

Immunization Equity



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Health inequities are the unjust differences in health among different social groups. Unfortunately, inequities are the norm, both in terms of health status and access to, and use of, health services. Childhood immunizations reduce the incidence of vaccine-preventable diseases and represent a cost-effective way to foster health equity. This paper reflects a 2015 review of data from surveys conducted in developing countries from 2005 to 2011 that show significant inequities in immunization coverage and discusses several initiatives currently underway (including Gavi, the Vaccine Alliance) that are directed at increasing childhood immunizations or reducing or abolishing overall health inequities. These initiatives have already had a significant impact on disease burden and childhood mortality and give rise to optimism that health disparities may further be reduced and health equity achieved as a result of investments made in immunization.

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Introduction

Health inequities are “the unjust differences in health between persons of different social groups, and can be linked to forms of disadvantage such as poverty, discrimination and lack of access to services or goods.”¹ Health inequities are unfortunately prevalent, both in terms of health status and in access to, and use of, health services. *The Lancet*–University of Oslo Commission on Global Governance for Health published a major article in *The Lancet* in 2014 in which the conclusion, albeit not restricted to immunizations, is profound: “The overarching message...is that grave health inequity is morally unacceptable, and ensuring that transnational activity does not hinder people from attaining their full health potential is a global political responsibility.”²

Childhood immunization is widely recognized and endorsed for its unparalleled impact on the incidence of disease. Immunization of children has repeatedly been shown to be a cost-effective way to reduce vaccine-preventable diseases and foster health equity.³ Although the price of vaccines has risen significantly over the past decade, much of the increase is because of more costly vaccines such as the pneumococcal, rotavirus, and human papillomavirus vaccines that have been introduced recently. Despite the increased costs, the investment

remains cost effective and yields benefits that go well beyond the critical role of reducing disease and extend to clear economic benefits such as avoidance of medical care costs, productivity gains, and community benefits including herd immunity and reduced antibiotic use and related reduction in development of antibiotic-resistant bacteria.⁴

In most developing countries, childhood vaccines have been provided free of charge since 1974 through the Expanded Program on Immunization (EPI) and, since 2000, also through Gavi, the Vaccine Alliance. Although immunizations are provided on a more equitable basis than many other maternal and child health services, more needs to be done in order for immunizations to have their maximal impact on health equity. This paper reflects a 2015 review of selected data from 2005–2011 regarding health equity and disparities, focusing on how immunizations have impacted health equity, and considers the prospects for the future.

Methods

Most studies assessing equity factors in developing countries have relied on Demographic and Health Surveys (DHSs) or Multiple Indicator Cluster Surveys (MICSs), which are nationally representative, multiple-indicator household surveys typically targeting women and yielding information about a number of indicators, including personal characteristics, health status, use of health services, health attitudes and behaviors, and living conditions.⁵ Maternal and child health services and outcomes are major targets of the surveys. SES is commonly categorized according to the wealth index, a composite measure of a household's cumulative living standard. Given that in many countries there are not reliable data on income and expenditures, the wealth index is calculated using easy-to-collect data on selected assets in a household such as type of flooring, water supply, sanitation facilities, electricity, radio,

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TV, telephone, refrigerator, type of vehicle, people per sleeping room, ownership of agricultural land, domestic servants, and country-specific items. Based on these characteristics, individual households are listed on a continuous scale of relative wealth and divided into wealth quintiles.

The indicator used to represent immunization coverage by most organizations, including WHO and Gavi, is immunization coverage among 1-year-olds with the third dose of diphtheria-tetanus-pertussis vaccine (DTP3). For this paper, both absolute inequality (difference in DTP3 coverage between highest wealth quintile [Q5] and lowest wealth quintile [Q1]) and relative inequality (ratio of DTP3 coverage Q5:Q1) were considered.¹

This paper focused on data from DHSs/MICSs carried out from 2005 to 2011 that have been summarized in the WHO Global Health Observatory Data Repository, although initial reference was also made to comparative summaries of earlier surveys.^{6–8} Additionally, reports^{9–11} from selected countries that reviewed national experience in reducing disparities were also summarized.

