

# Measles Supplementary Immunization Activities and GAVI Funds as Catalysts for Improving Injection Safety in Africa

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**Background.** In 2000, reuse of disposable syringes and inadequately sterilized syringes resulted in 39% of all injections being unsafe, causing 22 million infections. We describe the contribution of measles supplemental immunization activities (SIAs) and Global Alliance for Vaccines and Immunisation (GAVI) funding in replacing disposable and sterilizable syringes with auto-disable (AD) syringes to improve injection safety in 39 African countries.

**Methods.** We assessed trends in nationwide introduction of AD syringes against measles catch-up SIAs and GAVI funding using World Health Organization/United Nations Children's Fund (UNICEF) Joint Reporting Form for Immunization and UNICEF supply data.

**Results.** In 19 (49%) of 39 countries, the measles program catalyzed the introduction of injection safety equipment, including AD syringes and safety boxes, training, and procurement of safety equipment during SIAs. GAVI was catalytic through financial support in 14 countries (36%) for including safe injection equipment in routine immunization. Additionally, GAVI funded 21 countries that had already introduced AD syringes in their national program. UNICEF AD syringe shipments to sub-Saharan Africa increased from 11 million to 461 million from 1997 to 2008. All 39 countries stopped using sterilizable syringes by 2004.

**Conclusions.** The measles mortality reduction program and GAVI complemented each other in improving injection safety. All countries continued with AD syringes for immunization after measles catch-up SIAs and GAVI funding ended.

In 2000, before the large-scale introduction of auto-disable (AD) syringes, an estimated 6.7 billion (39%) of the roughly 17.2 billion injections administered globally were given with equipment that had previously been used [1]. Reuse or improper sterilization of needles and

syringes were common practice. In 2000, unsafe injections caused an estimated 20.6 million new hepatitis B viral infections, 2 million hepatitis C, and 260,000 human immunodeficiency virus (HIV) infections, accounting for 32%, 40%, and 5% of new infections, respectively. The burden due to past and present exposure accounted for an estimated 501,000 deaths and 1,046,100 disability-adjusted life years in 2000 [2]. In addition, health workers were exposed to occupational risks to hepatitis B, hepatitis C, and HIV infections. In 2000, approximately 66,000 hepatitis B infections, approximately 16,000 hepatitis C, and approximately 1000 HIV infections may have occurred among health care workers as a result of percutaneous injuries during their work [3]. Around 1 billion injections (5% of the annual total) given are for immunization [4]. As a public health prevention strategy, it is essential that immunization injections do not unnecessarily expose the receiver to any pathogens.

From the beginning of the Expanded Program on Immunization, the United Nations Children's Fund

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(UNICEF) and partner agencies supported injection safety by supplying developing countries with sterilizable glass syringes with detachable needles and portable steam sterilization kits, fuel, and extensive training for health workers to operate them. Gradually, middle-income countries started to imitate good practice in industrialized countries by switching to disposable plastic syringes with detachable needles. However, as during the 1990s it became clear that injection safety was still a problem in many countries in sub-Saharan Africa, UNICEF and partners decided to put additional measures into place to improve immunization practices, including guidelines, a joint statement, and an exclusive supply of AD syringes and safety boxes for contaminated sharps [1, 3-5]. The problematic reuse of disposable syringes and inadequately sterilized syringes by staff of the immunization services prompted industry to develop an AD syringe designed to lock automatically after a single injection, thus preventing reuse of the syringe.

