FINDING THE **FINAL FIFTH**

Inequalities in immunisation

ACTION

Save the Children

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Save the Children works in more than 120 countries.
We save children's lives. We fight for their rights.
We help them fulfil their potential.

Acknowledgements

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Cover photo: Nine-month-old Nikita is given life-saving vaccinations in a slum area of Delhi where Save the Children runs a mobile health clinic. (Photo: Rachel Palmer/ Save the Children)

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FOREWORD

No child should have to live with the threat of dying before his or her fifth birthday, especially from a disease that could have been prevented by a vaccine. Every child deserves the opportunity to enjoy a healthy, successful life, and immunisation is one of the best tools we have that can turn that opportunity into a reality.

Globally, immunisation rates have increased, pushing child mortality rates down. Today, polio is endemic in only a few countries, down from more than 125 in 1988, and we are on the verge of making it the second disease after smallpox to be eradicated. The next step is to close the gap and go the final mile with health ministries and other partners to ensure the success of vaccination efforts for all.

Immunisation and health leaders have called for "a decade of vaccines" to generate excitement around completing the last leg of the immunisation journey. This idea spurred the launch of a collaborative effort with the goal of extending the full benefits of immunisation to all people, regardless of where they are born, who they are or where they live, by the year 2020.

Thus, the Decade of Vaccines Collaboration formed to gather input from stakeholders all over the world – including governments and elected officials, health professionals, academia, manufacturers, global agencies, development partners, civil society, media and the private sector – and incorporated it into the first Global Vaccine Access Plan (GVAP).

Success of the GVAP requires mutual accountability and cooperation on behalf of those who will execute it. Countries must have ownership over their immunisation programmes just as much as individuals should demand immunisation. Industry, academia and civil society sectors also have important roles to play.

We welcome the report *Finding the Final Fifth: Inequalities in immunisation* since it brings to the forefront that one fifth of the world's children – 19.3 million – were not fully immunised in 2010. As the report states, we believe that by harnessing the enthusiasm and expertise of all stakeholders, we have the power to reduce this unacceptable gap. Our success will be rewarded with up to 26 million lives saved by the end of the decade.

Dr Ciro de Quadros and **Prof Pedro Alonso**
Co-Chairs
Decade of Vaccines Collaboration

ABBREVIATIONS AND ACRONYMS

DHS	Demographic and Health Survey
DRC	Democratic Republic of Congo
DTP3	diphtheria-tetanus-pertussis three-dose vaccine
EPI	Expanded Program on Immunization
GAVI	Global Alliance for Vaccine and Immunisation
GIVS	Global Immunisation Vision and Strategy
GVAP	Global Vaccine Action Plan
HIC	high-income country
Lao PDR	People's Democratic Republic of Lao
LIC	low-income country
LiST	Lives Saved Tool
LMIC	lower-middle-income country
LSHTM	London School of Hygiene and Tropical Medicine
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
OPV	oral polio vaccine
PCM	post-campaign monitoring
RED	Reaching Every District
SIA	supplementary immunisation activities
UNICEF	United Nations Children's Fund
VCI	Vaccine Confidence Index
WHA	World Health Assembly
WHO	World Health Organization

EXECUTIVE SUMMARY

Vaccination works, and every child has the right to benefit from it. A number of global targets have been adopted to increase immunisation coverage, and progress is being made, with more children immunised against more diseases than ever before. By 2010, 85% of the world's children were vaccinated with three doses of a diphtheria-, tetanus- and pertussis-containing vaccine (DTP3), compared with 75% two decades earlier.[1] The number of countries that have achieved the global target of 90% DTP3 coverage in children under the age of one is now 130.[2]

Despite impressive global progress, there is still a long way to go until the full benefits of immunisation are enjoyed by *all* children. In 2008, 1.5 million children under the age of five died needlessly as a result of vaccine-preventable causes; this represents 17% of all under-five deaths.[3] In 2010, almost one in five children – nearly 20 million – did not receive the most basic vaccinations.[4] Reaching the unimmunised[5] is essential if we are to meet Millennium Development Goal (MDG) 4: to cut the under-five mortality rate by two-thirds by 2015.[6]

This is the first of two reports identifing *who* these 19.3 million unimmunised children are and *why* they aren't being reached.[7] Limited data constrains our ability to understand the full complexity of such inequalities, but through analysis of available data, supplemented with a literature review, we trace patterns in respect of wealth, education, geography and sex. We focus mainly on DTP3 as a proxy for routine immunisation coverage.

THE FINAL FIFTH OF CHILDREN WHO REMAIN UNIMMUNISED NEED VACCINES MOST

Every child has a right to health, including immunisation, as part of an essential package of health services. However, one-fifth of children worldwide are still missing out on immunisation. Whether or not children are immunised is not down to chance: the distribution of unimmunised children corresponds to gross inequalities both across and within countries.

The world's poorest countries suffer from the lowest rates of immunisation. Children born in low-income countries are least likely to be immunised, on average falling 14 percentage points behind high-income countries in DTP3 coverage rates. In absolute terms, low- and lower-middle-income countries together account for 90% of the total unimmunised population, the majority of whom are in south-east Asia[8] and Africa. Within these regions, just three countries are home to nearly 10 million unimmunised children, with more than one-third of all unimmunised children in India alone.

Inequalities within countries are even wider. A child's immunisation status is strongly associated with their household wealth, mother's education and whether they live in an urban or a rural location. In countries where inequalities are most acute, the poorest children are three times less likely to receive DTP3 than the richest, with DTP3 most unequal in Nigeria, where the ratio between poorest and richest children was 1:9 in 2008. As mothers' education increases from none to secondary, DTP3 coverage more than doubles.[9] A child living in a rural area is just under half as likely to receive DTP3 as is a child in an urban area.[10] Inequalities across districts remain common, with more than two-thirds of all countries failing to reach 80% DTP3 coverage in all districts by 2010. The pattern of progress varies widely across countries, with DTP3 inequalities widening in some countries despite increased national coverage.

Access to essential healthcare is something we all need and we all have the right to. Poor children's lack of access to basic healthcare is compounded by the fact that they are less likely to be immunised, making it more likely they will need curative services. Once a child is sick, poverty again comes into play, reducing their chances of accessing healthcare, and making it more likely that they will die from a disease that could have been prevented.[11] This synergy between immunisation coverage and poverty exacerbates health outcomes and inequalities for children who need vaccines most.[12]

IT'S TIME TO REACH THE FINAL FIFTH

Pursuing progress in immunisation coverage without addressing inequalities can actually exacerbate gaps in coverage. An equity-focused approach that addresses both demand- and supply-side barriers to immunisation is essential to ensure that the hardest-to-reach are at the centre of strategies to expand coverage, while also ensuring that gains made to date are sustained.[13]

There is a moral imperative both to achieve high national coverage and to reach the children who remain unimmunised. There is also an economic case for doing so: addressing inequalities in immunisation coverage is cost-effective.[14] For every pound spent, more lives would be saved and progress towards global and national goals would be accelerated using an equity-focused approach.[15] As UNICEF estimated for health more broadly,[16] for every $1 million invested through an equity-oriented approach[17], 60% more deaths will be prevented than through pursuing the current path – ie, existing mainstream strategies to achieve the health MDGs for children.[18]

In the 12 countries[19] with the largest inequalities in DTP3 coverage by household wealth, if national coverage rates of routine immunisation were brought up to the level achieved for the richest households – ie, reducing inequalities by household wealth – it is estimated that almost 140,000 additional future under-five deaths would be averted each year.[20] If this package of routine vaccines was expanded to include pneumococcal and rotavirus in these 12 countries – as per the WHO global recommendation[21] – the number of future annual child deaths averted would rise to more than 370,000. This amounts to almost 5% of total annual child deaths worldwide.[22]

Immunisation strategies and strengthened health systems are essential to expand coverage progressively. But overcoming such inequalities also requires wider efforts to address the social determinants of health.[23]

We know the importance of focusing on addressing inequities in immunisation coverage. To that end, this report calls on governments, development partners and the global community to implement the following recommendations, both in the Global Vaccine Action Plan (GVAP) and in its implementation:

RECOMMENDATIONS

For governments:

- All member states should support **a resolution on the GVAP** at the 65th World Health Assembly, with strong emphasis on the importance of addressing inequities as part of efforts to expand coverage of both traditional and new vaccines. This objective should be country-owned, with progress routinely reported through country and global mutual accountability frameworks.
- **Political will** is crucial to progress and the reduction of inequities within countries. In all countries, and especially where inequalities are wide, the government (at national, state and district levels) should make **an explicit commitment to reduce inequalities** in coverage of essential health interventions, developing equity-sensitive strategies and allocating sufficient human and financial resources to implement them.
- This commitment should be translated into fully funded **national and sub-national immunisation strategies**, developed with meaningful multi-stakeholder engagement, and which address the range of local barriers to universal child immunisation.
- Efforts to overcome inequities in immunisation coverage should be used to **strengthen health systems** and promote access for children and their families to other health services. Communities should be empowered to claim their right to immunisation and influence delivery mechanisms, to ensure these are appropriate.
- National information systems should be strengthened, and regular household surveys supported by development partners, to **improve the availability and quality of data** to measure disaggregated progress towards targets and inform policy and programme design.

For development partners:

- National strategy development and implementation should be supported with **financial and technical support** from development partners as appropriate.[24]
- **Global goals**[25] should specify reductions in inequalities and should be monitored routinely. Standardised indicators should be adopted that track progress in reducing inequities in access to essential health interventions, including immunisation – for example, coverage rates disaggregated by household wealth, educational attainment, and urban/rural location.

For the private sector:

- Pharmaceutical **research and development** should prioritise vaccines that target the greatest burden of disease in low- and middle-income countries, and adapt products to help overcome barriers to access and increase coverage of traditional and new vaccines.[26]

Later in 2012, Save the Children plans to publish a report on how to reach the final fifth, exploring lessons from contexts where progressive gains have been made, as well as the opportunity of immunisation to catalyse access to other health services[27] and strengthen health systems. Such opportunities must be seized if we are to achieve national and global goals.

INTRODUCTION

Despite impressive global progress in increasing the levels of immunisation coverage, there is still a long way to go until the full benefits are enjoyed by *all* children. In 2010, almost one in five children – nearly 20 million – did not receive the most basic vaccinations that all children are meant to receive.[28]

This global final fifth of children who remain unimmunised[29] are not a random selection. They are excluded from services owing to poverty, sex, race, religion, caste and ethnicity. Limited data constrains our ability to understand the full complexity of such inequalities, but household survey data makes it possible to trace patterns in respect of wealth, education, geography and sex. This is the first of two reports identifying *who* these 19.3 million unimmunised children are and *why* they aren't being reached.[30]

PROGRESS TOWARDS GLOBAL TARGETS

Immunisation is a proven cost-effective service, as part of a basic package of essential preventive, promotive and curative health interventions.[31] Through vaccination, smallpox has been eradicated, and poliomyelitis is nearing eradication. Current coverage of immunisation with the measles vaccine and three doses of diphtheria, tetanus and pertussis-containing vaccine (DTP3)[32] averts around 2.5 million deaths each year.[33] Immunisation has also contributed to the 78% reduction in deaths caused by measles since 2000,[34] and the 90% drop in deaths due to maternal and neonatal tetanus over the past 20 years.[35] New vaccines are currently improving our potential to fight pneumonia and diarrhoea – the two leading killers of children[36] – and more countries are introducing these in national immunisation schedules (see Box 1).[37] The expansion of immunisation

BOX 1: GLOBAL ALLIANCE FOR VACCINES AND IMMUNISATION (GAVI): EXPANDING ACCESS TO NEW VACCINES

GAVI works to save children's lives and protect people's health by increasing access to immunisation in poor countries. Established in 2000 with key international stakeholders, GAVI's funding has supported the roll-out of new and under-used vaccines in 72 of the world's poorest countries, preventing more than five million future deaths.

As a result of its successful pledging conference in June 2011, GAVI will support governments to immunise more than a quarter of a billion children in developing countries by 2015 and prevent an additional 3.9 million deaths.

GAVI supports increased access to life-saving vaccines in the poorest countries by funding gaps in immunisation schedules, and by helping countries purchase new life-saving vaccines that were previously too expensive for poor countries. As a result, GAVI helps to reduce the delay in vaccine introduction in low-income countries. With GAVI's support Ghana, for example, introduced vaccines against pneumonia and rotavirus in April 2012. Thirty-seven countries were approved funding for new and underutilised vaccines in 2011.

Source: Adapted from the GAVI website: http://www.gavialliance.org/ (accessed March 2012)

coverage is helping to reduce overall child mortality and to accelerate progress towards the health-related Millennium Development Goals (MDGs).[38] Vaccination works and every child has the right to benefit from it.

Various targets have been adopted to increase immunisation coverage, and progress is being made, with more children immunised against more diseases than ever before. In 1991, Universal Child Immunisation – defined as 80% global coverage for DPT3, BCG, OPV3 and measles – was declared as having been achieved.[39] Following a World Health Assembly (WHA) decision in 1992 that recommended hepatitis B vaccination, the number of countries with HepB vaccine in their routine schedule increased from 31 to 171 by 2007.[40]

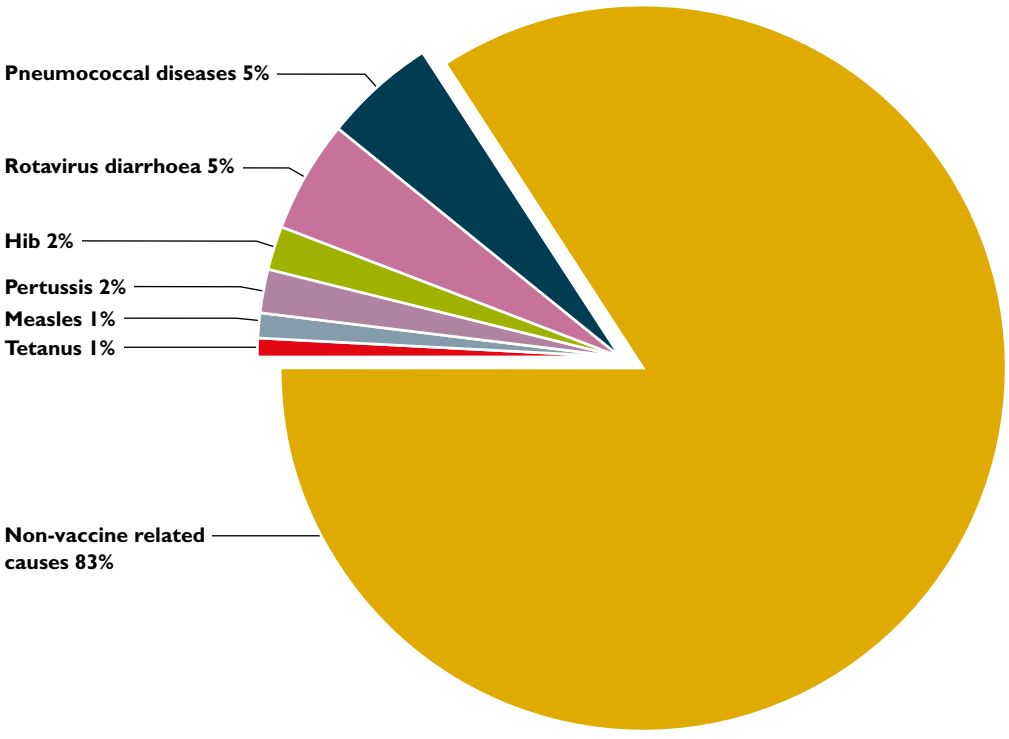
In 2005, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) adopted the Global Immunisation Vision and Strategy (GIVS). This ten-year framework (2006–15) includes the goal of at least 90% national vaccination coverage[41] and 80% coverage in every district or equal administrative unit by 2010.[42] At the 64th WHA, the Decade of Vaccines Collaboration was launched to develop a Global Vaccine Action Plan (GVAP) for 2011–20.

The GVAP echoes and expands on existing goals for the decade. These include introducing at least one new or underutilised vaccine in at least 80 low- and middle-income countries by 2015, extending the GIVS target date for DTP3 to 2015, and expanding it to all vaccines in national programmes by 2020.[43] Achieving 90% coverage of a package of DTP, Haemophilus influenzae type b (Hib), pneumococcal, rotavirus and measles vaccinations by 2020 in low-income countries could avert more than 1 million future under-five deaths, and almost 2.5 million under-five deaths if achieved in all GAVI-eligible countries.[44]

The vaccinations included in immunisation schedules vary across countries.[45] WHO recommends a basic package of routine immunisation that includes BCG, HepB, polio, DTP, Hib, pneumococcal (conjugate), rotavirus, measles, rubella and HPV.[46] By 2010, 85% of the world's children were vaccinated with DTP3, compared with 75% two decades earlier.[47] A total of 130 countries have now reached the global target of 90% DTP3 coverage in children under the age of one.[48]

Nevertheless, 1.5 million children under the age of five needlessly died in 2008 as a result of vaccine-preventable causes. This represents 17% of all under-five deaths (Figure 1).[49] Expanding immunisation coverage is essential if we are to meet the MDG 4 target of cutting the under-five mortality rate by two-thirds by 2015.[50]

FIGURE 1: UNDER-FIVE DEATHS FROM VACCINE-PREVENTABLE DISEASES (2008)



Source: World Health Organization, 2010[51]

EQUITY MATTERS

Celebrating global progress disguises huge discrepancies between regions and countries and within countries, which this report will explore. Aggregate national targets are dangerous in that they can encourage measures that favour easy-to-reach children, and can maintain disparities. In some cases, efforts to achieve national aggregate targets can cause the equity gap to widen.[52]

Poverty increases a child's exposure to disease and reduces their ability to fight it,[53] making poor children most likely to fall ill. Without essential vaccines, along with other preventive health interventions, this likelihood increases further. In this report, we find that the likelihood that a child is unimmunised is closely associated with poverty. This synergy exacerbates poor health outcomes and inequalities for children who most need vaccines.[54]

Inequity in health can be defined as "unfair and unnecessary social gaps in health and health care".[55] A child's access to national immunisation schedules is determined by social conditions such as where they are born and their parents' wealth. These inequalities are a fundamental injustice.

The Millennium Declaration was a commitment to equity, equality and human rights; however, the targets and indicators for the Goals themselves are mostly national averages. These fail to capture sub-national disparities, and thereby hide deep inequalities. A focus on equity is recognised as an objective of both the GIVS and the GVAP. After all, universal goals for immunisation can be achieved only if the unimmunised are reached, while at the same time high coverage is maintained among those who are currently immunised.

METHODOLOGY

Both quantitative and qualitative analyses were undertaken as part of the research for this report.

For analysis at the **global level**, UNICEF/WHO estimates of national coverage for 2010 have been used.[56] Countries have been grouped according to World Bank country income groups[57] and WHO regions.[58] The number of unimmunised children has been arrived at using UNICEF/WHO estimates of national routine immunisation coverage (2010) and population data for surviving infants obtained from the UN Department of Economic and Social Affairs, Population Division, for the same year.

To analyse **inequalities within countries**, we have used the most recent Demographic and Health Survey (DHS) or Multiple Indicator Cluster Survey (MICS) datasets since 2005. On this basis, surveys were available for 87 countries.[59] Using these household surveys, we analysed DTP3 and measles immunisation coverage, disaggregated by the following background characteristics, for all countries where data was available: wealth quintile, mother's educational attainment, urban/rural, and sex.[60] For selected surveys in countries where inequalities are wide, DTP3 and measles coverage rates were also analysed by sub-national geographical region. To discover trends over time within countries, the last two surveys were analysed, with the most recent survey dating from 2005 or later. Data was available to analyse trends in 42 countries.[61]

A **Lives Saved Tool** (LiST) analysis looking at the impact of scaling up immunisation coverage on under-five mortality was carried out by Johns Hopkins Bloomberg School of Public Health using: population trends from the 2010 revision of the World Population Prospects (UN Population Division); 2010 child mortality estimates from http://www.childmortality.org; causes of death in children under five from the Child Health Epidemiology Reference Group of WHO and UNICEF (2010); and vaccine coverage values 2004–11 from WHO/UNICEF estimates (last updated 3 August 2011). For the projected impact of narrowing inequalities within certain countries, DHS and MICS data were used.