Results

Houweling et al.⁷ carried out an international comparative study of maternal and child care in 45 developing countries using data from DHSs conducted between 1990 and 1998. They found striking differences in five indicators of healthcare use comparing the poorest and richest quintiles of the population. Only 49% of children were fully immunized and the gap between poorest and richest was > 20%.

Delamonica, Minujin, and Gulaid⁸ reviewed DHS data from 21 countries that had comparable data on immunization coverage from at least two rounds of surveys between 1988 and 1999. They found that although overall coverage had improved between the two rounds in 16 of 21 countries, few countries experienced substantial reductions in disparities.

World Health Statistics 2013 presents data on health inequities in 82 of the poorest countries, based on DHSs or MICSs carried out in 2005–2011.¹² The most recent data are shown in Table 1 and reflect the major disparities observed around the world. With respect to immunization, the greatest disparity exists for children born to women with no education compared with those born to women with secondary (or higher) education. Coverage was lower in rural areas compared to urban areas and in those belonging to the lowest wealth quintile compared to those in the highest wealth quintile. No gender disparity was noted.

The WHO Global Health Observatory Data Repository presents information on DHSs/MICSs carried out in member states. In the most recent DHSs/MICSs conducted in 70 countries from 2005 to 2011, DTP3 coverage was assessed among 1-year-olds.⁶ The greatest differences between the wealthiest and the poorest quintiles was 64.1% (Nigeria) and the median was

Table 1. Median Value of Selected Indicators for WHO Member States According to Place of Residence, Wealth, and Educational Level of Women

Indicator	Sex			Residence			Wealth quintile			Female education			
	M	F	F - M	Diff	Ratio	U - R	Diff	Ratio	H/L	Diff	Ratio	Diff	Ratio
				U - R	U/R	U - R	H - L	H/L	H - L	≥ 2° - 0	≥ 2° / 0	≥ 2° - 0	≥ 2° / 0
DTP3 coverage among 1-year-olds (%)	77	78	1	8	1.10	83	15	1.20	87	8	1.01	26	1.43
Contraceptive prevalence: modern methods (%)				8	1.29	27	17	1.80	38	17	1.80	18	2.05
Antenatal care coverage: ≥ 4 visits (%)				16	1.28	56	32	1.68	79	32	1.68	32	1.71
Births attended by skilled health personnel (%)				17	1.44	61	46	1.93	95	46	1.93	48	2.20
Children < 3 years old stunted (%)	35	31	-4	7	1.25	27	-6	0.76	20	-6	0.76	23	0.57
< 5 mortality/ 1,000 live births	86	76	-10	-19	0.78	88	-51	0.50	53	-51	0.50	56	0.52

Source: DHS/MICSs conducted 2005–2011.⁶ DHS, Demographic and Health Survey; Diff, difference; DTP3, third dose of diphtheria-tetanus-pertussis vaccine; F, female; H, high; L, low; M, male; MICSs, Multiple Indicator Cluster Surveys; R, rural; U, urban.

13.5%, with the greatest relative difference in Somalia (Q5:Q1=5.29). Nine countries reported similar to slightly higher DTP3 coverage in the lowest compared to the highest wealth quintile (Belarus, Belize, Burundi, Kazakhstan, Maldives, Tajikistan, Thailand, Uzbekistan, and Swaziland). The reasons for this difference are not clear. **Figure 1** displays the range of differences graphically.

Thirty-nine countries have carried out at least two DHSs/MICSs in the 2005–2011 period and reported complete information.⁶ In 62% (24/39) of the countries, the absolute difference between Q5 and Q1 narrowed, and in 67% (26/39) the ratio Q5:Q1 decreased. Although this is encouraging, in 38% (15/39) of countries the differences increased over time, with five countries reporting increases in disparities of > 10% (Cameroon, Ethiopia, Lao People's Democratic Republic, Nigeria, and Pakistan). Though Nigeria and Pakistan have had significant internal security and programmatic issues, the reasons behind the increase in inequity in the other countries are not immediately apparent.

