# REACHING *FOR* UNIVERSAL IMMUNIZATION COVERAGE:

## Results and program recommendations from combined immunization coverage and serology surveys in three woredas (districts) of Ethiopia in 2013 and 2016

In 2011, the Universal Immunization through Improving Family Health Services (UI-FHS) project was awarded to JSI Research & Training Institute, Inc. (JSI) as a learning grant from the Bill & Melinda Gates Foundation to explore what it would take to reach and sustain high immunization coverage in Ethiopia. UI-FHS developed an approach to strengthen the routine immunization system called Reaching Every District using Quality Improvement Methods (RED-QI), which was piloted in three woredas in Ethiopia between 2014 and 2016.

In an effort to understand levels of immunization coverage and protection (serologic protection) in the three program woredas, UI-FHS conducted combined immunization coverage and serology surveys at baseline in 2013 and again after RED-QI program implementation in 2016. UI-FHS partnered with two separate Ethiopian firms to conduct the coverage surveys in 2013 and 2016. UI-FHS worked with the Ethiopian Public Health Institute and the Center for Vaccine Development (CVD) from the University of Maryland, Baltimore, USA to conduct the serology surveys.

In 2013, the surveys included 6-8 month old infants and children 12–23 months of age. In 2016, the surveys only included children who were 12–23 months of age. All infants and children were selected based on population proportional sampling to select clusters, using WHO protocols. Vaccination coverage was estimated from administrative reports, documented data from health facility registers and home based vaccination cards, and data from parental recall. Serum antibody titers were measured for antigens from two vaccines, tetanus (pentavalent vaccine) and measles to provide serologic evidence on whether vaccinated infants and children were immunologically protected against tetanus and measles.

### Tetanus Results

Survey results from all three woredas show that **immunization coverage (Penta3) and immunological protection from tetanus significantly increased from 2013 to 2016** (Table 1). In 2016, the proportion of children protected against tetanus ranged from 79–99% among survey woredas. Tetanus immunological protection is a proxy for protection against all of the pathogens covered in the pentavalent vaccine, which is administered through the routine immunization system in Ethiopia. As such, results indicate performance improvement of the routine immunization system from 2013 to 2016 in all three districts. It should be noted that documented coverage results range from 29–66%, substantially underestimating serological protection.

**Table 1 | Tetanus antibody levels, vaccination coverage (Penta3) and administrative report among children 12–23 months of age by the time of survey**

| | ARBEGONA | | ASSAIETA | | HINTALO WAJERATE | |
|---|---|---|---|---|---|---|
| | 2013 | 2016 | 2013 | 2016 | 2013 | 2016 |
| Tetanus (sero) protected (≥ 0.05 IU/mL) (%) | 73 n=251 | 84* n=258 | 60 n=215 | 79* n=239 | 94 n=263 | 99* n=273 |
| Documented† coverage (%) | 36 | 29 | 27 | 28 | 83 | 66 |
| Crude†† coverage (%) | 40 | 59 | 35 | 46 | 85 | 87 |
| Administrative††† report (%) | 98 | 102 | 79 | 109 | 95 | 89 |

*Results statistically significant (p-value < 0.05) by McNemar test

†Documented and valid coverage = percent of 12-23 month olds with 3 doses of pentavalent vaccine given no younger than 39 days of life as recorded on the vaccination card or in the health facility register.

††Crude coverage = percent of 12-23 month olds with 3 doses of pentavalent vaccine as determined by vaccination card, health facility register, or parental recall.

†††Administrative coverage = proportion of 12-23 month olds with 3 doses of pentavalent vaccine as reported by the WHO Joint Reporting Form and the Ethiopian Ministry of Health

## Measles Results

Review and interpretation of data on measles is more complex. As shown in Table 2, the percentage of children protected against measles increased between 2013 and 2016 in all three survey woredas; however, the level of protection indicated by serology is still too low to prevent measles outbreaks. Documented coverage is less consistent, with increases in Assaieta and decreases in Arbegona and Hintalo Wajerate. The crude coverage data showed an increase in Arbegona and Assaieta, while Hintalo Wajerate remained stagnant. Review of administrative data provided a much higher coverage estimate showing levels considerably above the serologic evidence of protection.

## Vaccination Status & Levels of Protection

As shown in Figure 1, the majority of children with documented evidence (card or register) of vaccination with pentavalent vaccine demonstrate serologic protection against tetanus, 99% in Assaieta, 89% in Arbegona and 99% in Hintalo Wajerate.