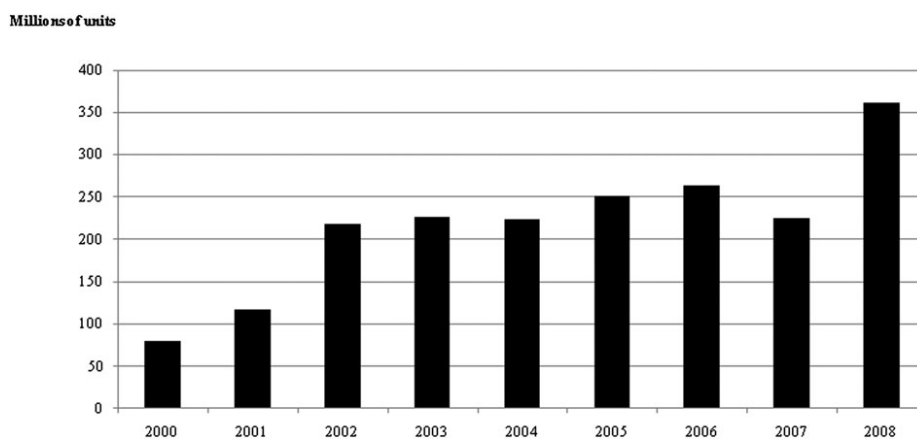
The World Health Organization (WHO) and UNICEF called for an improvement in injection safety standards, including the use of AD syringes for administering vaccines and safety boxes to collect sharps after use. A safe injection can be defined as one that results in no harm to the recipient, the vaccinator, or the surrounding community. Proper equipment, such as AD syringes and safety boxes, is necessary [6]. These must be used efficiently and exclusively. Initially, the recommendation referred specifically to mass vaccination supplemental immunization activities (SIAs) [7]. In 1999, a joint statement by the WHO, UNICEF, the United Nations Population Fund, and the International Federation of the Red Cross and Crescent Societies was issued that urged countries to use AD syringes in all immunization activities [8].

In 1992, one single type of 0.5-mL AD syringe was pre-qualified by the WHO for purchase through the United Nations system. The AD syringe was offered at a price of US \$0.13 per unit to UNICEF, compared with approximately US \$0.02 per disposable syringe. Countries started to introduce AD syringes

while simultaneously phasing out older technology in the immunization program. Despite these efforts, change to improved injection safety technology was limited. By 1997, countries had purchased 11.3 million syringes through UNICEF, but many countries remained reluctant to purchase the AD syringes because of the price. By 2003, the price had decreased by half, and UNICEF made it a policy to ship only AD syringes for all 0.05-, 0.1-, and 0.5-mL syringes to be used in the immunization program. UNICEF's deliveries of AD syringes to the countries increased substantially from 2000 onward (see Figure 1). At the same time, the use of sterilizable syringes was phased out; they remained in use in 31 countries in 2001 but only 5 in 2006 (China, Cuba, Haiti, Kiribati, and Micronesia). Meanwhile, China and Haiti stopped using sterilizable syringes for immunization in 2007.

From 2001 onward, the Measles Initiative (MI) started large-scale, nationwide measles catch-up SIAs in sub-Saharan Africa (countries included in this analysis: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), (Kinshasa), Côte d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe), typically targeting all children aged 9 months to 14 years. The MI is a partnership committed to decreasing measles deaths globally. Launched in 2001, the MI—led by the American Red Cross, the United Nations Foundation, the US Centers for Disease Control and Prevention (CDC), UNICEF, and the WHO—provides technical and financial support to governments and communities for vaccination SIAs and disease surveillance worldwide.

All measles SIAs funded by the MI were conducted using safe injection materials as the new gold standard in immunization to



**Figure 1.** Number of 0.5-mL auto-disable syringes shipped to sub-Saharan Africa by the United Nations Children's Fund, 2000–2008.

improve injection safety: AD syringes, reconstitution syringes, and safety boxes, in compliance with the WHO/UNICEF measles strategic plan [9].

The measles control strategy aims (1) to achieve a high rate of coverage of the first measles vaccine dose in infants; (2) to provide a second dose through routine immunization services in countries with high immunization coverage, and in countries with low immunization coverage through a catch-up SIA followed by a follow-up SIA every 3–4 years, the latter typically targeting all children between 9 months of age and 4–5 years of age; (3) to improve laboratory-backed measles surveillance; and (4) to enhance case management, including vitamin A supplementation. The strategy was adopted after the tremendous success in reducing measles-related deaths in the Americas and similar success in 7 countries in southern Africa between 1996 and 2000 (Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, and Zimbabwe) [9, 10].