If a difference < 5% between Q5 and Q1 is considered to represent equity, one third of countries (23/70) with recent DHSs/MICSs have achieved equity. Sixteen countries (Belarus, Bosnia and Herzegovina, Burundi, Egypt, Ghana, Honduras, Jordan, Kazakhstan, the Former Yugoslav Republic of Macedonia, Malawi, Maldives, Mongolia, Rwanda, Tajikistan, Thailand, and Uzbekistan) have achieved DTP3 coverage in Q1 > 90% as well as a < 5% difference between Q1 and Q5.

In countries that did more than one DHS/MIC Surveys from 2005 to 2011, 77% (30/39) have shown increases in DTP3 coverage in the lowest wealth quintile and the trend is toward decreasing disparities comparing Q1 and Q5. Countries that have achieved immunization equity have generally taken explicit measures to do so. Nonetheless, serious inequities still exist based on wealth, residence, and education.

Initiatives to Increase Vaccinations—National Level

Gwatkin, Bhuiya, and Victora¹³ assert that health systems are consistently inequitable, with more and better services provided to the affluent than to the poor. They state that the inequities are likely to continue unless specific efforts are made to reduce them, and describe some pro-poor approaches that have worked, at least in small-scale: improved means of identifying poor individuals, cash payments for use of services, contracting with non-governmental organizations, mass campaigns, and social marketing.

Why do large disparities remain and how can they be addressed going forward? Brazil's success in achieving equity with EPI vaccines (initially Bacillus Calmette–Guérin [BCG], DTP, polio, and measles) is attributed to

immunization being a part of the country's Unified Health System, with the federal government purchasing recommended EPI vaccines and offering them at no cost throughout the country on an ongoing basis. This is also the case in most developing countries. Non-EPI vaccines are available for purchase in private clinics.⁹

In Ghana, concerted efforts to strengthen immunization resulted in near-elimination of disparities.¹⁰ In Thailand, the authors attribute the relatively equitable distribution of most indicators to government commitment to investment in health infrastructure and expansion of health insurance coverage over the past three decades as well as the government's pro-rural policy of mandatory public service by all healthcare workers on graduation.¹¹

In a major effort to improve equity, on December 25, 2014, India launched Mission Indradhanush to reach all children with life-saving vaccines by 2020.¹⁴ The broad strategy has four basic elements:

1. meticulous planning campaigns/sessions at all levels;
2. effective communication and social mobilization efforts;
3. intensive training of health officials and frontline workers; and
4. establishment of accountability framework through task forces.

The experiences in countries like Brazil, Ghana, Thailand, and India indicate that reducing inequities requires conscious effort and government commitment to improvement.

Initiatives to Increase Vaccinations—Global Level

Throughout its 40-year history, EPI has played an exceptionally important role in bringing vaccines to developing countries.¹⁵ For the first 25 years of its existence, it provided support for BCG, DTP, oral polio, and measles vaccines and worked to encourage national government commitment to support vaccinations. In addition, in many developing countries, the private medical sector has begun providing an increasing proportion of childhood vaccines.

Development of newer, often much more costly, vaccines in the later years of the 20th century posed great challenges to EPI to prevent increasing disparities between developing and industrialized countries. In recent years, three important new lines of activity have had a dramatic impact on reducing disparities—Gavi; other immunization initiatives (e.g., Measles–Rubella Initiative, *Haemophilus influenzae* type b [Hib] Initiative); and global development initiatives.

