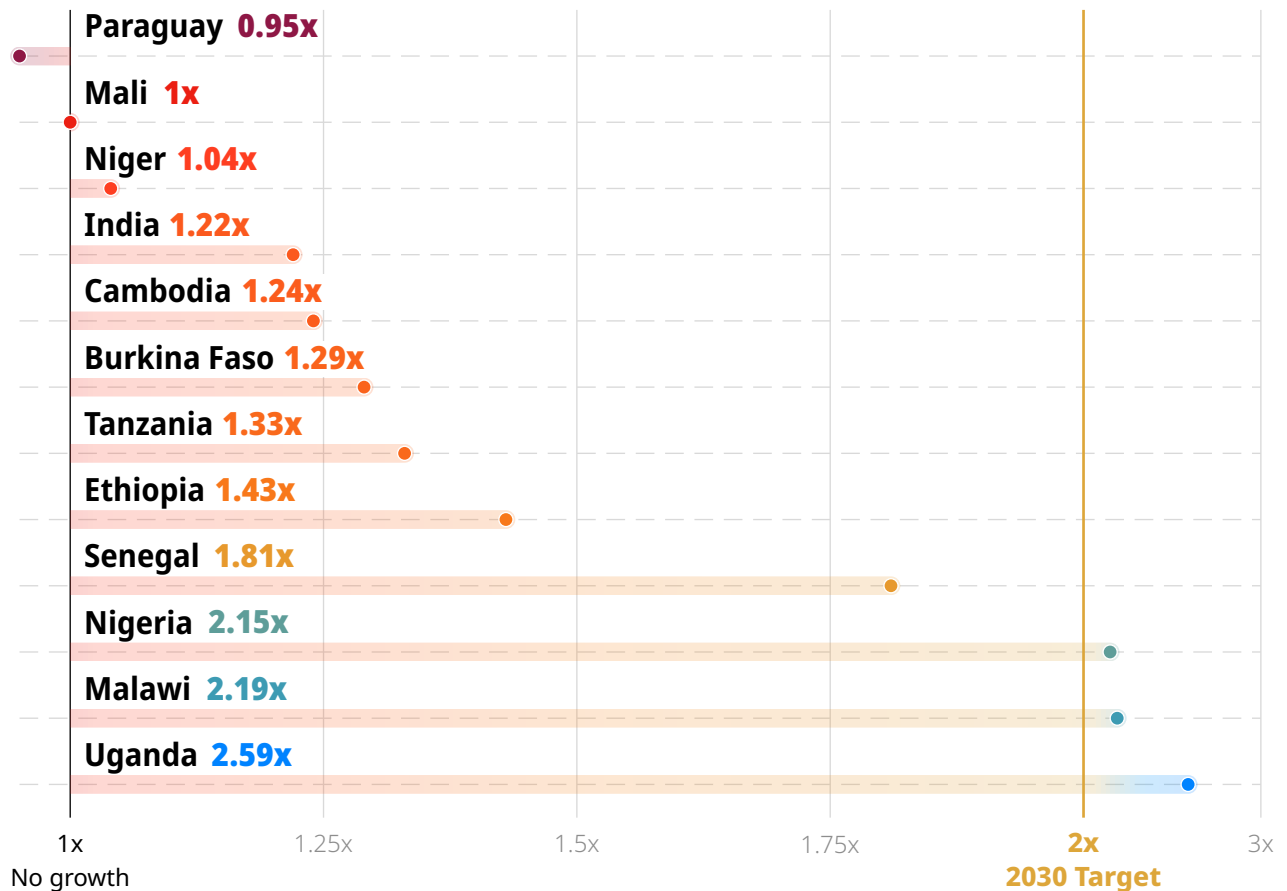


## SDG Target 2.3

Double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers.

Data related to incomes of small-scale food producers is increasing in quality and quantity over time—but remains limited for assessing progress against the target.

### Rate of average annual income growth from agriculture for small-scale food producers, PPP (constant 2011 international \$)



*Note: Country growth rates are not comparable since they are calculated over different year ranges. All date ranges can be found in data sources.*

# Maternal Mortality

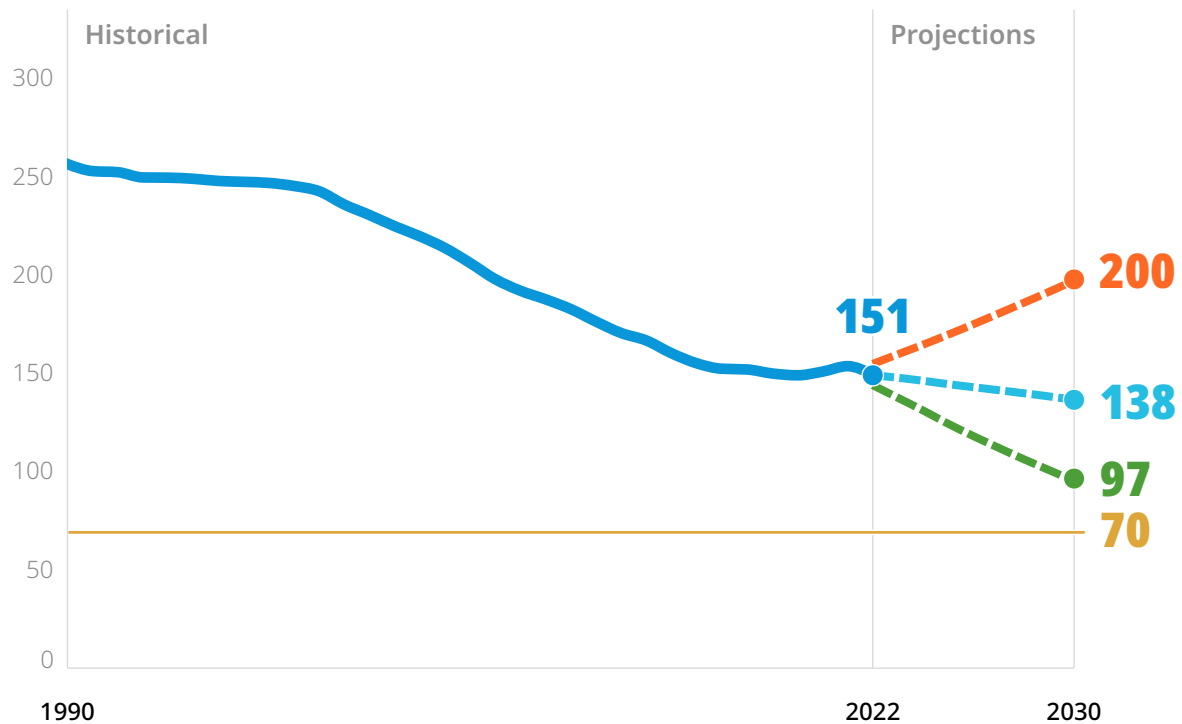


## SDG Target 3.1

Reduce the global maternal mortality ratio to less than 70 per 100,000 live births.

It's estimated that the global maternal mortality ratio dropped from 156 per 100,000 live births in 2021 to 151 in 2022. The 2030 projection estimates 138 maternal deaths per 100,000 live births—almost double the target.

### Maternal deaths per 100,000 live births



#### Legend



# Under-5 Mortality

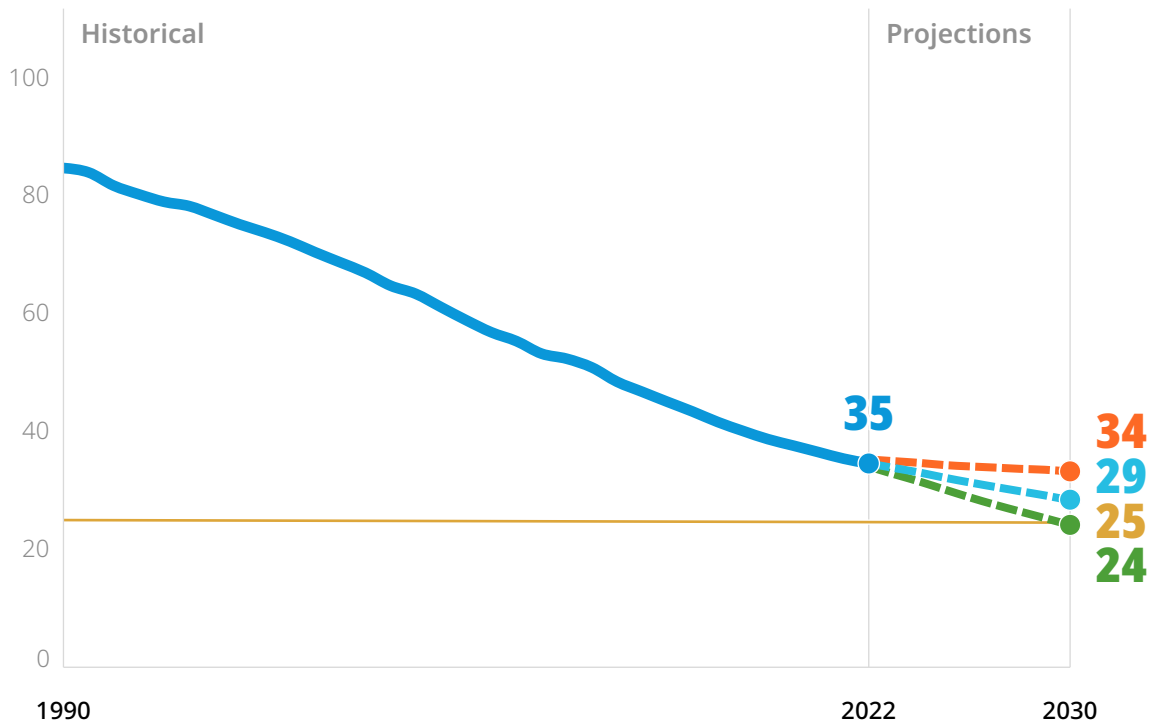


## SDG Target 3.2

End preventable deaths of children under five years of age, with all countries aiming to reduce under-5 mortality to at least as low as 25 per 1,000 live births.

It is estimated that the under-5 mortality rate has declined from 37 child deaths per 1,000 live births in 2021 to 36 child deaths per 1,000 live births in 2022. If we continue at the current pace the projected child mortality rate will be 29 per 1,000, missing the target of 25 child deaths per 1,000 live births. If progress accelerates, the 2030 target is within reach.