A qualitative **literature review** was undertaken to supplement the data analysis for the report. This drew heavily on the resources prepared for the Strategic Advisory Group of Experts meeting in November 2010, by the Centers for Disease Control and Prevention,[62] John Snow Inc.,[63] and WHO.[64]

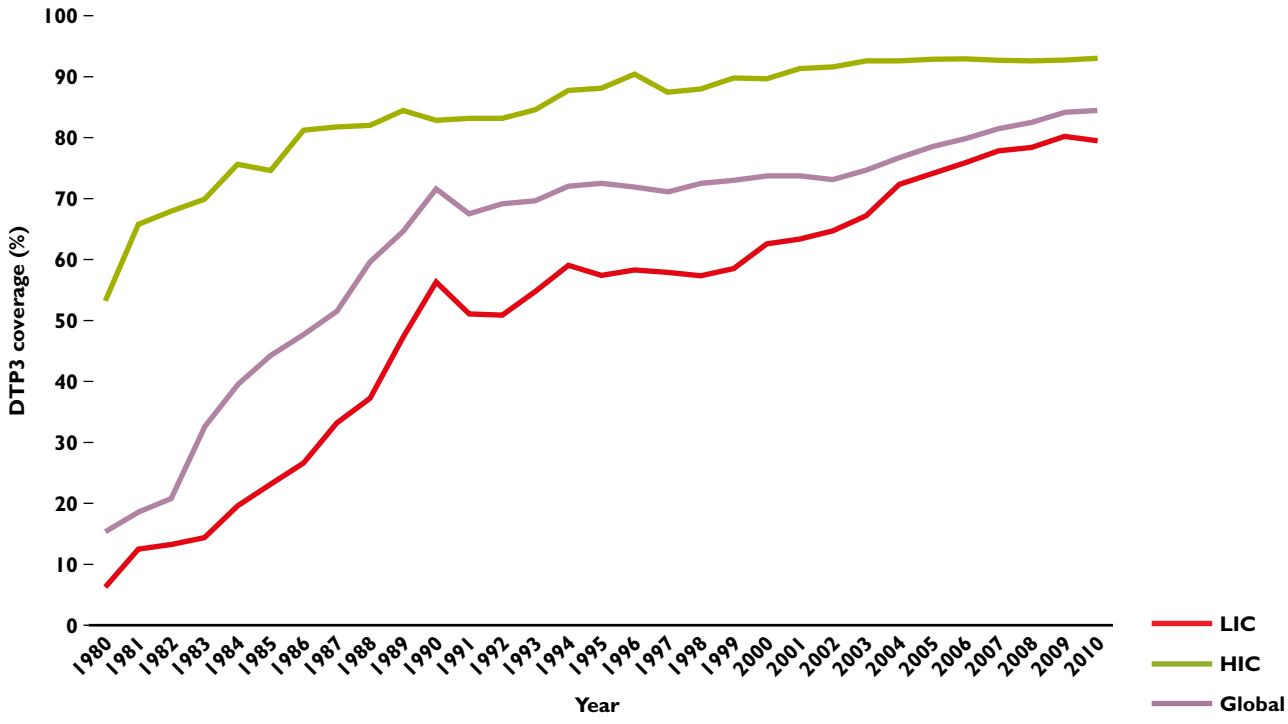
1 WHERE ARE THE UNIMMUNISED CHILDREN ACROSS COUNTRIES?

Global progress in immunisation coverage is impressive, but a child's chance of being immunised is still associated with the income level of the country in which they are born. Children in low-income countries (LICs) fall 14 percentage points behind children in high-income countries (HICs) in DTP3 coverage rates. The world's unimmunised children are also highly concentrated within Africa and in south-east Asia, with more than one-third of all unimmunised children in India. Living in a fragile state, where health systems are weak and conflict can interrupt access to essential services, can also affect a child's chance of being immunised. Without access to a health worker, a child will not be immunised.

POOR COUNTRIES STILL FALL BEHIND

Over the past few decades, DTP3 coverage rates have increased enormously (Figure 2). Progress has been made in countries across all categories of income level.[65] Average DTP3 immunisation rates in LICs have risen more than tenfold over the past 30 years. Yet gaps between rich and poor countries remain wide: a child born in a LIC is 14 percentage points less likely

FIGURE 2: DTP3 COVERAGE RATES BY WORLD BANK COUNTRY INCOME GROUP (1980–2010)



Source: UNICEF/WHO national coverage estimates, grouped by World Bank country income categories, and weighted by surviving infants data from the UN Population Division.

to receive DTP3 than one from an HIC.[66] The level of DTP3 coverage in LICs in 2010 is about equal to levels in HICs in 1986. That poor countries are over 20 years behind wealthy ones in terms of coverage for such a basic health intervention as immunisation is a grave injustice.

Some of the countries with the lowest coverage rates are those classified as 'fragile states'.[67] In such contexts, public service provision can be especially weak, with families' access to health services undermined by conflict and insecurity.[68] Somalia and Chad, for example, have the lowest measles vaccination coverage rates worldwide, with less than half of children immunised. These two countries also fall into the top five countries with highest under-five mortality rates (180 and 173 per thousand live births respectively), with Somalia having the highest rate globally.

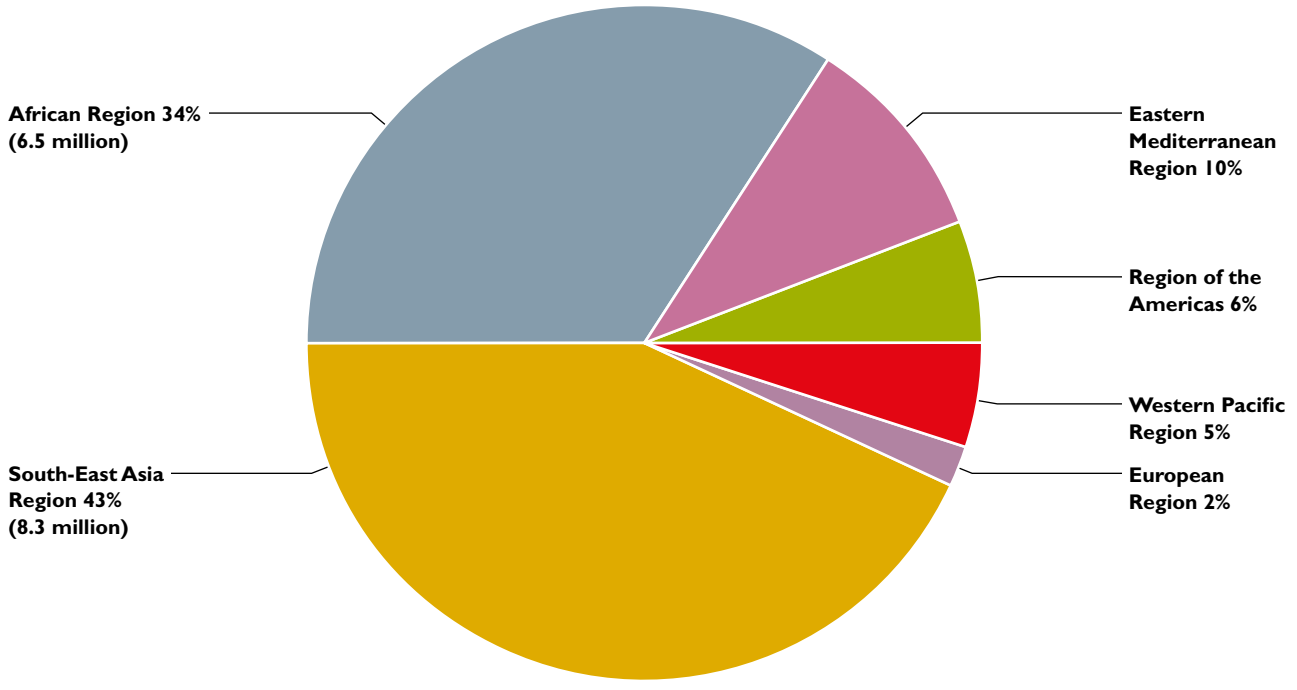
Children in LICs are also less likely to have access to new vaccines. For example, only 2% of children in LICs had pneumococcal conjugate vaccines included in their national immunisation schedules in 2010,[69] compared with 87% of children born in HICs that year.[70] Only 12% of LICS have introduced both pneumococcal and rotavirus vaccines, compared with almost 80% of HICs.[71]

AFRICA AND SOUTH-EAST ASIA ARE HOME TO 80% OF THE WORLD'S UNIMMUNISED CHILDREN

For both relative coverage rates and absolute numbers of unimmunised children, Africa and south-east Asia fare the worst. Together, these two regions are home to nearly 80% of the unimmunised children, totalling almost 15 million children (Figure 3).[72] They also account for over two-thirds of global vaccine-preventable disease burden, and are where child mortality rates are highest.[73] According to a recent review of progress towards the GIVS targets, countries in Africa were reported to be the most off-track.[74]

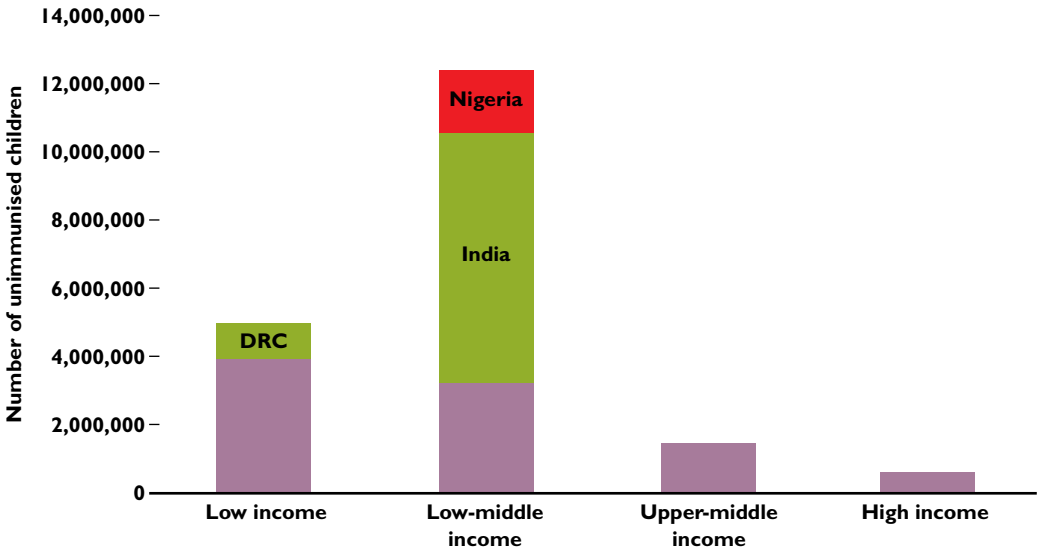
Around 70% (13 million) of all unimmunised children are in just 10 countries,[75] and 52% (10 million) are concentrated in just three: India, Nigeria and the Democratic Republic of Congo (DRC). More than one in three of the world's unimmunised children live in India. This concentration in three countries can be explained both by their large population size and by their relatively low vaccination coverage rates (at 72%, 69% and 63% respectively for DTP3 in 2010).[76] The fact that so many unimmunised children live in lower-middle-income countries (LMICs)

FIGURE 3: REGIONAL DISTRIBUTION OF UNIMMUNISED CHILDREN (2010)



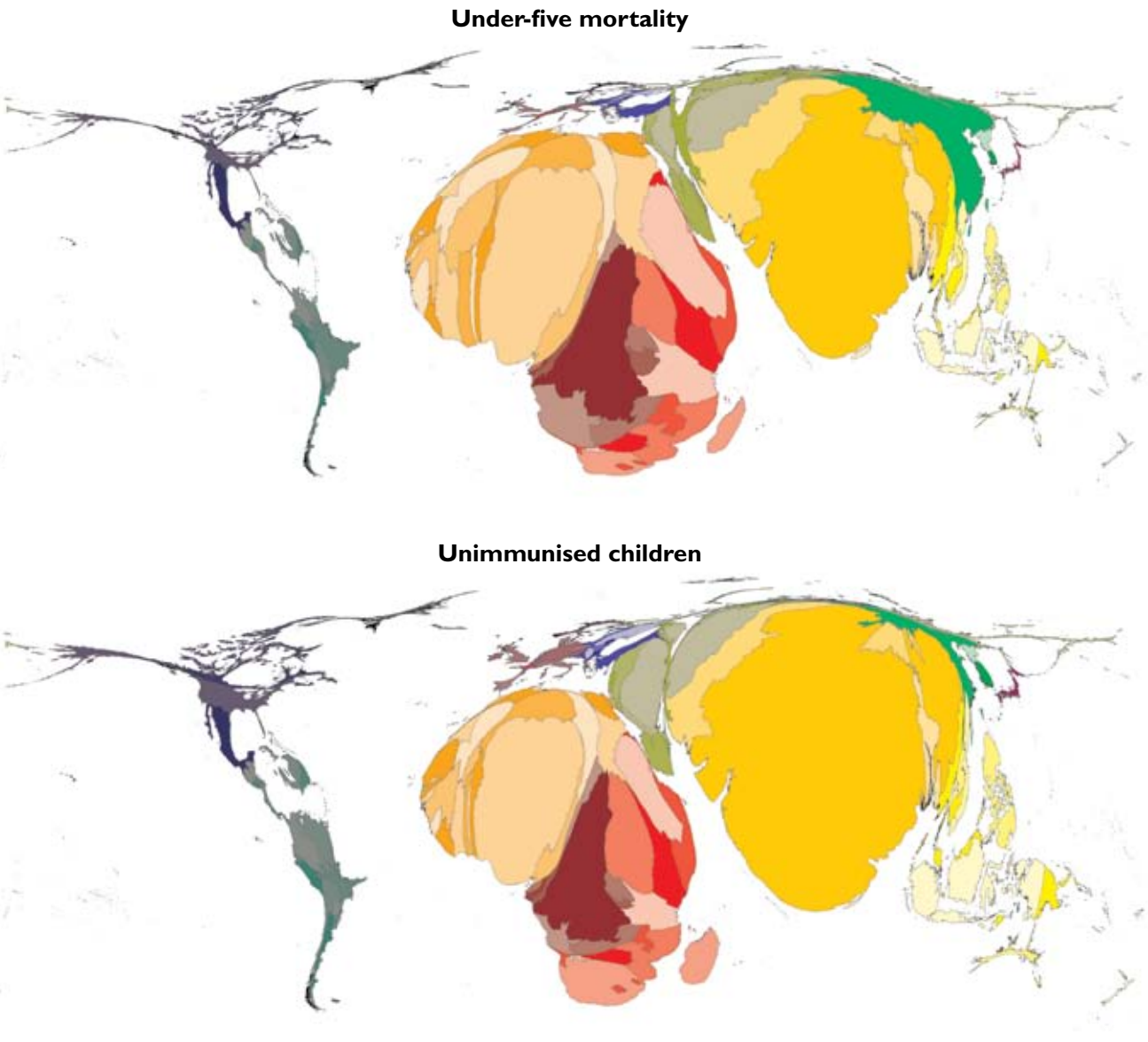
Source: Unimmunised children are calculated based on UNICEF/WHO national DTP3 coverage estimates for 2010 and population data for surviving infants for the same year obtained from the UN Population Division.

FIGURE 4: NUMBER OF CHILDREN NOT IMMUNISED WITH DTP3 (2010)



Source: Unimmunised children are calculated based on UNICEF/ WHO national DTP3 coverage estimates for 2010 and population data for surviving infants for the same year obtained from the UN Population Division.

FIGURE 5: MAP OF THE WORLD SHOWING COUNTRIES' SIZES ACCORDING TO CHILD MORTALITY, HEALTH WORKER SHORTAGE AND UNIMMUNISED CHILDREN



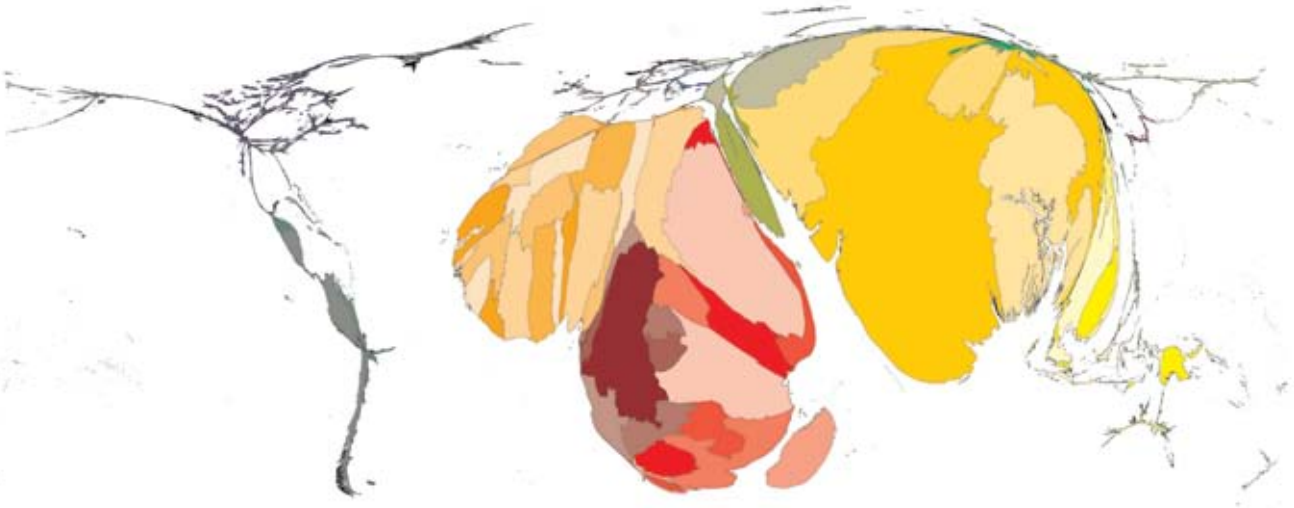
such as India and Nigeria (Figure 4)[77] must be considered in efforts to overcome inequalities and reach global targets.

NO IMMUNISATION WITHOUT A HEALTH WORKER

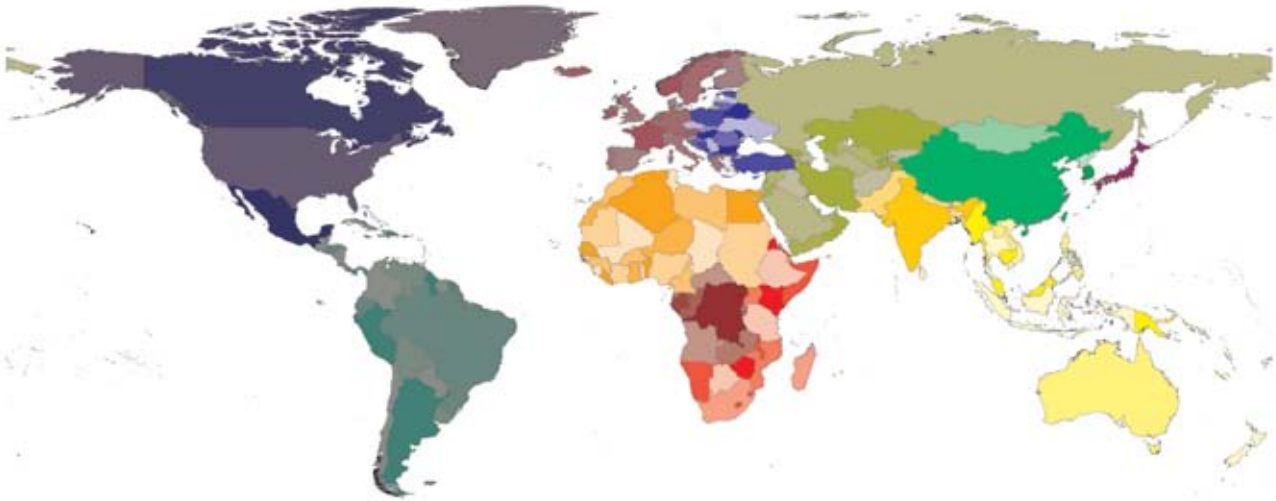
Typically, where children are unimmunised and dying before the age of five, access to essential health services is limited and health systems are weak.