Gavi was established in 2000 with a goal of saving children's lives and protecting people's health by increasing access to immunization in poor countries. It has

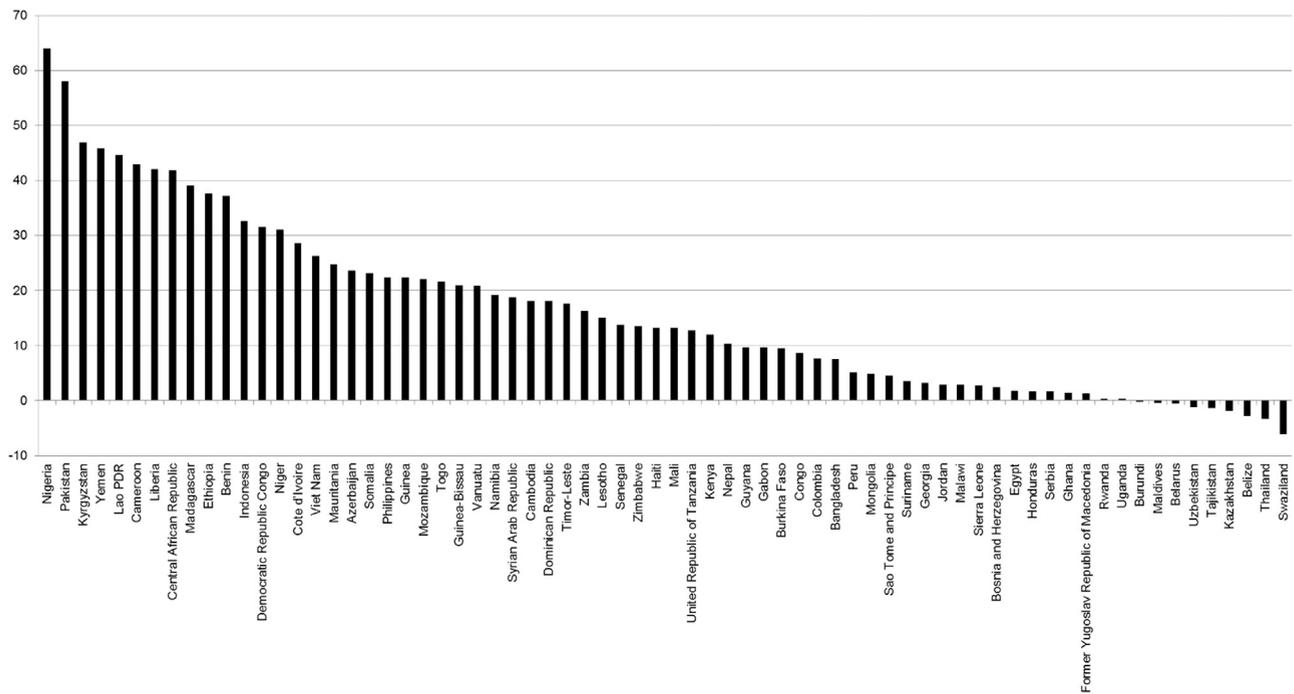


Figure 1. Difference in DTP3 immunization coverage among 1-year-olds by country according to wealth quintile ranked by difference Q5.

DTP3, third dose of diptheria-tetanus-pertussis vaccine.

provided support to the poorest countries in the world (initially 72 countries in which gross national income/capita was <\$1,000/year). Gavi provides vaccines directly as well as the financial support needed to introduce new/underutilized vaccines, strengthen immunization systems, strengthen health systems, improve injection safety, and support civil society organizations.¹⁶

Gavi explicitly addresses issues of equity. According to Seth Berkley, Gavi CEO, “Equity is a very important part of what we do. Our partners, UNICEF and WHO, have really stepped up to the plate. We’ve invested significant [sic] more finance in trying to deal with the lower coverage countries, putting in country tailored approaches, also in the countries that have the largest inequities.”¹⁷

In the 2000–2013 period, Gavi provided a total of \$8.4 billion in support to the poorest countries, \$6.6 billion of which has supported introduction of new and underutilized vaccines, including hepatitis B, Hib, pentavalent (DTP-Hib–hepatitis B), rotavirus, pneumococcal conjugate, meningococcal conjugate, and human papillomavirus vaccines. This represents a major investment in equity.