### Under-5 deaths per 1,000 live births



#### Legend



# Neonatal Mortality

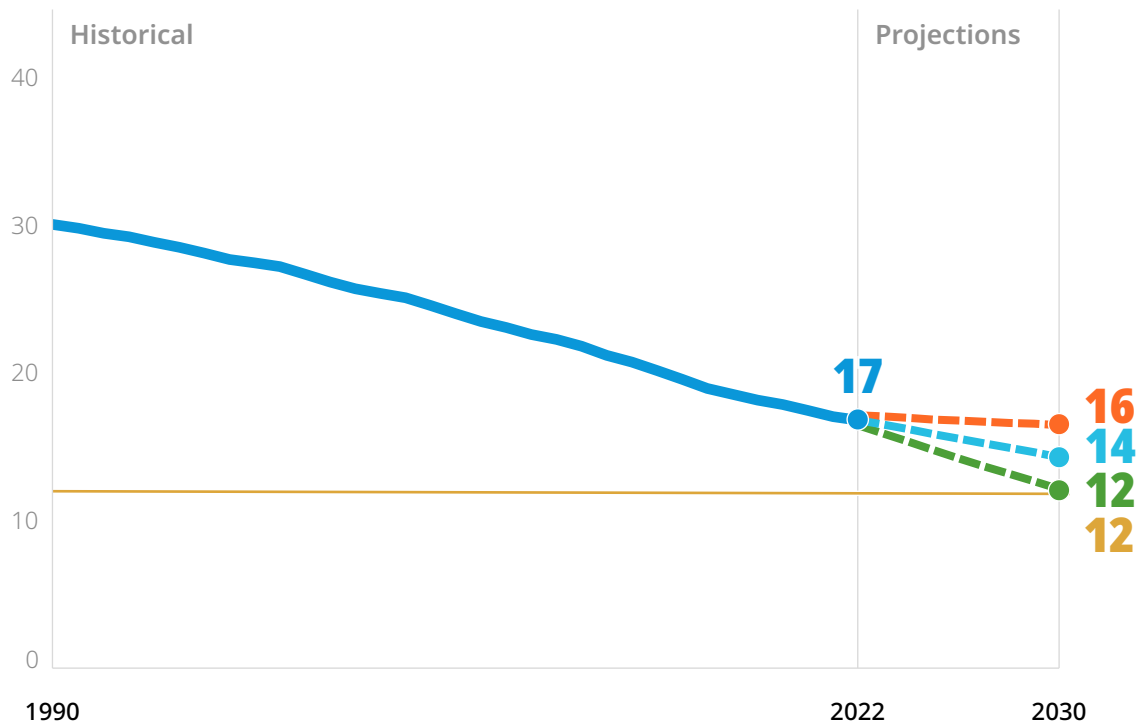


## SDG Target 3.2

End preventable deaths of newborns, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births.

Globally, the neonatal mortality rate has declined slightly since 2021, from 17.1 to 16.8 neonatal deaths per 1,000 live births in 2022. If we continue at the current pace the projected rate will be 14.3 neonatal deaths per 1,000, missing the target of 12 neonatal deaths per 1,000 live births. But if progress accelerates by improving care and scaling up new breakthroughs that could prevent childbirth-related deaths, we could meet the 2030 target.

### Neonatal deaths per 1,000 live births



#### Legend





# HIV

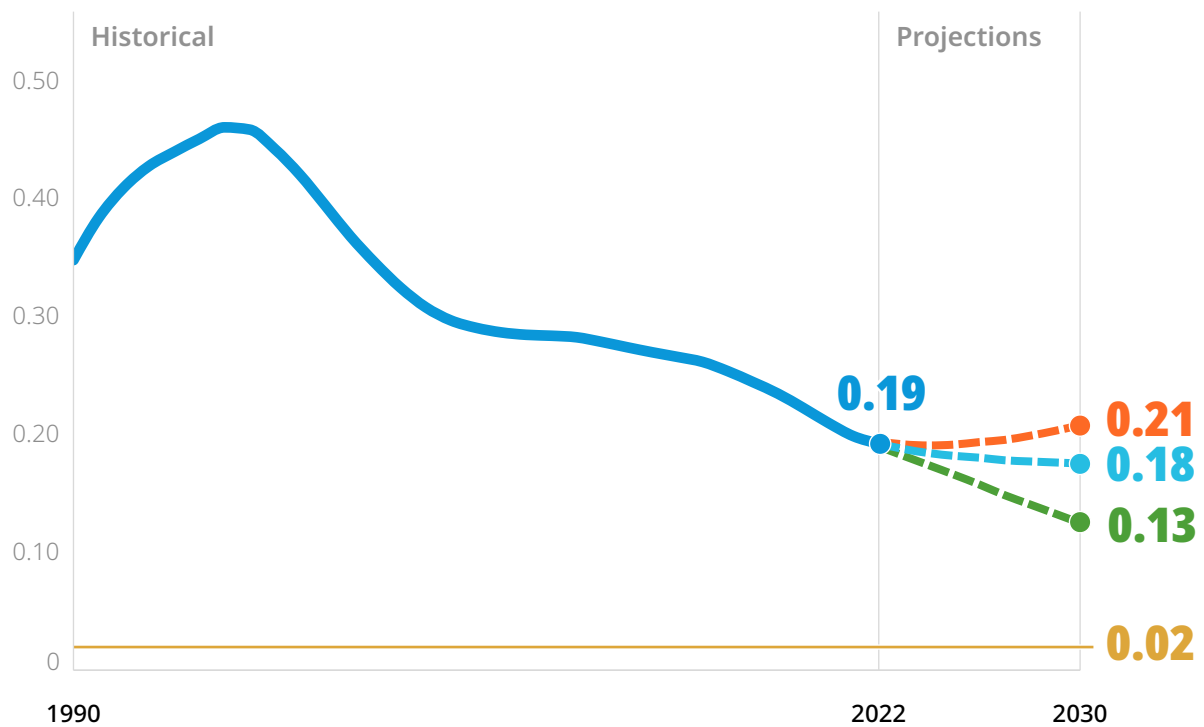


## SDG Target 3.3

End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

Globally, it's estimated that new cases of HIV per 1,000 people have declined slightly from 0.2 in 2021 to 0.19 in 2022. The 2030 projection estimates that the new cases of HIV will be 0.17 per 1,000 people—almost 10 times the target of 0.02 new cases per 1,000 people.

### New cases of HIV per 1,000 people



#### Legend



# Tuberculosis

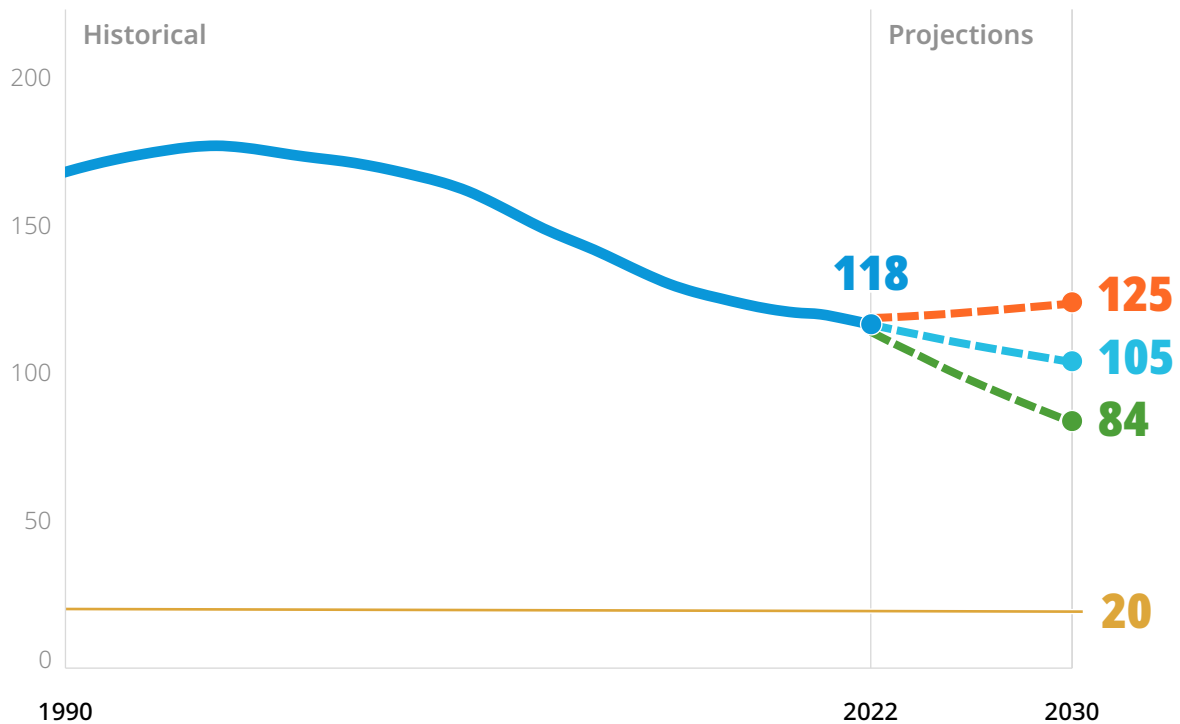


## SDG Target 3.3

End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

Globally, new cases of tuberculosis have decreased from 120 per 100,000 people in 2021 to 118 per 100,000 people in 2022. The 2030 projection estimates that new cases of tuberculosis will be 105 per 100,000 people—that’s more than 5 times the target of 20 new cases per 100,000 people.

### New cases of tuberculosis per 100,000 people



#### Legend



# Malaria

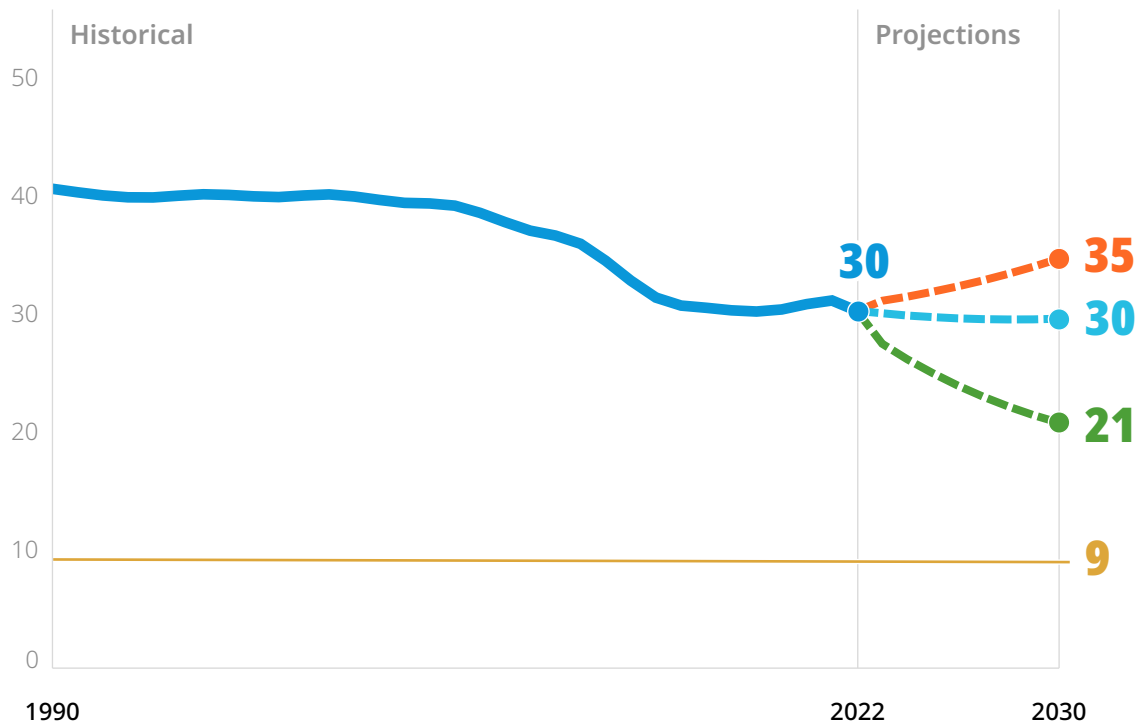


## SDG Target 3.3

End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.

It's estimated that new cases of malaria have declined globally, from 31 per 1,000 people in 2021 to 30 per 1,000 people in 2022. The 2030 projection estimates significant stalling of progress, with new cases remaining the same (30 cases per 1,000 people) by 2030—that's three times more than the SDG target.