**Table 2 | Measles antibody levels, vaccination coverage and administrative report among randomly selected sub-sample of children 12–23 months of age by the time of the survey**

| | ARBEGONA | | ASSAIETA | | HINTALO WAJERATE | |
|---|---|---|---|---|---|---|
| | 2013 | 2016 | 2013 | 2016 | 2013 | 2016 |
| Measles (sero) protected (≥ 120 mIU/mL) (%) | 26 n=100 | 36 n=100 | 31 n=100 | 50 n=100 | 63 n=100 | 76 n=100 |
| Documented† coverage (%) | 24 | 22 | 16 | 29 | 67 | 55 |
| Crude†† coverage (%) | 49 | 68 | 40 | 66 | 78 | 78 |
| Administrative††† report (%) | 91 | 100 | 69 | 98 | 89 | 85 |

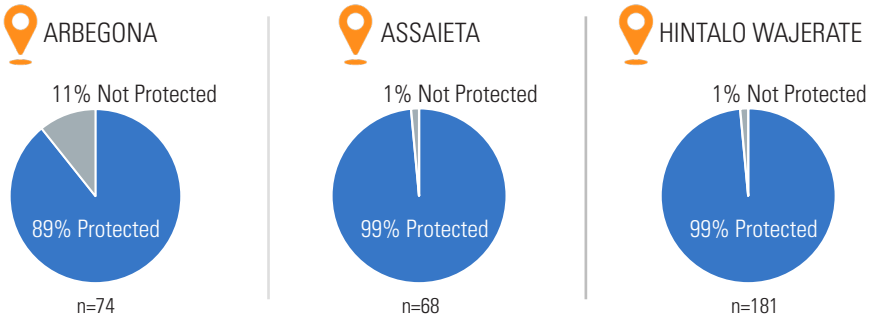
Note: Due to smaller sample sizes, testing for significance was not possible.

†Documented and valid coverage = percent of 12-23 month olds with measles vaccine given no younger than 267 days of life as recorded on the vaccination card or in the health facility register.

††Crude coverage = percent of 12-23 month olds with measles vaccine as determined by vaccination card, health facility register, or parental recall.

†††Administrative coverage = proportion of 12-23 month olds with measles vaccine as reported by the WHO Joint Reporting Form and Ethiopian Ministry of Health

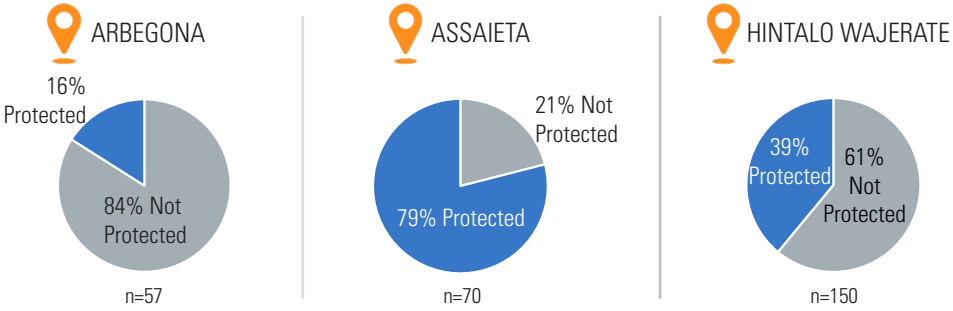
**Figure 1 | Serologic protection from tetanus among children with documented evidence of vaccination, 2016**




Conversely, for measles, only 16% of children in Arbegona, 39% in Hintalo Wajerate and 79% in Assaieta, had serologic evidence of protection against measles despite having documentation of vaccination (either through card or health facility register) (Figure 2). There are many possible reasons for the discrepancies between the serology, coverage survey, and administrative data sources for measles. A few of the most likely reasons are: 1) issues with the handling of the vaccine and/or vaccination services (i.e. the cold chain is ineffective, use of expired vaccine, vaccines are reconstituted with diluent that is at an inappropriate temperature, 2) issues with data quality of administrative data ( i.e. numerators are inaccurate, denominators are too low, incorrect or incomplete recording), 3) not all vaccinated infants will seroconvert; at 9 months, the proportion of infants that seroconvert is about 85%, and 4) in children who mount only modest levels of measles antibodies, determination of the exact proportion of children protected, as reported by serologic assay, may be difficult.