Introduction of New Vaccines

As a result of Gavi support, there has been a major reduction in inequities in use of hepatitis B, Hib, and pneumococcal conjugate vaccines. In 2000, only one low-

income country had introduced both Hib and hepatitis B vaccines into its routine immunization program. By the end of 2013, all but one of the Gavi-eligible low-income countries had introduced pentavalent vaccine, and the last one (South Sudan) planned to introduce pentavalent vaccine in 2014. Gavi is also providing support for introduction of pneumococcal conjugate, rotavirus, human papillomavirus, and meningitis type A vaccines.¹⁸

Coverage

Gavi has established an equity goal: DTP3 coverage in the lowest wealth quintile should be not >20 percentage points lower than coverage in the highest wealth quintiles. In 2013, it was estimated that 57% of Gavi-supported countries had met this goal.¹⁸

As a result of Gavi support, a higher proportion of poor countries than wealthier countries are now using hepatitis B vaccine. Gavi estimates that as of the end of 2013, Gavi support had resulted in 440 million additional children receiving vaccines in 77 countries and had contributed to preventing six million future deaths.

Disease Incidence

Three vaccines recently introduced in poor countries (usually with Gavi support)—Hib, rotavirus, and pneumococcal conjugate—have had a significant impact in reducing disease. Cowgill et al.¹⁹ demonstrated significant reductions in Hib disease in Kenya starting 3 years

after introduction. Sow and colleagues²⁰ showed that introduction of Hib vaccine in Mali led to rises in seroprevalence of anti-Hib antibodies and significant reductions in Hib disease and all-cause hospitalizations. Hajjeh, Mulholland, and Santosham²¹ edited a supplement to the *Journal of Pediatrics* summarizing the impact of Hib vaccine in a range of countries around the world.

Madhi et al.²² demonstrated that introduction of rotavirus vaccine in South Africa and Malawi significantly reduced the incidence of severe rotavirus gastroenteritis among African infants during the first year of life. Lepage and Vergison²³ reviewed global experience with rotavirus vaccines and found significant reductions in rotavirus gastroenteritis following introduction, although protection was not as significant in some African settings as in Latin America and industrialized countries.

The experience with pneumococcal conjugate vaccine is similar. Clinical trials in Africa showed reductions in invasive pneumococcal disease due to vaccine serotypes as well as reductions in all-cause mortality and radiographically confirmed pneumonia.²⁴ More recently, Scott et al.²⁵ have shown significant declines in admissions for vaccine-specific serotype invasive pneumococcal disease in Kilifi District Hospital (Kenya) following introduction of pneumococcal conjugate vaccine into the routine immunization schedule accompanied by a catch-up campaign.

Support from Gavi and the Measles–Rubella Initiative has resulted in dramatic declines in measles mortality: a 2000–2012 global decline of 78%, with even greater decline (88%) in WHO's African region.^{26,27} Although measles accounted for 9% of all deaths in Gavi countries in 2000, it was reduced to just 3% in 2013.²⁸ These impressive changes can be attributed to measles vaccine provided by Gavi and the Measles–Rubella Initiative.

Global Development Initiatives

As inequities in immunization and other health indices are directly related to poverty, elimination of poverty should advance achievement of equity. Through a consultative process, the UN established eight Millennium Development Goals (MDGs) for the 1990–2015 period.²⁹ MDG 4 is to reduce by two thirds the mortality rate of children aged <5 years. As of 2013, the all-cause mortality rate for children aged <5 years had dropped by 47%. Measles vaccination accounted for nearly one quarter of the decline. Although achieving this target is unlikely, several countries have made significant progress by focusing on rural areas, targeting hard-to-reach communities and using other pro-equity approaches.