The maps in Figure 5 illustrate this trend, using health worker shortage as a proxy for health system weakness. This is not coincidental: vaccines cannot administer themselves, and without a trained, equipped, paid, supported and motivated health worker within reach of every child, universal access to immunisation – as well as other essential services – cannot be achieved. Because the same health workers who deliver vaccines can also deliver other important interventions, these human resource gaps directly reduce a child's chance of survival.

Health worker shortage



Regular map (Mercator projection)



Maps produced by Worldmapper Project, Sasi Research Group, University of Sheffield.

Sources: Under-five deaths are based on 2010 data from WHO Global Health Observatory Data Repository.
Unimmunised children are calculated based on UNICEF/WHO national DTP3 coverage estimates for 2010 and population data for surviving infants for the same year obtained from the UN Population Division.
Health worker shortages are calculated according to WHO recommended minimum ratio of 23 doctors, nurses and midwives per 10,000 population, using latest available country data (2000–09) from WHO Global Health Observatory Data Repository and UN population data.

2 WHO ARE THE UNIMMUNISED CHILDREN WITHIN COUNTRIES?

National immunisation coverage rates also mask great disparities within countries. To understand *who* the unimmunised children are, we must go beyond national averages and look at the distribution of immunisation within countries.[78] To this effect, we analysed the available data to explore distribution of unimmunised children by wealth quintile, mother's educational attainment, across districts and urban and rural areas, and by the sex of the child.

We find that **children from the poorest 20% of households are also those with the lowest DTP3 coverage rates** in almost all countries analysed;[79] on average they are three times less likely to be vaccinated than those from the richest households.[80] Similarly, DTP3 coverage more than doubles as mother's education increases from none to secondary level.[81] Wide inequalities in immunisation coverage rates are observed across districts, with more than two-thirds of all countries failing to reach 80% DTP3 coverage in all districts in 2010. Children living in rural areas are nearly half as likely to receive DTP3 as those in urban areas.[82] We also follow trends over time and see that progress means very different things in different countries, both widening and narrowing inequality gaps as national coverage rises.

Understanding such determinants of vaccination coverage within each context must inform policy and programme development to accelerate progress towards national and global targets, while also reducing unjust inequalities.

CHILDREN FROM POOR FAMILIES

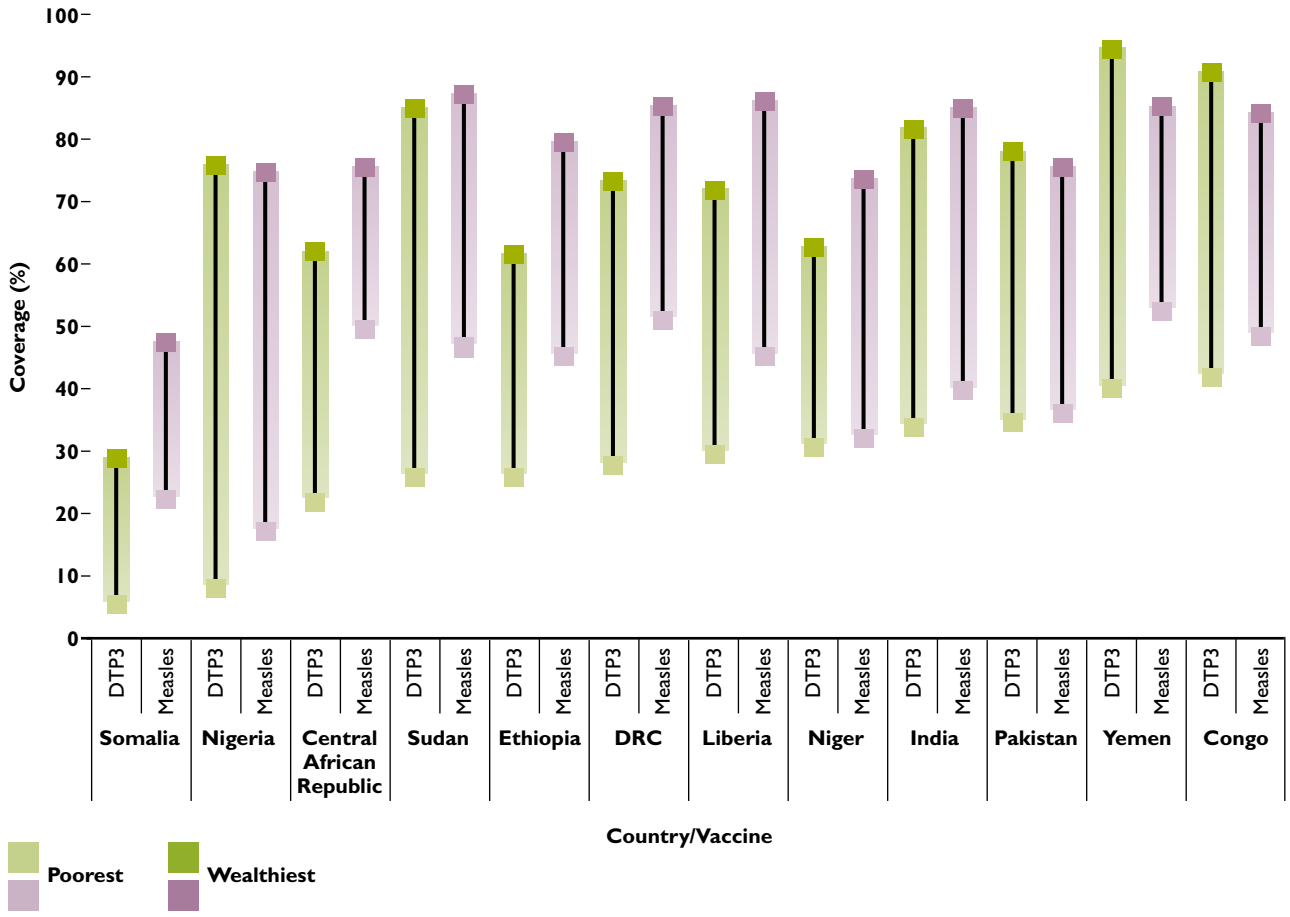
Household wealth is strongly associated with immunisation, with children from poor families far less likely to receive DTP3 than those from richer households in many countries (Figure 6).[83] In the countries with greatest inequalities in DTP3 coverage by wealth quintile,[84] only about a quarter of the poorest children are immunised, compared with almost three-quarters of the richest children. A similar trend is observed for measles vaccination coverage,[85] with only one-third of children vaccinated from the poorest households, yet three-quarters of children from the wealthiest households are immunised. Children in the poorest households are twice as likely to die before the age of five as are those from the wealthiest households.[86]

Nigeria's poorest children have the lowest DTP3 coverage rates, with just 8% of children immunised in 2008. Nigeria is also home to the widest inequalities in vaccination coverage by household wealth, with more than nine children from the richest households immunised with DTP3 for every one of the poorest children vaccinated. This is consistent with wide distribution of income inequality in the country, measured by Gini coefficient.[87] In Somalia, for every child vaccinated against DTP3 in the poorest households, five children from the richest households are immunised; in Sudan, the DRC and the Central African Republic, this ratio is about 1:3.

For measles vaccination, Nigeria again has the widest disparity in immunisation coverage between richest and poorest, where five of the wealthiest children are immunised for every one child from the poorest households. Yet, the poorest children in Nigeria are still twice as likely to be immunised with the measles vaccine than with DTP3. This discrepancy probably reflects the different delivery mechanisms for DTP3 and measles, with the latter also available through vaccination campaigns.

In several of the countries where wealth is closely associated with inequalities in immunisation coverage – Côte d'Ivoire, Yemen, Madagascar and Congo – the richest households have surpassed the global target of 90% DTP3 coverage, leaving the poorest households behind.

FIGURE 6: COUNTRIES WITH THE GREATEST INEQUALITIES IN DTP3 COVERAGE BETWEEN POOREST AND WEALTHIEST HOUSEHOLDS, PLOTTED WITH MEASLES COVERAGE



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005), with the most unequal countries identified as those with the highest ratios in immunisation coverage between richest and poorest quintiles.

The shape of the curve of immunisation coverage across wealth quintiles provides further information on the pattern of inequality within a country (Figure 7). For instance, in Ethiopia we see DTP3 coverage levels very similar for the first three wealth quintiles, then rising sharply for the fourth and fifth. Here, strategies should be broader than targeting just the poorest 20%. By contrast, in Congo, DTP3 coverage among the poorest quintile is much lower than coverage among subsequent quintiles. Interestingly, in Niger the relationship between immunisation coverage and household wealth is not linear, with children in the third wealth quintile even less likely to be immunised than those from the poorest households. Such trends across quintiles should also inform policy and programme development.

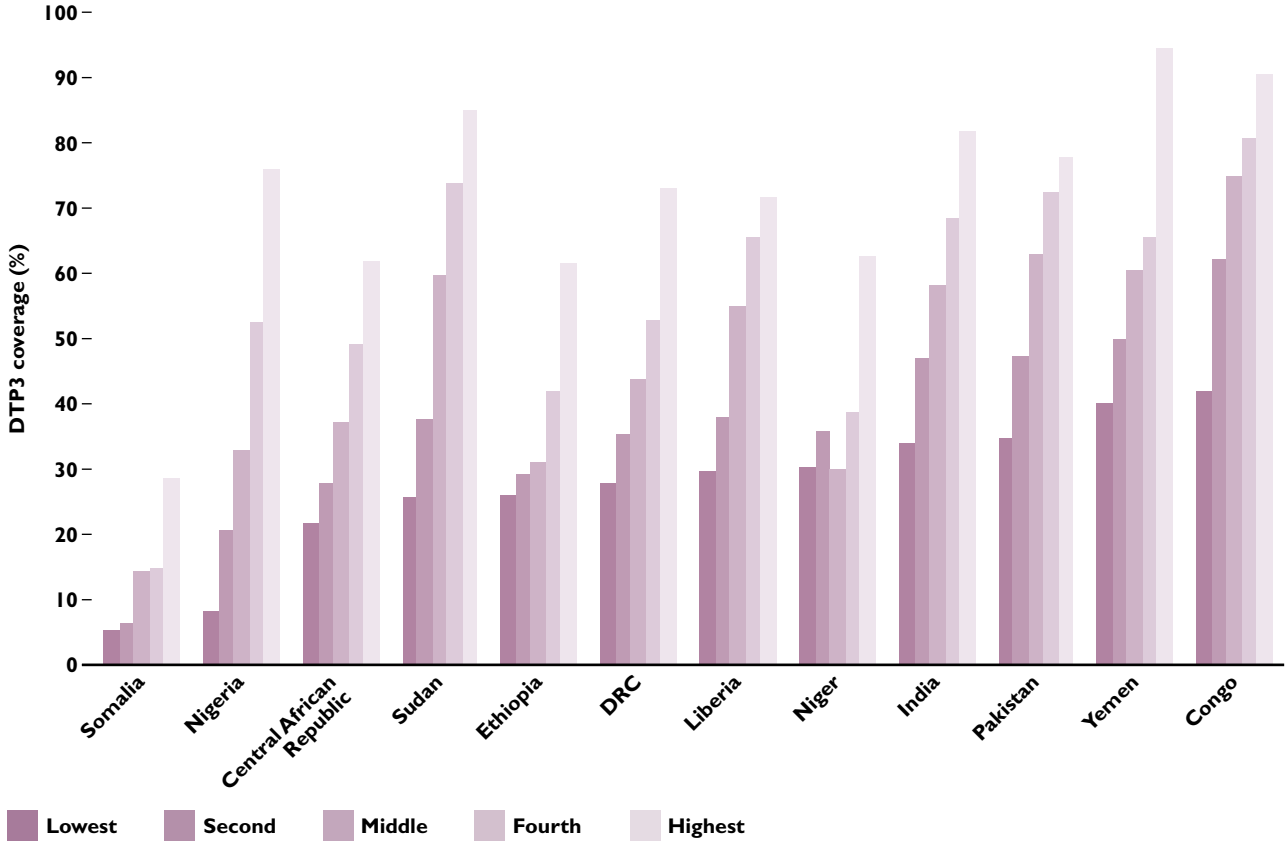
Inequalities between the rich and poor for other essential interventions – such as skilled birth attendance and use of modern family planning methods – are often even greater than those for vaccination.[88] This means that the families with unimmunised children are unlikely to access any other essential health services.[89] Immunisation strategies must explore how to both strengthen health systems and promote access for children and their families to other essential health services.

DISCREPANCIES ACROSS INDIA'S STATES

For countries with large populations and wide inequalities, further analysis is crucial in order to really understand patterns of inequality.

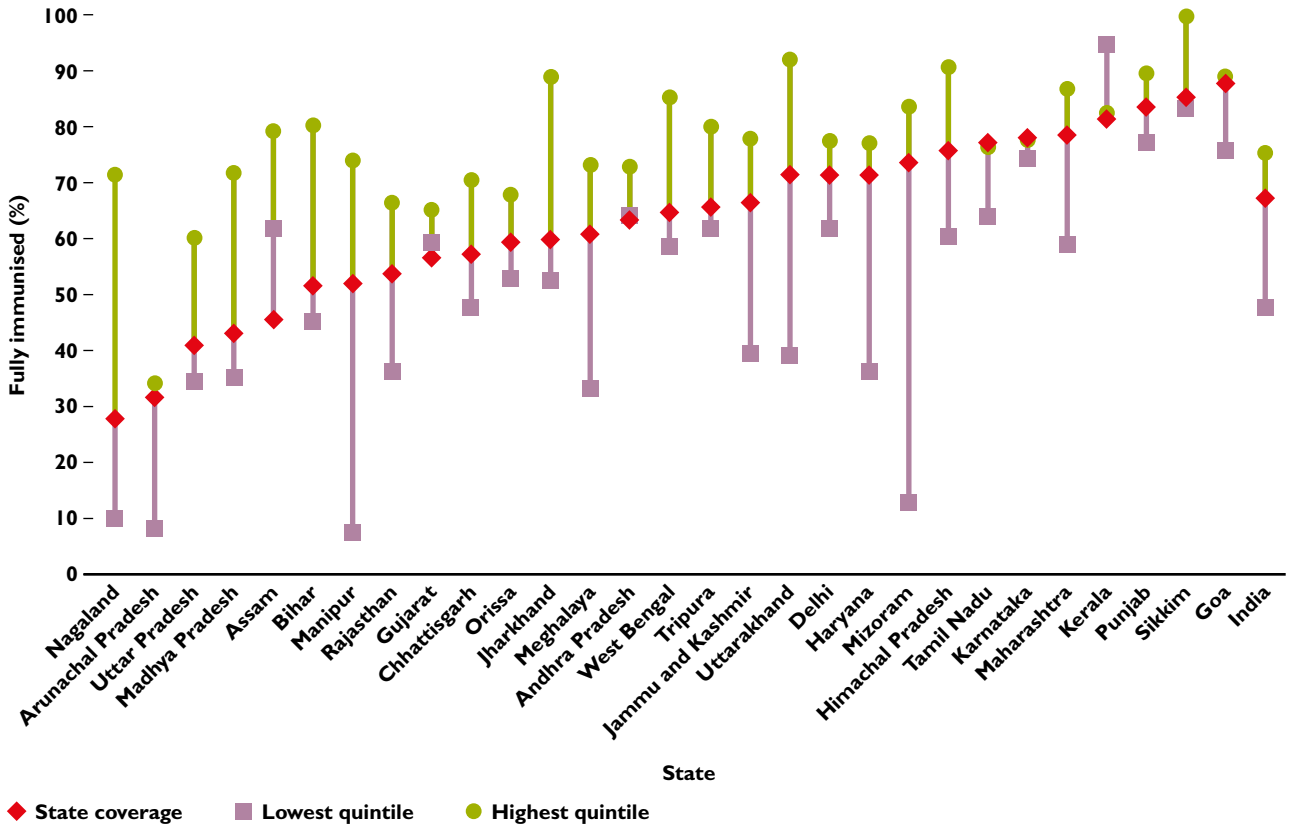
From a more in-depth analysis of India's Coverage Evaluation Survey[90] data from 2009, discrepancies in coverage rates for fully immunised children[91] by household wealth vary widely between and within states (Figure 8). Coverage gaps between rich and poor who are fully immunised are as wide as 71, 67 and 62 percentage points in Mizoram, Manipur and Nagaland respectively. In Nagaland, just one in ten of the poorest children are fully immunised, and even fewer in Arunachal Pradesh (8%).

FIGURE 7: PATTERNS OF VACCINATION COVERAGE ACROSS WEALTH QUINTILES



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005), for the 12 countries with the largest ratios between the first and fifth wealth quintiles for DTP3 coverage.

FIGURE 8: FULL IMMUNISATION COVERAGE BY WEALTH QUINTILE IN INDIA'S STATES (2009)



Source: Save the Children UK analysis of the 2009 Coverage Evaluation Survey (CES) data.

PROGRESS FOR WHOM?

All countries should be striving to increase national immunisation coverage rates while also reducing inequalities across the population. However, as mentioned above, increases in national average immunisation coverage do not necessarily translate into narrowing inequalities across the population: in certain countries, progress is concentrated among the wealthy households, leaving behind the poor and most in need.[92]

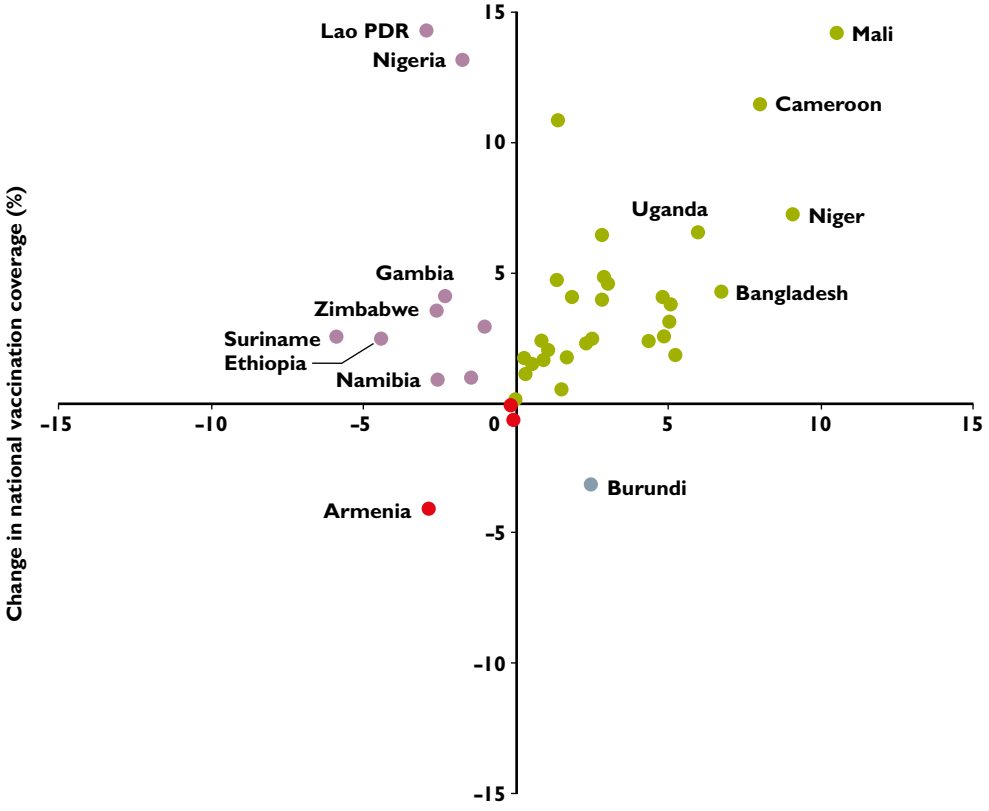
For the 42 countries with data available for multiple years, these trends over time are shown in Figure 9. The top right quadrant presents the best scenario – ie, countries where national coverage has increased and the inequality gap has narrowed; the bottom left shows decreasing coverage and widening inequality.