### New cases of malaria per 1,000 people



#### Legend



# Neglected Tropical Diseases

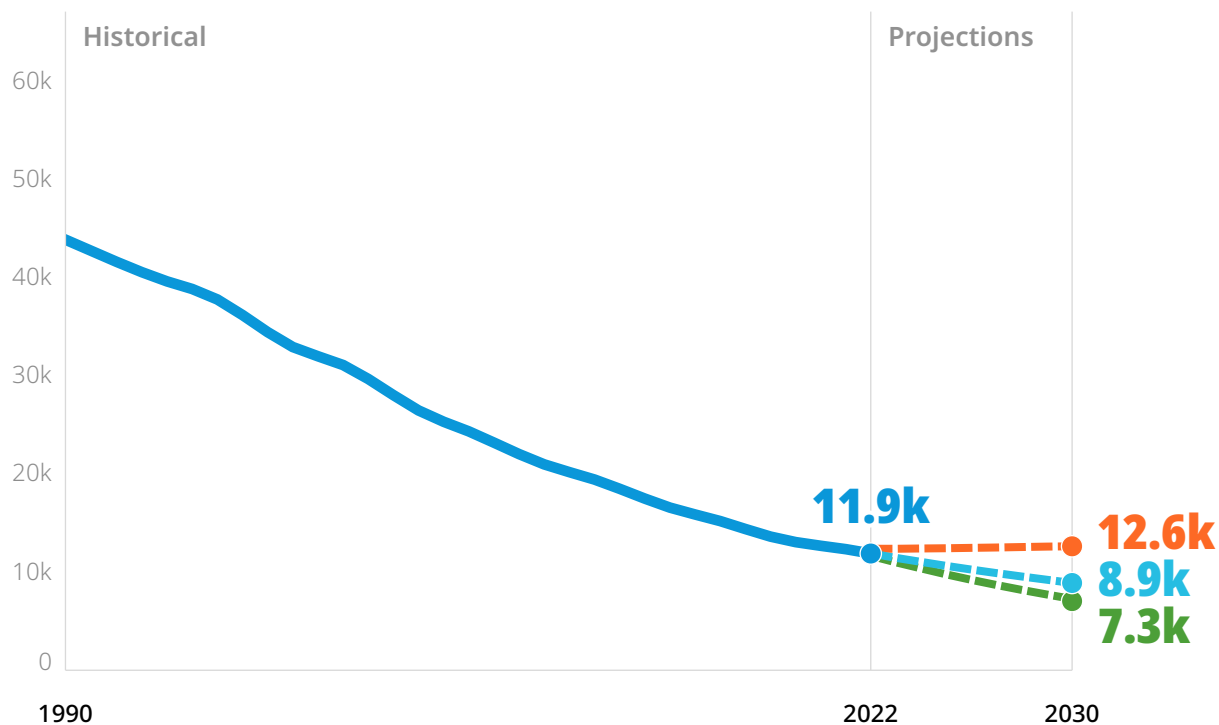


## SDG Target 3.3

End the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases (NTDs) and combat hepatitis, water-borne diseases and other communicable diseases.

For 15 NTDs, it is estimated that cases have declined globally in 2022 to 11,880 cases per 100,000 people from 12,321 per 100,000 people in 2021. Cases of these 15 NTDs are projected to continue to decline to 8,879 per 100,000 by 2030.

### Prevalence of 15 NTDs per 100,000 people



#### Legend



# Family Planning

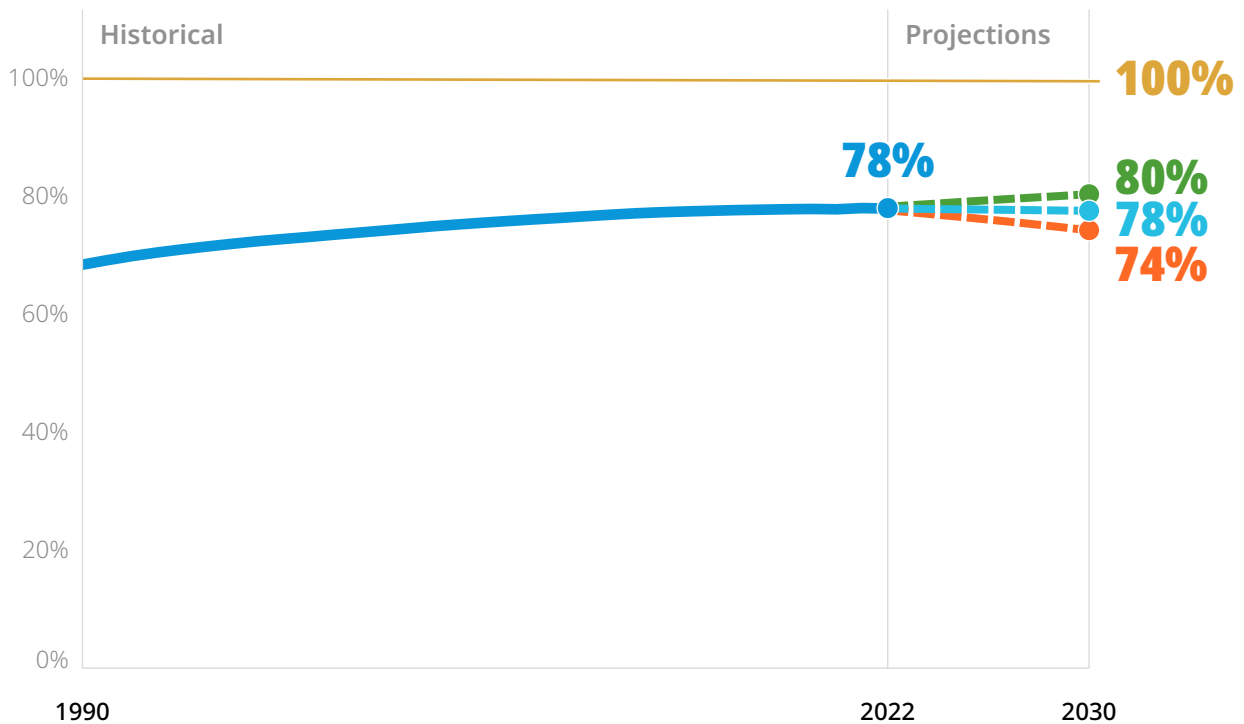


## SDG Target 3.7

Ensure universal access to sexual and reproductive health care services, including those for family planning.

Globally, it is estimated that nearly 78% of women ages 15–49 had their family planning needs met with modern methods in 2022. Current estimates project that met need will stall through 2030—missing the universal access target of 100%.

### Percentage of women of reproductive age (15–49) who have their need for family planning satisfied with modern methods



#### Legend



# Universal Health Coverage

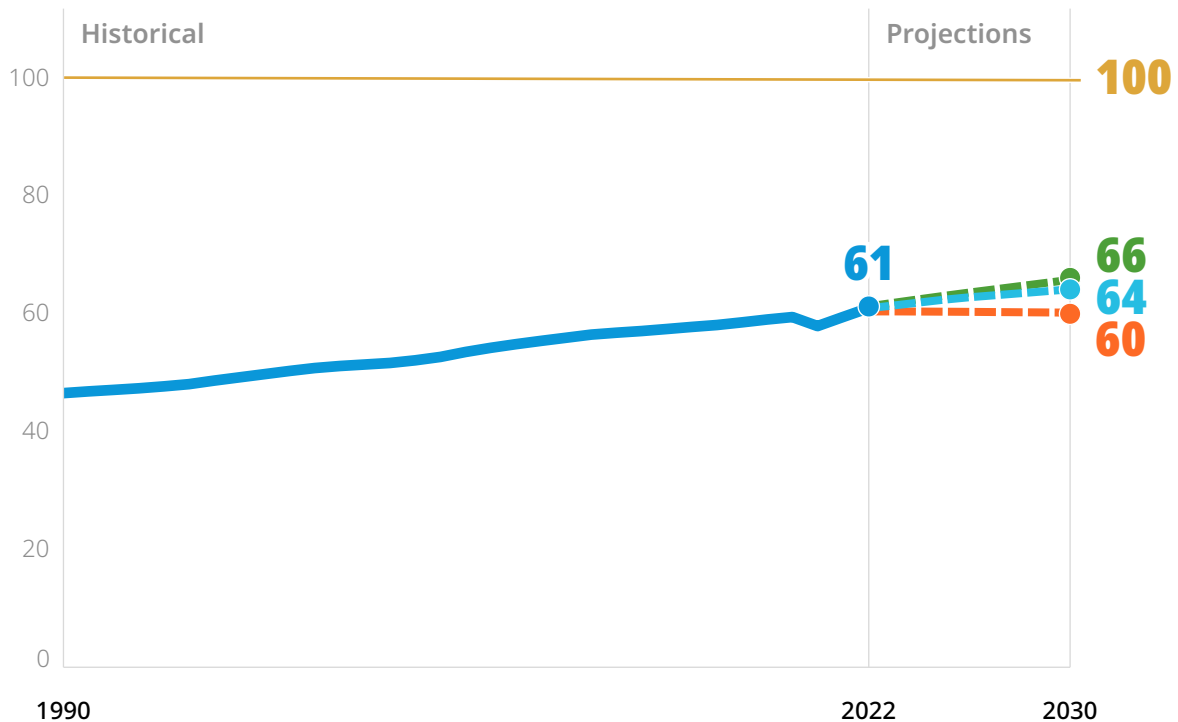


## SDG Target 3.8

Achieve universal health coverage for all.

The global score on the UHC effective coverage index is 61 in 2022, an increase from an index score of 59 in 2021. A projected score of 64 on the UHC effective coverage index is estimated for 2030—missing the target score of 100.

### Performance score of the UHC effective coverage index



#### Legend



# Smoking

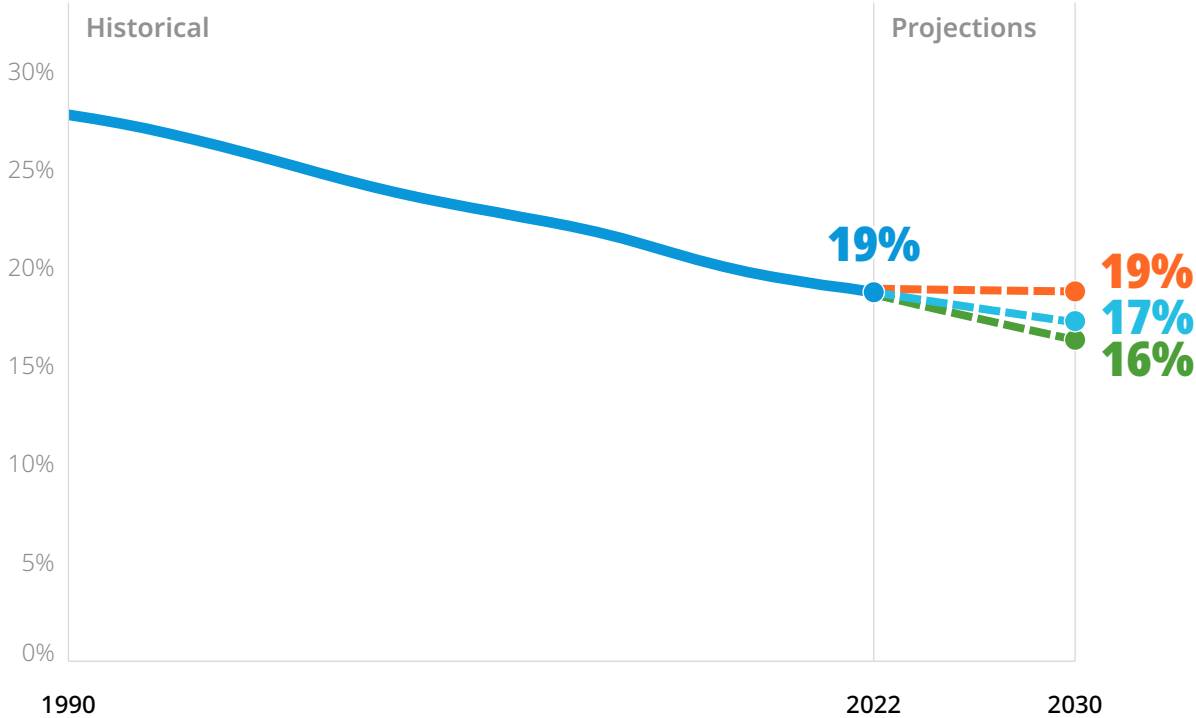


## SDG Target 3.A

Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries.