Since 2002, the Global Alliance for Vaccines and Immunisation (GAVI) has provided an opportunity for the poorest countries to receive injection safety support (INS). For each country, this included in-kind donation of AD syringes, reconstitution syringes, and safety boxes in quantities sufficient to vaccinate all women and infants aged <1 year who are targeted in national immunization schedules. Some countries received support in cash [11]. Funding support was provided during a 3-year period to each country. This paper analyzes the catalytic effect that measles catch-up SIAs and the GAVI INS funding had on the introduction and scale-up of the use of safe injection materials in sub-Saharan Africa.

## METHODS

This paper compares the timing of the measles catch-up SIAs supported by the MI, the period of GAVI INS funding, and the timing of nationwide introduction of AD syringes in the country, as reported by Ministries of Health in the Joint Reporting Form (JRF) for immunization submitted annually to the WHO and UNICEF. For the analysis, we used JRF data, WHO measles SIA data, UNICEF supply data, and publicly available GAVI data. The paper focuses on 39 countries in sub-Saharan Africa that conducted measles catch-up SIAs between 2001 and 2008 (see Tables 1 and 2). We chose this period because the MI started in 2001 and the latest available JRF data at the time our data analysis was performed were for 2008. JRF data were verified with the UNICEF AD syringe shipment data to countries: we assumed that, if a country's AD syringe supply was greater than the number of children to be vaccinated with the complete childhood immunization series and no mass SIA was conducted during that year, the country had implemented the use of AD syringes in all districts. The timing and type of GAVI INS funding, provided between 2002 and 2008, was analyzed on the basis of data and reports available on the GAVI website [12].

**Table 1. Comparison of Timing of Measles Catch-up Supplemental Immunization Activities (SIAs) Supported by the Measles Initiative (MI), Global Alliance for Vaccines and Immunisation (GAVI) Injection Safety Support (INS), and Introduction of Auto-Disable (AD) Syringes in All Districts**

Year	No. of countries starting measles catch-up SIA in specified year		No. of countries starting GAVI INS in specified year		No. of countries having introduced AD syringes in all districts from specified year onward	
	From countries with catch-up measles SIAs supported by MI	From countries with catch-up measles SIAs not supported by MI	From countries with catch-up measles SIAs supported by MI	From countries with catch-up measles SIAs not supported by MI	From countries with catch-up measles SIAs supported by MI	From countries with catch-up measles SIAs not supported by MI
2000	0	0	0	0	6	0
2001	8	0	0	0	6	0
2002	5	9	0	0	8	0
2003	10	13	1	1	8	2
2004	5	7	1	1	5	2
2005	8	2	0	0	4	0
2006	1	2	1	1	0	2
2007	2	0	0	0	2	0
2008	0	2	0	0	0	0
No AD syringes	0	0	0	0	0	1

Information about the introduction of AD syringes in the countries was collected from the annual JRF, submitted to UNICEF and the WHO by each country from 2000–2008, and from AD syringe shipment data from the UNICEF Supply Division from 2000–2008.

The timing and the results of the SIAs were collected from reports from the countries and compared with the WHO database of measles activities [13, 14]. Countries that started catch-up SIAs before 2001, Botswana (1997), Lesotho (1999), Malawi (1998), Namibia (1997), South Africa (1996), Swaziland (1998), and Zimbabwe (1998), were excluded from this analysis, because countries did not use AD syringes at the time of those SIAs [10]. The higher standard of injection safety was set and adopted by the MI after the 1999 joint statement on injection safety in immunization [8].

The measles follow-up SIAs were excluded from the analysis, because the AD syringes had already been introduced during the catch-up SIA. Typically, follow-up SIAs are conducted only after the catch-up SIAs are finished in each country and these SIAs continue to use AD syringes only.

## RESULTS

### Measles Catch-up SIA as Catalyst

Measles catch-up SIAs were planned and implemented by the national Ministries of Health with technical assistance from the WHO, UNICEF, and the CDC. The SIAs were conducted according to the global measles strategic plan [9]. Funding became available through the CDC, the United Nations Foundation, the American Red Cross, and other partners. GAVI has provided about 25% of the MI budget through 2008.

A total of 263 million children in sub-Saharan Africa were vaccinated using AD syringes in the 39 countries during catch-up SIAs between 2001 and 2008. Catch-up SIAs typically targeted all children in each country between 9 months and 14 years of age during a 2–3 week period.