Overall, countries with declining national coverage may be worst off – ie, those below the x-axis. Yet in countries where the gap between the rich and poor in DTP3 coverage has widened despite rising national coverage, progress is regressive and efforts must be made to access the hard-to-reach. Nine countries fall into this category.[94]

On the right-hand side of the chart, we see countries where immunisation inequalities between the rich and poor have reduced – most significantly in Mali. In the majority of these countries, reductions in inequality coincide with an increase in national coverage. Burundi is the only country where the immunisation gap between rich and poor households narrowed, despite a decline in national coverage rates.

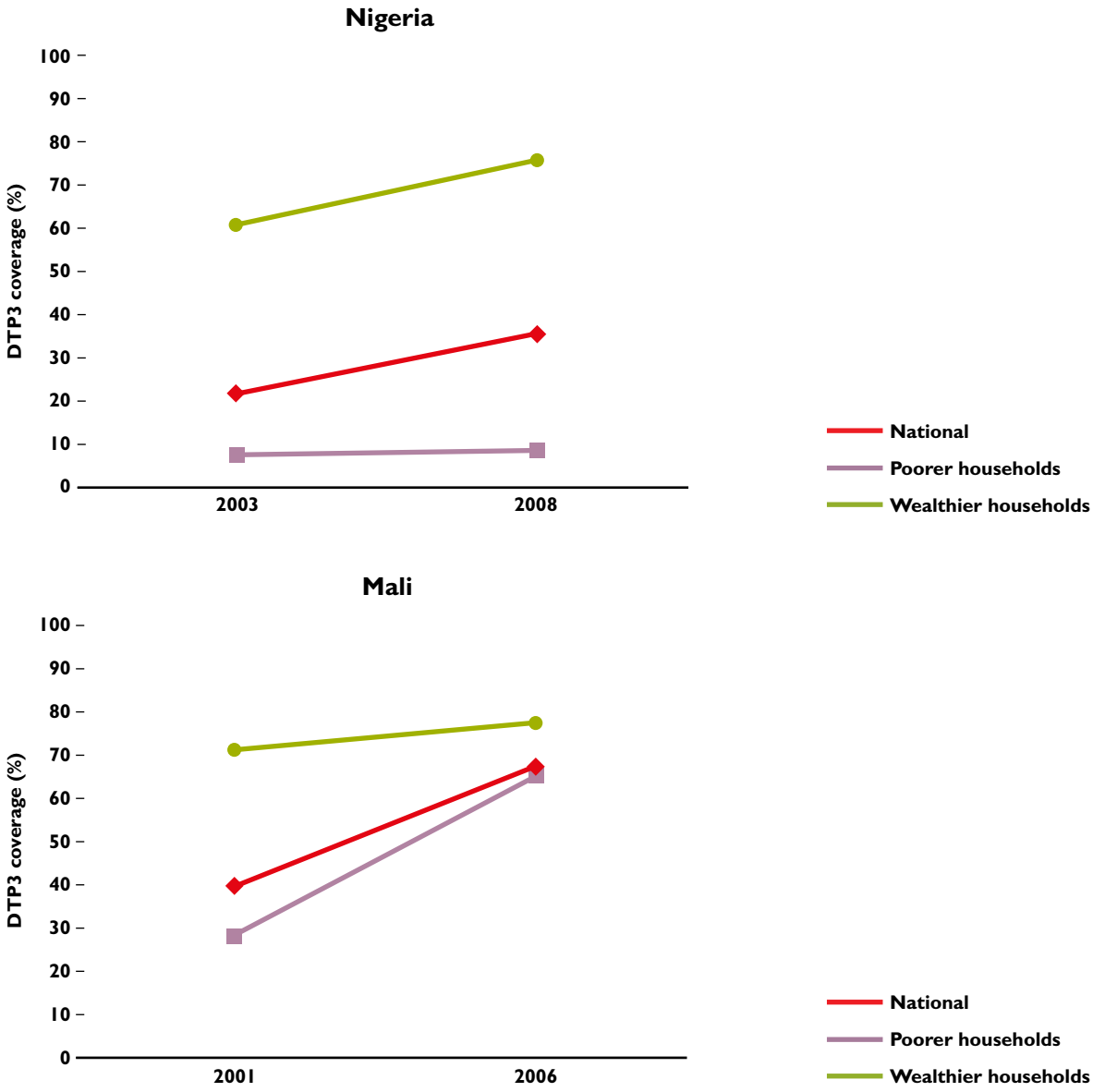
Figure 10 shows how DTP3 coverage in Nigeria became more inequitable between 2003 and 2008, with progress reserved for the richer households (increasing by 15 percentage points to reach 76%) while coverage remained virtually static for poor households (rising by just one percentage point to 8%). In contrast, coverage rates among poor households increased much faster than for wealthy

FIGURE 9: TRENDS IN DTP3 COVERAGE OVER TIME: INEQUALITIES BETWEEN THE POOREST AND RICHEST 20% AND NATIONAL RATES



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005) for countries where a previous survey is available. This is based on scenarios/classifications delineated by Delamonica et al.[93] Trends look at average annual change in coverage and in ratios between the lowest and the highest wealth quintile.

FIGURE 10: CHANGE IN DTP3 COVERAGE IN NIGERIA (2003–08) AND MALI (2001–06) BY HOUSEHOLD WEALTH LEVEL



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005).

households in Mali, more than doubling DTP3 coverage in just five years, compared with an increase of less than 7 percentage points among the rich. This significantly narrowed the inequality gap.

Even where the inequality gap in DTP3 coverage is narrowing, there is a long way to go to close coverage gaps in many countries – such as Niger, where the gap decreased by nearly 27 percentage points between 1998 and 2006, yet remains at 32 percentage points. Similar results were found in an earlier study, where declines in relative gaps still left large poor populations still without the benefits of immunisation.[95]

CHILDREN OF MOTHERS WITH LITTLE OR NO EDUCATION

The mother's educational attainment is also closely associated with immunisation rates.[96] This link relates to both the difference in effect between no education and primary education, and that between primary and secondary education (Figure 11). In countries with the greatest inequalities,[97] only 30% of children whose mothers have no education are immunised against DTP3. As the mother's level of education increases, so does the chance that her child is immunised, although the impact of this on immunisation coverage varies across countries. For the same set of countries,

coverage rates rise to over 54% and 71%, where mothers have completed primary and secondary school, respectively.[98]

Nigeria and the Philippines have the widest gaps in DTP3 coverage rates by education level of the mother, with more than 50 percentage points between those with no education and those with secondary education. Just one in ten of children born to mothers with no education in Nigeria received DTP3. Also in Nigeria, the children of mothers who have completed secondary education are more than six times more likely to be immunised with DTP3 than those of mothers with no education.

PROGRESS FOR WHOM?

Thirty-nine countries have sufficient data to measure changes over time in DTP3 immunisation coverage in relation to mother's educational attainment (Figure 12). Nine countries saw a widening of the inequality gap in DTP3 coverage linked to mother's education level between the two surveys, with national coverage rates increasing in seven of these countries. For instance, in the Philippines, DTP3 coverage reached the global target of 90% in 2008 for children whose mothers completed secondary education. Over the five previous years, DTP3 coverage among children whose mothers had no education declined by eight percentage points.

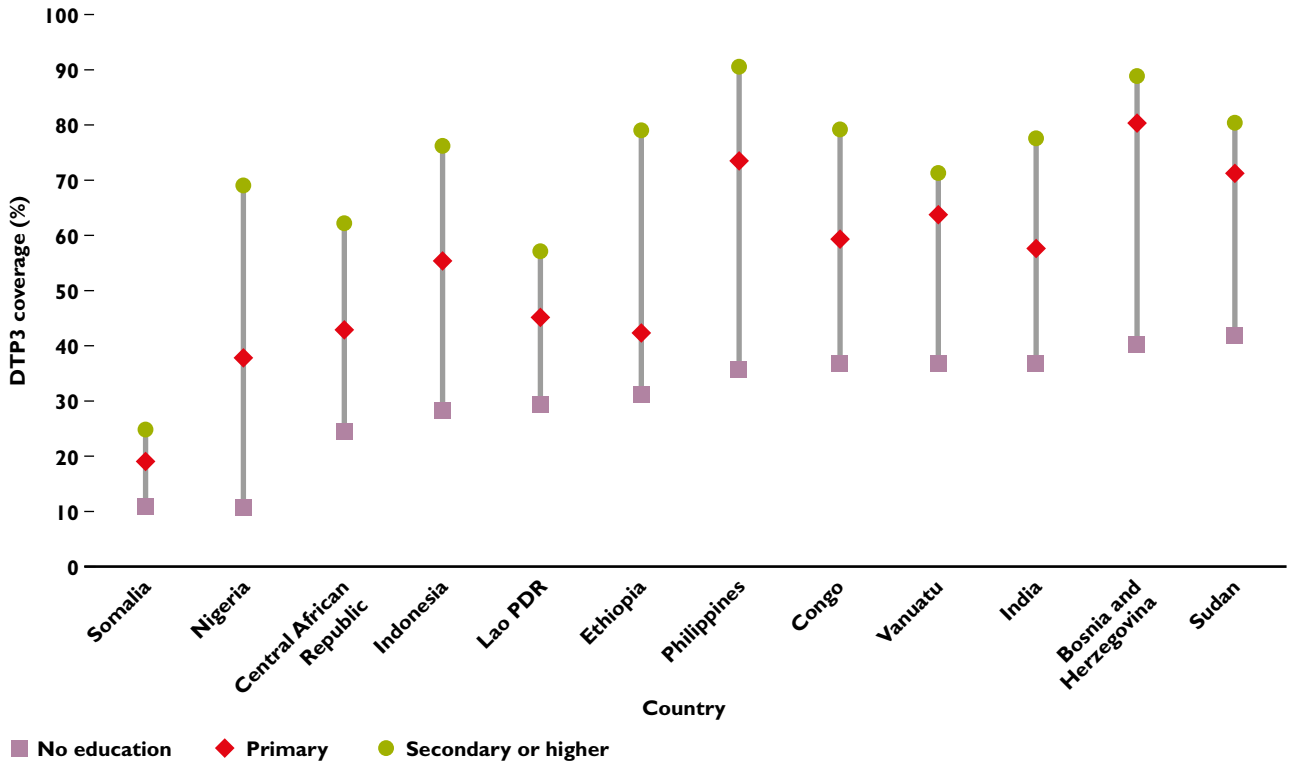
Most countries saw an increase in overall coverage, and a reduction in the inequality gaps in DTP3 coverage associated with mother's education level. In both Laos and Cameroon between 2000 and 2006, DTP3 coverage rates among children whose mothers were uneducated trebled, while coverage for children with the most educated mothers increased by about 40%. Although coverage rates in Nigeria for children whose mothers were uneducated doubled over five years, they still remained low at just 11% in 2008.

CHILDREN IN UNDERSERVED DISTRICTS

Within many countries, a child's chance of being immunised is also associated with where they live.

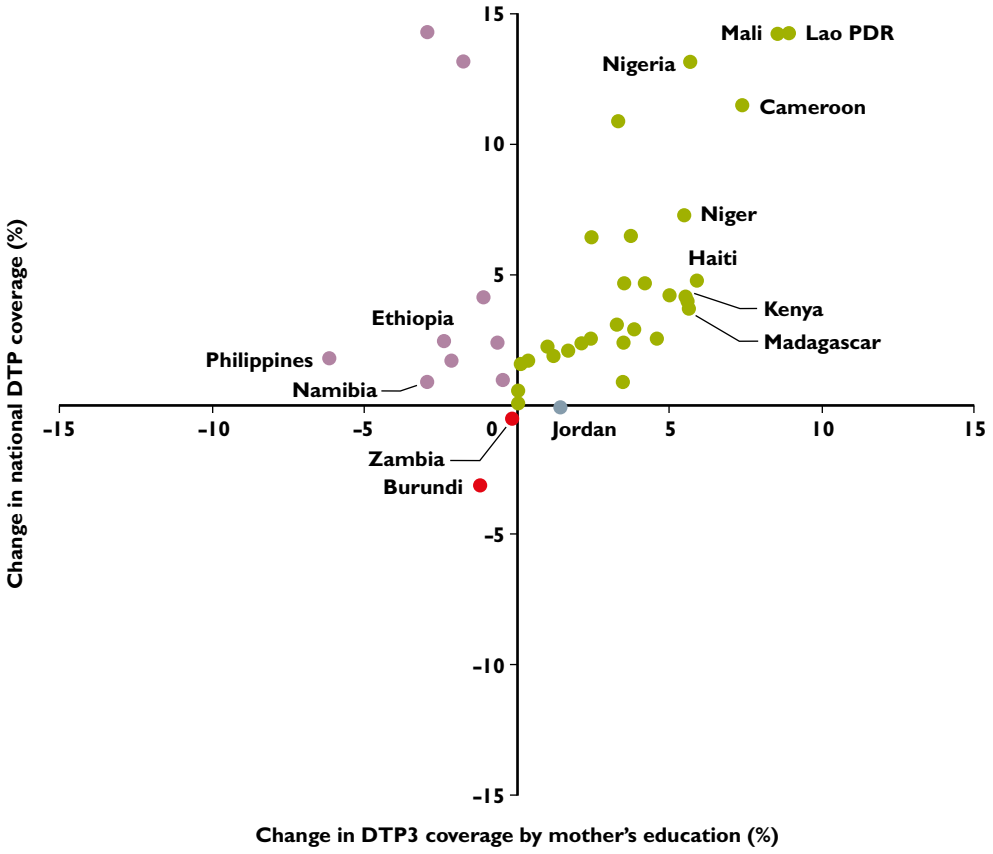
One of the goals of the GIVS and GVAP is for DTP3 coverage to reach at least 80% of children in every district or equivalent administrative unit. Progress

FIGURE 11: COUNTRIES WITH HIGHEST DISPARITIES IN DTP3 COVERAGE BY EDUCATION LEVEL



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005), for the 12 countries with the largest ratios between no education and secondary education for DTP3 coverage.

FIGURE 12: TRENDS IN DTP3 COVERAGE OVER TIME: INEQUALITIES BY MOTHER'S EDUCATION AND NATIONAL RATES



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005) for countries where a previous survey is available. This is based on scenarios/classifications delineated by Delamonica et al.[99]
Trends look at average annual change in coverage and in rural/urban ratios.

towards this is monitored by annual estimates by WHO and UNICEF for the proportion of districts achieving different thresholds of coverage. To accelerate progress towards this goal, the Reaching Every District (RED) strategy has sought to increase capacity at sub-national level (Box 2).

Nevertheless, progress towards this goal has been slow (Figure 13).[101] In 2010, only 31% of countries worldwide had achieved at least 80% coverage in every district, and only six of these countries are found in the African region.[102] In 22 countries, less than half their districts had achieved 80% coverage for children, with seven countries achieving the target in just one-fifth of districts or less. In Equatorial Guinea, where national DTP3 vaccination coverage is only 44%, not a single district has reached this target.[103]

Moreover, in some countries, many of the districts are struggling to reach even 50% DTP3 coverage (Figure 14). This is the case for more than three-quarters of districts in Equatorial Guinea, and for almost two-thirds of districts in Somalia and Senegal.[105]

For certain countries,[106] further disaggregated DHS and MICS survey data is available at sub-national level, which supports additional analysis across regions. Some of the biggest disparities in DTP3 coverage across districts can be found in Ethiopia, with coverage as low as 10% in Affar and nearly 90% in Addis Ababa, meaning that a child in Affar is almost nine times less likely to be immunised than one in Addis. Between the districts of Khartoum and the Lakes in Sudan, DTP3 coverage differs by 78 percentage points. The DRC has a wide gap of 66 percentage points between coverage rates in Maniema and Bas-Congo provinces. In both Congo and Nigeria, discrepancies across districts reach about 58 percentage points. In Arunachal Pradesh, India, vaccination coverage is 48 percentage points lower than it is in Himachal Pradesh. Niger also has wide variation across regions, with the lowest DTP3 coverage in Zinder (22%), which is just half the national rate, and coverage in Agadez is almost three times as high (62%).

BOX 2: THE REACHING EVERY DISTRICT (RED) STRATEGY

The Reaching Every District strategy produced by WHO and UNICEF provides tools for countries to achieve global goals of 80% DTP3 coverage in every district and 90% at the national level.

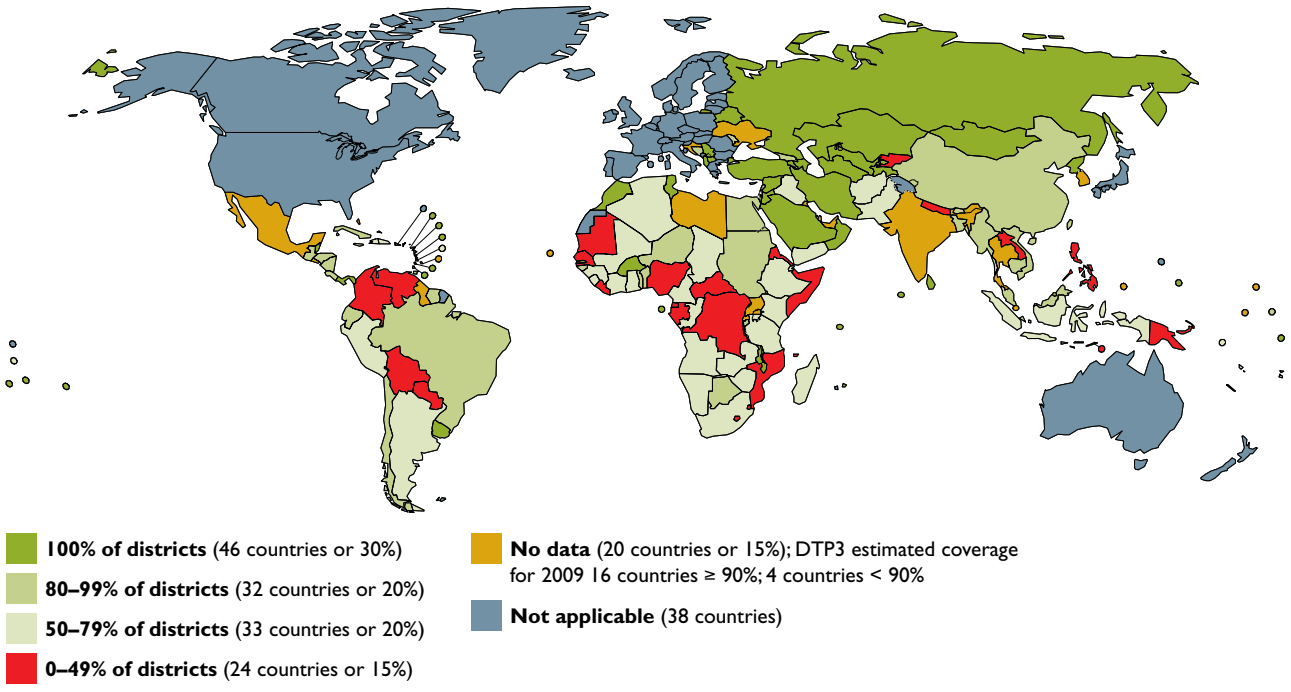
RED has five operational components: 1) Re-establishing outreach vaccination services; 2) Providing supportive supervision; 3) Linking services with communities; 4) Monitoring and utilisation of data for action; and 5) Planning and management of resources.