The global estimate for smoking prevalence is 18.8% in 2022, a slight decline from 19.0% in 2021. Projections estimate continued declines to 17.3% by 2030.

### Age-standardized smoking prevalence among people ages 15 and older



Legend

Historical average
Worse
Reference
Better

# Vaccines

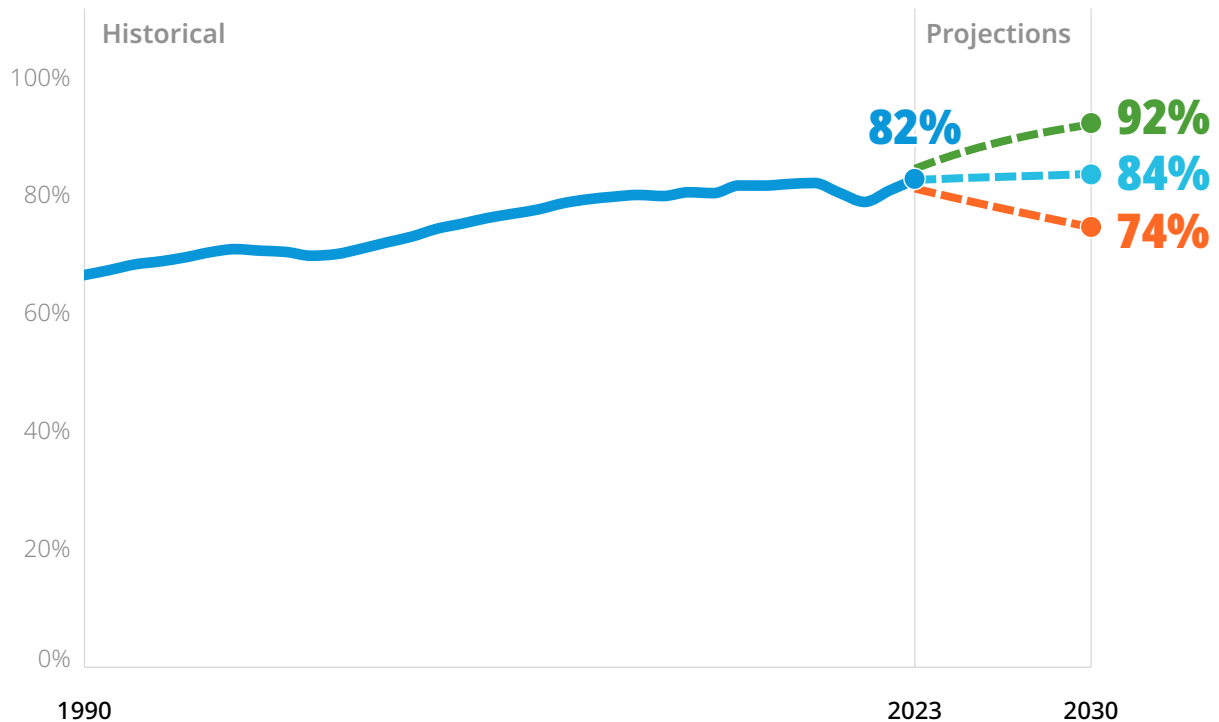


## SDG Target 3.B

Support the research and development of vaccines and medicines for the communicable and noncommunicable diseases that primarily affect developing countries and provide access to affordable essential medicines and vaccines.

The global estimate for diphtheria, tetanus, and pertussis (DTP) third dose vaccine coverage is showing uneven recovery from COVID-related disruptions to 81% in 2022, an increase from 79% in 2021. By 2030, DTP (third dose) vaccine coverage is estimated to be 84%. These global estimates mask significant differences at the subnational level that need to be better understood to address inequities in vaccine coverage.

### Coverage of DTP (third dose)



#### Legend





# Education

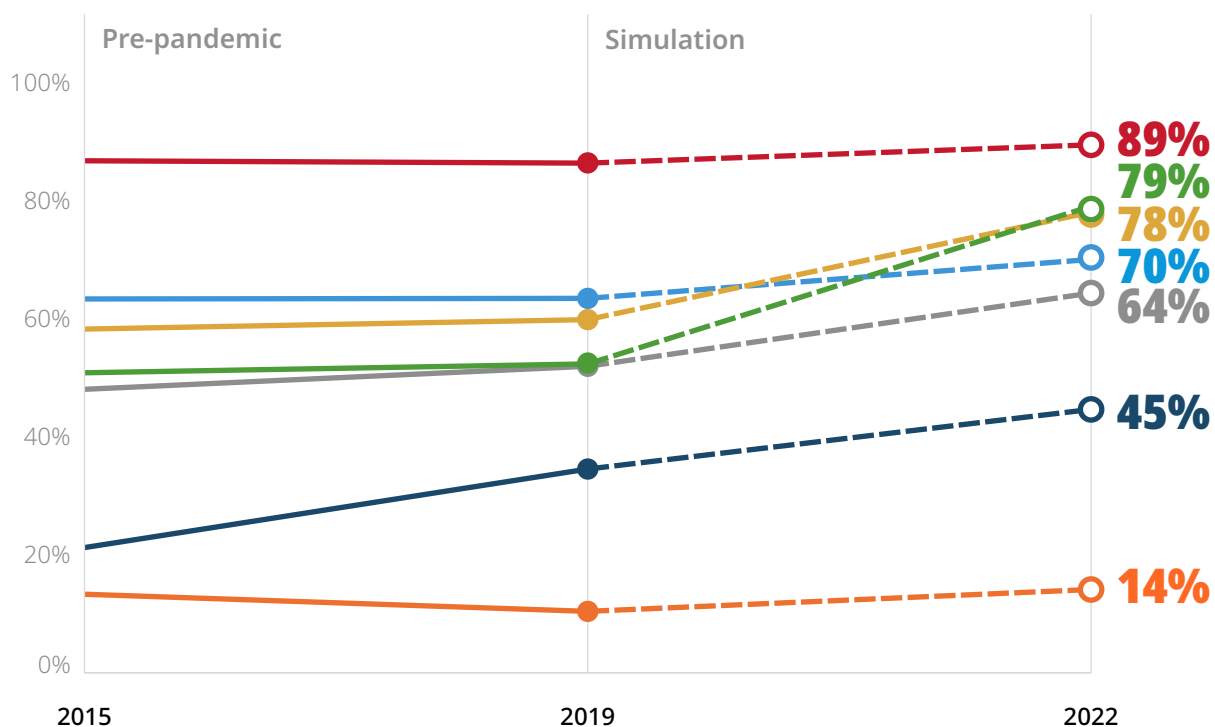


## SDG Target 4.1

Ensure that all girls and boys complete free, equitable, and quality primary and secondary education leading to relevant and effective learning outcomes.

Before the COVID-19 pandemic, the rate of learning poverty was already 52% in low- and middle-income countries. Simulations from 2022 suggest that it is now 64% in low- and middle-income countries.

### Proportion of children who cannot read and understand a simple text by age 10



#### Legend



# Gender Equality

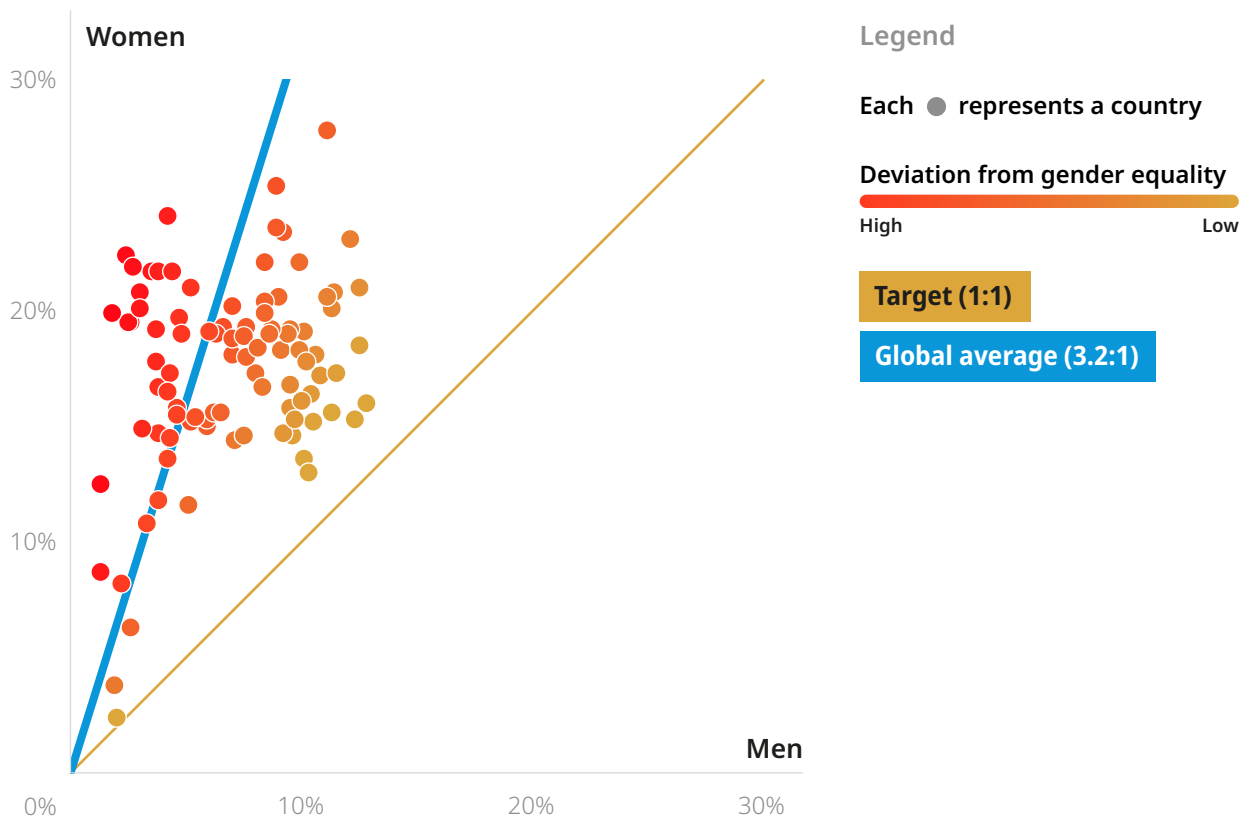


## SDG Target 5.4

Recognize and value unpaid care and domestic work through the provision of public services, infrastructure, and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.

Globally, women were estimated to spend three times as many hours as men performing domestic and care work, with the largest gap between men and women on average being in North African and West Asian countries.