In addition to the MDGs, in 2012 the governments of Ethiopia, India, and the U.S., in collaboration with UNICEF, convened a Child Survival Call to Action, seeking to accelerate reductions in child mortality to reach a level of ≤ 20 child deaths per 1,000 live births in every country by 2035—in essence, to end preventable child deaths.³⁰ In total, 176 governments have signed a pledge to accelerate efforts to reduce maternal, newborn, and child deaths, even “among the poorest households.”

Discussion

Experience with national and global initiatives (notably Gavi) demonstrate that explicit efforts to increase access, strengthen immunization systems, and remove financial barriers can reduce disparities in vaccine introduction, coverage, and disease incidence in the poorest countries of the world. Although Gavi has reduced disparities between the poorest and wealthiest countries, its mission does not extend to addressing the disparities between the poor countries that are not Gavi-eligible and wealthier countries. There is growing concern about the need to ensure equitable access to vaccines in low- and middle-income countries where the greatest number of the world's poor reside. Tiered pricing approaches, in which less-affluent countries pay lower prices than more-affluent countries, may help to address these inequities.³¹ This approach is controversial, however, as some assert that tiered pricing allows pharmaceutical companies to maximize profit in all countries, as prices are determined according to the highest a country is prepared to pay. With their emerging middle classes now firmly on the pharmaceutical industry's radar, middle-income countries are often left paying excessively high prices. Even poorer countries can lose out, as tiered pricing does not reflect the true lowest price potential of drugs, and acts against generic competition, which tends to deliver a lower sustainable price over the long term.³²

On the other hand, the argument in favor of tiered-pricing states that it is a widespread misconception that tiered pricing of vaccines entails the producers or consumers in the high-price markets subsidizing the consumers in the low-price markets. Such a view is inconsistent with realities, as well as with economic theory. In the vaccine sector, the cost and demand structures ensure that all three parties involved benefit. The developing countries' low-price market consumers get access to a product that would have been unattainable if the vaccines were offered at a uniform price. The producers benefit from increased revenues and profits, and the developed countries' high-price market consumers benefit from slightly lower prices than would be the case in the absence of the low-price market.³³

WHO and UNICEF developed a Global Immunization Vision and Strategy (GIVS) to guide activities in 2006–2015.³⁴ Of the seven guiding principles for the development of the GIVS, the first was to develop a vision and strategy rooted in “equity and gender equality.” Of the seven components of the vision for 2015, two specifically focused on equity: the first, that “every child, adolescent and adult has equal access to immunization as provided for in their national schedule” and the second, that “solidarity among the global community guarantees equitable access for all people to the vaccines they need.”

Finally, the Decade of Vaccines was announced at the Davos World Economic Forum in February 2010 and a Global Vaccine Action Plan (GVAP) was developed and subsequently approved by the World Health Assembly in May 2012.³⁵ GVAP builds on the success of GIVS. The vision of the Decade of Vaccines is “a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases.” Its mission is to extend, “by 2020 and beyond, the full benefits of immunization to all people, regardless of where they are born, who they are, or where they live.” One of the strategic objectives of the Decade of Vaccines is that “the benefits of immunization are equitably extended to all people.”

The various initiatives described above, which are designed to address vaccine and healthcare inequities, give rise to optimism that it may finally be possible to reduce health disparities and achieve equity in at least some areas of health, particularly immunizations and vaccine-preventable diseases. Gavi’s success in increasing vaccine access where the inequities are greatest has had a major impact on overall health equity in these countries. Although substantial progress has been made, there is still a long way to go. Given that Gavi is a time-limited program, countries will have to gradually assume greater ownership of immunization programs and overall health systems. Affordable access to vaccines through tiered pricing or other approaches will be essential. Disparities will not disappear by themselves; explicit and continuing measures are necessary to eliminate them and ensure that they do not recur. Immunization can and should be one of the leading strategies to achieve health equity. Whether it will be remains to be seen.

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