Most countries in WHO regions of Africa, the eastern Mediterranean, Europe, south-east Asia and the western Pacific have implemented the RED strategy since 2002. RED "priority" countries include those with the largest burdens of unimmunised infants, such as India, Indonesia, Nigeria, Ethiopia, and Pakistan.

Evaluations of RED in Africa in 2005 showed that the approach not only contributed to strengthening immunisation systems, but improved the delivery of vaccines, helping more districts to make progress towards the goal of 80% coverage. For example, in the five countries evaluated, districts meeting the 80% coverage goal increased from 70 to 197 between 2002 and 2004.

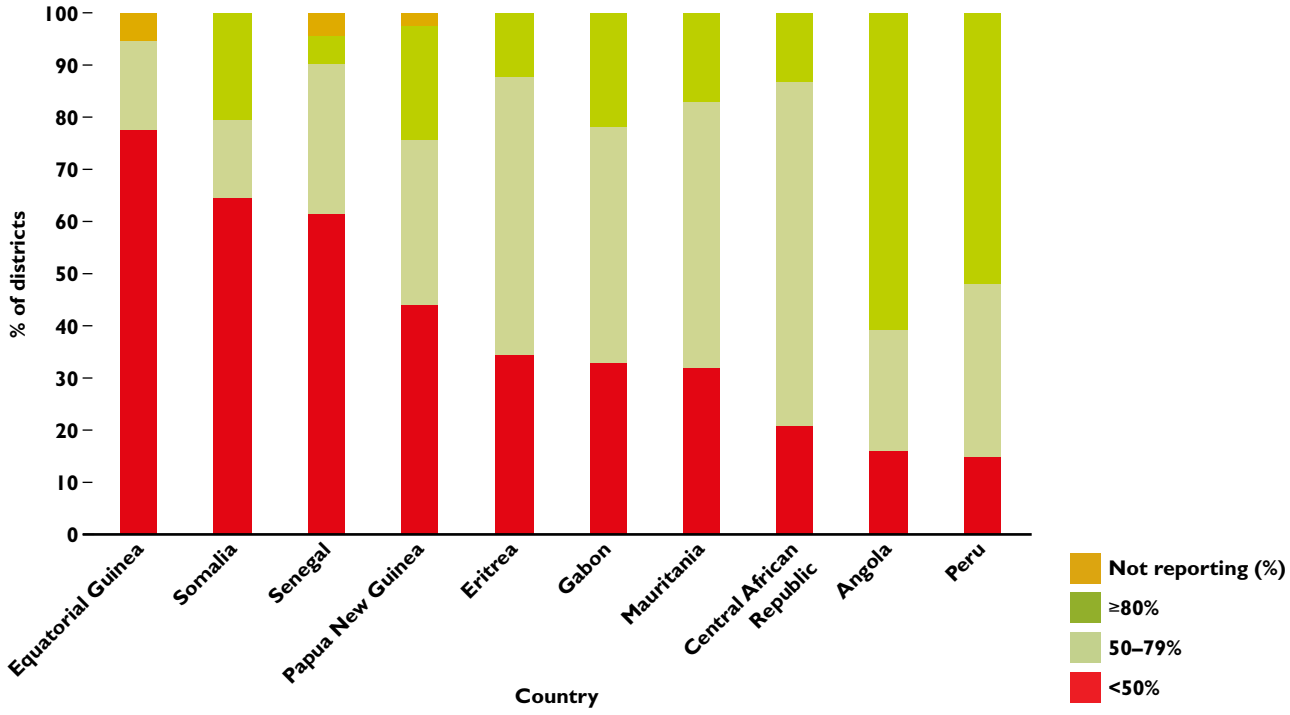
Source: World Health Organization[100]

FIGURE 13: DEVELOPING COUNTRIES WITH % OF DISTRICTS ACHIEVING AT LEAST 80% DTP3 COVERAGE (2010)



Source: UNICEF and World Health Organization, 2011[104]

FIGURE 14: COUNTRIES WITH HIGHEST NUMBER OF DISTRICTS BELOW 50% DTP3 COVERAGE (2010)



Source: WHO Immunization Indicators data (Last update: 3 October 2011)

Maps reveal stark patterns in disparities in coverage across a country. Although the national DTP3 coverage in Congo is almost 70%, less than half of children in the north of the country are immunised. There are huge discrepancies across Nigeria, with fewer children vaccinated as one moves towards the north of the country. DTP3 coverage rates of children in the north-west and north-east of Nigeria are 57 percentage points below those in the south (Figure 15).

Conversely, immunisation coverage progressively declines as one moves down the coast of Liberia from Monrovia – the region where the capital city is, where children are likely to have better access to health services – to South Eastern B region (Figure 16). In South Eastern B, DTP3 and measles coverage are 19% and 40% respectively, compared with 75% and 80% in Monrovia.

As observed for other parameters, gaps are wider for DTP3 coverage than for measles in most of the countries analysed. In some countries this discrepancy is more or less consistent across sub-national regions; in others there is wide variation. For instance, in Sudan, similar coverage rates are observed for DTP3 and measles in the Red Sea district, whereas measles coverage is 44 percentage points above DTP3 coverage rates in West Equatorial district. Again, this probably reflects the weakness of the health system.

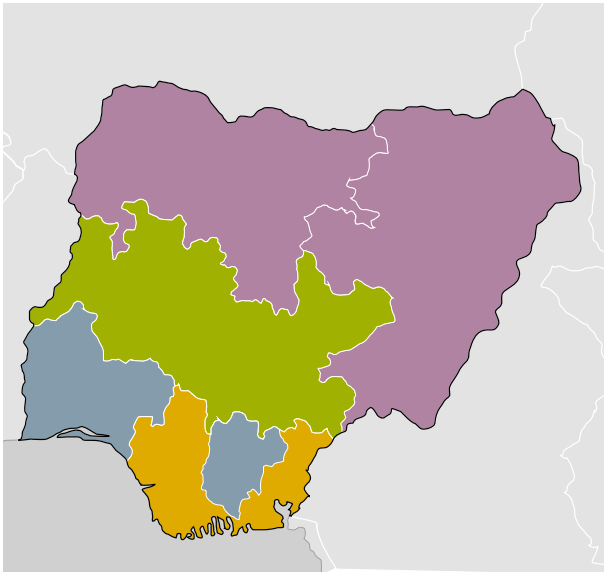
RURAL POPULATION

In many countries, whether a child is born in an urban or a rural location is associated with the likelihood that they will be immunised (Figure 17). These inequalities may be evident in district level data – as we see in the maps of Nigeria and Liberia – but many districts are a mixture of rural and urban areas.

When analysing data by urban and rural location, it should be noted that urban averages mask important disparities among sub-populations. Exposing these inequalities requires highly localised surveys to estimate coverage among urban slum-dwellers, but such studies have shown lower coverage among these groups.[109]

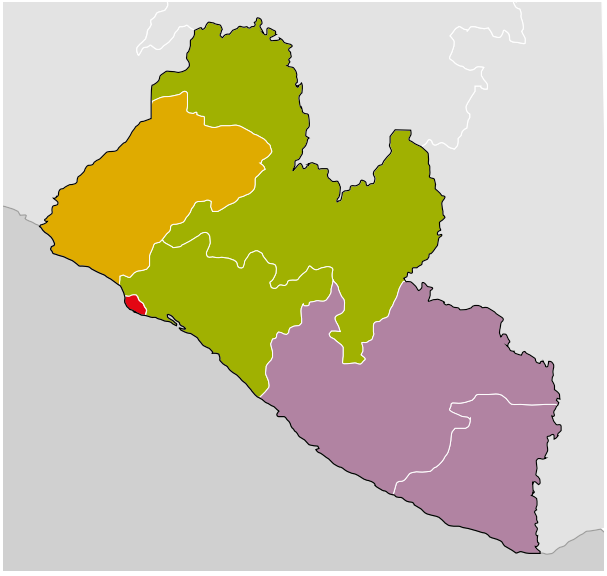
Rural Somalians are least likely to be immunised, with just 7% of children receiving DTP3. A rural child in Somalia is four times less likely than an urban child to receive DTP3. In Nigeria, Central African Republic and Ethiopia, rural children are about half as likely as urban children to be immunised against DTP3. With lower immunisation coverage, children in rural and remote areas are also less likely to have access to essential healthcare should they become sick.

FIGURE 15: DTP3 COVERAGE RATES IN NIGERIA



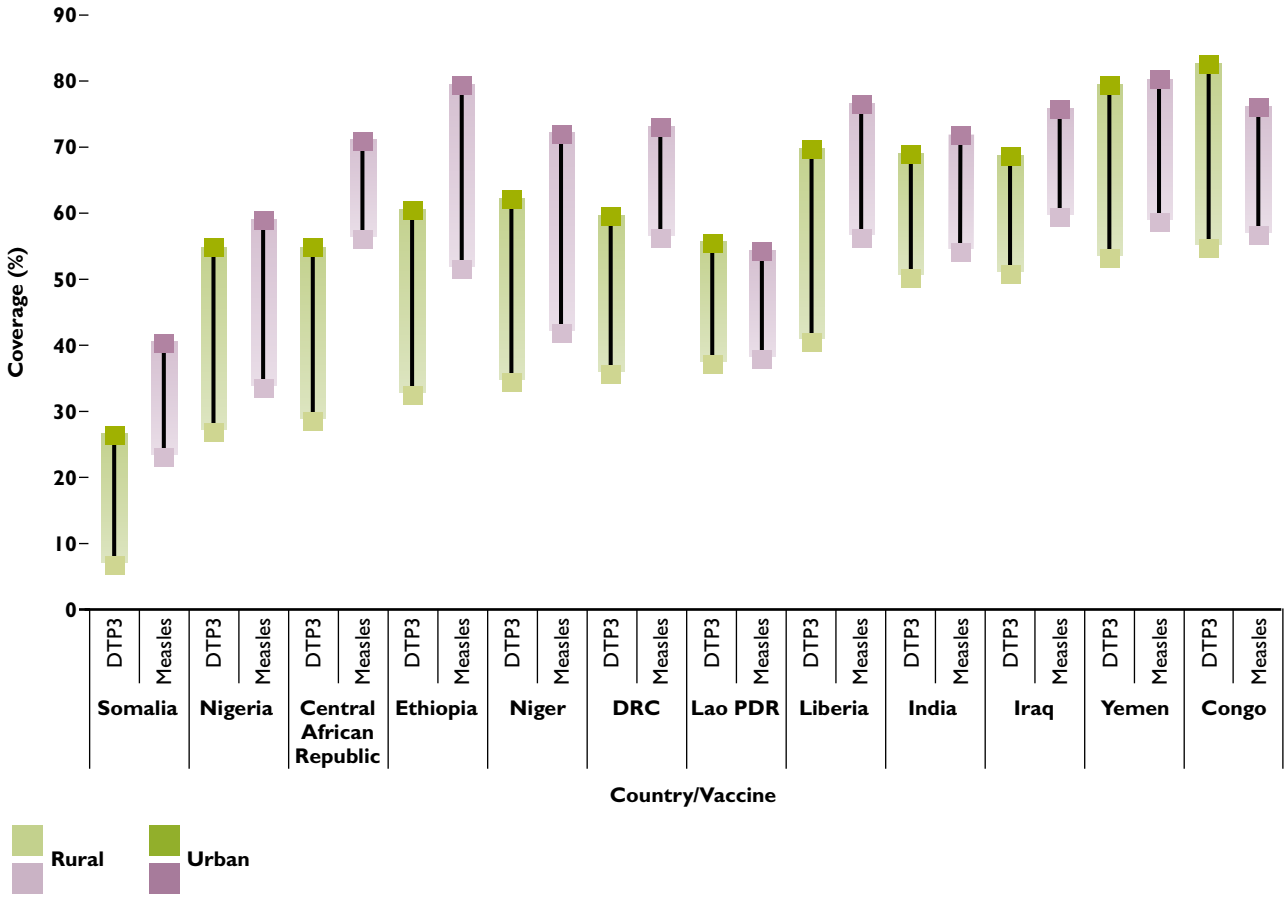
Source: ICF Macro, 2011107

FIGURE 16: DTP3 COVERAGE RATES IN LIBERIA



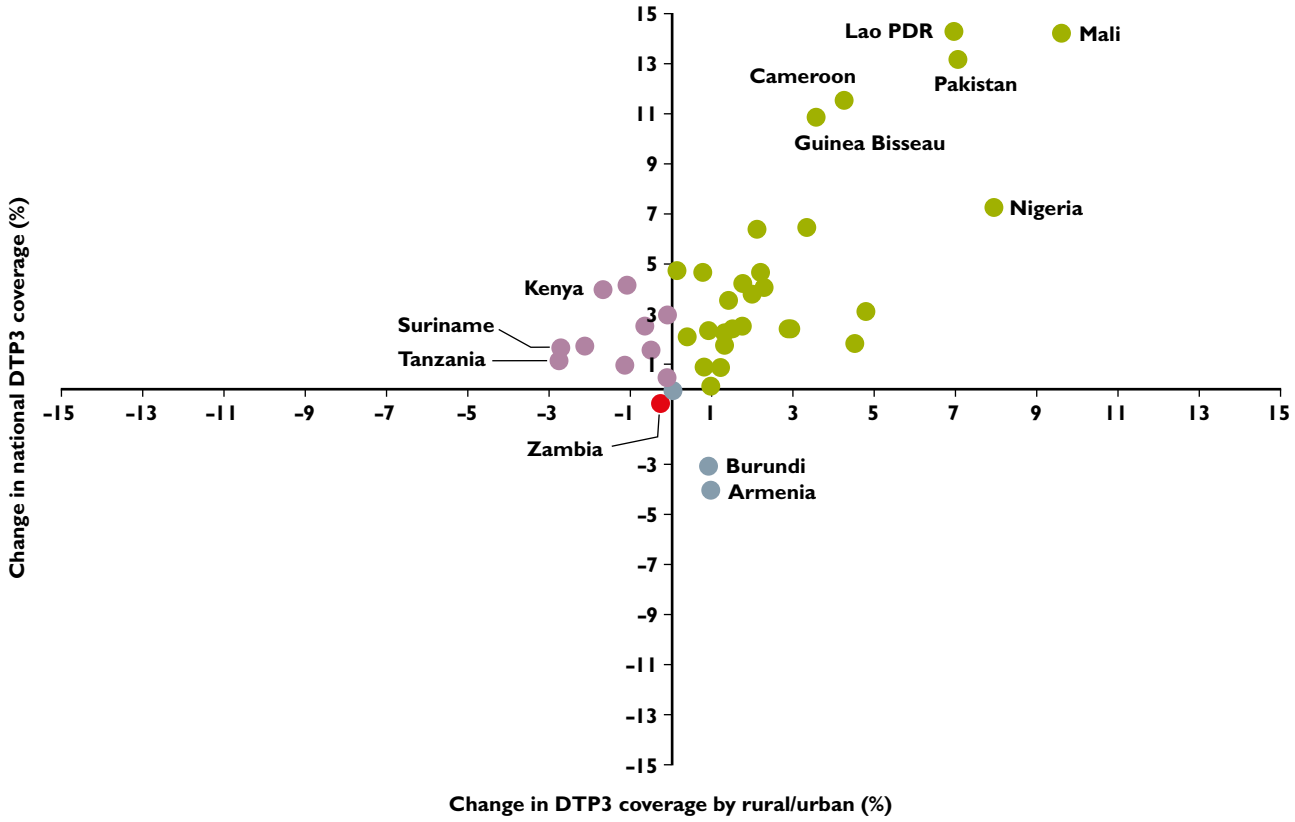
Source: ICF Macro, 2011108

FIGURE 17: COUNTRIES WITH THE HIGHEST DISPARITIES IN DTP3 COVERAGE BETWEEN RURAL AND URBAN AREAS, PLOTTED WITH MEASLES COVERAGE



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005), for the 12 countries with the largest ratios between urban and rural residence for DTP3 coverage.

FIGURE 18: TRENDS IN DTP3 COVERAGE OVER TIME: CHANGES IN URBAN/RURAL INEQUALITY AND NATIONAL COVERAGE RATES



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005) for countries where a previous survey is available. This is based on scenarios/classifications delineated by Delamonica et al.[111]
Trends look at average annual change in coverage and in rural/urban ratios.

PROGRESS FOR WHOM?

Forty-two countries have sufficient data to measure changes over time in DTP3 immunisation coverage by urban/rural residence (Figure 18). Of the 11 countries where inequality between urban and rural areas widened, ten also experienced increases in overall DTP3 coverage.[110] As with inequalities by wealth and education, the urban/rural discrepancy in DTP3 coverage narrowed in most countries. In 28 of these 31 countries, urban/rural DTP3 inequalities reduced as overall DTP3 coverage increased. For instance, in Lao PDR, rural DTP3 coverage rates more than doubled between 2000 and 2006 from 16% to 37%, while urban DTP3 coverage rose from 41% to 56%. Despite progress, many of these countries experience substantial rural/urban DTP3 coverage gaps, such as Ethiopia, Niger and Nigeria, all of which have a gap of about 28 percentage points.

THE SEX OF THE CHILD HAS LITTLE IMPACT

Inequalities in immunisation coverage by sex of the child are much less pronounced than those produced by difference in household wealth, education level or urban/rural situation.[112] The trends are also inconsistent: in some countries, vaccination coverage is higher among boys; in others, girls have higher rates. Azerbaijan is the most unequal, where DTP3 and measles coverage rates are respectively 11 and 12 percentage points higher for boys than for girls. Mali and Pakistan are the next most unequal.