## Proportion of unpaid domestic and care work by sex



# Sanitation

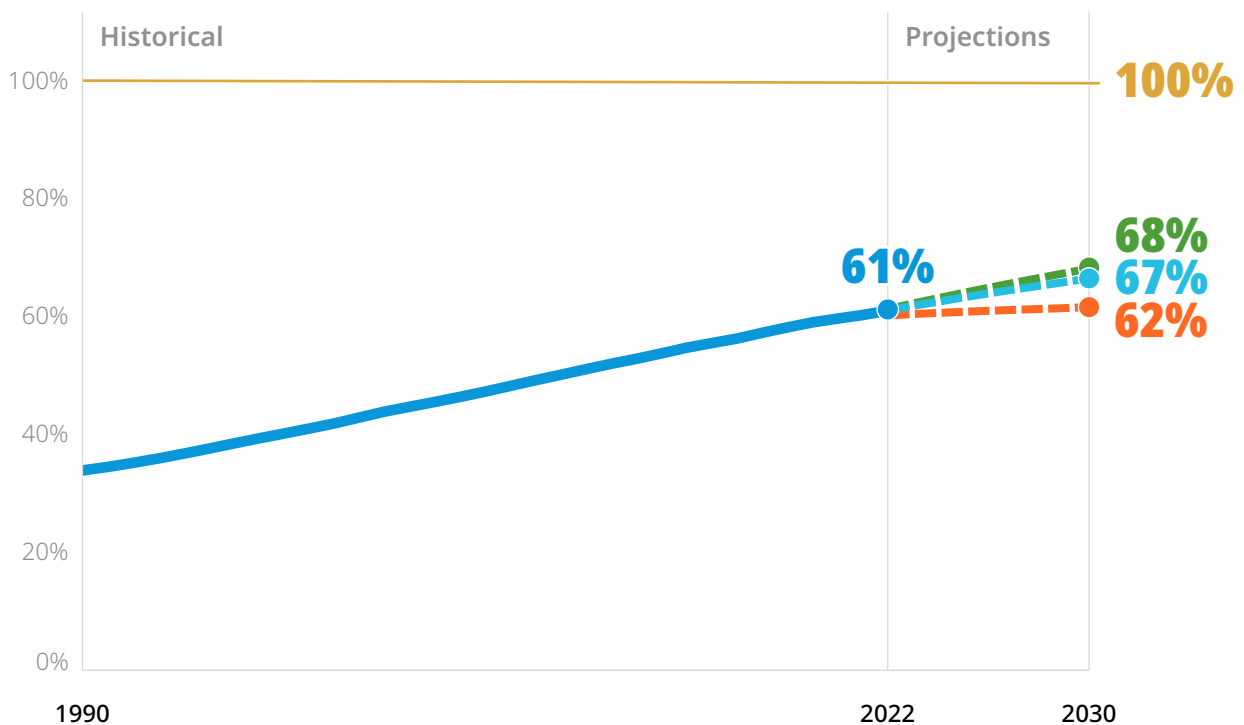


## SDG Target 6.2

Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

The estimated proportion of the population using safely managed sanitation has increased to 61% in 2022 from 60% in 2021. By 2030, it is projected that about two-thirds of the global population will be using safely managed sanitation—missing the target to ensure safe sanitation for all.

### Proportion of population using safely managed sanitation



#### Legend



# Financial Services for the Poor

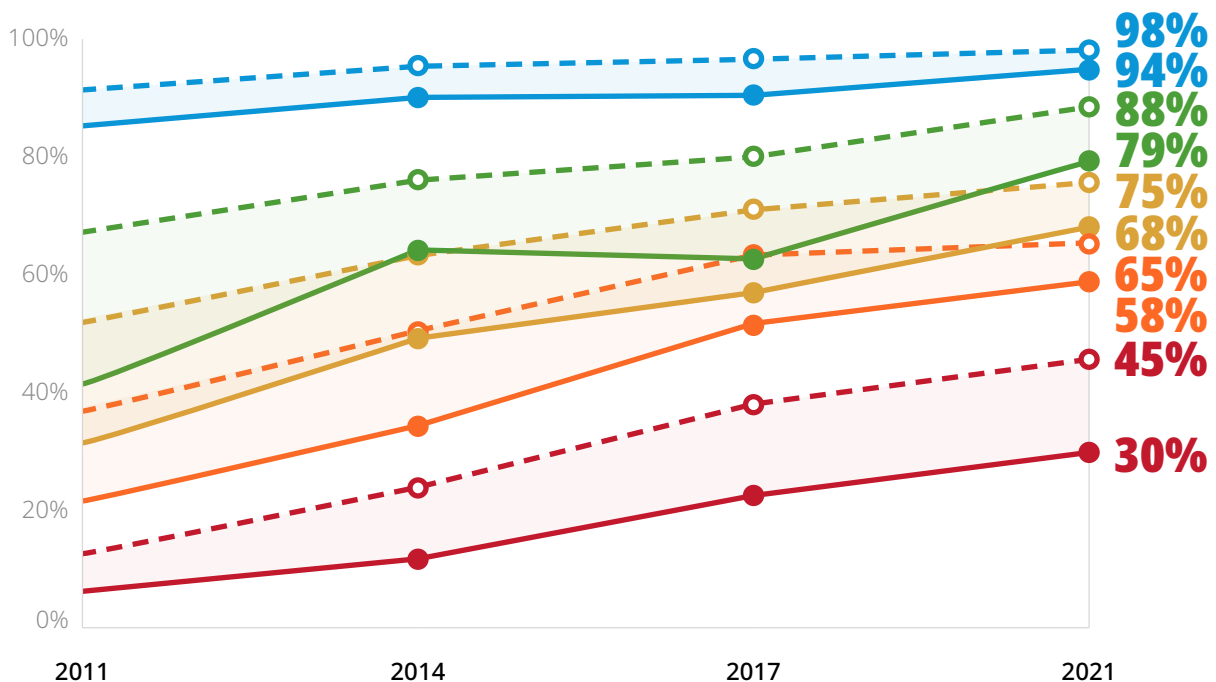


## SDG Target 8.10

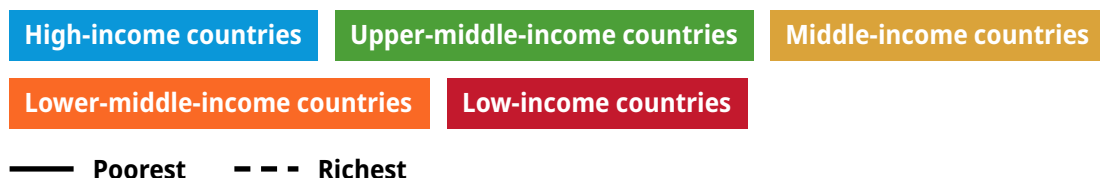
Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance, and financial services for all.

Over the past decade, the world has made rapid progress in expanding financial inclusion. Globally, 76% of adults now own a financial account, up from 51% a decade ago.

### Percentage of adults (ages 15 and older) with an account at a bank or other financial institution or with a mobile-money service provider, poorest and richest

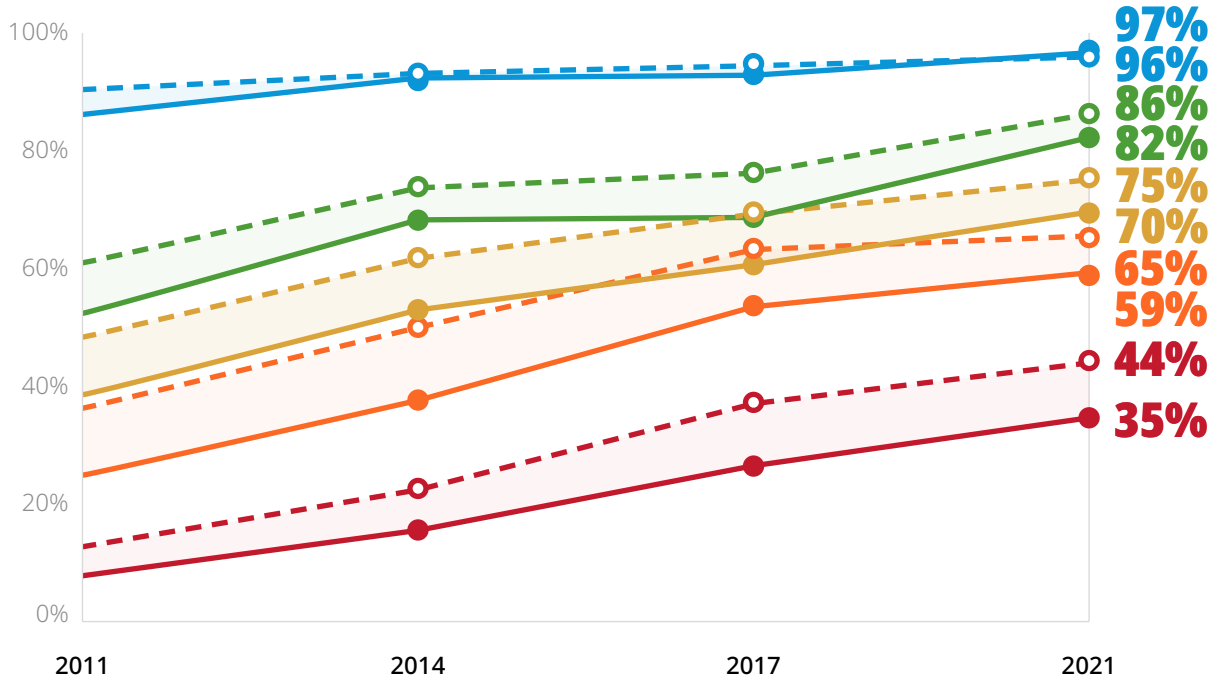


#### Legend

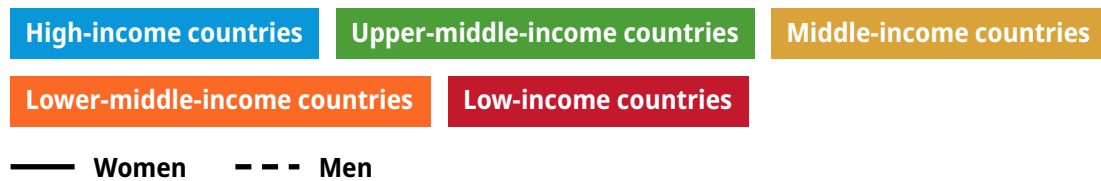


Importantly, the gender gap in account ownership is decreasing.

**Percentage of adults (ages 15 and older) with an account at a bank or other financial institution or with a mobile-money service provider, women and men**



Legend



# 2023 Data Sources and Notes

The data sources for facts and figures featured in the 2023 Goalkeepers Report are listed here by section. Brief methodological notes are included for unpublished analyses. Full citations, links to source materials, and additional references can be found on the Goalkeepers website at [gates.ly/data-sources](https://gates.ly/data-sources)

## Introduction

Pande, R., *et al.* (2015). Continuing with “...a heavy heart” - consequences of maternal death in rural Kenya. *Reproductive Health*, 12(Suppl 1), S2. Accessed May 2023. <https://doi.org/10.1186/1742-4755-12-S1-S2>

World Health Organization (WHO). (2023). *Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division*. Geneva: World Health Organization. Accessed May 2023. <https://apps.who.int/iris/rest/bitstreams/1492307/retrieve>

UN Inter-agency Group for Child Mortality Estimation (UN IGME). (2022). *Levels and trends in child mortality: estimates developed by the United Nations Inter-agency Group for child mortality estimation*. Accessed May 2023. <https://childmortality.org/wp-content/uploads/2023/01/UN-IGME-Child-Mortality-Report-2022.pdf>

UN Inter-agency Group for Child Mortality Estimation (UN IGME). (2022). *Never Forgotten: The situation of stillbirth around the globe*. Accessed May 2023. <https://childmortality.org/wp-content/uploads/2023/03/UN-IGME-Stillbirth-Report-2022.pdf>

### Two SDG targets that are off track

Institute for Health Metrics and Evaluation (IHME). (2023). *Maternal mortality ratio and neonatal mortality ratio* [Data set]. IHME. Note: Neonatal refers to the first 28 days (about 4 weeks) of life.

Fleszar, L., *et al.* (2023). Trends in state-level maternal mortality by racial and ethnic group in the United States. *JAMA*, 330(1), 52–61. <https://doi.org/10.1001/jama.2023.9043>

### Opportunity to save millions of lives

Bespoke modeling by the foundation in collaboration with Burnet Institute. August 2023. Full methodology is detailed below.

### Notes

New tools and practices to accelerate progress and boost survival rates for mothers and babies.