Eight countries began conducting catch-up measles SIAs in 2001 (Benin, Burkina Faso, Cameroon, Ghana, Mali, Togo, Uganda, and Tanzania). In 2002, 5 countries followed (Burundi, Congo [Kinshasa], Djibouti, Kenya, and Zambia). In 2003, an additional 10 countries followed suit (Angola, Congo [Brazzaville], Eritrea, Ethiopia, The Gambia, Guinea, Rwanda, Senegal, Sierra Leone, and Sudan). In 2004, 5 countries joined the list (Gabon, Liberia, Madagascar, Mauritania, and Niger). In 2005, another 8 countries began their own SIAs (Cape Verde, Central African Republic, Chad, Côte d'Ivoire, Equatorial Guinea, Mozambique, Nigeria, and Somalia). In 2006, Guinea-Bissau started its SIA, and in 2007 a final 2 countries participated (Comoros and Sao Tome and Principe). Large, logistically challenged countries spread the catch-up SIA over several time periods during the period of >1 year. All sub-Saharan countries

finished their initial catch-up SIA activities in 2008 (see Tables 1 and 2).

As part of the SIA preparations in all 39 countries, a large part of the Ministry of Health workers cadre and all vaccinators were trained in injection safety, ie, vaccine storage, reconstitution, mixing, and injection, use of the AD syringe, disposal of syringes in safety boxes, waste management, and surveillance for and management of adverse events following immunization. Of 39 countries, 16 (including Nigeria) started using the AD syringe for routine immunization in all districts after introducing it in measles catch-up SIAs. In addition to the theoretical training that was received, measles SIAs provided a critical opportunity for hands-on training for all vaccinators in using the new technology.

### GAVI Injection Safety Support

GAVI INS funding was provided to GAVI-eligible countries upon their request. From 2002 onward, 46 countries worldwide received support consisting of safe injection commodities for their routine vaccination program during 3 consecutive years. Of the 39 countries evaluated in this paper, 35 received GAVI INS (see Tables 1 and 2). From 2002 to 2004, 8 countries received GAVI INS (Burundi, Djibouti, Ethiopia, The Gambia, Senegal, Sudan, Uganda, and Zambia). From 2003 to 2005, 13 additional countries received INS (Burkina Faso, Cameroon, Central African Republic, Comoros, Congo [Kinshasa], Ghana, Kenya, Mali, Mozambique, Rwanda, Somalia, Tanzania, and Togo). Between 2004 and 2006, an additional 7 countries joined this list (Angola, Chad, Congo [Brazzaville], Eritrea, Guinea, Mauritania, and Niger). From 2005 to 2007, 2 additional countries received the support (Benin and Guinea-Bissau). From 2006 to 2008, 2 countries (Liberia and Madagascar), and in 2008–2010, 2 additional countries (Côte d'Ivoire and Nigeria) received INS. One country (Sierra Leone) received funding for 2 years: 2002 and 2005 (see Tables 1 and 2) [12]. Three of the 7 countries that had conducted measles catch-up SIAs before 2002 also received GAVI INS funding: Lesotho (2003–2005), Zimbabwe (2004–2006), and Malawi (2006–2008).

GAVI provided INS in kind by procuring safe injection materials (AD syringes, reconstitution syringes, and safety boxes) for routine immunization services to 29 of the 39 countries in sub-Saharan Africa. In addition, GAVI provided INS in the form of cash support to 6 African countries. All 6 countries had already introduced AD syringes prior to the start of the GAVI support. Rwanda and Somalia used the funds for international procurement of AD syringes, reconstitution syringes, and safety boxes, whereas Djibouti, Ghana, Mauritania, and Tanzania used the funds for construction and/or maintenance of incinerators. After the period of GAVI support, all supported African countries found domestic or donor funding to continue the procurement of safe injection materials and continued using AD syringes for their routine immunization programs [11].