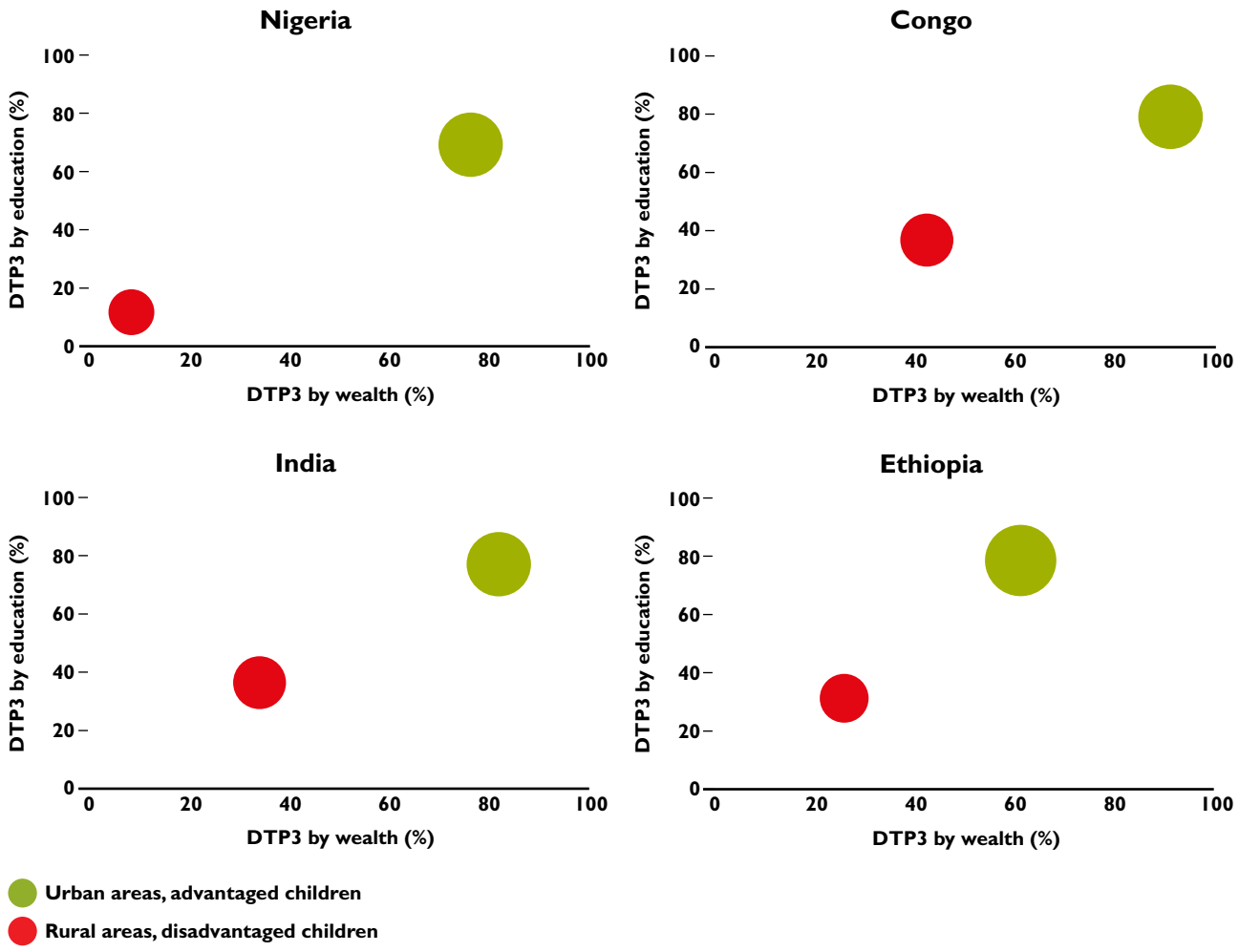
The reverse trend is observed in Kenya, Armenia, Guyana and Ethiopia, where girls have higher DTP3 coverage rates than boys (7, 6, 5 and 5 percentage points respectively). For measles, this pattern is observed in Haiti, Congo and the Dominican Republic (with 7, 5 and 5 percentage points respectively). Interestingly, although there is a disparity between boys and girls for DTP3 in Ethiopia, coverage for measles is exactly the same.

THE ADVANTAGED AND THE DISADVANTAGED CHILDREN

From the data available, poverty, mother's low education level, and then rural location are the characteristics most closely associated with a child being unimmunised.[113] How do these relate to one another within countries?

Where poverty, uneducated mothers and rural residence coincide, children are particularly disadvantaged. Figure 19 compares DTP3 coverage for these children in red, with the more advantaged children – the wealthy (x-axis), educated (y-axis) and urban (shown by the size of the bubble) – in green, within selected countries where inequalities are most acute.

FIGURE 19: MOST DISADVANTAGED AND LEAST DISADVANTAGED



Source: Save the Children UK analysis of most recent DHS and MICS data (since 2005), for selected countries that fall within the most unequal according to at least two of the following parameters: wealth quintile, education of mother, and rural/urban location. The size of the bubble presents coverage rates in urban areas (for the advantaged [green] children), and in rural areas (for the disadvantaged [red] children).

3 WHY AREN'T THE 'FINAL FIFTH' OF CHILDREN BEING REACHED?

Having identified where and who the unimmunised fifth of children are, the next question to be answered is *why* these children aren't being reached. This section draws on the literature to explore this further. The data analysis above shows a clear association between immunisation coverage and some of the key social determinants of health, to varying degrees across and within countries.

Some of the explanations for these inequalities may be straightforward; for instance, lower rural coverage could be partly explained by long distances to clinics for families living in remote areas. In many low- and middle-income countries, health systems are underfunded and weak. Health workers are too few, lack appropriate training and support, and are poorly equipped, without the capacity to extend services into all communities, particularly the hard-to-reach.

In addition to poverty, lack of education, rural residence and weak health systems, there are many more complex and interrelated factors that influence why children are not fully immunised. What is associated with a child being immunised in one community or country may be the reverse in another. For instance, child immunisation was more likely if mothers were *below* 30 years of age in southern Nigeria and *over* 30 years old in rural Ethiopia.[114] This reaffirms the need for a nuanced interpretation of the blend of factors that influence whether a child is immunised, from both the demand and the supply sides.

The relationship between different factors that affect a child's chance of being immunised is context-specific and complex. In some countries, certain factors are strongly associated with immunisation, while they may not explain the distribution of inequalities in another country. For example, children from minority ethnic groups in Kenya and Congo are far less likely to be immunised, whereas ethnicity has little impact on immunisation coverage in Niger and Guinea Bissau.[115]

A comprehensive review of peer-reviewed journals from 1999 to 2009 analysed additional factors and created four categories as a framework for understanding the causes of children not being fully immunised.[116] In terms of frequency, the review found that supply of and access to services made up 43% of factors reported, followed by parental knowledge and attitudes (28%), family characteristics (23%) and communications (6%).[117] Each of these categories can be broken down into a multitude of different factors, which are often interrelated. These could be primary causes, or underlying secondary contributory factors. For example, a poor mother[118] may be discouraged from accessing immunisation services for her child because of high indirect and opportunity costs, such as transport and time.[119] Here, both the underlying condition of poverty and supply-side constraints (distance) impede access to immunisation for the child. While it is helpful to understand the dynamic relationship of such factors, it is important not to oversimplify reasons why a child is unimmunised.

SUPPLY OF AND ACCESS TO QUALITY SERVICES

Access to immunisation services is affected by the location of health outposts as well as the quality of care available. Remote rural populations are less likely to have access to basic health services. Unofficial settlements may be deliberately excluded by healthcare providers, and nomadic or displaced families may be out of reach of essential services, although this data is not routinely collected.[120]

Distance, quality of care provided by health workers and reliability of services were frequently referred to in peer-reviewed literature. Of all the factors

related to the supply of and access to services, 34% were associated with distance and living in a rural area. But the interplay with demand means that some households are also sufficiently motivated to overcome this barrier despite the inconvenience and related costs.[121]

When parents do access health facilities, the motivation, performance and attitudes of the health worker are often cited as important factors influencing whether they return. Repeated access to services is necessary for children to complete the entire vaccination schedule, and a poor experience can lead to non-completion. Some mothers feel that they have been treated in an unfriendly manner – for example, if they have forgotten to bring a child's immunisation card or have missed a scheduled appointment.[122] Furthermore, inconvenient hours of vaccination services, long queues and waiting times can influence whether parents decide to bring their children back for subsequent immunisations – especially if they have had to travel far. This reaffirms the need for strong, well-funded health systems that provide reliable and good-quality services.

Even when a child is at a health clinic, missed opportunities for vaccination have been reported. This could be connected with the distribution of roles and responsibilities between health workers: for instance, in a study from India, physicians in primary care facilities felt that it was the responsibility of other types of health workers to deliver vaccinations, so they were less likely to administer vaccines themselves.[123] False beliefs that sick children should not be vaccinated or that multiple vaccinations at the same visit are unhealthy also deter some health workers from immunising children.[124]

Vaccines included in the national schedule are usually provided free of charge through the public sector, so direct fees are not a major barrier to access, which is different from other basic health services.[125] However, as mentioned above, there still may be other financial barriers, such as the indirect cost of transport, and the opportunity cost of time taken to seek health services. There may also be illicit charges for immunisations, such as additional fees for syringes or other materials. The extent to which these practices exist is difficult to measure.[126]

But even if all of the above factors are overcome, the availability of the vaccine is crucial. Parents may have crossed long distances, arrived on a day where immunisations are offered, waited in long queues, encountered a well-trained and respectful health worker who is ready to immunise their child – only to find that the clinic does not have an adequate supply of vaccines, needles or syringes. This requires the country to have sufficient stock of the vaccine, available at an affordable price. The vaccines and related products then need to reach all districts, all facilities, and be appropriately stored. This depends on an adequate cold chain,[127] which remains a challenge in many countries. In addition, fragile and conflict-affected states may be prone to frequent disruptions in immunisation activities. Problems concerning the availability of vaccines, their supply and storage are among the most commonly cited reasons for children being unimmunised.

PARENTAL ATTITUDES AND KNOWLEDGE

Even where immunisation services are available, parental attitudes and knowledge of vaccines can affect whether they decide to immunise their child. These perceptions vary widely but are increasingly better understood.[128] One factor is a lack of understanding of the health impact of immunisations:[129] parents are more likely to immunise their child if they recognise the value of preventive interventions and the health benefits of immunisation.[130] Another key practical issue that influences a child's immunisation is whether the parents simply know when and where to take their children for immunisation, and that there are multiple vaccines available.[131]

Aside from knowledge about accessing vaccinations, fears of negative side effects, and cultural and religious beliefs, deter parents from getting their children immunised in some circumstances. Rumours that vaccines cause infertility led to a near standstill in polio immunisation in northern Nigeria in 2003,[132] and rumours that vaccines cause paralysis have been reported in studies from Africa and Asia.[133] Efforts to understand the impact of rumours on vaccine confidence will be useful for designing locally tailored communication messages.

The London School of Hygiene and Tropical Medicine (LSHTM) is currently developing a Vaccine Confidence Index (VCI) to measure public confidence[134] in a vaccine or vaccines within a given geographical region or country. See Box 3 for an example of how the VCI can be applied.

BOX 3: THE VACCINE CONFIDENCE INDEX AND ITS APPLICATION TO SELECTED STATES IN NORTHERN NIGERIA

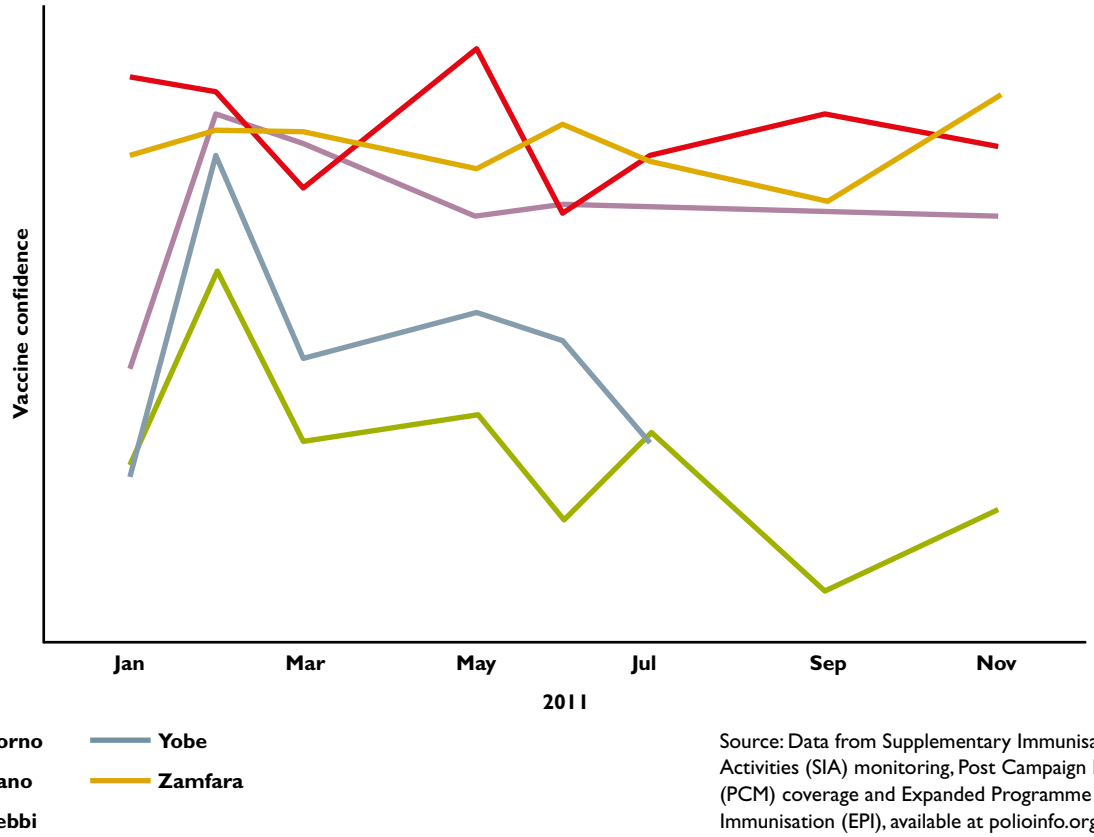
To estimate levels of confidence in vaccines, the LSHTM integrates multiple data streams, including surveys, vaccine coverage data, socio-economic and political information, and media surveillance.

For example, the tool can be used to show the evolution of confidence in oral polio vaccine (OPV) in northern Nigeria between January and November 2011 across states with available data, by tracking trends in household refusals. Measuring vaccine confidence is easier for OPV than for routine immunisation services because vaccination teams visit target households, recording refusals and the number of children missed. The VCI tool is being further developed for other vaccines.

As seen in Figure 20, both Kano and Yobe saw significant declines in confidence levels during this period. Multiple factors are likely to affect this, which may include tensions around the Presidential and State elections and attacks by militant extremists – on several sites including a vaccine storage facility in Borno.

The VCI can support communications and implementation strategies, and provide an early warning signal for localised decreases in confidence that could potentially disrupt an immunisation programme.

FIGURE 20: ORAL POLIO VACCINE CONFIDENCE IN SELECTED STATES IN NORTHERN NIGERIA (JANUARY–NOVEMBER 2011)



Source: Data from Supplementary Immunisation Activities (SIA) monitoring, Post Campaign Monitoring (PCM) coverage and Expanded Programme on Immunisation (EPI), available at polioinfo.org

Source: content provided by LSHTM

HOUSEHOLD CHARACTERISTICS

Various underlying factors also influence whether a child is fully immunised. These are demographic characteristics, which are indicative of a complex set of social, economic and cultural barriers to access and factors that influence demand for health services – including immunisation.

A recent study[135] analysed 241 nationally representative household surveys in 96 countries to identify predictors of children receiving no vaccinations at all, as compared with partial or full vaccination. Twenty-one potential predictors were explored in order to understand which were associated with – and to what extent these were associated with – children not being fully immunised.

Of the parameters analysed, household wealth and educational attainment of the parent are the two most significant characteristics associated with immunisation status; this is consistent with the findings from the analysis of DHS and MICS data above. These are not mutually exclusive characteristics, as a family with a lower level of wealth is less likely to be educated. Another indicator that was found to be closely associated with no immunisation was the mother not having received tetanus toxoid vaccine during pregnancy. This suggests that if a mother does not access antenatal care, it is less likely that she will access immunisation services for her infant too.

Interestingly, some of the dimensions of equity analysed have very little or no relationship with immunisation coverage. For instance, sex of the child, sex of the head of household, and number of household members were rarely associated with immunisation status.[136]

The strong association between vaccination coverage and household wealth and education suggests that strategies to overcome such inequalities need to go beyond immunisation alone to ensure that the more structural determinants of inequities in health are addressed.

COMMUNICATION AND INFORMATION

Communicating compelling and accurate information about the value of immunisation and interventions to improve child health can influence immunisation coverage levels. The quality of communication and outreach strategies directly affects parental knowledge and attitudes. Some immunisation campaigns that are focused on individual diseases such as polio or measles are often widely publicised, but many parents of unimmunised children lack information about routine immunisation programmes.[137] Although this category was the least influential cause of unimmunised status, it was consistently cited by countries from all WHO regions and still has an important role to play.[138]

Effective communication strategies can be pivotal to successful implementation, as has been the case with the incredible momentum of polio eradication in India. Timely and accurate information can influence the knowledge and attitudes of both health worker and parent, and empower parents to seek immunisations.

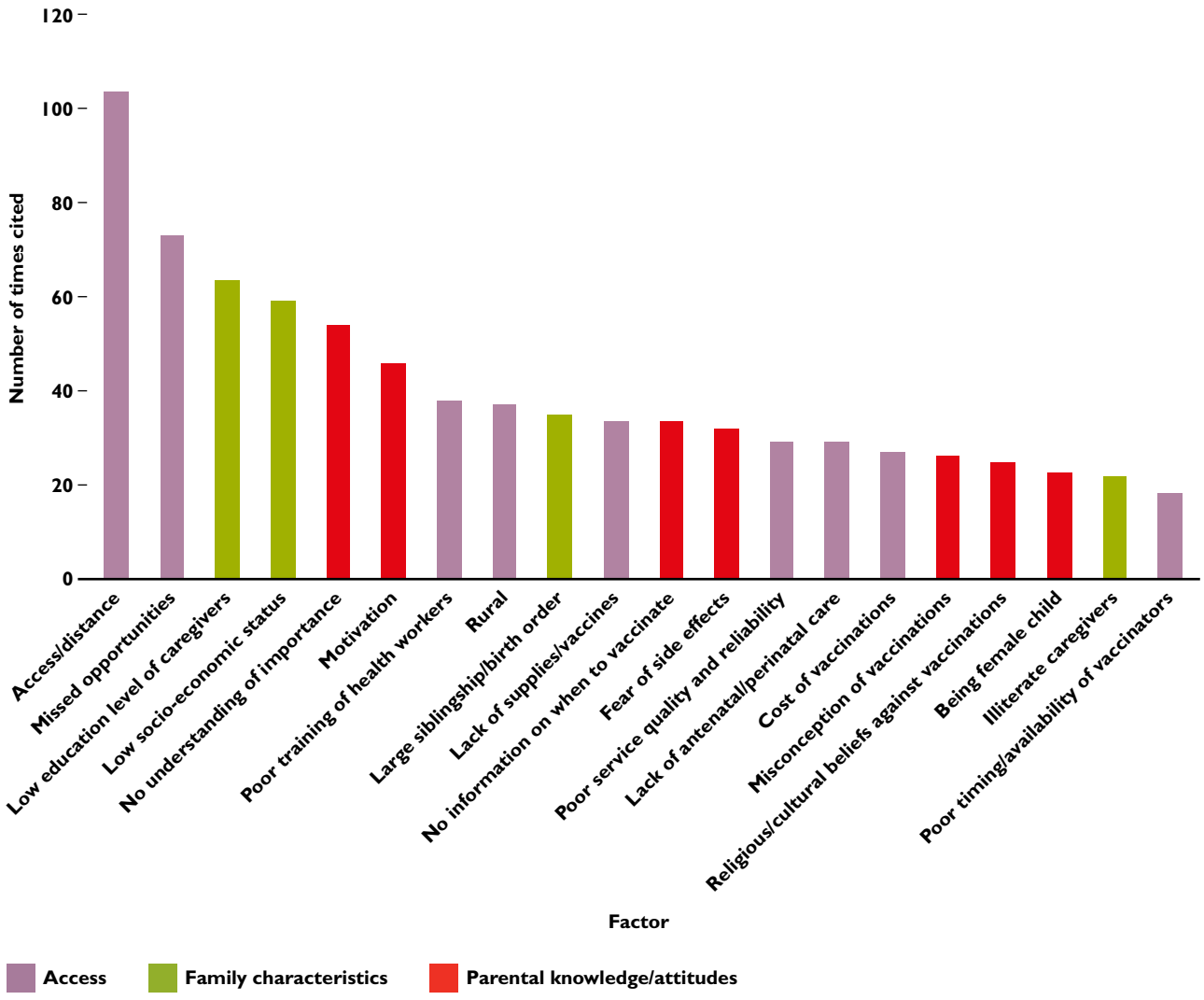
There is evidence to suggest that communication strategies can often be improved. Studies from India reveal that parents knew about polio but had not heard messages about routine immunisations.[139] Further, some parents thought polio was the only vaccine that children needed.[140] This represents a missed opportunity, and such lessons should be incorporated into future strategies and healthcare worker training so that parents are encouraged to access the range of essential services – including vaccinations – that promote child survival. Though not frequently cited as a dominant factor affecting vaccination status, communication and information have an underlying influence that is vital to any strategy for reaching the unimmunised.