The package of breakthroughs modeled included maternal azithromycin (pregnancy), maternal azithromycin (intrapartum), infant azithromycin, multiple micronutrient supplements (MMS), maternal intravenous (IV) iron, AI-enabled ultrasound, antenatal corticosteroids (ACS), B. infantis probiotic, and postpartum hemorrhage treatment bundles.

In addition to the tools mentioned in this report, new practices to accelerate progress and boost survival rates for mothers and babies are also being used. For example, earlier this year, the World Health Organization released a global position paper on kangaroo mother care (KMC), an intervention that enables a mother to take a central role in her own and her newborn's care.

Researchers believe many of these innovations could also be used to fight the epidemic of maternal mortality globally, including in the United Kingdom and the United States, where death rates for Black mothers have doubled since 1999.

In wealthy countries, pregnant women could benefit from increased use of IV iron, maternal intrapartum azithromycin, and the postpartum hemorrhage treatment bundle described in Melinda's essay.

## Delivering hope

Petersen, E., *et al.* (2019). Racial/ethnic disparities in pregnancy-related deaths - United States, 2007–2016. *Morbidity and Mortality Weekly Report*, 68(35), 762–765. <https://dx.doi.org/10.15585/mmwr.mm6835a3>

### A big impact for mothers

Bespoke modeling by the foundation in collaboration with Burnet Institute. August 2023. Full methodology is detailed below.

## Treating postpartum hemorrhage

World Health Organization (WHO). (2023). *Postpartum haemorrhage*. Accessed June 2023. <https://www.who.int/teams/sexual->

[and-reproductive-health-and-research-\(srh\)/areas-of-work/maternal-and-perinatal-health/postpartum-haemorrhage](https://www.who.int/teams/sexual-and-reproductive-health-and-research-(srh)/areas-of-work/maternal-and-perinatal-health/postpartum-haemorrhage)

World Health Organization (WHO). (2023, May 9). *Lifesaving solution dramatically reduces severe bleeding after childbirth*. Accessed June 2023. <https://www.who.int/news/item/09-05-2023-lifesaving-solution-dramatically-reduces-severe-bleeding-after-childbirth>

## Preventing PPH in the first place

World Health Organization (WHO). (2021). *WHO global anemia estimates, 2021 edition*. Accessed June 2023. [https://www.who.int/data/gho/data/themes/topics/anaemia\\_in\\_women\\_and\\_children](https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children)

## Preventing infections

Tita, A., *et al.* for the A-PLUS Trial Group. (2023). Azithromycin to prevent sepsis or death in women planning a vaginal birth. *The New England Journal of Medicine*, 388, 1161–1170. <https://dx.doi.org/10.1056/NEJMoa2212111>

Chen, L., *et al.* (2021). The global burden and trends of maternal sepsis and other maternal infections in 204 countries and territories from 1990 to 2019. *BMC Infectious Diseases*, 21, Article 1074. <https://doi.org/10.1186/s12879-021-06779-0>

Gunja, M., Gumas, E., Williams, R. (2022, December 1). The U.S. maternal mortality crisis continues to worsen: an international comparison. *The Commonwealth Fund*. Accessed July 2023. <https://www.commonwealthfund.org/blog/2022/us-maternal-mortality-crisis-continues-worsen-international-comparison>

## The baby knowledge boom

### More precise understanding of why children die

Child Health and Mortality Prevention Surveillance (CHAMPS). (2023). *CHAMPS data as of July 2023* [Data set]. CHAMPS. Summarized data, links to access full data

set, and R packages for analysis are available at <https://champshealth.org/data/>

United Nations. (2010). *Millennium Development Goals report*. United Nations. <https://www.un.org/millenniumgoals/pdf/MDG%20Report%202010%20En%20r15%20-low%20res%2020100615%20-.pdf>

Bespoke modeling by the foundation in collaboration with Burnet Institute. August 2023. Full methodology is detailed below.

## Notes

**Our foundation estimates that ACS could save the lives of 144,000 infants in sub-Saharan Africa and South Asia by 2030 and nearly 400,000 by 2040.** To save even more lives, doctors can couple ACS with the use of lung surfactant, which is a mixture of fat and proteins made in the lungs. Paired together, these tools could ensure that nearly every premature baby survives their first, most dangerous days of life.

## Gut check

### Delivering healthy babies and saving millions of lives

Bespoke modeling by the foundation in collaboration with Burnet Institute. August 2023. Full methodology is detailed below.

## Methodology for Goalkeepers 2023 bespoke modeling: impact of novel maternal, neonatal, and infant interventions in low- and middle-income countries

### Methods

Bespoke modeling was conducted by the foundation in collaboration with Burnet Institute. We aimed to estimate the potential impact of novel interventions on maternal, neonatal, and infant burden in low- and middle-income countries (LMICs) from 2023 to 2040. To achieve this, we designed a dynamic compartmental modeling framework reflective of intervention target populations, conditions, and interventional windows across the pregnancy, postpartum, newborn, and infancy periods. Within this framework, we built a series of deterministic transition models in which compartments were assigned rates of pregnancy, live birth, condition-specific incidence, and mortality to define population characteristics and outcomes. We constructed 14 distinct, interconnected modules for maternal, newborn, and infant condition pathways to account for the intergenerational linkages between maternal, fetal, and newborn/infant risk factors and conditions. Interventions were assumed to affect the transition rates between compartments across the intergenerational framework. Estimated impact on averted burden was measured by overall and condition-specific cases, deaths, and disability-adjusted life years (DALYs). Importantly, we counted stillbirths

as neonatal deaths and calculated DALYs for stillbirths accordingly.

In addition to a baseline scenario where no interventions were introduced and condition burden forecasts were dependent only on secular trends, we ran more than 8,000 counterfactual scenarios of various intervention combinations and delivery assumptions. We selected interventions for inclusion based on potential to yield large, unrealized impact as determined by (i) available data showing significant effect on maternal, neonatal, and infant condition burden; and (ii) status as a novel intervention not currently launched or scaled in most LMIC countries. Our baseline forecasts of condition burden from 2023 to 2040 depended on forecasts of key drivers, including live births, antenatal care utilization, in-facility delivery, and prevalence of Caesarean section operations. We used live-birth forecasts produced by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington for the 2023 Goalkeepers Report and conducted forecasts of other drivers as a function of IHME forecasts of the Socio-demographic Index (SDI). Cause-specific condition incidence and burden forecasts were calibrated at a regional level to IHME Global Burden of Disease (GBD) 2019 estimates for the year 2019 and then projected to 2040 based on live-birth forecasts to generate forecasted secular trends. Counterfactual scenarios were compared against this baseline to quantify the condition burden averted by each intervention. To estimate the change in maternal mortality ratio (MMR), neonatal mortality rate (NMR), and infant mortality rate (IMR), we aggregated the deaths averted by causes specific to each target population from the counterfactual scenario where all novel interventions were introduced. To ensure consistency with Goalkeepers 2023 reference estimates of MMR, NMR, and IMR, we found the percentage of deaths averted in our models and applied that value to the Goalkeepers 2023 mortality estimates to quantify impact.

Products modeled were AI-enabled ultrasound; multiple micronutrient supplements (MMS); maternal IV iron; maternal azithromycin (pregnancy); maternal azithromycin (intrapartum); postpartum hemorrhage (PPH) management bundle; antenatal corticosteroids; B. infantis probiotic; and infant azithromycin.

### Data

We utilized published literature, available primary data sets, and IHME GBD 2019 estimates to assign values to the demographic, epidemiological, and health system parameters in our models. All models used region-specific data inputs where possible for three regional groupings: South Asia; sub-Saharan Africa; and other LMICs comprising countries in Latin America, North Africa/Middle East, and East/Southeast

Asia/Oceania. We based product effect size assumptions on published literature and available primary data. Coverage parameter values were constrained by intervention delivery channel access (e.g., antenatal care coverage, in-facility delivery coverage) where applicable and based on assumed product launch within the next three years followed by a three-year period of scale-up to 60 percent held constant through 2040.

## Explore the data

### IHME general methodology

Our primary data partner, IHME, produced estimates and forecasts for 13 of the SDG indicators included in the 2023 Goalkeepers Report. IHME worked together with many partners and used novel methods to generate a set of contemporary estimates, some as part of the Global Burden of Disease project. The indicator estimates presented may differ from other sources, particularly at the subnational level, due to differences in statistical models, data inputs, and assumptions used between modeling groups. The section below provides detail on how each indicator is estimated.

### Indicators estimated by IHME

#### Stunting

IHME measures stunting prevalence as height-for-age more than two standard deviations below the reference median on the height-age growth curve based on WHO 2006 growth standards for children 0–59 months. Estimates used several methods improvements, including ensemble model predictions for severity-specific stunting prevalence and mean height-for-age z-scores (HAZ) and further disaggregation of <5 age groups. This led to improved estimates in a number of countries, including South Africa, Democratic Republic of the Congo, India, and Pakistan. In addition, new data has improved estimates in a number of countries as well, including Pakistan.

To project stunting prevalence to 2030, we first projected overall risk-weighted prevalence of HAZ using the summary exposure value (SEV) with an ensemble modelling approach. We used a cascading random spline model to estimate age-specific stunting prevalence from the SEV. To optimize model configuration, we trained models on historical stunting estimates from 1990 to 2014 and used each model version to predict prevalence from SEVs for 2015 to 2021. We then used the best model to fit the full set of SEV and prevalence estimates from 1990 to 2021, and input corresponding SEV forecasts and SDI projections, to generate stunting prevalence projections through 2030.

#### Maternal Mortality Ratio

The maternal mortality ratio (MMR) is defined as the number of maternal deaths

among women ages 15–49 years during a given time period per 100,000 live births during the same time period. It depicts the risk of maternal death relative to the number of live births and essentially captures the risk of death in pregnancy. Projections to 2030 were modeled using an ensemble approach to forecast MMR, using SDI as a key driver.

Our analysis of direct and indirect maternal mortality in selected countries showed no significant relationship between direct mortality and indicators of the COVID-19 pandemic (i.e., COVID-19 infection incidence rate, COVID-19 mortality rate, changes in mobility). There was, however, a significant relationship between the COVID-19 pandemic and indirect maternal mortality. This relationship with indirect maternal mortality was modeled using COVID-19 mortality rate as a covariate. Our estimates of excess indirect maternal mortality related to COVID-19 were corrected to remove incidental COVID-19 deaths in pregnant or postpartum women that were not due to pregnancy. We employed the same general method and pandemic-year cause of death this year as in the 2022 Goalkeepers Report, but we incorporated more years of prepandemic data to estimate secular trends.

#### Under-5 Mortality Rate

The under-5 mortality rate is the probability of death between birth and age 5. It is expressed as number of deaths per 1,000 live births. Projections were based on a combination of key drivers, including Global Burden of Disease (GBD) risk factors, selected interventions (e.g., vaccines), and SDI. Additional short-term disruptions (2020–2021) from the COVID-19 pandemic incorporated the reductions seen in child deaths from infectious diseases (flu, respiratory syncytial virus [RSV], measles, pertussis) observed during the pandemic, driven primarily by social distancing and mask use. We also incorporate increases in malaria deaths due to service disruption, as well as child deaths due directly and indirectly to COVID-19. Most of the changes in U5MR estimates in the current Goalkeepers Report results came from new and additional input mortality data we have incorporated since the GBD 2019 study, including estimates of excess mortality observed during the COVID-19 pandemic.