**Table 2. Measles Catch-up Campaigns and Global Alliance for Vaccines and Immunisation (GAVI) Injection Safety Support (INS) Associated With Introduction of Auto-Disable (AD) Syringes in 39 Sub-Saharan African Countries, 2000–2008**

Country	Year(s) of measles catch-up campaign	Number of children reached	Years of GAVI Injection Safety Support	AD syringes available in all districts (1st year) (JRF <sup>a</sup> )	AD syringe in all districts same year of measles catch-up campaign or later	AD syringes in all districts in year of GAVI INS or later
1 Angola	2003	7,226,105	2004–2006	2000 <sup>b</sup>	No	No
2 Benin	2001, 2002	3,250,363	2005–2007	2003	Yes	No
3 Burkina Faso	2001	4,943,115	2003–2005	2003	Yes	Yes
4 Burundi	2002	2,767,054	2002–2004	2001	No	No
5 Cameroon	2001, 2002	7,360,359	2003–2005	2003	Yes	Yes
6 Cape Verde	2005	50,471	N/A	2007	No	N/A
7 Central African Republic	2005, 2006	1,699,539	2003–2005	2004	No	Yes
8 Chad	2005, 2006	4,377,656	2004–2006	2005	Yes	Yes
9 Comoros	2007	341,078	2003–2005	2002	No	No
10 Congo (Brazzaville)	2003	1,356,625	2004–2006	2003	Yes	No
11 Congo (Kinshasa)	2002, 2004, 2005, 2006	28,087,460	2003–2005	2004	Yes	Yes
12 Côte d'Ivoire	2005	7,894,327	2008–2010	2002	No	No
13 Djibouti	2002, 2003	150,708	2002–2004	2000 <sup>b</sup>	No	No
14 Equatorial Guinea	2005	119,462	N/A	2004	No	N/A
15 Eritrea	2003	1,047,862	2004–2006	2002	No	No
16 Ethiopia	2003, 2004, 2005	12,660,010	2002–2004	2004	Yes	Yes
17 Gabon	2004	502,959	N/A	2005	Yes	N/A
18 The Gambia	2003	677,830	2002–2004	2001	No	No
19 Ghana	2001, 2002	8,618,403	2003–2005	2000 <sup>b</sup>	No	No
20 Guinea	2003	3,202,848	2004–2006	2002	No	No
21 Guinea-Bissau	2006	590,602	2005–2007	2005	No	Yes
22 Kenya	2002	13,302,991	2003–2005	2004	Yes	Yes
23 Liberia	2004	1,569,807	2006–2008	2002	No	No
24 Madagascar	2004	8,900,657	2006–2008	2002	No	No
25 Mali	2001	4,998,491	2003–2005	2003	Yes	Yes
26 Mauritania	2004	1,167,307	2004–2006	2001	No	No
27 Mozambique	2005	8,222,157	2003–2005	2001	No	No
28 Niger	2004, 2005	5,403,467	2004–2006	2002	No	No
29 Nigeria	2005, 2006	54,892,767	2008–2010	2007	Yes	No
30 Rwanda	2003	3,082,583	2003–2005	2002	No	No
31 Sao Tome and Principe	2007	64,487	N/A	2000 <sup>b</sup>	No	N/A
32 Senegal	2003	4,854,077	2002–2004	2003	Yes	Yes
33 Sierra Leone	2003	2,404,882	2002, 2005	2005	No	Yes
34 Somalia	2005, 2006, 2007	5,113,216	2003–2005	2000 <sup>b</sup>	No	No
35 Sudan	2003–2008	19,486,566	2002–2004	2000 <sup>b</sup>	No	No
36 Tanzania	2001, 2002	10,426,587	2003–2005	2002	Yes	Yes

**Table 2.** (Continued)

37	Togo	2001	2,393,700	2003–2005	2003	Yes	Yes
38	Uganda	2001, 2003	14,071,643	2002–2004	2001	Yes	No
39	Zambia	2002, 2003	5,685,156	2002–2004	2003	Yes	Yes

**NOTE.** JRF, Joint Reporting Form; N/A, not applicable for GAVI support.

<sup>a</sup> JRF data were verified with UNICEF shipment data.

<sup>b</sup> Country reported using AD syringes in all districts in 2000. However, data before 2000 were not analyzed; thus, AD syringes could have been introduced prior to 2000.

### Safe Injection Implementation Rollout

Countries reported on the timing and scale of the introduction of AD syringes in their immunization program in the JRF from 2000 onward. By 2000, 6 (15%) of the 39 countries reported that AD syringes were available in all districts (Angola, Djibouti, Ghana, Sao Tome and Principe, Somalia, and Sudan).