HOW MANY FACTORS?

Of the above contributing factors, there is no sole cause for low levels of vaccination coverage in low- and middle-income countries. In fact, the analysis of

peer-reviewed journals identified 901 reasons for low vaccine uptake.[141] Each family has a unique set of beliefs, knowledge, understanding and barriers that can affect access to, and utilisation of, immunisation. The availability and quality of immunisation services likewise varies widely from place to place. When looking across regions, the frequency of the various factors cited as reasons for not being vaccinated paints a complex picture, but gives insight into what should be considered when designing a strategy to reach the unreached (Figure 21). Nevertheless, underlying structural factors and systems weaknesses have the greatest influence on whether a child is immunised. To overcome these inequalities, strategies must go beyond communications and attitudes to address the wider social determinants of health.

FIGURE 21: FREQUENCY OF FACTORS CITED FOR WHY CHILDREN ARE UNIMMUNISED



Source: Data from CDC review[142] with additions from peer-reviewed literature from 2009 to 2012.

CONCLUSION AND RECOMMENDATIONS

Every child has a right to health, including immunisation as part of the essential package of health services, but one-fifth of children worldwide are still being missed. Whether or not children are immunised is not down to chance: the distribution of unimmunised children corresponds to gross inequalities across and within countries.

Access to essential healthcare is something we all need and we all have the right to. Poor children's lack of access to basic healthcare is compounded by the fact that they are more likely to fall sick and are less likely to be immunised, further increasing their chance of falling ill. Once a child is sick, poverty again comes into play, reducing their chances of accessing healthcare, and making it more likely that they will die from a disease that could have been prevented.[143]

The world's poorest countries suffer from the lowest rates of immunisation. Children born in low-income countries are least likely to be immunised; these countries on average fall 14 percentage points behind high-income countries in DTP3 coverage rates. In absolute terms, low- and lower-middle-income countries together account for 90% of the total unimmunised population, the majority of whom are in south-east Asia and Africa. Within these regions, just three countries are home to nearly 10 million of the world's unimmunised children, with more than one-third of all unimmunised children in India.

Inequalities within countries are even wider. Household wealth, mother's education and urban/rural location are strongly associated with a child's immunisation status. In countries where inequalities are widest, the poorest children are three times less likely to receive DTP3 than the richest, with DTP3 coverage most unequal in Nigeria, where the ratio between poorest and richest children was 1:9 in 2008. As mother's education increases from none to secondary, DTP3 coverage more than doubles.[144] A child living in a rural area is just under half as likely to receive DTP3 as a child in an urban area.[145] Inequalities across districts remain common, with more than two-thirds of all countries failing to reach 80% DTP3 coverage in all districts in 2010. The pattern of progress varies greatly from one country to another, with DTP3 inequalities widening in some countries despite increased national coverage.

There is a moral imperative to achieve a high level of national coverage and to reach the children who remain unimmunised. There is also an economic case for doing so: addressing inequalities in immunisation coverage is cost-effective,[146] especially in low- and middle-income countries where mortality rates are high. For every pound spent, efforts through an equity-focused approach would save more lives and accelerate progress towards global and national goals. These efforts would also produce more sustainable health outcomes so that progress can be maintained over the long term.[147] As UNICEF estimated for health more broadly,[148] for every $1 million invested through an equity-oriented approach,[149] 60% more deaths will be prevented than through pursuing the current path – ie, existing mainstream strategies to achieve the health MDGs for children.[150]

Reducing inequalities in immunisation coverage can accelerate progress towards attaining global targets, which are due to be reasserted in the GVAP at the 65th WHA. Global and national goals that specify reductions in inequalities must be set and monitored routinely,[151] tracking progress towards narrowing the equity gap in immunisation as appropriate.

As we have seen, pursuing progress in immunisation coverage without addressing inequalities can actually widen gaps. An equity-focused approach that addresses both demand- and supply-side barriers to immunisation is essential to ensure that the hardest-to-reach are at the centre of strategies to expand coverage, while also ensuring that gains made to date are sustained.[152] Some of the numerous and complex interrelated factors that influence whether or not a child is immunised have been introduced in this report.

In the 12 countries[153] with the largest inequalities in DTP3 coverage by household wealth, if national coverage of routine immunisation were brought up to the level of the richest households – ie, reducing inequalities by household wealth –

nearly 140,000 additional future under-five deaths would be averted each year.[154] If this package of routine vaccines were expanded to include pneumococcal and rotavirus in these 12 countries – as per WHO global recommendation[155] – the number of future annual child deaths averted would rise to more than 370,000. This amounts to nearly 5% of total annual child deaths worldwide.[156]

Health policies have a role to play in overcoming such inequities.[157] Developing an immunisation strategy that considers such factors is complicated and highly context-specific. The strategy should have the dual objective of expanding coverage of routine immunisations and widening the national schedule to include new vaccines as appropriate. Political will is also crucial – at national, state and district levels. This political will must translate into implementation in order to achieve a reduction in inequalities in coverage. Such efforts should be truly country-owned with wide stakeholder involvement, including that of civil society and marginalised communities.

Immunisation strategies and strengthened health systems are essential to progressively expand coverage. But overcoming such inequalities also requires wider efforts to address the social determinants of health.[158]

We know the importance of focusing on addressing inequities in immunisation coverage. To that end, this report calls on governments, development partners and the global community to implement the following recommendations, both in the Global Vaccine Action Plan and in its implementation.

RECOMMENDATIONS

For governments:

- All member states should support a **resolution on the GVAP** at the 65th World Health Assembly, with strong emphasis on the importance of addressing inequities as part of efforts to expand coverage of both traditional and new vaccines. This objective should be country-owned, with progress routinely reported through country and global mutual accountability frameworks.
- **Political will** is crucial to progress and the reduction of inequities within countries. In all countries, and especially where inequalities are wide, the government (at national, state and district levels) should make an **explicit commitment to reduce inequalities** in coverage of essential health interventions, developing equity-sensitive strategies and allocating sufficient human and financial resources to implement them.
- This commitment should be translated into fully funded **national and sub-national immunisation strategies**, developed with meaningful multi-stakeholder engagement, and which address the range of local barriers to universal child immunisation.
- Efforts to overcome inequities in immunisation coverage should be used to **strengthen health systems** and promote access for children and their families to other health services. Communities should be empowered to claim their right to immunisation and influence delivery mechanisms, to ensure these are appropriate.
- National information systems should be strengthened, and regular household surveys supported by development partners, to **improve the availability and quality of data** to measure disaggregated progress towards targets and inform policy and programme design.

For development partners:

- National strategy development and implementation should be supported with **financial and technical support** from development partners as appropriate.[159]
- **Global goals**[160] should specify reductions in inequalities and should be monitored routinely. Standardised indicators should be adopted that track progress in reducing inequities in access to essential health interventions, including immunisation; for instance, coverage rates disaggregated by household wealth, educational attainment, and urban/rural location.

For the private sector:

- Pharmaceutical **research and development** should prioritise vaccines that target the greatest burden of disease in low- and middle-income countries, and adapt products to help overcome barriers to access and increase coverage of traditional and new vaccines.[161]

Later this year, Save the Children will publish a report on how to reach the final fifth. This will explore lessons from contexts where equitable progress in immunisation coverage has been achieved, and will identify approaches and innovations that have been successful in overcoming inequalities. Immunisation can catalyse access to other health services[162] and strengthen health systems so that children and their families have access to the wider range of essential interventions. Such opportunities must be seized if we are to achieve national and global goals for children's health and well-being.

ENDNOTES

[1] WHO and UNICEF, 2012. *Global immunization data*. Available at: <http://www.who.int/immunization_monitoring/Global_Immunization_Data.pdf> [Date accessed: 2 April 2012]

[2] Based on review of WHO/UNICEF DTP3 coverage estimates for 1980–2010 (as of July 2011).

[3] WHO, 2012. *Vaccine-preventable diseases*. Available at: http://www.who.int/immunization_monitoring/diseases/en/ [Date accessed: 2 April 2012]

[4] WHO and UNICEF, 2012.

[5] In this report the term unimmunised is used. It is defined as a child aged 12–23 months who has not received three doses of DTP. This includes underimmunised children – ie, who children have had some vaccines but haven't completed their basic series – as well as children who have had no immunisations at all. This definition drawn from: John Snow Inc., 2009. *Epidemiology of the unimmunized child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf> [Date accessed: 2 April 2012]

[6] From a baseline year of 1990.

[7] A subsequent report, planned for late 2012, will build on this analysis to explore how inequalities in immunisation can be overcome.

[8] The World Health Organization's south-east Asia region (one of six global regions) comprises the following countries: Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar (Burma), Nepal, Sri Lanka, Thailand and Timor-Leste. Available at: <http://www.who.int/about/regions/searo/en/>

[9] In countries where inequalities in immunisation coverage by mother's education are widest.

[10] In countries where inequalities in immunisation coverage between rural and urban areas are widest.

[11] Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*, 362, pp.233-41.

[12] Ibid.

[13] UNICEF, 2012. *The State of the World's Children 2012: Children in an urban world*. New York: UNICEF; Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*, 362, pp.233-41.

[14] This is supported by an analysis done for the UK on the cost-effectiveness of addressing inequalities in measles vaccination. National Collaborating Centre for Women's and Children's Health, 2009. An exploration of the cost-effectiveness of interventions to reduce differences in the uptake of childhood immunisations in the UK using threshold analysis. *Reducing differences in the uptake of immunisations: Economic analysis 2*. London: National Institute for Health and Clinical Excellence. Available at: http://www.nice.org.uk/nicemedia/live/12247/45530/45530.pdf [Date accessed: 12 April 2012]

[15] UNICEF, 2010. *Narrowing the gaps to meet the goals*. New York: UNICEF. Available at: <http://www.unicef.org.uk/Documents/Publications/narrowing-gaps.pdf> [Date accessed: 23 March 2012]

[16] Ibid.

[17] UNICEF defines the equity-focused approach as a model that aims to accelerate health MDG progress, reduce disparities and lower out-of-pocket expenditures for the poor through three key measures: (1) upgrade selected facilities; (2) overcome barriers that prevent the poorest from using services even when they are available to them; and (3) task shifting (UNICEF, 2010).

[18] The current path approach is defined as one that "broadly approximates contemporary approaches and depicts their path over the next five years… lend[ing] significant but less-focused attention to the most deprived groups and areas… [and with a focus to] use additional investment to increase the training and deployment of professional health workers, expand building infrastructure and use mass communication to encourage the poor to seek care." (UNICEF, 2010).

[19] Central African Republic, Congo, Democratic Republic of the Congo, Ethiopia, India, Liberia, Niger, Nigeria, Pakistan, Somalia, Sudan and Yemen.

[20] Analysis conducted by Johns Hopkins School of Public Health using Lives Saved Tool for DTP3, Hib and measles vaccines. DTP3 coverage rates from DHS/MICS latest survey have been used.

[21] WHO, 2012. *Table 2: Summary of WHO position papers – recommended routine immunizations for children* (updated 3 February 2012). Available at: <http://www.who.int/immunization/policy/Immunization_routine_table2.pdf> [Date accessed: 10 April 2012]

[22] Using the 2010 estimate that 7.6 million children under five died that year (Source: http://www.childinfo.org/mortality.html).

[23] Whitehead, M., Dahlgren, G. and Gilson, L., 2009. 'Developing the policy response to inequalities in health: A global perspective'. In: T. Evans, M. Whitehead, F. Diderichsen, A. Bhuiya, and M. Wirth, ed. 2009. *Challenging Inequities in Health*. Oxford: Oxford University Press, pp.309–323.

[24] In middle-income countries, where inequalities are wide and the numbers of unimmunised high, development partners should provide technical support, and efforts made to establish conducive conditions for sustainable access to affordable vaccines for countries that have graduated from GAVI eligibility. Source: Glassman, A., Duran, D. and Sumner, A., 2011. Global health and the new bottom billion: What do shifts in global poverty and the global disease burden mean for GAVI and the Global Fund? *Working Paper 270*. Washington: Center for Global Development. Available at: http://www.cgdev.org/files/1425581_file_Glassman_Duran_Sumner_MIC_global_health_FINAL.pdf [Date accessed: 8 April 2012]

[25] Including the GIVS, GVAP and GAVI goals.

[26] Medecins Sans Frontieres, 2012. *The Right Shot: Extending the reach of affordable and adapted vaccines*. Geneva: Medecins Sans Frontieres. Available at: <http://www.msfaccess.org/sites/default/files/MSF_assets/Vaccines/Docs/VACC_report_RightShot_ENG_2012.pdf> [Date accessed: 7 April 2012]

[27] For example, where immunisation campaigns are reaching more hard-to-reach populations, efforts should be made to raise awareness of routine immunisation and potentially expand access to other essential preventive interventions – e.g. using polio National Immunisation Days as a platform for vitamin A supplementation. Source: Goodman, T., Dalmiya, N., de Benioist, B. and Schultink, W., 2000. Polio as a platform: Using national immunization days to deliver vitamin A supplements. *Bulletin of the World Health Organization*, 78(3).

[28] WHO and UNICEF, 2012.

[29] In this report the term unimmunised is used. It is defined as a child aged 12–23 months who has not received three doses of DTP. This includes underimmunised children – i.e. children who have had some vaccines but haven't completed their basic series – as well as children who have had no immunisations at all. This definition drawn from: John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf> [Date accessed: 2 April 2012]

[30] A subsequent report, planned for late 2012, will build on this analysis to explore how inequalities in immunisation can be overcome.

[31] The basic package of services should include cost-effective interventions that address the burden of disease for a specific context, integrating interventions across the Continuum of Care from adolescence through pregnancy to childhood. Source: The Partnership for Maternal, Newborn & Child Health, 2011. *A Global Review of the Key Interventions Related to Reproductive, Maternal, Newborn and Child Health (RMNCH)*. Geneva: PMNCH.

[32] DTP3 is used as the main indicator of immunisation coverage in this report as it captures the ability of the system to identify and routinely administer three doses of vaccine to the same children. This is a better indicator of system strength than the use of measles, which only requires a single contact with a child in the first year of life.

[33] Brown, D., et al, 2011. A summary of global routine immunization coverage through 2010. *The Open Infectious Diseases Journal*, 5, pp.115–117. Cited in: UNICEF, 2012. *The State of the World's Children 2012: Children in an urban world*. New York: UNICEF.

[34] Centers for Disease Control and Prevention, 2011. *Global Vaccines and Immunization*. Available at: http://www.cdc.gov/vaccines/programs/global/default.htm [Date accessed: 15 April 2012]

[35] UNICEF, 2011. *Elimination of Maternal and Neonatal Tetanus*. Available at: <http://www.unicef.org/health/index_43509.html> [Date accessed: 15 April 2012]

[36] Black, R.E., Cousens, S., Johnson, H.L., Lawn, J.E., Rudan, I., Bassani, D.G., Jha, P., Campbell, H., Fischer Walker, C., Cibulskis, R., Eisele, T., Liu, L. and Mathers, C. (for the Child Health Epidemiology Reference Group of WHO and UNICEF), 2010. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *The Lancet*.

[37] With new vaccines under development for other major infectious diseases, such as malaria and tuberculosis.

[38] Duclos, P., Okwo-Bele, J.M., Gacic-Dobo, M., 2009. Global immunization: status, progress, challenges and future. *BMC International Health and Human Rights*, 9(Suppl 1):S2.

[39] Although a retrospective estimate suggested that only 75% coverage had been achieved. See: Vandelaer, J., Bilous, J. and Nshimirimana, D., 2008. *Bulletin of the World Health Organization*, 86(3), pp.161–240.; WHO vaccine-preventable disease monitoring system, 2011. *Global and Regional Immunization Profile*. Geneva: WHO. Available at: <http://apps.who.int/immunization_monitoring/en/globalsummary/GS_GLOProfile.pdf?CFID=4700814&CFTOKEN=10922440> [Date accessed: 12 April 2012]

[40] Duclos, P., Okwo-Bele, J.M., Gacic-Dobo, M. and Cherian, T., 2009. Global immunization: Status, progress, challenges and future. *BMC International Health and Human Rights*, 9(Suppl 1):S2.

[41] Referring to full immunization of children under one year of age (GIVS Global Immunization Vision and Strategy, WHO and UNICEF)

[42] World Health Organization and UNICEF, 2005. *GIVS Global immunization vision and strategy 2006-2015*. Geneva: World Health Organization. Available at: http://www.who.int/vaccines-documents/DocsPDF05/GIVS_Final_EN.pdf [Date accessed: 8 April 2010]

[43] Decade of Vaccines Collaboration, 2012. *Draft 4 of the Global Vaccine Action Plan – to be presented at the 2012 World Health Assembly*. Available at: http://www.dovcollaboration.org/wp-content/uploads/2012/01/GVAP_english.pdf [Date accessed: 16 April 2012]

[44] This analysis looks at the impact on under-five deaths of scaling DTP, Hib, Pneumo, Rota and Measles vaccination (as a combination) from their current coverage to 90% by year 2020. Scale up is based on equal annual increments from current coverage for the vaccine, until 90% coverage is reached in each country. When any base-year coverage for a vaccine exceeds 90%, it stays constant between 2011 and 2020. The number of under-five deaths averted is the difference between number of deaths with no scale up and the number of deaths with vaccination scale up. The analysis looks at the impact in two country groupings: (1) 35 low-income countries (according to World Bank country classifications) and (2) 57 GAVI-eligible countries.

[45] In addition to recommendations for all children, there are specific recommendations for children living in particular regions, in some high-risk populations, and receiving vaccinations from immunization programmes with certain characteristics.

[46] WHO, 2012. *Table 2: Summary of WHO position papers – recommended routine immunizations for children* (updated 3 February 2012). Available at: <http://www.who.int/immunization/policy/Immunization_routine_table2.pdf> [Date accessed: 10 April 2012]

[47] WHO and UNICEF, 2012. *Global immunization data*. Available at: <http://www.who.int/immunization_monitoring/Global_Immunization_Data.pdf> [Date accessed: 2 April 2012]

[48] Based on review of WHO/UNICEF coverage estimates for 1980–2010 (as of July 2011).

[49] WHO, 2012. *Vaccine-preventable diseases*. Available at: http://www.who.int/immunization_monitoring/diseases/en/ [Date accessed: 2 April 2012]

[50] From a baseline year of 1990.

[51] World Health Organization, 2012. *Estimates of disease burden and cost-effectiveness*. Available at: <http://www.who.int/immunization_monitoring/burden/estimates_burden/en/index.html> [Date accessed: 24 April 2012]

[52] Defined in the WHO Constitution, "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being". All countries are now party to at least one human rights treaty that assert this right. See: WHO, 2012. *Health and human rights*. Available at: <http://www.who.int/hhr/en/> [Date accessed: 29 March 2012]

[53] Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*, 362, pp.233-41.

[54] Ibid.

[55] Gwatkin, D., 2002. *Reducing Health Inequalities in Developing Countries*. The World Bank.

[56] UNICEF and WHO, 2012. *Immunization summary – A statistical reference containing data through 2010*. New York: UNICEF. Available at: <http://www.childinfo.org/files/immunization_summary_en.pdf> [Date accessed: 3 April 2012]

[57] World Bank list of economies. Available at: <http://siteresources.worldbank.org/DATASTATISTICS/Resources/CLASS.XLS> [Date accessed: 15 April 2012]

[58] WHO, 2012. WHO regional offices. Available at: http://www.who.int/about/regions/en/index.html [Date accessed: 16 April 2012]

[59] Limitations in the availability and quality of data should be noted. The rigorous review of WHO/UNICEF estimates may not be systematically conducted for sub-national data. The analysis in this report is based on countries where recent (no later than 2005) disaggregated data is available. For each country, the most recent survey data is used, whether it is from MICS or DHS, limiting the comprehensiveness and comparability of data. For a list of DHS and MICS country surveys used by type and year, see www.savethechildren.org.uk/resources/online-library

[60] Some surveys also allow for disaggregation according to birth order, ethnicity and language of household head, however, these variables have not been analysed. Similar analyses looking at inequalities tend to focus on the same variables analysed for this report.