**IN ARBEGONA & HINTALO WAJERATE, THE QUALITY OF MEASLES VACCINATION IS A CONCERN.**

**Figure 2 | Serologic protection* from measles among children with documented evidence of vaccination, 2016**



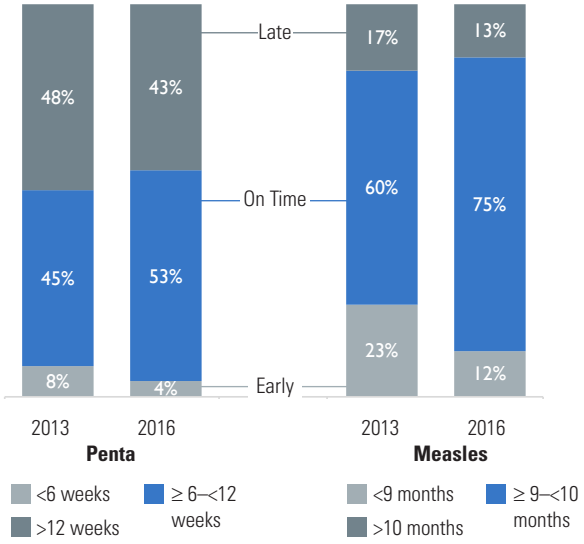

*These figures of serologic protection against measles under-estimate the level of population-wide immunity in that some children without documented evidence, including those reached on mass campaigns, will also have serologic protection. Also children who have already experienced measles infection contribute to the level of immunity in the population.

In Ethiopia, the immunization schedule for vaccination is to receive first, second and third doses of pentavalent vaccine at 6, 10 and 14 weeks of age respectively, followed by a first dose of measles containing vaccine when the child reaches 9 months of age.[1] The number of children receiving a vaccine on time, at 6–<12 weeks for penta1 and between 9–10 months for measles, improved for both penta1 (8 pp increase) and measles (15 pp increase) vaccination between 2013 and 2016 (Figure 3). However, a large number of children continue to be vaccinated after the recommended schedule, particularly for penta1 (43% in 2016), leaving children at prolonged risk of disease. Children are also being vaccinated before the recommended age, compromising their ability to produce antibodies that protect against disease.

**DESPITE SOME IMPROVEMENT, CHILDREN ARE STILL BEING VACCINATED BEFORE THE RECOMMENDED AGE, COMPROMISING THEIR PROTECTION AGAINST VACCINE PREVENTABLE DISEASE.**

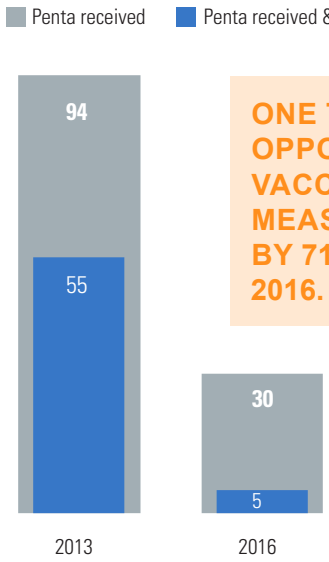
**CHILDREN VACCINATED ON TIME IMPROVED FOR BOTH MEASLES & PENTA 1 FROM 2013 TO 2016.**

**Figure 3 | Comparison of timeliness of 1st dose of measles & Penta 1 vaccines among children aged 12–23 months**




In 2013, 94 surveyed children received late dose(s) of pentavalent vaccine at nine months or later (Figure 4). In addition, despite being eligible, most of these children (55 of 94) did not simultaneously receive measles vaccination when they were given the delayed penta dose. This represents a missed opportunity to vaccinate for measles. In the 2016 survey, the number of children receiving penta vaccine after 9 months of age dropped from 94 to 30. Similarly, the number of children who at 9 months of age received a late penta dose but did not receive measles vaccine dropped from 55 to only 5. Overall, there was a 71% decrease in this type of missed opportunity for vaccinating for measles. **Furthermore, the median age among those who received a measles vaccine in 2013 was 417 days (about 14 months of age), while the median age to receive measles vaccine in 2016 declined to 365 days (12 months), getting closer to the optimal age of 9–10 months.** This improvement from 2013 to 2016 reflects the efforts by health workers, with support from the UI-FHS project, to strengthen the delivery of timely services and to reduce missed opportunities for vaccinations.