In 2001, 6 additional countries were added to the list (Burundi, Côte d'Ivoire, The Gambia, Mauritania, Mozambique, and Uganda). In 2002, an additional 8 countries reported using only AD syringes in all districts for vaccinations (Comoros, Eritrea, Guinea, Liberia, Madagascar, Niger, Rwanda, and Tanzania). In 2003, 8 additional countries reported using only AD syringes in all districts for immunization (Benin, Burkina Faso, Cameroon, Congo [Brazzaville], Mali, Senegal, Togo, and Zambia). In 2004, an additional 5 countries (Central African Republic, Congo [Kinshasa], Equatorial Guinea, Ethiopia, and Kenya) had fully introduced AD syringes for immunization. In 2005, an additional 4 countries followed (Chad, Gabon, Guinea-Bissau, and Sierra Leone). In 2007, Cape Verde and Nigeria reported using only AD syringes in all districts for immunization. In 2008, all 39 countries used AD syringes in their immunization programs.

Of the countries that conducted their measles catch-up SIA before 2000, Lesotho and Malawi used AD syringes in all districts from 2003 onward, Swaziland and Zimbabwe from 2004, and Botswana and Namibia starting in 2006. By 2008, only South Africa had not introduced AD syringes in its national immunization program.

### Reduction in Use of Sterilizable Syringes

During the 1990s, sterilizable syringes were still used regularly in the immunization programs. With the introduction of AD syringes in sub-Saharan Africa, the use of sterilizable syringes for routine immunization has rapidly decreased. In 2000, 22 sub-Saharan African countries reported the use of sterilizable syringes for immunizations. According to the JRF, none of the countries used sterilizable syringes in 2004 or after.

### Countries That Conducted Measles SIAs Prior to 2000

Although this was not the primary purpose of our analysis, we note that all 7 countries that started catch-up SIAs before 2001 (Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, and Zimbabwe) did not use AD syringes for their immunization activities at that time. Three of these countries (Malawi, Lesotho, and Zimbabwe) were eligible for GAVI INS. As of 2008, 6 of these 7 countries had introduced AD syringes in their immunization programs; only South Africa had not (see Tables 1 and 3).

## DISCUSSION

The critical step for improving safe injection practices in immunization programs to protect the beneficiaries of the vaccines



**Table 3. Measles Catch-up Campaigns and Global Alliance for Vaccines and Immunisation (GAVI) Injection Safety Support (INS) Associated With Introduction of Auto-Disable (AD) Syringes in 7 Sub-Saharan African Countries, 1996–2008**

	Country	Year(s) of measles catch-up campaign	Years of GAVI INS	AD syringes available in all districts (1st year) (JRF) <sup>a</sup>	AD syringes in all districts same year of measles catch-up campaign or later	AD syringes in all districts in year of GAVI INS or later
1	Botswana	1997–1998	N/A	2006	No	N/A
2	Lesotho	1999, 2000	2003–2005	2003	No	Yes
3	Malawi	1998	2006–2008	2003	No	No
4	Namibia	1997	N/A	2006	No	N/A
5	South Africa	1996, 1997	N/A	No	No	N/A
6	Swaziland	1998, 1999	N/A	2004	No	N/A
7	Zimbabwe	1998	2004–2006	2004	No	Yes

**NOTE.** JRF, Joint Reporting Form; N/A, not applicable for GAVI support.

<sup>a</sup> JRF data were verified with UNICEF shipment data.

is the universal use of AD syringes, which are designed to lock automatically after a single injection. In addition, safety boxes are needed for the collection of used syringes, and procedures need to be in place for disposal of the waste.

Since the 1990s, UNICEF and the WHO have encouraged the improvement of injection safety standards for immunizations through both bundling vaccines with appropriate amounts of supporting equipment and supplying AD syringes for injections. The success of introducing these syringes in immunization programs in the developing world was due to increased awareness regarding the risks of reusable syringes, large-scale mass SIAs, and support from GAVI.