[61] For a list of DHS and MICS country surveys used by type and year, see www.savethechildren.org.uk/resources/online-library

[62] Centers for Disease Control and Prevention, 2009. *Epidemiology of the Unimmunized Child: Findings from the peer-reviewed published literature, 1999–2009*. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/CDC_UNVACC_REPORT_FINAL_v2.pdf> [Date accessed: 12 April 2012]

[63] John Snow, Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf> [Date accessed: 12 April 2012]

[64] World Health Organization, 2010. Update on the epidemiology of the unvaccinated child. *Meeting of the Strategic Advisory Group of Experts (SAGE)*. 9–11 November 2010. Available at: <http://www.who.int/immunization/sage/nov2010_unvacc_update_eggers.pdf> [Date accessed: 12 April 2012]

[65] Country income groupings are based on World Bank classification.

[66] Coverage estimates by country income grouping are calculated as non-weighted averages of WHO and UNICEF estimates of national routine immunization coverage (Source: WHO/UNICEF coverage estimates by country for DTP3 (1980–2010), as of July 2011).

[67] See: <http://siteresources.worldbank.org/INTLICUS/Resources/FCS_FY12__External_List.pdf>

[68] WHO, UNICEF and World Bank, 2009. *State of the world's vaccines and immunization*, 3rd ed. Geneva: World Health Organization.

[69] Pneumococcal conjugate vaccine is among WHO's recommended immunisations for all children.

[70] Decade of Vaccines Collaboration, 2012. *Draft 4 of the Global Vaccine Action Plan – to be presented at the 2012 World Health Assembly*. Available at: http://www.dovcollaboration.org/wp-content/uploads/2012/01/GVAP_english.pdf [Date accessed: 16 April 2012]

[71] Of countries with available data. See: <www.unicef.org/publications/files/Achieving _the_MDGs_with_Equity-Pamphlet_EN_092010.pdf>

[72] WHO, 2012. *Global and regional data and statistics*. Available at: <http://www.who.int/immunization_monitoring/data/data_regions/en/index.html> [Date accessed: 10 April 2012]

[73] UNICEF, WHO, World Bank and UNDESA, 2011. *Levels & Trends in Child Mortality: Report 2011*. New York: UNICEF.

[74] 33 of the 50 countries reviewed. See: Brown, D., Burton, A., Gacic-Dobo, M., Karimov, R., Vandelaer, J. and Okwo-Bele, J.M., 2011. A mid-term assessment of progress towards the immunization coverage goal of the Global Immunization Vision and Strategy (GIVS). *BMC Public Health*, 11(806).

[75] India, Nigeria, DRC, Indonesia, Uganda, Pakistan, Afghanistan, Iraq, South Africa, Ethiopia.

[76] In many smaller countries, coverage rates are even lower. Less than half of children born in Equatorial Guinea, Gabon, Somalia and Palau were immunised with DTP3 in 2010. The lowest national DTP3 coverage

rate was in Equatorial Guinea, where just one in three children were vaccinated. See: <http://www.childinfo.org/immunization_countrydata.php> [Date accessed: 10 April 2012]

[77] Figures are calculated based on WHO/UNICEF estimates of national routine immunization coverage (as of July 2011) and population data for surviving infants obtained from United Nations Population Division.

[78] Unless specified, the statistics cited in this section are from Save the Children UK's analysis of the latest available DHS and MICS data.

[79] Except for Indonesia, Madagascar and Congo, where lack of education characterises the lowest coverage rates.

[80] In countries where inequalities in immunisation coverage by household wealth are widest.

[81] In countries where inequalities in immunisation coverage by mother's education are widest.

[82] In countries where inequalities in immunisation coverage between rural and urban areas are widest.

[83] Note that wealth quintiles are relative, meaning that the level of poverty for the poorest 20% will differ across countries.

[84] Using the 12 countries with biggest inequalities defined as those with the highest ratios for DTP3 coverage between the richest and poorest wealth quintiles.

[85] Using the 12 countries with the biggest inequalities defined as those with the highest ratios for measles coverage between the richest and poorest quintiles.

[86] UNICEF, 2010. *Progress for children: Achieving the MDGs with equity*. New York: UNICEF.

[87] In 2010, the Gini coefficient was 48.8%. See: <http://data.worldbank.org/indicator/SI.POV.GINI> [Date accessed: 13 April 2012]

[88] Save the Children UK's analysis of available DHS and MISC data. See also: Barros, A., Ronsmans, C., Axelson, H., Loaiza, E., Bertoldi, A.D., França, G., Bryce, J., Ties Boerma, J. Victora, C., 2012. Equity in maternal, newborn, and child health interventions in Countdown to 2015: a retrospective review of survey data from 54 countries. *The Lancet*, 379(9822), pp.1225–1233.

[89] Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *The Lancet*, 362, pp.233-41.

[90] UNICEF, 2010. *Coverage evaluation survey – All India report*. New Delhi, UNICEF.

[91] Fully immunised refers to children (12–23 months age) receiving one dose of BCG, 3 doses of DPT/OPV each and 1 measles vaccine (UNICEF, 2010. *Coverage evaluation survey – All India report*. New Delhi, UNICEF)

[92] Delamonica, E., Minujin, A. and Gulaid, J., 2005. Monitoring equity in immunisation coverage. *Bulletin of the World Health Organization*, 83(5).

[93] Ibid.

[94] Ethiopia, Gambia, Indonesia, Lao PDR, Mongolia, Namibia, Nigeria, Suriname.

[95] Delamonica, E., Minujin, A. and Gulaid, J., 2005. Monitoring equity in immunisation coverage. *Bulletin of the World Health Organization*, 83(5).

[96] It is important to note that maternal education is also associated with wealth, and this relationship has not been controlled for in this analysis.

[97] Twelve countries with the largest ratios in DTP3 immunisation coverage between secondary and no education level.

[98] Using the average coverage rate for the 12 countries with the highest inequalities measured by ratios.

[99] Delamonica, E., Minujin, A. and Gulaid, J., 2005. Monitoring equity in immunisation coverage. *Bulletin of the World Health Organization*, 83(5).

[100] World Health Organization. *The reaching every district strategy*. Available at: <http://www.who.int/immunization_delivery/systems_policy/RED-FactSheet.pdf> [Date accessed: 11 April 2012]

[101] Duclos, P., Okwo-Bele, J.M., Gacic-Dobo, M., 2009. Global immunization: status, progress, challenges and future. *BMC International Health and Human Rights*, 9(Suppl 1):S2.

[102] Burkina Faso, Gambia, Malawi, Mauritius, Sao Tome and Principe, Seychelles. Based on analysis of WHO Immunization Indicators data (Last update: 3 October 2011).

[103] Note that 5.6% of districts did not report.

[104] World Health Organization, 2011. *Progress Towards Global Immunisation Goals – 2010: Summary presentation of key indicators*. Available at: <http://www.who.int/immunization_monitoring/data/SlidesGlobalImmunization.pdf> [Date accessed: 19 April 2012]

[105] Based on analysis of WHO Immunization Indicators data (Last update: 3 October 2011).

[106] Following an analysis of data from available DHS and MICS surveys (not older than 2005), countries identified as having high inequalities across various criteria (e.g. wealth quintile, geographic location, education of mother) were further analysed across districts. The following countries/surveys were included: India (CES 2009), Nigeria (DHS 2008), Central African Republic (MICS 2006), Congo (DHS 2005), Sudan (MICS 2006), DRC (DHS 2007), Liberia (DHS 2007), Pakistan (DHS 2006-07), Madagascar (DHS 2008-09), Ethiopia (DHS 2005) and Niger (DHS 2006).

[107] MEASURE DHS STATcompiler. Available at: <http://www.statcompiler.com> [Date accessed: 14 March 2012]

[108] MEASURE DHS STATcompiler. Available at: <http://www.statcompiler.com> [Date accessed: 14 March 2012]

[109] For instance in the following survey in Bangladesh: Perry, H., Weierbach, R., Hossain, I. and Islam, R., 1997. Immunization coverage in zone 3 of Dhaka city, Bangladesh. *Working Paper No. 25*. Dhaka: International Centre for Diarrhoeal Disease Research.

[110] These are: Tanzania, Suriname, Cambodia, Kenya, Mongolia, Gambia, Tajikistan, Egypt, Togo and Indonesia; only in Zambia did inequality between rural/urban widen and overall coverage decline.

[111] Delamonica, E., Minujin, A. and Gulaid, J., 2005. Monitoring equity in immunisation coverage. *Bulletin of the World Health Organization*, 83(5).

[112] Findings from: Bosch-Capblanch, X., Schindler, C., Beck, L., Secula, F. and Hilber, A.M., 2010. *WHO Project gender and immunisation – statistical component*. Basel: Swiss Centre for International Health.

[113] Sex of the child is not included here as big variations in vaccination coverage between boys and girls were not observed, nor were patterns of disparities. This is also supported by the analysis carried out by Bosch-Capblanch et al, which found that sex of the child is not a strong determinant/predictor of immunisation.

[114] Sullivan, M.C., Tegegn, A., Tessema, F., Galea, S. and Hadley, C., 2010. Minding the immunization gap: family characteristics associated with completion rates in rural Ethiopia. *J Community Health*, 35(1):53–9; Kusuma, Y.S., Kumari, R., Pandav, C.S. and Gupta, S.K., 2010. Migration and immunization: determinants of childhood immunization uptake among socioeconomically disadvantaged migrants in Delhi, India. *Trop Med International Health*, 15(11), pp.1326–32; Fatiregun, A.A. and Okoro, A.O., 2010. Maternal determinants of complete child immunization among children aged 12–23 months in a southern district of Nigeria. *Vaccine*, 30(4), pp.730–736.

[115] Bosch-Capblanch, X. 2010. *Assessment of determinants of children unreached by vaccination services: Fact sheets report*. Geneva: WHO. Available at: <http://www.who.int/immunization/sage/Unreached_factsheets_SCIH_v2.pdf>

[116] Centers for Disease Control and Prevention, 2009. *Epidemiology of the unimmunized child: Findings from the peer-reviewed published literature, 1999-2009*. World Health Organization. Available at: <http://www.who.int/immunization/sage/CDC_UNVACC_REPORT_FINAL_v2.pdf>

[117] Ibid.

[118] Where poverty is considered to be a family characteristic.

[119] Centers for Disease Control and Prevention, 2009. *Epidemiology of the unimmunized child: Findings from the peer-reviewed published literature, 1999-2009*. World Health Organization. Available at: <http://www.who.int/immunization/sage/CDC_UNVACC_REPORT_FINAL_v2.pdf>

[120] WHO, UNICEF, World Bank. 2009. *State of the world's vaccines and immunization*. Third edition. Geneva: WHO. Available at: <http://whqlibdoc.who.int/publications/2009/9789241563864_eng.pdf>

[121] John Snow Inc., 2009. *Epidemiology of the unimmunized child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf>

[122] Ibid.

[123] Primary health care physicians were 50% to 70% less likely to vaccinate a child themselves if they thought another type of health care worker was responsible. See: Gargano, L.M., Thacker, N., Choudhury, P., Weiss, P.S., Pazol, K., Bahl, S., Jafari, H.S., Arora, M., Orenstein, W.A., Hughes, J.M., Omer, S.B. 2012. Attitudes of pediatricians and primary health center physicians in India concerning routine immunization, barriers to vaccination, and missed opportunities to vaccinate. In *The Pediatric Infectious Diseases Journal*. Feb; 31(2): e37–42.

[124] John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf>

[125] Wilson, P. 2010. *Giving Countries the Best Shot: An overview of vaccine access and R&D*. Oxfam & Medecins Sans Frontieres. Available at: <http://www.oxfam.org/sites/www.oxfam.org/files/giving-developing-countries-best-shot-vaccines-2010-05.pdf>

[126] John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. Available at: <http://www.who.int/immunization/sage/ImmBasics_Epid_unimm_Final_v2.pdf>

[127] Vaccines need to be kept in temperature controlled environments, as both high and low temperatures can reduce their potency. For a cold chain to function effectively, the right equipment and trained health workers are essential.

[128] Kenny, C. 2011 Shot in the Dark. In *Foreign Policy*. Available at: <http://www.foreignpolicy.com/articles/2011/06/27/shot_in_the_dark?page=0,0>

[129] 58 grey literature projects, see: John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization. 54 cited no understanding of importance, 34 cited no information on when to vaccinate, see: Centers for Disease Control and Prevention, 2009. *Epidemiology of the unimmunized child: Findings from the peer-reviewed published literature, 1999-2009*. World Health Organization.

[130] John Snow Inc., 2009. *Epidemiology of the unimmunized child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization.

[131] One study from India cited that many mothers of underimmunised children thought that oral polio vaccine was the only one needed. Kumar, D, Aggarwal, A, Gomber, S. 2010. Immunization status of children admitted to a tertiary-care hospital of north India: reasons for partial immunization or non-immunization. *Journal of Health, Population and Nutrition*. Jun; 28(3): 300–4.

[132] Yahya, M. 2007. Polio vaccines—"no thank you!" barriers to polio eradication in Northern Nigeria. In *Journal of African Affairs*; 106 (423): 185–204.

[133] John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization.

[134] The VCI is a quantitative estimate of the confidence of a specific population to use vaccines (assuming the vaccine is available), distinguishing confidence and demand from other supply and infrastructure-related factors that affect vaccine take up. Fast-moving, immediately available data streams such as those available through social media, mobile technology and on-line media sources are used as a proxy for public sentiment and these are calibrated against benchmark historic data (survey/coverage) to anticipate where there are changes emerging between, for example, high historic coverage but low public confidence, indicating a potential drop in coverage and therefore improving the need to build confidence, or to see where historic vaccine coverage data may be improving in light of indicators of positive confidence. The VCI index is being further developed to incorporate survey data on vaccine acceptance and the drivers of vaccine acceptance and refusal.

[135] Bosch-Capblanch, X. 2010. *Assessment of determinants of children unreached by vaccination services: Fact sheets report*. Geneva: WHO.

[136] Ibid.

[137] John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization.

[138] Centers for Disease Control and Prevention, 2009. *Epidemiology of the unimmunized child: Findings from the peer-reviewed published literature, 1999-2009*. World Health Organization.

[139] John Snow Inc., 2009. *Epidemiology of the Unimmunized Child: Findings from the grey literature*. IMMUNIZATIONbasics Project. Geneva: World Health Organization.

[140] Kumar, D, Aggarwal, A, Gomber, S. 2010. Immunization status of children admitted to a tertiary-care hospital of north India: reasons for partial immunization or non-immunization. *Journal of Health, Population and Nutrition*. Jun; 28(3): 300–4.

[141] Centers for Disease Control and Prevention, 2009. *Epidemiology of the Unimmunized Child: Findings from the peer-reviewed published literature, 1999-2009*. World Health Organization.

[142] Ibid.

[143] Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*, 362, pp.233–41.

[144] In countries where inequalities in immunisation coverage by mother's education are widest.

[145] In countries where inequalities in immunisation coverage between rural and urban areas are widest.

[146] This is supported by an analysis done for the UK on the cost-effectiveness of addressing inequalities in measles vaccination. See: Jacklin, P. 2009. An exploration of the cost-effectiveness of interventions to reduce differences in the uptake of childhood immunisations in the UK using threshold analysis. *Reducing differences in the uptake of immunisations: Economic analysis 2*. London: National Institute of Health and Clinical Excellence. Available at: http://www.nice.org.uk/nicemedia/live/12247/45530/45530.pdf

[147] UNICEF, 2010. *Narrowing the Gaps to Meet the Goals*. New York: UNICEF.

[148] Ibid.

[149] UNICEF defines the equity-focused approach as a model that aims to accelerate health MDG progress, reduce disparities and lower out-of-pocket expenditures for the poor through three key measures: (1) upgrade selected facilities; (2) overcome barriers that prevent the poorest from using services even when they are available to them; and (3) task shifting. Ibid.

[150] The current path approach is defined as one that "broadly approximates contemporary approaches and depicts their path over the next five years… lend[ing] significant but less-focused attention to the most deprived groups and areas… [and with a focus to] use additional investment to increase the training and deployment of professional health workers, expand building infrastructure and use mass communication to encourage the poor to seek care." Ibid.

[151] Delamonica, E., Minujin, A., Gulaid, J. 2005. Monitoring equity in immunisation coverage. *Bulletin of the World Health Organization*, 83(5).

[152] UNICEF, 2012. *The State of the World's Children 2012: Children in an urban world*. New York: UNICEF; Victora, C.G., Wagstaff, A., Armstrong Schellenberg, J., Gwatkin, D., Claeson, M., Habicht, J.P., 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet*, 362, pp.233–41.

[153] Central African Republic, Congo, Democratic Republic of the Congo, Ethiopia, India, Liberia, Niger, Nigeria, Pakistan, Somalia, Sudan and Yemen.

[154] Analysis conducted by Johns Hopkins School of Public Health using Lives Saved Tool for DTP3, Hib and measles vaccines. DTP3 coverage rates from DHS/MICS latest survey have been used.

[155] WHO. 2012. Summary of WHO Position Papers – Recommended Routine Immunisations for Children. Available at: <http://www.who.int/immunization/policy/Immunization_routine_table2.pdf>

[156] Using the 2010 estimate that 7.6 million children under five died that year. Data available at: <http://www.childinfo.org/mortality.html>

[157] Minujin, A., Delamonica, E. Chapter 3: Mind the gap! Child mortality differentials by income group. In Cornia, G.A. 2001. *Harnessing Globalisation for Children: A report to UNICEF*. Available at: <http://www.unicef-irc.org/research/ESP/globalization/chapter3.pdf>

[158] Whitehead, M., Dahlgren, G. and Gilson, L., 2009. Developing the policy response to inequalities in health: A global perspective. In: T. Evans, M. Whitehead, F. Diderichsen, A. Bhuiya, and M. Wirth, ed. 2009. *Challenging inequities in health*. Oxford: Oxford University Press, pp.309–323.

[159] In middle-income countries, where inequalities are wide and the numbers of unimmunised high, development partners should provide technical support, and efforts made to establish conducive conditions for sustainable access to affordable vaccines for countries that have graduated from GAVI eligibility. See: Glassman, A., Duran, D. and Sumner, A., 2011. Global health and the new bottom billion: What do shifts in global poverty and the global disease burden mean for GAVI and the Global Fund? *Working Paper 270*. Washington: Center for Global Development.

[160] Including the GIVS, GVAP and GAVI goals.

[161] Medecins Sans Frontieres, 2012. *The Right Shot: Extending the reach of affordable and adapted vaccines*. Geneva: Medecins Sans Frontieres.

[162] For example, where immunisation campaigns are reaching more hard-to-reach populations, efforts should be made to raise awareness of routine immunisation and potentially expand access to other essential preventive interventions – e.g. using polio National Immunisation Days as a platform for vitamin A supplementation. See: Goodman, T., Dalmiya, N., de Benioist, B. and Schultink, W., 2000. Polio as a platform: Using national immunization days to deliver vitamin A supplements. *Bulletin of the World Health Organization*, 78(3).

FINDING THE FINAL FIFTH

Inequalities in immunisation

"We are reaching four out of five children with routine vaccinations. Too often, the fifth child lives in one of the poorest, most disadvantaged communities. This is simply wrong. And *Finding the Final Fifth* makes clear, we must reach these communities if we are to achieve universal immunisation coverage. That will take political will, new investment, and community engagement. We have the power to do this. And because we can, we must."

Anthony Lake, Executive Director, UNICEF

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