Wang, H., Paulson, K. R., Pease, S. A., Watson, S., Comfort, H., *et al.* (2022). Estimating excess mortality due to the COVID-19 pandemic: A systematic analysis of COVID-19-related mortality, 2020–21. *The Lancet*, 399(10334), 1513–1536. [https://doi.org/10.1016/S0140-6736\(21\)02796-3](https://doi.org/10.1016/S0140-6736(21)02796-3)

#### Neonatal Mortality Rate

IHME defines the neonatal mortality rate as the probability of death in the first 28 completed days of life. It is expressed as the number of deaths per 1,000 live

births. Projections were based on a combination of key drivers, including GBD risk factors, selected interventions (e.g., vaccines), and SDI. Most of the changes in neonatal mortality estimates in this year's Goalkeepers Report are the result of new data, including estimates of excess mortality observed during the COVID-19 pandemic.

Wang, H., Paulson, K. R., Pease, S. A., Watson, S., Comfort, H., *et al.* (2022). Estimating excess mortality due to the COVID-19 pandemic: A systematic analysis of COVID-19-related mortality, 2020–21. *The Lancet*, 399(10334), 1513–1536. [https://doi.org/10.1016/S0140-6736\(21\)02796-3](https://doi.org/10.1016/S0140-6736(21)02796-3)

#### HIV

IHME estimates the HIV rate as new HIV infections per 1,000 population. Forecasts of HIV incidence were based on forecasted antiretroviral therapy (ART), prevention of maternal-to-child transmission (PMTCT) coverage, and transmission rate as inputs into a modified version of Avenir Health's Spectrum software (Mahy *et al.*, 2017). Adult ART is forecasted using location-specific rates of change, capping forecasted coverage using CD4 count-specific coverage caps developed for allocation of ART in GBD estimation. GBD estimates incorporated methodological changes to cause of death data for HIV as well as the adjustment of incidence estimates to be consistent with vital registration data.

Mahy, M., Penazzato, M., Ciaranello, A., Mofenson, L., Yiannoutsos, *et al.* (2017). Improving estimates of children living with HIV from the Spectrum AIDS Impact Model. *AIDS*, 31(Suppl 1), S13–S22. <https://doi.org/10.1097/QAD.0000000000001306>

Eaton, J. W., Brown, T., Puckett, R., Glaubius, R., Mutai, K., *et al.* (2019). The Estimation and Projection Package Age-Sex Model and the r-hybrid model: New tools for estimating HIV incidence trends in sub-Saharan Africa. *AIDS*, 33(Suppl 3), S235–S44. <https://doi.org/10.1097/QAD.0000000000002437>

Jahagirdar, D., Walters, M. K., Novotney, A., Brewer, E. D., Frank, T. D., *et al.* (2021). Global, regional, and national sex-specific burden and control of the HIV epidemic, 1990–2019, for 204 countries and territories: the Global Burden of Diseases Study 2019. *The Lancet HIV*, 8(10), e633–e651. [https://doi.org/10.1016/S2352-3018\(21\)00152-1](https://doi.org/10.1016/S2352-3018(21)00152-1)

#### Tuberculosis

IHME estimates new and relapse tuberculosis cases diagnosed within a given calendar year (incidence) using data from prevalence surveys, case notifications, and cause-specific mortality estimates as inputs to a statistical model that enforces internal consistency among the estimates. GBD estimates in the 2022 Goalkeepers Report incorporated methodological improvements to better capture the quality of case notification data. We refined this approach for the current

Goalkeepers Report. This refinement is mainly reflected in the time trends of countries in North Africa and the Middle East. Additionally, refinements were made to the model to better follow the data, which resulted in changes in the time trend in some countries, including Malawi and Botswana.

IHME evaluated the literature on COVID-19 disruptions to TB incidence and identified three types of studies: studies reporting raw data on diagnosis and treatment in 2020, studies reporting on service disruption from new surveys, and studies reporting on models of TB impacts using notification data or theoretical COVID scenarios. Due to the lack of counterfactual data in prepandemic time periods and modeling assumptions used in the current studies, we did not estimate an additional disruption in TB incidence due to COVID-19. IHME will continue to evaluate and analyze as more data is released. In addition to historical trends, projections to 2030 were modeled using an ensemble approach to forecast the incidence of TB, using SDI as a key driver in order to capture the effects of the COVID-19 pandemic on income per capita and education.

#### Malaria

IHME estimates the malaria rate as the number of new cases per 1,000 population. To estimate malaria incidence in 2020 and 2021, we take into account updated reports regarding pandemic-related disruptions to malaria interventions and effective treatment with an antimalarial drug (which includes insecticide-treated bed nets (ITN), indoor residual spraying, antimalarial treatment, and drug effectiveness). These reports were used to apply an adjustment to estimates of effective antimalarial treatment coverage, which were then utilized to produce estimates of malaria prevalence and subsequently incidence. Projections to 2030 were derived using an ensemble model. First, coverage of artemisinin-based combination therapy (ACT) and ITNs is forecast as a function of the SDI, which is predicted in turn by projections of income per capita and education. For countries where there exists available data on intervention coverage, malaria incidence is forecasted through 2030 using an ensemble approach, incorporating past trends and forecasts of ACT and ITN coverage to produce the projections. For countries where there is no available data on ACT or ITN coverage, an ensemble approach is used based on past trends in incidence as well as projections of SDI, which incorporates the effects of the COVID-19 pandemic through income per capita and education.

Due to reporting lags, there is still relatively little data to inform pandemic-related impacts on malaria incidence. The WHO pulse surveys, which were used to adjust 2020 and 2021 incidence results, were applied to only 33 countries in Africa at this time due to a lack of comparable method for



applying the adjustment to other regions arising from the difference in incidence estimation. Furthermore, although those pulse surveys currently allow us to begin trying to capture malaria pandemic-related impacts, the surveys were completed by national level health officials and capture only their individual assessment of how the pandemic has impacted care-seeking.

World Health Organization. (2022, February). *Third round of the global pulse survey on continuity of essential health services during the COVID-19 pandemic: Interim report - November–December 2021*. Accessed July 27, 2022. [https://www.who.int/publications-detail-redirect/WHO-2019-nCoV-EHS\\_continuity-survey-2022.1](https://www.who.int/publications-detail-redirect/WHO-2019-nCoV-EHS_continuity-survey-2022.1)

### Neglected Tropical Diseases

IHME measures the sum of the prevalence of 15 neglected tropical diseases (NTDs) per 100,000 that are currently measured in the annual Global Burden of Disease study: human African trypanosomiasis, Chagas disease, cystic echinococcosis, cysticercosis, dengue, food-borne trematodiasis, Guinea worm, soil-transmitted helminths (STH, comprising hookworm, trichuriasis, and ascariasis), leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, rabies, schistosomiasis, and trachoma. In the 2022 Goalkeepers Report, IHME applied an adjustment to the dengue estimates to account for COVID-19 disruptions from Chen et al (2022). Based on an updated literature review and due to data gaps, lags in availability, and challenges in accounting for the likely disruptions to NTD surveillance during the pandemic, we did not estimate a COVID-19 effect on dengue this year, or similar to last year, an effect on other NTDs. Modeling studies and available data suggest that the COVID pandemic likely resulted in disruptions to NTD epidemiology, though these disruptions are likely to vary by disease and location and may be variably amenable to mitigation through increased control efforts (Hollingsworth et al., 2021). While modeling studies can characterize potential disruptions under different scenarios, reliable data to quantify the true magnitude of pandemic effects on NTD epidemiology is sparse.

Projections to 2030 used an ensemble model, driven both by trends in the past as well as projections of SDI, which incorporated disruptions from the COVID-19 pandemic on income per capita and education.

Hollingsworth, T. D., Mwinzi, P., Vasconcelos, A., & de Vlas, S. J. (2021). Evaluating the potential impact of interruptions to neglected tropical disease programmes due to COVID-19. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(3), 201–204. <https://doi.org/10.1093/trstmh/traab023>

Chen, Y., Li, N., Lourenço, J., Wang, L., Cazelles, B., et al. (2022). Measuring the effects of COVID-19-related disruption on dengue transmission in southeast Asia

and Latin America: A statistical modelling study. *The Lancet Infectious Diseases*, 22(5), 657–667. [https://doi.org/10.1016/S1473-3099\(22\)00025-1](https://doi.org/10.1016/S1473-3099(22)00025-1)

### Family Planning

IHME estimates the proportion of women of reproductive age (15–49 years) who have their need for family planning satisfied with modern contraceptive methods. Modern contraceptive methods include the current use of male or female sterilization, male or female condoms, diaphragms, cervical caps, sponges, spermicidal agents, oral hormonal pills, patches, rings, implants, injections, intrauterine devices (IUDs), and emergency contraceptives. Projections to 2030 used an ensemble model, based both on past trends as well as utilizing SDI as a key driver, which incorporates projections of income per capita and education and the effects of the COVID-19 pandemic.

Our analysis of PMA surveys and other pandemic era surveys do not show a consistent, significant reduction in contraception use due to the pandemic. As a result, we did not incorporate a pandemic effect on the family planning indicator. Changes to the historical estimates can be attributed to methodological updates and the addition of new data from eight countries: Pakistan, India, Vietnam, Madagascar, Nigeria, Fiji, Uzbekistan, and Cambodia. We model demand satisfied via three underlying components of the indicator—any contraceptive use, proportion of use that is modern, and the proportion of non-use that is unmet need—separately for partnered and unpartnered women. This modelling approach aligns with data restrictions such as only surveying partnered (married or in-union) women and allows us to construct the full range of family planning indicators. In prior iterations we had constrained modern contraceptive prevalence to the sum of all modern methods, but this year we estimate modern contraceptive prevalence as a proportion of all use directly.

Performance Monitoring for Action. (2023). *Available Datasets* [Data set]. <https://www.pmadata.org/data>

### Universal Health Coverage

The universal health coverage (UHC) effective coverage index is a metric composed of 23 effective coverage indicators that cover population age groups across the entire life course (maternal and newborn age groups, children under age 5, youths ages 5–19 years, adults ages 20–64, and adults ages 65 years old or older). These indicators fall within several health service domains: promotion, prevention, and treatment.

Health system **promotion** indicators include met need for family planning with modern contraception.

Health system **prevention** indicators include the proportion of children receiving the third dose of the diphtheria-tetanus-pertussis (DTP) vaccine and children receiving the first dose of measles-containing vaccine. Antenatal care for mothers and antenatal care for newborns are considered indicators of health system prevention and treatment of diseases affecting maternal and child health.

Indicators of **treatment** of communicable diseases are scaled mortality-to-incidence (MI) ratios for lower respiratory infections, diarrhea, and tuberculosis, as well as coverage of antiretroviral therapy (ART) among those with HIV/AIDS. Indicators of treatment of noncommunicable diseases include scaled MI ratios for acute lymphoid leukemia, appendicitis, paralytic ileus and intestinal obstruction, cervical cancer, breast cancer, uterine cancer, and colorectal cancer. Indicators of treatment of noncommunicable diseases also include scaled mortality-to-prevalence (MP) ratios for stroke, chronic kidney disease, epilepsy, asthma, chronic obstructive pulmonary disease, diabetes, and the risk-standardized death rate due to ischemic heart disease. The effective coverage indicators are weighted in the index according to the potential health gain that each country could achieve if it were to improve coverage of that indicator.

To produce forecasts of the UHC index from 2022 to 2030, a meta-stochastic frontier model for UHC was fit, using total health spending per capita projections as the independent variable. Country- and year-specific inefficiencies were then extracted from the model and forecasted to 2030 using a linear regression with exponential weights across time for each country level. These forecasted inefficiencies, along with forecasted total health spending per capita estimates, were substituted into the previously fit frontier to obtain forecasted UHC for all countries for 2022–2030.