Since the start of measles catch-up SIAs in 2001 and GAVI INS funding in 2002, demand for AD syringes has increased substantially. The quantity of AD syringes for immunization delivery purchased by UNICEF increased from a mere 11.3 million in 1997 to 236 million in 2000 and 927 million in 2006 (UNICEF unpublished data, 2008). In sub-Saharan Africa, the use of AD syringes in immunization programs has been widely accepted, and by 2008, AD syringes were used exclusively in all countries in sub-Saharan Africa, except South Africa.

The MI partners have ensured sufficient provision of AD syringes, reconstitution syringes, and safety boxes to vaccinate typically all children from 9 months to 14 years of age during each measles catch-up SIA, by funding and delivering safety devices and monitoring their use at the operational level. In 16 (41%) of 39 countries that conducted measles SIAs in sub-Saharan Africa, the measles catch-up SIA catalyzed nationwide introduction of AD syringes, reconstitution syringes, and safety boxes, reaching >173 million children (see Tables 1 and 2). In addition, measles catch-up SIAs systematically provided training for all vaccinators in proper use of this new technology and safe injection in all 39 countries that were supported by the measles partners between 2001 and 2008. This includes the countries that introduced AD syringes with GAVI INS and those that did not receive GAVI INS, except the 7 southern

African countries that conducted the catch-up SIA before 2001. GAVI INS did not provide specific funding for training of the health workers.

GAVI INS funding was associated with the introduction of AD syringes and safe injection materials in 14 (36%) of 39 countries, as AD syringe availability in all districts was reported only in the same year or after the GAVI INS had started. The GAVI INS established the new technology in the routine program and ensured that financing for the safe injection material was available for 3 years. By the time GAVI support ended, countries continued to use AD syringes in their immunization programs. Domestic funding, donor funding, or a combination of these were used to purchase AD syringes.

AD syringes are now the standard for delivery of immunization in sub-Saharan Africa. The use of sterilizable syringes for immunization ended in 2004; hence, it is assumed that the unnecessary risk for health care–associated infections due to hepatitis B, hepatitis C, HIV, and other bloodborne pathogens is effectively reduced within the immunization programs.

One gap in the current strategy to prevent syringe reuse remains. The continued use of standard disposable syringes—which do not have this disabling mechanism—for the reconstitution of lyophilized vaccines continues to put immunization programs at risk of contamination. The problem of this gap is important, in light of the fact that, worldwide, reconstitution was required by nearly 450 million doses of UNICEF vaccine in 2007 [15]. Recently, the attention of safe injection advocates has moved beyond the scope of the syringes used to administer injections to include those used to reconstitute vials of vaccine. The use of nonreusable syringes for reconstitution in conjunction with providing AD syringes for injections could potentially eliminate the possibility of syringe reuse during immunization sessions and would provide a more comprehensive and consistent injection safety policy, closing the safety gap in current immunization programs.

The measles strategy has been one of the most successful public health strategies in reducing child mortality. In the WHO

African region (AFRO), measles mortality decreased 92% from an estimated 371,000 (95% confidence interval, 270,000–483,000) in 2000 to an estimated 28,000 (95% confidence interval, 19,000–40,000) in 2008, as a result of the implementation of the comprehensive measles control strategy that has used safe injection practices as a core principle [15, 16].

There are a few limitations to this report. First, the JRF contains self-reported data from Ministries of Health to UNICEF and the WHO. Second, data from some countries that did not purchase AD syringes through UNICEF but directly from suppliers will not have been included in our analysis, leading to a possible underreporting of the number of AD syringes for the reviewed time period. Third, although we are unsure whether all reported AD syringes were actually used for the immunization program, we assume that, because 0.5-mL syringes can be used only in immunization programs and have no further value to other programs, it is unlikely that the syringes would have been sold or used elsewhere.

In summary, the measles mortality reduction program and GAVI support complemented one another in improving injection safety—the measles program by training the health care workers prior to the measles catch-up SIAs and by procuring safe injection equipment during SIAs and GAVI through financial support for including safe injection equipment in the routine immunization service delivery. Together, the programs are associated with the introduction of AD syringes in 19 (49%) of the 39 countries evaluated. All countries evaluated continued with AD syringes for SIAs and routine immunization even after measles catch-up SIAs and the GAVI funding ended.

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