**Figure 4 | Number of children with documentation (card or health facility register) who received penta vaccination after 9 months of age, among children 12–23 months at time of survey (combined data for 3 woredas)**




**ONE TYPE OF MISSED OPPORTUNITY TO VACCINATE FOR MEASLES DECREASED BY 71% FROM 2013 TO 2016.**

Despite progress, challenges remain with children being given penta and measles vaccination before, or after, the recommended or optimal age. Children who are given vaccines too early are less likely to be immunologically protected against the disease and those who are given vaccines too late are left unnecessarily susceptible for prolonged periods to diseases that could otherwise be prevented.

In the 2016 survey, many caregivers (70%) across all three woredas reported receiving a vaccination card; however, nearly a third (30%) of caregivers reported never receiving a vaccination card. Among those who received vaccination cards, a sizable proportion of caregivers (35.2%) had either lost their card or were unable to show at the time of the survey (Table 3). As the overall percentage of caregivers able to produce a vaccination card at the time of the coverage survey was low (35% average among the three woredas), UI-FHS visited health facilities and looked at health facility registers to confirm reports of vaccination for children without vaccination cards.

[1] A second dose of measles containing vaccine was added to the immunization schedule in February 2019.

Even with additional documentation from health facilities, only 55% of the children included in the 2016 survey had documented evidence of vaccination.

**THE HOME-BASED RECORD (HBR) OR VACCINATION CARD IS A CRITICAL HEALTH TOOL FOR FAMILIES TO UNDERSTAND HOW OFTEN AND WHEN TO VACCINATE THEIR CHILDREN.**

**Table 3 | Availability of home-based records (HBRs) in children 12–23 months by time of survey, 2016**

| Source of Data | % reported ever received | % observed day of survey | % not able to produce* | % **reported never received** |
|---|---|---|---|---|
| ARBEGONA | 60.2 | 20.1 | 40.1 | 39.8 |
| ASSAIETA | 68.8 | 35.5 | 33.3 | 31.2 |
| HINTALO WAJERATE | 81.2 | 49.3 | 31.8 | 18.9 |

*(% who ever received - % observed on day of survey)/ % who ever received

## Recommendations for the Ethiopian Ministry of Health

1. **Strengthen** data quality, use, and accountability at each level of the health system and build in incentives to report accurate data. High, inaccurate reported administrative coverage data may mask large numbers of unimmunized children, increasing the risk of measles virus circulation and potential outbreaks.
2. **Address** quality issues with vaccination sessions. Strengthen monitoring of the cold chain during supportive supervision visits to ensure that vaccines are stored at the correct temperature, vaccine vial monitors are used correctly, expired vaccines are not used, and to ensure that during vaccination sessions, health workers properly handle vaccines and diluents.
3. **Work** with health personnel to build managerial and technical capacity to plan how to identify and reach all target populations and to track infants from birth to vaccination completion.
   - » **Set up** a system of registering pregnant women and tracking all newborns and infants.
   - » **Provide** a mix of services with appropriate strategy (static, outreach, mobile) to reach all eligible children efficiently, predictably, and with good quality.
4. **Strengthen** partnership between communities and health facilities, which promotes a sense of shared accountability and makes communities more likely to use services.
5. **Support** health workers with flexible policies to provide timely, potent vaccines. Implement the existing open vial policy, which allows health workers to open a vial even for a single child; and encourage health workers to use every opportunity to vaccinate even if that increases vaccine wastage. Reinforce that children must receive all vaccines for which they are eligible on the same day.
6. **Prioritize** efforts to improve documentation of vaccinated children through improved recording and maintenance of tools such as health facility registers.
   - » **Strengthen** recording of vaccinations given at the health facility and during mobile and outreach visits, including checking for data consistency as the data are sent upward.
   - » **Provide** supportive supervision to health workers during vaccination sessions focusing on how doses are recorded in the tally sheet, health facility register and monthly reports to facilitate training of individuals and monitoring of program performance.
7. **Commit** to the distribution of a home based record so that parents can be aware of and share accountability for their children's immunizations, particularly as the immunization schedule grows with the addition of new vaccines and additional vaccines over the life course.
   - » Health workers should **explain** how to use the card, encourage caregivers and families to keep the card, and advise them to bring it to each contact with the health system.
   - » Health workers should **provide** the caregiver with a replacement card without punishment if the card is lost, as reprimanding the caregiver may deter return visits in the future.