Effects due to the pandemic were included in our final results with some exceptions. ART coverage scores and met demand for family planning were not adjusted, due to limitations in data as described in previous sections. Adjustments for vaccine delivery are described in the Vaccines section. For other indicators (19 out of 23), in the absence of data to inform the correspondence between reductions in utilization and reductions in coverage, we applied 25 percent of the reduction in monthly missed health care visits (excluding routine services). Details of the estimation of missed health care visits are described in last year's report.

Bill & Melinda Gates Foundation. (2022) *2022 Goalkeepers Report: The Future of Progress*. <https://www.gatesfoundation.org/goalkeepers/report/2022-report/>

## Smoking

IHME measures the age-standardized prevalence of any current use of smoked tobacco among those aged 15 and older. IHME collates information from available representative surveys that include questions about self-reported current use of tobacco and information on the type of tobacco product smoked (including cigarettes, cigars, pipes, hookahs, as well as local products). IHME converts all data to its standard definition of any current smoking within the last 30 days so that meaningful comparisons can be made across locations and over time. Estimates this year are higher than last year to reflect the update in the indicator from daily smoking to any smoking within the last 30 days to better align with the SDG definition. Projections to 2030 used SDI as a key driver, which incorporates projections of income per capita, education, and the effect of the COVID-19 pandemic.

## Vaccines

IHME measurement of immunization coverage reports on the coverage of the following vaccines separately: three-dose diphtheria-tetanus-pertussis (DTP3), measles second dose (MCV2), and three-dose pneumococcal conjugate vaccine (PCV3). IHME estimated the pandemic era (2020–2022) effects on vaccine coverage via administrative data coverage. To estimate disruptions in vaccine coverage during the COVID pandemic, IHME used administrative vaccine coverage data collected through the 2023 Joint Reporting Form. First, they assembled a “shock-free” time series of administrative vaccine coverage data, omitting country-year-vaccine data points for which countries reported stockouts or for which other known service delivery disruptions made sudden decreases in vaccine coverage plausible. In this step, they omitted all data points from 2020 through 2022 for all countries due to the COVID pandemic. Second, they fit spatiotemporal Gaussian process regression (ST-GPR) models to this “shock-free” administrative time series, producing estimates of expected administrative coverage in the absence of disruptions. Third, they compared the reported administrative coverage to these expectations to estimate the magnitude of disruption implied by the administrative data for each country, vaccine, and year. Last, they used these estimated disruptions in administrative coverage to generate as covariates in the final ST-GPR coverage models, which were fit to survey data and bias-adjusted administrative data. If administrative data was missing for 2020 through 2022, IHME imputed disruptions using vaccine- and year-specific distributions of observed disruptions in countries with available administrative data, propagating uncertainty throughout this imputation process. This approach allowed the use of the magnitude of coverage disruptions implied by administrative data, while still adjusting for bias in this data.

World Health Organization. (2023). *The Big Catch-Up: An Essential Immunization Recovery Plan for 2023 and Beyond*. Accessed August 8, 2023. <https://www.who.int/publications/item/9789240075511>

## Sanitation

IHME estimates the proportion of population with access to safely managed sanitation.

As defined by the Joint Monitoring Programme (JMP), safely managed facilities must meet three criteria: 1) is not shared with multiple households, 2) is an improved sanitation facility, and 3) wastewater is disposed of safely (World Health Organization 2021). Safe wastewater disposal can consist of being treated and disposed of in situ, stored temporarily and treated off-site, or transported through a sewer and treated (World Health Organization 2021). Safely managed treated wastewater must have received at least secondary treatment (World Health Organization 2021). IHME measured households with piped sanitation (with a sewer connection or septic tank); households with improved sanitation but without a sewer connection (pit latrine, ventilated improved latrine, pit latrine with slab, composting toilet); households without improved sanitation (flush toilet that is not piped to sewer or septic tank, pit latrine without a slab or open pit, bucket, hanging toilet or hanging latrine, no facilities); and wastewater treatment type for sewer-connected households, as defined by the JMP for Water Supply and Sanitation.

For the 2023 Goalkeepers Report, we developed models to estimate two components of safely managed sanitation: 1) the proportion of sewer-connected facilities that are safely managed and 2) the proportion of improved, nonsewer facilities that are safely managed. For both components we selected the final model from a collection of candidate models based on out-of-sample root-mean-squared error (RMSE) estimated by cross-validation. Candidate models varied in model type (MR-BRT Bayesian spline cascade models versus shape constrained additive models), and predictive covariates (SDI, lag distributed income per capita [LDI], and both linear and log transformations). For the Bayesian spline cascade models, we tested models that varied in the strength of the priors used in the spline cascade.

Data for estimating the proportion of sewer-connected facilities that are safely managed were extracted from Eurostat, Aquastat, and the Organization for Economic Co-operation and Development (OECD). The resulting estimates from this model were multiplied by the existing IHME estimates of the proportion of the population with sewer-connected facilities to estimate the proportion of the population with safely managed sewer-connected facilities.

Data for estimating the proportion of improved, non sewer facilities that are safely managed were extracted from Multiple Indicator Cluster Surveys (MICS), Demographic and Health Surveys (DHS), national surveys (in Canada and Norway), and Eurostat. Crosswalks were performed to estimate toilet type and wastewater treatment where data was unknown within the MICS and DHS microdata. The resulting estimates from this model were multiplied by the IHME estimates of the proportion of the population with improved, nonsewer-connected facilities to estimate the proportion of the population with safely managed improved nonsewer facilities.

We estimated the proportion of the total population with safely managed sanitation as the sum of the proportion of the population with safely managed sewer-connected facilities and the proportion of the population with safely managed improved nonsewer facilities.

World Health Organization & UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP). (2021). *Proportion of population using safely managed sanitation services* [SDG indicator 6.2.1a metadata]. JMP. Accessed December 12, 2021. <https://washdata.org/sites/default/files/2022-01/jmp-2021-metadata-sdg-621a.pdf>

## IHME Indicator Sources

Data source information for each indicator is listed below and will be available online at <https://ghdx.healthdata.org/> following publication of GBD 2021.

## Indicators estimated from other sources

### Poverty

World Bank. *Poverty headcount ratio at \$2.15 a day (2017 PPP) (% of population)*. [Data set]. Poverty and Inequality Platform: World Development Indicators. Accessed July 2023. <https://data.worldbank.org/indicator/SI.POV.DDAY>. License: CC BY-4.0.

For methodology, see: World Bank. (2023). *Poverty and Inequality Platform Methodology Handbook*. <https://worldbank.github.io/PIP-Methodology/>

### Agriculture

The FAO computation on national survey data (RuLIS Project) and official estimates were computed with the support of the 50x2030 Initiative.

50x2030. (2023). *A partnership for data-smart agriculture*. <https://www.50x2030.org/>

Food and Agriculture Organization of the United Nations (FAO). *Average annual income from agriculture, PPP (constant 2011 international USD)* [Data set]. RuLIS - Rural Livelihoods Information System. FAO. Accessed June 2023.

<https://www.fao.org/in-action/rural-livelihoods-dataset-rulis/data-application/data/en>

Food and Agriculture Organization of the United Nations (FAO). (2021). Use of AGRISurvey data for computing SDG's and national indicators: Experience in three countries [Country brief]. [www.fao.org/3/cb4762en/cb4762en.pdf](http://www.fao.org/3/cb4762en/cb4762en.pdf). License: CC BY-NC-SA 3.0 IGO.

Small food producers' income growth for selected countries with at least two entries for small food producers' income from 2005 to 2022. For all countries without data for 2014 and 2019, the earliest and most recent years were used to calculate income growth. Small food producers' income growth is calculated per country and using years listed below:

Location	Year range
Burkina Faso	2014–2019
Cambodia	2019–2020
Ethiopia	2014–2019
India	2005–2012
Malawi	2011–2020
Mali	2014–2019
Niger	2011–2014
Nigeria	2016–2019
Paraguay	2015–2020
Senegal	2018–2021
Tanzania	2009–2015
Uganda	2010–2019

For methodology, see: Food and Agriculture Organization of the United Nations (FAO). (2018). *Rural Livelihoods Information System (RuLIS): Technical notes on concepts and definitions used for the indicators derived from household surveys* [Report]. FAO. <https://www.fao.org/3/ca2813en/CA2813EN.pdf>. License: CC BY-NC-SA 3.0 IGO.

### Education

World Bank, UNESCO Institutes for Statistics (UIS), UNICEF, the Foreign, Commonwealth & Development Office

(FCDO), USAID, et al. (2022). *The State of Global Learning Poverty: 2022 Update*. <https://www.unicef.org/media/1122921/file/StateofLearningPoverty2022.pdf>

Source for Learning Poverty 2022 simulations:

Azevedo, J., Demombynes, G. & Wong, Y.N. (2023, April 20). Why has the pandemic not sparked more concern for learning losses in Latin America? *World Bank Blog*. <https://blogs.worldbank.org/education/why-hasnt-pandemic-sparked-more-concern-learning-losses-latin-america-perils-invisible>

### Gender Equality

The chart is based on data from the United Nations Global SDG Database, the Government of India's National Statistical Office, and the International Labour Organization.

The data is the most recent available for 93 countries and territories (2001–2022). The age group is 15 or older where available (18 or older in Ghana). In a number of cases, data is for those ages 10 or older (n=13) or 12 or older (n=3). The data for Malaysia, Ireland, and Cambodia refers to individuals ages 15–64. In the case of Thailand (2015) and India (2019), it is for those ages 6 or older, and in the United Republic of Tanzania (2014) for those ages 5 or older. Data for Bulgaria, Denmark, Latvia, the Netherlands, Slovenia, and Spain correspond to time spent on unpaid care among those ages 20 to 74 only. Differences across countries should be interpreted with caution, given heterogeneity across surveys and countries in definitions, methodology, and sample coverage. Time-diary data often excludes supervisory responsibilities, leading to underestimation of the time constraints of care.

The regional average ratios are the averages of the ratios of the component countries, and the global average ratio is the average of the ratios of all countries included.

For further information on the country-level data, see: UN Statistics Division. (2022, May). *SDG Indicators: United Nations Global SDG Database*. <https://unstats.un.org/sdgs/dataportal>

Data for India and Madagascar are not currently available in the SDG data portal, so they come from:

Government of India. (2020). *Time Use in India-2019*. Ministry of Statistics and Programme Implementation, National Statistical Office. [https://mospi.gov.in/sites/default/files/publication\\_reports/Report\\_TUS\\_2019\\_0.pdf](https://mospi.gov.in/sites/default/files/publication_reports/Report_TUS_2019_0.pdf)

Addati, L., Cattaneo, U., Esquivel, V., & Valarino, I. (2018). *Care Work and Care Jobs for the Future of Decent Work*. Geneva: International Labour Organization. [https://www.ilo.org/global/publications/books/WCMS\\_633135/lang--en/index.htm](https://www.ilo.org/global/publications/books/WCMS_633135/lang--en/index.htm)

### Financial Services for the Poor

The "Income" comparison refers to what the World Bank calculates as account ownership of the richest 60 percent of households and poorest 40 percent of households, respectively.

Demirgüç-Kunt, A., Klapper, L., Singer, D. & Ansar, S. (2022). *The Global Findex database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19*. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/37578>. License: CC BY 3.0 IGO.

World Bank. (2022). *Account ownership at a financial institution or with a mobile-money-service provider (% of population ages 15+)* [Data set]. Global Findex Database. Accessed June 2023. <https://data.worldbank.org/indicator/FX.OWN.TOTL.ZS>. License: CC BY-4.0.

For methodology, see: World Bank. (2022). *Survey Methodology. In The Global Findex database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19* (pp. 181–197). Washington, DC: World Bank. <https://thedocs.worldbank.org/en/doc/f3ee545aac6879c27f8acb61abc4b6f8-0050062022/original/Findex-2021-Methodology.pdf>. License: CC BY-4.0.